2021 IBC Special Building Types, Features and Hazards

Based on the 2021 International Building Code® (IBC®)

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Description

- This course provides an overview of selected 2018 IBC Chapter 4 provisions and the application of the code requirements for various building types and features that are addressed in Chapter 4.

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Objectives

- Upon completion, participants will be better able to:
  - Understand the scope and application of the provisions of Chapter 4.
  - Apply the unique provisions applicable to special building types, such as high-rise and underground buildings, parking garages, open and covered mall buildings, and special amusement areas.

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Objectives (continued)

- Upon completion, participants will be better able to:
  - Apply the code provisions applicable to special building features, such as atriums, stages and platforms.
  - Apply the specific provisions applicable to special hazards, such as the storage and use of hazardous materials, control areas and laboratory suites, combustible storage, spray application of flammable finishes, and medical gas storage rooms.

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Course Overview

- Module 1 – Overview, Scope and Application of IBC Chapter 4
- Module 2 – Special Types of Buildings
  - High-rise Buildings
  - Underground Buildings
  - Parking Garages
  - Open and Covered Mall Buildings
  - Special Amusement Areas

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Course Overview

- Module 3 – Special Building Features
  - Atriums
  - Stages and Platforms
- Module 4 – Special Hazards
  - Combustible Storage
  - Use and Storage of Hazardous Materials
  - Control Areas and Laboratory Suites
  - Spray Application of Flammable Finishes
  - Medical Gas Storage Rooms

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Overview, Scope and Application of IBC Chapter 4

Module 1

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Overview of Chapter 4

- The detailed requirements in Chapter 4 are varied in their scope and application.
- The provisions found in Chapter 4 typically modify or expand the general requirements established throughout the IBC.
- As the provisions of Chapter 4 are specific in nature, they will take precedence over any general provisions.

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Subjects Addressed in Chapter 4

- The provisions of Chapter 4 can be organized into several basic categories:
  - Special types of buildings
  - Special building features
  - High-hazard areas and operations
  - Facilities where people sleep, and/or are under care or restrained
- Not all subject areas of Chapter 4 will be addressed in this program

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Special Types of Buildings

Module 2

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High-Rise Buildings

Section 403

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Definition of High-rise Building Section 202

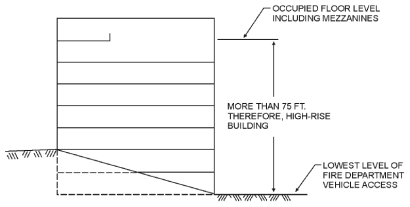

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Figure 403.1(1)
HIGH-RISE BUILDING

12

Applicability Section 403.1

- All high-rise buildings, as defined by Section 202, are subject to the special provisions of Section 403, except for:
  - Aircraft traffic control towers
  - Open parking garages
  - Portions of buildings containing a Group A-5 occupancy
  - Special industrial occupancies
  - Buildings with Group H-1 and specified Group H-2 and H-3 occupancies

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Fire-resistance Ratings Section 403.2.1

- A reduction is permitted in the required fire-resistance ratings for type of construction purposes where the building has sprinkler control valves equipped with supervisory initiating devices and water-flow initiating devices for each floor.
- The reductions are selectively applied to various building elements as addressed in Table 601.

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Fire-resistance Ratings Section 403.2.1.1

- For buildings not greater than 420 feet in height, the building elements (other than columns supporting floors) in Type IA construction are permitted to be reduced to those required for Type IB buildings.
- In other than Group F-1, H-2, H-3, H-4, M and S-1 occupancies, the building elements in Type IB construction are permitted to be reduced to those required for Type IIA buildings.

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Shaft Enclosures Section 403.2.1.2

- For buildings not greater than 420 feet in height, the required fire-resistance ratings for vertical shafts (other than interior exit stairway and elevator hoistway enclosures) are permitted to be reduced to 1-hour.
  - Automatic sprinklers are required to be installed within the shafts at the top and at alternate floors.

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Structural Integrity of Enclosures Section 403.2.2

- Special structural integrity provisions for interior exit stairways and elevator hoistway enclosures must be applied to:
  - High-rise buildings of Risk Category III or IV, and
  - All buildings more than 420 feet in building height.
- The wall assemblies must comply with established levels of impact resistance as set forth in the provisions.

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Sprayed Fire-resistant Materials Section 403.2.3

- The bond strength of the SFRM installed throughout the building shall comply with:

Table 403.2.3 Minimum Bond Strength

HEIGHT OF BUILDING	SFRM MINIMUM BOND STRENGTH
Up to 420 feet	430 psf
Greater than 420 feet	1,000 psf

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Automatic Sprinkler System Section 403.3

- A key component of high-rise buildings is the required sprinkler system.
- The provisions of Section 403.3 address:
  - Number of sprinkler risers
  - System design
  - Riser location
  - Water supply to fire pumps
  - Secondary water supply

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Required Emergency Systems Section 403.4

- The detection, alarm and emergency systems required in a high-rise building are also a part of the fire- and life-safety package. Such systems include:
  - Smoke detection
  - Fire alarm system
  - Standpipe system
  - Emergency voice/alarm communication system
  - Emergency communication coverage
  - Fire command
  - Smoke removal
  - Standby and emergency power

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Remoteness of Stairways Section 403.5.1

- In addition to the general provisions for exit separation as established in Section 1007.1.1, at least two required interior exit stairways shall be separated by a distance of at least:
  - 30 feet, or
  - ¼ of the maximum overall diagonal dimension
  - Whichever distance is less
- Measurement made in a straight line between the nearest points of the enclosures.

