

ADA, Building Codes, and Standards Relating to Handrails and Guards

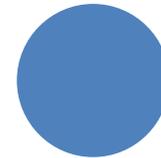
Presented by:
The Wagner Companies



Credit(s) earned upon completion of this course will be reported to AIA CES for AIA members. Certificates of completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



Copyright Materials

This presentation is protected by U.S. and international copyright laws. Reproduction, distribution, display, and use of the presentation without written permission is prohibited.

© The Wagner Companies 2018



Course Description

This course will discuss the difference between handrails and guardrails, and building codes related to the design and installation of such rails.

Gain knowledge of available resources to answer code-related questions.

Learning Objectives

At the end of this course, you should be able to:

- Explain the differences between handrails and guardrails.
- Discuss building codes related to the design and installation of handrails and guardrails.
- Apply the International Code Council's I-Codes to handrails and guardrails.
- Understand the Americans With Disabilities Act (ADA) and Accessible and Usable Buildings and Facilities (ANSI A117.1) in relation to handrails and guardrails.

Agenda



- Code Bodies and Standards
 - International Code Council
 - NFPA
 - ADA, ABA, & ANSI A117.1
 - OSHA
- Handrails & Guardrails
 - Definition
 - The Ladder Effect
 - Load Requirements

Code Bodies and Standards

- International Code Council (ICC)
 - International Residential Code (IRC)
 - International Building Code (IBC)
- National Fire Protection Association (NFPA)
 - NFPA 101
 - NFPA 5000
- Accessibility
 - ANSI-A117.1: Accessible & Usable Buildings & Facilities
 - Americans with Disabilities Act (ADA)
 - Architectural Barriers Act (ABA)
- Occupational Safety and Health Administration (OSHA)



International Code Council

- Prior to 1999, there were multiple model code bodies across the country, including:
- Building Officials Code Administrators International (BOCA) – National Building Code (NBC);
- Southern Building Code Congress International (SBCCI) – Southern Building Code (SBC); and
- International Conference of Building Officials (ICBO) – Uniform Building Code (UBC).
- In 1999, these three code groups combined to create the International Code Council (ICC).



The I-Codes

- The International Code Council publishes what are known as the I-Codes.
 - It includes the International Building Code (IBC) and the International Residential Code (IRC).
 - The IRC code applies to one- and two-family dwellings, while the IBC code applies to commercial properties and multifamily residential dwellings.
- The first I-Codes were published in 2000 and are updated on a three-year cycle, the most recent being 2018.
- The IBC and IRC publish “model” codes which are then adopted or modified by code bodies and local jurisdictions.
- Always check with your local authority having jurisdiction (AHJ).
- The I-Codes are considered a minimum standard for safety.
- Anyone can submit a code change.



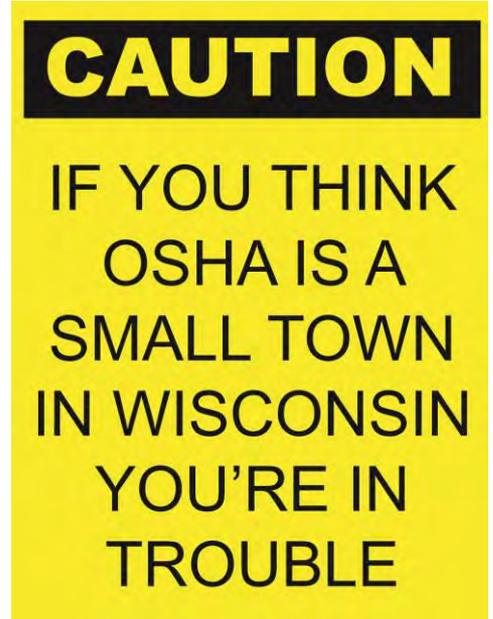
National Fire Protection Association

- This group is known for NFPA 101 and NFPA 1.
- The NFPA is made up of fire inspectors, firefighters, and government agencies.
- In 2000, this group created its own building code:
 - NFPA 5000 Building Construction and Safety Code.
 - NFPA 5000 did not gain general acceptance and has had minimal impact. However, some elements of NFPA 5000 have been pulled into NFPA 101: Life Safety Code.



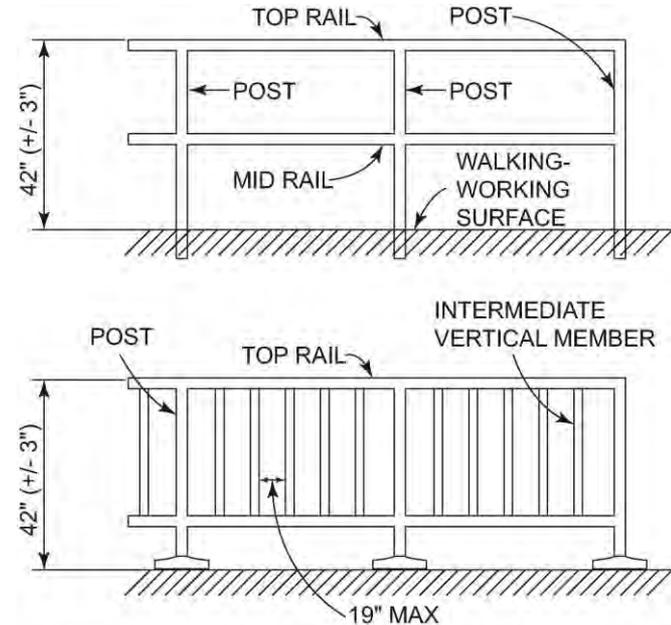
Occupational Safety and Health Administration (OSHA)

- OSHA regulates areas not generally open to the public, such as warehouses, manufacturing facilities, and wastewater treatment plants.
- OSHA is overseen by the U.S. Department of Labor.
- The section that includes railing requirements is 1910.29: Fall Protection Systems and Falling Object Protection – Criteria and Practices (updated in January 2017).



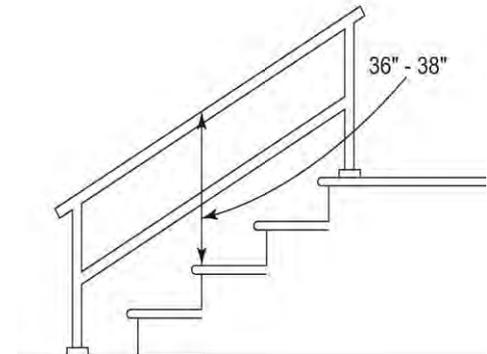
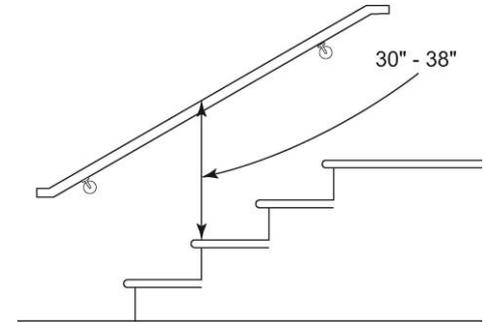
Guardrailings

- If there is a “drop” of 48 inches or higher, a guardrail is required.
- The guardrail must be 42 inches in height (+/- 3 inches) above the working/walking surface.
- A horizontal intermediate rail is required and is placed “about halfway up.”
- Openings must be less than 19 inches, and intermediate balusters are to be spaced no more than 19 inches apart.
- A toe board is required to prevent debris or tools from accidentally falling to areas below the guardrail.
- Top rails and midrails must be at least 0.25 inches in diameter or thickness.
- Load requirement: withstand a 200-pound load applied in a downward or outward direction within 2 inches of the top edge of the top rail.



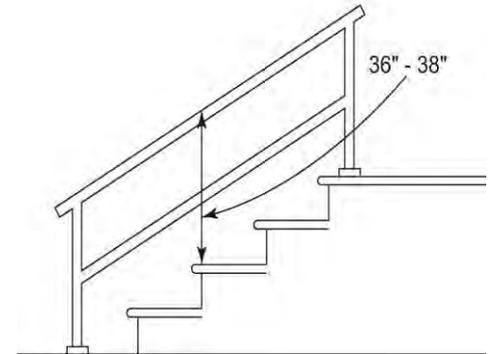
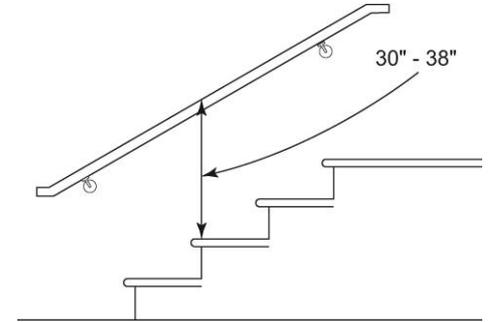
Handrail and Stair Rail Systems

- If a stair has a minimum of four risers, a handrail is required.
- Handrails must be between 30 and 38 inches as measured from the leading edge of the stair tread.
- Stair rail system:
 - Top rail may also serve as handrail if height of the system is between 36 and 38 inches.
 - Before January 17, 2017: not less than 30 inches above the nosing.
 - After January 17, 2017: not less than 42 inches above the nosing.



