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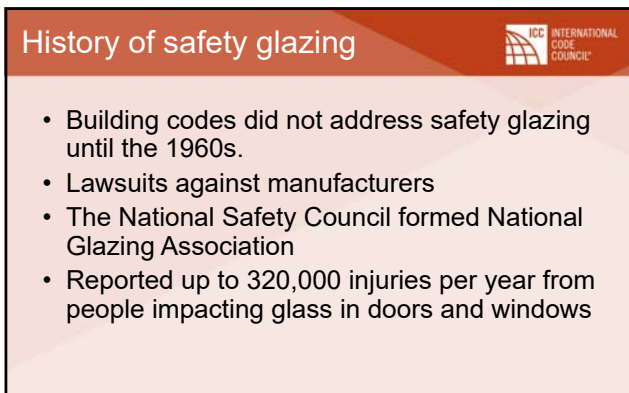
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**History of safety glazing** 

- ANSI Z97.1 standard formed in 1966 for impact resistance of glass
- 1968-73: Greatest number of injuries in residential applications
  - patio doors and shower enclosures

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**History of safety glazing** 

- The Consumer Product Safety Commission (CPSC) created in 1972.
- Developed a two-tiered standard
- Greater hazard in impact with large area of glass
- Category I glass rated at 150 pounds
- Category II rated at 400 pounds
- CPSC 16 CFR 1201 became law on July 6, 1977

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**Impact Test** 

- CPSC 16 CFR 1201
  - Glazing shall comply with the test criteria for Category II unless otherwise indicated in the Table
- Exception:
  - ANSI Z97.1
  - Glazing not in doors or enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers
  - Glazing shall comply with the test criteria for Class A unless indicated in Table

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**CPSC 16 CFR 1201 - Impact Test**



Exposed surface area	Doors	Sliding patio doors	Glazing near floor
≤ 9 sq ft	I	II	NR
> 9 sq ft	II	II	II

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**CPSC 16 CFR 1201 - Impact Test**



Exposed surface area	Adjacent to Doors	Tub/shower enclosures & doors
≤ 9 sq ft	I	II
> 9 sq ft	II	II

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**ANSI Z97.1 - Impact Test**



Exposed surface area	Glazing near floor	Adjacent to Doors	Exception to wet surfaces
≤ 9 sq ft	NR	B	A
> 9 sq ft	A	A	A

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**Types of glazing** 

- Annealed glass (float glass)
  - Ordinary glass
  - Can be cut
  - Breaks into shards.
- Plate glass
  - Heavier
  - Stronger
- Heat strengthened glass
  - Double strength
  - Cannot be cut after manufacture

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**Wired glass** 

- Not safety glazing
- ANSI Z97.1 Category class C
- Used for fire resistance
- Some history of use as safety glazing in fire doors

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**Louvered Windows or Jalousies** 

- Regular, float, wired or patterned glass in jalousies and louvered windows:
  - $\geq 3/16$  in. thick nominal and
  - $\leq 48$  in. in length
- Exposed glass edges shall be smooth.
- Wired glass with wire exposed on longitudinal edges prohibited

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**Types of safety glazing** 

- Tempered glass
  - Heating and rapid cooling process
  - Four times more resistant to impact than annealed glass
  - Fractures perpendicular to the plane of the surface
  - Small pebbles less likely to cause significant injury
  - Cannot be cut after manufacture

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**Types of Glazing** 



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**Types of safety glazing** 

- Laminated glass
  - Two layers of annealed, heat-strengthened or tempered glass
  - Clear polyvinyl butaryl (PVB) center membrane
  - Used in car windshields
  - Often used for frameless glass railings
  - Annealed laminated can be cut to size after manufacture
- Proprietary

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**Identification of safety glazing** 

Manufacturer's designation for each pane of glazing in hazardous location:

- Who applied the designation
- Type of glass
- Safety glazing standard
- Visible in the final installation
- Label permitted



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**Identification of safety glazing** 

Exceptions:

- Certificate, affidavit or other evidence (not tempered)
- Tempered spandrel glass - removable paper



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**Identification of safety glazing** 

Multiple assemblies

- Individual panes  $\leq 1$  sq. ft.
- $\geq$  one pane identified
- Other panes labeled
  - CPSC 16 CFR 1201 or
  - ANSI Z97.1

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### Human Impact Loads



- Glazed areas in hazardous locations shall pass the test requirements
- Exceptions:
  - Mirrors and other glass panels mounted or hung on a surface that provides a continuous backing support
  - Glass unit masonry
  - IRC: Louvered windows and jalousies
  - IBC: Plastic glazing shall meet the weathering requirements of ANSI Z97.1.