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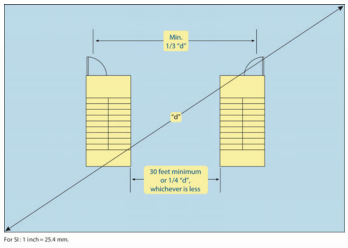
Remoteness of Stairways Section 403.5.1



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Additional Interior Exit Stairway Section 403.5.2

- Only required in buildings over 420 feet in height, one additional exit stairway shall be provided in addition to those typically mandated.
  - Not applicable to:
    - Group R-2 occupancies and their ancillary spaces
    - Buildings having elevators used for occupant self-evacuation
    - Portions of building with highest floor less than 420 feet in height
- The total width of any combination of remaining stairways with one removed shall not be less than the total width required by Section 1005.1.

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Stairway Door Operation Section 403.5.3

- Other than the exit discharge doors, stairway doors can be locked on the stairway side provided they are capable of being unlocked simultaneously without unlatching upon a signal from the fire command center.
- A telephone or other two-way communications system connected to an approved constantly attended station shall be provided, at minimum, at every fifth floor.

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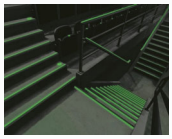
Smokeproof Enclosures Section 403.5.4

- Where a required stairway serves a floor above the "high-rise" level, it shall be constructed as a smokeproof enclosure.
- The enclosure shall consist of an enclosed interior exit stairway with either an open exterior balcony or a ventilated vestibule.
  - As an option, the balcony or vestibule is not required where the interior exit stairway is pressurized per Section 909.20.5.

25

Luminous Egress Path Markings Section 403.5.5

- Approved luminous egress markings are required to delineate the exit paths, other than at the level of exit discharge, in high-rise buildings of Group A, B, E, I-1, M and R-1 occupancies.
- The markings shall be provided in interior exit stairway and exit passageways.
- Detailed provisions provided in Section 1025.



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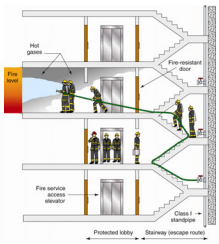
Fire Service Access Elevators Section 403.6.1

- In buildings with an occupied floor more than 120 feet above the lowest level of fire department vehicle access, at least two fire service access elevators must be provided.



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Occupant Evacuation Elevators Section 403.6.2

- Passenger elevators installed per Section 3008 permitted to be used for occupant self-evacuation.
- Minimum required number of such elevators based on egress analysis addressing:
  - Full-building evacuation in less than 1 hour, or
  - Evacuation of 5 consecutive floors with the highest accumulation occupant load in less than 15 minutes
- Where occupant evacuation elevators are provided, the additional stairway is not required.

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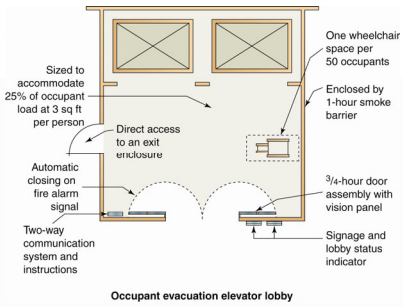
Occupant Evacuation Elevators Section 403.6.2



Occupant evacuation elevator lobby

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Underground Buildings

Section 405

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Underground Buildings

- Underground buildings, as defined in the IBC, present unique hazards to life safety.
  - To egress the structure, occupants must travel in an upward direction.
  - The direction of occupant travel is the same as the direction that the products of combustion travel.
  - As such, both the occupants and rescue personnel are potentially exposed to the products of combustion along the entire means of egress.

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Underground Buildings

- The requirements for underground buildings are similar to those for high-rise structures.
- Both types of structures are unusual since they are virtually inaccessible to exterior fire suppression and exterior rescue and have greater potential to trap occupants inside.

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Applicability Section 405.1

- Buildings or portions of buildings that are underground and require occupants of the lowest level to travel upwards for more than 30 feet to reach the level of exit discharge are regulated as Underground Buildings.

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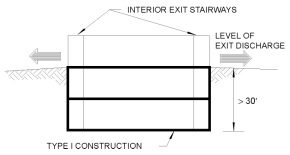
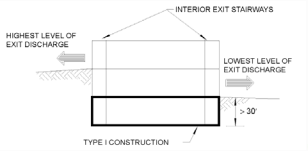
Applicability
Section 405.1





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Exemptions
Section 405.1

- The provisions of Section 405 are not applicable to the following buildings:
  - One-and two-family dwellings
  - Sprinklered parking garages
  - Subway transit systems
  - Stadiums and arenas
  - Pumping stations
  - Underground buildings with a small floor plate and low occupant load

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Construction Requirements
Section 405.2

- Type I construction is required for all below-grade levels of an underground building.
- The permitted construction types for the above-grade stories are regulated by the general building limitations of Chapters 5 and 6.

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Automatic Sprinkler System Section 405.3

- A sprinkler system is required at the highest level of exit discharge serving the underground portions of the building and all levels below.