Handrail and Stair Rail Systems

- The minimum clearance between handrails and other objects is 2.25 inches.
- Handrails have the shape and dimension necessary to grasp firmly.
- Ends of handrails and systems do not present any projection hazards.
- Load requirement: withstand a 200-pound load applied in a downward or outward direction within 2 inches of the top edge of the top rail.



ANSI A117.1-2009: Accessible and Usable Buildings and Facilities

- ANSI A117.1 was overseen by CABO but is now overseen by ICC.
- The standard hasn't been updated since 2009.
- ANSI A117.1 is still used for reference for projects not covered under the ADA.
- The 1986 standard had incorrect handrail dimension: $1\frac{1}{4}$ to $1\frac{1}{2}$ inches OD with an absolute clearance of $1\frac{1}{2}$ inches between wall and rail.



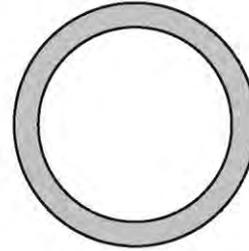
**ACCESSIBLE AND
USABLE BUILDINGS
AND FACILITIES**

ICC A117.1-2009

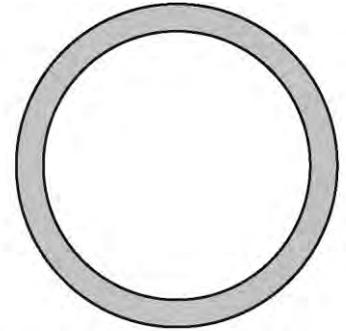
 American National Standard

Pipe vs. Tube

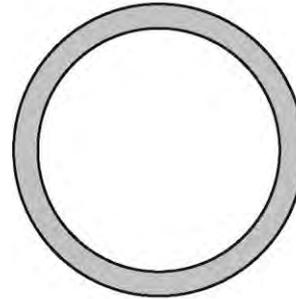
- The dimensions noted were for tube sizes, while the railing industry generally used pipe for railing.
- Tube is designated by outside diameter such that a 1¼-inch round tube has an actual diameter of 1¼ inches.
- Pipe uses a nominal inside diameter. 1¼-inch pipe has an actual outside diameter of 1.66 inches. 1½-inch pipe has an actual outside diameter of 1.90 inches.



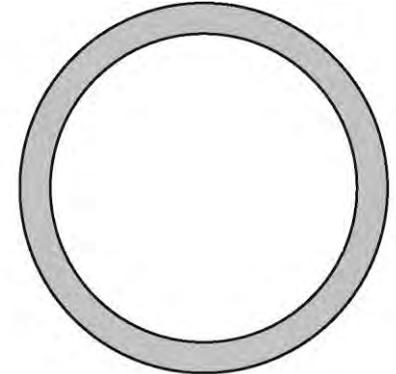
1-1/4" (32mm) Tube
1/8" (3mm) Wall



1-1/4" pipe size (1.66" [43mm])
Schedule 40 (.140" (3.6mm)) Wall



1-1/2" (39mm) Tube
1/8" (3mm) Wall



1-1/2" pipe size (1.90" [48mm])
Schedule 40 (.145" (3.7mm)) Wall

Accessible and Usable Buildings and Facilities

- The council of American Building officials was contacted.
- The error was admitted and acknowledged that 1¼- to 1½ -inch pipe size was acceptable for handrails.
- Correction was published in the 1990 update.



ACCESSIBLE AND USABLE BUILDINGS AND FACILITIES

ICC A117.1-2009

 American National Standard

Americans with Disabilities Act (ADA)

- The ADA was signed into law in July 1990.
- It's a civil rights law that prohibits discrimination on the basis of disability.
- The ADA is overseen by the Access Board.
- It applies to facilities in the private sector (places of public accommodation and commercial facilities) and to state and local government facilities.
- You cannot be “grandfathered” under the ADA, and it is not optional.
- The ADA does not apply to residential properties. (Be aware though that some jurisdictions require the residential property to be “visit-able.”)
- A residential property is “visit-able” when it meets three basic requirements:
 - One zero-step entrance;
 - Doors with 32 inches of clear passage; and
 - One bathroom on the main floor that is wheelchair accessible.



Americans with Disabilities Accessibility Guidelines (ADAAG)

- The guidelines were published in 1991, revised in 1994, and updated in 2004, and they were used in determining compliance with the ADA.
- The guidelines were originally based on the 1986 ANSI A117 publication which had *incorrect* dimensions for the handrail.
- The Access Board was contacted and acknowledged the error, noting that pipe size was acceptable although refusing to put the clarification in writing.
- Clarification of acceptability of “pipe sizes” (1.66 and 1.90 inches) was finally published in 1994 and updated in 2004, including:
 - 1¼ to 2 inches outside diameter, and
 - 1½-inch *minimum* between wall and handrail.
- The “new” ADA was finally approved on July 23, 2010, which was the 20-year anniversary of the original ADA.

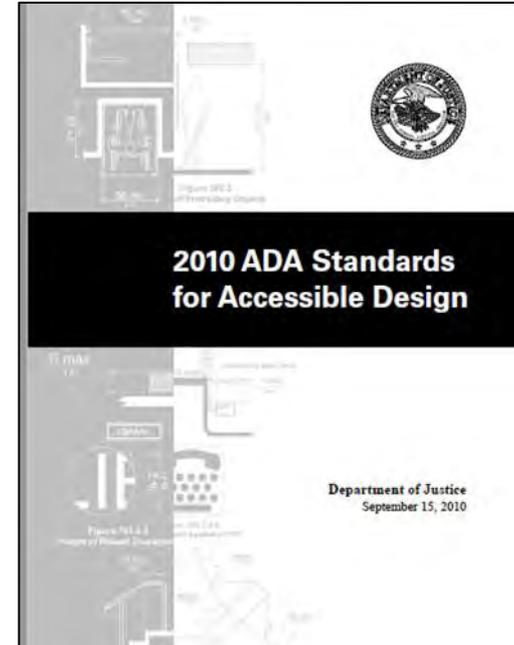


UNITED STATES ACCESS BOARD

The Americans with Disabilities Act Accessibility Guidelines (ADAAG)

2010 ADA Standards for Accessible Design (ADASAD)

- ADAAG was replaced with the Americans with Disabilities Act Standards for Accessible Design (ADASAD).
- ADASAD went into effect on March 15, 2011.
 - Compliance was permitted as of September 15, 2010 but not required until March 15, 2012.
- ADASAD are minimum standards, and therefore some states can be more stringent.
 - Florida and Texas updated their standards to match up with federal standards.



Architectural Barriers Act (ABA)

- Applies to federally funded facilities, including:
 - U.S. Postal Service (USPS) for postal facilities;
 - Department of Defense for military facilities; and
 - The Department of Housing (HUD)
- The General Services Administration (GSA) updated its ABA standards, which apply to most facilities covered by the ABA.
- Like the ADA, the ABA uses the ADASAD. The difference was that while the ADA required congressional approval before implementation, the ABA was implemented soon after its completion in 2004.

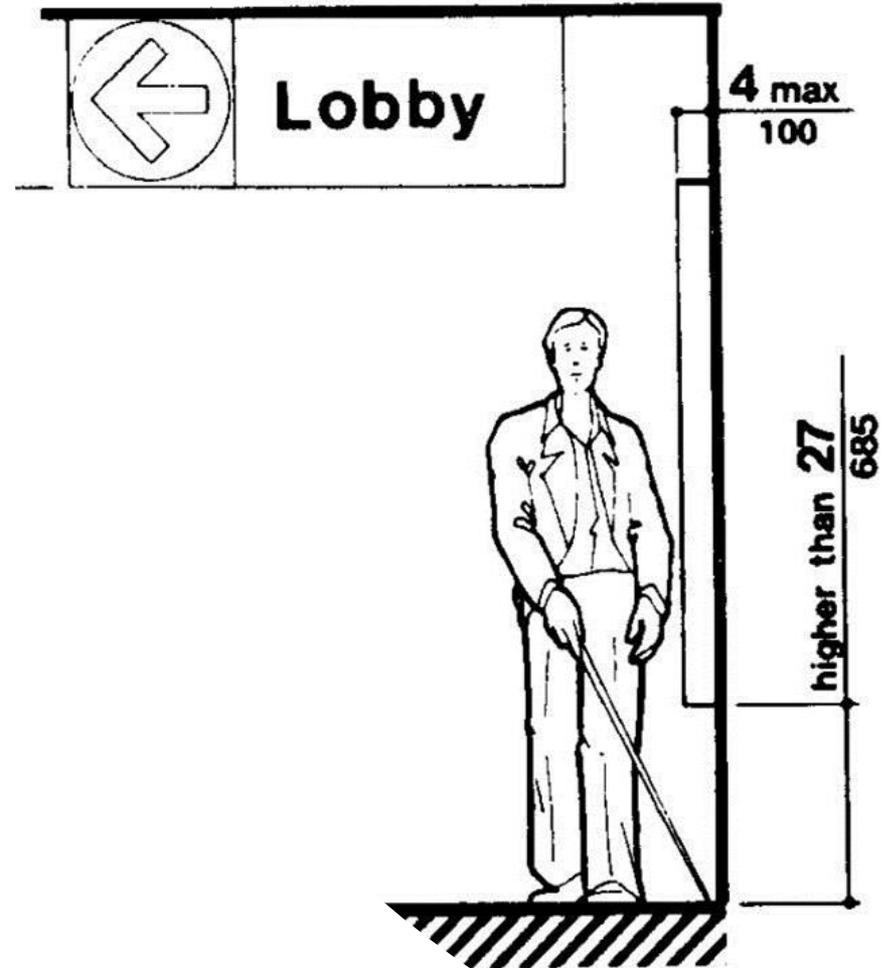


Protruding Objects

Let's review some items from ADASAD that apply to railings.

