

CONST-181

Building Code Interpretation:

Non-Structural

Chapter 1 & 35: Learning Objective

To obtain an understanding of the administrative provisions of the International Building Code.

- Understand the scope and purpose of the code,
- Duties of the building official
- Issuance of permits
- Inspection procedures
- Special inspections
- Existing buildings and referenced standards.

IBC Appendix

If there is a conflict in the code between a general requirement and a specific requirement, the _____ requirement shall apply.

- a. general
- b. specific
- c. least restrictive
- d. most restrictive

Class 2: Chapter 3, Section 508/509: Learning Objective

302.1 Occupancy Classification

- Assembly (see Section 303): Groups A-1, A-2, A-3, A-4 and A-5.
- Business (see Section 304): Group B.
- Educational (see Section 305): Group E.
- Factory and Industrial (see Section 306): Groups F-1 and F-2.
- High Hazard (see Section 307): Groups H-1, H-2, H- 3, H-4 and H-5.
- Institutional (see Section 308): Groups I-1, I-2, I-3 and I-4.
- Mercantile (see Section 309): Group M.
- Residential (see Section 310): Groups R-1, R-2, R-3 and R-4.
- Storage (see Section 311): Groups S-1 and S-2.
- Utility and Miscellaneous (seeSection312):GroupU

303.1 Occupancy Classification

Group A-1

Motion picture theaters
Theaters
Symphony and
concert halls

Group A-3

Amusement arcades
Art galleries
Bowling alleys
Places of worship
Community halls
Conference rooms
Exhibition halls
Lecture halls
Libraries
Museums
Passenger stations

Group A-4

Arenas
Skating rinks
Swimming pools
Tennis courts

Group A-2

Banquet halls
Casino gaming areas
Night clubs
Restaurants
Taverns

Group A-5

Amusement park
structures
Bleachers
Grandstands
Stadiums

Unique conditions are represented by the classifications of Groups A-1, A-2, A-4 and A-5. However, the category Group A-3 includes a variety of broad and diverse assembly uses. It is not uncommon to find high combustible loading in Group A-3 occupancies.

304.1 Occupancy Classification: Group B

Group B

- Ambulatory care facilities
- Animal hospitals, kennels and ponds
- Banks
- Barber and beauty shops
- Car wash
- Civil administration
- Clinic-outpatient
- Educational occupancies above the 12th grade
- Food processing \leq 2,500 sf
- Laboratories; testing and research
- Motor vehicle showrooms
- Post offices
- Print shops
- Professional services
- Radio and television stations
- Training and skill development

305.1 Occupancy Classification: Group E

- Educational Group E occupancy includes, among others, the use of a building or structure, or a portion thereof, by six or more persons at any one time for educational purposes through the 12th grade. This group includes buildings and structures or portions thereof occupied by more than five children older than 2½ years of age who receive educational, supervision or personal care services for fewer than 24 hours per day.
- Educational occupancies include classroom uses for students of high school age and younger.
- Education facilities limited to use by older students, such as college classrooms, are classified as Group B occupancies; however, a Group A classification should be considered for lecture halls and similar large occupant load spaces.

306.1 Occupancy Classification: Group F

Group F-1

- Aircraft
- Appliances
- Automobiles
- Bakeries
- Business machines
- Carpets and rugs
- Clothing
- Electric generation
- ESS (dedicated use)
- Food processing > 2,500 sf
- Furniture
- Laundries
- Millwork
- Paper mills or products
- Plastic products
- Printing or publishing
- Refuse incineration
- Textiles
- Water/sewer treatment
- Woodworking

Group F-2

- Brick and masonry
- Ceramic products
- Foundries
- Glass products
- Gypsum
- Ice
- Metal products

Classification as a Group F-2 occupancy is strictly limited because of the restrictions placed on such uses. The fabrication or manufacture of noncombustible materials, as well as their finishing, packaging or processing operations, cannot involve a significant fire hazard.

307.1 Occupancy Classification: Group H

- High-hazard Group H occupancy includes, among others, the use of a building or structure, or a portion thereof, that involves the manufacturing, processing, generation or storage of materials that constitute a physical or health hazard in quantities in excess of those allowed in control areas complying with Section 414, based on the maximum allowable quantity limits for control areas set forth in Tables 307.1(1) and 307.1(2).
- There is only one fundamental type of Group H occupancy—that which is designated based solely on excessive quantities of hazardous materials contained therein. The quantities of hazardous materials that necessitate a Group H classification vary, based on the type, quantity, condition (use or storage) and environment of the materials. Where the use does not exceed the maximum allowable quantities set forth in the code, a classification other than Group H is appropriate.

307.1 Occupancy Classification: Exceptions to Group H

Four other options are available to further increase the quantities of hazardous materials in any building:

- Provide additional control areas as limited by Table 414.2.2,
- Provide one or more fire walls in conformance with Section 706,
- Apply the allowances for unlimited quantities in Section 307.1.1,
- Construct the building as required for a Group H occupancy.

309.1 Occupancy Classification: Group I

Group I-1

Alcohol and drug centers
Assisted living facilities
Congregate care facilities
Group homes
Halfway houses
Residential board and care facilities
Social rehabilitation facilities

Group I-2

Foster care facilities
Detoxification facilities
Hospitals
Nursing homes
Psychiatric hospitals

Group I-3

Correctional centers
Detention centers
Jails
Prerelease centers
Prisons
Reformatories

Group I-4

Adult day care
Child day care

309.1 Occupancy Classification: Group M

Group M
Department stores
Drug stores
Greenhouses (display and sale)
Markets
Motor fuel-dispensing facilities
Retail or wholesale stores
Sales rooms

310 Occupancy Classification: Group R

Group R-1

Boarding houses (transient)
> 10 occupants
Congregate living facilities (transient) > 10 occupants
Hotels (transient)
Motels (transient)

Group R-2

Apartment houses
Congregate living facilities (nontransient)
> 16 occupants
Hotels (nontransient)
Live/work units
Motels (nontransient)
Vacation timeshare properties

Group R-3

Buildings with \leq two dwelling units
Care facilities \leq 5 persons receiving care
Congregate living facilities (nontransient) \leq 16 occupants
Congregate living facilities (transient) \leq 10 occupants
Lodging houses with \leq 5 guest rooms and \leq 10 occupants

Group R-4

Alcohol and drug centers
Assisted living facilities
Congregate care facilities
Convalescent facilities
Group homes
Halfway houses
Residential board and custodial care facilities
Social rehabilitation facilities

311 Occupancy Classification: Group S

Group S-1

Aerosols products
Level 2 and Level 3
Aircraft repair hangar
Bags; cloth, burlap, paper
Belting; canvas, leather
Books
Paper in rolls
Cardboard and cardboard boxes
Clothing
Furniture
Grains
Lumber
Motor vehicle repair garages
Self-service storage facility
Tires, bulk storage of
Tobacco, cigars, cigarettes
Upholstery and mattresses

Group S-2

Aircraft hangar
Asbestos
Cement in bags
Chalk and crayons
Dairy products
Dry cell batteries
Electric motors
Food products
Fresh fruits and vegetables
Frozen foods
Glass
Gypsum board
Meats
Metals
Open parking garages
Enclosed parking garages
Porcelain and pottery

312 Occupancy Classification: Group U

Group U
Agricultural buildings
Barns
Carports
Fences more than 7 feet in height
Livestock shelters
Private garages
Retaining walls
Sheds
Stables
Tanks
Towers

508.1 Occupancy Classification: Mixed Occupancies

- Each portion of a building shall be individually classified in accordance with Section 302.1. Where a building contains more than one occupancy group, the building or portion thereof shall comply with the applicable provisions of Section 508.2 (Accessory Occupancies), 508.3 (Nonseparated Occupancies), 508.4 (Separated Occupancies), or 508.5 (Live/Work Units), or a combination of these sections. See the exceptions for: (1) occupancies separated in accordance with Section 510 (Special Provisions), and (2) Group H- 1, H-2 and H-3 occupancies required by Table 415.6.5 to be located in a separate and detached building.
- It is not uncommon for two or more distinct occupancy classifications to occur in the same building. Where such conditions exist, the code requires that such multiple occupancies be either (1) isolated from each other using fire-resistive separation elements (fire barriers and/or horizontal assemblies), or (2) imposed with special provisions that eliminate the need for such fire separations.

Class 3: Chapter 6 Type of Construction

602.1 Construction Classification

Noncombustible	Exterior and interior (bearing or nonbearing) walls, floors, roofs and structural elements are to be of noncombustible materials	I	A	B
		II	A	B
Noncombustible or combustible	Exterior walls are to be of noncombustible materials	III	A	B
		IV	A	B
	V	A	B	C
				HT

It is the intent of the *International Building Code* that each building be classified as a single type of construction. The construction materials and the degree to which such materials are protected determine the classification based on the criteria of Table 601 and Chapter 6.

Source: 2021 IBC

Wood and hours

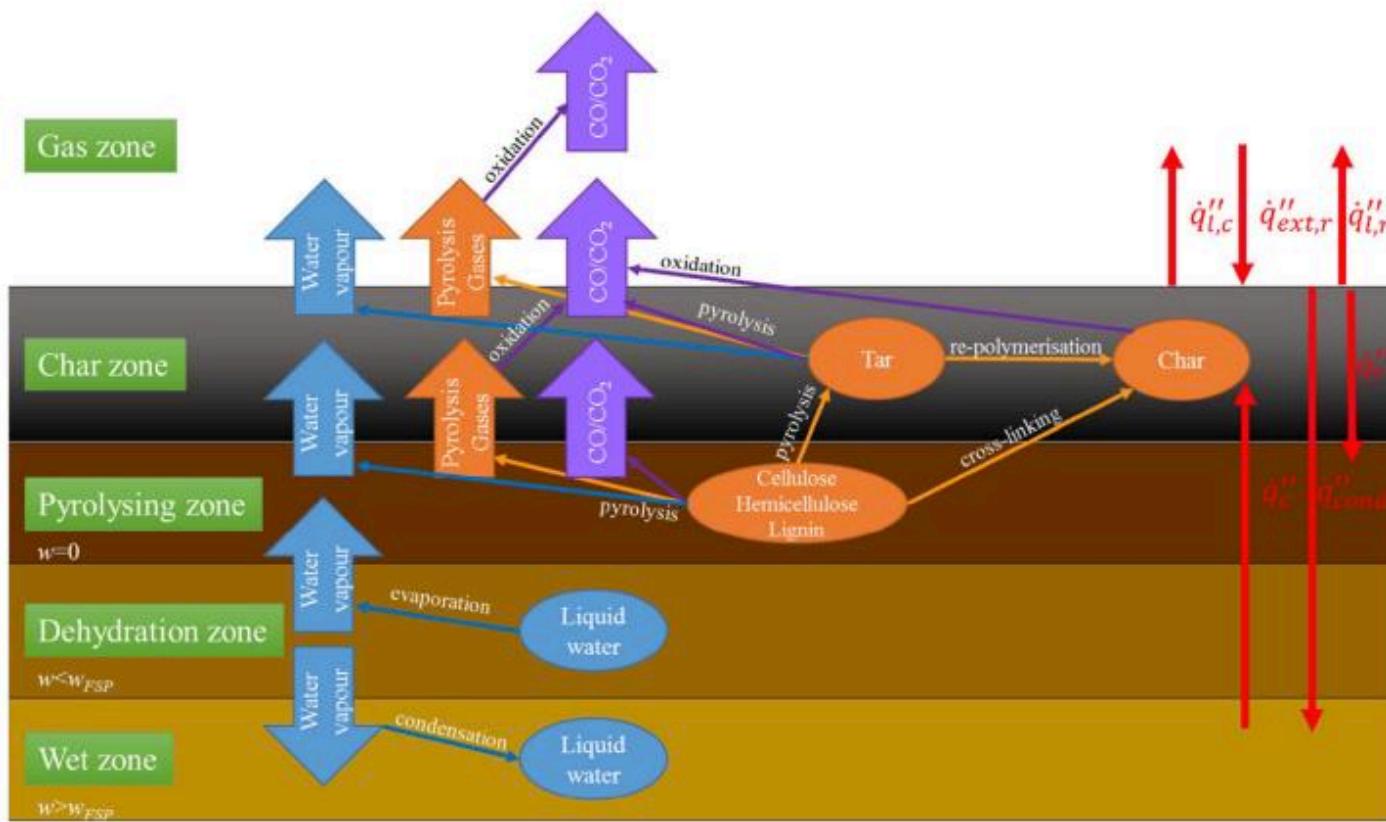


Figure 1. Chemical and physical processes within a burning timber sample; $\dot{q}_{l,c}''$ is the surface heat losses by convection, $\dot{q}_{l,r}''$ is the surface heat losses by radiation, $\dot{q}_{ext,r}''$ is the external heat flux, \dot{q}_r'' is in-depth radiation, \dot{q}_{cond}'' is conduction into the sample, and \dot{q}_c'' is convective heat transfer through cracks in the sample.

Wood and hours



Test 1-3 compartment 3 hours and 6 minutes after ignition.
NIST

Source: 2021 IBC

1. The Five Basic Construction Types



T601, 202 Primary Structural Frames

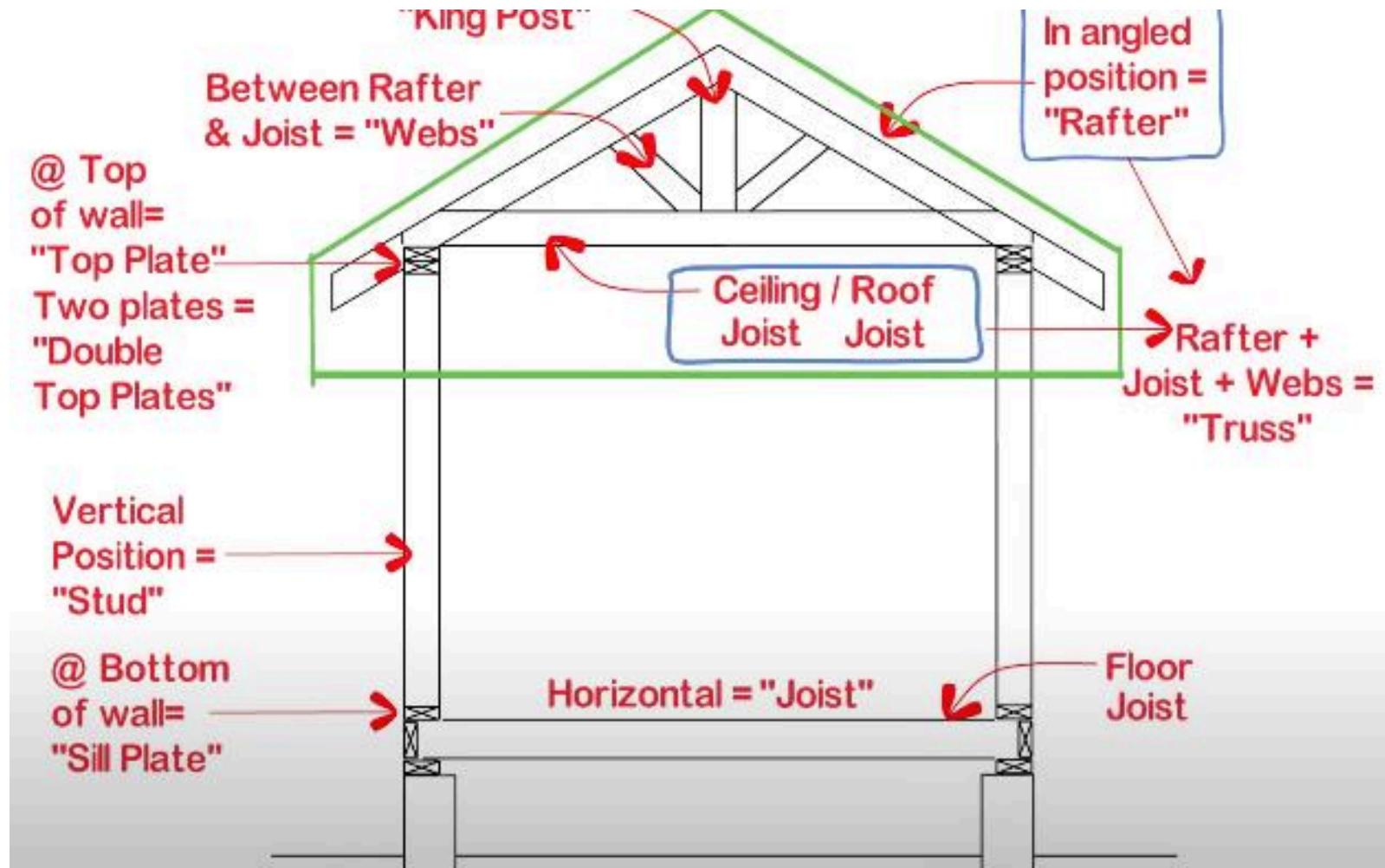
Joist?

Rafter?

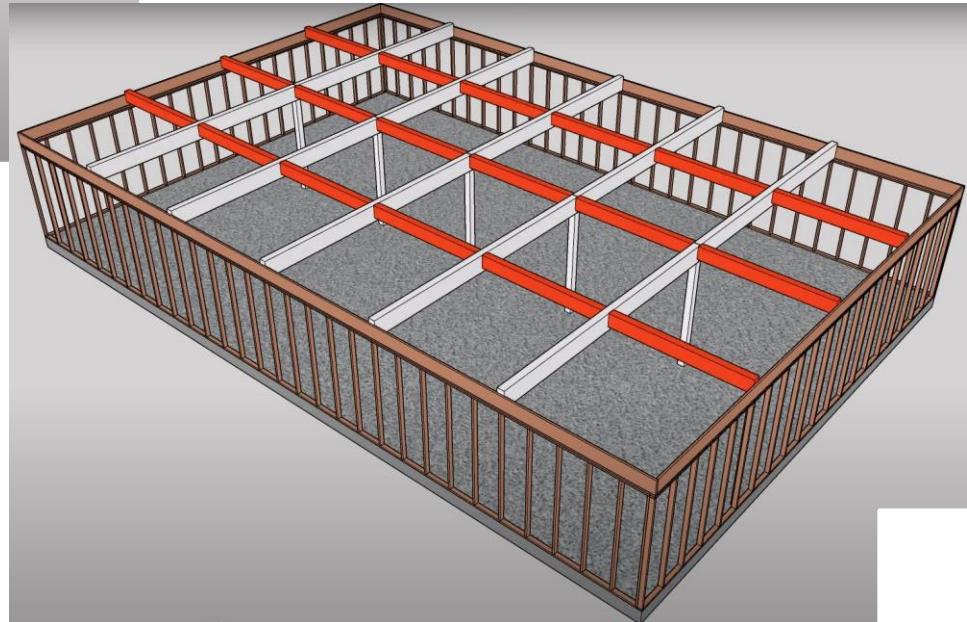
2x4



T601, 202 Primary Structural Frames



T601, 202 Primary Structural Frames (Beams –Girders – Column)



Class 4: Chapter 5, General Building Heights and Areas

602.1 General Building Heights and Areas

- To gain an understanding of how a building is classified and regulated based on its floor area, height and number of stories.

502.1 Address Identification



As a fundamental requirement, the approved street numbers are to be placed in a location readily visible from the street fronting the property. The fire code official has the authority to require that the address numbers be posted in more than one location to help eliminate any confusion or delay in identifying the location of the emergency.

504.3, Table 504.3 Allowable Height Determination

- The maximum height, in feet, of a building shall not exceed the limits specified in Table 504.3. See the exception for towers, spires, steeples and other roof structures.*

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE*

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV			Type V		
		A	B	A	B	A	B	C	HT	A	B		
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	65	65	50	40	
	S	UL	180	85	75	85	75	270	180	85	70	60	
H-1, H-2, H-3, H-5	NS ^{c, d}	UL	160	65	55	65	55	120	90	65	65	50	40
	S	UL	160	65	55	65	55	140	100	85	85	70	60
H-4	NS ^{c, d}	UL	160	65	55	65	55	65	65	65	50	40	
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 1, I-3	NS ^{d, e}	UL	160	65	55	65	55	65	65	65	50	40	
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS ^{d, f}	UL	160	65	55	65	55	65	65	65	50	40	
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-4	NS ^{d, g}	UL	160	65	55	65	55	65	65	65	50	40	
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R ^h	NS ^d	UL	160	65	55	65	55	65	65	65	50	40	
	S13D	60	60	60	60	60	60	60	60	60	50	40	
	S13R	60	60	60	60	60	60	60	60	60	60	60	
	S	UL	180	85	75	85	75	270	180	85	70	60	

For SI: 1 foot = 304.8 mm.

UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.1.1; S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2; S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3.

a. See Chapters 4 and 5 for specific exceptions to the allowable height in this chapter.

b. See Section 903.2 for the minimum thresholds for protection by an automatic sprinkler system for specific occupancies.

c. New Group H occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.5.

d. The NS value is only for use in evaluation of existing building height in accordance with the *International Existing Building Code*.

e. New Group I-1 and I-3 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6. For new Group I-1 occupancies Condition 1, see Exception 1 of Section 903.2.6.

f. New and existing Group I-2 occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.6 and Section 1103.5 of the *International Fire Code*.

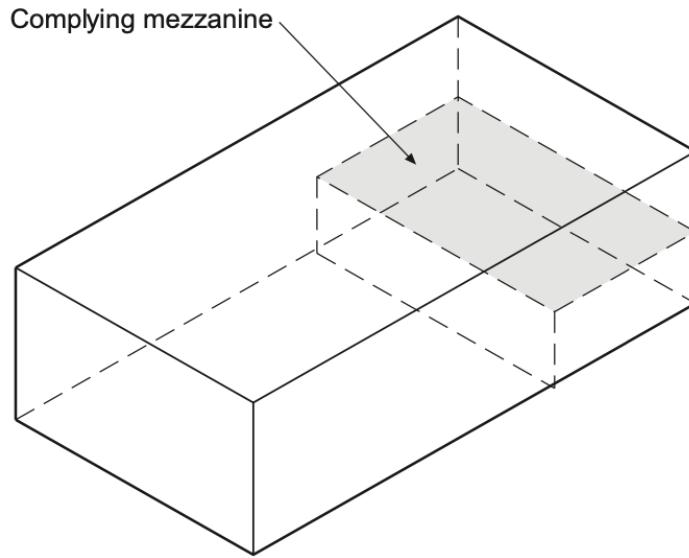
g. For new Group I-4 occupancies, see Exceptions 2 and 3 of Section 903.2.6.

h. New Group R occupancies are required to be protected by an automatic sprinkler system in accordance with Section 903.2.8.

Where an NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low Rise Residential Occupancies*, sprinkler system is installed in a residential building, the table reflects a maximum building height of 60 feet, regardless of the building's type of construction.

Source: 2021 IBC

505.2 Mezzanines Scope



Mezzanine:

- Does not contribute to floor area for maximum allowable area
- Does not contribute as an additional story
- Does contribute to floor area for fire area size determination

Example:

For 8,000 sq ft first floor as shown with 2,000 sq ft mezzanine, building area is 8,000 sq ft, building is one story in height, and fire area is 10,000 sq ft

For SI: 1 square foot = 0.093 m²

Although it is quite possible that an individual floor level within a building can meet all of the provisions of the IBC and qualify as a mezzanine, its actual designation is the choice of the designer. It may be more advantageous to treat the floor level simply as an additional story.

506.3 Frontage Increase

- Every building shall adjoin or have access to a public way to receive an area factor increase based on frontage. The area factor increase based on frontage shall be determined in accordance with Sections 506.3.1 through 506.3.3. The area factor increase based on frontage shall be determined in accordance with Table 506.3.3.
- The frontage increase is based on the smallest public way or open space that is 20 feet or greater, as well as the percentage of the building perimeter having a minimum 20-foot public way or open space.



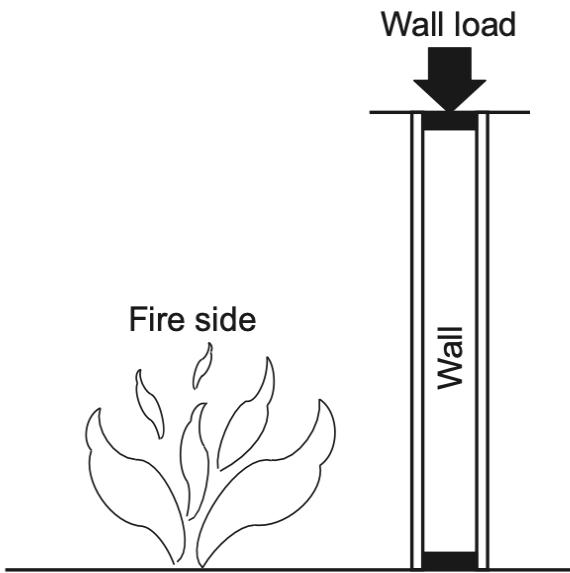
Source: 2021 IBC

Class 5: Chapter 7, 701-705 Fire and Smoke Protection Features I

510.7 Objective

- To gain an understanding of
 - the fundamentals of fire-resistance-rated construction,
 - the methods for the determination of fire resistance, and
 - the regulation of exterior walls for fire-resistance rating and opening protection.

703.2.1 202 Materials and Systems



Assembly must:

- sustain applied load,
- have no passage of flame or gases hot enough to ignite cotton waste,
- have average temperature rise on unexposed surface not more than 250°F above initial temperature or more than 325°F at any point, and
- have no water pass through during hose-stream test.

Conditions of acceptance - wall fire test

For nonsymmetrical wall construction, where interior walls and partitions are provided with differing membranes on opposing sides, the IBC mandates that tests be performed from both sides. The side with the shortest test duration is the basis for the fire-resistance rating.

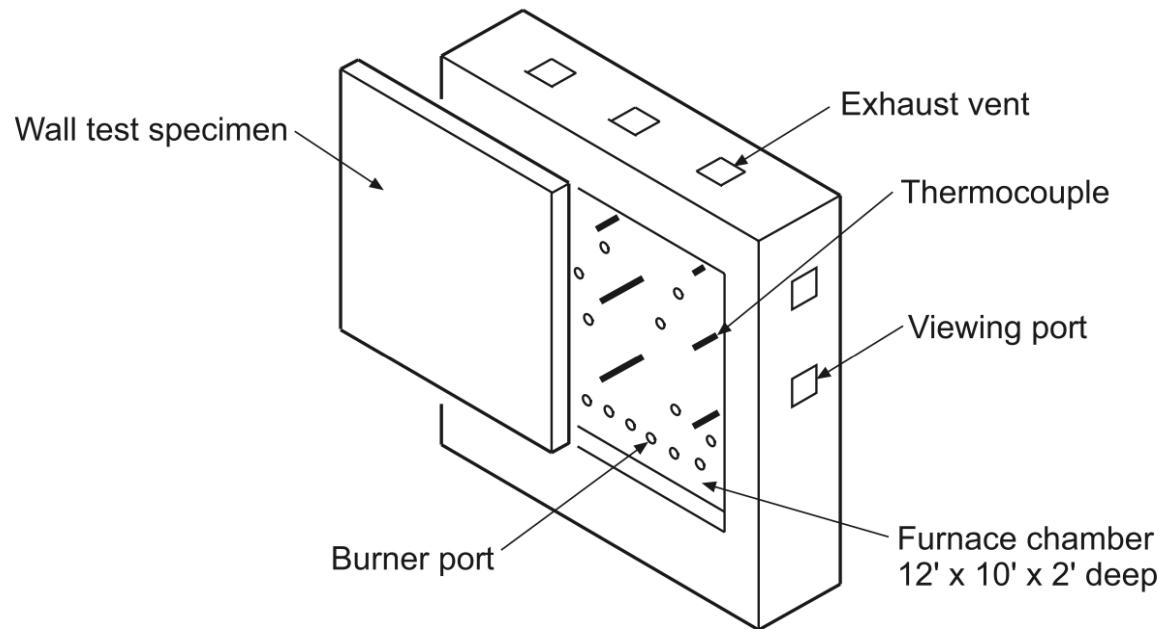
703.2.1 202 Materials and Systems

- Fire-resistance rating is the period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both as determined by the tests, or the methods based on tests, prescribed in Section 703. A fire-resistance rating of building elements, components or assemblies shall be determined by the test procedures set forth in ASTM E119 or UL 263 or by analytic methods set forth in Section 703.2.2.
- ASTM E119 is the referenced standard, Standard Test Methods for Fire Tests of Building Construction and Materials. These test methods are used for the great majority of building components or assemblies that are mandated by the code to have a fire resistance rating. Assemblies tested under the criteria of UL 263 are also considered to have the fire-resistance rating as assigned.

703.2 Analytical Methods

- The fire resistance of building elements, components or assemblies established by an analytical method shall be of any of the following methods listed in Section 703.2.2, based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263: (1) fire- resistance designs documented in approved sources; (2) prescriptive designs of fire-resistance-rated building elements as prescribed in Section 721; (3) calculations in accordance with Section 722; (4) engineering analysis based on a comparison of building element, component or assembly designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E119 or UL 263; or (5) fire- resistance designs certified by an approved agency.
- Prescriptive details of fire-resistance-rated building elements are contained in Section 721. Generic listings for structural parts, walls, partitions, floor systems and roof systems are addressed.

703.2 Analytical Methods



For SI: 1 foot = 304.8 mm.

Wall test furnace

Section 722 provides methods of calculated fire resistance for concrete, masonry, steel, wood assemblies or members, and mass timber elements. The procedures and calculations are limited to the specific information set forth in this section and are not to be used in any other manner.

703.2.1 202 Materials and Systems

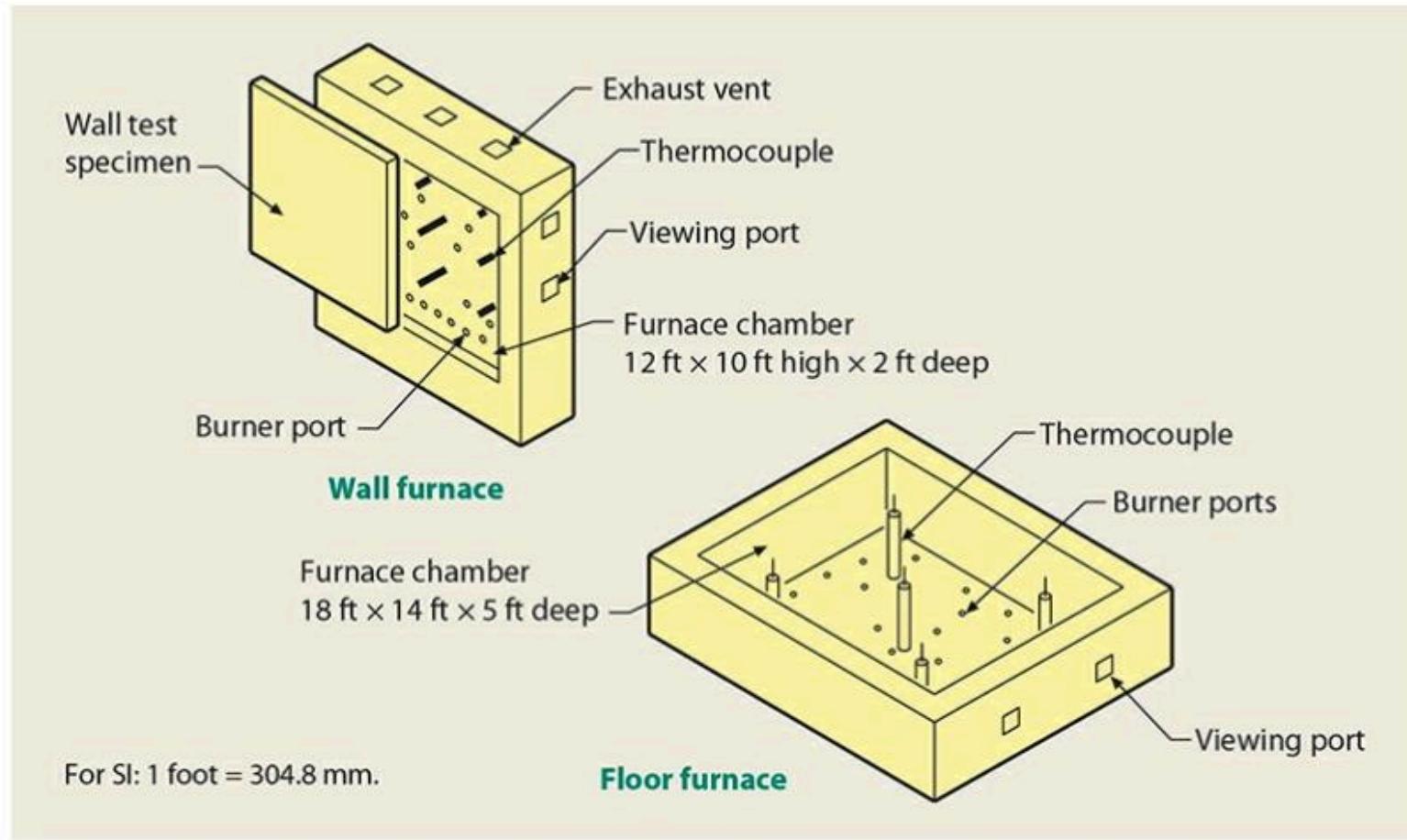


Figure 703-1 Test furnaces.

703.2.1 202 Materials and Systems

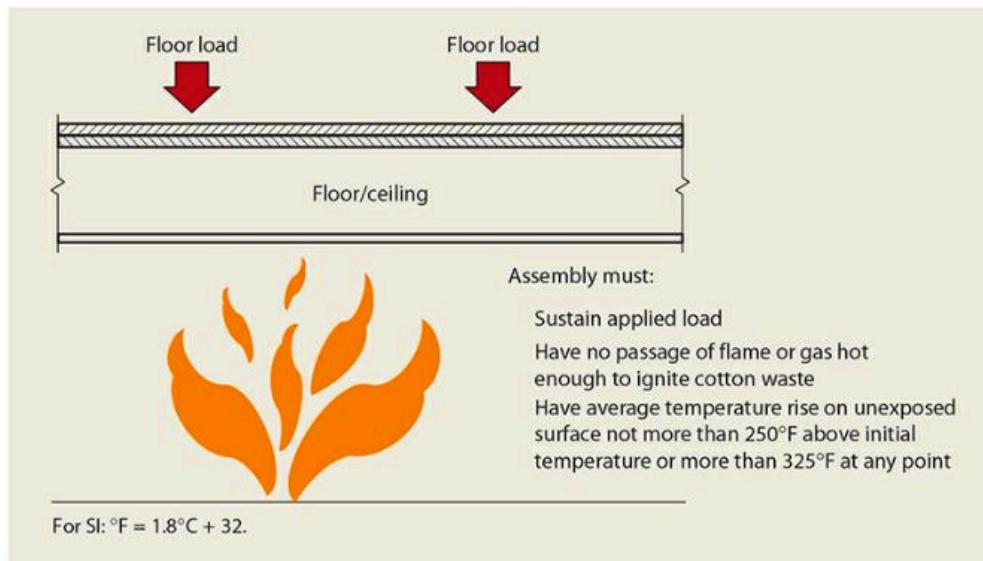


Figure 703-2 Floor assembly fire test.

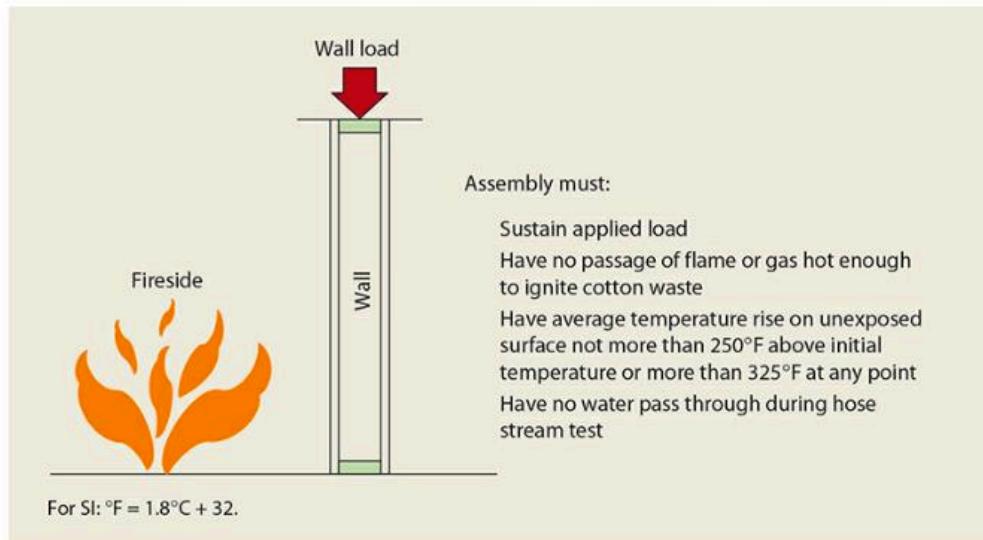


Figure 703-3 Conditions of acceptance—wall fire test.

Source: 2021 IBC

703.2.1 202 Materials and Systems

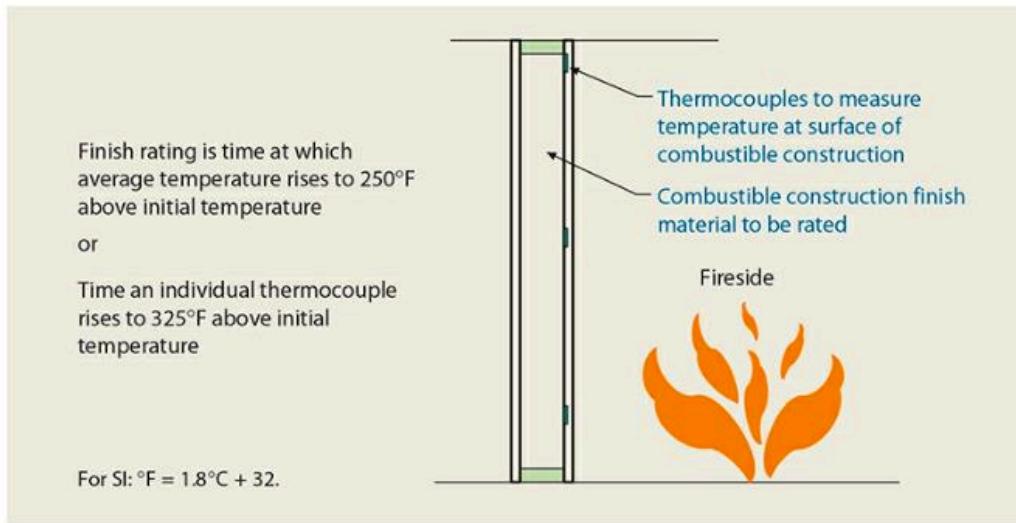


Figure 703-4 Combustible assembly for determining finish rating.

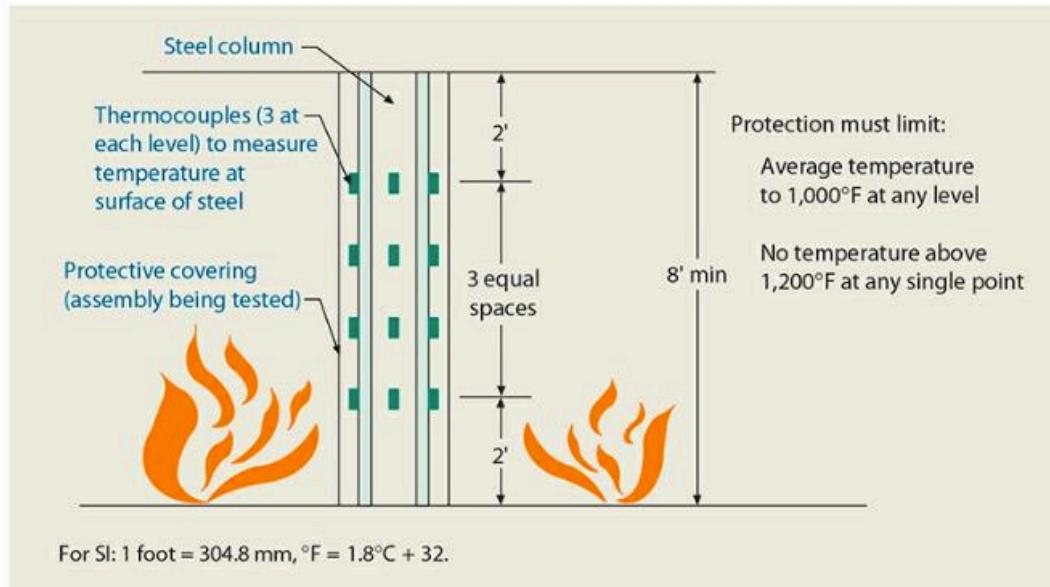


Figure 703-5 Alternative fire test of steel column protection.

Source: 2021 IBC

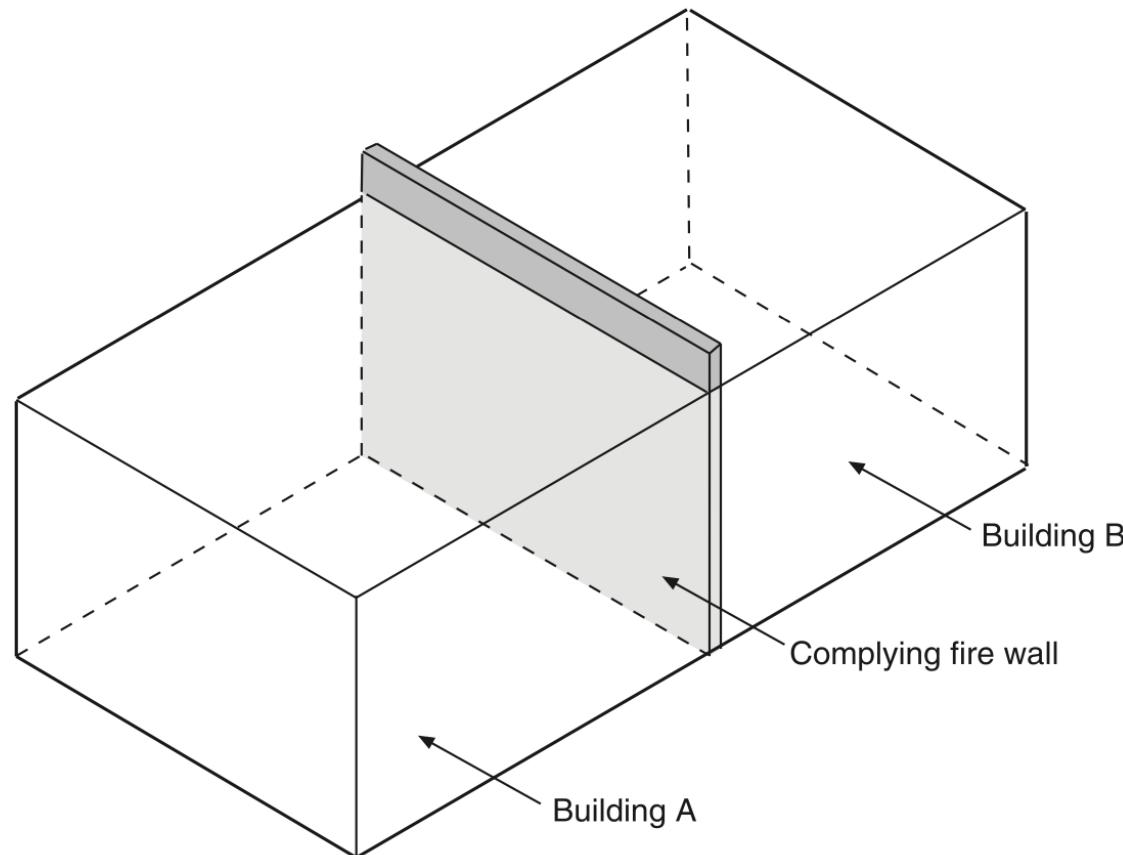
Class 6: Chapter 7, Sections 706 through 712—Fire and Smoke Protection Features II

706-712 Objective

- To gain an understanding of the fire-resistance-rated building components such as fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions, and horizontal assemblies and vertical openings.