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Compartmentation Section 405.4

- Underground buildings with a floor level more than 60 feet below the level of exit discharge require a minimum of two smoke compartments separated with a smoke barrier (Section 709).
- Compartmentation is required at the level of exit discharge and every level below.
- Compartmentation is a key element for occupant egress and fire fighter access.
  - Compartments allow occupants to travel horizontally to escape a fire and also provide a staging area for the fire service.

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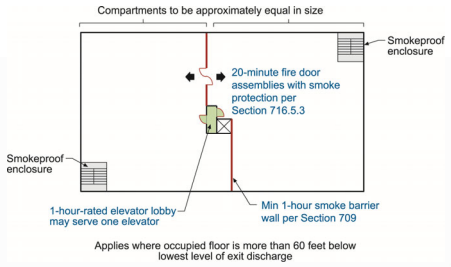
Compartmentation Section 405.4



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Elevators and Smoke Control Sections 405.4.3 and 405.5.2

- Where a single elevator is provided to serve all compartments, an elevator lobby compartment with direct access to each smoke compartment is required.
- Where compartmentation is required because of building depth, the required smoke control system in Section 405.5 is to be an independent system within each compartment.

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Smoke Control System Section 405.5

- A smoke control system designed in accordance with Section 909 is required for all underground buildings.
  - The smoke control system is an integral part of the required fire protection systems and is focused on mechanically managing smoke during the period of occupant evacuation.
  - A smoke control system will require some form of compartmentation regardless of whether or not compartmentation is required by Section 405.4.

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Smoke Control System Section 405.5

- The goal of smoke control is to contain smoke and hot gases to the immediate area of origin.
- The most common type of smoke control is a pressurization system where the smoke is managed by maintaining pressure differences across smoke barriers.

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Fire Alarm Systems
Section 405.6

- A manual fire alarm system is required in underground buildings.
- The fire alarm system shall include emergency voice/alarm communication (EVAC) when the lowest floor level is more than 60 feet below the exit discharge.

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Means of Egress
Section 405.7

- A minimum of two exits are required for each level.
- All stairways must be smokeproof enclosures in accordance with Sections 1023.12 and 909.21.
- Each compartment required by Section 405.4 requires direct access to an exit and a second means of egress through an adjoining compartment.

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Standby Power
Section 405.8.1

- Full standby power is required for the following building systems:
  - smoke control systems
  - ventilation and automatic fire detection equipment for smokeproof enclosures
  - elevators

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Emergency Power Section 405.9

- Full emergency power is required for the following building systems:
  - emergency voice/alarm communication
  - fire alarm
  - automatic fire detection
  - elevator car lighting
  - means of egress illumination
  - exit sign illumination
  - fire pumps

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Parking Garages

Section 406

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Motor-Vehicle-Related Uses Section 406

- Special provisions for parking garages are set forth in Section 406, along with those provisions unique to repair garages and motor vehicle fuel-dispensing facilities.

Use	Code Section
All motor-vehicle related uses	Section 406.2
Private garages and carports	Section 406.3
Public garages, both open and enclosed	Section 406.4
Open parking garages	Section 406.5
Enclosed parking garages	Section 406.6
Motor fuel-dispensing facilities	Section 406.7
Repair garages	Section 406.8

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All Motor-Vehicle-Related Uses Section 406.2

- Clear height in vehicle and pedestrian traffic areas to be no less than 7 feet.
- Openings between such uses and a room used for sleeping purposes are prohibited.
- Mixed occupancies and uses permitted in accordance with Section 508.
- Equipment and appliances having an ignition source to be elevated to point where ignition source is at least 18 inches above floor surface where appliance or equipment rests.

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Private Garages and Carports Section 406.3

- Private garages, classified as Group U occupancies, are limited in floor area to 1,000 square feet; however, multiple garages are permitted in the same building where each garage is separated from other garages by minimum 1-hour fire barriers.
- Prescriptive separations are established for garages attached to dwelling units.
- Carports, also classified as Group U, must be open on at least two sides.
  - No separation required between Group U carport and Group R-3 provided no enclosed areas above carport.

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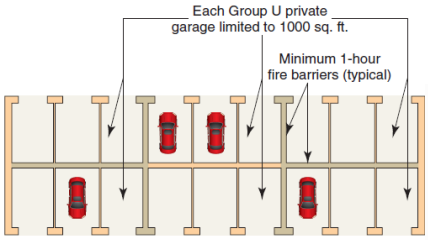
Private Garages and Carports Section 406.3



Example: If non-sprinklered building of Type VB construction, total allowable area limited to 5500 sq. ft. plus any applicable frontage increase

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Public Parking Garages Section 406.4

- Public parking garages, both open and enclosed, are regulated as Group S-2 storage occupancies.
- In addition to the provisions of Section 406, parking garages must also comply with the code provisions for Group S-2 occupancies.

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Public Parking Garages Section 406.4

- Complying guards shall be provided for pedestrians with a minimum height of 42 inches where the drop-off exceeds 30 inches.
- Vehicle barriers a minimum of 33 inches in height are required where the drop-off exceeds 12 inches.

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Public Parking Garages Section 406.4

- Vehicle ramps intended for parking and pedestrian use cannot exceed a 1:15 slope.
- Steeper vehicle ramps cannot be part of pedestrian routes.
- Sloped pedestrian routes intended for egress between garage levels must comply with normal ramp requirements with respect to slope, landings, guards, handrails, etc., and not be shared with vehicles.