ADASAD has limitations on protruding objects into a walkway. Objects with leading edges more than 27 inches and not more than 80 inches above the finish floor or ground shall protrude 4 inches maximum horizontally into the circulation path.

- EXCEPTION: Handrails shall be permitted to protrude 4½ inches maximum.



Accessible Routes

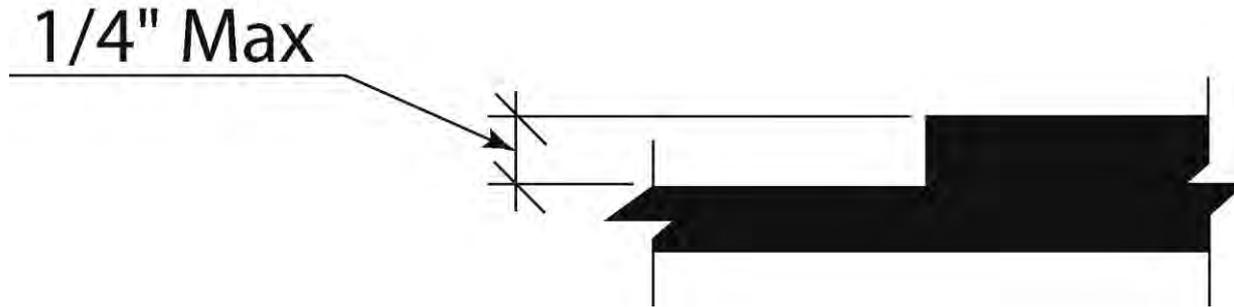
Accessible routes shall consist of one or more walking surfaces with a running slope not steeper than 1:20, including:

- Doorways
- Ramps
- Curb ramps
- Elevators
- Platform lifts



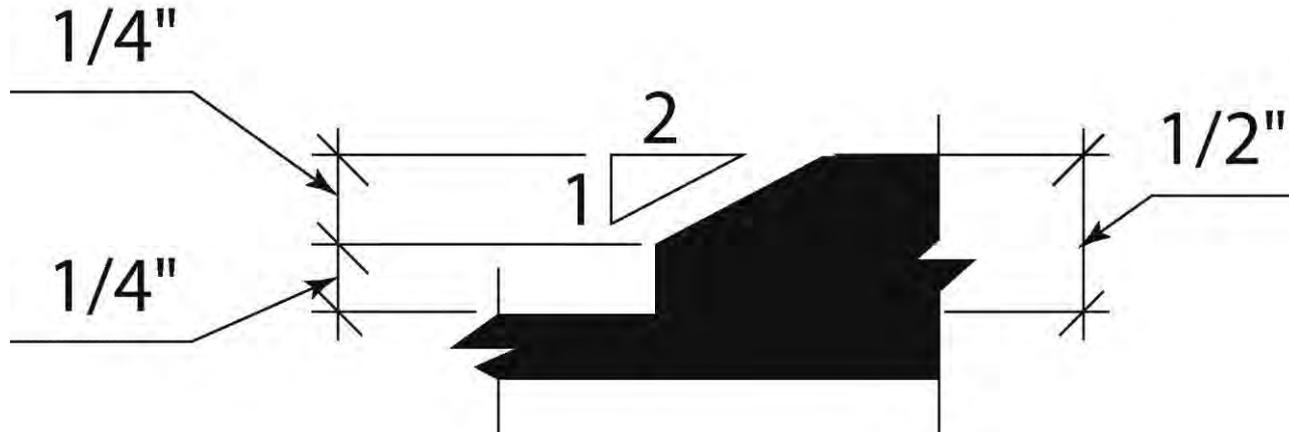
Changes in Level

Changes in level of $\frac{1}{4}$ -inch high maximum shall be permitted to be vertical.



Changes in Level

Changes in level between $\frac{1}{4}$ -inch high minimum and $\frac{1}{2}$ -inch high maximum shall be beveled with a slope not steeper than 1:2.



Changes in level greater than $\frac{1}{2}$ inch shall be ramped.



Ramp runs shall have a running slope not steeper than 1:12.

Ramps

Ramps

Clear width

- The clear width of a ramp run and, where handrails are provided, the clear width between handrails shall be 36 inches minimum.

Rise

- The rise for any ramp run shall be 30 inches maximum.

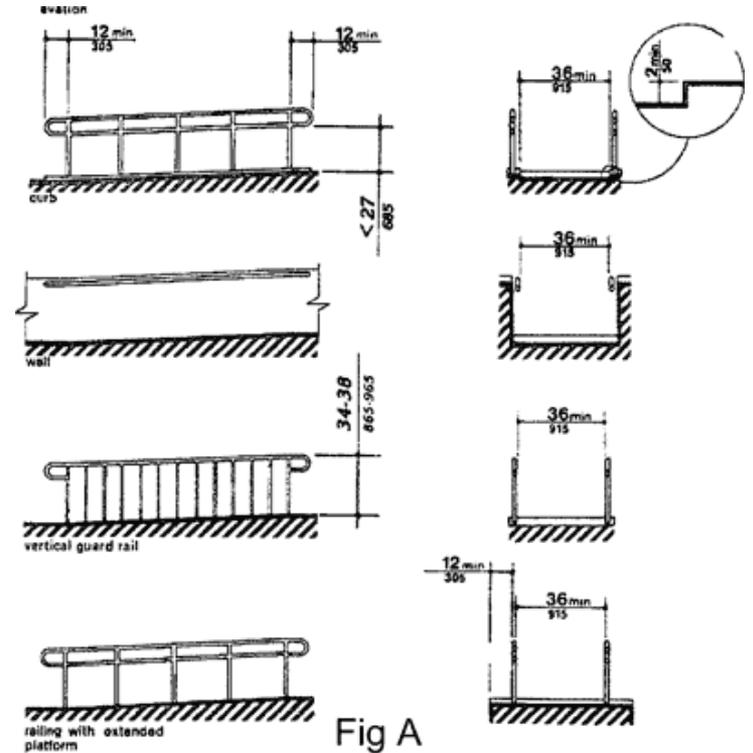
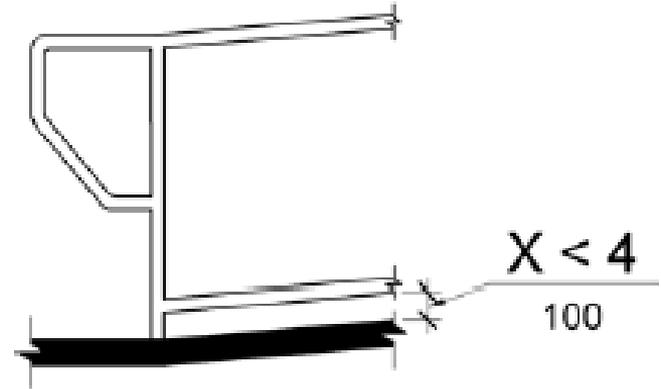


Fig A

Examples of edge protection and handrail extensions

Curb or Barrier

A curb or barrier shall be provided that prevents the passage of a 4-inch-diameter sphere, where any portion of the sphere is within 4 inches of the finish floor or ground surface.



Handrails

- The I-Codes define handrail as being in place to provide guidance.
- A handrail is required on stairs with two or more risers and ADA ramps with a rise of 6 inches.
- Handrails are not required on walking surfaces with running slopes less than 1:20.
- They are required on both sides of stairs and ramps.
- If you choose to place a handrail in another area, such as a corridor, it must meet the handrail requirements.



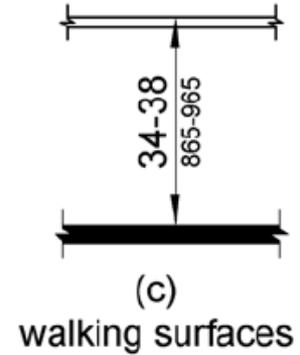
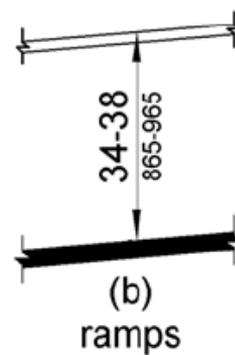
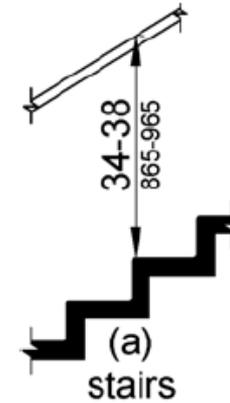
Intermediate Rails

- Based on the expected building occupancy, intermediate rails will be required.
- All portions of an egress path must be within 30 inches of a handrail.