706.1, 202 Scope: Fire Walls

Fire wall to have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of wall



In a situation where a fire wall separates distinct occupancy groups that are required to be separated by a fire barrier wall, the most restrictive requirements of each separation apply. This includes both the wall's continuity and the required fire-resistance rating.

Source: 2021 IBC

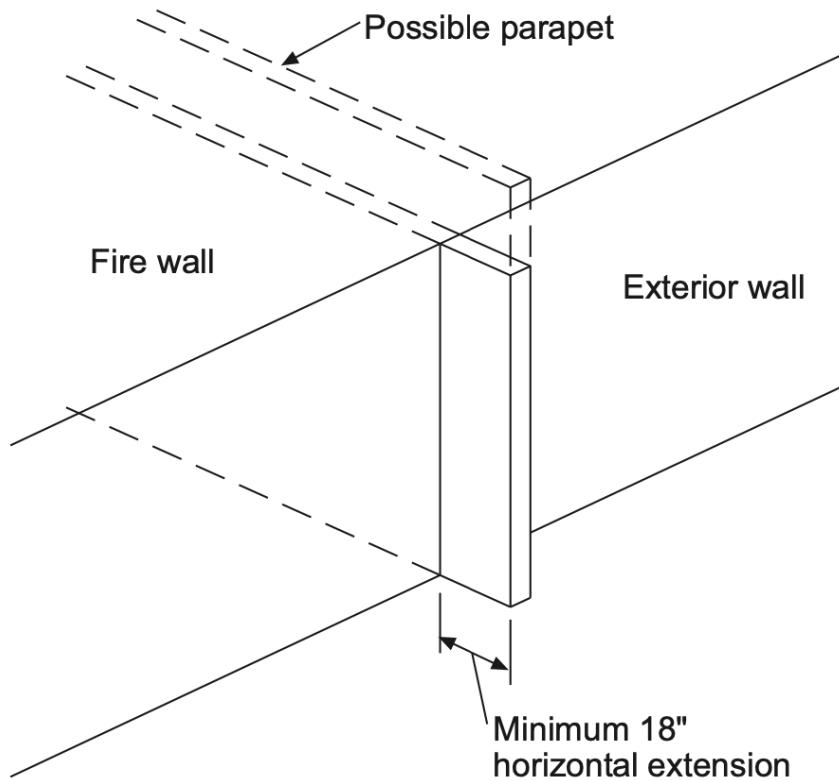
706.3, 706.4 Construction: Fire Walls

**TABLE 706.4
FIRE WALL FIRE-RESISTANCE RATINGS**

GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3 ^a
F-1, H-3 ^b , H-5, M, S-1	3
H-1, H-2	4 ^b
F-2, S-2, R-3, R-4	2

- a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.
- b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.4 and 415.5.

706.5 Horizontal Continuity: Fire Walls



Horizontal continuity

For SI: 1 inch = 25.4 mm.

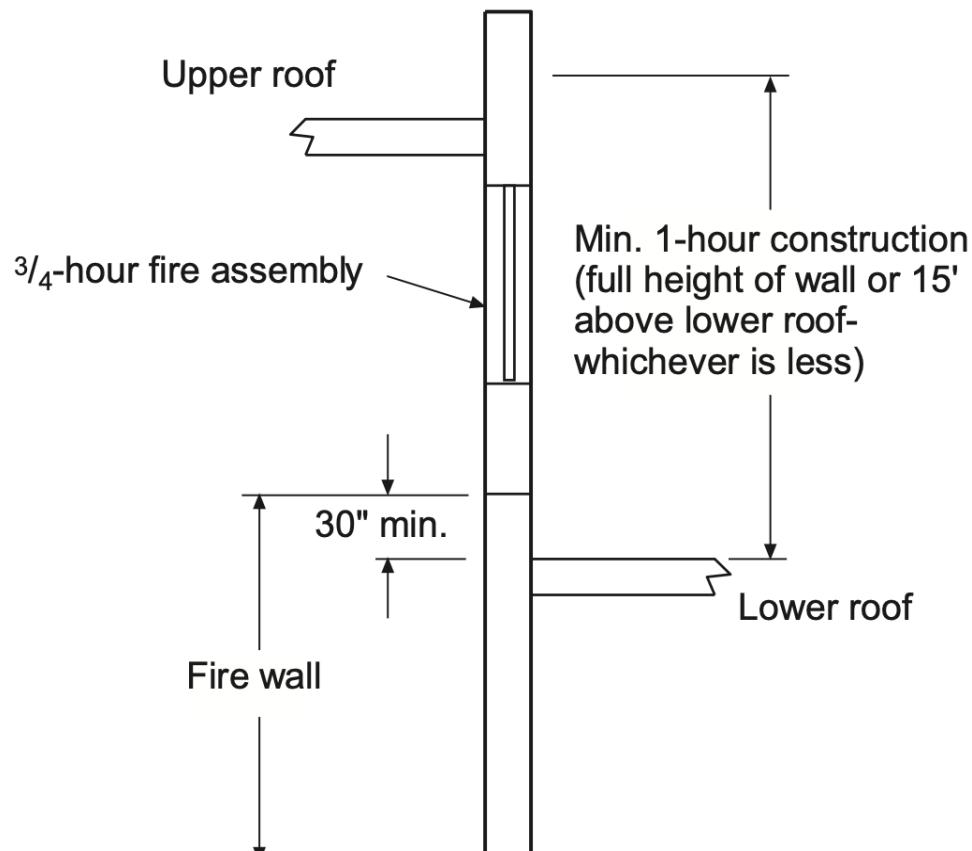
The three exceptions acknowledge the effect certain types of exterior wall construction will have on fire breaching the exterior of the building and exposing the adjacent building. These methods of protection are similar to those used at the roof construction where a parapet is not provided.

Source: 2021 IBC

706.6 Vertical Continuity: Fire Walls

- Fire walls shall extend from the foundation to a termination point not less than 30 inches (762 mm) above both adjacent roofs. See the exceptions for buildings with different roof levels, those with noncombustible roof construction, and those constructed under special provisions.
- To ensure the separate building concept, a fire wall must be continuous vertically with no horizontal offsets from the foundation, through the roof to a point at least 30 inches above. Various exceptions to the parapet requirement allow the fire wall to terminate at the bottom of the roof deck or sheathing. According to many of the exceptions, the roof covering must be minimum Class B, and no openings in the roof are permitted within 4 feet of the fire wall.

706.6 Vertical Continuity: Fire Walls



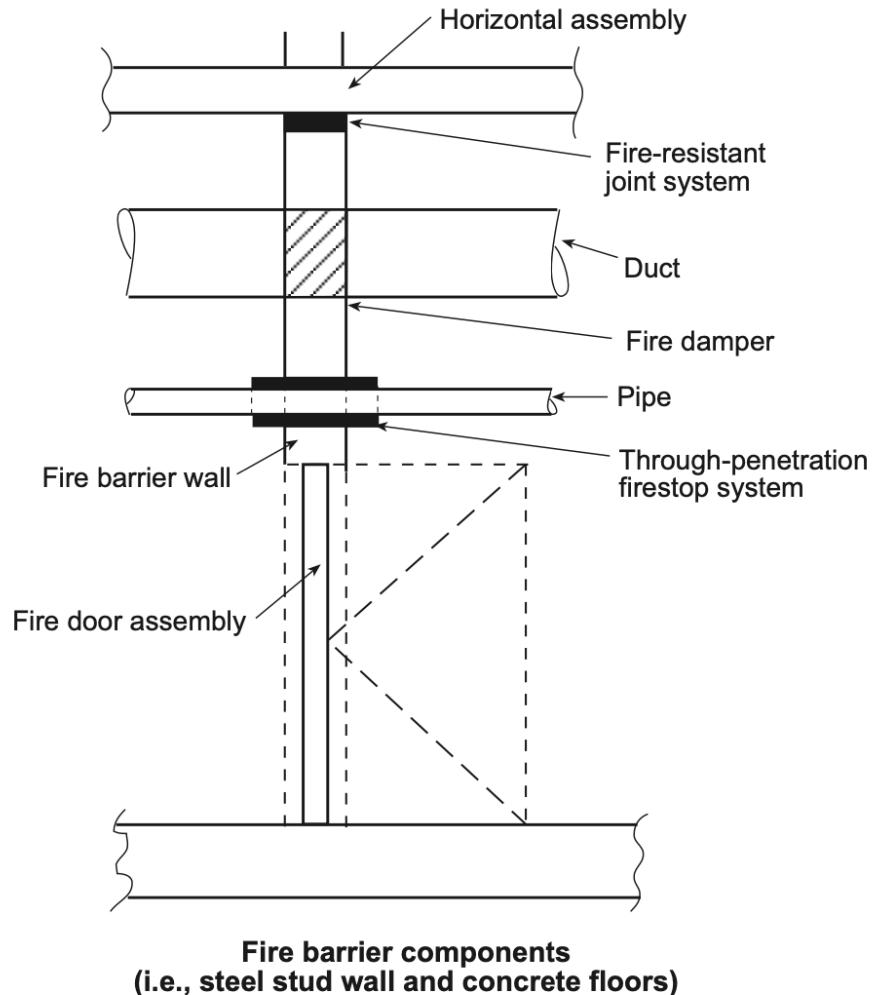
Stepped buildings

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

A stepped building, where the fire wall separates buildings having different roof levels, may require additional fire resistance to a point 15 feet above the lower roof. An alternative method provides for minimum 1-hour horizontal protection of the lower roof assembly.

Source: 2021 IBC

707.1, 202 Fire Barriers: Definition and Scope

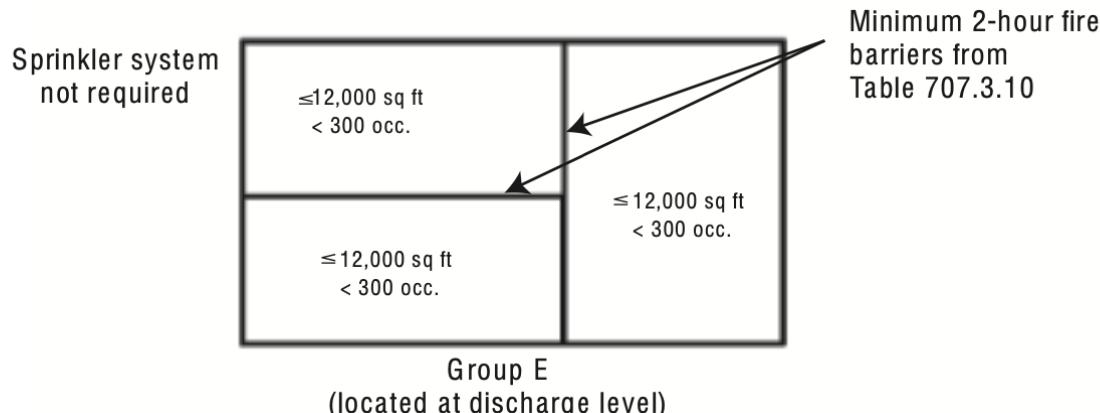


Fire barriers may also be mandated for specific conditions not specifically mentioned in Section 707. Throughout the IBC, as well as the other *International Codes*, fire barriers are identified as the element used to provide the necessary fire separation for compartmentation of building spaces.

Source: 2021 IBC

707.3.10, Table 707.3.10 Fire Areas

Example of the use of fire area concept



For SI: 1 square foot = 0.093 m²

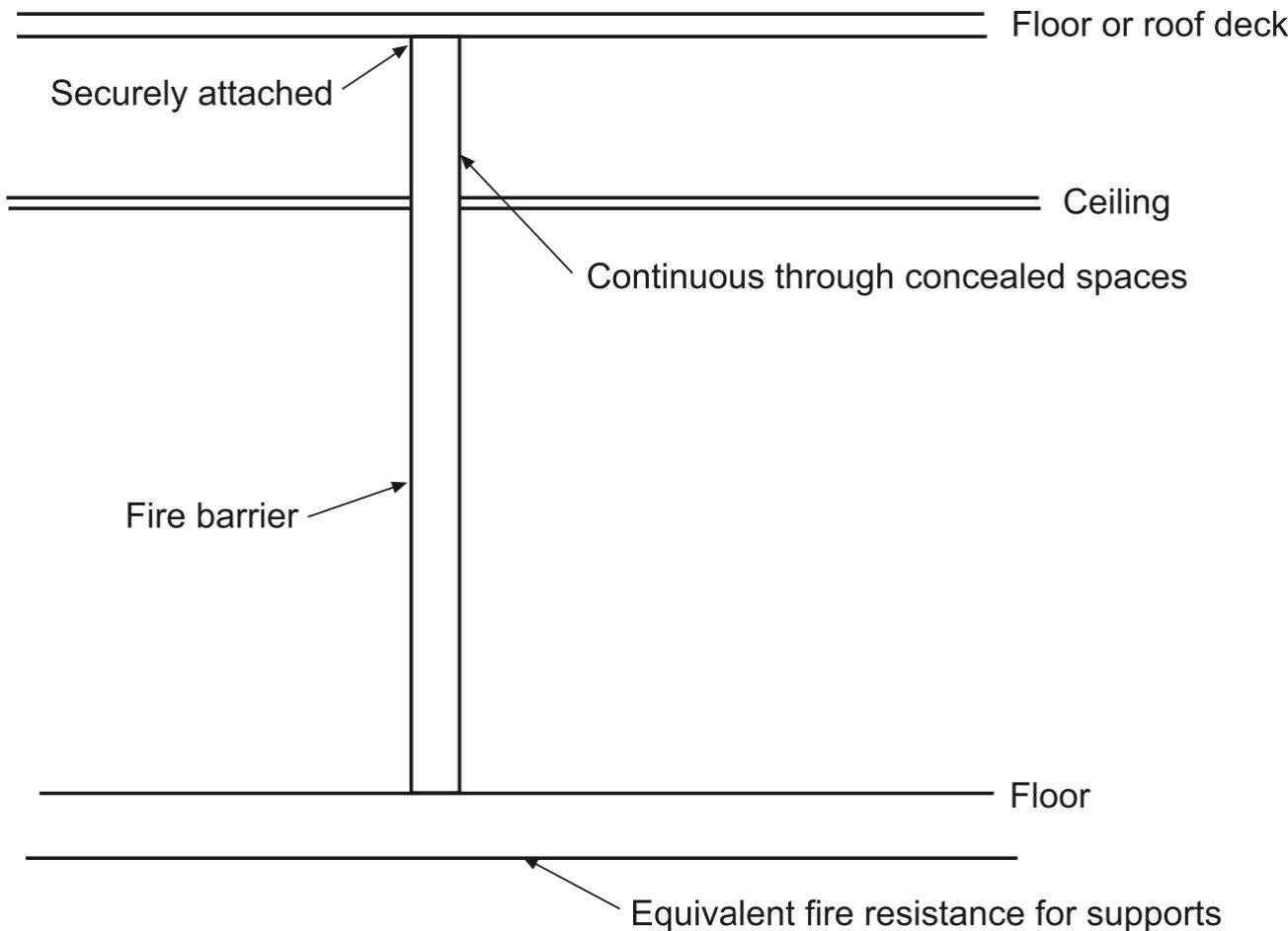
TABLE 707.3.10
FIRE-RESISTANCE RATING REQUIREMENTS FOR
FIRE BARRIERS, FIRE WALLS OR HORIZONTAL
ASSEMBLIES BETWEEN FIRE AREAS

OCCUPANCY GROUP	FIRE-RESISTANCE RATING (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

A fire area is considered the aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or horizontal assemblies of a building. The floor area under a canopy or similar horizontal projection is also included in the fire area determination.

ce: 2021 IBC

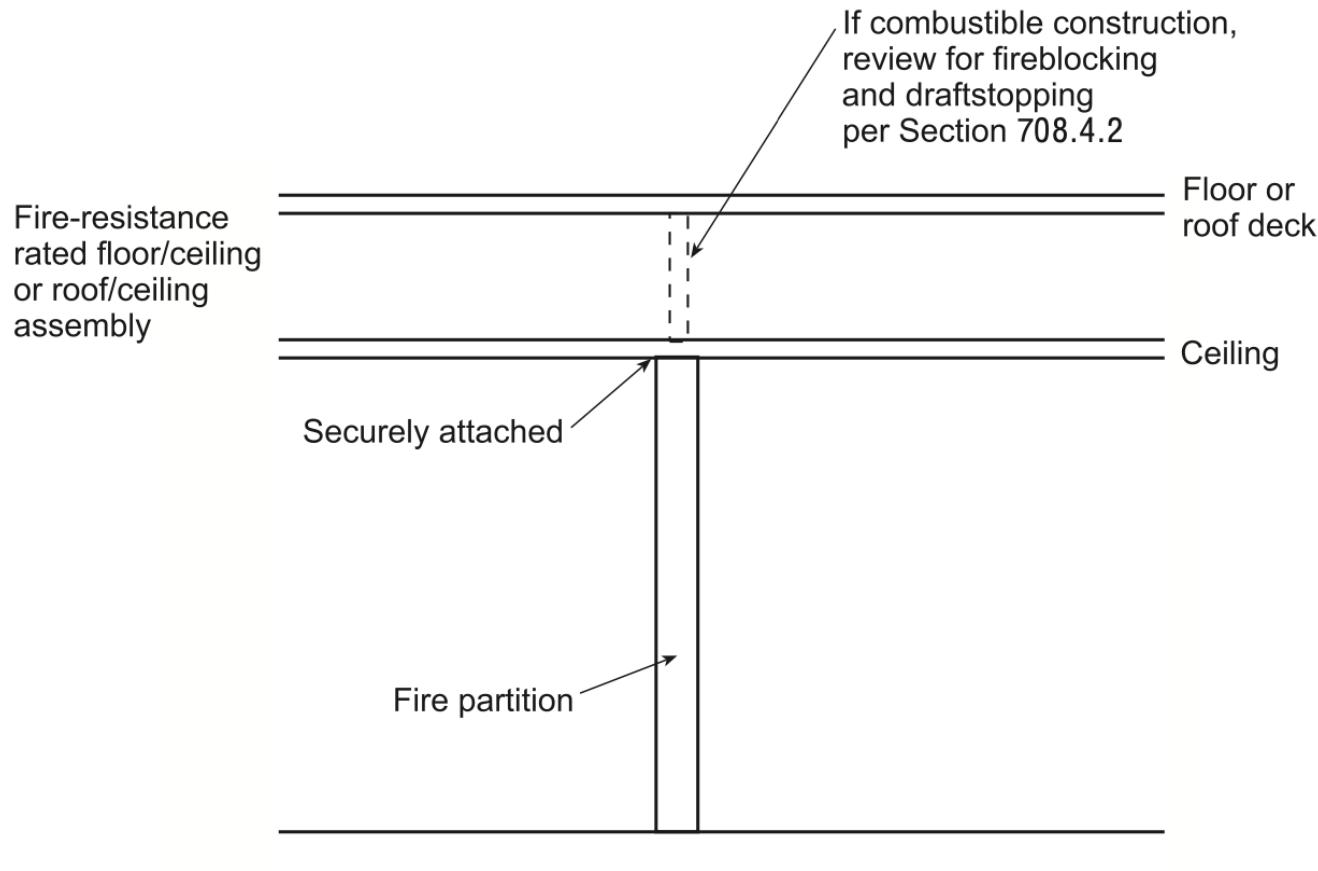
707.5, 707.5.1 Continuity: Fire Barriers



Under most conditions, the structural members or assemblies supporting fire barriers must be provided with equivalent or better fire resistance. It is important that the integrity of fire barriers supported by other building elements be maintained for the mandated time period.

Source: 2021 IBC

708.4 Fire Partitions: Continuity

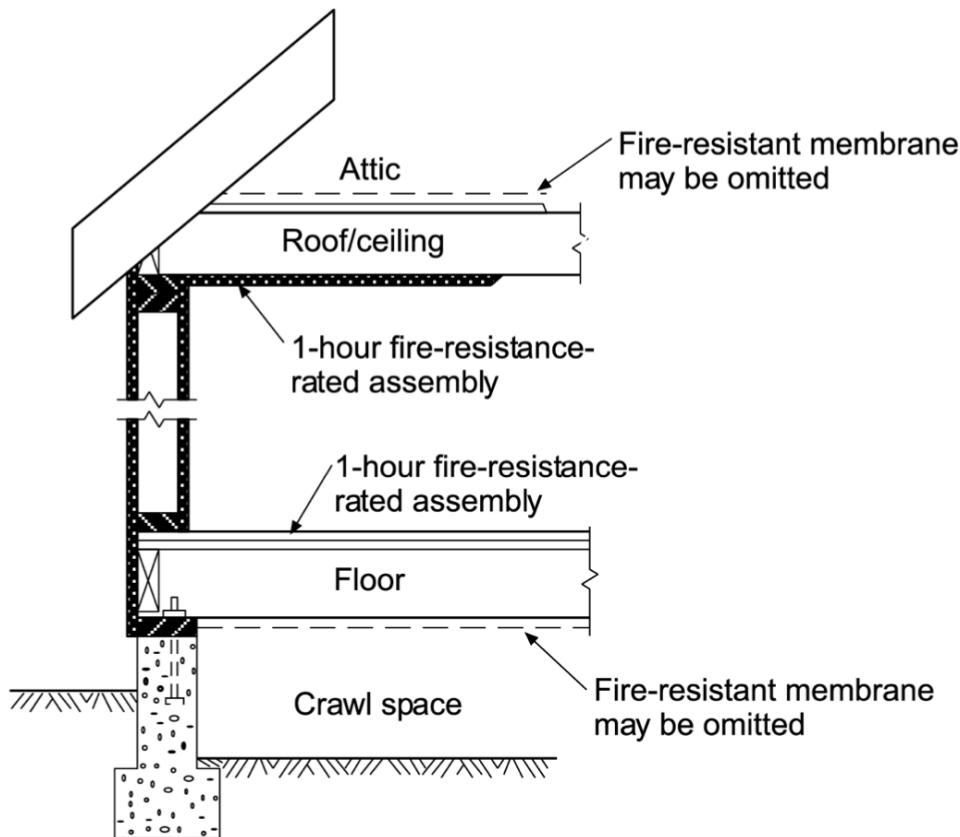


A variety of additional methods are described for creating a fire-resistance-rated corridor. A common construction technique is the “tunnel” corridor, where the corridor ceiling is constructed in a manner consistent with that of the corridor walls.

710 Smoke Partition: General Provisions

- Smoke partitions installed as required elsewhere in the IBC shall comply with Section 710. The walls shall be of materials permitted by the building type of construction. Unless required elsewhere in the IBC, smoke partitions are not required to have a fire- resistance rating. Smoke partitions shall extend from the top of the foundation or floor below to the underside of the floor or roof sheathing, deck or slab above or to the underside of the ceiling above where the ceiling membrane is constructed to limit the transfer of smoke.
- A smoke partition is designed for a singular purpose, to limit the movement of smoke from one area to another. Therefore, windows in smoke partitions must be sealed, penetrations and joints must be adequately filled, and smoke dampers used to protect air transfer openings. The most common application of smoke partitions is corridor walls of Group I-2 occupancies.

711.2 Fire-Resistance Rating



Omission of ceiling and flooring in horizontal assemblies per Section 711.2.6

Other than permitted openings, penetrations or joints, horizontal assemblies must be continuous in order to isolate totally one floor from another. An allowance is permitted for fire-resistance-rated roof construction, where skylights and other penetrations may be unprotected.

712.1 Applications: Vertical Openings

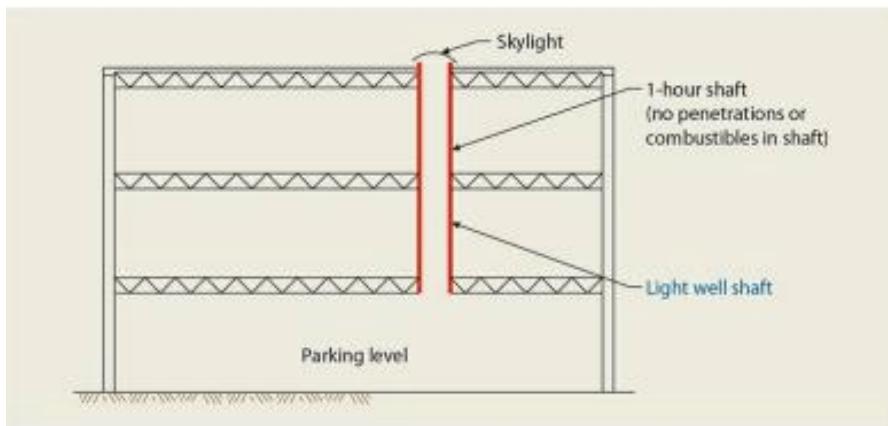


Figure 713-2 Vertical shafts—bottom enclosure.

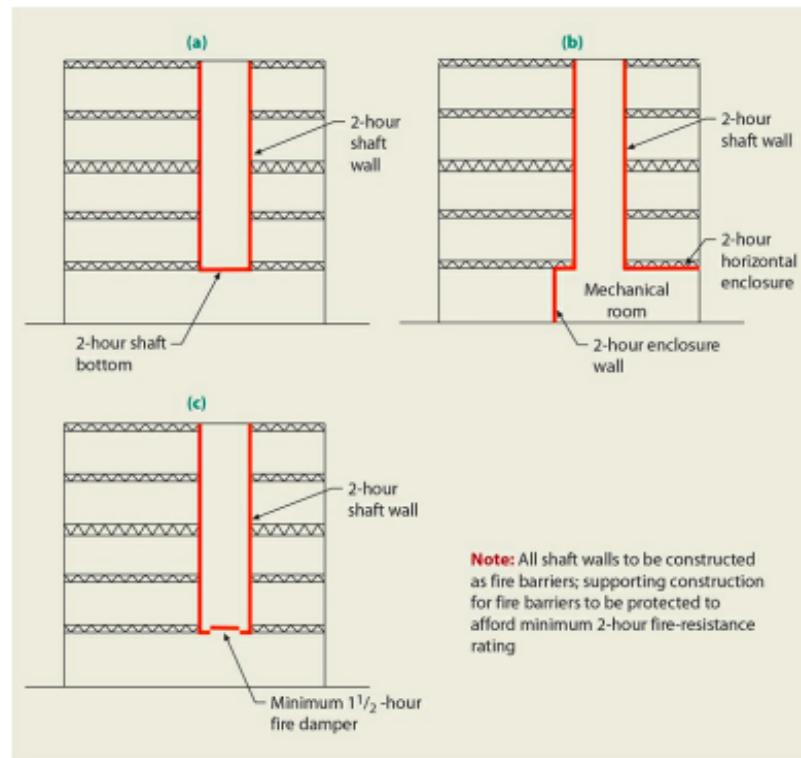


Figure 713-1 Enclosure at shaft bottom.

Class 7: Chapter 7, Sections 713 through 720—Fire and Smoke Protection Features III

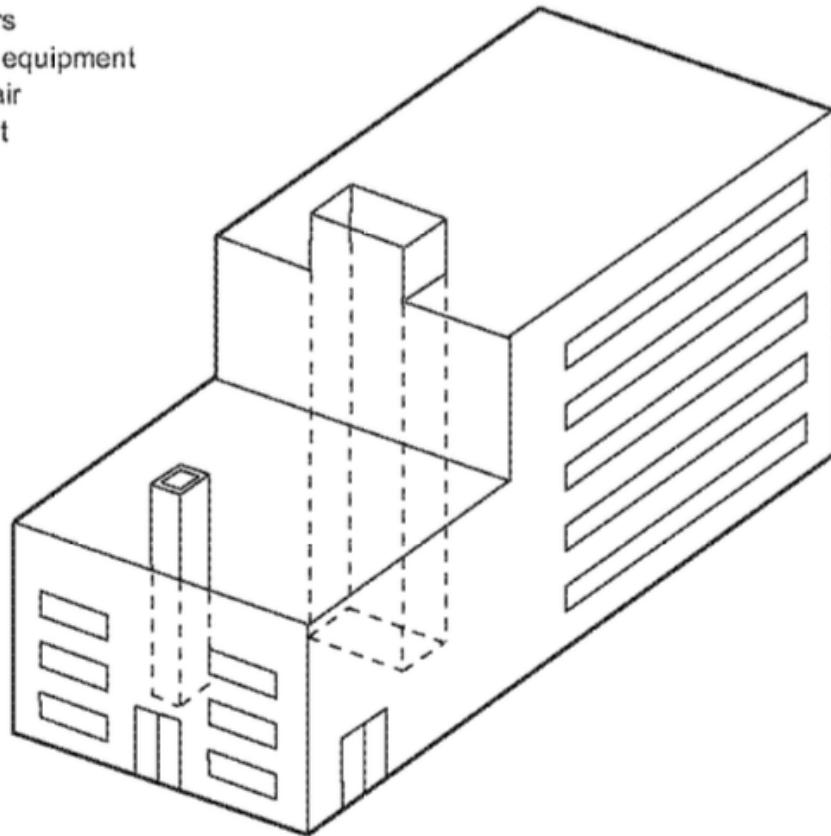
713-720 Objective

- To gain an understanding of shaft enclosures, fireblocking and draftstopping, as well as the methods of protecting fire-resistance-rated building components where they contain doors, windows, ducts, air transfer openings and penetrations.

713.1, 202 Shaft Enclosures: Scope

Shaft enclosure utilized to enclose interior space extending through floors and may accommodate:

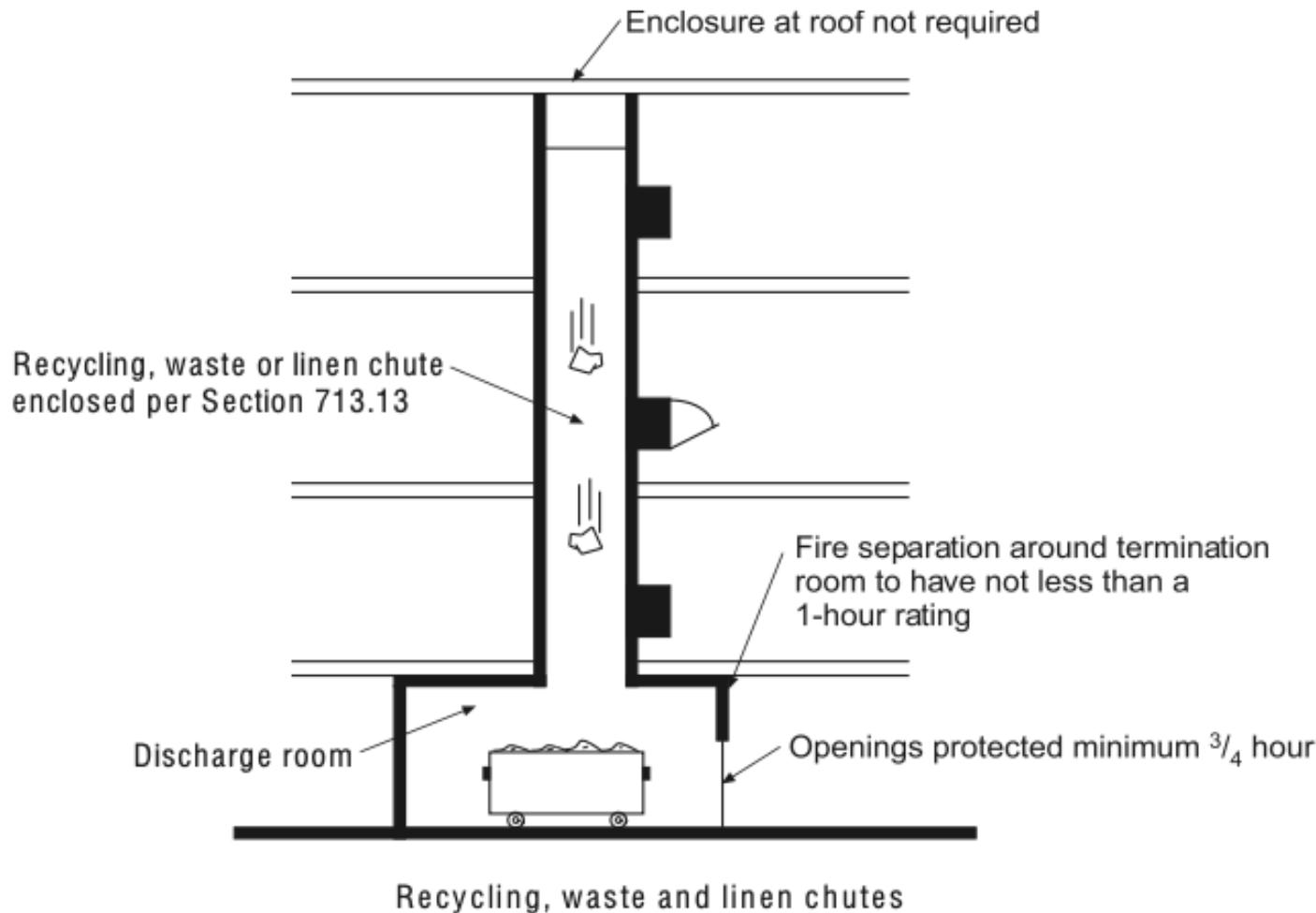
- Elevators
- Dumbwaiters
- Mechanical equipment
- Ventilation air
- Exterior light



The fire-resistance rating required for a shaft enclosure is based on the building height, with 2 hours being required where four stories or more are connected. Where less than four stories are connected, 1 hour is required. The enclosure rating cannot be less than that of any floor penetrated.

Source: 2021 IBC

713.2, 713.7 Shaft Enclosures: Continuity



Where a shaft enclosure terminates short of the roof, the top enclosure must be constructed to a fire-resistance degree consistent with that of the top floor penetrated. In no case may the enclosure at the top be rated less than that for the remainder of the shaft enclosure.

Source: 2021 IBC

713.13 Chute

713.13.2 Materials. A *shaft enclosure* containing a waste, recycling, or linen chute shall be constructed of materials as permitted by the building type of construction.

713.13.3 Chute access rooms. Access openings for waste, recycling or linen chutes shall be located in rooms or compartments enclosed by not less than 1-hour *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both. Openings into the access rooms shall be protected by opening protectives having a *fire protection rating* of not less than $\frac{3}{4}$ hour. Doors shall be self- or automatic-closing upon the detection of smoke in accordance with Section 716.2.6.6. The room or compartment shall be configured to allow the access door to the room or compartment to close and latch with the access panel to the chute in any position.

713.13.4 Chute discharge room. Table 509.1Waste, recycling or linen chutes shall discharge into an enclosed room separated by *fire barriers* with a *fire-resistance rating* not less than the required fire rating of the *shaft enclosure* and constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with

713.13 Chute

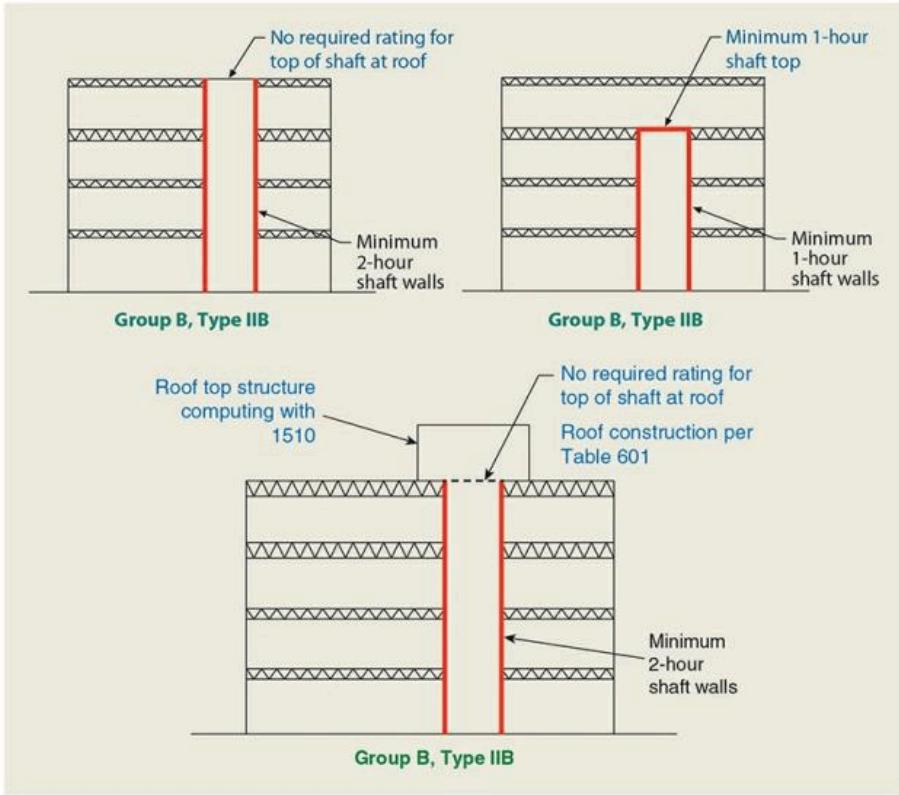


Figure 713-3 **Top enclosure of shaft.**

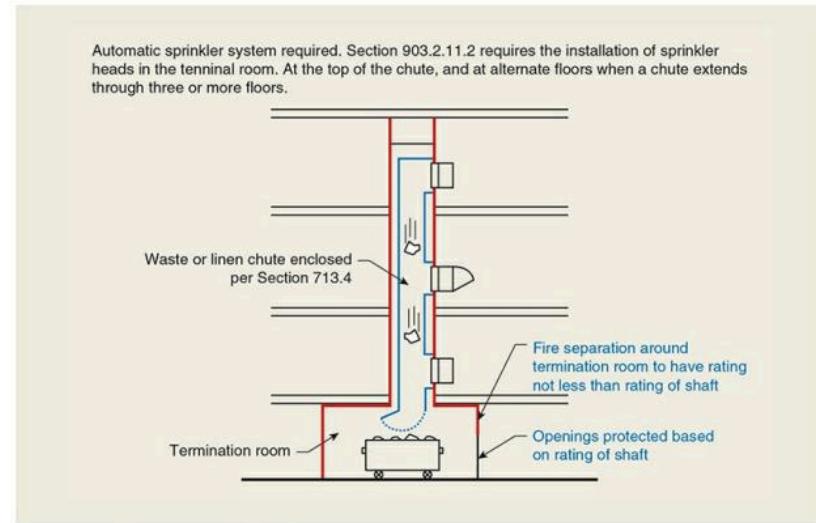
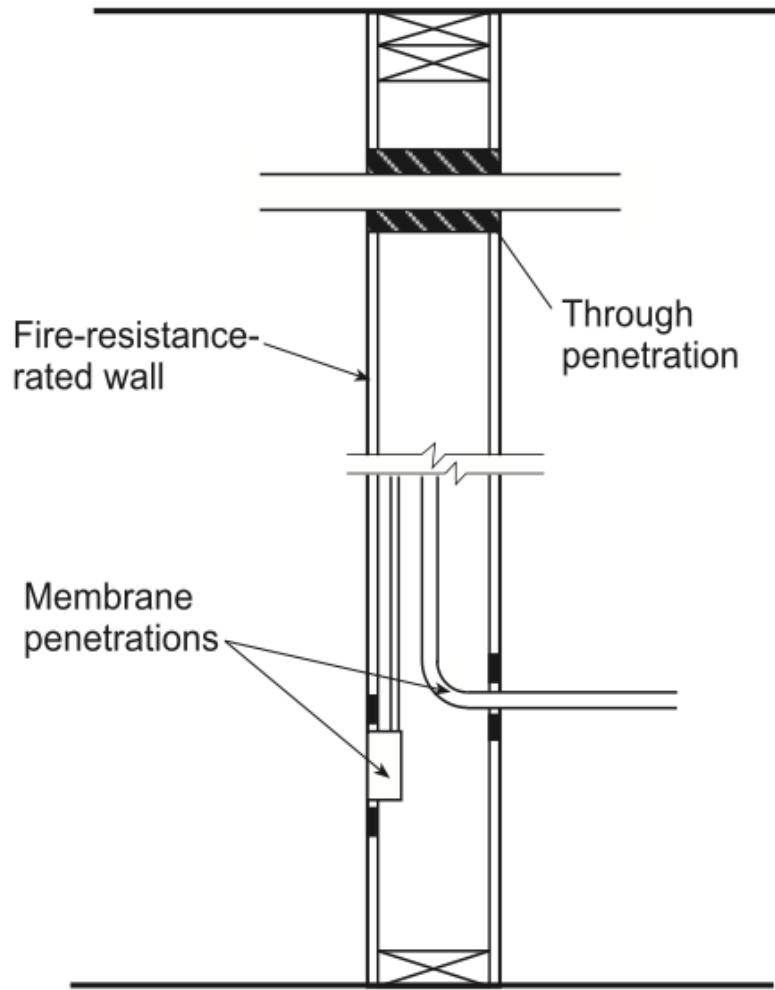


Figure 713-4 **Waste and linen chutes.**

714.1, 202 Penetrations: Definitions and Scope

- A through penetration is a breach in both sides of a floor, floor-ceiling or wall assembly to accommodate an item passing through the breaches. A membrane penetration is a breach in one side of a floor-ceiling, roof-ceiling or wall assembly to accommodate an item installed into or passing through the breach. The provisions of Section 714 shall govern the materials and methods of construction used to protect through penetrations and membrane penetrations of horizontal assemblies and fire-resistance-rated wall assemblies.
- Fire-resistance-rated walls and horizontal assemblies are usually penetrated, both fully and partially, with piping, conduit, outlet boxes, cable, vents and similar penetrating items. The IBC regulates both the materials and the methods of penetration based on the specific conditions that exist. Where sleeves are used, they must be fastened securely in place, and all open space within and around the sleeve must be appropriately protected.