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Definition of Open Parking Garage Section 202

A structure or portion of a structure with the openings as described in Section 406.5.2 on two or more sides that is used for the parking or storage of private motor vehicles.

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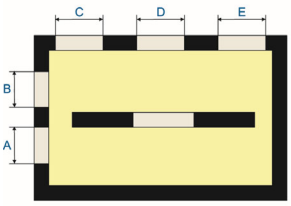
Open Parking Garage Openings Section 406.5.2

Exterior walls must have uniformly distributed openings on two or more sides

Interior wall and column lines shall be at least 20 percent open (area) with uniformly distributed openings



1. Area:
A + B + C + D + E ≥ 20% total area of each tier

2. Length:
A + B + C + D + E ≥ 40% total perimeter of each tier*

* Minimum of 40 percent not required where required opening uniformly distributed over two opposing sides

General case

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Open Parking Garages Section 406.5

- Open parking garages must be of Type I, II or IV construction.
- Garages are to be used to store only private motor vehicles. All garages allowing commercial trucks or buses must be classified as enclosed parking garages, open or not.
- Vehicle repair and dispensing of fuel is not permitted. A limited amount of garage support spaces can be in the structure.

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Open Parking Garages Section 406.5.4

- A variety of height and area increases are permitted for single-use open parking garages.

TABLE 406.5.4
OPEN PARKING GARAGES AREA AND HEIGHT

TYPE OF CONSTRUCTION	AREA PER TIER (square feet)	HEIGHT (in tiers)		
		Ramp access	Mechanical access	
			Automatic sprinkler system	
			No	Yes
IA	Unlimited	Unlimited	Unlimited	Unlimited
IB	Unlimited	12 tiers	12 tiers	18 tiers
IIA	50,000	10 tiers	10 tiers	15 tiers
IIB	50,000	8 tiers	8 tiers	12 tiers
IV	50,000	4 tiers	4 tiers	4 tiers

For SI: 1 square foot = 0.0929 m^2.

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Open Parking Garages Section 406.5

- Unprotected exterior openings are permitted where the fire separation distance is at least 10 feet.
- The means of egress is based on one person per 200 square feet of gross floor area.
- Enclosure is not required for exit stairways and elevator lobbies.

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Open Parking Garages Section 406.5.11

- The following uses and alterations are prohibited:
  - Vehicle repair.
  - Parking of buses, trucks, commercial vehicles.
  - Temporary or permanent enclosing of required perimeter openness.
  - Dispensing of fuel.

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Enclosed Parking Garages Section 406.6

- The general height and area limitations of Chapter 5 apply to parking garages not meeting the minimum openness provisions for open parking garages.
- Mechanical ventilation system and exhaust system required in all enclosed parking garages.
- An automatic sprinkler system required in enclosed parking garages where:
  - the fire area exceeds 12,000 square feet, or
  - the garage is located beneath other occupancies.

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Mechanical-Access Garages Section 406.6.4

- Mechanical-access enclosed parking garages are specifically regulated for:
  - Separation: Minimum of 2 hours from other occupancies and accessory uses
  - Smoke removal: Mechanical smoke removal system required
  - Fire control equipment room: Fire control equipment to be provided in minimum 50 sf room that is located in an approved location and accessed by fire service from secured exterior door
  - Emergency shutdown: Manually activated emergency shutdown switch required for use by emergency personnel

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Open and Covered Mall Buildings

Section 402

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Applicability
Section 402.1

- The special provisions applicable to covered mall buildings and open mall buildings are only applicable to those buildings no more than:
  - 3 floor levels at any point, and
  - 3 stories above grade plane.
- Buildings need not comply with Section 402 if they totally comply with other applicable provisions of the code.

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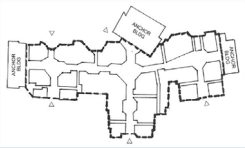
Perimeter Line
Section 402.1.1

- A building perimeter line encircling all buildings and structures comprising an open mall building must be established.
- The perimeter line encloses all portions of the open mall building, including open-air walkways and spaces, but does not enclose any anchor buildings or parking garages adjacent to the open mall building.



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Open Space
Section 402.2

- A required minimum open space of 60 feet must be provided in all directions around the perimeter of the mall building and at the perimeter of anchor buildings and parking garages attached to the covered mall building.
- The same open space is required to surround open mall buildings.
- The open space can be reduced in the same manner as for unlimited area buildings.

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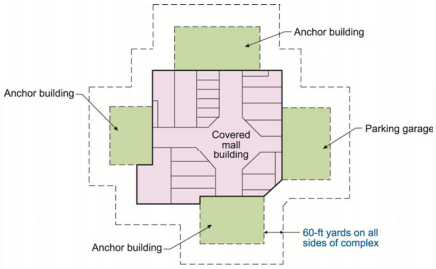
Open Space
Section 402.2



Unlimited area permitted if building surrounded by minimum 60-foot open space and of other than Type V construction.

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Lease Plan
Section 402.3

- Building and fire departments require the filing of up-to-date lease plans for open mall and covered mall buildings.
- These lease plans are typically submitted after the mall certificate of occupancy has been issued since initial tenant lease lines are rarely known at the time of mall construction.