Handrail

- Other than OSHA, all other codes and standards require that handrails be placed between 34 and 38 inches above the ramp, walking surface, or nosing.
 - For children, the 2010 ADASAD recommends a maximum height of 28 inches with a minimum of 9 inches of clearance between the child's rail and the adult rail. (This is not a requirement, it is only a recommendation.)



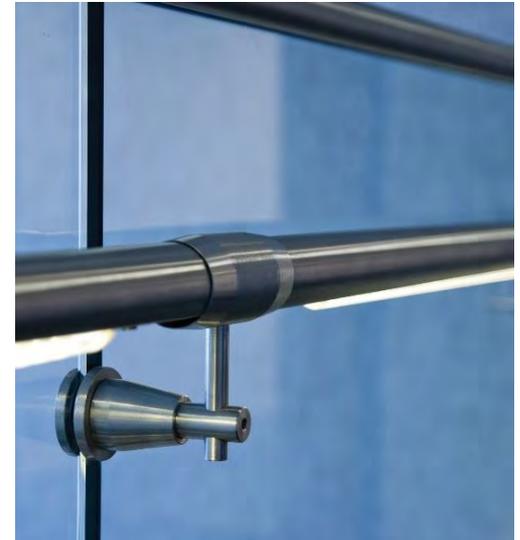
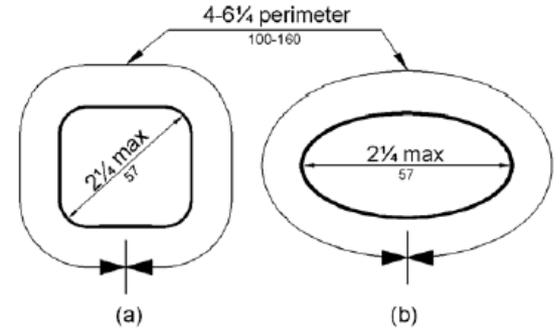
Handrail Continuity

- Handrails must be continuous within the full length of each stair flight or ramp run.
- Inside handrails on switchback or dogleg stairs and ramps shall be continuous between flights or runs.
- They must not be obstructed along their tops or sides.



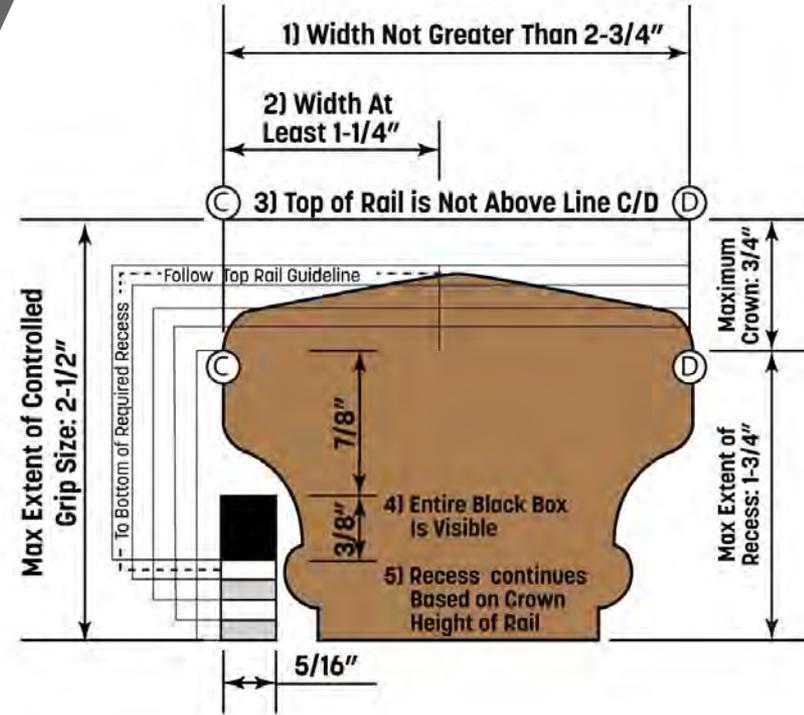
Handrail Size Limitations

- Handrail size limitations are now consistent within all the building codes and standards. Handrails must be between $1\frac{1}{4}$ and 2 inches in diameter.
- Equivalent graspability
 - Handrail gripping surfaces with a noncircular cross section shall have a perimeter dimension of 4 inches (100 millimeters) minimum and $6\frac{1}{4}$ inches maximum, and a cross section dimension of $2\frac{1}{4}$ inches (57 millimeters) maximum.

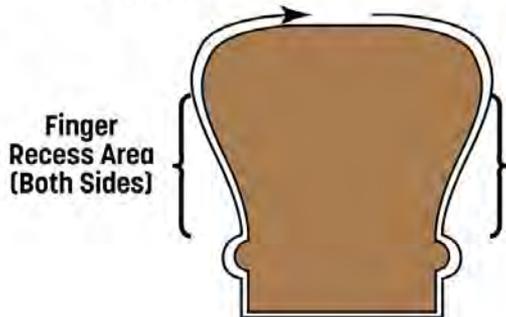


Type II Definition

- Handrails used in residential construction tended to be larger than this. The Stair Manufacturers Association funded a study that determined that a pinch grip could provide graspable handrail.
- Type II handrail
- Perimeter greater than $6\frac{1}{4}$ inches
 - Provide a graspable finger recess on both sides of the profile
 - Added in 2001 IRC and 2009 IBC for multifamily residential



Perimeter Greater Than 6-1/4"

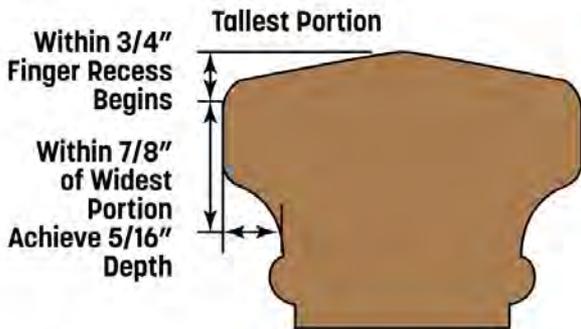
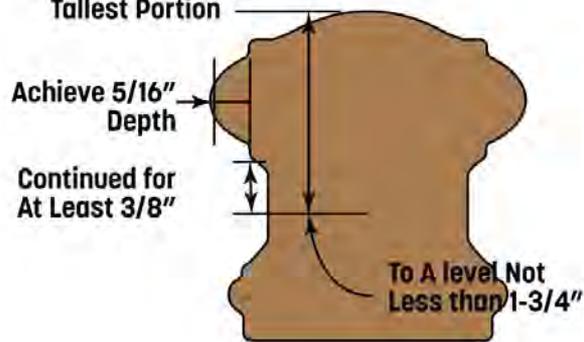


Tallest Portion

Achieve 5/16" Depth

Continued for At Least 3/8"

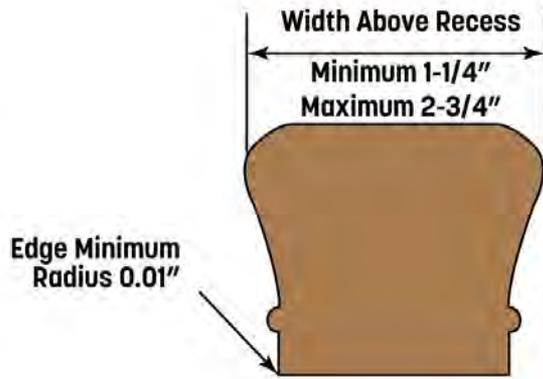
To A level Not Less than 1-3/4"



Width Above Recess

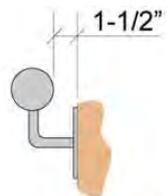
Minimum 1-1/4" Maximum 2-3/4"

Edge Minimum Radius 0.01"

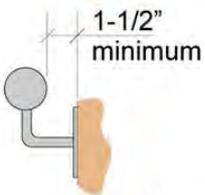


Bracket Clearance – Horizontal

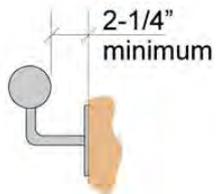
**1991
ADAAG**



**IBC, IRC,
ANSI, &
ADASAD**

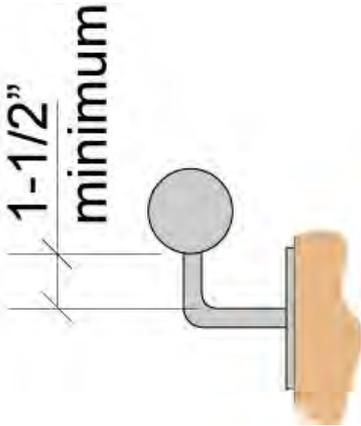


**NFPA &
OSHA**



Maximum Projection: 4½"