714.1, 202 Penetrations: Definitions and Scope



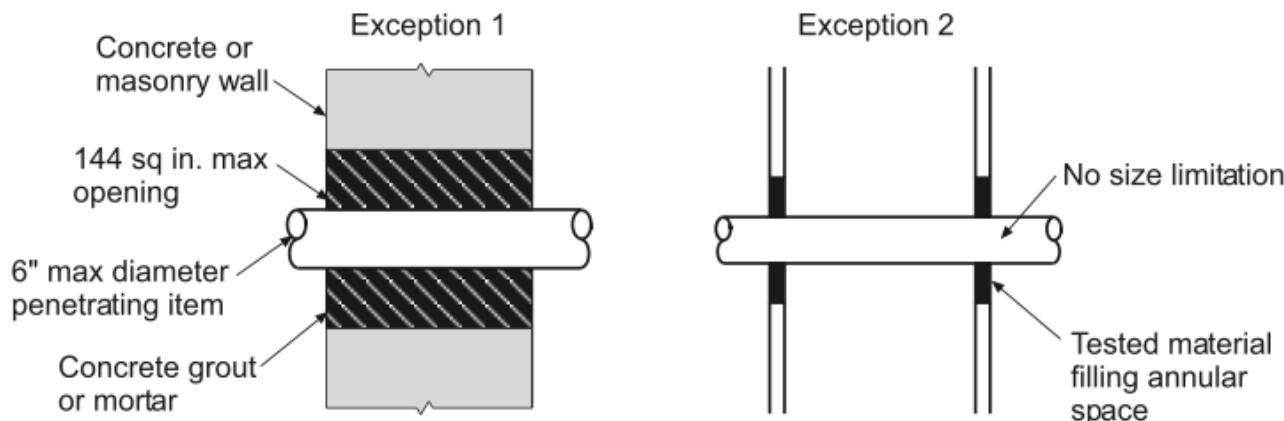
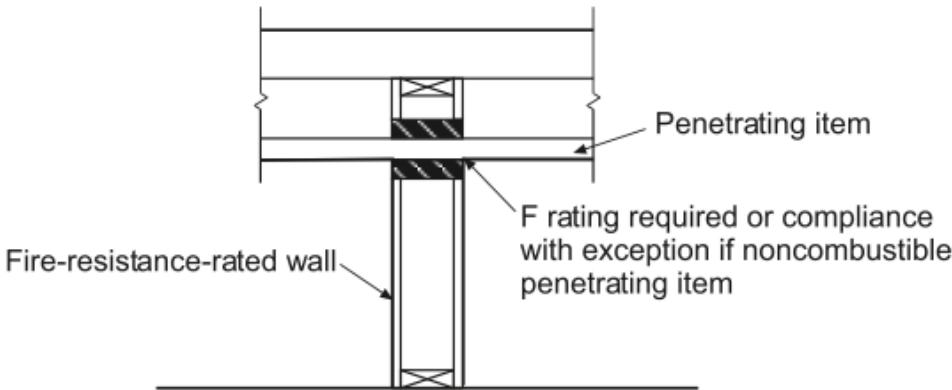
Penetrations of nonfire-resistance-rated horizontal assemblies are regulated by Section 714.6. Although some horizontal assemblies may not require a fire-resistance rating, the code intends that some degree of separation (compartmentalization) be provided from one story to another.

Source: 2021 IBC

714.4 Penetrations: Fire-Resistance-Rated Walls

- Penetrations into or through fire walls, fire barriers, smoke barrier walls, and fire partitions shall comply with Sections 714.4.1 through 714.4.3. Penetrations in smoke barrier walls shall also comply with Section 714.5.4.
- In general, penetrations into or through fire-resistance-rated walls must be either protected with an approved through-penetration firestop system or installed as a tested component of an approved fire-resistance-rated assembly. These methods are considered proprietary, with each penetration being regulated by the specifics of the installation. Two generic methods are identified as exceptions to the general requirements; however, both methods are based on the penetration only of steel, ferrous or copper pipes or steel conduits. Under such conditions, the annular space around the penetrating items shall be filled with an appropriate material.

714.4 Penetrations: Fire-Resistance-Rated Walls



Penetrating items to be steel, ferrous or copper pipes, or steel conduit

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm².

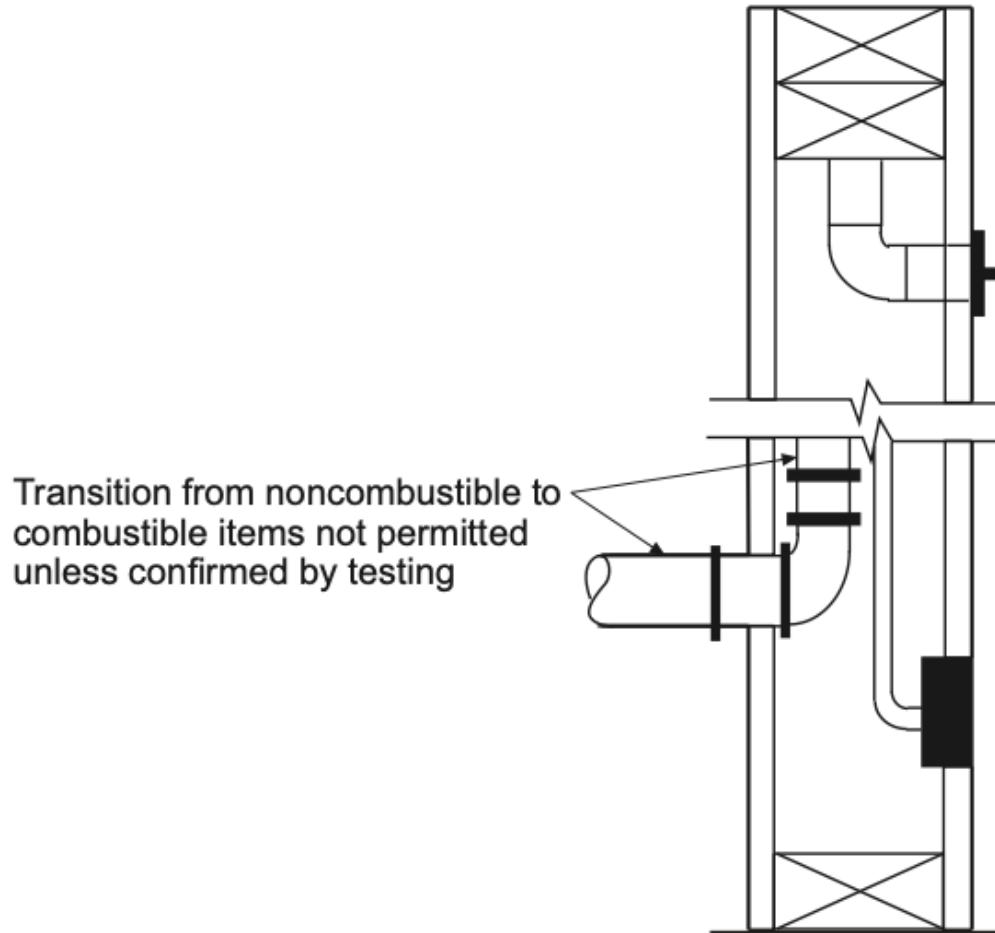
Membrane penetrations are usually addressed in the same manner as through penetrations. Additional exceptions address steel outlet boxes of limited size, listed electrical outlet boxes and fire sprinklers covered by metal escutcheon plates.

Source: 2021 IBC

714.4.3, 717.1.2 Penetrations: Fire-Resistance-Rated Walls

- Noncombustible penetrating items shall not connect to combustible items beyond the point of firestopping unless it can be demonstrated that the fire-resistance integrity of the wall is maintained. Ducts that penetrate fire-resistance-rated assemblies and are not required by Section 717 to have fire dampers shall comply with the requirements of Sections 714.3 through 714.4.3.
- Duct penetrations of fire-resistance-rated wall assemblies are typically protected with fire dampers in accordance with Section 717.5. However, in those locations where dampers are not required, it is still necessary to address the structural integrity of the fire resistive-rated wall where it is penetrated. Thus, the space between the duct and the wall must be protected in a manner consistent with that used for pipes, conduits and similar items.

714.4.3, 717.1.2 Penetrations: Fire-Resistance-Rated Walls



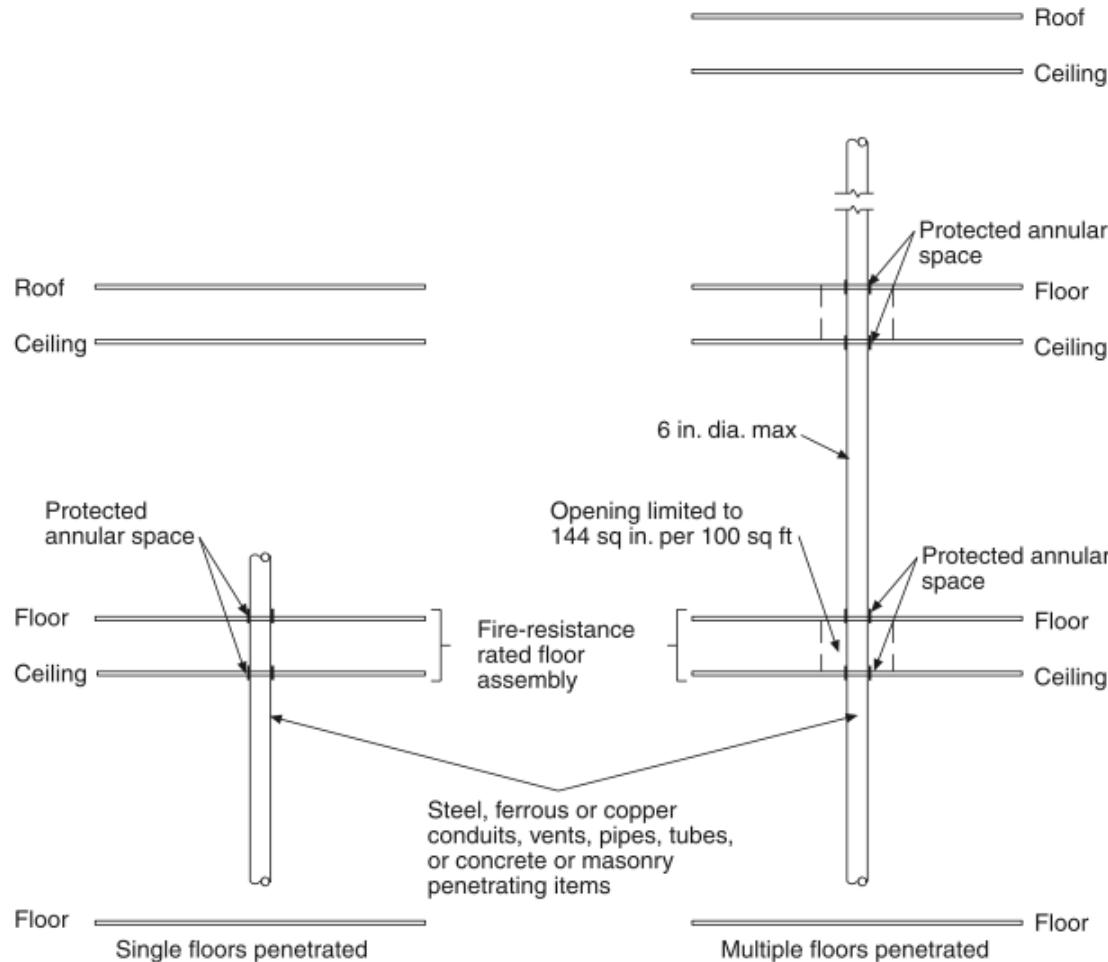
To prevent the creation of an open penetration, the transition from a noncombustible penetrating item to a combustible item is prohibited beyond the point of firestopping. Such a condition is only permitted when its suitability has been demonstrated through testing.

Source: 2021 IBC

714.5 Penetrations: Horizontal Assemblies

- Penetrations of a fire-resistance-rated floor, fire-resistance-rated floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly not required to be enclosed in a shaft by Section 712.1 shall be protected in accordance with Sections 714.5.1 through 714.5.4. Through penetrations of horizontal assemblies shall comply with Section 714.5.1.1 or 714.5.1.2.
- Where horizontal construction is penetrated by a duct, pipe, tube, wire, conduit, cable, vent or similar item, the primary requirements are based on Section 713 for shaft enclosures. However, Section 712.1.4 permits the use of Section 714 for both through penetrations and membrane penetrations. The provisions for horizontal assemblies are very similar to those for walls, with special allowances for steel, copper or ferrous penetrating items. Where the penetrations occur in smoke barriers, any firestop system must also be tested for air leakage and provided with the appropriate L rating.

714.5 Penetrations: Horizontal Assemblies



Penetrations of horizontal assemblies

For SI: 1 square inch = 645.16 mm², 1 square foot = 0.093 m².

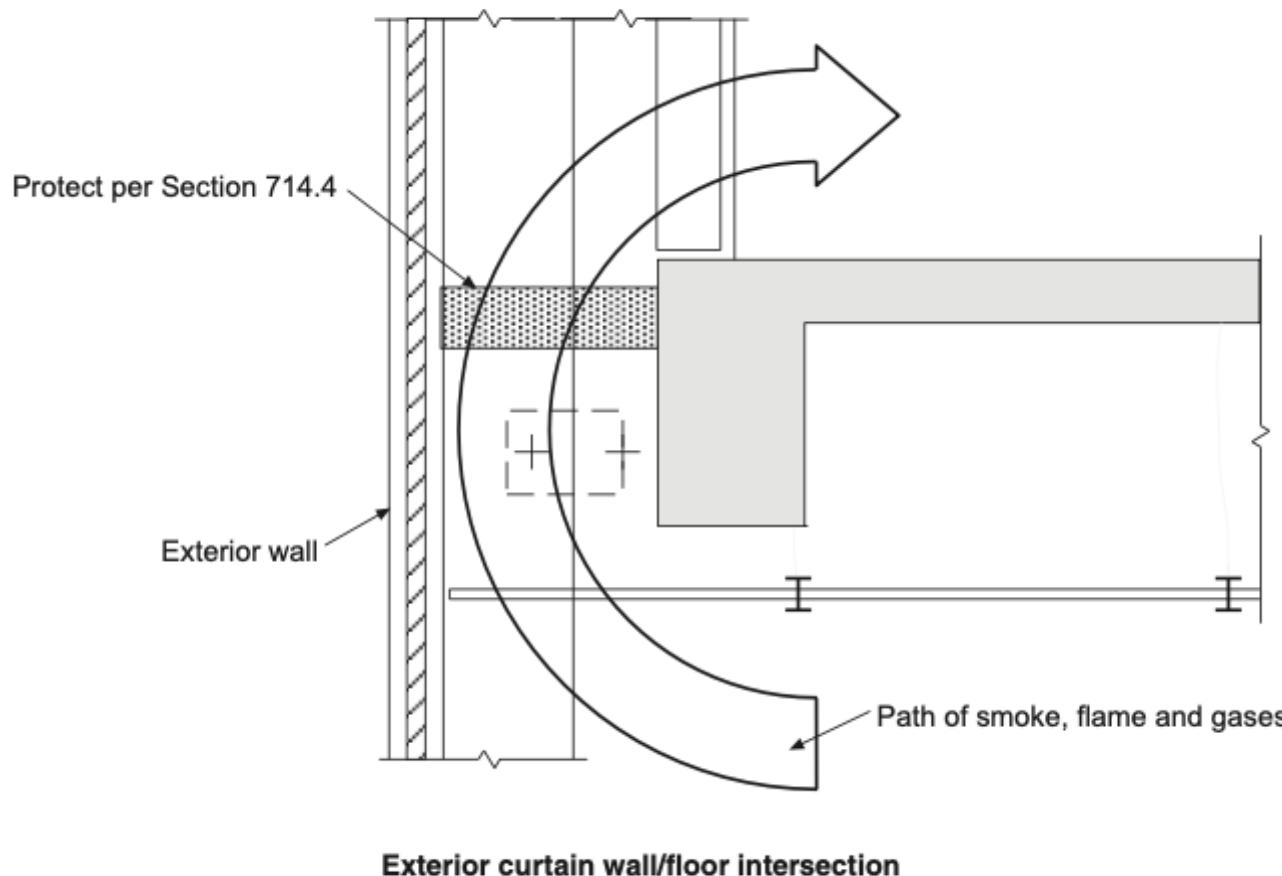
Nonfire-resistance-rated wall assemblies need not be protected where penetrated by conduits, piping and similar penetrating items. However, such protection is mandated for the penetration of nonfire-resistance-rated horizontal assemblies to limit vertical fire spread.

Source: 2021 IBC

715.3, 715.2 Fire-Resistant Joint System

- Joints installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies shall be protected by an approved fire-resistant joint system designed to resist the passage of fire for a time period not less than the required fire-resistance rating of the wall, floor or roof in or between which it is installed. See the exception for 10 locations where joint systems are not required. Systems or materials protecting joints and voids shall be securely installed in accordance with the manufacturer's installation instructions in or on the joint or void for its entire length so as not to dislodge, loosen, or otherwise impair its ability to accommodate expected building movements and to resist the passage of fire and hot gases.
- Joints are created where the structural design of a building necessitates a separation between building components in order to accommodate anticipated structural displacements caused by thermal expansion and contraction, seismic activity, wind or other loads. The integrity of the fire-resistant separation must be maintained where such joints occur.

715.3, 715.2 Fire-Resistant Joint System



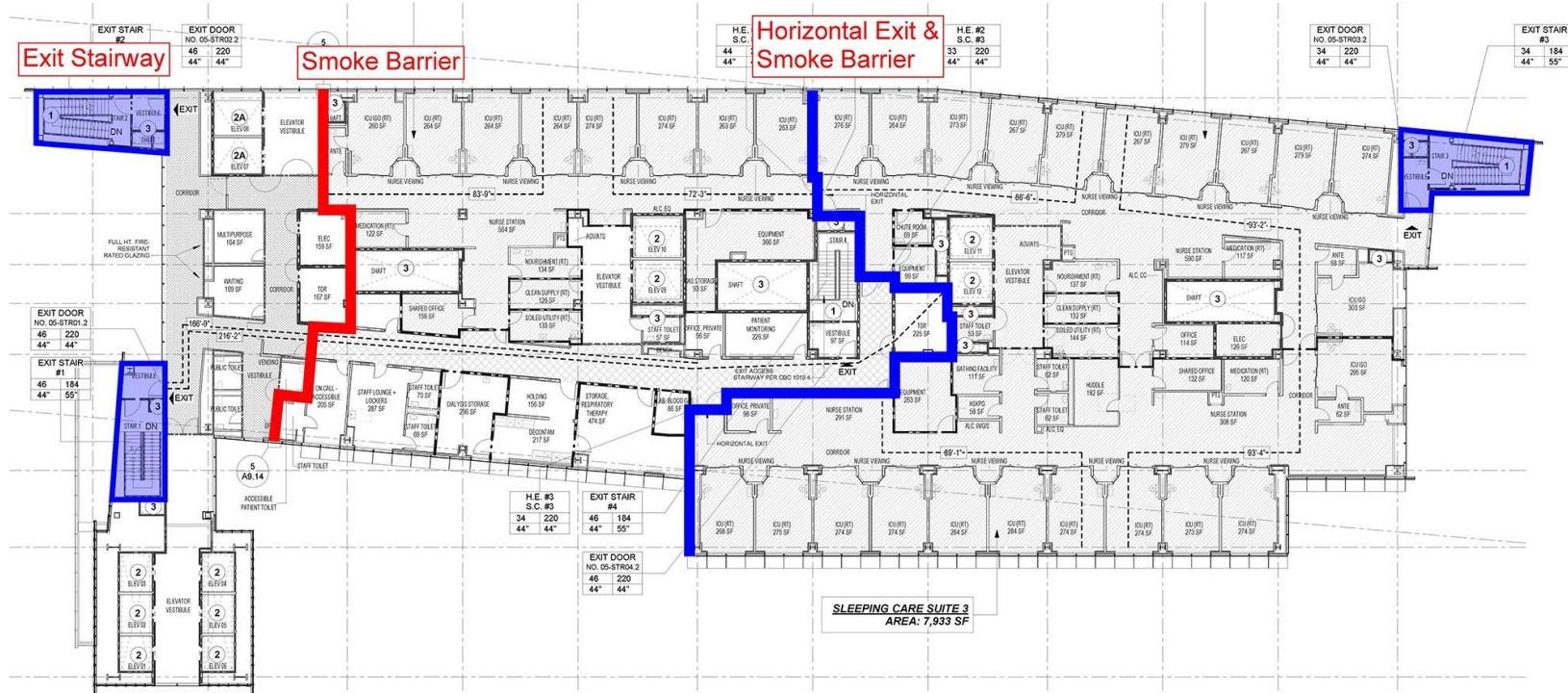
When not utilizing fire-resistant joint systems, the void created at the intersection of a floor/ceiling assembly and an exterior curtain wall assembly must be protected in a similar manner to prevent the spread of flame and hot gases vertically from floor to floor.

Source: 2021 IBC

715.3, 715.2 Fire-Resistant Joint System

In which of the following locations is a fire-resistant joint system required to protect all joints?

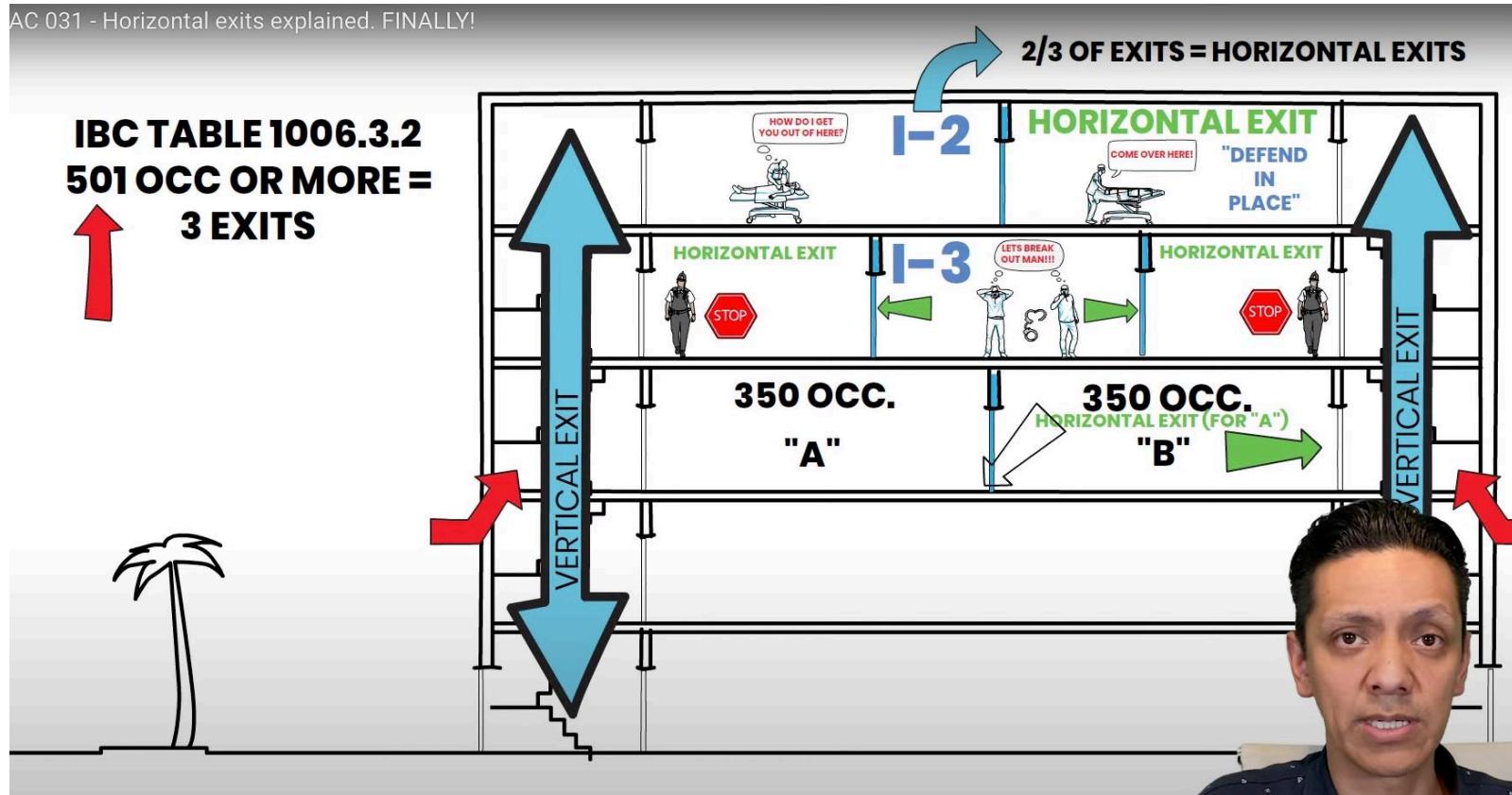
- a. floors within malls
 - b. horizontal exit walls
 - c. mezzanine floors
 - d. roofs where openings are permitted



715.3, 715.2 Fire-Resistant Joint System

In which of the following locations is a fire-resistant joint system required to protect all joints?

- a. floors within malls
- b. horizontal exit walls
- c. mezzanine floors
- d. roofs where openings are permitted



Source: https://www.youtube.com/watch?v=E_6HVShMG-4

Source: 2021 IBC

715.3, 715.2 Fire-Resistant Joint System: Exception

Exception: *Fire-resistant joint systems* shall not be required for *joints* in the following locations:

1. Floors within a single *dwelling unit*.
2. Floors where the *joint* is protected by a shaft enclosure in accordance with Section 713.
3. Floors within *atriums* where the space adjacent to the *atrium* is included in the volume of the *atrium* for smoke control purposes.
4. Floors within *malls*.
5. Floors and ramps within parking garages or structures constructed in accordance with Sections 406.5 and 406.6.
6. *Mezzanine* floors.
7. Walls that are permitted to have unprotected openings.
8. Roofs where openings are permitted.
9. Control *joints* not exceeding a maximum width of 0.625 inch (15.9 mm) and tested in accordance with ASTM E119 or UL 263.
10. The intersection of exterior curtain wall assemblies and the roof slab or roof deck.

715.3, 715.2 Fire-Resistant Joint System: Exception

SECTION 712 VERTICAL OPENINGS

712.1 General. Each vertical opening shall comply in accordance with one of the protection methods in Sections 712.1.1 through 712.1.16.

712.1.1 Shaft enclosures. Vertical openings contained entirely within a *shaft enclosure* complying with Section 713 shall be permitted.

712.1.2 Individual dwelling unit. Unconcealed vertical openings totally within an individual residential *dwelling unit* and connecting four *stories* or less shall be permitted.

712.1.3 Escalator openings. Where a building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1, vertical openings for escalators shall be permitted where protected in accordance with Section 712.1.3.1 or 712.1.3.2.

712.1.3.1 Opening size. Protection by a draft curtain and closely spaced sprinklers in accordance with NFPA 13 shall be permitted where the area of the vertical opening between *stories* does not exceed twice the horizontal projected area of the escalator. In other than Groups B and M, this application is limited to openings that do not connect more than four *stories*.

712.1.3.2 Automatic shutters. Protection of the vertical opening by approved shutters at every penetrated floor shall be permitted in accordance with this section. The shutters shall be of noncombustible construction and have a *fire-resistance rating* of not less than 1.5 hours. The shutter shall be so constructed as to close immediately upon the actuation of a smoke detector installed in accordance with Section 907.3.1 and shall completely shut off the well opening. Escalators shall cease operation when the shutter begins to close. The shutter shall operate at a speed of not more than 30 feet per minute (152.4 mm/s) and shall be equipped with a sensitive leading edge to arrest its progress where in contact with any obstacle, and to continue its progress on release therefrom.

712.1.4 Penetrations. Penetrations, concealed and unconcealed, shall be permitted where protected in accordance with Section 714.

712.1.5 Joints. *Joints* shall be permitted where complying with Section 712.1.5.1 or 712.1.5.2, as applicable.

8. Roofs where openings are permitted.

712.1.5.1 Joints in or between horizontal assemblies. *Joints* made in or between *horizontal assemblies* shall comply with Section 715. The void created at the intersection of a floor/ceiling assembly and an exterior curtain wall assembly shall be permitted where protected in accordance with Section 715.4.

712.1.5.2 Joints in or between nonfire-resistance-rated floor assemblies. *Joints* in or between floor assemblies without a required *fire-resistance rating* shall be permitted where they comply with one of the following:

1. The *joint* shall be concealed within the cavity of a wall.
2. The *joint* shall be located above a ceiling.
3. The *joint* shall be sealed, treated or covered with an *approved* material or system to resist the free passage of flame and the products of combustion.

Exception: *Joints* meeting one of the exceptions specified in Section 715.3.

715.3, 715.2 Fire-Resistant Joint System: Exception

10. The intersection of exterior curtain wall assemblies and the roof slab or roof deck.

715.4 Exterior curtain wall/fire-resistance-rated floor intersections. Voids created at the intersection of exterior curtain wall assemblies and fire-resistance-rated floor or floor/ceiling assemblies shall be protected with an *approved perimeter fire containment system* to prevent the interior spread of fire. Such systems shall provide an *F rating* for a time period not less than the *fire-resistance rating* of the floor or floor/ceiling assembly.

715.4.1 Fire test criteria. *Perimeter fire containment systems* shall be tested in accordance with the requirements of ASTM E2307.

Exception: Voids created at the intersection of the exterior curtain wall assemblies and floor assemblies where the vision glass extends to the finished floor level shall be permitted to be protected with an approved material to prevent the interior spread of fire. Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch (0.254 mm) of water column (2.5 Pa) for the time period not less than the fire-resistance rating of the floor assembly.

715.5 Exterior curtain wall/nonfire-resistance-rated floor assembly intersections. Voids created at the intersection of exterior curtain wall assemblies and nonfire-resistance-rated floor or floor/ceiling assemblies shall be filled with an *approved material or system* to retard the interior spread of fire and hot gases between *stories*.

715.6 Exterior curtain wall/vertical fire barrier intersections. Voids created at the intersection of nonfire-resistance-rated exterior curtain wall assemblies and vertical *fire barriers* shall be filled with an *approved material or system* to retard the interior spread of fire and hot gases.

715.7 Curtain wall spandrels. Height and *fire-resistance requirements* for curtain wall spandrels shall comply with Section 705.8.5. Where Section 705.8.5 does not require fire-resistance-rated curtain wall spandrels, the requirements of Sections 715.4 and 715.5 shall still apply to the intersection between the curtain wall spandrels and the floor.

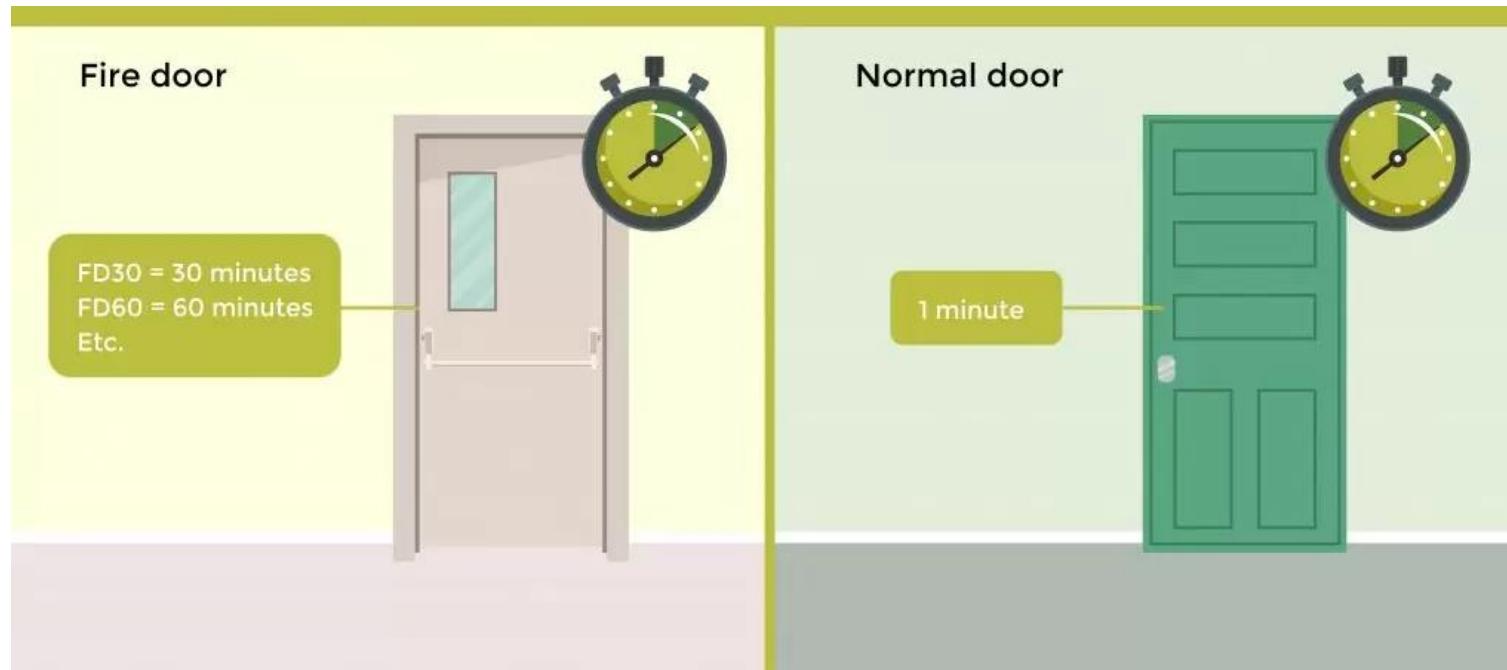
715.8 Joints and voids in smoke barriers. *Fire-resistant joint systems* protecting joints in *smoke barriers*, and perime-

ter fire containment systems protecting voids at the intersection of a horizontal *smoke barrier* and an exterior curtain wall, shall be tested in accordance with the requirements of UL 2079 for air leakage. The L rating of the joint system shall not exceed 5 cubic feet per minute per linear foot ($0.00775 \text{ m}^3/\text{s m}$) of joint at 0.30 inch (74.7 Pa) of water for both the ambient temperature and elevated temperature tests.

716.2.1 Fire Door Assemblies: Opening Protectives

- Approved fire door and fire shutter assemblies shall be constructed of any material or assembly of component materials that conforms to the test requirements of Section 716.2.1.1 (side-hinged or pivoted swinging doors), 716.2.1.2 (other types of assemblies) or (glazing in transom lights and sidelights in corridors and smoke barriers), and 716.2.1.4 (smoke and draft control) and the fire-protection rating indicated in Table 716.1(2). See the exceptions for tin-clad fire doors and floor fire doors.
- The level of protection required for a fire door is commensurate with that required for the wall or partition in which it is installed. The minimum fire protection rating varies based on the wall's required rating as well as the type and use of the wall assembly under consideration. In addition to establishing the minimum fire-protection rating required for fire door assemblies. Table 716.1(2) also provides information on door vision panels, side-lights and transoms.

716.2.1 Fire Door Assemblies: Opening Protectives



716.2.1 Fire Door Assemblies: Opening Protectives

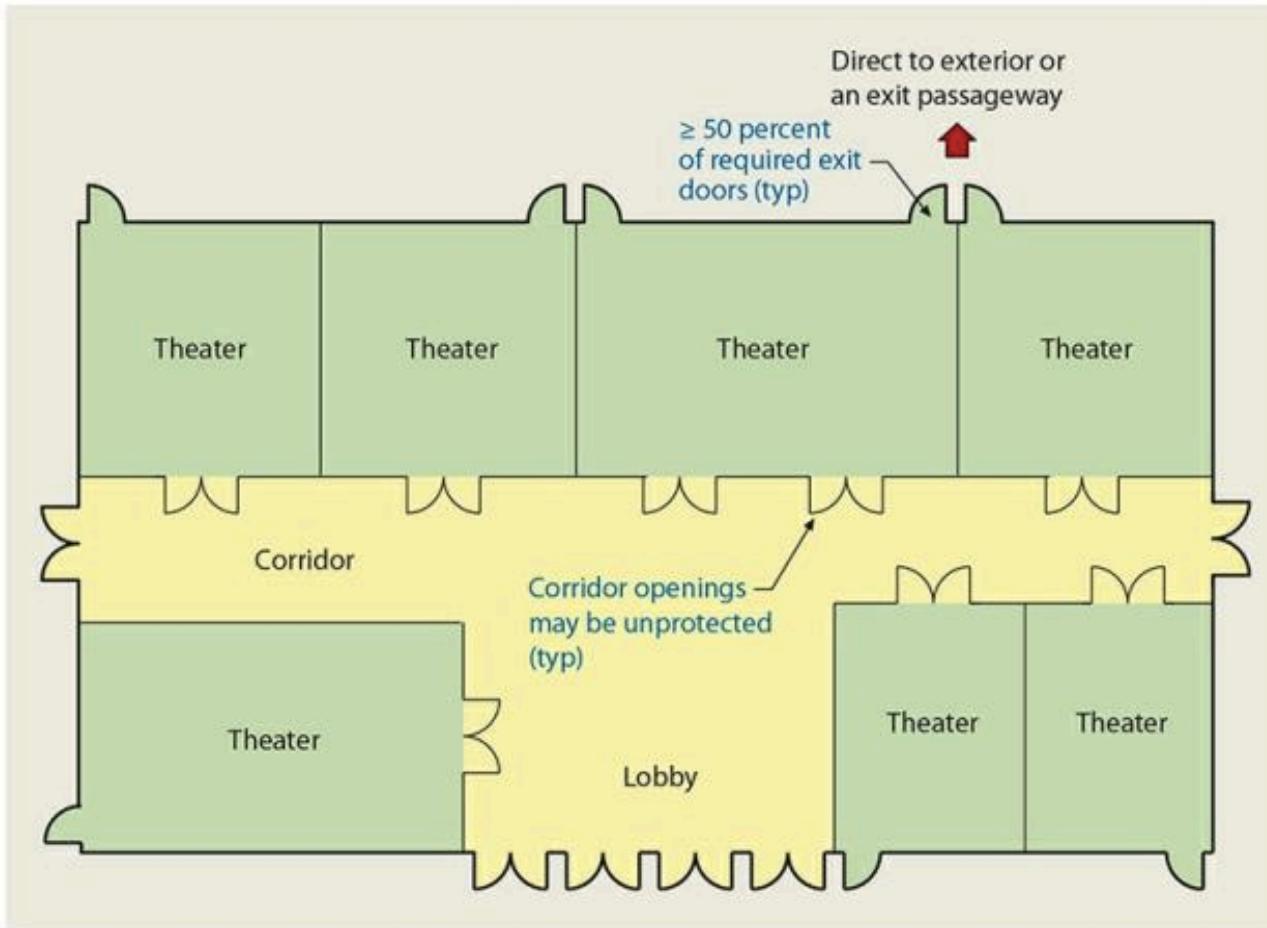


Figure 716-2 Corridor doors in a multitheater complex.

Table 716.1(2)

TABLE 716.1(2)
OPENING FIRE PROTECTION ASSEMBLIES, RATINGS AND MARKINGS

TYPE OF ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)	DOOR VISION PANEL SIZE ^a	FIRE-RATED GLAZING MARKING DOOR VISION PANEL ^{b,c}	MINIMUM SIDELIGHT/TRANSOM ASSEMBLY RATING (hours)		FIRE-RATED GLAZING MARKING SIDELIGHT/TRANSOM PANEL	
					Fire protection	Fire resistance	Fire protection	Fire resistance
Fire walls and fire barriers having a required fire-resistance rating greater than 1 hour	4	3	See Note a	D-H-W-240	Not Permitted	4	Not Permitted	W-240
	3	3 ^d	See Note a	D-H-W-180	Not Permitted	3	Not Permitted	W-180
	2	1 ^{1/2}	100 sq. in.	$\leq 100 \text{ sq. in.} = \text{D-H-90}$ $>100 \text{ sq. in.} = \text{D-H-W-90}$	Not Permitted	2	Not Permitted	W-120
	1 ^{1/2}	1 ^{1/2}	100 sq. in.	$\leq 100 \text{ sq. in.} = \text{D-H-90}$ $>100 \text{ sq. in.} = \text{D-H-W-90}$	Not Permitted	1 ^{1/2}	Not Permitted	W-90
Fire barriers having a required fire-resistance rating of 1 hour: Enclosures for shafts, exit access stairways, exit access ramps, interior exit stairways and interior exit ramps; and exit passageway walls	1	1	100 sq. in.	$\leq 100 \text{ sq. in.} = \text{D-H-60}$ $>100 \text{ sq. in.} = \text{D-H-T-W-60}$	Not Permitted	1	Not Permitted	W-60

TABLE 716.1(2)—continued
OPENING FIRE PROTECTION ASSEMBLIES, RATINGS AND MARKINGS

Table 7

TYPE OF ASSEMBLY	REQUIRED WALL ASSEMBLY RATING (hours)	MINIMUM FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)	DOOR VISION PANEL SIZE ^a	FIRE-RATED GLAZING MARKING DOOR VISION PANEL ^{b,c}	MINIMUM SIDELIGHT/TRANSOM ASSEMBLY RATING (hours)		FIRE-RATED GLAZING MARKING SIDE-LIGHT/TRANSOM PANEL	
					Fire protection	Fire resistance	Fire protection	Fire resistance
Horizontal exits in fire walls ^d	4	3	100 sq. in.	≤100 sq. in. = D-H-180 > 100 sq. in.=D-H-W-240	Not Permitted	4	Not Permitted	W-240
	3	3 ^d	100 sq. in.	≤100 sq. in. = D-H-180 > 100 sq. in.=D-H-W-180	Not Permitted	3	Not Permitted	W-180
Fire barriers having a required fire-resistance rating of 1 hour: Enclosures for shafts, exit access stairways, exit access ramps, interior exit stairways and interior exit ramps; and exit passageway walls	1	1	100 sq. in.	≤100 sq. in. = D-H-60 >100 sq. in.=D-H-T-W-60	Not Permitted	1	Not Permitted	W-60
Fire protection								
Other fire barriers	1	3/4	Maximum size tested	D-H	3/4 ^b		D-H ^b	
Fire partitions: Corridor walls	1	1/3 ^a	Maximum size tested	D-20	3/4 ^b		D-H-OH-45	
	0.5	1/3 ^a	Maximum size tested	D-20	1/3		D-H-OH-20	
Other fire partitions	1	3/4 ⁱ	Maximum size tested	D-H-45	3/4		D-H-45	
	0.5	1/3	Maximum size tested	D-H-20	1/3		D-H-20	
Exterior walls	3	1 1/2	100 sq. in. ^a	≤100 sq. in. = D-H-90 > 100 sq. in = D-H-W-90	Not Permitted	3	Not Permitted	W-180
	2	1 1/2	Maximum size tested	D-H 90 or D-H-W-90	1 1/2 ^b	2	D-H-OH-90 ^b	W-120
					Fire protection			
	1	3/4	Maximum size tested	D-H-45	3/4 ^b		D-H-45 ^b	

Table 716.1(2)

Fire door assemblies required in a 2-hour exterior wall shall have a minimum fire protection rating of _____.