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Area and Types of Construction
Section 402.4.1.1

- Covered mall and open mall buildings are addressed as special types of unlimited area buildings that are exempt from the area limitations of IBC Chapter 5 where the building is:
  - of Type I, II, III or IV construction
  - not more than three stories above grade
  - limited in height to three floor levels at any point

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Area and Types of Construction Section 402.4.1.2

- Anchor buildings regulated for building area and building height based on type of construction as required by general provisions of Chapter 5, <u>except</u>:
  - Building area not limited where anchor building is:
    - of Type I, II, III or IV construction
    - not more than three stories above grade

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Fire Separations Section 402.4.2

- Anchor buildings are regulated as separate buildings.
  - As separate buildings, fire walls are required at the anchor/mall common wall.
  - Minimum 2-hour fire barriers may be used for separation when the anchor building is:
    - limited to 3 stories above grade plane, and
    - of the same occupancy as the general mall tenants.
  - Openings between the anchor building and pedestrian area of the mall need not be protected where the anchor building is of Type I or II construction.

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Open Mall Construction Section 402.4.3

- A minimum open area width of 20 feet is required between opposing structures from the lowest grade level to the sky above.
  - The width of the opening is measured perpendicular from the face of the tenant spaces, essentially across the pedestrian mall.
- Balconies and other projections are permitted but may not project into the required 20-foot minimum mall width.

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Automatic Sprinkler System Section 402.5

- Both covered and open mall buildings and any connected buildings, other than open parking garages, must be protected with an automatic sprinkler system.
- The system but be:
  - Designed, installed, tested and maintained in accordance with Chapter 9, the International Fire Code (IFC) and NFPA 13.
  - Installed such that any portion serving tenant spaces in a covered mall building may be shut down independently so that changes can be made to it during tenant modifications.
- Exterior areas in open malls below overhead walkways must be provided with sprinklers.

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Kiosks Section 402.6.2

- The restriction on the construction and location of kiosks is intended to minimize the potential for fire spread through the mall area.
  - Acceptable construction materials include: fire-retardant treated wood, foam plastics meeting specific ignition and heat release tests, and aluminum composite materials meeting Class A finish requirements.
  - Kiosks, kiosk groups and similar non permanent structures are limited to 300 square feet in area.
  - Kiosk separation from other kiosks, kiosk groups or mall structures is 20 feet minimum.
  - Kiosks with roofs or covers require sprinklers and fire detection.

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Emergency Systems Section 402.7

- In addition to the automatic sprinkler system required by Section 402.5, the following systems are required:
  - Standpipes,
  - Smoke control,
  - Emergency power,
  - Emergency voice/alarm communication and
  - Fire department access to equipment.

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Means of Egress
Section 402.8

- Most of the special mall building means of egress requirements are based on the assumption that the use of a mall building will be primarily mercantile and business, with some assembly.
- The specific egress requirements in Section 402.8 supersede some of the more general provisions of Chapter 10.

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Mall Width
Section 402.8.1

- Circulation routes in open and covered malls function as exitways without consideration as corridors.
  - 20-foot mall width minimum is based on the need to provide adequate access to the exits
  - Width shall be sufficient for the occupant load served
- Every portion of the minimum width is to be maintained to a height of 8 feet. Kiosks, vending machines, furniture, displays and other potential obstructions are not permitted in any portion of the minimum required aggregate mall width.

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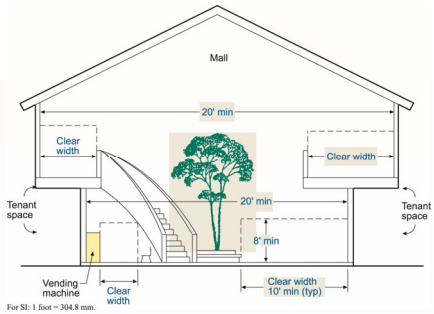
Mall Width
Section 402.8.1



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Occupant Load Determination Section 402.8.2

- Since the tenant spaces of covered and open mall buildings can be used for varied occupancies, the design occupant loads will also vary.
- Each tenant space has its own occupant load calculated using the general provisions of Chapter 10.
- In addition, an occupant load determination is required to provide adequate egress from the mall itself.

79

Anchor Buildings Section 402.8.2.3

- The required exit and exit capacities for an anchor building must be provided independent of the mall or mall exits.
- Since independent exits are provided, the occupant load of anchor stores is not included in determining the exit requirements for the mall.

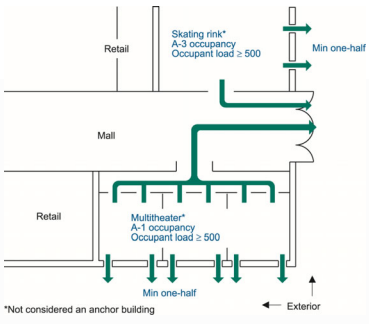
80

Assembly Means of Egress Section 402.8.4

- Assembly occupancies (movie theaters, nightclubs and large restaurants) with an occupant load of 500 or more must be located on an exterior wall of a covered mall building and adjacent to the mall's exits.
- A maximum of 50 percent of the means of egress from these assembly occupancies is permitted to discharge into the mall.