Bracket Clearance – Vertical

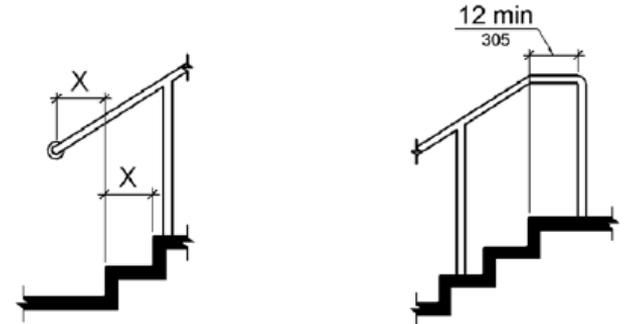
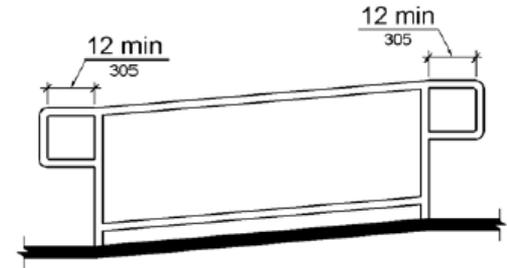


To allow for variation, it is permissible to decrease the clearance by 1/8 inch for each 1/2 inch of perimeter over 4 inches.

Railing Diameter	Clearance from Underside
1.25"	1½"
1.50"	1-3/8"
1.66"	1¼"
1.90" or 2.00"	1"

Rail Extensions

- Extensions of the handrail is required by the ADA and building codes.
- Ramps: handrails extend horizontally above the landing for 12 inches minimum beyond the top and bottom of the ramp runs.
- Stairs, top extension: handrails extend horizontally above the landing for 12 inches minimum beginning directly above first riser nosing.
- Stairs, bottom extension: handrails extend at the slope of the stair flight for a horizontal distance equal to one tread depth beyond the last riser nosing.



Note: X = tread depth

Extensions shall return to a wall, guard, or the landing surface or continue to another stair run.

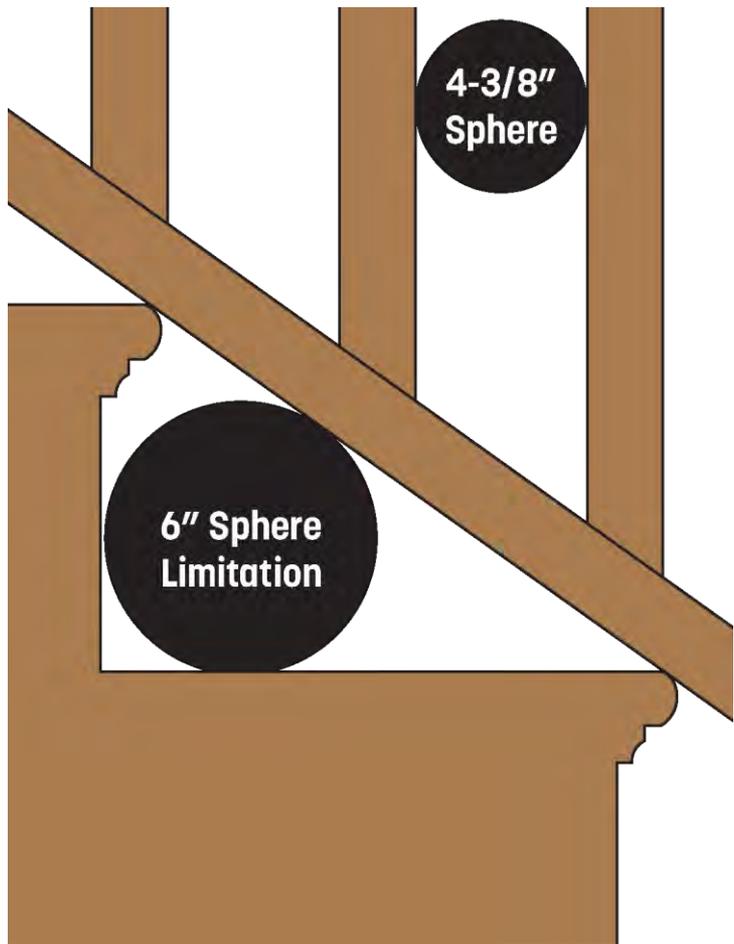




Guard

- Definitions within the building codes are critical for the proper interpretation of what is or is not safe.
- The I-Codes define guard as “a structure in place to prevent accidental falls.”
- Must be a height of 42 inches in (IBC) commercial applications and 36 inches in (IRC) residential applications.
- A guard is generally not required unless there is a 30-inch drop within 36 inches.
- No opening in the guard can be large enough that a 4-inch sphere can pass.





The Ladder Effect

- First appeared in BOCA's National Building Code 1993. There was no similar restriction in either SBCCI or ICBO.
- It was only approved for the 2000 IRC. It was not approved for the 2000 IBC.
- The section of concern stated:
 - "Required guards shall not be constructed with horizontal rails or other ornamental pattern that result in a ladder effect."
- Decision based on perception, not reality.
 - No hard evidence ever presented to indicate there was an epidemic of injuries to young children related to climbing.



The Ladder Effect

- The “ladder effect” wording was removed from the 2001 IRC Supplement.
- However, some jurisdictions have chosen to keep some form of climb-ability restrictions in their codes. Most notably the cities of Chicago, Pittsburgh, Baltimore, and Washington, D.C., still have climb-ability restrictions in their codes.
- The term does not appear in the 2003, 2006, or 2009 ICC codes.
- However, it is being applied on a local basis in various parts of the country.



The Ladder Effect

Cable railing would not be permitted under the ladder effect.



The Ladder Effect

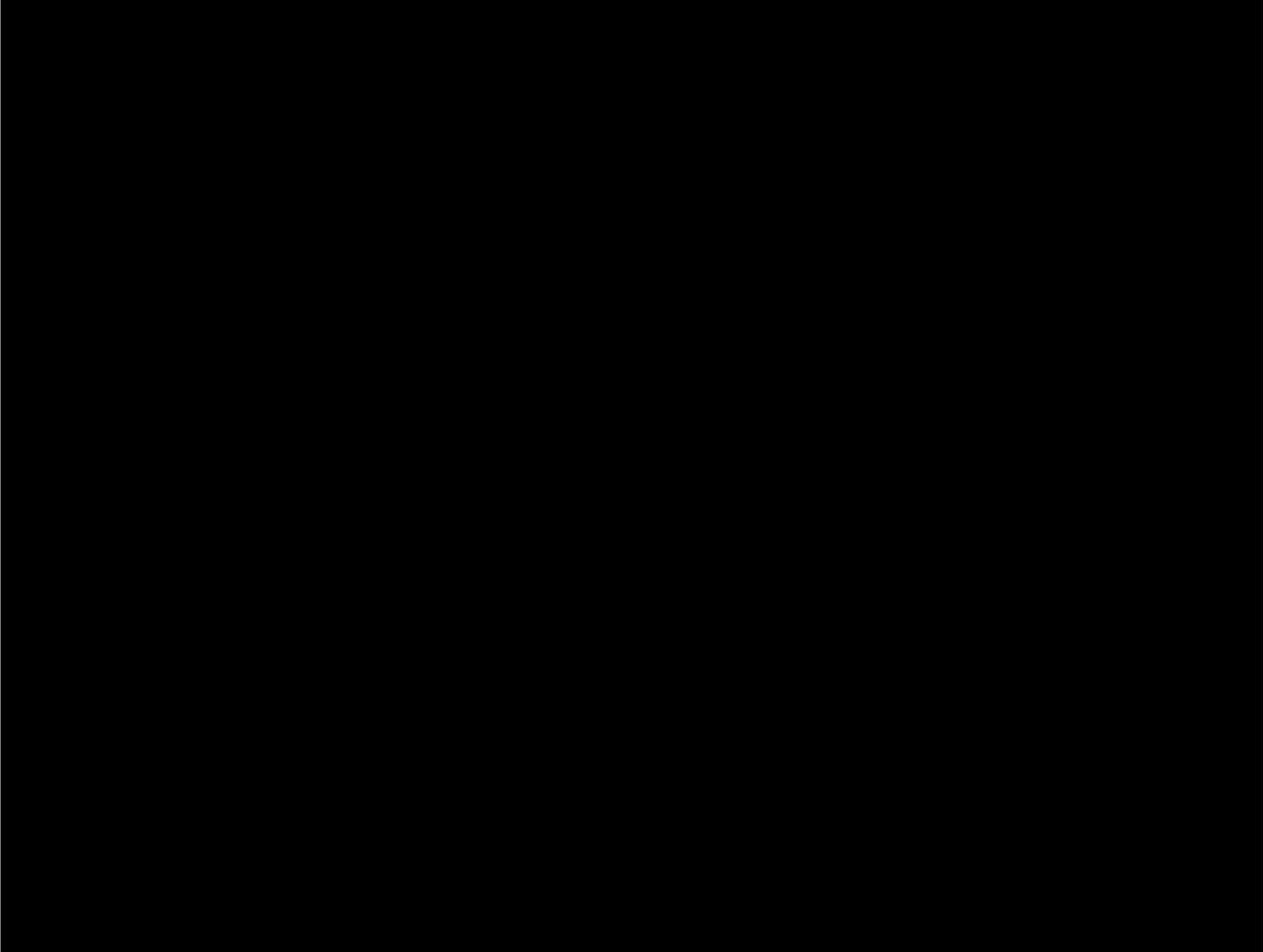
Ornamental railing was also subject to this restriction. Any toe hold would be considered climbable.