- a. 20 minutes
- b. 45 minutes
- c. 1 hour
- d. 90 minutes



A common belief is that the rating of a fire door assembly is always equal to three quarters of the required rating of the wall.

Answer:

<https://www.youtube.com/watch?v=ABOzoK6PNBA&t=107s>

4



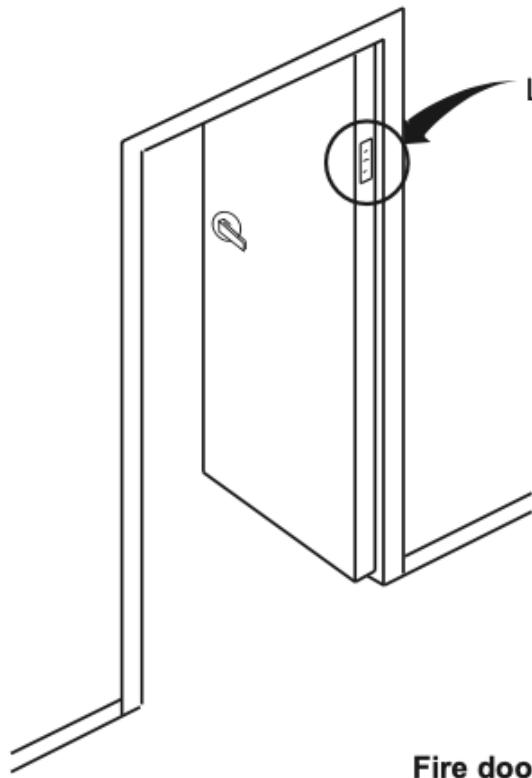
Fuel load less since wall has furniture fuel load.

<https://www.youtube.com/watch?v=9cADBexRFIY>

Fire load examples on door:

<https://www.youtube.com/watch?v=1FJdWTITXG0>

716.2.1 Labeling Requirements: Fire Door Assemblies



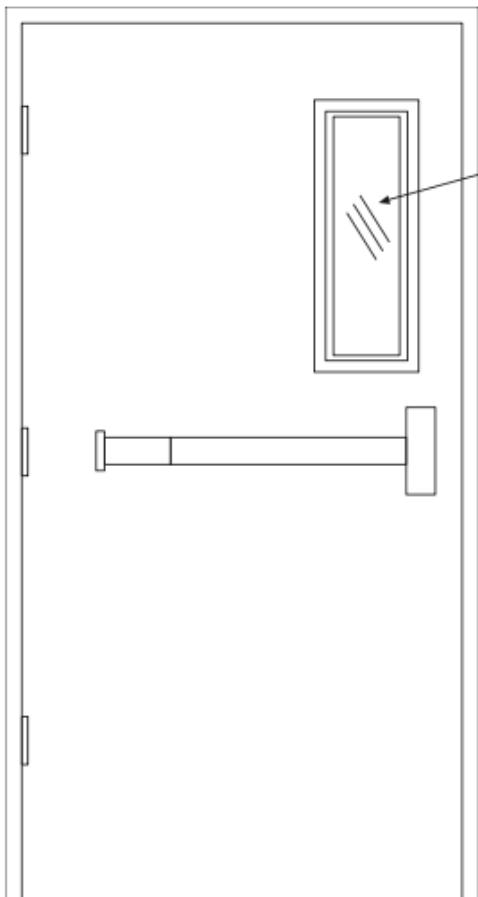
Label to be permanently affixed and include:

- Name of manufacturer
- Name of third-party inspection agency
- Fire protection rating
- Maximum transmitted temperature end point (where required)
- Designation as smoke and draft control door with "S" label (where required)

Fire door assembly

Some fire door assemblies are too large to be tested in available furnaces. Therefore, the code recognizes a certificate of inspection as proof that the oversized doors comply with the requirements for materials, design and construction for a comparable fire door.

716.1.2.2 Fire Door Glazing Identification: Opening Protectives



Glazing to be labeled with 4-part identifier:

- “D”: applicable for fire-door assemblies and meets applicable fire-resistance requirements
- “H”: meets hose stream requirements
- “T”: meets temperature requirements
- “XXX”: fire-protection rating in minutes

The identification methods for glazing found in Table 716.1(1) are also applicable to fire-resistance-rated glazing utilized as wall assemblies as well as fire-protection-rated glazing used in fire window assemblies as established in Table 716.1(3).

Source: 2021 IBC

717, 202: Fire and Smoke Dampers: Definitions

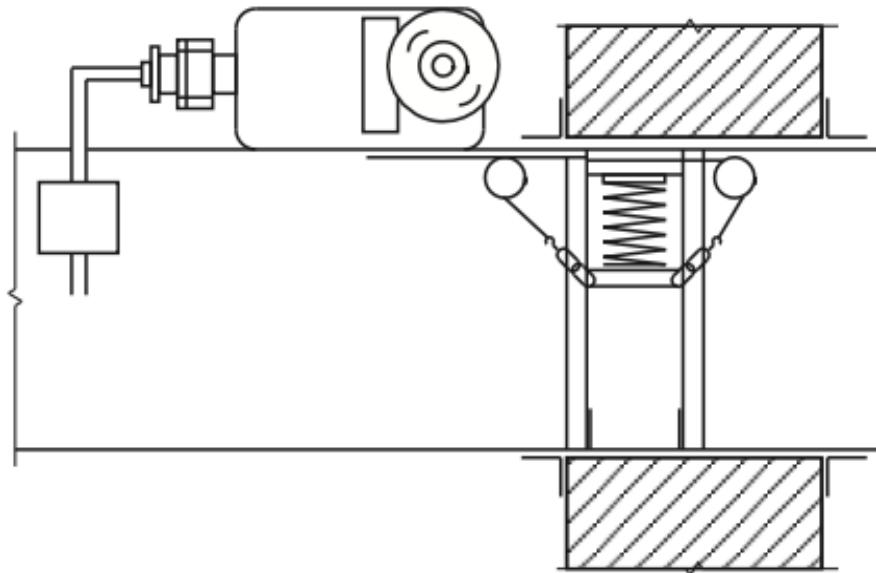


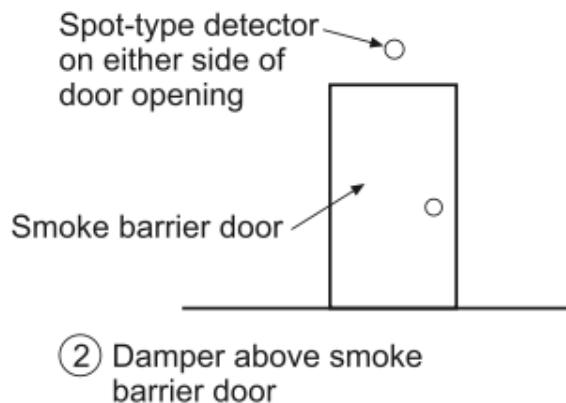
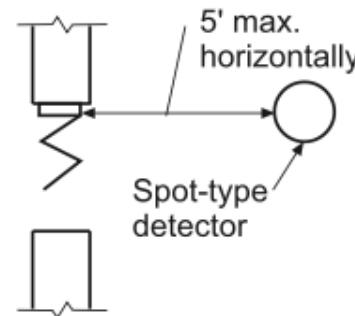
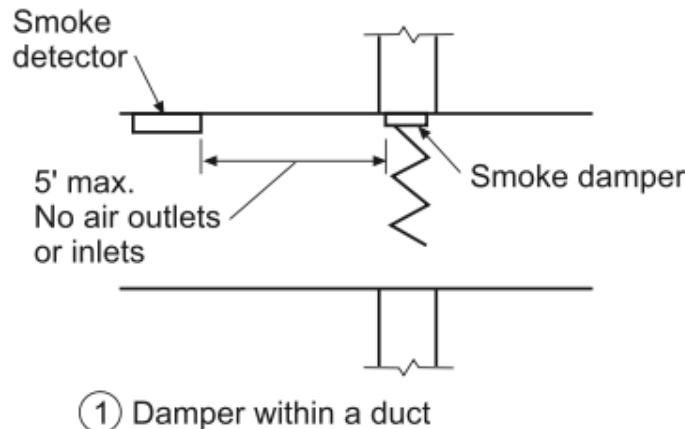
Figure courtesy
Sheet Metal and Air Conditioning Contractors National Association

Note: This illustration is not intended to exclusively endorse or indicate preference for a combination fire and smoke damper. Two separate dampers that satisfy the requirements for the respective functions may also be used for fire and smoke control.

Combination fire and smoke dampers

Where both a fire and a smoke damper are mandated, the use of a combination damper is permitted. This type of listed device is designed to close automatically upon detecting heat and to resist the passage of air and smoke.

717.3.1: Ducts and Air Transfer Openings.



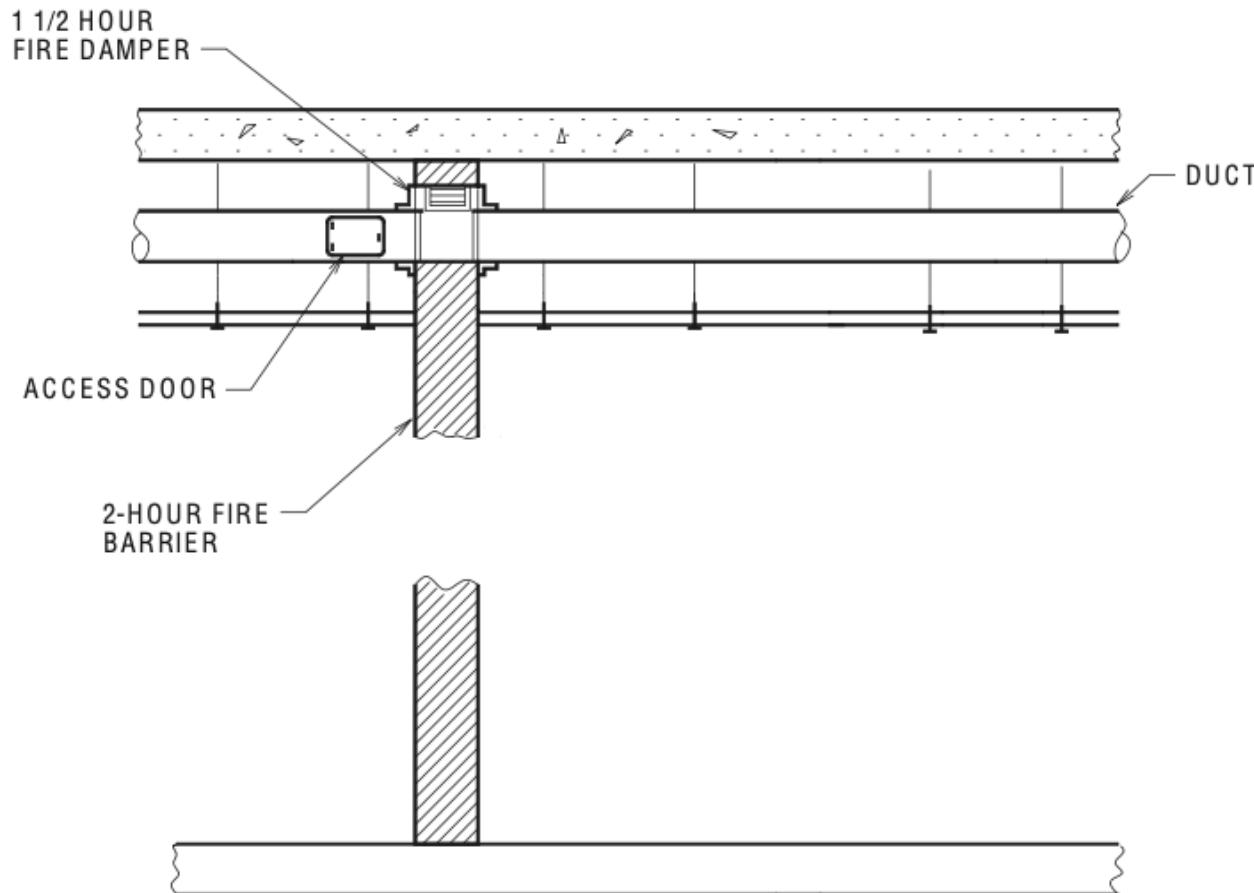
- ④ In corridor wall or ceiling, damper controlled by smoke-detection system installed in corridor
- ⑤ When total-coverage smoke-detection system provided within all areas served by HVAC system, dampers controlled by smoke detection system

1 foot = 304.8 mm

A smoke damper must close upon actuation of a listed smoke detector or smoke detection system. The IBC identifies five methods, one or more of which may be applicable, for the detector location and/or actuation.

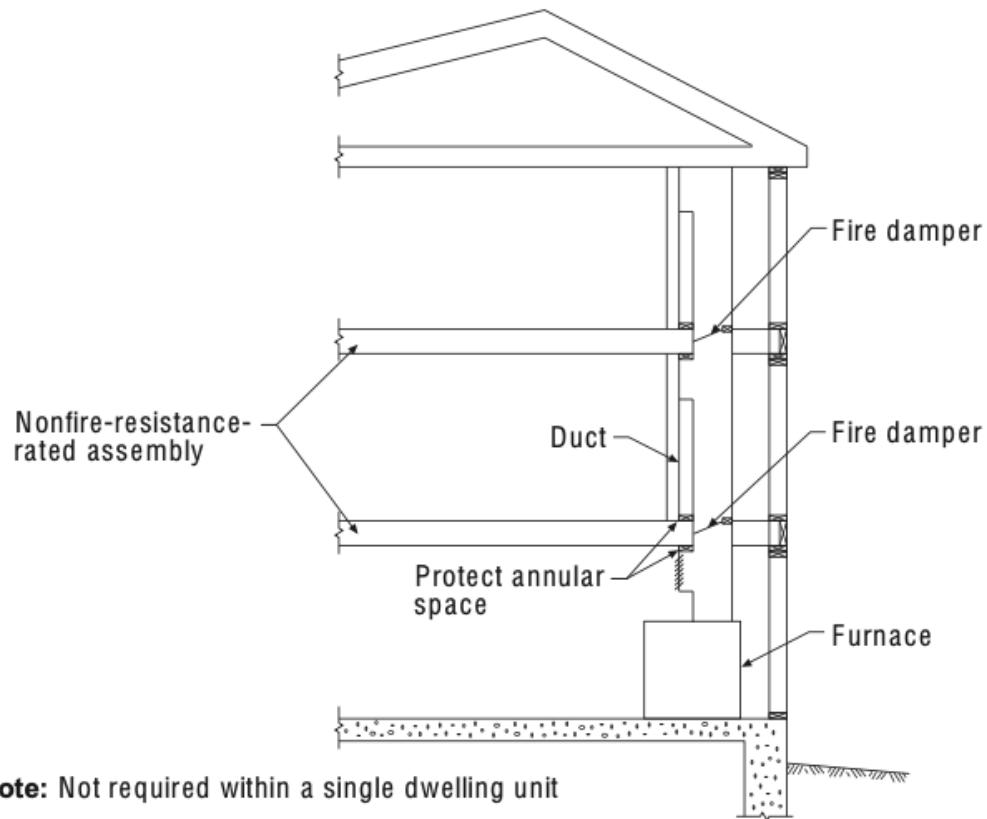
Source: 2021 IBC

717.5: Fire and Smoke Dampers



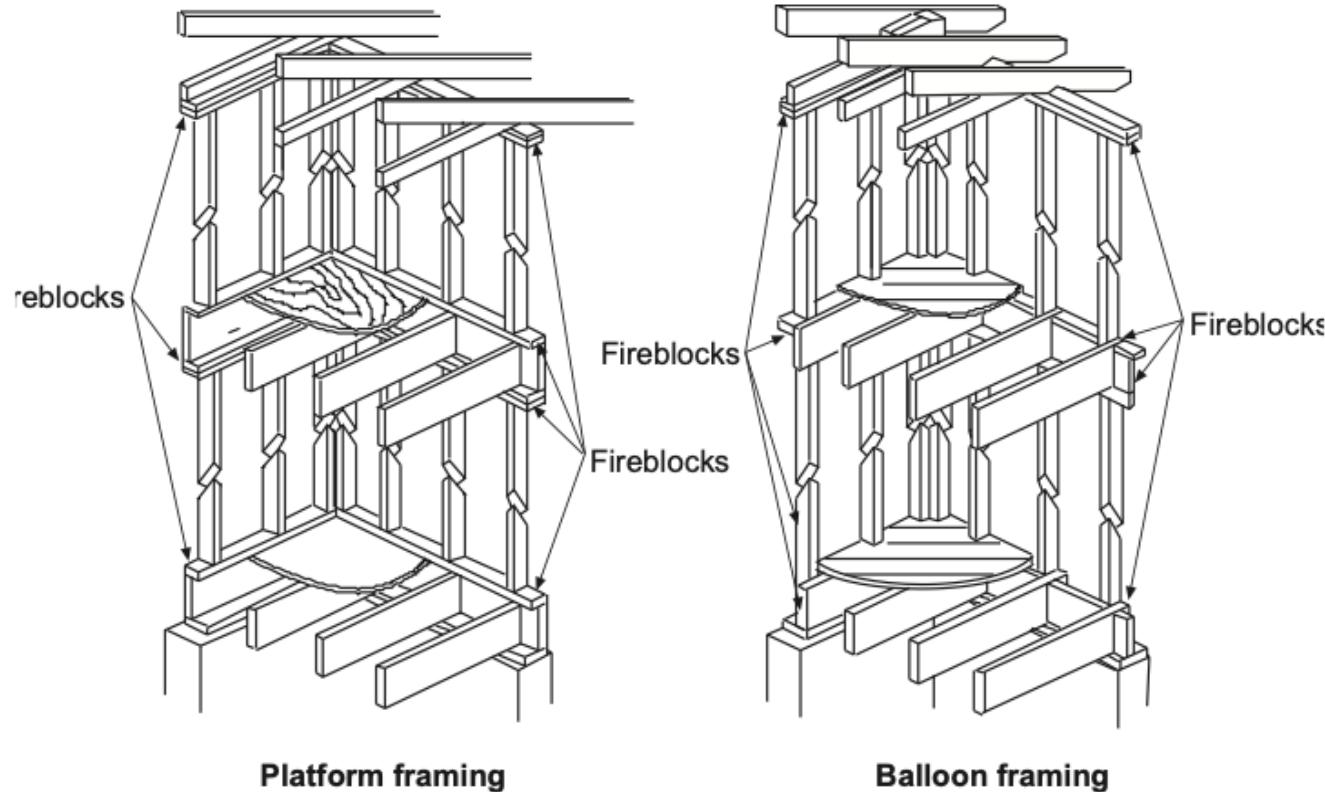
There will be times when a fire-resistance-rated assembly is penetrated by a duct or transfer opening that is not required to be protected by a fire or smoke damper. In such situations, the condition will be regulated and protected as a penetration in accordance with Section 714.

717.6.3: Nonrated Floor Assemblies: Ducts and Air Transfer Openings



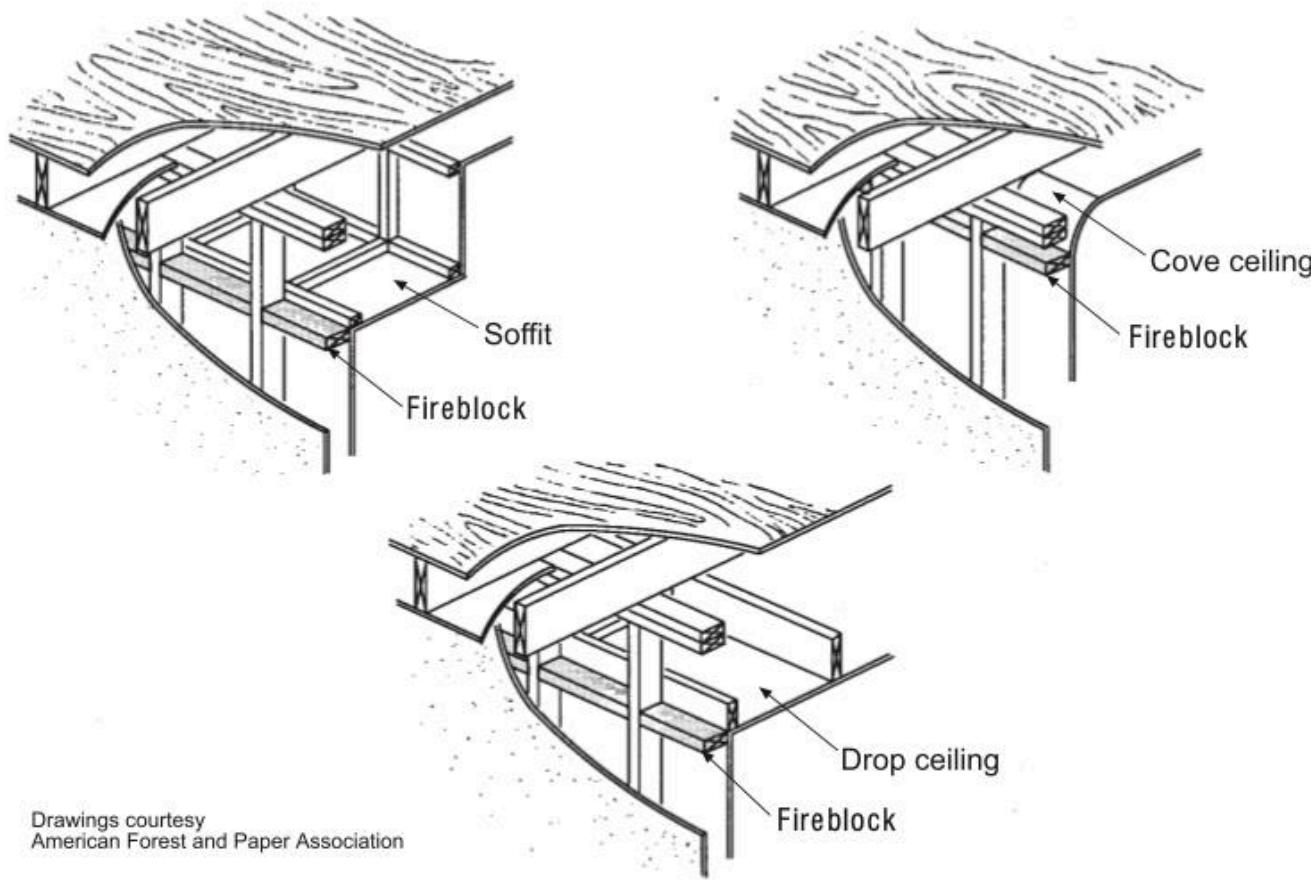
Where Item 3 is utilized for a duct that connects three stories, a minimum $1\frac{1}{2}$ -hour fire damper is required at each floor line even though the floor or floor/ceiling assembly is not required to have a fire-resistance rating, because the damper is an alternative to a 1-hour shaft enclosure.

718.2 202: Fireblocking: Concealed Spaces



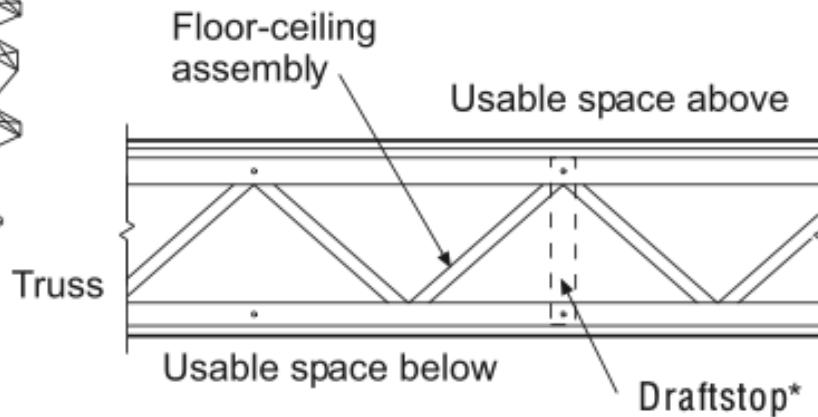
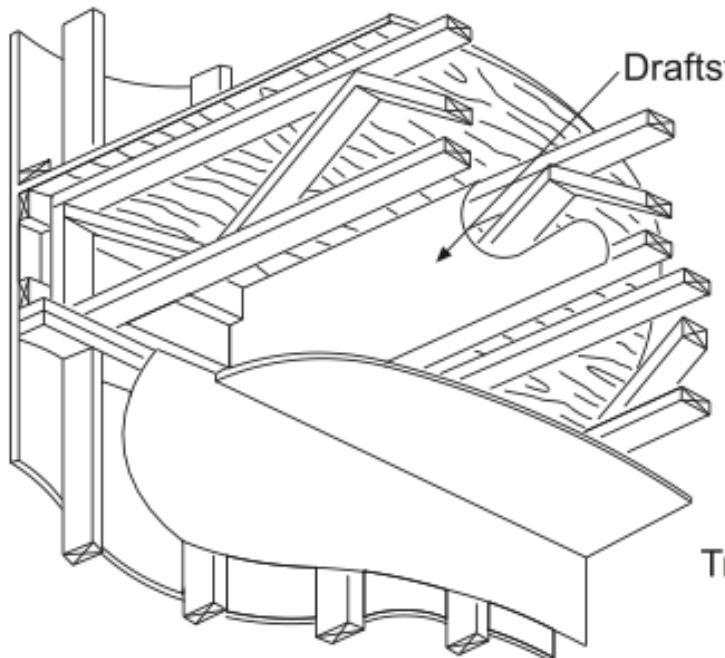
In noncombustible construction, building materials located in concealed areas of the building construction do not contribute to the spread of fire. Therefore, fireblocking and draftstopping are required only in buildings of combustible construction.

718.2 202: Fireblocking: Concealed Spaces



In general, fireblocking materials must consist of lumber or wood structural panels of the thicknesses specified, gypsum board, cement fiber board, batts or blankets of mineral wool or glass fiber, or any other approved materials securely fastened in place.

718.3.1 202: Draftstopping: Definition and Materials



*Required to divide space into areas no greater than 1,000 sq ft

Drawings courtesy
American Forest and Paper Association

For SI: 1 square foot = 0.093 m².

The provisions for draftstops are categorized for two general occupancy categories: residential and all uses other than residential. Both floor/ceiling assemblies and attics are addressed for each category. Many of the requirements are eliminated in fully sprinklered buildings.

718.3.1 202: Draftstopping: Definition and Materials

Draftstopping shall be installed in combustible floor/ceiling spaces of a nonsprinklered Group E occupancy such that the horizontal floor areas are a maximum of _____ square feet.

-
- a. 100
 - b. 400
 - c. 1,000
 - d. 3,000

Source: <https://www.youtube.com/watch?v=OzDQHs6zt6k&t=45s>

718.3.1 202: Draftstopping: Definition and Materials

Draftstopping shall be installed in combustible floor/ceiling spaces of a nonsprinklered Group E occupancy such that the horizontal floor areas are a maximum of _____ square feet.

- a. 100
- b. 400
- c. 1,000
- d. 3,000

718.3 Draftstopping in floors. Draftstopping shall be installed to subdivide floor/ceiling assemblies where required by Section 708.4.2. In other than Group R occupancies, draftstopping shall be installed to subdivide combustible floor/ceiling assemblies so that horizontal floor areas do not exceed 1,000 square feet (93 m^2).

Exception: Buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

718.3.1 Draftstopping materials. Draftstopping materials shall be not less than $\frac{1}{2}$ -inch (12.7 mm) gypsum board, $\frac{3}{8}$ -inch (9.5 mm) wood structural panel, $\frac{3}{8}$ -inch (9.5 mm) particleboard, 1-inch (25-mm) nominal lumber, cement fiberboard, batts or blankets of mineral wool or glass fiber, or other *approved* materials adequately supported. The integrity of *draftstops* shall be maintained.

718.4 Draftstopping in attics. Draftstopping shall be installed to subdivide *attic* spaces where required by Section 708.4.2. In other than Group R, draftstopping shall be

Class 8: Chapter 9, Fire Protection and Life Safety Systems

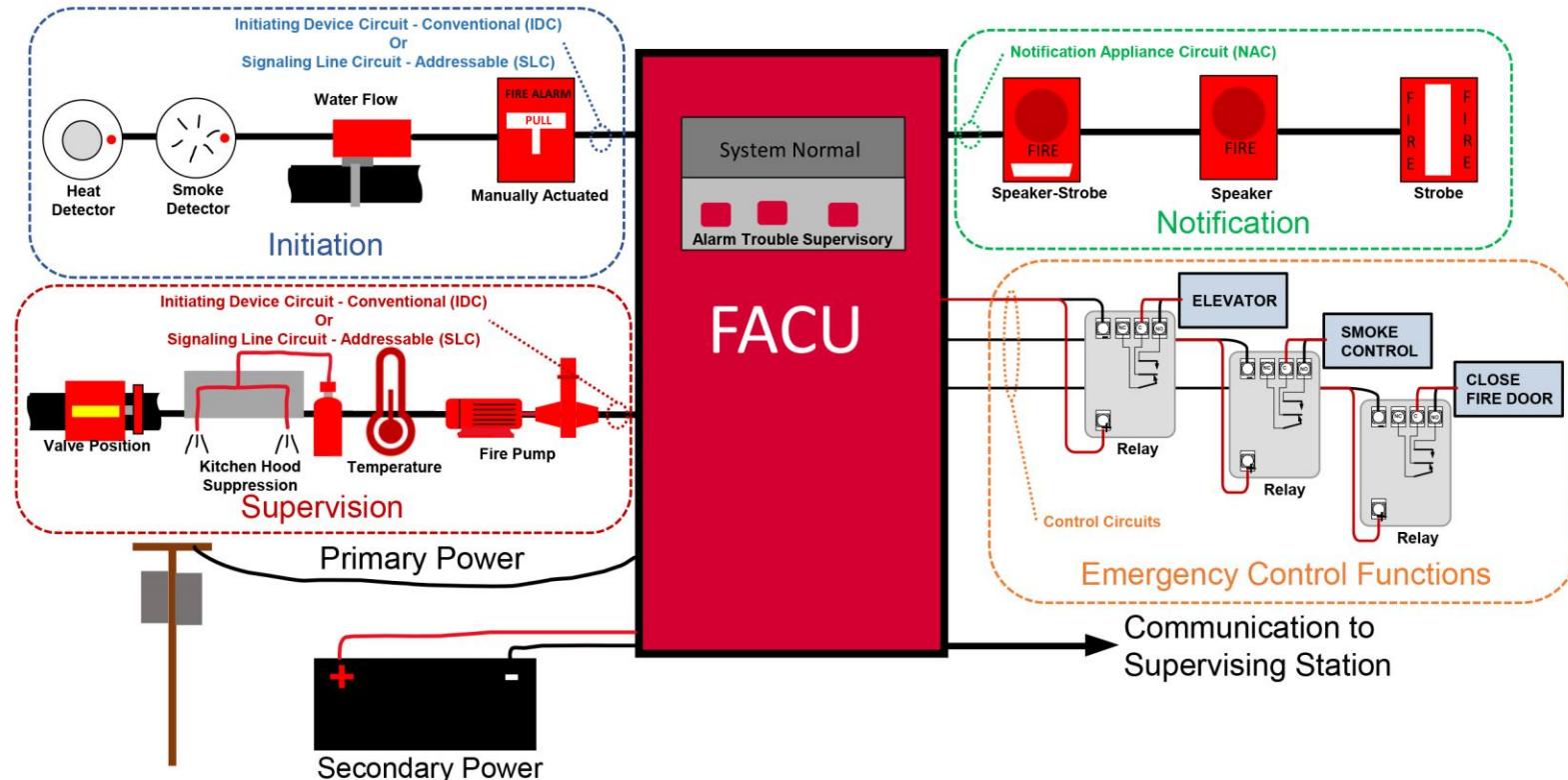
901, 202 Objective

- To obtain an understanding of the design and installation of fire protection systems, including automatic sprinkler systems, standpipe systems, fire alarm and detection systems, smoke control systems, and smoke and heat vents.

901, 202 Objective

- A *fire protection system* consists of approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof. The provisions of Chapter 9 shall specify where fire protection systems are required and shall apply to the design, installation and operation of fire protection and life safety systems. Fire protection and life safety systems shall be installed, repaired, operated and maintained in accordance with the International Building Code and the International Fire Code.
- The code provides requirements for three distinct systems considered vital to a safe building environment. The first system is intended to control and limit fire spread and to provide building occupants and fire personnel with the means of fighting a fire. The second system provides for detection of a fire condition and a means of notification. The third system is intended to control smoke migration.

901, 202 Objective



NFPA 72 outlines the requirements for four different types that are permitted in new installations, which includes both wired and wireless methods.

901.6, 202 Objective

1. Where a fire protection system is required to be monitored, the approved supervising station must comply with _____.
 - a. NFPA 4
 - b. NFPA 13
 - c. NFPA 70
 - d. NFPA 72

901.6 Supervisory service. Where required, *fire protection systems* shall be monitored by an approved supervising station in accordance with NFPA 72.

901.7, 202 Fire Areas

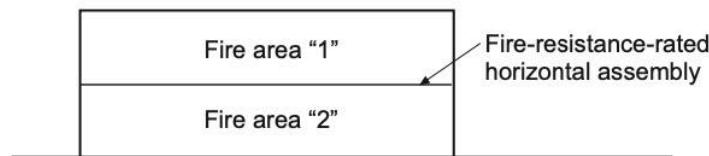
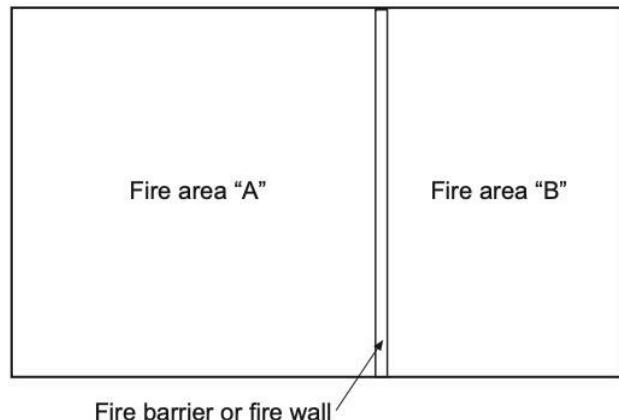


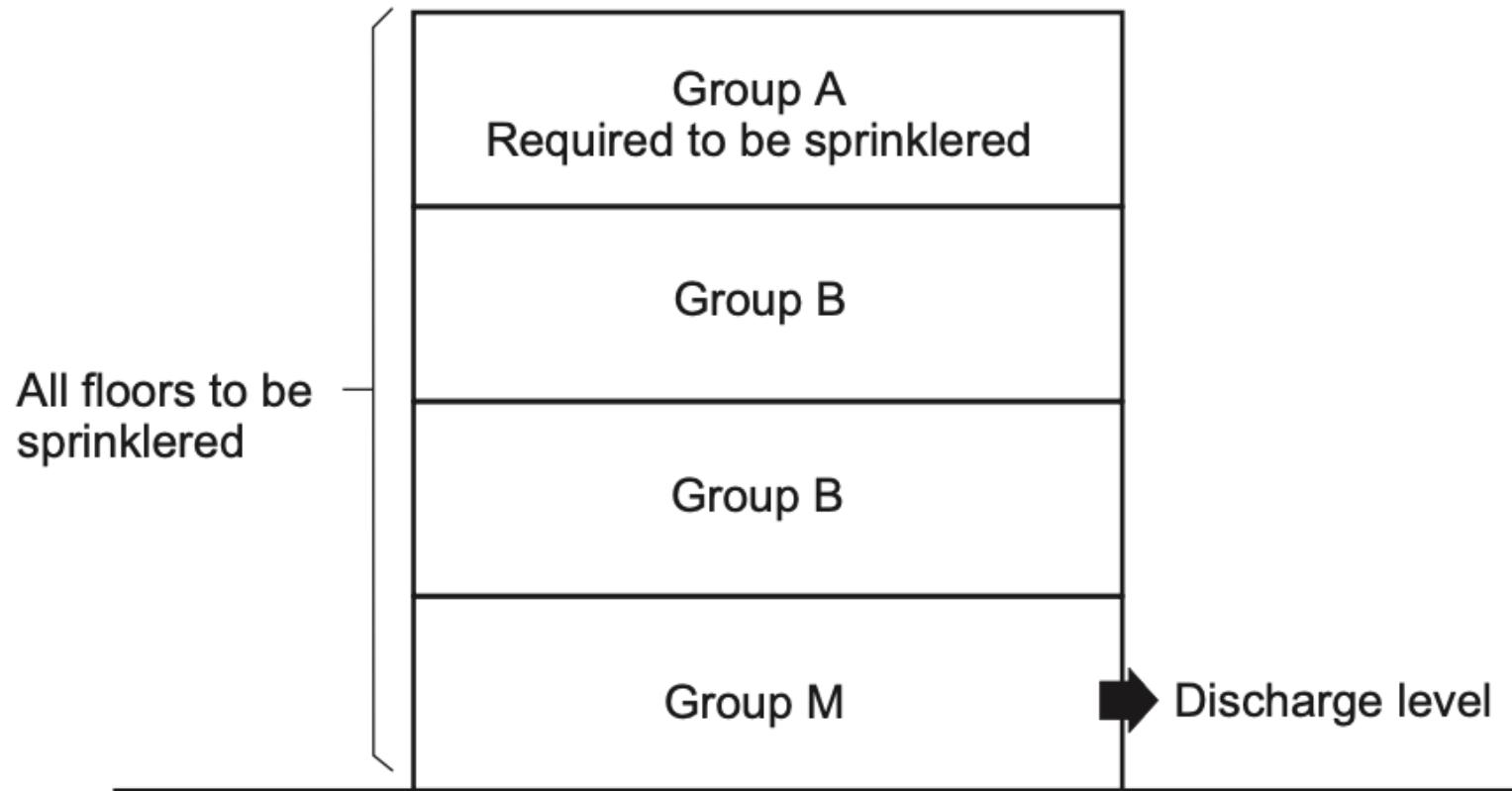
TABLE 707.3.10
FIRE-RESISTANCE RATING REQUIREMENTS FOR FIRE
BARRIER ASSEMBLIES OR HORIZONTAL ASSEMBLIES
BETWEEN FIRE AREAS

OCCUPANCY GROUP	FIRE-RESISTANCE RATING (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

To determine the appropriate level of fire resistance for fire barriers used to create one or more fire areas, refer to Table 707.3.10. This table mandates the minimum hourly rating for fire barriers separating one or more occupancies into different fire areas.

Source: 2021 IBC

903.2.1, Group A Occupancies



In all Group A occupancies, other than Group A-5, that require sprinkler protection, the sprinkler system must be provided throughout the entire story on which the Group A is located. In multistory buildings, the sprinkler system must also be provided on all stories between, and including, the Group A occupancy and the level of exit discharge.

903.2.1.1–903.2.1.5, Group A Occupancies

Automatic sprinkler system required where:

A-1
A-3
A-4

> 12,000 sq ft, or
≥ 300 occupants, or
located above or below discharge level

A-2

> 5,000 sq ft, or
≥ 100 occupants, or
located above or below discharge level

For SI: 1 square foot = 0.093 m²

Sprinkler protection may also be required in a building where a Group A occupancy occurs on the roof, with a threshold of 100 or more occupants in a Group A-2 occupancy and 300 or more occupants in other Group A occupancies.

Source: 2021 IBC

903.2.1.1–903.2.1.5, Group A Occupancies

A stadium press box in a Group A-5 occupancy having a maximum floor area of _____ square feet need not be sprinklered.

- a. 400
- b. 1,000
- c. 5,000
- d. 12,000

903.2.1.1–903.2.1.5, Group A Occupancies

A stadium press box in a Group A-5 occupancy having a maximum floor area of _____ square feet need not be sprinklered.

- a. 400
- b. 1,000
- c. 5,000
- d. 12,000

[F] **903.2.1.4 Group A-4.** An *automatic sprinkler system* shall be provided throughout stories containing Group A-4 occupancies and throughout all stories from the Group A-4 occupancy to and including the *levels of exit discharge* serving that occupancy where one of the following conditions exists:

1. The *fire area* exceeds 12,000 square feet (1115 m^2).
2. The *fire area* has an *occupant load* of 300 or more.
3. The *fire area* is located on a floor other than a *level of exit discharge* serving such occupancies.