81

Assembly Means of Egress
Section 402.8.4



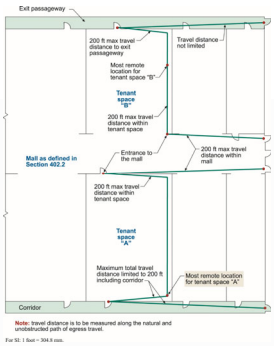
82

Distance to Exits
Section 402.8.5

- The maximum permissible travel distance from any point in a tenant space to the mall is 200 feet.
- The same 200-foot limitation is applied from any point within a covered mall building to an exit, as well as from any point within an open mall building to the perimeter line.

83

Distance to Exits
Section 402.8.5



84

Exit Passageway Service Areas Section 402.8.7

- As a general rule, openings from normally unoccupied spaces are prohibited in exit passageways.
- In the case of mall buildings, service spaces are permitted to open into exit passageways provided the fire-resistance protection of the exit passageway is maintained.
- Service areas limited to:
  - Mechanical rooms
  - Electrical rooms
  - Building service areas
  - Service elevators

85

Security Grilles and Doors Section 402.8.8

- Limits to the use of security grilles as a part of the means of egress include:
  - During business hours, a grille must remain in its full, open position.
  - Security grilles cannot be used for more than 50 percent of the exits serving a space.
  - A grille may be partially closed at a sole means of egress when less than 10 persons occupy the space.
  - A grille may be partially closed at one opening of a two-egress space when less than 50 persons occupy the space.

86

Special Amusement Areas

Section 411

87

Special Amusement Area Section 202

- A special amusement building is any temporary or permanent building or portion thereof that is used for amusement, entertainment or educational purposes, and is arranged in a manner that:
  - Makes the means of egress path is not readily apparent due to visual or audio distractions, or
  - Intentionally confounds identification of the egress path, or
  - Otherwise makes the means of egress path not readily available because of the nature of the attraction or mode of conveyance through the building or structure.

88

Special Amusement Buildings Section 411.1

- Section 411 does not apply to a facility without a roof or enclosing walls, such as outdoor mazes and similar seasonal facilities.
- Free and immediate ventilation of smoke eliminates the primary hazard associated with enclosed special amusement buildings, ensuring that egress is readily apparent and not intentionally confusing.

89

Special Amusement Areas Section 411.1

- Enclosed special amusement areas with an occupant load of 50 or more shall be classified as a Group A occupancy.
- Where the occupant load is less than 50, a Group B classification is warranted.
- These provisions apply in addition to the other requirements for the appropriate use.

90

Automatic Sprinkler System Automatic Smoke Detection Sections 411.2, 411.3

- Special amusement areas require an automatic sprinkler system, except where all of the following conditions exist:
  - where the area is less than 1,000 square feet, and
  - the travel distance to an exit is less than 50 feet, and
  - the facility is used only on a temporary basis.
- In addition, an automatic smoke detection system is required.

91

Alarm Section 907.2.12

- Activation of any single fire detection device or sprinkler head must cause an alarm to be sounded at a constantly attended location.
- Staff then shall initiate the process of providing egress illumination, stopping all confusing sounds and distractions, activating the lighted exit markings, and preventing additional persons from entering the facility.
- Activation of two or more devices requires automatic activation of these safety features.

92

Emergency Voice/Alarm System Section 411.4

- An emergency voice/alarm communication system (EV/AC) must be provided.
  - The EV/AC may serve as a public address system to alert the occupants of an emergency and provide them with instructions.
- The system must be installed in accordance with NFPA 72 and must be heard throughout the entire building containing a special amusement area.

93

Puzzle Room Exiting Section 411.5

- A puzzle rooms is defined as *a type of special amusement area in which occupants are encouraged to solve a challenge to escape from a room or series of rooms.*
- Puzzle room exiting shall:
  - Comply with Chapter 10, or
  - Be an approved alternate design, or
  - Be open and readily available upon activation by the automatic fire alarm system, automatic sprinkler system, and a manual control at a constantly attended location.

94

Exit Marking Section 411.6

- In addition to the normally required exit signs, approved directional exit markings shall also be provided.
- Where the path of egress travel is intentionally not apparent, complying low-level exit signs and directional markings are required.
  - Floor-proximity directional markings and exit signage may be dimmed provided they become immediately visible in an emergency.

95

Exit Marking Section 411.6

- The automatic smoke detection system and/or automatic sprinkler system must activate all dimmed or darkened exit markings.

96

Interior Finish
Section 411.7

- Due to the potential for fire to spread quickly in the relatively confined spaces in these structures, only Class A materials are permitted to be used as interior finishes.
- Special amusement areas are not permitted finish classification reductions normally allowed by Table 803.13 for sprinklered buildings.

97

Special Building Features

Module 3

98

Atriums

Section 403

99

General Atrium Requirements Section 404.1

- An atrium is a space within a building that extends vertically to connect multiple stories.
  - Atriums are not considered unprotected vertical openings because they are protected by means other than typical floor assemblies or shaft enclosures.
  - They typically function as circulation or lobby space and often include a range of other functions.
  - As with any floor opening atriums provide an increased potential for the spread of smoke and fire between the connected stories.

2021 IBC Special Building Types, Features and Hazards 100

100

General Atrium Requirements Section 404.1

- Atrium provisions do not apply to spaces that comply with at least one of the other vertical opening protection methods established in Sections 712.1.1 through 712.1.3, and Sections 712.1.9 through 712.1.14.
- Atrium provisions are essentially one of several options for regulating vertical openings in horizontal assemblies in buildings.
- Atrium provisions are not to be applied to Group H occupancies.