The Ladder Effect

But the true target was horizontal railings. Code officials were hoping to prevent homeowners from nailing 2-by-4s on their deck railings to meet the infill requirements because this created climbing hazards. However, there was no evidence indicating that even horizontal railings were being climbed by young children.





The Ladder Effect

Take the case of benches. In a residential application where only a 36-inch-high guard is required, once a bench is attached to the deck rail, you now only have an 18-inch-high guard. When the climbing of furniture was pointed out at a code hearing, a building official said, “We can’t control the furniture, but we can control you.”



The Ladder Effect

This is a case in Toronto. Note that this guard uses solid infills and would be considered non-climbable. However, the parents in this home draped their bicycles over the guard.





Kidsafe.org

Child accident prevention group **Kidsafe** has stated that balconies are a death trap for toddlers.

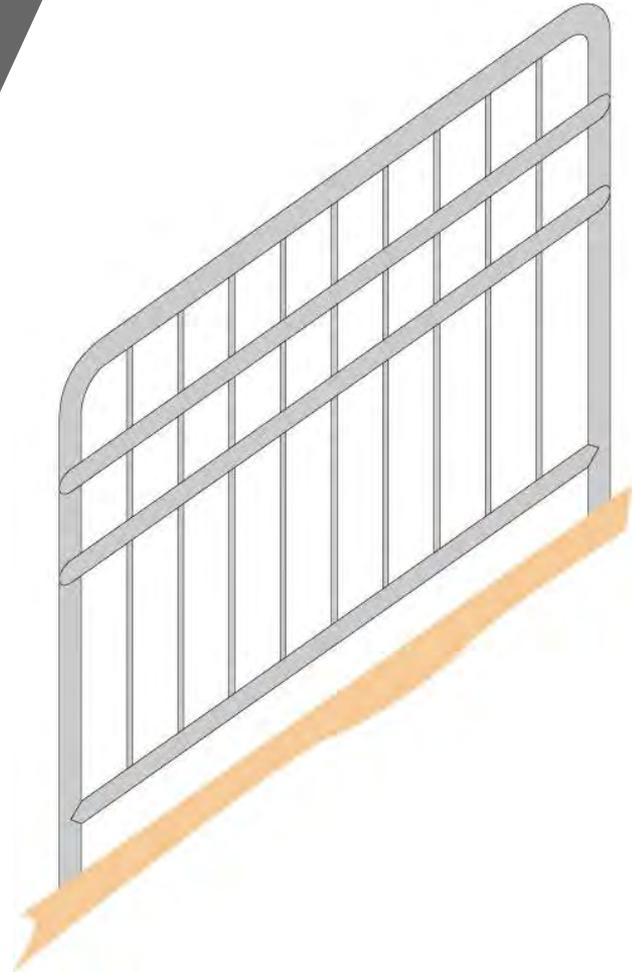
- Most of these small balconies usually have a combination of table and chairs, which if left against the safety railing can act as a simple set of steps for toddlers. A toddler can easily climb onto a chair and then onto the top of the table, placing him or her in a very dangerous situation.



Guardrail with Secondary Handrail for Children

2010 ADASAD Advisory 505.4

- **Height:** When children are the principle users in a building or facility (e.g., elementary schools), a second set of handrails at an appropriate height can assist them and aid in preventing accidents. A maximum height of 28 inches.



The Ladder Effect

But, as this photo shows, it is more common that you think. And the code did not cover things like “pony walls,” which contribute to climbability.



Pool Barriers

- Pool barriers are not in the model codes but in the appendix.
- They are optional.
- They must be 48 inches minimum in height.
- There must be a maximum of 2 inches between the ground and bottom of the barrier.
- There are multiple other limitations depending on the structure of the barrier.



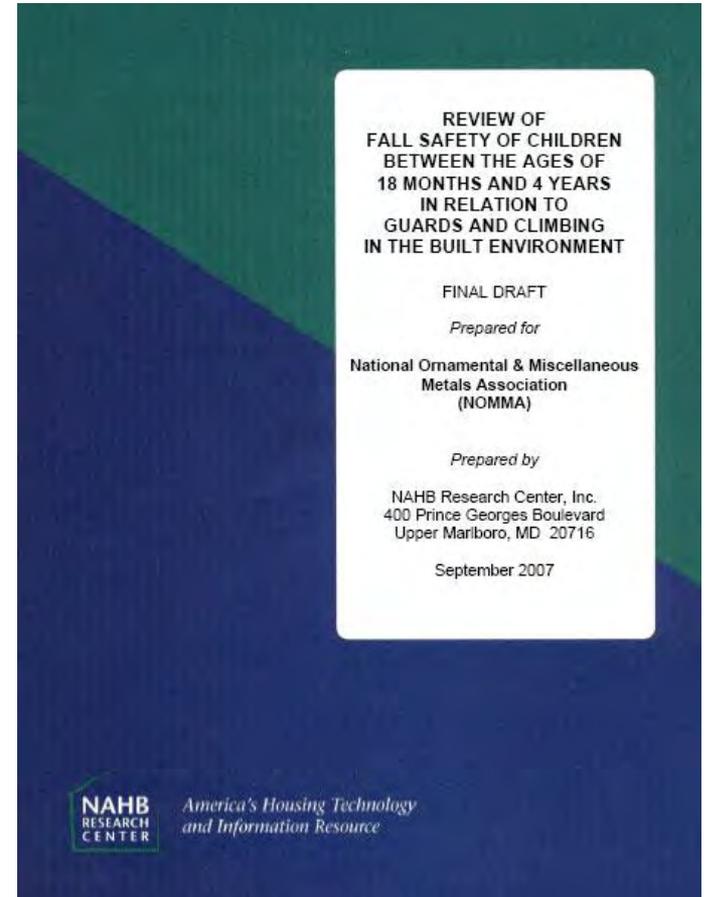
The Ladder Effect

- In 2004, the ICC Code Technology Committee (CTC) was given the task to determine how to make guards less climbable “if necessary.”
- In 2007, the National Ornamental & Miscellaneous Metals Association (NOMMA) commissioned the National Association of Home Builders (NAHB) Research Center to review all existing peer reviewed reports and CPSC data.



The Ladder Effect

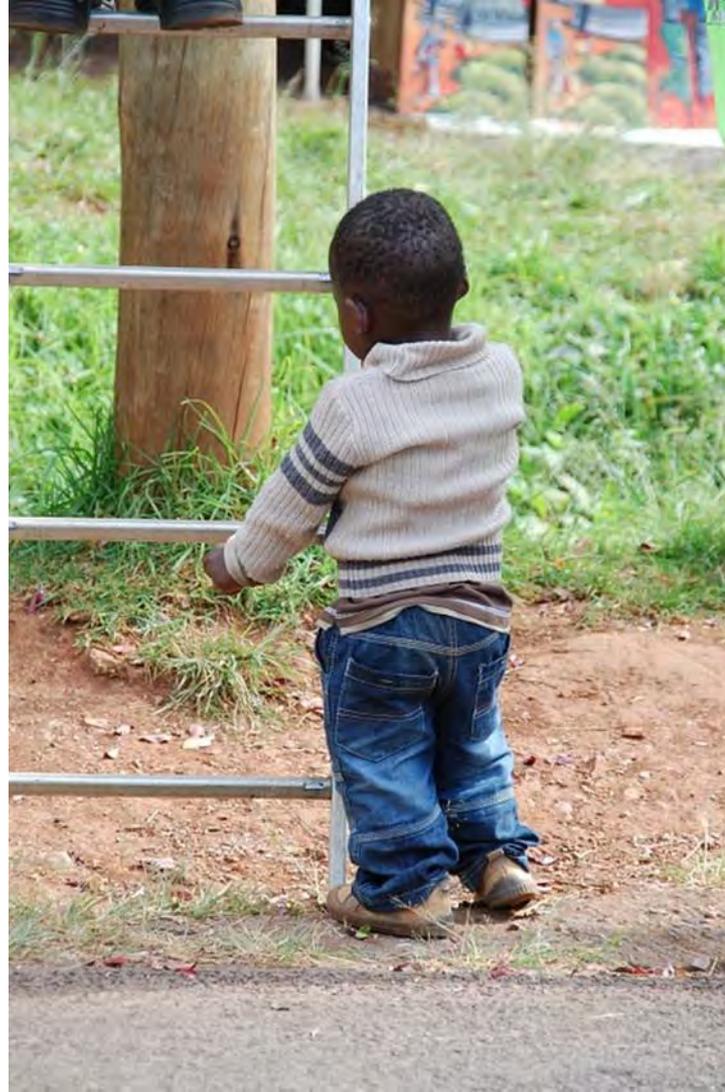
- The report was assembled by the National Association of Home Builders' Research Center and was issued in October 2007. It was called the "Review of Fall Safety of Children Between the Ages of 18 Months and 4 Years in Relation to Guards and Climbing in the Built Environment."
- The researchers felt that those who were younger than 18 months did not have the strength to climb a guard and those older than 4 years would be able to climb just about anything
- The report included:
 - Critical review of peer-reviewed scientific literature relating to "why children climb," and
 - Review of injury data.