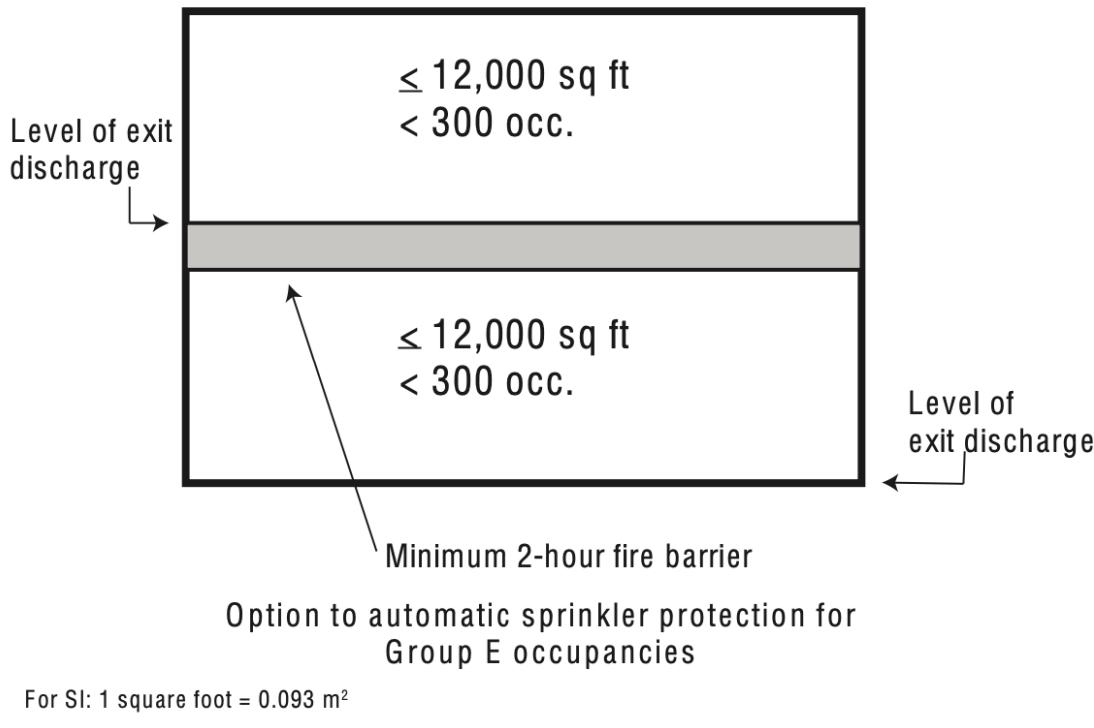
[F] **903.2.1.5 Group A-5.** An *automatic sprinkler system* shall be provided for all enclosed Group A-5 accessory use areas in excess of 1,000 square feet (93 m^2).

[F] **903.2.1.5.1 Spaces under grandstands or bleachers.** Enclosed spaces under *grandstands* or *bleachers* shall be equipped with an *automatic sprinkler system* in accordance with Section 903.3.1.1 where either of the following exist:

1. The enclosed area is 1,000 square feet (93 m^2) or less and is not constructed in accordance with Section 1030.1.1.1.
2. The enclosed area exceeds 1,000 square feet (93 m^2).

903.2.3, Group E Occupancies

Automatic fire sprinkler system required throughout all Group E fire areas exceeding 12,000 square feet or 299 occupants in fire area

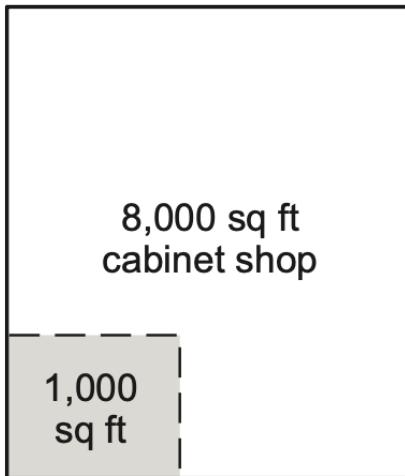


Minimum 2-hour fire-resistance-rated fire barriers (Table 707.3.10) can be used to subdivide the building into small fire areas, thereby eliminating the sprinkler requirement. Direct egress at ground level from each classroom in the building is considered as an alternative to basement sprinkler protection.

Source: 2021 IBC

903.2.4, 903.2.7, 903.2.9, Group F-1, M and S-1 Occupancies

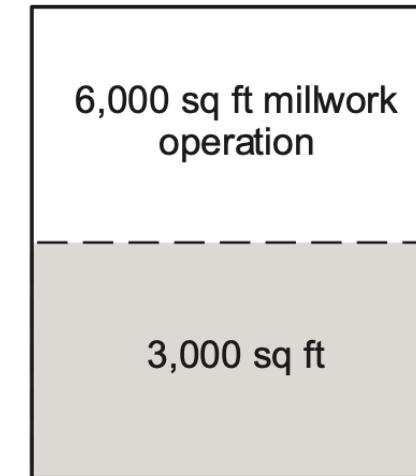
Sprinkler protection
not required



Sprinkler protection
not required



Sprinkler protection required
throughout building
(single fire area)



Denotes area where finely divided combustible waste is generated or
finely divided combustible material is used

Woodworking operations

For SI: 1 square foot = 0.093 m².

In addition to the general provisions for sprinkler protection in manufacturing occupancies, IBC Section 903.2.4.1 mandates a more restrictive limitation for woodworking operations. Sprinkler protection for high-piled or rack storage is also addressed in the *International Fire Code*.

903.2.4, 903.2.7, 903.2.9, Group F-1, M and S-1 Occupancies

Where woodworking operations in a Group F-1 occupancy generate finely divided combustible waste, an automatic sprinkler system is required where such operations occupy a minimum size floor area of _____ square feet.

- a. 1,001
- b. 2,501
- c. 5,001
- d. 12,001

903.2.4, 903.2.7, 903.2.9, Group F-1, M and S-1 Occupancies

Where woodworking operations in a Group F-1 occupancy generate finely divided combustible waste, an automatic sprinkler system is required where such operations occupy a minimum size floor area of _____ square feet.

- a. 1,001
- b. 2,501
- c. 5,001
- d. 12,001

[F] 903.2.4.1 Woodworking operations. An *automatic sprinkler system* shall be provided throughout all Group F-1 occupancy *fire areas* that contain woodworking operations in excess of 2,500 square feet (232 m²) in area that generate finely divided combustible waste or use finely divided combustible materials.

903.2.5.1, 903.2.6, Group H and I Occupancies

- An automatic sprinkler system shall be installed in Group H occupancies. An automatic sprinkler system shall be provided throughout buildings with a Group I fire area. See the exceptions for Group I-1 and day-care facilities.
- Hazardous occupancies require automatic sprinkler systems to protect not only the building's occupants and contents, but also the surrounding property. The sprinkler system only need be provided in the portion of the building classified as Group H. Buildings containing institutional uses must be protected throughout due to the lack of mobility of the occupants. The sprinkler system is intended to limit the size and the spread of a fire, thereby allowing extra time for moving occupants of the institutional building into an adjoining smoke compartment or through a horizontal exit.

903.2.5.1, 903.2.6, Group H and I Occupancies

**[F] TABLE 903.2.5.2
GROUP H-5 SPRINKLER DESIGN CRITERIA**

LOCATION	OCCUPANCY HAZARD CLASSIFICATION
Fabrication areas	Ordinary Hazard Group 2
Service corridors	Ordinary Hazard Group 2
Storage rooms without dispensing	Ordinary Hazard Group 2
Storage rooms with dispensing	Extra Hazard Group 2
Corridors	Ordinary Hazard Group 2

In a semiconductor fabrication facility classified as a Group H-5 occupancy, the sprinkler system must be installed throughout the entire building. For sprinkler design criteria, the code identifies the occupancy hazard classifications based on the various areas and locations.

903.2.8, Group R Occupancies



The scope of the IBC, *Section 101.2*, defers certain residential occupancies to the construction regulations of the *International Residential Code*. As such, this sprinkler requirement applies only to those residential structures constructed under the requirements of the *International Building Code*.

903.2.8, Group R Occupancies

Buildings containing which of the following residential occupancies must be sprinklered under all conditions?

- a. Groups R-1 and R-2 only
- b. Groups R-1, R-2 and R-4 only
- c. Groups R-2 and R-4 only
- d. All Group R occupancies

903.2.8, Group R Occupancies

Buildings containing which of the following residential occupancies must be sprinklered under all conditions?

- a. Groups R-1 and R-2 only
- b. Groups R-1, R-2 and R-4 only
- c. Groups R-2 and R-4 only
- d. All Group R occupancies

[F] **903.2.8 Group R.** An *automatic sprinkler system* installed in accordance with Section 903.3 shall be provided throughout all buildings with a Group R fire area.

[F] **903.2.8.1 Group R-3.** An *automatic sprinkler system* installed in accordance with Section 903.3.1.3 shall be permitted in Group R-3 occupancies.

[F] **903.2.8.2 Group R-4, Condition 1.** An *automatic sprinkler system* installed in accordance with Section 903.3.1.3 shall be permitted in Group R-4, Condition 1 occupancies.

[F] **903.2.8.3 Group R-4, Condition 2.** An *automatic sprinkler system* installed in accordance with Section 903.3.1.2 shall be permitted in Group R-4, Condition 2 occupancies.

[F] **903.2.8.4 Care facilities.** An *automatic sprinkler system* installed in accordance with Section 903.3.1.3 shall be permitted in care facilities with five or fewer individuals in a single-family dwelling.

903.2.10, Group S-2 Parking Garages

Sprinkler system required throughout building where:

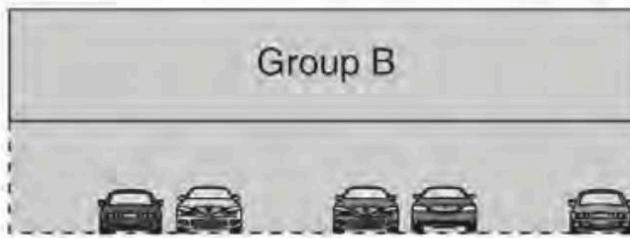
Fire area exceeds
12,000 sq ft



2-story Group S-2
enclosed parking garage

OR

Enclosed parking garage of any size located beneath another occupancy



Group B office building with Group S-2
enclosed parking garage below

Sprinkler protection of Group S-2 enclosed parking garages

Where the vehicles being stored consist of commercial trucks or buses, a more stringent fire area threshold is appropriate. The limitation of 5,000 square feet without sprinkler protection is typically applied to garages housing larger vehicles rather than pick-up trucks and similar-sized vehicles used for business activities.

Source: 2021 IBC

903.2.10, Group S-2 Parking Garages

- A Group S-2 parking garage used to store commercial buses need not be sprinklered where the fire area has a maximum size of _____ square feet.
- a. 2,500
 - b. 5,000
 - c. 10,000
 - d. 12,000

903.2.10, Group S-2 Parking Garages

- A Group S-2 parking garage used to store commercial buses need not be sprinklered where the fire area has a maximum size of _____ square feet.
- a. 2,500
 - b. 5,000
 - c. 10,000
 - d. 12,000

[F] **903.2.10 Group S-2 parking garages.** An *automatic sprinkler system* shall be provided throughout buildings classified as parking garages where any of the following conditions exists:

- 1. Where the fire area of the enclosed parking garage in accordance with Section 406.6 exceeds 12,000 square feet (1115 m^2).
- 2. Where the enclosed parking garage in accordance with Section 406.6 is located beneath other groups.

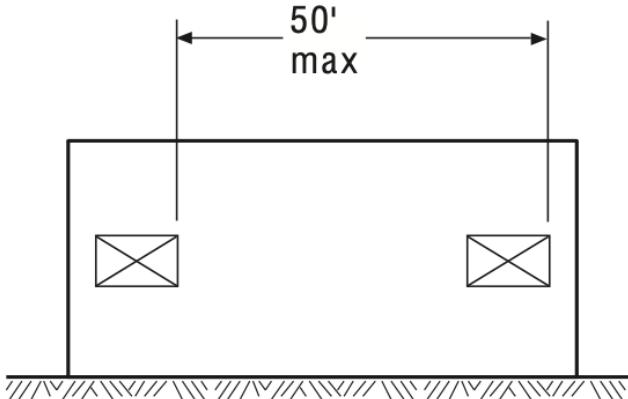
Exception: Enclosed parking garages located beneath Group R-3 occupancies.

- 3. Where the *fire area* of the *open parking garage* in accordance with Section 406.5 exceeds 48,000 square feet (4460 m^2).

[F] **903.2.10.1 Commercial parking garages.** An *automatic sprinkler system* shall be provided throughout buildings used for storage of commercial motor

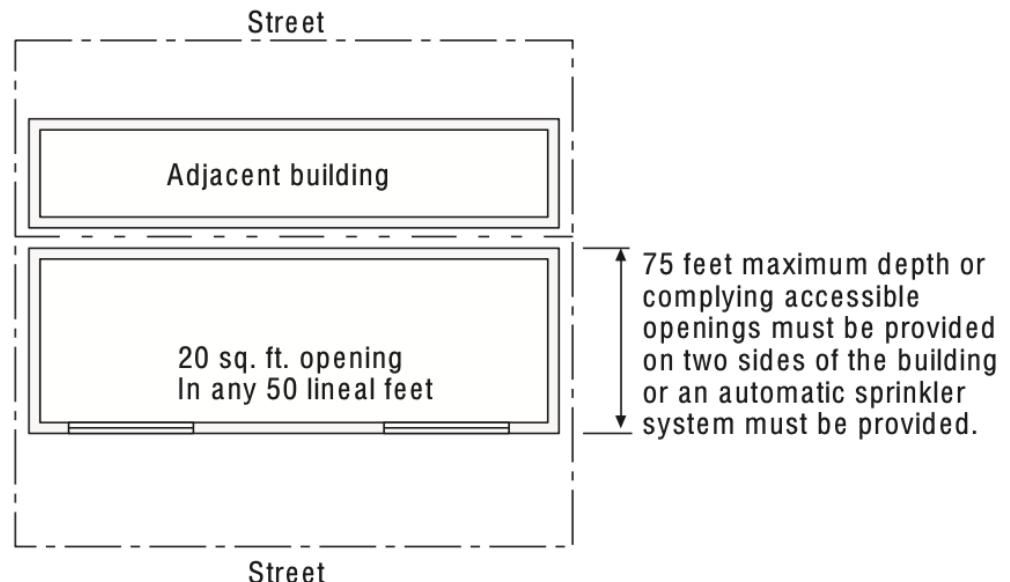
vehicles where the *fire area* exceeds 5,000 square feet (464 m^2).

903.2.11.1, Fire Department Access



Required exterior opening:

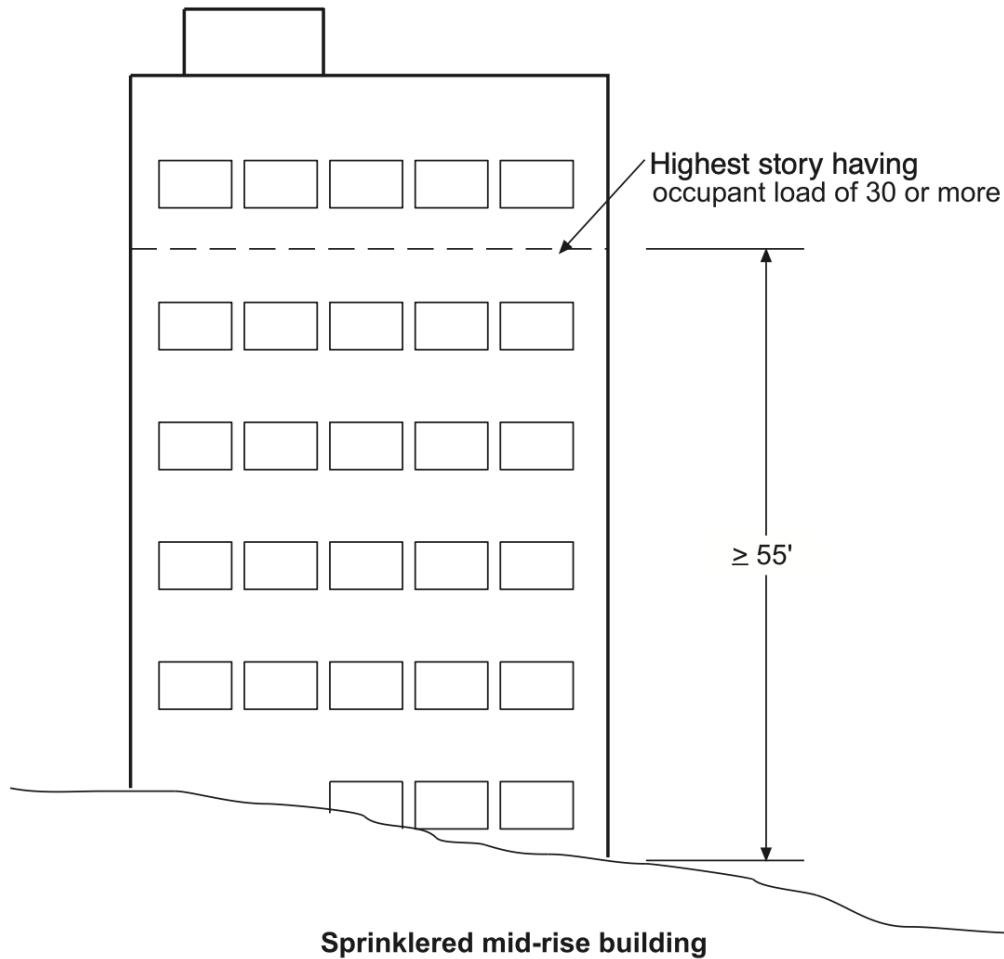
1. Twenty square feet of opening in any 50 lineal feet or fraction thereof.
2. Minimum dimension of 30 inches.
3. Accessible to the fire department from the exterior.
4. Cannot be obstructed in a manner that prevents firefighting or rescue from the exterior.



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

If complying openings are provided on two or more sides of the building, or if an exterior wall is less than 75 feet from an opposing exterior wall provided with complying openings, then an automatic sprinkler system is not required by this provision.

903.2.11.3, Buildings Over 55 ft in Height



For SI: 1 foot = 304.8 mm.

Low-hazard manufacturing facilities are exempt from the sprinkler requirement due to their lack of combustible contents.

Source: 2021 IBC

905.3, Required Installations



Source: 2021 IBC

905.3, Required Installations

REQUIRED STANDPIPE INSTALLATIONS

LOCATION OR USE	NONSPRINKLERED BUILDING	SPRINKLERED BUILDING
Buildings of 4 or more stories above grade plane or with floor level of the highest story located at more than 30 feet above lowest level of fire department vehicle access	Class III ^{1,2,5,6}	Class I
Buildings of 4 or more stories below grade plane or with floor level of the lowest story located at more than 30 feet below highest level of fire department vehicle access	Class III ^{1,2,5,6}	Class I
Group A occupancies with occupant load exceeding 1,000	Class I ⁴	No requirement
Covered mall buildings	—	Class I
Stages more than 1,000 square feet	Class III	Class III ⁵
Underground buildings	—	Class I

1 Class I standpipes permitted in basements equipped with automatic sprinkler system
2 Class I standpipes permitted in parking garages
3 Not required in open-air seating spaces without enclosed spaces
4 Hose connections permitted to be supplied by sprinkler system
5 Class I standpipes permitted in Groups B and E
6 Class I standpipes permitted in buildings where occupant-use hose lines will not be utilized by trained personnel or the fire department

Fire hose cabinets in which hoses are attached to outlets on Class II standpipes (as well as the use of portable fire extinguishers) are provided as a means by which the building occupants can control the fire prior to either sprinkler activation or fire personnel arrival.

Source: 2021 IBC

905.3, Required Installations

SECTION 905 STANDPIPE SYSTEMS

[F] 905.1 General. Standpipe systems shall be provided in new buildings and structures in accordance with Sections 905.2 through 905.11. In buildings used for high-piled combustible storage, fire protection shall be in accordance with the *International Fire Code*.

[F] 905.2 Installation standard. Standpipe systems shall be installed in accordance with this section and NFPA 14. Fire department connections for standpipe systems shall be in accordance with Section 912.

[F] 905.5 Location of Class II standpipe hose connections. Class II standpipe hose connections located so that all portions of the building are within 30 feet (9144 mm) of a nozzle attached to 100 feet (30 480 mm) of hose. Class II standpipe hose connections shall be located where they will have *ready access*.

[F] 905.5.1 Groups A-1 and A-2. In Group A-1 and A-2 occupancies having *occupant loads* exceeding 1,000 persons, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony and on each tier of dressing rooms.

[F] 905.5.2 Protection. Fire-resistance-rated protection of risers and laterals of Class II standpipe systems is not required.

[F] 905.5.3 Class II system 1-inch hose. A minimum 1-inch (25 mm) hose shall be allowed to be used for hose stations in light-hazard occupancies where investigated and *listed* for this service and where *approved* by the fire code official.

905.3, Required Installations

- . Connections for Class II standpipe systems shall be located so that all portions of the building are within _____ feet of a nozzle attached to _____ feet of hose.
- a. 20, 50
 - b. 30, 100
 - c. 40, 125
 - d. 40, 150

905.3, Required Installations

- . Connections for Class II standpipe systems shall be located so that all portions of the building are within _____ feet of a nozzle attached to _____ feet of hose.
- a. 20, 50
 - b. 30, 100
 - c. 40, 125
 - d. 40, 150

interconnected in accordance with NFPA 14.

[F] 905.5 Location of Class II standpipe hose connections.

Class II standpipe hose connections located so that all portions of the building are within 30 feet (9144 mm) of a nozzle attached to 100 feet (30 480 mm) of hose. Class II standpipe hose connections shall be located where they will have *ready access*.

[F] 905.5.1 Groups A-1 and A-2. In Group A-1 and A-2 occupancies having *occupant loads* exceeding 1,000 persons, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony and on each tier of dressing rooms.

[F] 905.5.2 Protection. Fire-resistance-rated protection of risers and laterals of Class II standpipe systems is not required.

[F] 905.5.3 Class II system 1-inch hose. A minimum 1-inch (25 mm) hose shall be allowed to be used for hose stations in light-hazard occupancies where investigated and *listed* for this service and where *approved* by the fire code official.

906.1, Where Required



In addition to portable fire extinguishers, many of the other fire protection components and systems found in the IBC are also replicated directly from the *International Fire Code* (IFC). IFC provisions addressing automatic sprinkler systems, standpipe systems, fire alarm systems, smoke and heat vents, fire pumps and emergency responder safety features are also inserted into the IBC to provide for greater convenience to the code user.

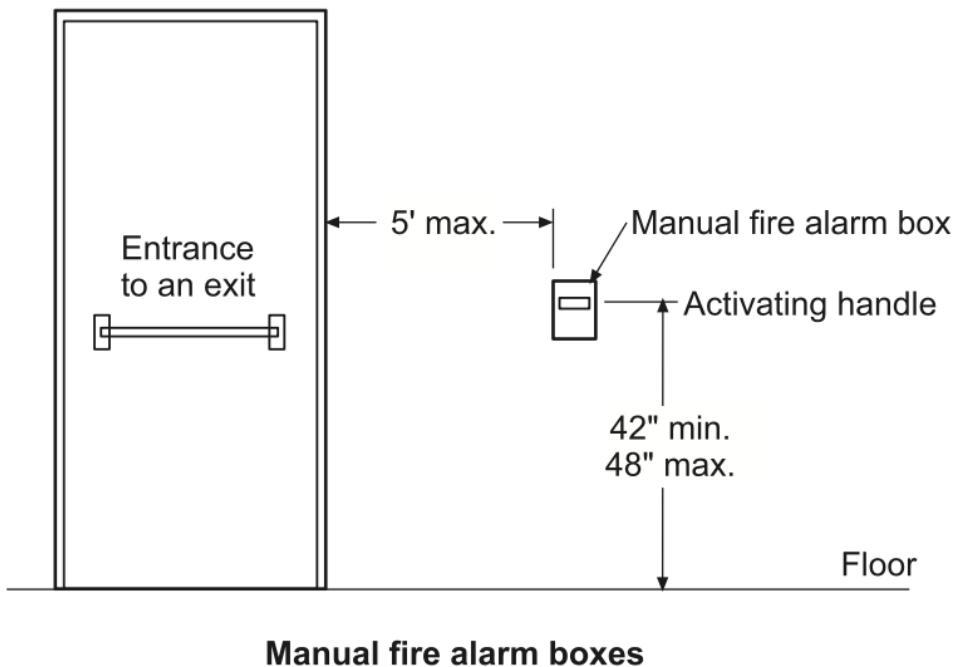
907.2, Where Required



Audible alarm notification appliances are to be provided and shall create a distinctive sound that is used for no other purpose. Visual alarm notification appliances are also required, to varying degrees, in public and common areas, employee work areas, and Group I-1, R-1 and R-2 occupancies.

Source: 2021 IBC

907.4.2, Where Required



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

Where a manual fire alarm system is required, manual fire alarm boxes (pull stations) must be installed. However, in some occupancies the code permits the elimination of such boxes if water flow in an automatic sprinkler system installed throughout the building activates the notification appliances.

907.4.2, Where Required

Manual fire alarm boxes, where required, shall be located a maximum of _____ feet from the entrance to each exit.

-
- a. 5
 - b. 10
 - c. 12
 - d. 20

907.4.2, Where Required

Manual fire alarm boxes, where required, shall be located a maximum of _____ feet from the entrance to each exit.

- a. 5
- b. 10
- c. 12
- d. 20

[F] 907.4.2.1 Location. Manual fire alarm boxes shall be located not more than 5 feet (1524 mm) from the entrance to each *exit*. In buildings not protected by an *automatic sprinkler system* in accordance with Section 903.3.1.1 or 903.3.1.2, additional manual fire alarm boxes shall be located so that the distance of travel to the nearest box does not exceed 200 feet (60 960 mm).

TABLE 907.5.2.3.2

[F] TABLE 907.5.2.3.2
VISIBLE ALARMS

NUMBER OF SLEEPING UNITS	SLEEPING ACCOMMODATIONS WITH VISIBLE ALARMS
6 to 25	2
26 to 50	4
51 to 75	7
76 to 100	9
101 to 150	12
151 to 200	14
201 to 300	17
301 to 400	20
401 to 500	22
501 to 1,000	5% of total
1,001 and over	50 plus 3 for each 100 over 1,000

TABLE 907.5.2.3.2

In a Group R-1 hotel providing 220 sleeping units, a minimum of _____ such units shall be provided with visible alarm notification devices.

- a. 3
- b. 11
- c. 17
- d. 22

TABLE 907.5.2.3.2

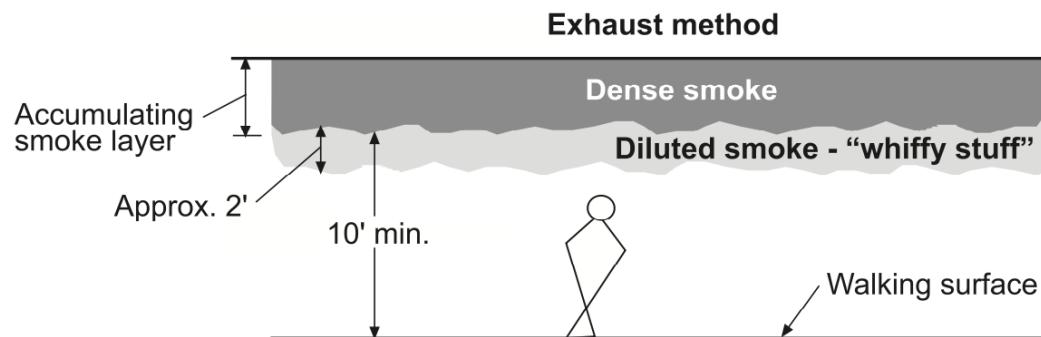
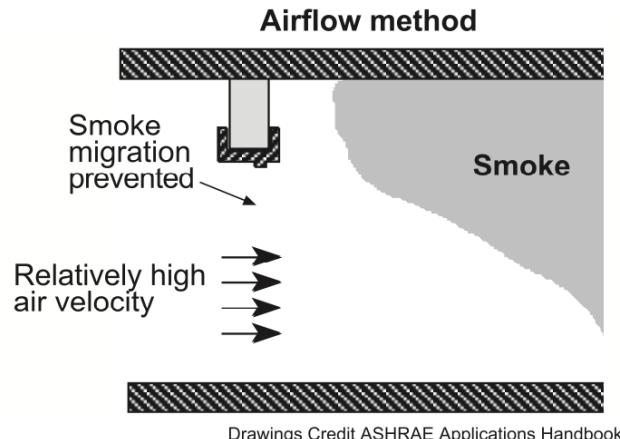
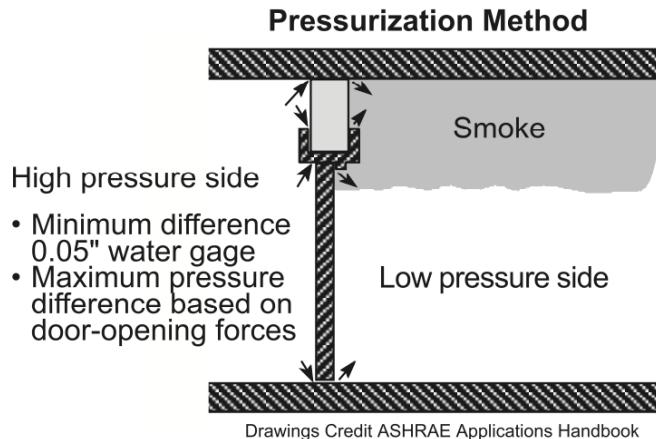
In a Group R-1 hotel providing 220 sleeping units, a minimum of _____ such units shall be provided with visible alarm notification devices.

- a. 3
- b. 11
- c. 17
- d. 22

[F] TABLE 907.5.2.3.2
VISIBLE ALARMS

NUMBER OF SLEEPING UNITS	SLEEPING ACCOMMODATIONS WITH VISIBLE ALARMS
6 to 25	2
26 to 50	4
51 to 75	7
76 to 100	9
101 to 150	12
151 to 200	14
201 to 300	17
301 to 400	20
401 to 500	22
501 to 1,000	5% of total
1,001 and over	50 plus 3 for each 100 over 1,000

909.1, Scope

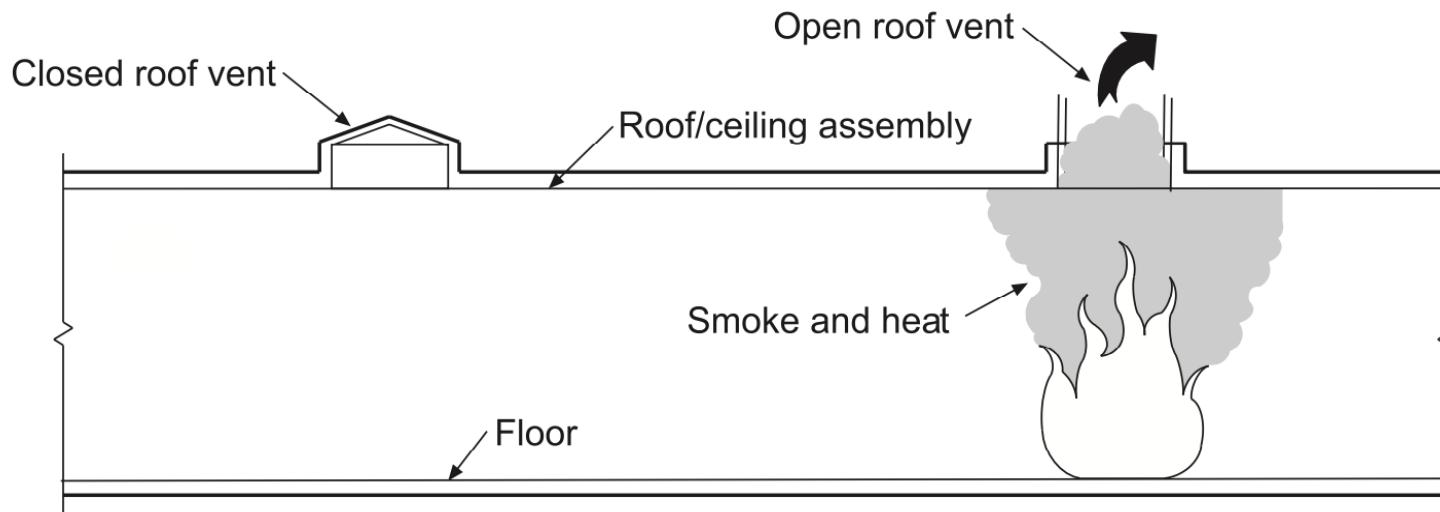


For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Three methods of mechanical smoke control are addressed: pressurization, airflow and exhaust. Pressure differences across smoke barriers shall be the primary means of smoke control. The building official may accept the airflow or exhaust methods in specific situations.

Source: 2021 IBC

910.2, 910.3.5 Where Required



Note: In general, several small vents are more effective than a larger vent of equal area.

Roof vents

A mechanical smoke exhaust system is also permitted to ventilate the building as an alternative to smoke and heat vents. In addition to other conditions of acceptance, the exhaust fans in such a system are regulated for size, location, operation, wiring, control, supply air and interlocks.

910.2, 910.3.5 Where Required

Other than for an aircraft repair hangar, a one-story Group S-1 occupancy shall be provided with smoke and heat vents or a mechanical smoke removal system where it exceeds _____ square feet in undivided area.

- a. 8,000
- b. 10,000
- c. 15,000
- d. 50,000

910.2, 910.3.5 Where Required

Other than for an aircraft repair hangar, a one-story Group S-1 occupancy shall be provided with smoke and heat vents or a mechanical smoke removal system where it exceeds _____ square feet in undivided area.

- a. 8,000
- b. 10,000
- c. 15,000
- d. 50,000

910.2.1 Group F-1 or S-1. Smoke and heat vents installed in accordance with Section 910.3 or a mechanical smoke removal system installed in accordance with Section 910.4 shall be installed in buildings and portions thereof used as a Group F-1 or S-1 occupancy having more than 50,000 square feet (4645 m^2) of undivided area. In occupied portions of a building equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1 where the upper surface of the *story* is not a roof assembly, a mechanical smoke removal system in accordance with Section 910.4 shall be installed.

Exception: Group S-1 aircraft repair hangars.

915 Carbon Monoxide Detection

SECTION 915 CARBON MONOXIDE DETECTION

[F] 915.1 General. Carbon monoxide detection shall be installed in new buildings in accordance with Sections 915.1.1 through 915.6. Carbon monoxide detection shall be installed in existing buildings in accordance with Chapter 11 of the *International Fire Code*.

[F] 915.1.1 Where required. Carbon monoxide detection shall be provided in Group I-1, I-2, I-4 and R occupancies and in classrooms in Group E occupancies in the locations specified in Section 915.2 where any of the conditions in Sections 915.1.2 through 915.1.6 exist.

[F] 915.1.2 Fuel-burning appliances and fuel-burning fireplaces. Carbon monoxide detection shall be provided in *dwelling units*, *sleeping units* and classrooms that contain a fuel-burning appliance or a fuel-burning fireplace.

[F] 915.1.3 Fuel burning, forced-air furnaces. Carbon monoxide detection shall be provided in dwelling units, sleeping units and classrooms served by a fuel-burning, forced-air furnace.

Exception: Carbon monoxide detection shall not be required in *dwelling units*, *sleeping units* and classrooms if a carbon monoxide detector is provided in the first room or area served by each main duct leaving the furnace, and the carbon monoxide alarm signals are automatically transmitted to an approved location.

sleeping units and classrooms located in buildings that contain fuel-burning appliances or fuel-burning fireplaces.

Exceptions:

1. Carbon monoxide detection shall not be required in *dwelling units*, *sleeping units* and classrooms without communicating openings between the fuel-burning appliance or fuel-burning fireplace and the *dwelling unit*, *sleeping unit* or classroom.
2. Carbon monoxide detection shall not be required in *dwelling units*, *sleeping units* and classrooms where a carbon monoxide detector is provided in one of the following locations:
 - 2.1. In an *approved* location between the fuel-burning appliance or fuel-burning fireplace and the *dwelling unit*, *sleeping unit* or classroom.
 - 2.2. On the ceiling of the room containing the fuel-burning appliance or fuel-burning fireplace.

[F] 915.1.5 Private garages. Carbon monoxide detection shall be provided in *dwelling units*, *sleeping units* and classrooms in buildings with attached *private garages*.

Exceptions:

1. Carbon monoxide detection shall not be required in dwelling units, sleeping units and classrooms without communicating openings between the *private garage* and the *dwelling unit*, *sleeping unit* or classroom.
2. Carbon monoxide detection shall not be required in *dwelling units*, *sleeping units* and classrooms located more than one story above or below a *private garage*.
3. Carbon monoxide detection shall not be required where the *private garage* connects to the building through an *open-ended corridor*.
4. Where a carbon monoxide detector is provided in an *approved* location between openings to a *private garage* and *dwelling units*, *sleeping units* or classrooms.

[F] 915.1.6 Exempt garages. For determining compliance with Section 915.1.5, an *open parking garage* complying with Section 406.5 or an enclosed parking garage complying with Section 406.6 shall not be considered a *private garage*.

[F] 915.2 Locations. Where required by Section 915.1.1, carbon monoxide detection shall be installed in the locations specified in Sections 915.2.1 through 915.2.3.

[F] 915.2.1 Dwelling units. Carbon monoxide detection shall be installed in *dwelling units* outside of each separate sleeping area in the immediate vicinity of the bedrooms. Where a fuel-burning appliance is located within a bedroom or its attached bathroom, carbon monoxide detection shall be installed within the bedroom.

[F] 915.2.2 Sleeping units. Carbon monoxide detection shall be installed in *sleeping units*.

Exception: Carbon monoxide detection shall be allowed to be installed outside of each separate sleeping area in the immediate vicinity of the *sleeping unit* where the *sleeping unit* or its attached bathroom does not contain a fuel-burning appliance and is not served by a forced air furnace.

[F] 915.2.3 Group E occupancies. Carbon monoxide detectors shall be installed in classrooms in Group E occupancies. Carbon monoxide alarm signals shall be automatically transmitted to an on-site location that is staffed by school personnel.

Exception: Carbon monoxide alarm signals shall not be required to be automatically transmitted to an on-site location that is staffed by school personnel in Group E occupancies with an *occupant load* of 30 or less.

[F] 915.3 Carbon monoxide detection. Carbon monoxide detection required by Sections 915.1 through 915.2.3 shall be provided by carbon monoxide alarms complying with Section 915.4 or carbon monoxide detection systems complying with Section 915.5.

[F] 915.4 Carbon monoxide alarms. Carbon monoxide alarms shall comply with Sections 915.4.1 through 915.4.4.

[F] 915.4.1 Power source. Carbon monoxide alarms shall receive their primary power from the building wiring where such wiring is served from a commercial source, and when primary power is interrupted, shall receive power from a battery. Wiring shall be permanent and without a disconnecting switch other than that required for overcurrent protection.

Exception: Where installed in buildings without commercial power, battery-powered carbon monoxide alarms shall be an acceptable alternative.

[F] 915.4.2 Listings. Carbon monoxide alarms shall be listed in accordance with UL 2034.

[F] 915.4.3 Locations. Carbon monoxide alarms shall only be installed in *dwelling units* and in *sleeping units*. They shall not be installed in locations where the code requires carbon monoxide detectors to be used.

[F] 915.4.4 Combination alarms. Combination carbon monoxide/smoke alarms shall be an acceptable alternative to carbon monoxide alarms. Combination carbon monoxide/smoke alarms shall be listed in accordance with UL 217 and UL 2034.

[F] 915.5 Carbon monoxide detection systems. Carbon monoxide detection systems shall be an acceptable alternative to carbon monoxide alarms and shall comply with Sections 915.5.1 through 915.5.3.

[F] 915.5.1 General. Carbon monoxide detection systems shall comply with NFPA 720. Carbon monoxide detectors shall be listed in accordance with UL 2075.

[F] 915.5.2 Locations. Carbon monoxide detectors shall be installed in the locations specified in Section 915.2.

915 Carbon Monoxide Detection

Carbon monoxide detection, when required, shall be provided in all but which one of the following locations?

- a. Group E classrooms
- b. Group I-1 group home sleeping units
- c. Group I-3 housing units
- d. Group R-1 sleeping units

915 Carbon Monoxide Detection

Carbon monoxide detection, when required, shall be provided in all but which one of the following locations?

- a. Group E classrooms
- b. Group I-1 group home sleeping units
- c. Group I-3 housing units
- d. Group R-1 sleeping units

SECTION 915 CARBON MONOXIDE DETECTION

[F] 915.1 General. Carbon monoxide detection shall be installed in new buildings in accordance with Sections 915.1.1 through 915.6. Carbon monoxide detection shall be installed in existing buildings in accordance with Chapter 11 of the *International Fire Code*.

[F] 915.1.1 Where required. Carbon monoxide detection shall be provided in Group I-1, I-2, I-4 and R occupancies and in classrooms in Group E occupancies in the locations specified in Section 915.2 where any of the conditions in Sections 915.1.2 through 915.1.6 exist.

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Exception: Carbon monoxide detection shall not be required in *dwelling units*, *sleeping units* and classrooms if a carbon monoxide detector is provided in the first room or area served by each main duct leaving the furnace, and the carbon monoxide alarm signals are automatically transmitted to an approved location.

**Class 9:
Chapter 10, Sections 1001
through 1005, 1008, 1009, 1013
and 1015**

1001 Objective

- To obtain an understanding of the general system design requirements of a means of egress system, including the determination of occupant load, the required width and capacity of egress components, means of egress identification and illumination, accessible means of egress and the provisions regulating guards.

What is egress

<https://ccpia.org/what-is-a-means-of-egress/>

YouTube: <https://www.youtube.com/watch?v=idPJ1mdMQAY>

Chapter Overview

CHAPTER 10 MEANS OF EGRESS10-1

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Exit Access
Exit
Exit Discharge
Special Attention

What is egress

CHAPTER 10

1001: BUILDINGS OR PORTIONS THEREOF SHALL BE PROVIDED WITH A MEANS OF EGRESS SYSTEM AS REQUIRED BY THIS CODE. THE PROVISIONS OF THIS CHAPTER CONTROL THE DESIGN, CONSTRUCTION AND ARRANGEMENT OF THE MEANS OF EGRESS COMPONENTS REQUIRED TO PROVIDE AN APPROVED MEANS OF EGRESS FROM STRUCTURES AND PORTIONS THEREOF.



THESE SECTIONS
APPLY TO: ALL
THREE COMPONENTS



- 1003: 1) EXIT ACCESS.
2) EXIT.
3) EXIT DISCHARGE.

1004 - OCC. LOAD
1005 - MEANS OF EGRESS SIZING
1006 - NUMBER OF EXITS AND EXIT
ACCESS DOORWAYS.

1007 - EXIT AND EXIT ACCESS
DOORWAY CONFIG.

1008 - MEANS OF EGRESS
ILLUMINATION.

1009 - ACCESSIBLE MEANS OF EGRESS.
1010 - DOORS, GATES AND TURNSTILES.