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### Doors



- Glazing in fixed and operable panels of swinging, sliding and bi-fold doors
- Exceptions:
  - Glazed openings where a 3-in.-diameter sphere cannot pass through
  - Decorative glazing
- IBC Exceptions
  - Curved glazed panels in revolving doors
  - Commercial refrigerated cabinet glazed doors

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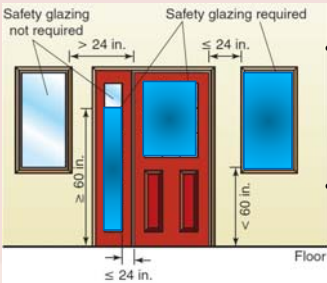

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### Adjacent to Doors



- Within 24 in. horizontally of door in closed position
- < 60 in. above floor

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Adjacent to Doors 

- Bottom exposed edge < 60 inches above floor **and**
- 1. Glazing is within 24 inches of either side of door in the plane of the door in a closed position.

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Adjacent to Doors 



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Adjacent to Doors 



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**Adjacent to Doors** 

- Bottom exposed edge < 60 inches above floor **and**
- 2. Where the glazing is on a wall perpendicular to the plane of the door in a closed position and within 24 inches of the hinge side of an in-swinging door.

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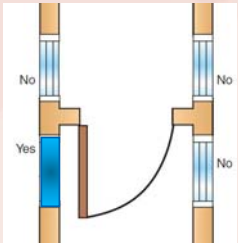
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**Adjacent to Doors** 

- Glazing installed perpendicular to a door
- < 24 inches from door
- Safety glazing if on hinge side of an in-swinging door
- IRC
- IBC Limited Exception



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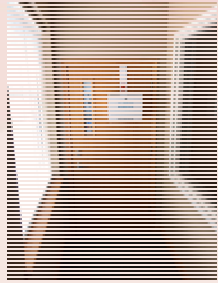
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**Adjacent to Doors** 

- IBC Exception:
- Glazing in walls on the latch side of and perpendicular to the plane of the door in a closed position in one- and two-family dwellings or within dwelling units in Group R-2.



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**Adjacent to Doors** 

- **Exceptions:**
  - Decorative glazing
  - Intervening wall or other permanent barrier between door and glazing
  - Access through door is to closet or storage area  $\leq 3$  ft. in depth
  - Glazing that is adjacent to the fixed panel of patio doors (IRC)

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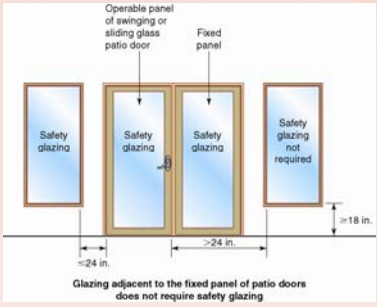
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**R308.4.2 – Glazing adjacent doors** 



Operable panel of swinging or sliding glass patio door

Fixed panel

Safety glazing

Safety glazing not required

$\geq 24$  in.

$\geq 24$  in.

$\geq 18$  in.

Glazing adjacent to the fixed panel of patio doors does not require safety glazing

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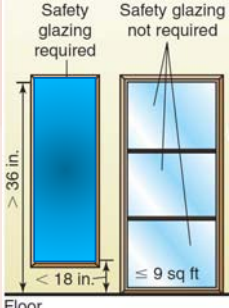
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**Windows** 

- Exposed area of an individual pane  $> 9$  sq. ft.
- Bottom edge of glazing  $< 18$  in. above floor
- Top edge of glazing  $> 36$  in. above floor
- Walking surface within 36 in.



Safety glazing required

Safety glazing not required

$> 36$  in.

$< 18$  in.

Floor

$\leq 9$  sq ft

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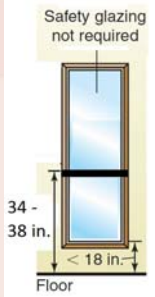
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**Windows** 

**Exceptions**

- Decorative glazing
- Horizontal rail on accessible side 34 to 38 in. above walking surface.
  - Withstand horizontal load of 50 lb. per lin. ft. without contacting glass
  - $\geq 1 \frac{1}{2}$  in. in height.
- Outboard panes  $\geq 25$  feet above any grade, roof, walking surface or other surface adjacent to the glass exterior




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**R308.4.4 Glazing in guards and railings** 

- Always require safety glazing
- Table R301.5 requires a safety factor of 4
  - h. The safety factor is applied to concentrated loads at top of rail and to load on in-fill components.

USE	LIVE LOAD (psf)	
Guardrails and handrails	200	Single concentrated load applied in any direction along the top.
Guardrail in-fill components	50	Horizontally applied normal load of 50 lb. on area of 1 sq. ft.