2021 IBC Special Building Types, Features and Hazards 101

101

Atrium Use Section 404.2

- Low fire-hazard uses are limited on the atrium floor to such functions as pedestrian walk-through areas, security desks, reception areas, etc.
  - In addition, only approved materials and decorations that meet the IFC shall be used in the atrium space.
- When the atrium floor area is equipped with an automatic sprinkler system that can provide the required protection, then its use is not restricted.

2021 IBC Special Building Types, Features and Hazards 102

102

Automatic Sprinkler Protection Section 404.3

- All floor areas connected to the atrium are to be protected with an automatic sprinkler system, including the atrium space itself.
- When the atrium space is separated from the remainder of the building by 2-hour fire barriers or horizontal assemblies, only the atrium space is required to be sprinklered (except as required by other code sections).
- Sprinklers are not required at the atrium ceiling when the ceiling is greater than 55 feet above the atrium floor.

103

Fire Alarm System Section 404.4

- Section 907.2.14 requires a fire alarm system in atriums connecting more than two stories.
- When atriums are located in Groups A, E and M occupancies, an emergency voice/alarm communication system is also required.

104

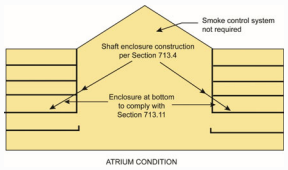
Smoke Control Section 404.5

- A mechanical smoke control system is required in all atriums connecting three or more stories to prevent the migration of smoke throughout interconnected levels of a building via an atrium.
  - Two or more stories for Groups I-2 and I-3
- The typical method of smoke control in atriums is the exhaust method (Section 909). Smoke control systems are required to be connected to a standby source of power (Section 404.7).

105

Smoke Control
Section 404.5, Exception 2

- A smoke control system is not required for atriums connecting more than two stories where:
  - Only the two lowest stories are open to the atrium, and
  - All stories above the lowest two stories are separated from the atrium as required for a fire-resistance-rated shaft.



106

Enclosure of Atriums
Section 404.6

- Although a fire-resistance-rated separation is typically required as the atrium enclosure, a glass wall that forms a smoke partition can be substituted.
  - Sprinklers are to be provided on both sides of the glass wall, but permitted on only the room side where no walkway occurs on the atrium side.
- Up to three floors can be open to the atrium without any form of separation if accounted for in the design of the smoke control system.

107

Interior Finish
Section 404.8

- Interior finishes in atriums can be no less than Class B.
- The presence of a sprinkler system does not allow a reduction of the finish class.

108

Travel Distance
Section 1017.3.2

- The total exit access travel distance through the upper levels of an atrium is limited to 200 feet.
- Since smoke is being drawn to the atrium via smoke control, the time allowed to reach an exit through the upper levels needs to be limited.
- Exit access travel distance at the atrium floor level and at levels that do not communicate with the atrium is regulated by the general provisions in Table 1017.2.

2021 IBC Special Building Types, Features and Hazards 109

109

Interior Exit Stairways
Section 404.10, 404.11

- Where an atrium contains an interior exit stairway, it is acceptable for up to 50 percent of such stairways to egress through an atrium at the level of exit discharge in accordance with Section 1028.
  - Five conditions must be met where an interior exit stairway is located within an atrium.

2021 IBC Special Building Types, Features and Hazards 110

110

Stages and Platforms

Section 410

111

Stages and Platforms Section 410

- The provisions of Section 410 are intended to limit the threat to an audience from a stage fire.
- Requirements address construction material restrictions, sprinkler systems, ventilation, separation of the stage from the audience and compartmentation of backstage areas.
- Special allowances are provided for galleries, gridirons, catwalks and other technical production areas.

2021 IBC Special Building Types, Features and Hazards 112

112

Stages and Platforms Section 410

- Hazards associated with stages include:
  - Combustible scenery, suspended lighting and special effects
  - Soft acoustical treatments throughout stage areas
  - Workshops, scene docks and dressing rooms around the stage perimeter
  - Under-stage storage and property rooms.

2021 IBC Special Building Types, Features and Hazards 113

113

Definitions Section 202

- **STAGE.** A space within a building utilized for entertainment or presentations, which includes overhead hanging curtains, drops, scenery or stage effects other than lighting and sound.
- **PROSCENIUM WALL.** The wall that separates the stage from the auditorium or assembly seating area.

2021 IBC Special Building Types, Features and Hazards 114

114

Definitions: Section 202

- **PLATFORM**. A raised area within a building used for worship, the presentation of music, plays or other entertainment; the head table for special guests; the raised area for lecturers and speakers; boxing and wrestling rings; theater-in-the round stages; and similar purposes wherein there are no overhead hanging curtains, drops, scenery or stage effects other than lighting and sound. A temporary platform is one installed for not more than 30 days.

2021 IBC Special Building Types, Features and Hazards 115

115

Definitions Section 202

- **TECHNICAL PRODUCTION AREAS.** Open elevated areas or spaces intended for entertainment technicians to walk on and occupy for servicing and operating entertainment technology systems and equipment. Galleries, including fly and lighting galleries, gridirons, catwalks, and similar areas are designed for these purposes.