1011 - STAIRWAYS

1012 - RAMPS

1013 - EXIT SIGNS

1014 - HANDRAILS

1015 - GUARDS



THESE SECTIONS
APPLY TO:
EXIT ACCESS



- 1016 - EXIT ACCESS
1017 - EXIT ACCESS TRAVEL DISTANCE
1018 - AISLES
1019 - EXIT ACCESS STAIRWAYS AND RAMPS.
1020 - CORRIDORS
1021 - BALCONIES

THESE SECTIONS
APPLY TO:
EXIT



- 1022 - EXITS
1023 - INTERIOR EXIT STAIRWAYS & RAMPS.
1024 - EXIT PASSAGeways
1025 - LUMINOUS EGRESS PATH MARKINGS.
1026 - HORIZONTAL EXITS
1027 - EXTERIOR EXIT STAIRWAYS AND RAMPS

THESE SECTIONS
APPLY TO:
EXIT DISCHARGE



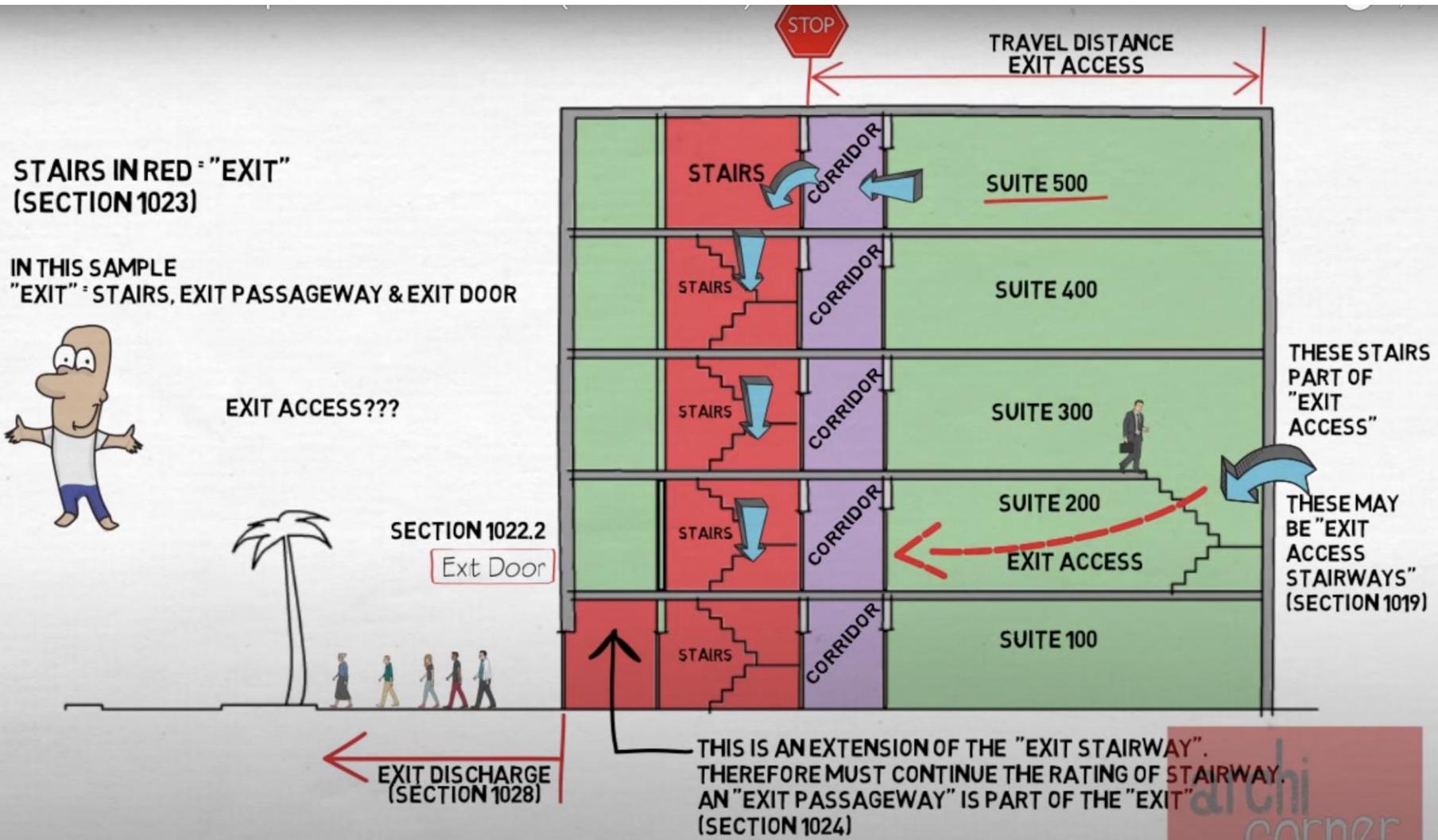
- 1028 - EXIT DISCHARGE

SPECIAL ATTENTION:

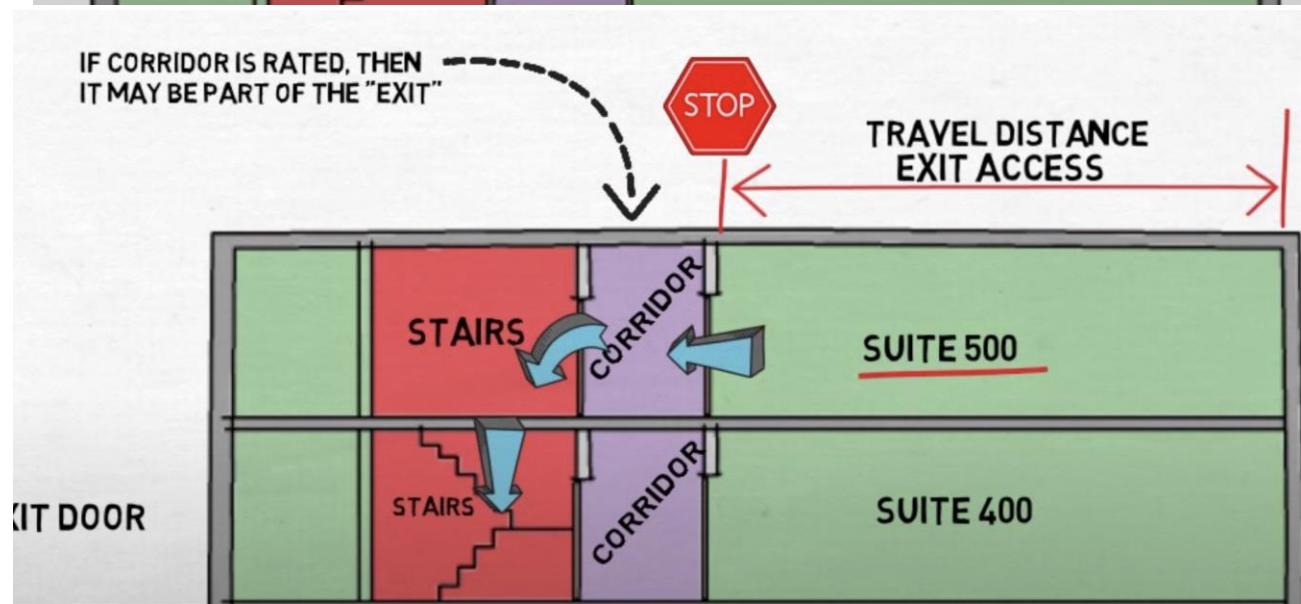
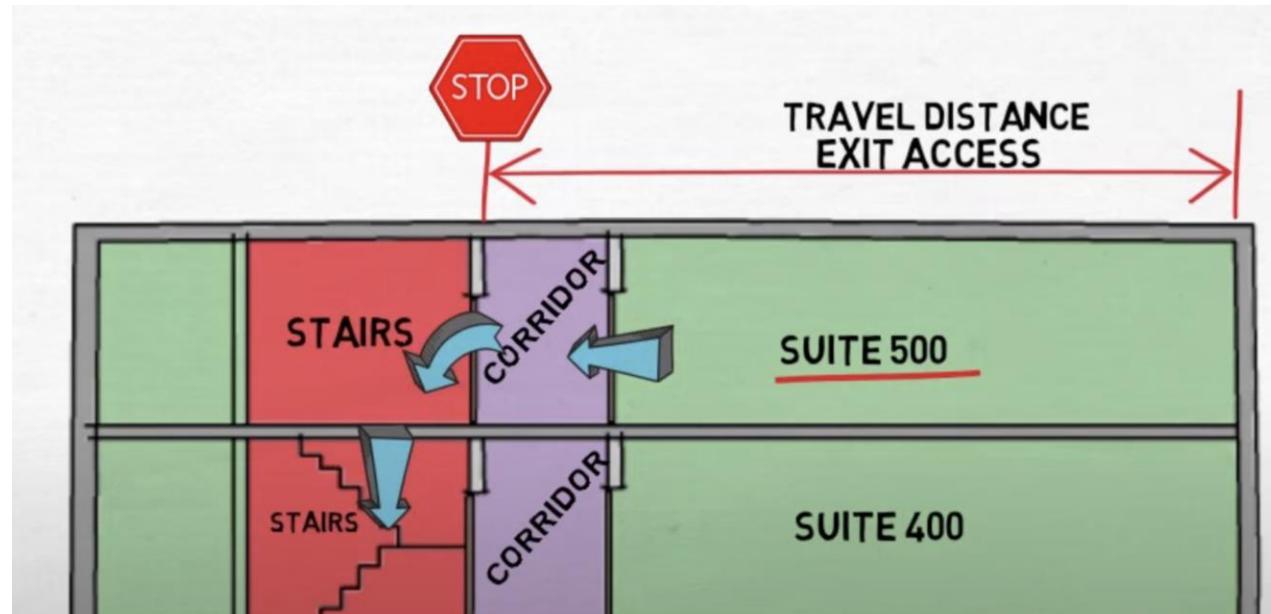
- 1029 - ASSEMBLY
1030 - EMERGENCY ESCAPE
AND RESCUE

archi
corner

What is egress



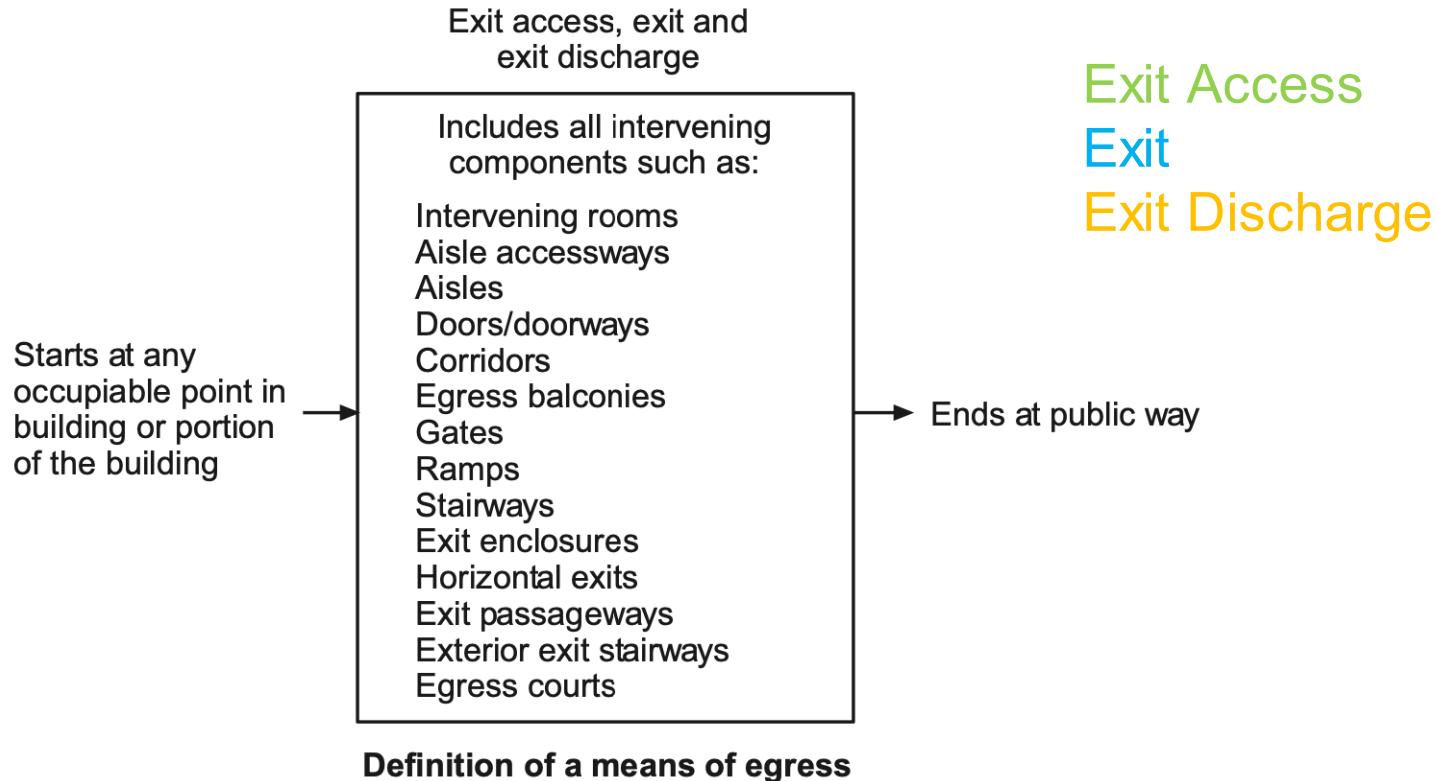
What is exit access vs exit



1001.1 General

- Buildings or portions thereof shall be provided with a means of egress system as required by Chapter 10. The provisions of Chapter 10 shall control the design, construction and arrangement of means of egress components required to provide an approved means of egress from structures and portions thereof.
- The International Building Code regulates the design, construction and maintenance of an exiting system through two general categories—system design and egress components. Any building elements that are a part of the system must be reviewed for compliance with the criteria for the number, location, width or capacity, height, continuity and arrangement of egress components, and all other applicable provisions.

1001.1 General

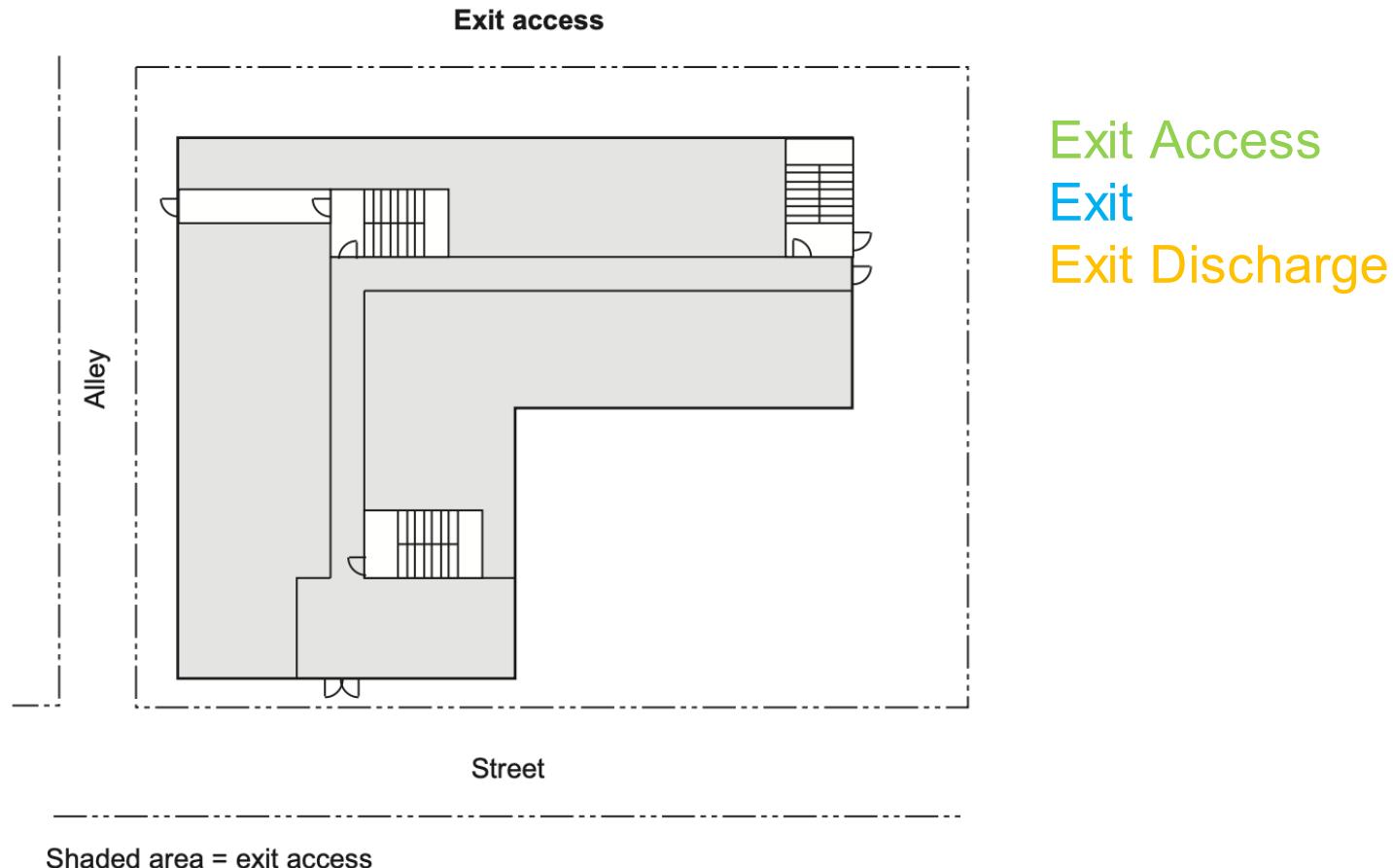


Building components along the path of egress travel might include aisle accessways, aisles, doors or doorways, intervening rooms, gates, corridors, ramps, exit access stairways, interior exit stairways, exit passageways, horizontal exits, exterior balconies, exterior exit stairways and egress courts.

1003.1, 202 Three-Part Egress System

- A means of egress is a continuous and unobstructed path of vertical and horizontal egress travel from any occupied portion of a building or structure to a public way. A means of egress consists of three separate and distinct parts: the exit access, the exit, and the exit discharge.
- The exit access begins at any occupied location within the building and does not end until it reaches the door to an interior exit stairway or ramp, a horizontal exit or exit passageway, an exterior exit stairway or ramp, or an exterior exit door at the level of exit discharge. Travel distance is regulated throughout the exit access, and the path of travel is seldom a fire-protected environment. At the exit discharge, which begins where the exit ends, egress remains regulated until the public way is reached.

1003.1, 202 Three-Part Egress System



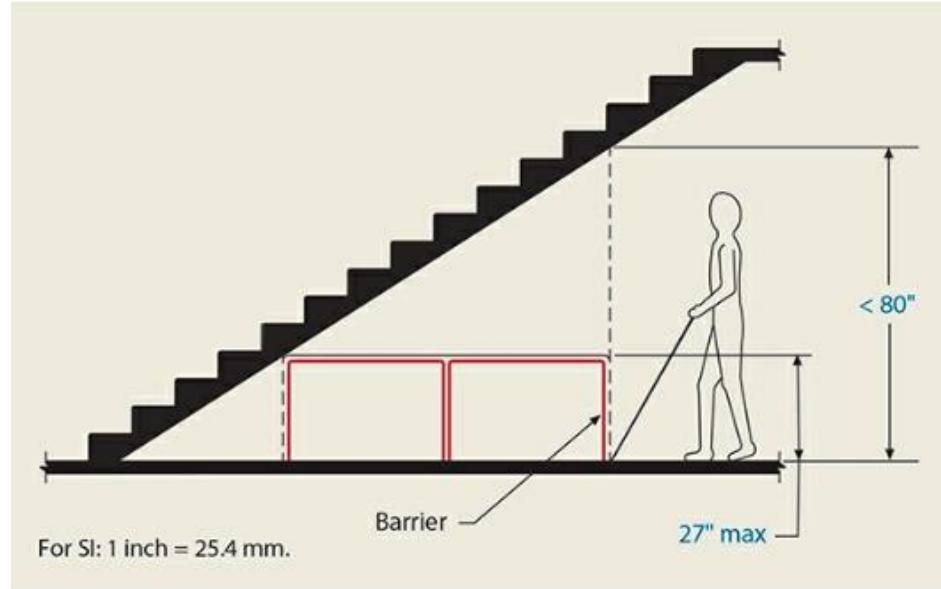
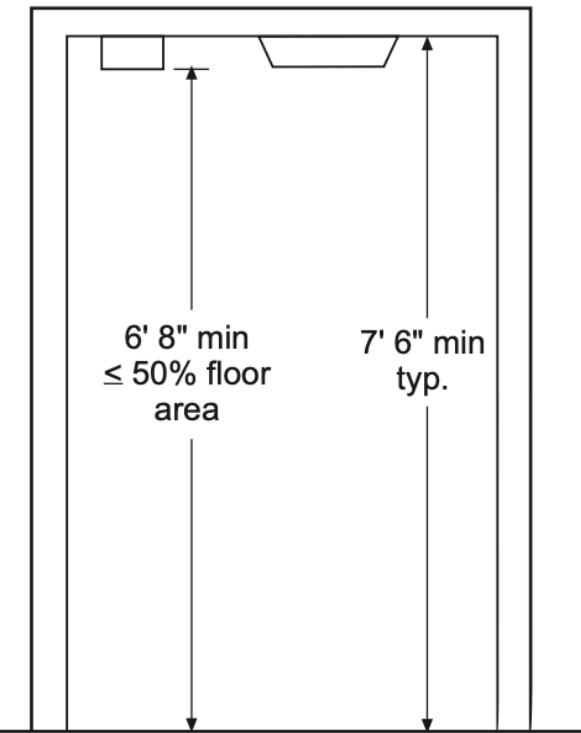
An exit provides a protected path of travel to an exit discharge. Because an exit component affords protection, travel distance is no longer a concern once the exit has been reached. Exit discharge travel distance to the public way is also unlimited.

Source: 2021 IBC

1003.2, Ceiling Height

- The means of egress shall have a ceiling height of not less than 7 feet 6 inches (2286 mm) above the finished floor. See the exceptions for sloped ceilings, ceilings of dwelling units and sleeping units, allowable projections, stair and ramp headroom, door height, mezzanines and parking garages.
- In addition to providing a travel path of adequate width, the code requires that the clear height of the means of egress be maintained at least 7 1/2 feet above the walking surface. There are several exceptions to this general requirement that permit limited reductions in the mandated height. Under most conditions, the vertical clearance at a stairway or doorway may be reduced to 80 inches. Protruding objects, such as sprinklers and light fixtures, are also permitted to extend below the minimum required ceiling height for up to 50 percent of ceiling area of the means of egress, provided such objects maintain a headroom clearance of at least 80 inches. Special provisions are applicable to sloped ceilings.

1003.2, Ceiling Height



03-2 Reduced vertical clearance.

Corridor, aisle, passageway or any walking surface along egress of path travel

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

The minimum ceiling heights established for environmental concerns are addressed in Section 1208.2. Habitable spaces, such as bedrooms and living rooms in residential occupancies, occupiable spaces and corridors must be at least 7 feet 6 inches in height. In other areas, reduced headroom is permitted.

Source: 2021 IBC

1003.2, Ceiling Height

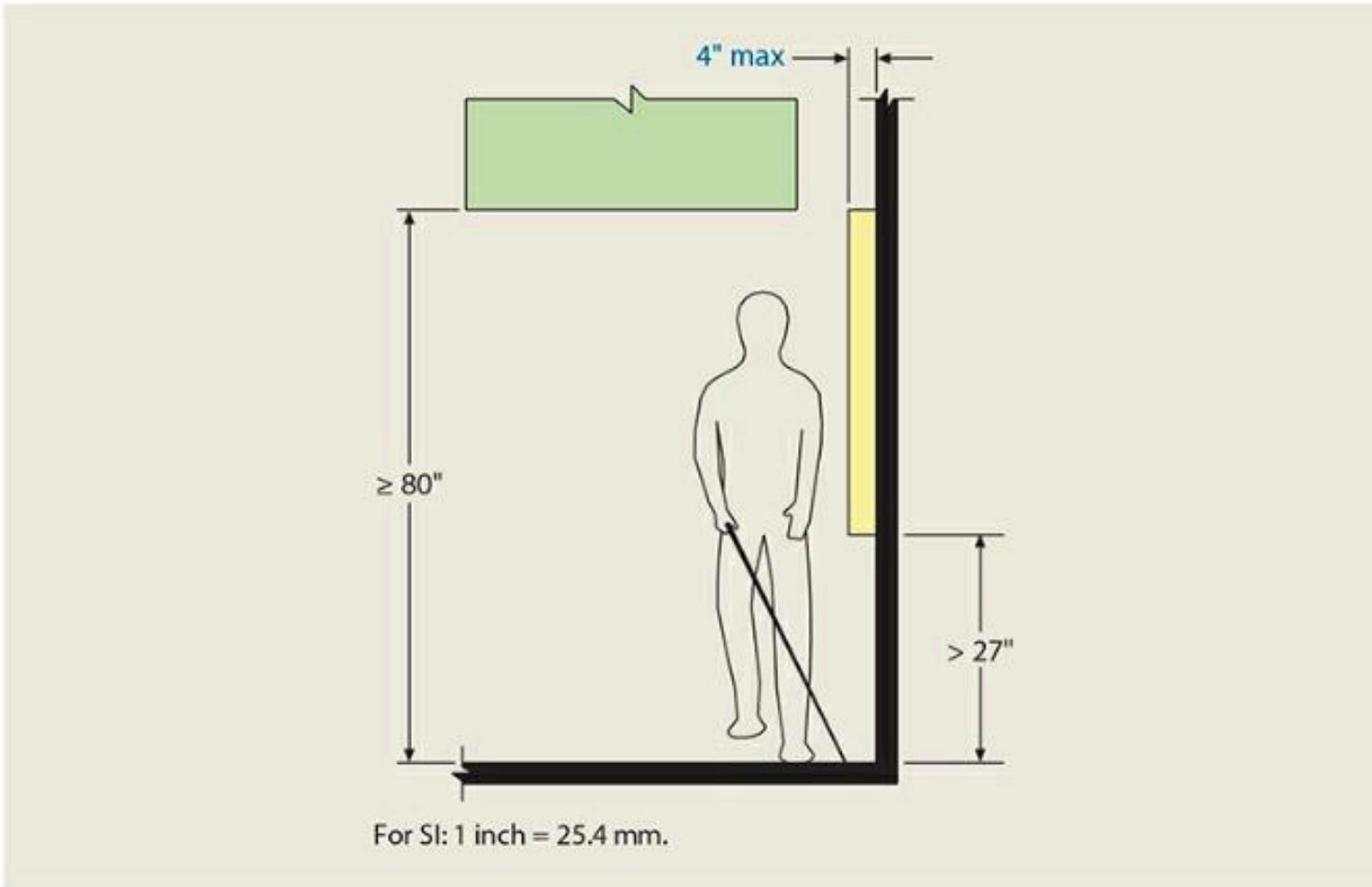


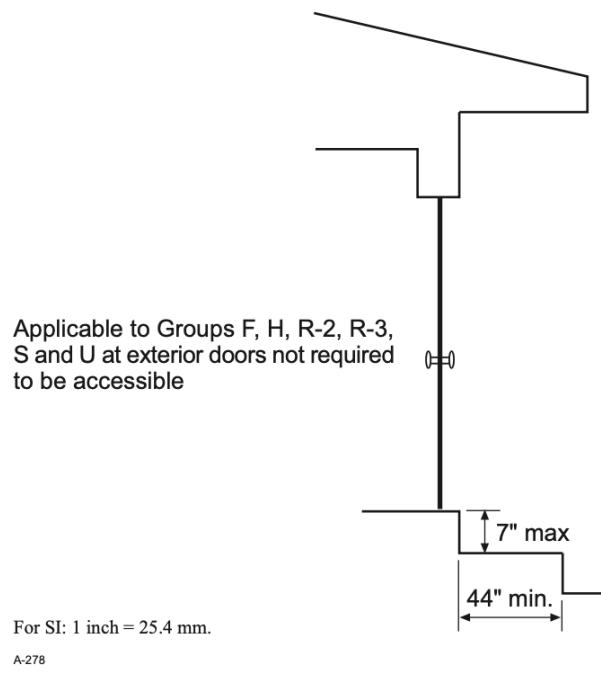
Figure 1003-4 **Limits of protruding objects.**

Source: 2021 IBC

1003.5, Ceiling Height

- Where changes in elevation of less than 12 inches (305 mm) exist in the means of egress, sloped surfaces shall be used. Where the slope is greater than 1 unit vertical in 20 units horizontal (5-percent slope), ramps complying with Section 1012 shall be used. Where the difference in elevation is 6 inches (152 mm) or less, the ramp shall be equipped with either handrails or floor finish materials that contrast with adjacent floor finish materials. See the exceptions for (1) a single 7-inch maximum step in Groups F, H, R-2, R-3, S and U; (2) a stair with one or two risers with a handrail provided; and (3) steps at exterior doors that comply with Section 1010.1.4 (Floor elevation).
- Along the egress path, there is a concern about slight changes in elevation that are not readily apparent to persons seeking to exit under emergency conditions. Therefore, a single riser or a pair of shallow risers is not permitted. Steps used to achieve minor differences in elevation frequently go unnoticed, and as such, can cause accidents.

1003.5, Ceiling Height



Section 1010.1.4, Exc. 2

The limitation on elevation changes does not apply to specific situations where accessibility is not required. Section 1010.1.4, Exception 2 permits a maximum 7-inch step at exterior doors of Groups F, H, R-2, R-3, S and U. In addition, one or two complying steps are allowed when an additional handrail is provided.

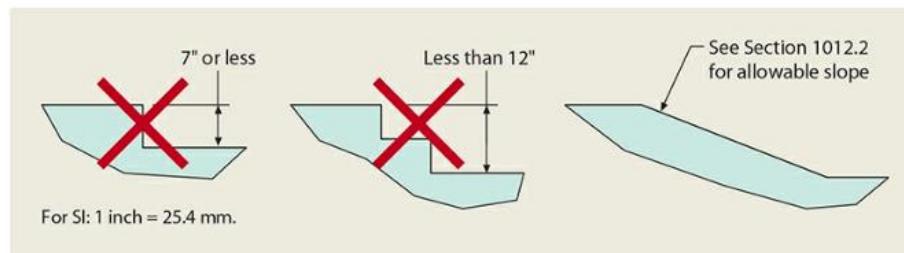


Figure 1003-5 Longitudinal section through corridor or other exit path.

1004.1, 1004.5 Design Occupant Load

- In determining means of egress requirements, the number of occupants for whom means of egress facilities shall be provided shall be determined in accordance with Section 1004. The number of occupants shall be computed at the rate of one occupant per unit of area as prescribed in Table 1004.5. For areas without fixed seating, the occupant load shall not be less than that number determined by dividing the floor area under consideration by the occupant load factor assigned to the function of the space as set forth in Table 1004.5. See the exception where the building official is authorized to reduce occupant load below that calculated.
- For occupant load determination, it must be assumed that under normal conditions all portions of a building are fully occupied at the same time. The density characteristics of the various uses identified in Table 1004.5 are considered “occupant load factors.” For most occupancies, the gross floor area is to be considered. However, a few of the occupant load factors are based on net floor area, which allows the deduction of areas such as corridors, stairways, toilet rooms, equipment rooms and closets.

1004.1, 1004.5 Design Occupant Load

**TABLE 1004.5
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT**

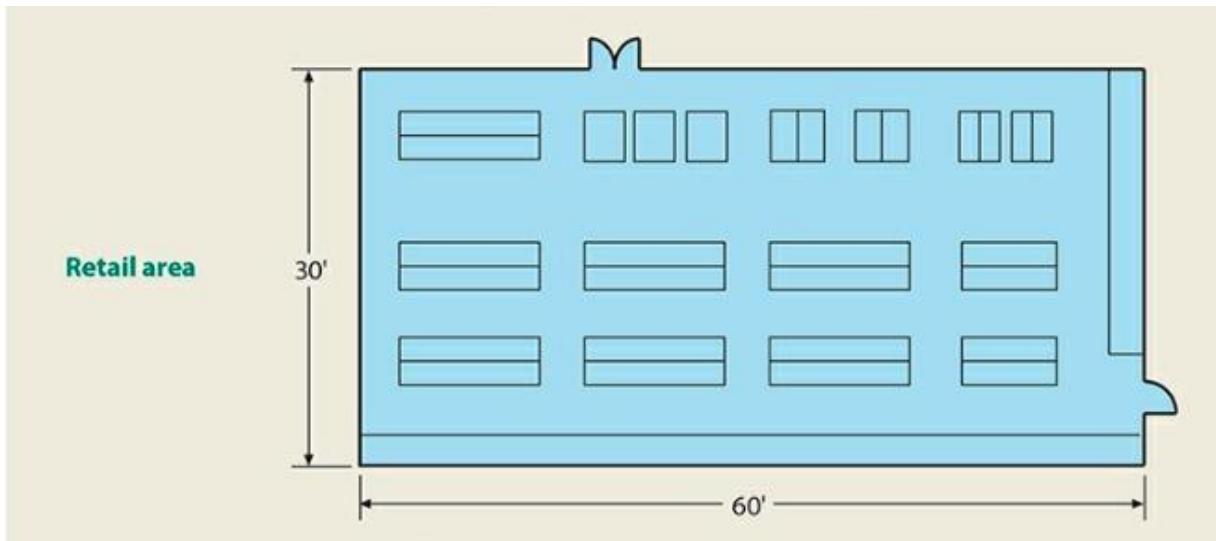
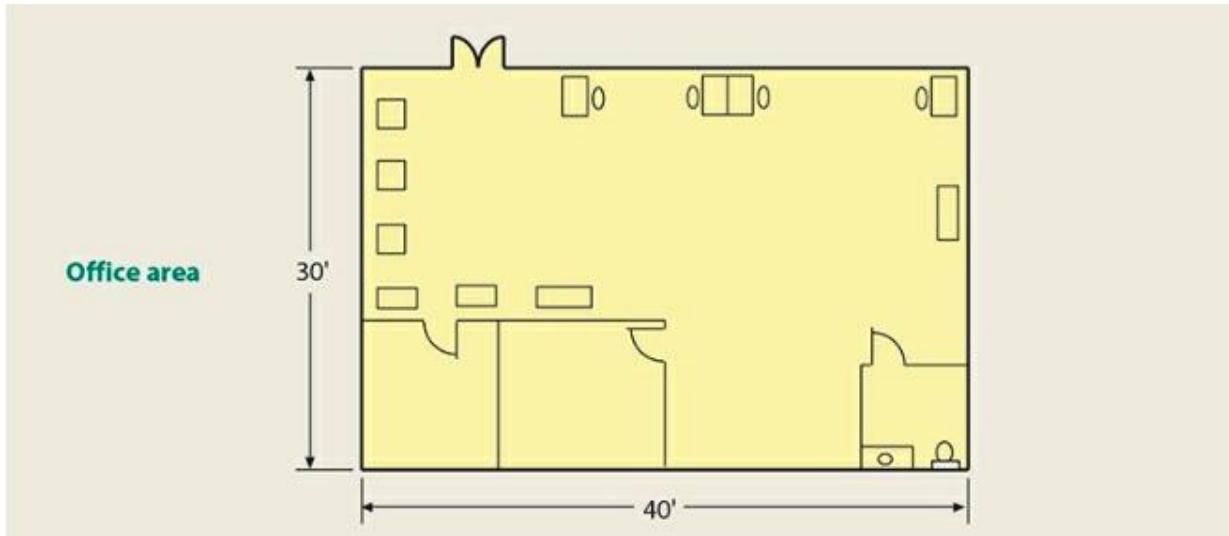
FUNCTION OF SPACE	OCCUPANT LOAD FACTOR ^a
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit gallery and museum	30 net
Assembly with fixed seats	See Section 1004.6
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	150 gross
Concentrated business use areas	See Section 1004.8
Courtdoms—other than fixed seating areas	40 net
Day care	35 net
Dormitories	50 gross
Educational	

Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
Group H-5 fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mall buildings—covered and open	See Section 402.8.2
Mercantile	60 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

a. Floor area in square feet per occupant.

1004.1, 1004.5 Design Occupant Load



Source: 2021 IBC

1004.1, 1004.5 Design Occupant Load

**TABLE 1004.5
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a. Floor area in square feet per occupant.

1004.1, 1004.5 Design Occupant Load

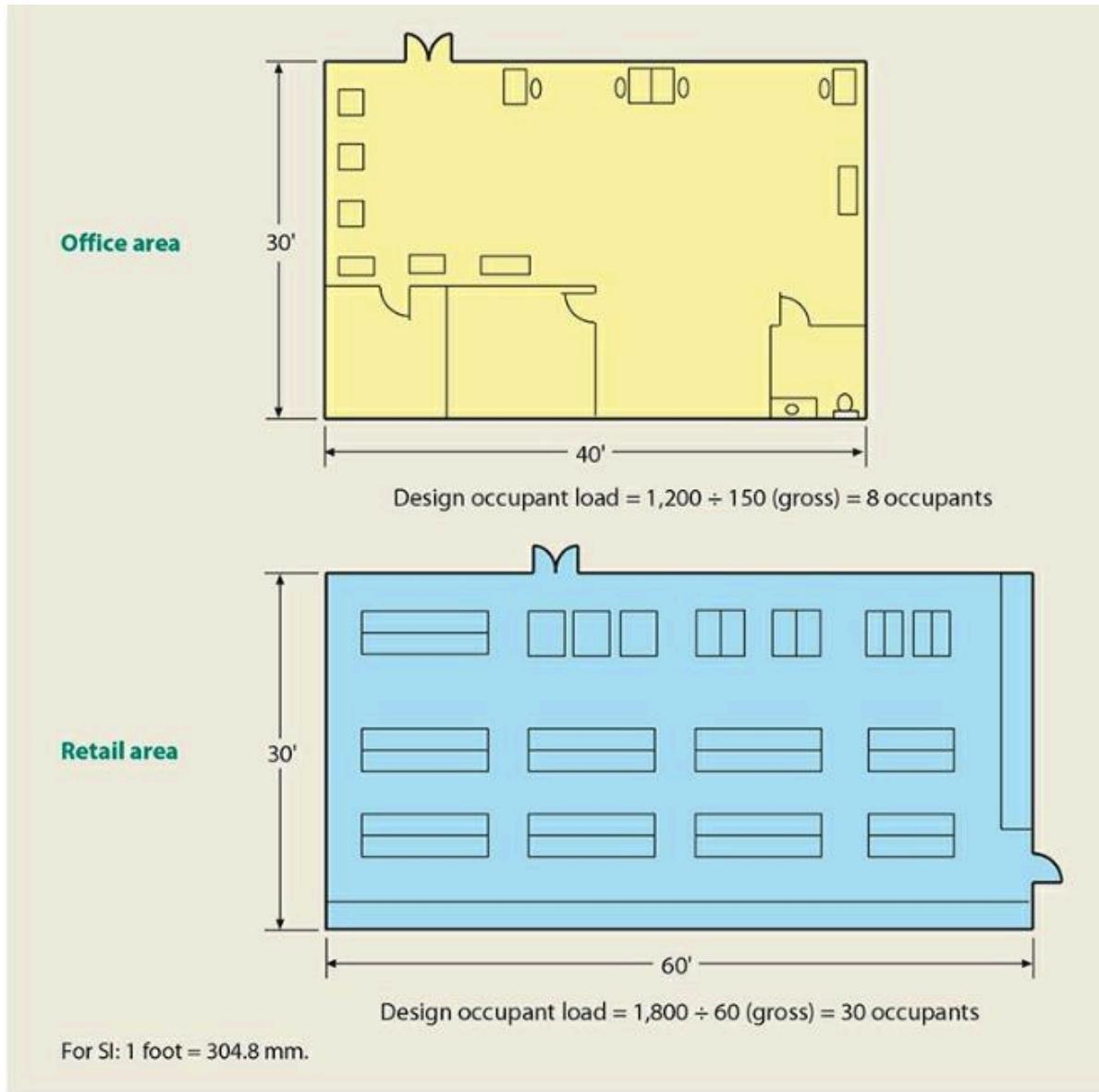


Figure 1004-5 Design occupant load examples.

Source: 2021 IBC

GIVEN: A 1,600-square-foot conference room in a hotel.

DETERMINE: The design occupant load of the room.

TABLE 1004.5

MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

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Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	150 gross
Concentrated business use areas	See Section 1004.8
Courtrooms—other than fixed seating areas	40 net
Day care	35 net
Dormitories	50 gross
Educational	

Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
Group H-5 fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mall buildings—covered and open	See Section 402.8.2
Mercantile	60 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

a. Floor area in square feet per occupant.

GIVEN: A 1,600-square-foot conference room in a hotel.

DETERMINE: The design occupant load of the room.

TABLE 1004.5

MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR ^a
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit gallery and museum	30 net
Assembly with fixed seats	See Section 1004.6
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	150 gross
Concentrated business use areas	See Section 1004.8
Courtrooms—other than fixed seating areas	40 net
Day care	35 net
Dormitories	50 gross
Educational	

Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
Group H-5 fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mall buildings—covered and open	See Section 402.8.2
Mercantile	60 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

a. Floor area in square feet per occupant.

1004.1, 1004.5 Design Occupant Load

GIVEN: A 1,600-square-foot conference room in a hotel.

DETERMINE: The design occupant load of the room.

SOLUTION: Because a variety of assembly activities can occur within the room, the use creating the largest occupant load would be evaluated.

(1) Conference/seminar use with tables and chairs

$$1 \text{ person per } 15 \text{ sq ft} = 106.67 = 106 \text{ occupants}$$

(2) Conference/seminar use with chairs only (auditorium-style seating)

$$1 \text{ person per } 7 \text{ sq ft for seating} = 228.57 = 228$$

Therefore for egress purposes, a design occupant load of 228 shall be used. Note that other potential uses of the room (dining, receptions, dances, etc.) would also utilize these factors.

OCCUPANT LOAD DETERMINATION

Application Example 1004-2

GIVEN: A restaurant where the occupant load of the dining area is calculated at 135, based on Table 1004.5 (2,025 sq ft/15). The restaurant's owner would like to establish a higher occupant load.

DETERMINE: The maximum permitted occupant load of the dining area.

TABLE 1004.5

MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR ^a
Accessory storage areas, mechanical equipment room	300 gross
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Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	150 gross
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Courtrooms—other than fixed seating areas	40 net
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Educational	

Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
Group H-5 fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
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Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mall buildings—covered and open	See Section 402.8.2
Mercantile	60 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

a. Floor area in square feet per occupant.

GIVEN: A restaurant where the occupant load of the dining area is calculated at 135, based on Table 1004.5 (2,025 sq ft/15). The restaurant's owner would like to establish a higher occupant load.