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**Glazing in guards and railings** 

- Glazing used in guards require a safety factor of 4
  - 4 x 50 psf (minimum design load for infill components) = 200 psf



IRC Table R301.5  
Minimum Uniformly Distributed Live Loads  
Footnote h

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Glazing in guards and railings



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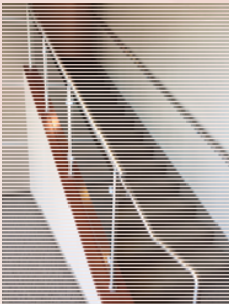
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Glazing in guards and railings



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Glazing in guards and railings

- **IBC Section 2407 Glass in Handrails and Guards**
  - Loads. A design factor of four
  - Each rail supported by  $\geq 3$  glass balusters or equivalent
  - Glass balusters shall not be installed without an attached handrail or guard



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**Glazing in guards and railings** 

- **IBC Section 2407**  
Glass in Handrails and Guards
- **Exception:** A top rail not required where laminated glass balusters
  - ≥ 2 glass plies of equal thickness
  - When approved by the building official




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**Glazing and Wet Surfaces** 

- Where the bottom exposed edge of the glazing is less than 60 inches above standing or walking surface, and
- Glazing in walls, enclosures or fences containing ...
- Glazing in walls, enclosures or fences ... facing
  - Bathtubs, showers, hot tubs, spas, whirlpools, saunas, steam rooms, and swimming pools

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**Glazing and Wet Surfaces** 

- **Exception:** Glazing that is more than 60 inches, measured horizontally and in a straight line, from the water's edge of a bathtub, hot tub, spa, whirlpool or swimming pool or from the edge of a shower, sauna or steam room.

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Wet Surfaces 



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Wet Surfaces 



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Wet Surfaces 

- Glazing in walls or fences near swimming pools
  - ≤ 60 in. of water's edge
  - < 60 in. above walking surface



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**Adjacent Stairs and Ramps**  
**IRC**



ICC - Safety glazing required  
42-inch required to be safety glazing  
Measurements are to exterior glazing

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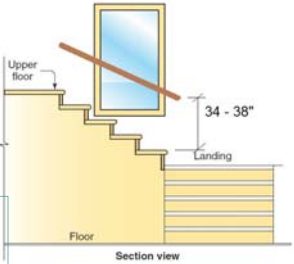
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**Adjacent Stairs and Ramps**  
**IRC**

- Exception if rail installed:
  - Withstand horizontal load of 50 plf without contacting glass
  - Cross-sectional height  $\geq 1\frac{1}{2}$  in.

Glazing 36 in. horizontally from walking surface.




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**Adjacent Stairs and Ramps**  
**IBC**

- **< 60 inches** above the plane of the adjacent walking surface of stairways, landings between flights of stairs and ramps
- Exceptions:
  - A guard and the plane of the glass >18 inches (457 mm) from the railing
  - Glazing  $\geq 36$  inches horizontally from the walking surface (IBC and IRC)

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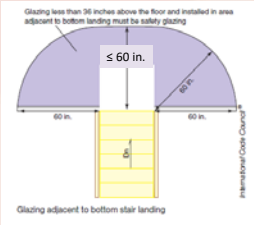
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**Adjacent Bottom Stair Landing**  
IRC

• Applies to the area in front of the plane of the bottom tread.

Glazing adjacent to bottom stair landing

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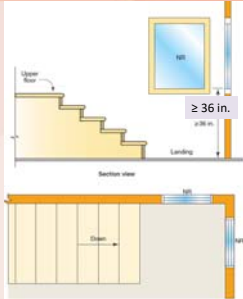
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**Adjacent Bottom Stair Landing**  
IRC

Glazing adjacent to bottom stair landing

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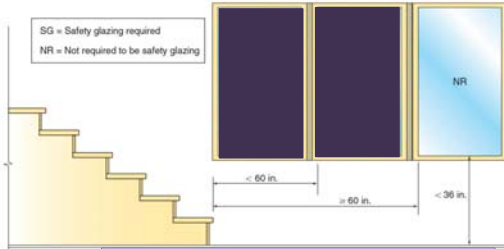
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**Adjacent Bottom Stair Landing**  
IRC

SG = Safety glazing required  
NR = Not required to be safety glazing



Exception: Glazing that is protected by a guard where the plane of the glass is >18 inches from the guard

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**Adjacent Bottom Stair Landing**  
**IBC**



- Glazing < 60 inches above the landing and within a 60-inch horizontal arc from the bottom tread nosing
- Exception:
  - Glazing that is protected by a guard where the plane of the glass is >18 inches from the guard

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Safety Glazing

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