The Ladder Effect

Peer-reviewed studies conclusions

- The human child is built to climb and loves to do so! (Readdick and Park, 1998)
- Climbing is involved in the child's physical, psychological, and social development.
- Climbing skills are often taught and encouraged by parents, especially with boys.
- Climbing is a part of physical education at school.
- There is no evidence of a gender difference in either climbing skill or climbing speed in young children.
- Difficult barrier designs merely present a greater challenge to the determined child.
- Studies also generally agree that it is probably impossible and most likely undesirable to render any environment completely "safe" from children's climbing.



National Home Builders Association

NEISS Data Review

- The National Home Builders Association (NAHB) Research Center's review went on to analyze Consumer Product Safety Commission (CPSC) data collected by the National Electronic Injury Surveillance System (NEISS).
- Previous analysis of this data had been unscientific and inconclusive.
- Following a thorough, scientific analysis, the review of NEISS data resulted in the following conclusions:



NAHB Conclusions

- The results indicate that falls from porches, balconies, open-side floors, floor openings, handrails, railings, and banisters among young children ages 18 months to 4 years account for an estimated **0.032 percent of injuries in that population.**
- The incident rate is approximately 2.5 per 100,000 children between 18 months and 4 years of age.
- The CPSC noted there was too much uncertainty in the data to ascribe causality or the physical situation that lead to reported injuries.
- The CPSC felt the number was already so small that it was not an area of concern.

NAHB Peer Review

- The peer review of NAHB report was completed in May 2008.
- The CTC determined the low incidence rate does not warrant the creation of specific code language.
- Attempts to return “The Ladder Effect” to the model codes have since been unsuccessful.
- But remember that some local jurisdictions have maintained climb-ability restrictions in their codes.
- Confirm with your local authority having jurisdiction (AHJ) prior to specifying a guard.

Load Requirements

- Load requirements for handrails and guards are a uniform load of 50 pounds per foot or a concentrated load of 200 pounds.
- Guard infills must meet a load of 50 pounds per square foot.



Glass Railing Code Requirements

- Glass railing is treated uniquely in the model codes.
- Prior to 2015 IBC:
 - IBC 2407.1.2 – Support: Each handrail or guard section shall be supported by a minimum of three glass balusters or shall be supported to remain in place should one baluster panel fail.
 - **Glass balusters shall not be installed without an attached handrail or guard.**





Does this guard with ½-inch monolithic tempered glass meet IBC 2407.1?

IBC 2407.1.2 – Support: Each handrail or guard section shall be supported by a minimum of three glass balusters or shall be supported to remain in place should one baluster panel fail. **Glass balusters shall not be installed without an attached handrail or guard.**

We Think Not

- The initial problem is that the guard is improperly used in this section.
- By code definition, the “guard” is the full structure, not the part that is supported by the glass—that is a top rail.
- In this application, the handrail is not required.
- It is in place due to the ambiguity of the code language.
- The interpretation should have been that a handrail should have an attached handrail and a guard should have an attached top rail.
- Attempts to change this were not welcome, as fabricators prefer the ambiguity.



Does this ½-inch monolithic glass guard meet this requirement?

IBC 2407.1.2 – Support: Each handrail or guard section shall be supported by a minimum of three glass balusters or shall be supported to remain in place should one baluster panel fail.

Glass balusters shall not be installed without an attached handrail or guard.

We Think Not

- IBC understood the need for clarification so in 2009 it updated the section with an exception referring to “top rail” in place of the incorrect use of “guard”:
 - A top rail shall not be required where the glass balusters are laminated glass with two or more glass plies of equal thickness and the same glass type. The panels shall be designed to withstand the loads specified in Section 1607.8.
- IBC’s position was that no top rail is required if the glass is laminated or the guard meets the structural load requirements.
- In 2015, the IBC updated the exception to read:
 - A top rail shall not be required when the glass balusters are laminated glass with two or more glass plies of equal thickness and the same glass type **when approved by the building official.**
- The requirement for approval by the building official was removed in 2018.



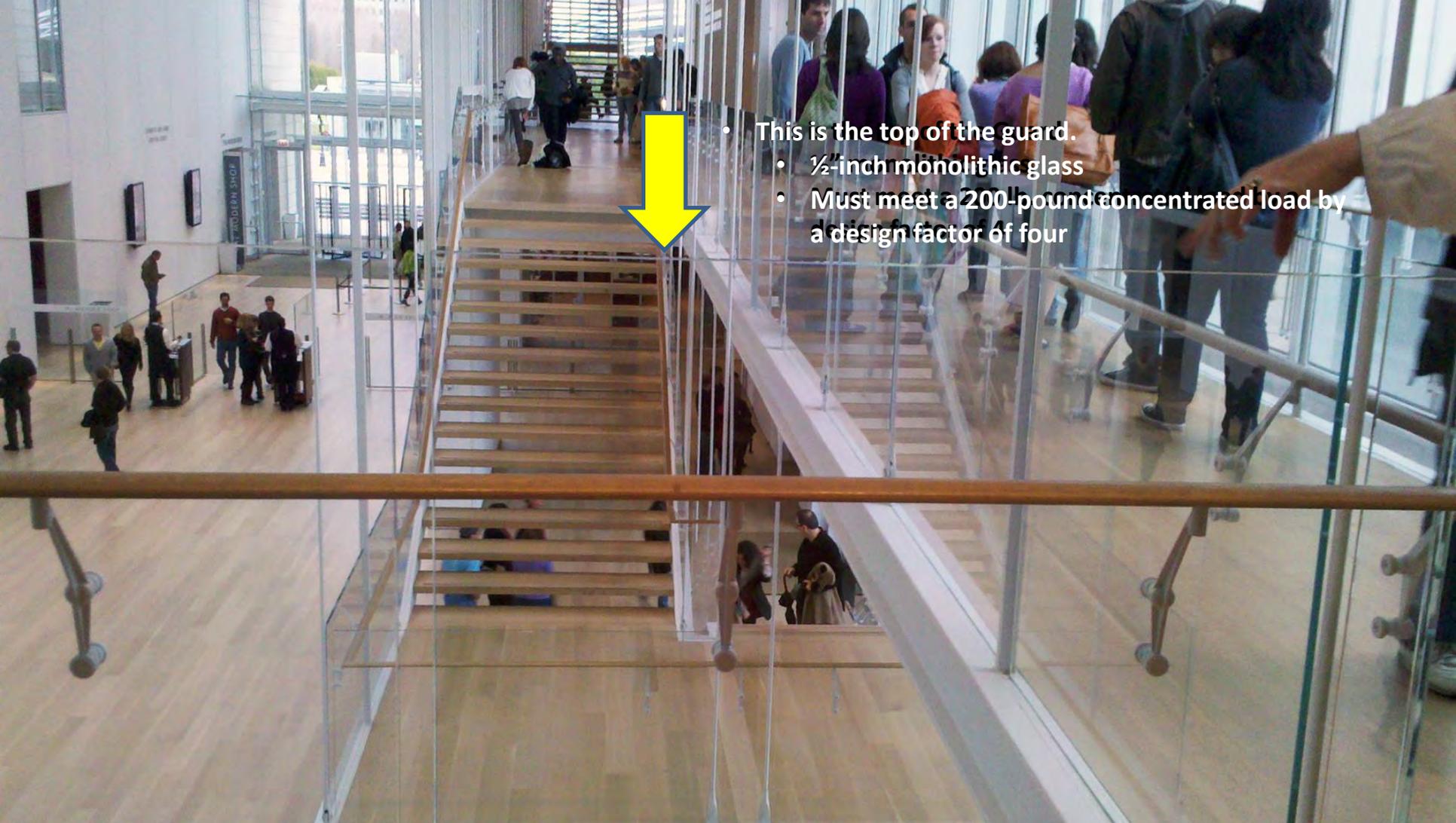
Does this ½-inch monolithic glass guard meet this requirement?

IBC 2407.1.2 – Support: Each handrail or guard section shall be supported by a minimum of three glass balusters or shall be supported to remain in place should one baluster panel fail. **Glass balusters shall not be installed without an attached handrail or guard.**

Glass Railing Load Requirements

But, it's the load requirements referred to in the section that make the best argument for a top-rail requirement. While 1607.8 is noted, what is often overlooked is Section 2407.1.1, which has unique safety factors for glass in glass railing.