DETERMINE: The maximum permitted occupant load of the dining area.

TABLE 1004.5

MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

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For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

a. Floor area in square feet per occupant.

1004.1, 1004.5 Design Occupant Load

GIVEN: A restaurant where the occupant load of the dining area is calculated at 135, based on Table 1004.5 (2,025 sq ft/15). The restaurant's owner would like to establish a higher occupant load.

DETERMINE: The maximum permitted occupant load of the dining area.

SOLUTION: The absolute maximum occupant load per Section 1004.5.1 appears to be 289 (2,025/7). However, it is obviously impossible for such an occupant load to safely occupy the space, even if adequate exit doors were provided. If tables and chairs were provided to seat 289 customers, there would be inadequate aisle accessways and aisles. In addition, the potential for egress obstruction would be significant. The appropriate maximum occupant load would be approved by the building official on a case-by-case basis, relying on the specific design of the space, the furniture and/or equipment layout, and the egress patterns created.

MAXIMUM OCCUPANT LOAD

In determining the design occupant load for the sales area of a mercantile facility, the floor area shall be divided by a factor of one occupant per _____ square feet.

- a. 20
- b. 30
- c. 50
- d. 60

TABLE 1004.5

MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR ^a
Accessory storage areas, mechanical equipment room	300 gross
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Institutional areas	
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Mercantile	60 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Warehouses	500 gross

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

a. Floor area in square feet per occupant.

1004.1, 1004.5 Design Occupant Load

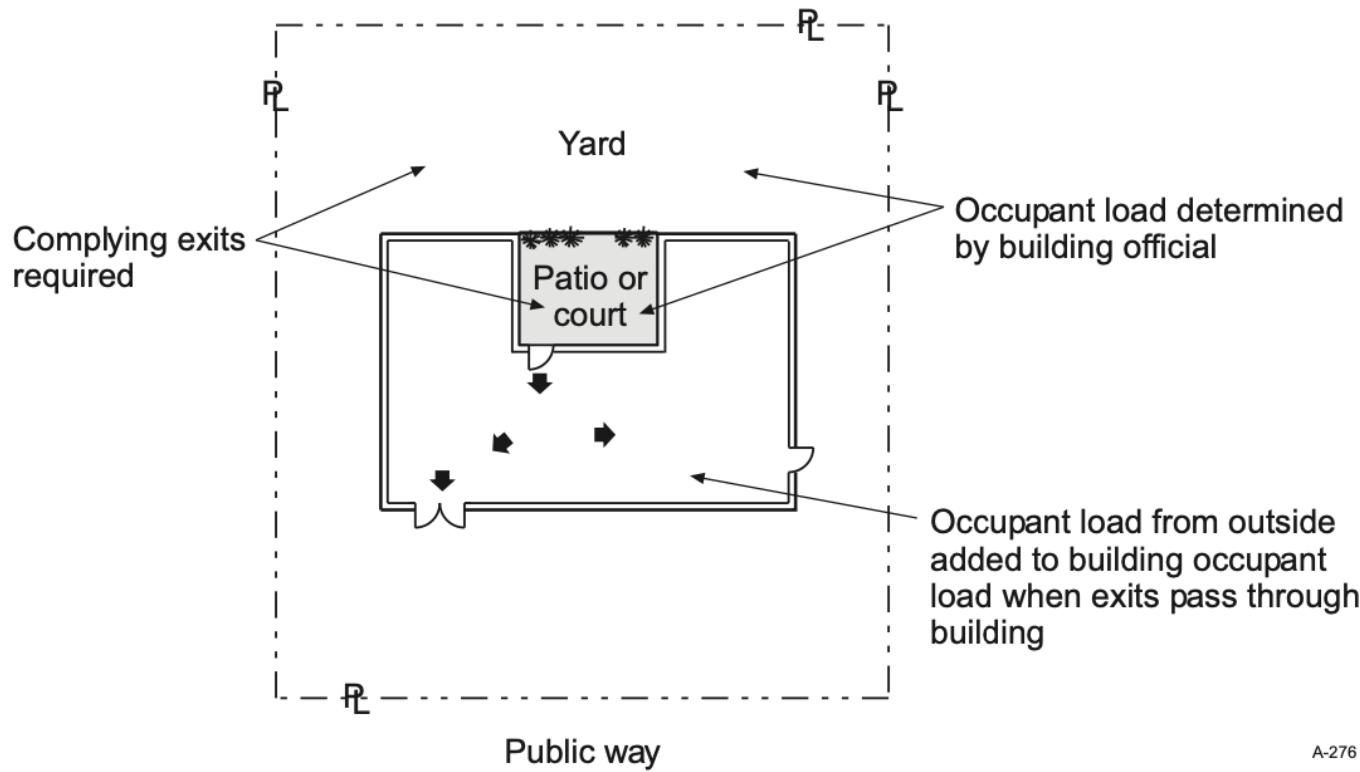
In determining the design occupant load for the sales area of a mercantile facility, the floor area shall be divided by a factor of one occupant per _____ square feet.

- a. 20
- b. 30
- c. 50
- d. 60

1004.7, Outdoor Areas

- Yards, patios, occupied roofs, courts and similar outdoor areas accessible to and usable by the building occupants shall be provided with means of egress as required by Chapter 10. Where outdoor areas are to be used by persons in addition to the occupants of the building, and the path of egress travel from the outdoor areas passes through the building, means of egress requirements shall be based on the sum of the occupant loads of the building plus the outdoor areas. See the exceptions for service areas and dwellings.
- Although not limited in application, the regulation of egress from outdoor areas often addresses the use of exterior spaces for dining and/or drinking in restaurants and similar establishments. In addition, the means of egress required from occupied roofs is determined based upon the requirements for outdoor areas. The building official is authorized to establish an occupant load for the outdoor space in accordance with its anticipated use and to apply all means of egress provisions that would be appropriate.

1004.7, Outdoor Areas



A-276

Where seating is provided without dividing arms, such as for benches and booths, it is reasonable to base the occupant load individually to each bench or booth. Similarly, it is appropriate to round the calculated occupant load down to the lower value, as this section only regulates each full **18 inches or 24 inches** of width.

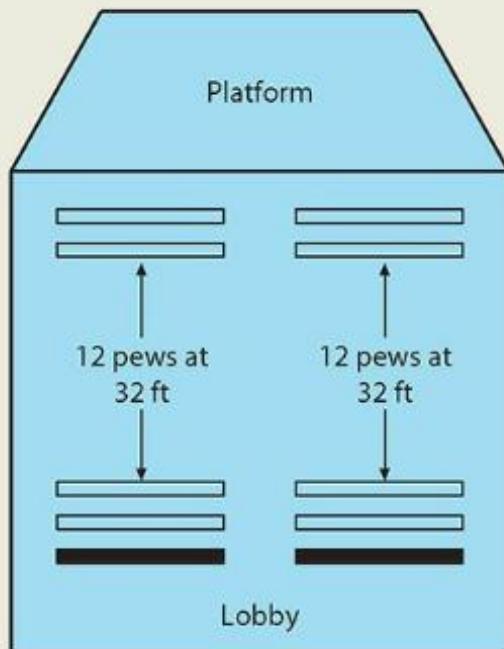
Outdoor reviewing stands, grandstands and bleachers must have their occupant loads calculated according to the specific types of seating arrangements, such as chair backs, benches, loose chairs, etc. Additional specific requirements are contained in Section 1030.

Source: 2021 IBC

1004.7, Outdoor Areas

GIVEN: A church sanctuary having pews as shown.

DETERMINE: The design occupant load of the sanctuary.



For SI: 1 inch = 25.4 mm.

MAXIMUM OF OCCUPANT LOAD

1004.7, Outdoor Areas

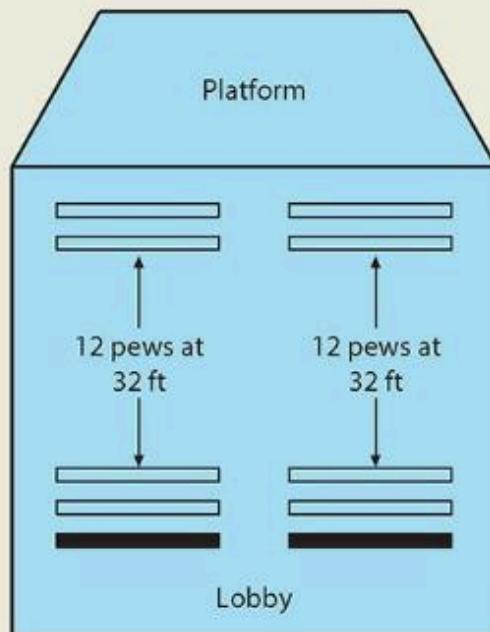
GIVEN: A church sanctuary having pews as shown.

DETERMINE: The design occupant load of the sanctuary.

$$\frac{32 \text{ ft}}{1.5 \text{ ft}} = 21.33 = 21$$

$$(21 \text{ occupants/pew}) \times (24 \text{ pews}) = 504 \text{ occupants}$$

Total occupant load = 504 + occupant load of platform + occupant load of additional seating areas (wheelchair spaces, etc.)



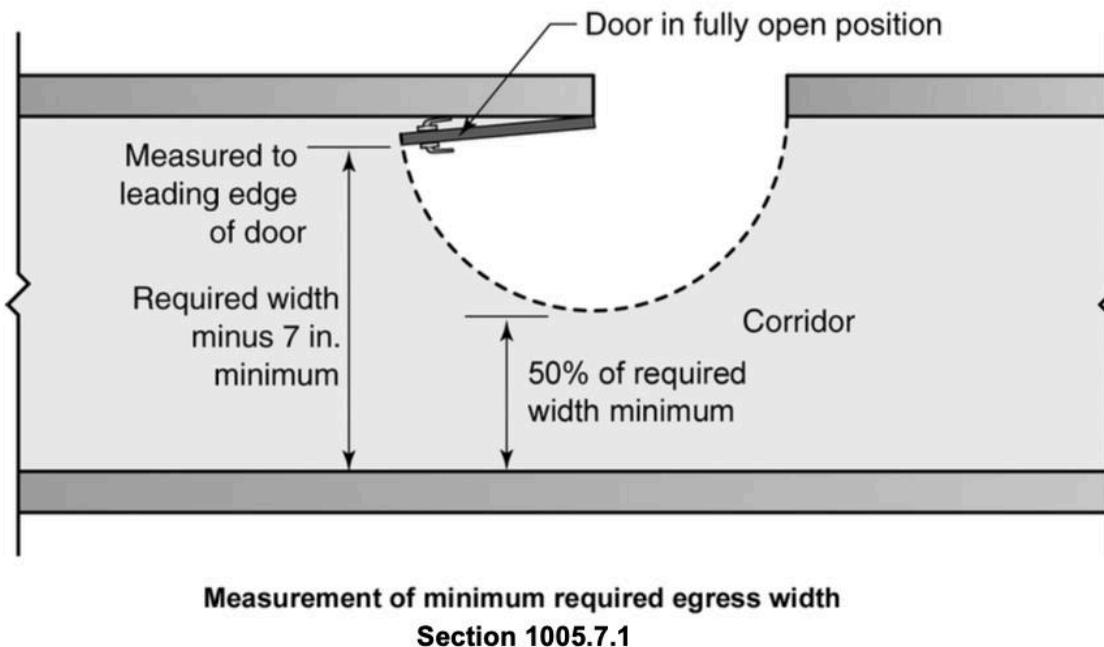
For SI: 1 inch = 25.4 mm.

MAXIMUM OF OCCUPANT LOAD

1005.2, 1005.3 Width and Capacity

- The minimum width, in inches, of any means of egress components shall not be less than that specified for such component, elsewhere in the IBC. The capacity, in inches, of means of egress stairways shall be calculated by multiplying the occupant load served by such stairway by a means of egress capacity factor of 0.3 inches (7.6 mm) per occupant. The capacity, in inches, of means of egress components other than stairways shall be calculated by multiplying the occupant load served by such component by a means of egress capacity factor of 0.2 inches (5.1 mm) per occupant. See the exceptions that reduce the capacity factors to 0.2 inches and 0.15 inches, respectively, for buildings equipped throughout with an automatic sprinkler system and an emergency voice/alarm communication system.
- In a given means of egress system, different components will afford different capacities. The most restrictive component will establish the capacity of the overall system. Doorways, aisles, stairways and corridors also have minimum established widths that must be provided.

1005.2, 1005.3 Width and Capacity



Width, in terms of a means of egress system or component, is the clear, unobstructed usable width afforded along the exit path by the individual components. Unless the code provides for a permitted projection, the minimum required clear width may not be reduced throughout the travel path.

Source: 2021 IBC

1005.2, 1005.3 Width and Capacity

A stairway serving 160 occupants in a fully-sprinklered Group I-2 hospital shall be a minimum of _____ inches in width.

- a. 42
- b. 44
- c. 48
- d. 60

1005.2, 1005.3 Width and Capacity

A stairway serving 160 occupants in a fully-sprinklered Group I-2 hospital shall be a minimum of _____ inches in width.

- a. 42
- b. 44
- c. 48
- d. 60

1005.3 Required capacity based on occupant load. The required capacity, in inches (mm), of the *means of egress* for any room, area, space or *story* shall be not less than that determined in accordance with Sections 1005.3.1 and 1005.3.2.

1005.3.1 Stairways. The capacity, in inches, of means of egress *stairways* shall be calculated by multiplying the *occupant load* served by such *stairways* by a *means of egress* capacity factor of 0.3 inch (7.6 mm) per *occupant*. Where *stairways* serve more than one *story*, only the *occupant load* of each *story* considered individually shall

1005.5, Distribution of Egress Capacity

- Where more than one exit, or access to more than one exit, is required, the means of egress shall be configured such that the loss of any one exit, or access to one exit, shall not reduce the available capacity or width to less than 50 percent of the required capacity or width.
- Where two complying means of egress are provided, the occupant load is to be distributed evenly between the two means of egress. However, where three or more means of egress are available, it is permissible to size one of the egress points for up to 50 percent of the occupant load, while distributing the remaining occupant load among the other means of egress. This distribution is not required to be equally applied; however, a dramatic imbalance of egress component capacities relative to occupant load distribution should be avoided.

1005.5, Distribution of Egress Capacity

TABLE 1006.2.1
SPACES WITH ONE EXIT OR EXIT ACCESS DOORWAY

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)			
		Without Sprinkler System (feet)		With Sprinkler System (feet)	
		Occupant Load			
		OL ≤ 30	OL > 30		
A ^c , E, M	49	75	75	75 ^a	
B	49	100	75	100 ^a	
F	49	75	75	100 ^a	
H-1, H-2, H-3	3	NP	NP	25 ^b	
H-4, H-5	10	NP	NP	75 ^b	
I-1, I-2 ^d , I-4	10	NP	NP	75 ^a	
I-3	10	NP	NP	100 ^a	
R-1	10	NP	NP	75 ^a	
R-2	20	NP	NP	125 ^a	
R-3 ^e	20	NP	NP	125 ^{a, g}	
R-4 ^e	20	NP	NP	125 ^{a, g}	
S ^f	29	100	75	100 ^a	
U	49	100	75	75 ^a	

For SI: 1 foot = 304.8 mm.

NP = Not Permitted.

- a. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.2.
- b. Group H occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.
- c. For a room or space used for assembly purposes having fixed seating, see Section 1030.8.
- d. For the travel distance limitations in Group I-2, see Section 407.4.
- e. The common path of egress travel distance shall only apply in a Group R-3 occupancy located in a mixed occupancy building.
- f. The length of common path of egress travel distance in a Group S-2 open parking garage shall be not more than 100 feet.
- g. For the travel distance limitations in Groups R-3 and R-4 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.3, see Section 1006.2.2.6.

GIVEN: A sprinklered office tenant space as shown with a total occupant load of 73.

DETERMINE: The minimum number of exit access doorways required.

TABLE 1006.2.1
SPACES WITH ONE EXIT OR EXIT ACCESS DOORWAY

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)			
		Without Sprinkler System (feet)		With Sprinkler System (feet)	
		Occupant Load			
		OL ≤ 30	OL > 30		
A ^c , E, M	49	75	75	75 ^a	
B	49	100	75	100 ^a	
F	49	75	75	100 ^a	
H-1, H-2, H-3	3	NP	NP	25 ^b	
H-4, H-5	10	NP	NP	75 ^b	
I-1, I-2 ^d , I-4	10	NP	NP	75 ^a	
I-3	10	NP	NP	100 ^a	
R-1	10	NP	NP	75 ^a	
R-2	20	NP	NP	125 ^a	
R-3 ^e	20	NP	NP	125 ^{a, g}	
R-4 ^e	20	NP	NP	125 ^{a, g}	
S ^f	29	100	75	100 ^a	
U	49	100	75	75 ^a	

For SI: 1 foot = 304.8 mm.

NP = Not Permitted.

- a. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.2.
- b. Group H occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.
- c. For a room or space used for assembly purposes having fixed seating, see Section 1030.8.
- d. For the travel distance limitations in Group I-2, see Section 407.4.
- e. The common path of egress travel distance shall only apply in a Group R-3 occupancy located in a mixed occupancy building.
- f. The length of common path of egress travel distance in a Group S-2 open parking garage shall be not more than 100 feet.
- g. For the travel distance limitations in Groups R-3 and R-4 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.3, see Section 1006.2.2.6.

GIVEN: A sprinklered office tenant space as shown with a total occupant load of 73.

DETERMINE: The minimum number of exit access doorways required.

TABLE 1006.2.1
SPACES WITH ONE EXIT OR EXIT ACCESS DOORWAY

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)		
		Without Sprinkler System (feet)		With Sprinkler System (feet)
		Occupant Load	OL ≤ 30	OL > 30
A ^c , E, M	49	75	75	75 ^a
B	49	100	75	100 ^a
F	49	75	75	100 ^a
H-1, H-2, H-3	3	NP	NP	25 ^b
H-4, H-5	10	NP	NP	75 ^b
I-1, I-2 ^d , I-4	10	NP	NP	75 ^a
I-3	10	NP	NP	100 ^a
R-1	10	NP	NP	75 ^a
R-2	20	NP	NP	125 ^a
R-3 ^e	20	NP	NP	125 ^{a, g}
R-4 ^e	20	NP	NP	125 ^{a, g}
S ^f	29	100	75	100 ^a
U	49	100	75	75 ^a

For SI: 1 foot = 304.8 mm.

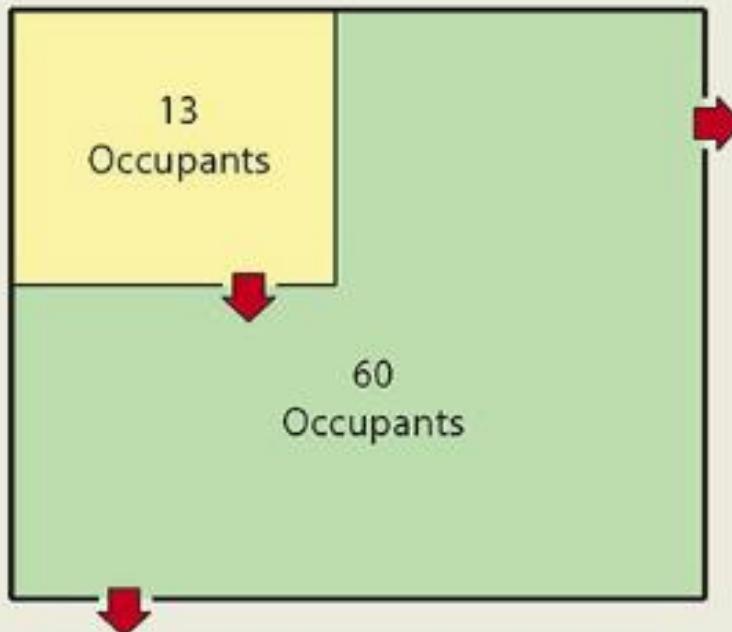
NP = Not Permitted.

- a. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.2.
- b. Group H occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.
- c. For a room or space used for assembly purposes having fixed seating, see Section 1030.8.
- d. For the travel distance limitations in Group I-2, see Section 407.4.
- e. The common path of egress travel distance shall only apply in a Group R-3 occupancy located in a mixed occupancy building.
- f. The length of common path of egress travel distance in a Group S-2 open parking garage shall be not more than 100 feet.
- g. For the travel distance limitations in Groups R-3 and R-4 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.3, see Section 1006.2.2.6.

1005.5, Distribution of Egress Capacity

GIVEN: A sprinklered office tenant space as shown with a total occupant load of 73.

DETERMINE: The minimum number of exit access doorways required.



Minimum of two exit access doorways required as occupant load exceeds 49 persons.

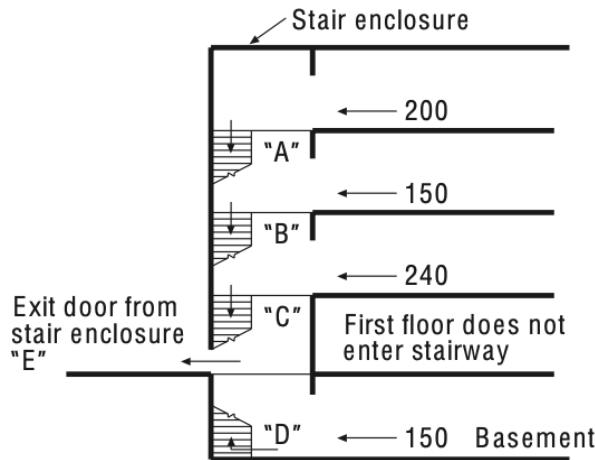
MULTIPLE MEANS OF EGRESS

Application Example 1006-1

1005.3.1, 1005.4, 1005.6, Exiting from Multiple Levels

- Where stairways serve more than one story, only the occupant load of each story considered individually shall be used in computing the required capacity of the stairway serving that story. The minimum width or required capacity of the means of egress required from any story of a building shall not be reduced along the path of egress travel until arrival at the public way. Where the means of egress from stories above and below converge at an intermediate level, the capacity of the means of egress from the point of convergence shall not be less than the largest minimum width or the sum of the required capacities for the stairways serving the two adjacent stories, whichever is larger.
- It is not necessary to add occupants together for required capacity calculations as they travel vertically from one story to the next. Only the capacity for each individual story is utilized in establishing the minimum required stairway width at each flight. However, once a minimum required width has been established along the stair path, it cannot be reduced.

1005.3.1, 1005.4, 1005.6, Exiting from Multiple Levels



Given:

- A nonsprinklered four-story office building with basement
- Occupant load exiting into stair enclosure at each level as indicated
- First floor occupants exit to exterior without entering the stair enclosure

Exit element	Occupant load served	Required width
Stair-point "A"	200	60"
Stair-point "B"	150	60" ¹
Stair-point "C"	240	72"
Stair-point "D"	150	45"
Stair-point "E"	390 ²	78"

¹Required width from above must be maintained

²Door at point "E" serves occupants from "C" and "D" egress convergence per Section 1005.6

There is an allowance for adding the occupant loads of floors above and below an intermediate level together where they converge along the exit path. The aggregate occupant load of such converging floors is to be used in determining the minimum required exit width.

1005.3.1, 1005.4, 1005.6, Exiting from Multiple Levels

TABLE 1006.3.4(2)
STORIES WITH ONE EXIT OR ACCESS TO ONE EXIT FOR OTHER OCCUPANCIES

STORY	OCCUPANCY	MAXIMUM OCCUPANT LOAD PER STORY	MAXIMUM EXIT ACCESS TRAVEL DISTANCE (feet)
First story above or below grade plane	A, B ^b , E, F ^b , M, U	49	75
	H-2, H-3	3	25
	H-4, H-5, I, R-1, R-2 ^{a, c}	10	75
	S ^{b, d}	29	75
Second story above grade plane	B, F, M, S ^d	29	75
Third story above grade plane and higher	NP	NA	NA

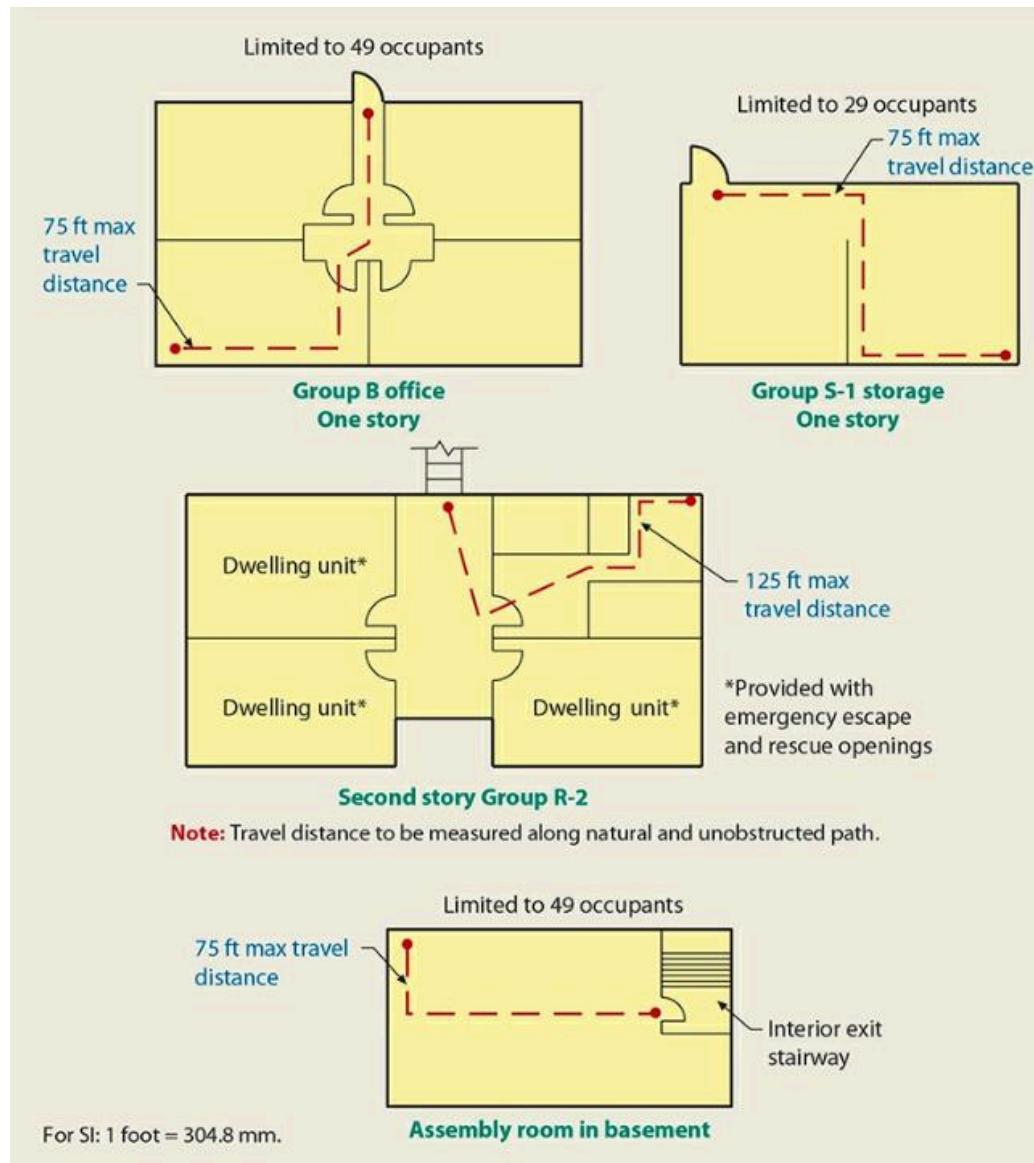
For SI: 1 foot = 304.8 mm.

NP = Not Permitted.

NA = Not Applicable.

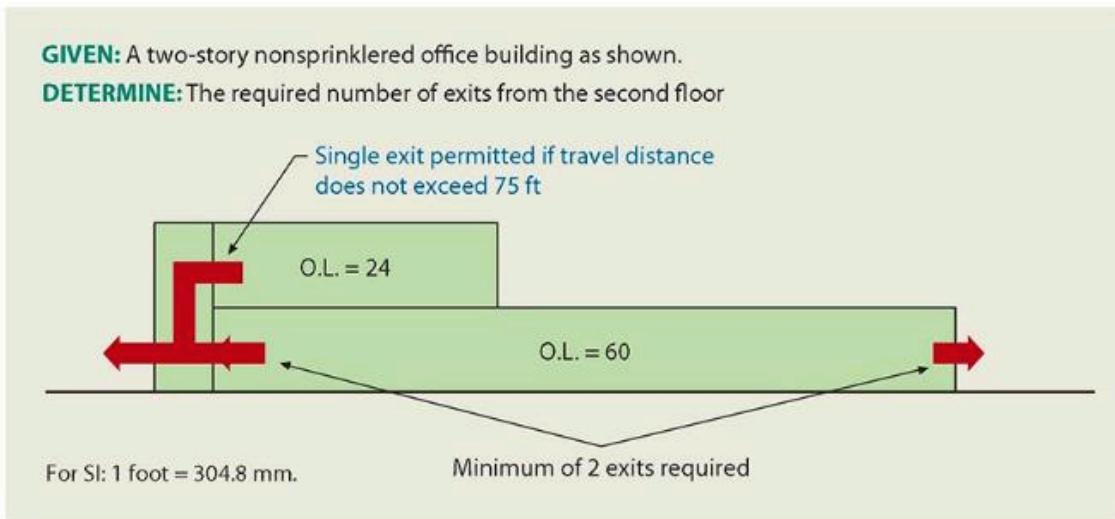
- a. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section 1031.
- b. Group B, F and S occupancies in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 shall have a maximum exit access travel distance of 100 feet.
- c. This table is used for R-2 occupancies consisting of sleeping units. For R-2 occupancies consisting of dwelling units, use Table 1006.3.4(1).
- d. The length of exit access travel distance in a Group S-2 open parking garage shall be not more than 100 feet.

1005.3.1, 1005.4, 1005.6, Exiting from Multiple Levels



Source: 2021 IBC

1005.3.1, 1005.4, 1005.6, Exiting from Multiple Levels



Application Example 1006-4

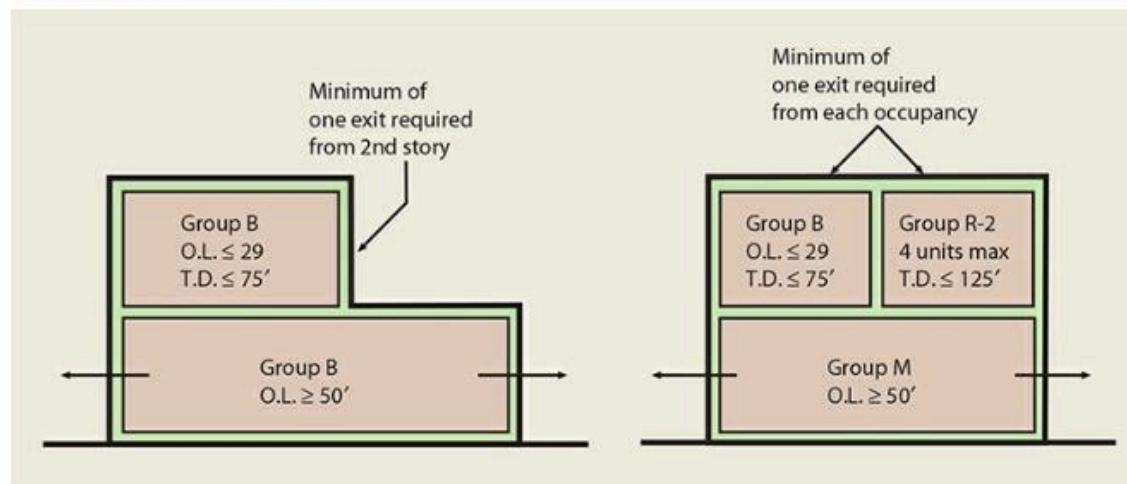


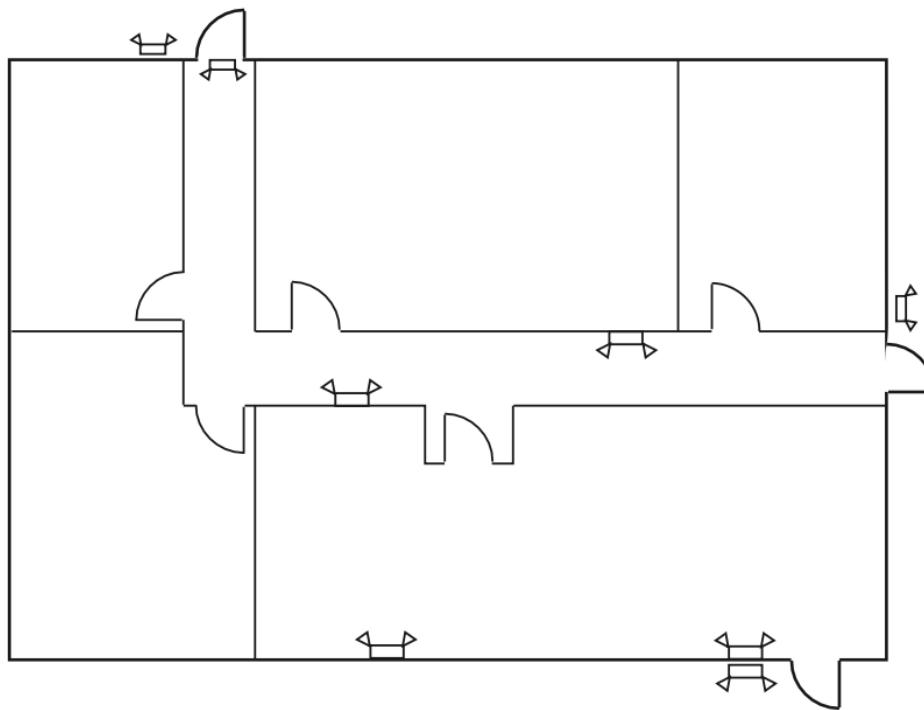
Figure 1006-5 Stories with one exit examples.

Source: 2021 IBC

1008.2, 1008.3 Emergency Power

- The means of egress serving a room or space shall be illuminated at all times that the room or space is occupied. See the exceptions for (1) Group U occupancies; (2) aisle accessways in Group A; (3) dwelling and sleeping units in Groups R-1, R-2 and R-3; and (4) sleeping units of Group I. The power supply for means of egress illumination shall normally be provided by the premises electrical supply. In the event of power supply failure in rooms and spaces that require two or more means of egress, an emergency electrical system shall automatically illuminate all of the following areas: (1) aisles, (2) corridors and (3) exit access stairways and ramps. Additional requirements for emergency power for illumination is required for buildings that require at least two means of egress and for special spaces such as fire pump rooms and large public restrooms.
- Often identified as emergency lighting, a completely separate source of power from the premise's wiring system is required when the life-safety risk in a building becomes sufficiently great. This threshold is recognized as the point at which the occupant load of the room, area or building is high enough so that two means of egress are required.

1008.2, 1008.3 Emergency Power



For the building occupant to be able to negotiate safely the means of egress system, the entire system must be illuminated any time the building is occupied. The illumination must provide an intensity of at least one foot-candle at the floor level. Stairway walking surfaces must be provided with at least 10 footcandles of illumination when the stairway is in use.

1008.2, 1008.3 Emergency Power

Emergency lighting facilities for means of egress illumination shall initially provide _____ along the path of egress at floor level.

- a. at least 1 foot-candle
- b. an average of 1 foot-candle
- c. at least 5 foot-candles
- d. an average of 0.2 foot-candle

1008.2, 1008.3 Emergency Power

Emergency lighting facilities for means of egress illumination shall initially provide _____ along the path of egress at floor level.

- a. at least 1 foot-candle
- b. an average of 1 foot-candle
- c. at least 5 foot-candles
- d. an average of 0.2 foot-candle

1008.3.5 Illumination level under emergency power.

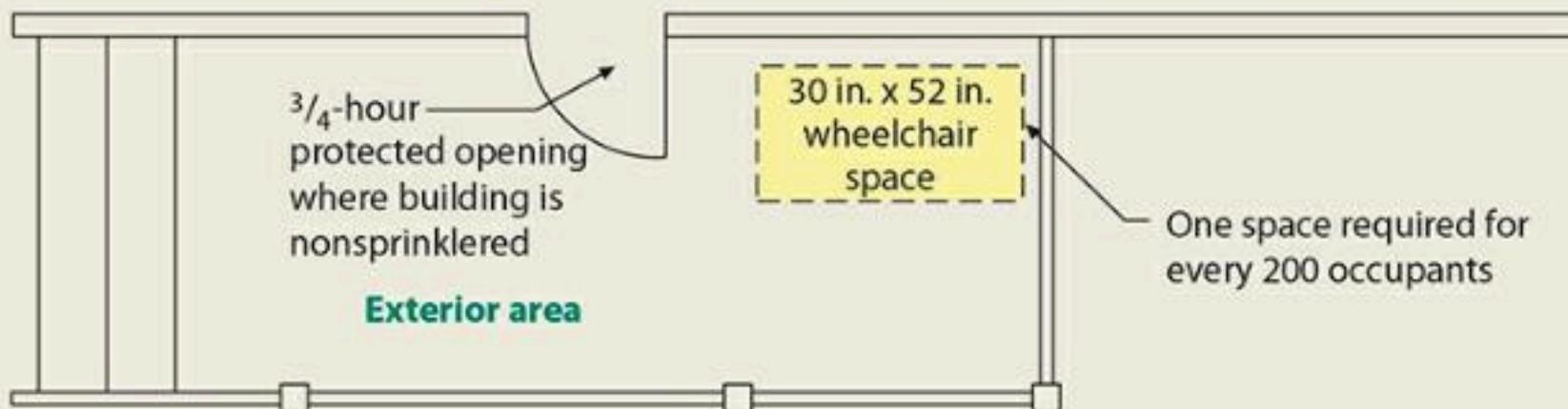
Emergency lighting facilities shall be arranged to provide initial illumination that is not less than an average of 1 footcandle (11 lux) and a minimum at any point of 0.1 footcandle (1 lux) measured along the path of egress at floor level. Illumination levels shall be permitted to decline to 0.6 footcandle (6 lux) average and a minimum at any point of 0.06 footcandle (0.6 lux) at the end of the emergency lighting time duration. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded. In Group I-2 occupancies, failure of a single lamp in a luminaire shall not reduce the illumination level to less than 0.2 footcandle (2.2 lux).

1009.1, 1009.2 General

- Accessible spaces shall be provided with not less than one accessible means of egress. Where more than one means of egress is required by Sections 1006.2 or 1006.3 from any accessible space, each accessible portion of the space shall be served by not less than two accessible means of egress. See the exceptions for (1) accessible mezzanines and (2) assembly spaces with sloped floors. Each required accessible means of egress shall be continuous to a public way and shall consist of one or more of the following components: accessible routes, interior exit stairways, exit access stairways, exterior exit stairways, elevators, platform lifts, horizontal exits, ramps, areas of refuge and exterior areas for assisted rescue.
- An accessible means of egress is a continuous and unobstructed way of egress travel, from any accessible point in a building or facility to a public way.

1009.1, 1009.2 General

In a nonsprinklered building, wall protected per Section 705, but at least a 1-hour wall a minimum of 10 ft horizontally beyond landing; and to a minimum height of 10 ft above floor level, or to the roof line, whichever is lower



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

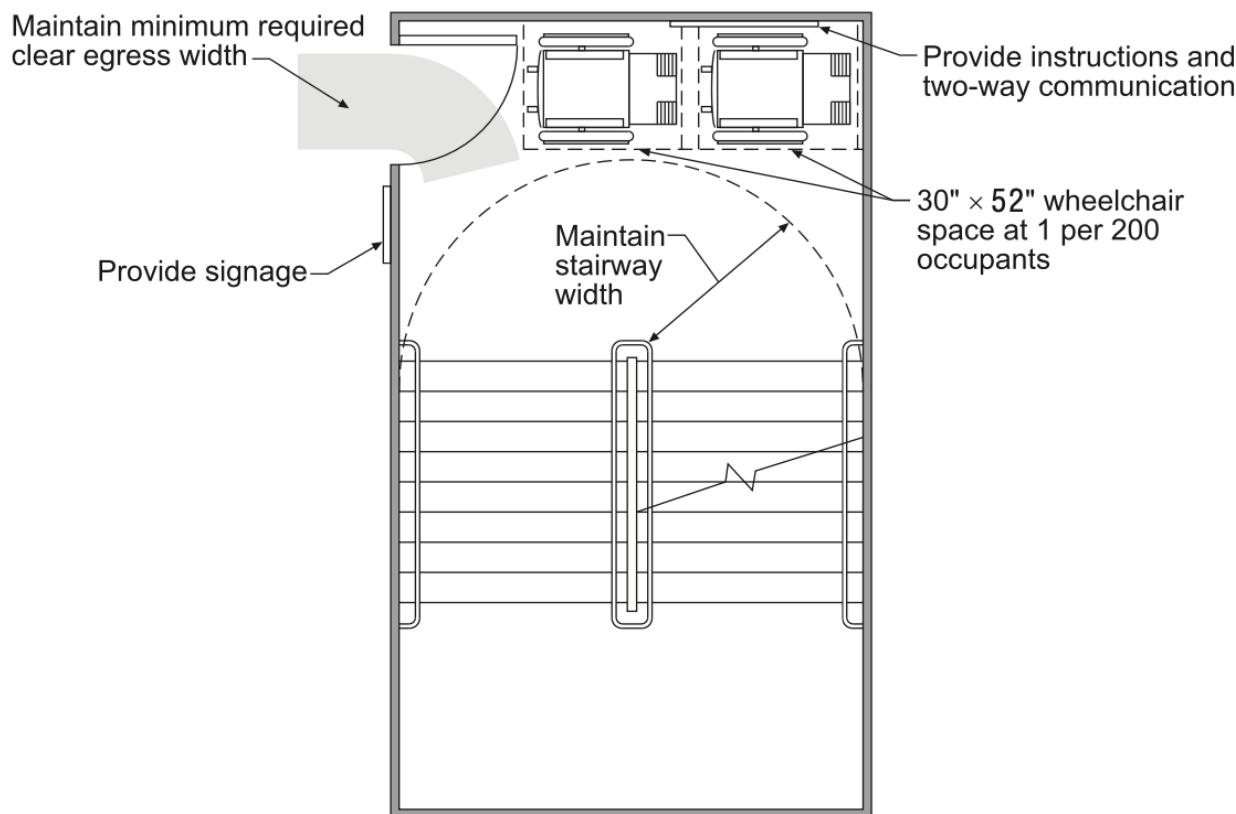
Figure 1009-2 Exterior area for assisted rescue.