- Glass railing specific load requirement:
 - **IBC 2407.1.1 – Loads:** The panels and their support system shall be designed to withstand the loads specified in section 1607.8. A design factor of four shall be used for safety.
- Section 1607.8 specifies the load requirement for handrails and guards.
- All guard and handrail requirements:
 - **IBC1607.8.1 – Handrails and Guards:** Handrail assemblies and guards shall be designed to resist a linear load of 50 pounds per linear foot (plf) (0.73 kN/m) in accordance with Section 4.5.1 of ASCE 7.
 - **IBC1607.8.1.1 – Concentrated Load:** Handrails and guards shall be designed to resist a concentrated load of 200 pounds (0.89 kN), in accordance with Section 4.5.1 of ASCE 7.
 - ASCE7 notes the load needs to be placed at the “top” of the guard.



- This is the top of the guard.
 - ½-inch monolithic glass
 - Must meet a 200-pound concentrated load by a design factor of four

What Is
Nelophobia?



What Is Nelophobia?

- **Nelophobia is the fear of glass (breakage).**
- Nelophobia is also called Hyalophobia and Huelophobia and related to Crystallophobia (fear of crystal or glass) as well as Spasmenagaliaohobia, which is the fear of broken glass.
- In Europe and Asia, you will see structural glass in use everywhere. But the United States is a litigious society, and glass breakage is a liability concern.
- There were multiple failures in glass railings over the years that fostered these concerns. The image is relating to an incident at the W Hotel in Austin, Texas, in July 2011.
- Monolithic tempered glass was used. The glass shattered, and as it rained down, the debris caused other panels below to shatter.
- In the end, the hotel was closed, and eventually all of the glass was replaced with laminated, tempered glass.



Glass Failures in Guards

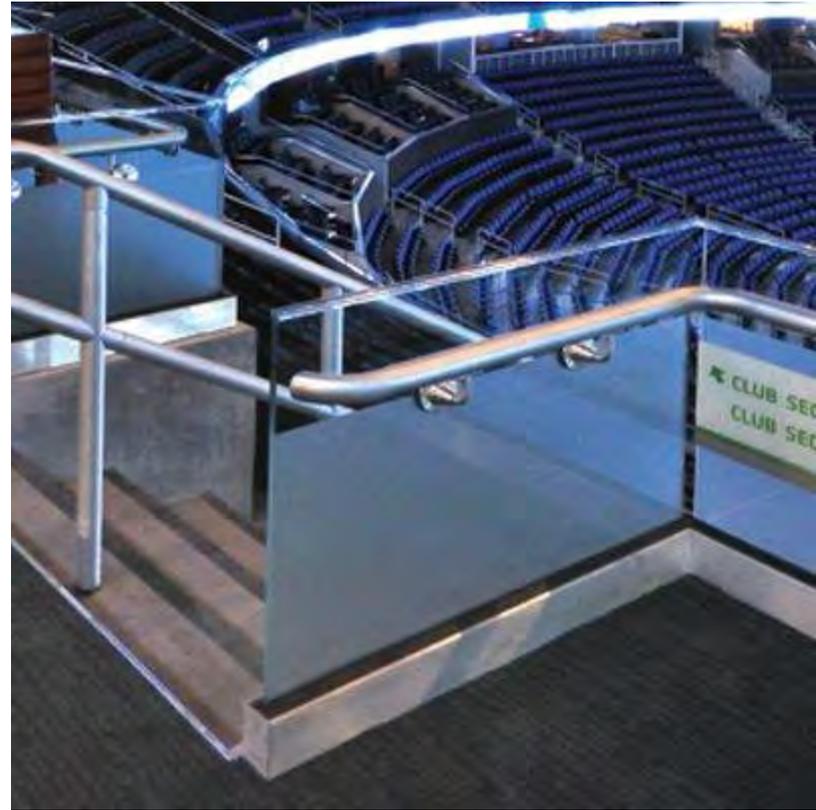
- Monolithic tempered glass was breaking across North American cities, including Austin, Texas; Toronto; Houston; Seattle; New York City; Chicago; Dallas; and Cleveland.
- Possible causes:
 - Spontaneous glass breakage resulting of nickel-sulfide inclusions within glass structure.
 - Likely caused by the presence of contaminants emanating from oil-fired vs. gas-fired glass manufacturing furnaces.
 - To avoid this issue, glass can be purchased as “heat soaked.” Heat-soaked glass goes through a secondary heating process to force the nickel-sulfide inclusion to shatter in the plant rather than in the field.



Laminated Glass

In response to the issue of glass breakage across North America, the 2015 IBC now requires laminated glass in all glass railing applications.

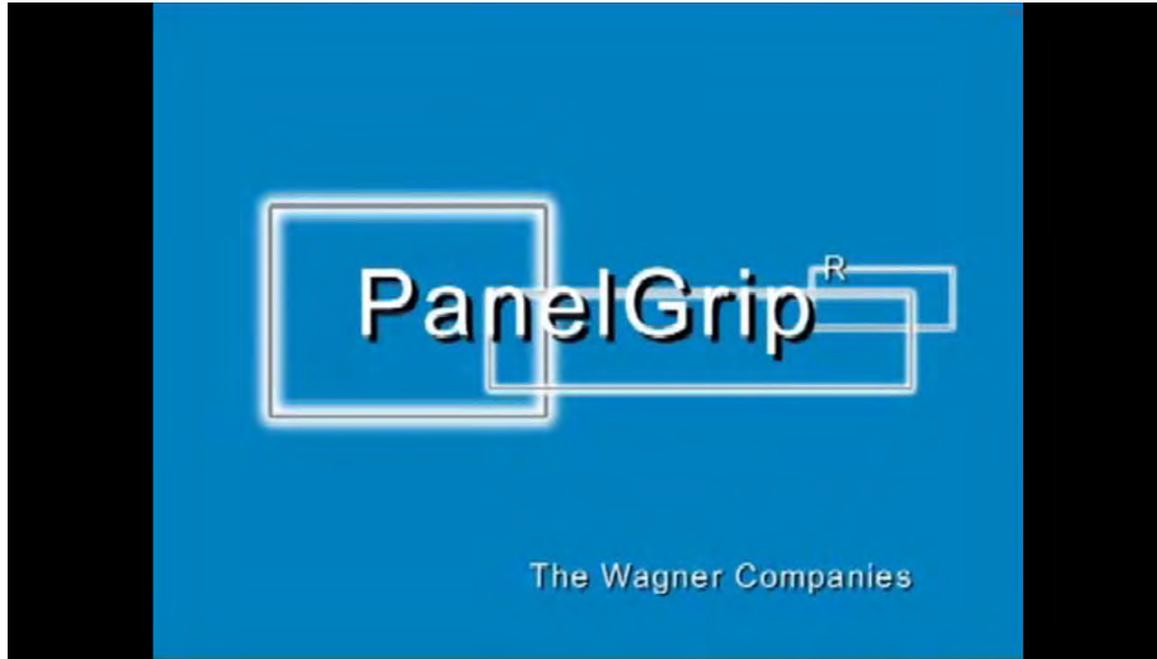
For example, this applies to infill panels and glass balustrades.



Glass Rail Pushed to Failure



PVB vs. Lonoplast Rigid Interlayer



Glass Rail Deflection



For More Information

For more information on building codes, visit www.iccsafe.org.

Since ICC sells the code books, you will not be able to view all the building codes. However, you can view individual sections of the code.

Additional Resources

codes.iccsafe.org/public/collections/I-Codes

www.usdoj.gov/crt/ada/adahom1.html

www.nomma.org

The image shows a screenshot of the International Code Council (ICC) website homepage. The top navigation bar includes links for "About ICC", "Membership", "Education & Certification", "Codes & Tech Support", "Forum", and a user profile icon. The main content area is divided into several sections:

- premiumACCESS Digital Codes:** A banner featuring a computer monitor and a tablet displaying digital code content, with the text "offer powerful features that work for you" and a "FREE" badge.
- COLUMBUS INTERNATIONAL CODE COUNCIL 2017 ICC Annual Conference & Expo:** A banner with a cityscape background and a call to "register today!".
- Residential Inspection Institute:** A green banner with the text "This event fills up fast — register today!".
- Quick Connections:** A green sidebar with icons and text for "Get an ICC Plan Review", "Get a Code Opinion", "Career Center", "Become a Member", "Get Certified", "Get Involved in Code Development", "Calendar Events", and "Shop ICC".
- Accreditation and Services:** A vertical list of logos for "INTERNATIONAL CODE COUNCIL", "INTERNATIONAL ACCREDITATION SERVICE", "EVALUATION SERVICE", and "SOLAR RATING & CERTIFICATION CORPORATION".
- BUILDING SAFETY MONTH MAY:** A banner with a yellow hard hat and architectural plans, featuring the text "INTERNATIONAL CODE COUNCIL".



This concludes the continuing education unit on ADA, Building Codes, and Standards Relating to Handrails and Guards.

Thank you for your interest in Wagner Architectural.

For more information, please visit:

www.wagnerarchitectural.com

www.wagnercompanies.com

Twitter: @wagnercompanies