Exterior stairways and nonaccessible exit discharge areas may be served by exterior areas for assisted rescue. These specific exterior refuge areas must be adequately separated from the interior of the building by fire-resistance-rated construction and fire-protected openings.

1009.6 Areas of Refuge

- Every required area of refuge shall be accessible from the space it serves by an accessible means of egress. Every required area of refuge shall have direct access to a stairway complying with Sections 1009.3 and 1023 or an elevator complying with Section 1009.4.
- An area of refuge is defined as an area where persons unable to use stairways can remain temporarily to await instructions or assistance during emergency evacuation. An area of refuge needs to be separated from the remainder of the story by a smoke barrier or horizontal exit unless the refuge area is located within an enclosure for an exit access stairway or an interior exit stairway. A two-way communication system with appropriate instructions must be provided in each area of refuge and must also be identified by complying signs. There are several conditions under which areas of refuge are not required. The most commonly utilized exception to areas of refuge applies to buildings that are fully sprinklered.

1009.6 Areas of Refuge



Required areas of refuge

For SI: 1 inch = 25.4 mm.

Although three or more means of egress from an accessible space may be required, only two of the exitways must be accessible. However, where an area of refuge is used as part of the egress system, the maximum travel distance set forth in Section 1017.2 must be maintained.

Source: 2021 IBC

1009.8 Where Required: Two Way Communication

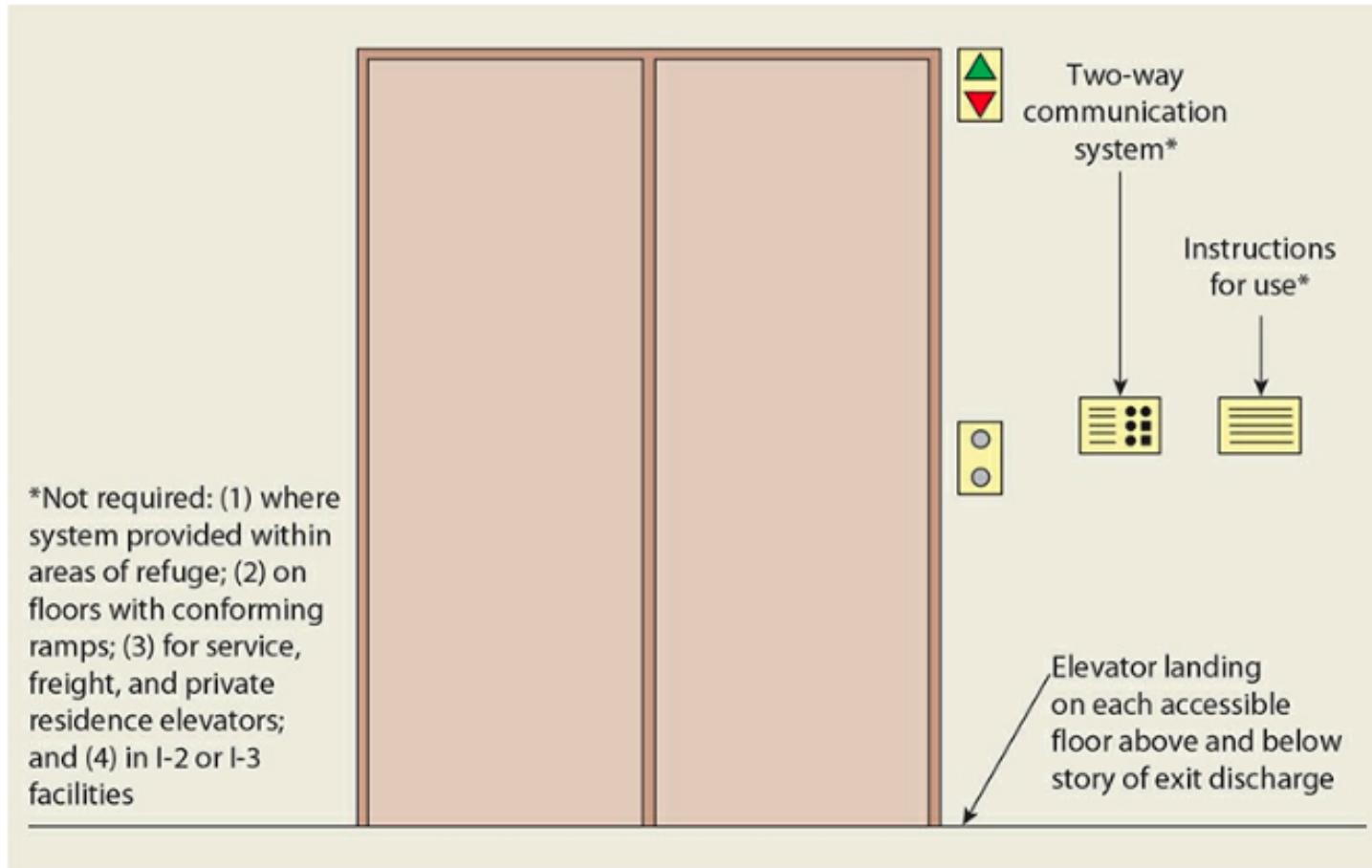


Figure 1009-3 Two-way communication system at elevator landing.

The provisions of Section 1009.6.5 require that all areas of refuge be provided with a two-way communication system. The specific requirements for the system are the same as those for the two-way communication systems mandated at elevator landings as set forth in Section 1009.8.

1009.8 Where Required: Two Way Communication

- A two-way communication system complying with Sections 1009.8.1 and 1009.8.2 shall be provided at the landing serving each elevator or bank of elevators on each accessible floor that is one or more stories above or below the level of exit discharge. See the exceptions where (1) the two-way communication system is provided within complying areas of refuge, (2) the floor level is provided with complying exit ramps, (3) landings serve only service elevators, (4) landings serve only freight elevators, (5) a landing serves a private residence elevator, or (6) the facility is a Group I-2 or I-3 occupancy.
- In multistory buildings, two-way communication systems must be located at the elevator landing on each accessible floor level, with the exception of the level of exit discharge. The system is intended to offer a means of communication to disabled individuals who need assistance during an emergency situation. Such a system can be useful not only in the event of a fire but also in the case of a natural or technological disaster by providing emergency responders with the location of individuals who will require assistance to be safely evacuated from floor levels above or below the discharge level.

1009.8 Where Required: Two Way Communication

In a nonsprinklered building, a stairway utilized as an accessible means of egress shall be a minimum of _____ inches in clear width between handrails.

- a. 36
- b. 44
- c. 48
- d. 60

1009.8 Where Required: Two Way Communication

In a nonsprinklered building, a stairway utilized as an accessible means of egress shall be a minimum of _____ inches in clear width between handrails.

- a. 36
- b. 44
- c. 48
- d. 60

1009.3 Stairways. In order to be considered part of an *accessible means of egress*, a *stairway* between *stories* shall comply with Sections 1009.3.1 through 1009.3.3.

1009.3.1 Exit access stairways. *Exit access stairways* that connect levels in the same *story* are not permitted as part of an *accessible means of egress*.

Exception: *Exit access stairways* providing *means of egress* from *mezzanines* are permitted as part of an *accessible means of egress*.

1009.3.2 Stairway width. *Stairways* shall have a clear width of 48 inches (1219 mm) minimum between *handrails*.

Exceptions:

1. The clear width of 48 inches (1219 mm) between *handrails* is not required in buildings equipped throughout with an *automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2.
2. The clear width of 48 inches (1219 mm) between *handrails* is not required for *stairways* accessed from a *refuge area* in conjunction with a *horizontal exit*.

1010.6 Floor Elevations (Details in CH 11)

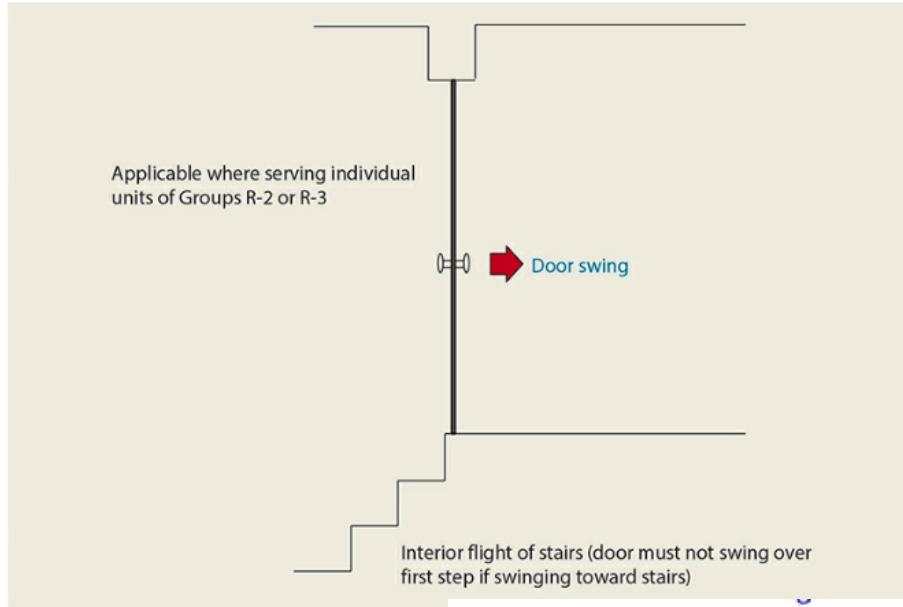


Figure 1010-6 Floor level at doors.

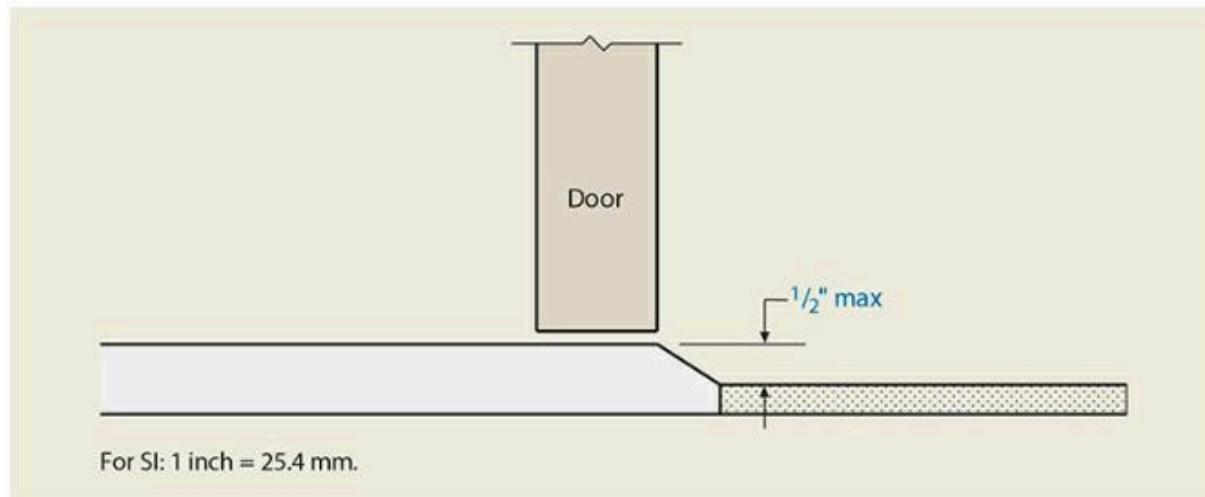


Figure 1010-5 Floor elevation.

Source: 2021 IBC

1012 Ramps

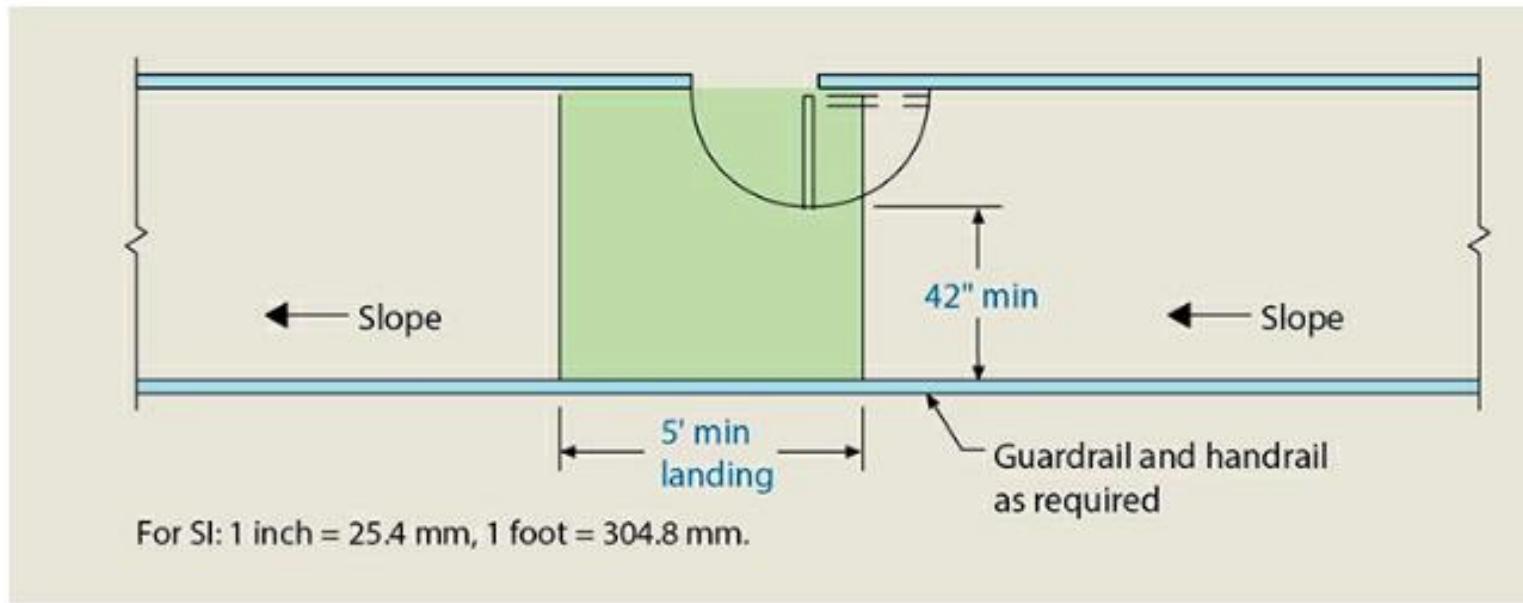


Figure 1012-1 Intermediate ramp landings.

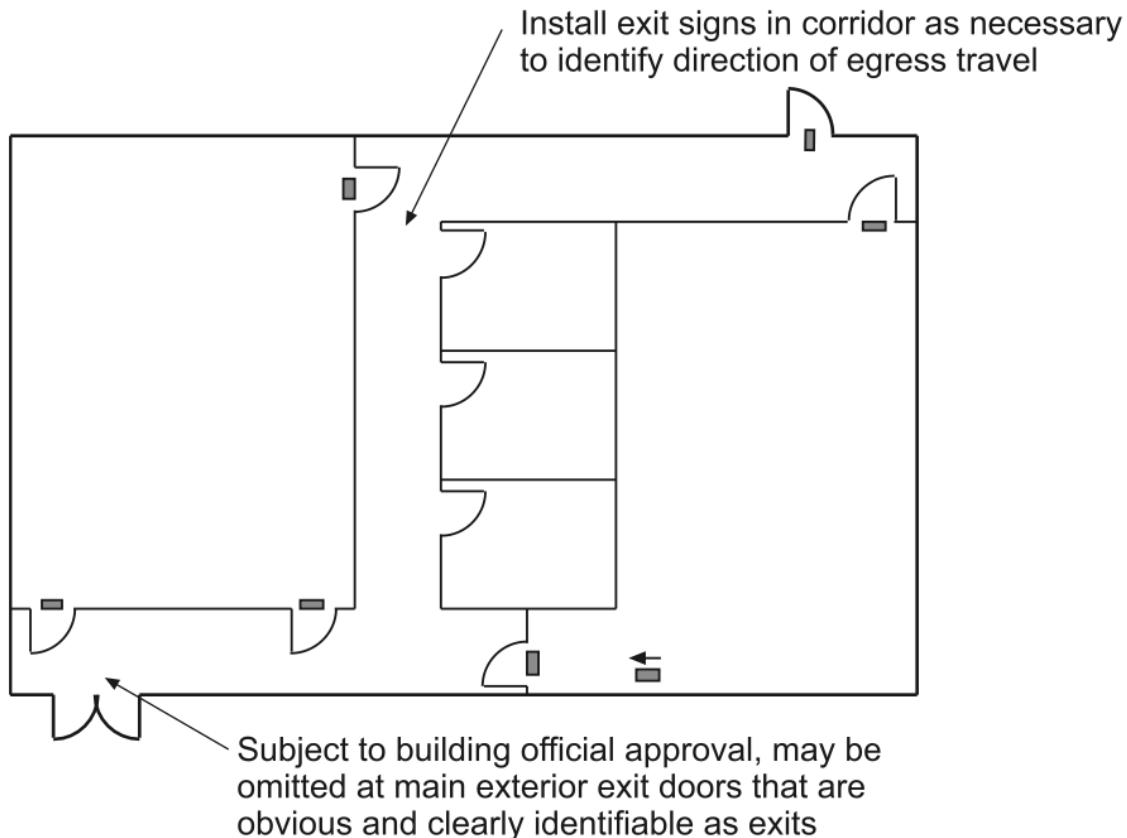
The net clear width between the handrails is to be no less than 36 inches (914 mm), differing from the stairway provisions that allow for handrail projections into the required width.

Where doors enter onto or swing over ramp landings, the doors may not, during the course of their swing, reduce the minimum dimension of the landing to less than 42 inches (1,067 mm).

1013.1 Where Required: Exit Signs

- Exit and exit access doors shall be marked by an approved exit sign readily visible from any direction of egress travel. The path of egress travel to exits and within exits shall be marked by readily visible exit signs to clearly indicate the direction of egress travel in cases where the exit or the path of egress travel is not immediately visible to the occupants. See the five exceptions for uses or conditions where exit signs are not required.
- Exit signs are only mandated when the room or area under consideration is required to have multiple exits or exit access doors. Other locations are also specified where the presence of an exit sign is deemed unnecessary, such as clearly identifiable main exterior doors. Although the appropriate locations for exit signs should be identified during the plan review phase of a project, the true evaluation of their effectiveness should be done just prior to occupancy, when the correct location and orientation of the signs can be checked.

1013.1 Where Required: Exit Signs

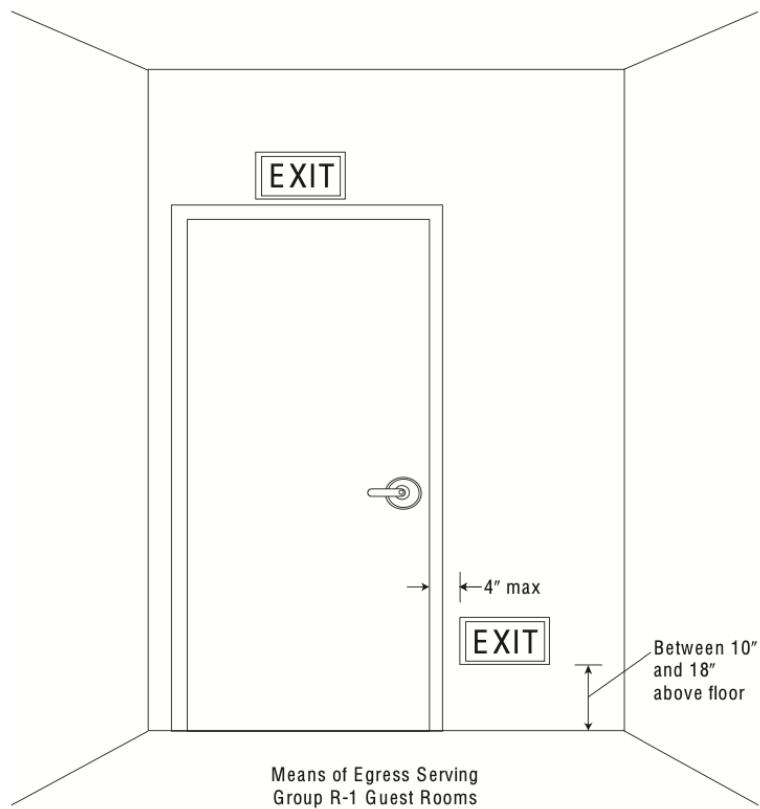


Additional exit signs may be necessary in lengthy exit access corridors and exit passageways to reinforce the direction of egress travel. It is possible that individuals subjected to extended travel would question the availability of an exit and attempt to locate an alternative egress path.

1013.2 Low-level Signs in Group R-1

- Where exit signs are required in Group R-1 occupancies by Section 1013.1, additional low-level exit signs shall be provided in all areas serving guest rooms in Group R-1 occupancies and shall comply with Section 1013.5. The bottom of the sign shall be not less than 10 inches (254 mm) nor more than 18 inches (455 mm) above the floor level. The sign shall be flush mounted to the door or wall. Where mounted on the wall, the edge of the sign shall be within 4 inches (102 mm) of the door frame on the latch side.
- In the means of egress system for Group R-1 occupancies, additional exit signs are mandated for those portions of the system serving the guest rooms. Occupants of such facilities are transient and typically not familiar with their surroundings. If a corridor or other egress component serving the guest rooms were to fill with smoke, the general exit signs located high in the space could quickly become obscured. The installation of additional signs at floor level provides for a secondary identification of the egress path.

1013.2 Low-level Signs in Group R-1

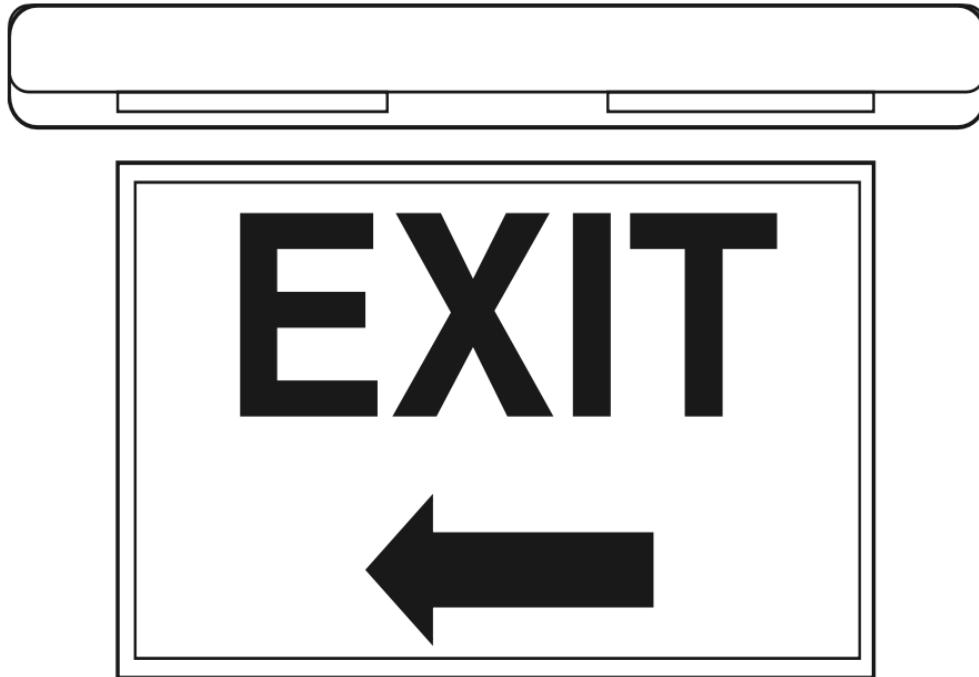


Low-level exit signs must be either electrically powered, self-luminous or photoluminescent exit signs that are listed and labeled in accordance with UL 924 and installed in accordance with the manufacturer's instructions. Consistent with the requirements for all other exit signs, low-level signs shall be illuminated at all times.

1013.3, 1013.6.3 Illumination and Power Source

- Exit signs shall be internally or externally illuminated. See the exception for tactile signs. Exit signs shall be illuminated at all times. To ensure continued illumination for a duration of not less than 90 minutes in case of primary power loss, the sign illumination means shall be connected to an emergency system provided from storage batteries, unit equipment or an on-site generator.
- To ensure visibility under all conditions, required exit signs must always be illuminated. For those signs that are internally illuminated, which make up the vast majority of exit signs, compliance with UL 924 is mandated. Such exit signs, which includes electrically-powered, self-luminous and photo luminescent signs, must be listed and labeled. In addition, they must be installed in accordance with the manufacturer's installation instructions.

1013.3, 1013.6.3 Illumination and Power Source



Externally-illuminated exit signs are regulated through prescriptive requirements addressing the sign's graphics, illumination and power source. The word "EXIT" must be at least 6 inches in height, and at least 5 foot-candles of external illumination must be provided.

1014 Guard and Hand Rail

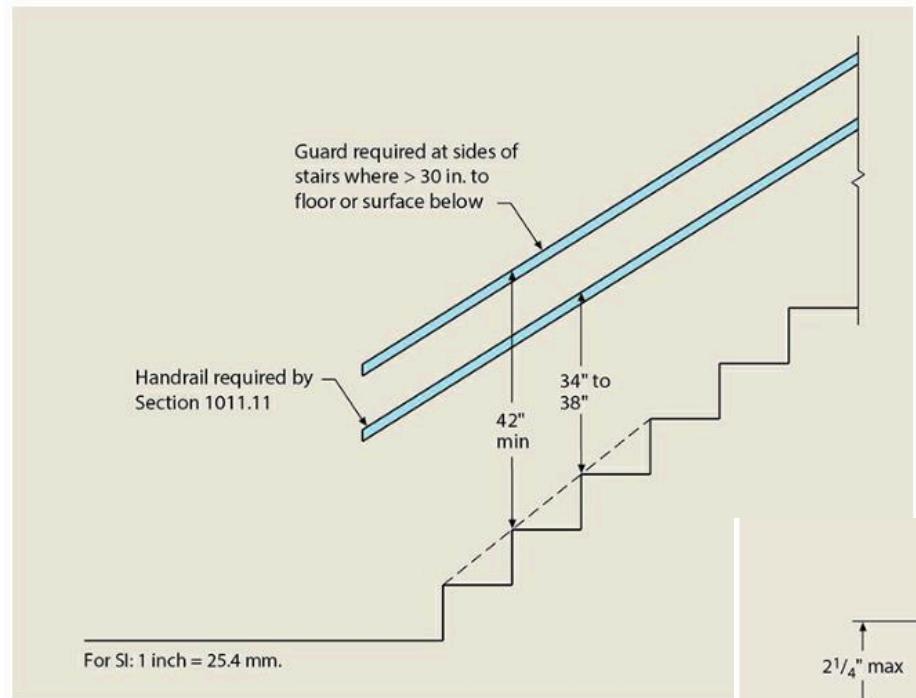


Figure 1014-1 Guard and handrail.

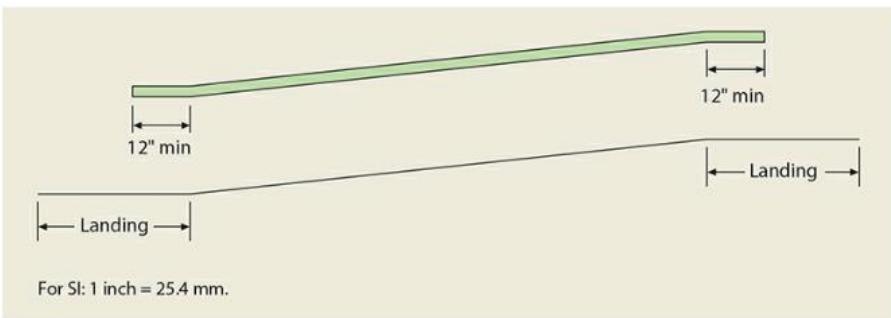


Figure 1014-6 Ramp handrail extensions.

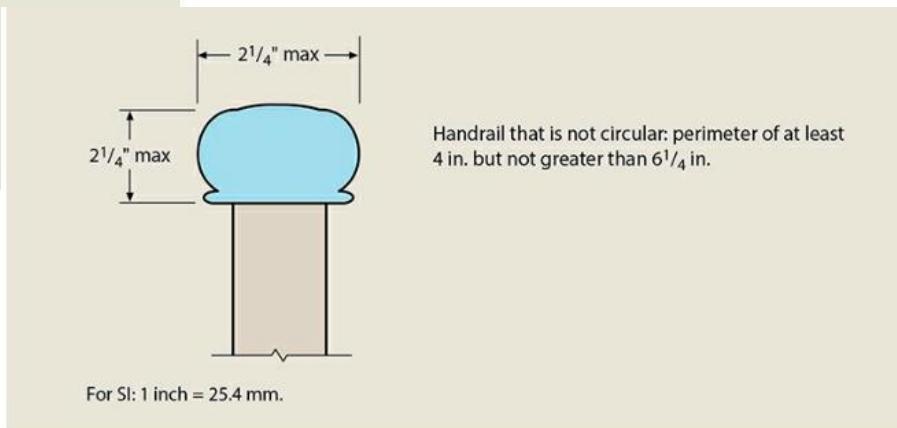
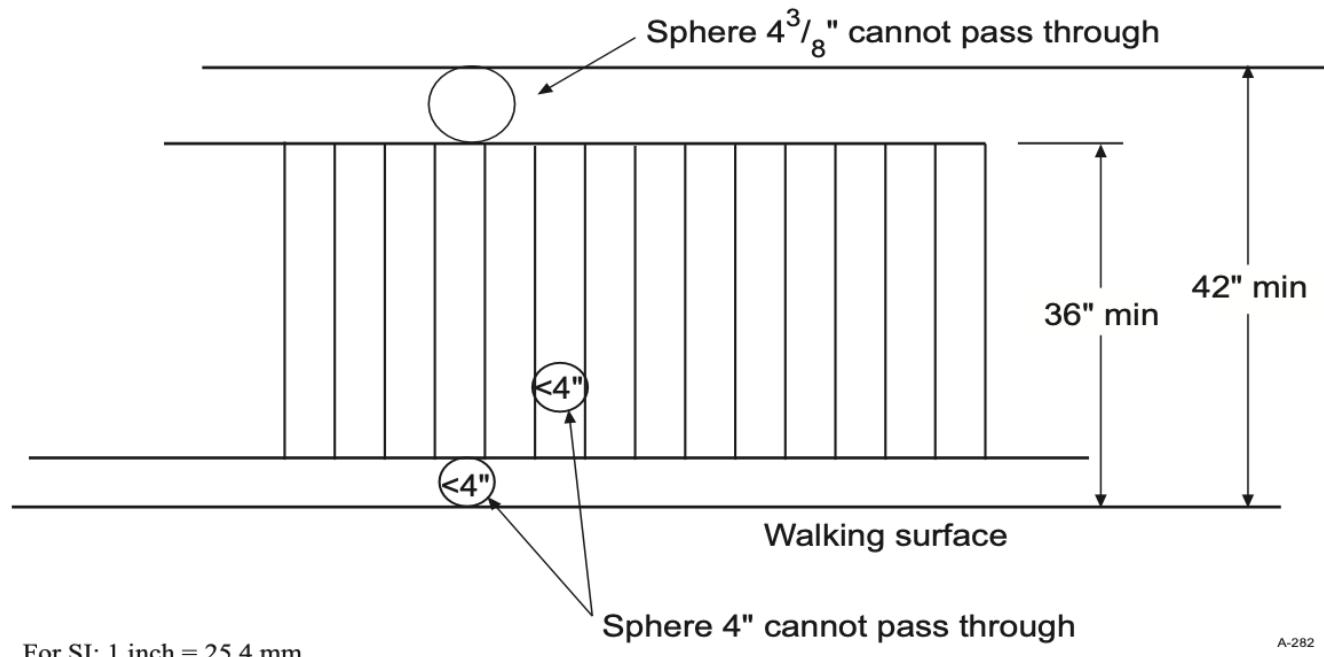


Figure 1014-2 Noncircular handrail.

1015 Guards: Location, Height and Openings

- Guards shall be located along open-sided walking surfaces, including mezzanines, equipment platforms, aisles, 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. See the exceptions. Required guards shall be not less than 42 inches (1067 mm) high, measured vertically (1) from the adjacent walking surfaces; (2) on stairways and stepped aisles, from the line connecting the leading edges of the tread nosings; and (3) on ramps and ramped aisles, from the ramp surface at the guard. See the exceptions. Required guards shall not have openings which allow passage of a sphere 4 inches (102 mm) in diameter from the walking surface to the required guard height. See the exceptions.
- Guards must be of adequate height and structural stability to prevent an individual from accidentally falling from the protected area. They must also be designed also to prevent small children from intentionally crawling through the barrier.

1015 Location, Height and Openings

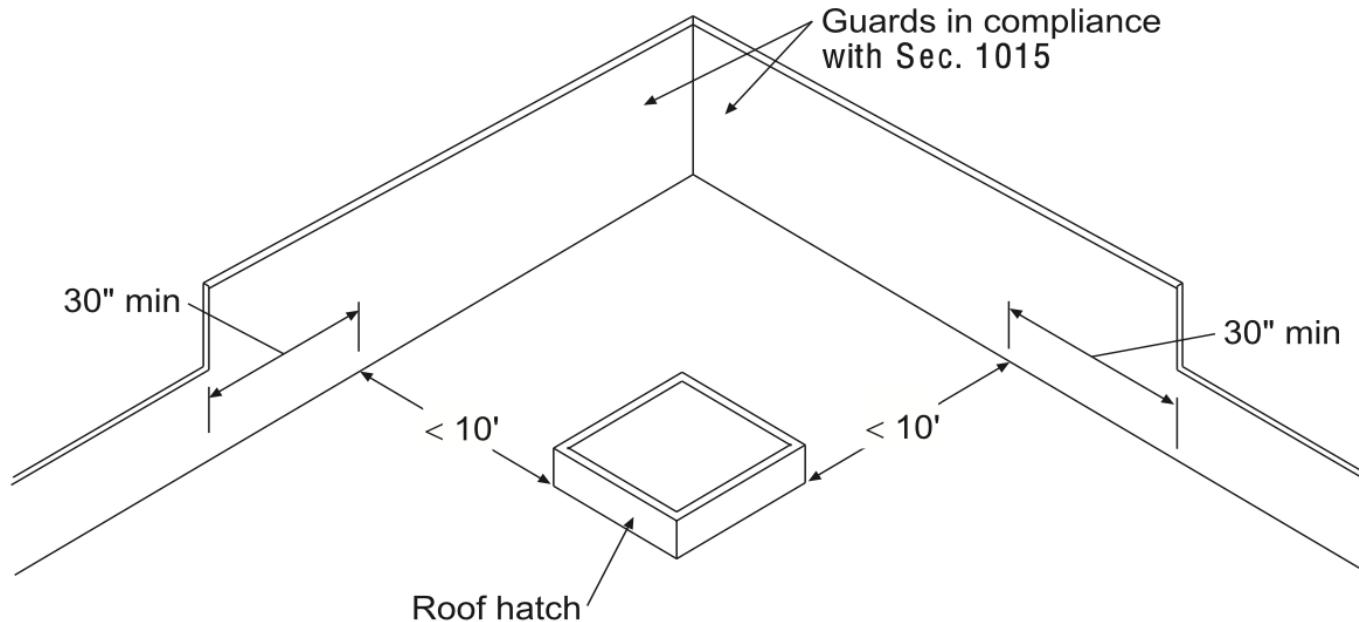


In certain industrial-type areas, the degree of guard protection is reduced because of the nonpublic uses involved. In addition, guards are not mandated in specific applications relating to loading docks, stages, platforms and vehicle service pits.

1015.6 Rooftop Access and Equipment

- Guards shall be provided where various components that require service are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof or grade below. The guard shall extend not less than 30 inches (762 mm) beyond each end of such components. The guard shall be constructed so as to prevent the passage of a sphere 21 inches in diameter (533 mm). See the exception for locations where personal fall arrest/ restraint anchorage connector devices are installed.
- The requirement for guards primarily addresses the hazard created when service personnel are working on rooftop equipment. Where such activity occurs close to a roof edge, it is critical that guards be provided to prevent an accidental fall.

1015.6 Rooftop Access and Equipment



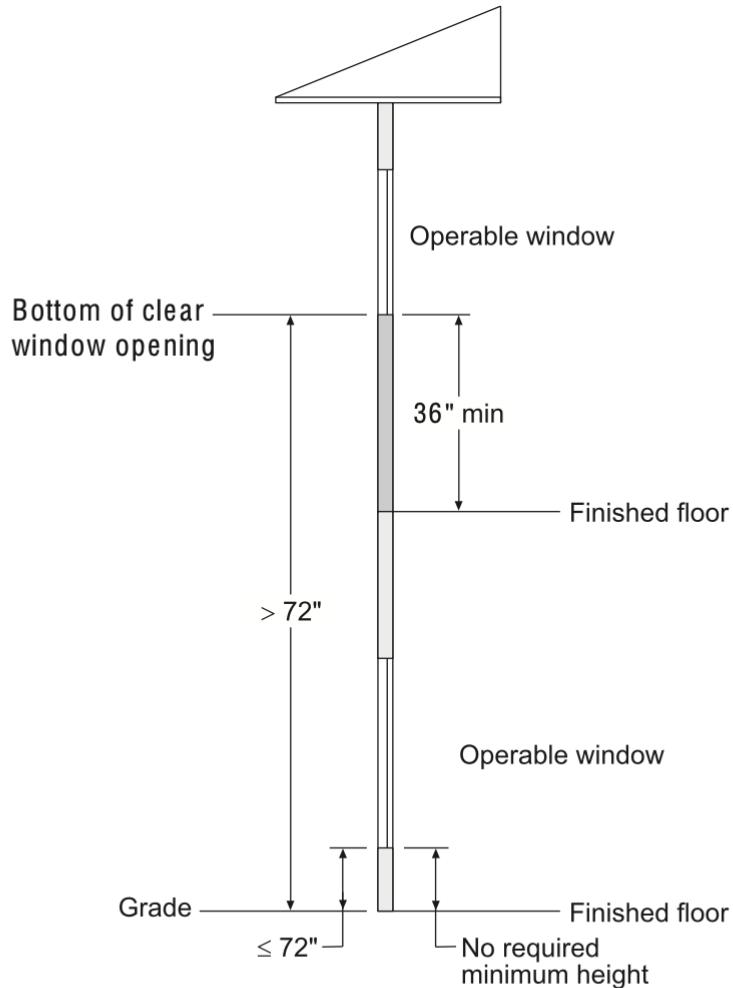
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm

A guard is also mandated where a roof hatch is located near a roof edge. At times, these roof accesses are used during inclement weather, emergency situations or times of darkness. The area around roof hatch openings is also often utilized as a staging area or work area.

1015.8 Window Sills

- Windows in Group R-2 and R-3 buildings including dwelling units, where the bottom of the clear opening of an operable window opening is located less than 36 inches (914 mm) above the finished floor and more than 72 inches (1829 mm) above the finished grade or other surface below on the exterior of the building, shall comply with one of the following: See the four options, including limited-size openings or the use of window fall-prevention devices or window opening-control devices.
- The opening height for operable windows located a considerable height above the surface below is intended to reduce the number of falls by children from such windows. The minimum height is established at a point above the center of gravity of most children.

1015.8 Window Sills



The measurements on both the interior and exterior sides of the building are taken from the top of the clear opening of the operable window, providing for consistent application. Where the lower window panel is inoperable, the measurement is to be taken to the lowest point of the lowest operable panel.

1028 Exit Discharge

Exits are intended to discharge directly to the exterior of the building. Three exceptions permit the exit path to include a portion of the building beyond the exit component. An exception to the requirements for the continuity of interior exit stairways (and ramps) is permitted where a maximum of 50 percent of the exits pass through areas on the level of exit discharge. The path of travel to the exterior must be unobstructed and easily recognized. Sprinkler protection is required for the egress path between the termination of the interior exit stairway to the building's exterior, as is fire-resistance-rated construction isolating any areas below the discharge level.

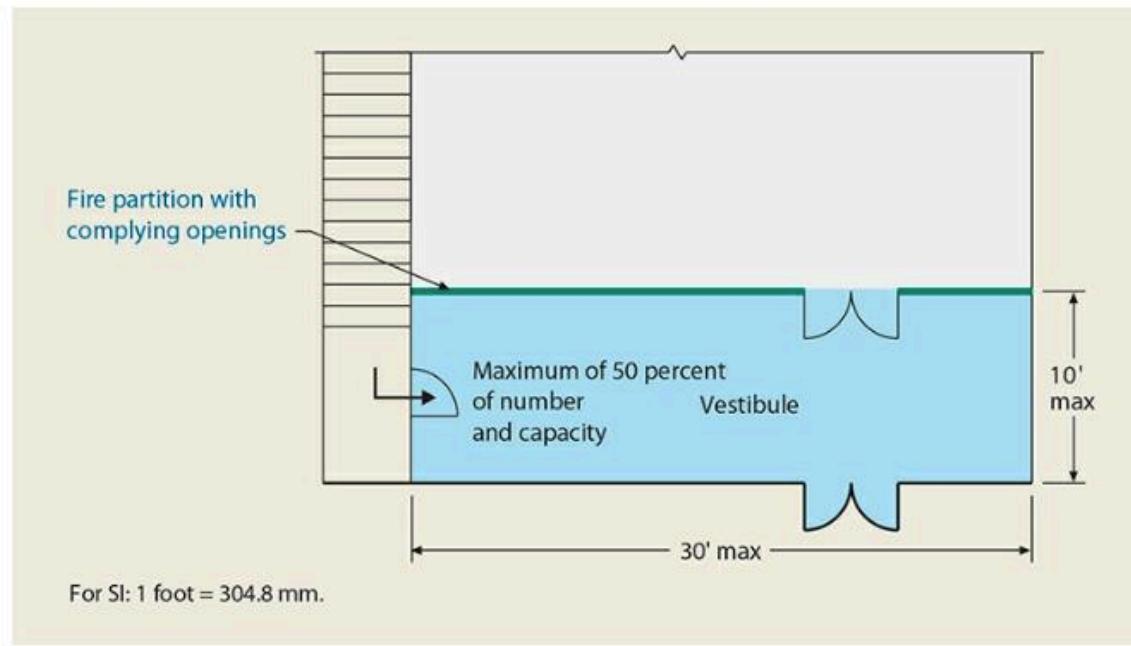


Figure 1028-2 Exit discharge through vestibule.