2021 IBC Special Building Types, Features and Hazards 116

116

Stage Construction Section 410.2.1

- Stages shall be constructed of materials as required for floors based on the building's type of construction.
  - Exception 1 allows buildings of any construction type to be constructed with a nominal 2-inch (51 mm) wood deck supported by either unprotected noncombustible construction (Type IIB) or heavy timber construction (Type IV).
  - Exception 2 does not require stages to be fire-resistance rated in buildings of Types IIA, IIIA and VA where the space below the stage is equipped with an automatic sprinkler system or fire-extinguishing system.

2021 IBC Special Building Types, Features and Hazards 117

117

Stage Height and Area Section 410.2.1.1

- All wing areas and backstage areas are included as the stage area, unless separated by fire-resistance-rated construction.
- Stage height is defined as the height from the stage floor to the stage roof or highest horizontal assembly that encloses the stage space.
- Stage height includes the fly gallery and fly loft above the stage.

118

Stage Proscenium Wall Section 410.2.4

- A minimum two-hour fire-resistance-rated proscenium wall is required where the stage height is greater than 50 feet.
- Stages with a height less than 50 feet do not require separation from the audience since they have a lesser fuel load potential from scenery, drops and curtains.

119

Stage Proscenium Curtain Section 410.2.5

- The proscenium opening must be protected with either a fire curtain or a water curtain.
- A curtain is not required where a smoke control system or natural ventilation is provided.
  - The special smoke-protected assembly seating allowances for the egress system are not permitted to be applied.
  - The smoke level shall be maintained at least 6 feet above the floor of the means of egress.
- Horizontal sliding doors are also permitted if they have a minimum fire protection rating of 1 hour.

120

Stage Ventilation Section 410.2.7

- Stages larger than 1,000 square feet in area, or with a height greater than 50 feet, must have emergency ventilation to control smoke.
- Roof vents, when used, must open automatically by heat-activated devices with supplemental manual means.
- Smoke control may be used as an option to required roof vents.

121

Permanent Platform Construction Section 410.3

- Permanent platforms are required to be constructed of materials as required for the building's type of construction.
  - Platforms are permitted to be constructed of fire-retardant-treated wood in Type I, II and IV buildings when they are:
    - no more than 30 inches above the main floor,
    - no more than one-third of the floor area of the room, and
    - no more than 3,000 square feet in area.

122

Permanent Platform Construction Section 410.3

- Where the space below a permanent platform is used for storage or any purpose other than equipment, plumbing or wiring, a minimum 1-hour platform floor assembly is required.

123

Temporary Platform Construction Section 410.3

- Temporary platforms (installed for 30 days maximum) may be constructed of any approved material.
- The space beneath a temporary platform may not be used for any purpose other than electrical wiring or plumbing to the platform equipment.

124

Dressing and Appurtenant Rooms Section 410.4

- Backstage rooms, including dressing rooms, storage rooms, prop rooms and shop rooms, must be separated from the stage and from each other.
  - Separation from stage where stage height exceeds 50 feet: 2-hour fire barriers and/or horizontal assemblies
  - Separation from stage where stage height is 50 feet or less: 1-hour fire barriers and/or horizontal assemblies
  - Separation from each other: 1-hour fire barriers and/or horizontal assemblies

125

Technical Production Areas Section 410.5.3

- Fly galleries, gridirons and other technical production areas need only be provided with one approved means of egress.
- Travel distance is limited to 300 feet, 400 feet where the building is sprinklered.
  - Where two or more means of egress are required, one of the means of egress may lead to the roof.
- The egress path may include spiral stairways, alternating tread devices or fixed ladders.

126

Automatic Sprinkler System Section 410.6

- Stages to be provided with automatic sprinkler protection
- In addition, area such as dressing rooms, workshops and storerooms are required to be protected with an automatic sprinkler system.
  - Exception 1 applies to areas less than 4 feet in clear height under stages that are used only for the storage of tables and chairs.
  - Exception 2 applies to stages 1,000 square feet or less in area and 5 feet or less in height.
  - Exception 3 acknowledges portable orchestra enclosures which are temporary in nature and are intended to improve the acoustics of the stage performances.

127

Standpipes Section 410.7

- A Class III wet standpipe system is required on each side of stages greater than 1,000 square feet in area.
- The standpipes require both a 1½-inch and a 2½-inch hose connection.

128

Special Hazards

Module 4

129

Combustible Storage

Section 413

130

High-Piled Combustible Stock Section 413.1

- High-piled combustible storage, including rack storage, to be regulated by IFC.
- Additional IFC requirements apply to specific materials in a storage condition

Material	Location
Aerosols	Chapter 51
Flammable and combustible liquids	Chapter 57
Hazardous materials	Chapter
Combustible paper records	NFPA 13
Combustible fibers	Chapter 37
General storage of combustible materials	Chapter 3

2021 IBC Special Building Types, Features and Hazards 131

131

Concealed Spaces Section 413.2

- Attics, crawl spaces and similar concealed areas are regulated where such spaces are used for the storage of combustible materials.
  - Provisions not applicable to basements, closets and other areas of building that are typically accessed during building use.
  - Such areas not usually required to have complying means of egress
- Spaces to be protected on storage side only.

2021 IBC Special Building Types, Features and Hazards 132

132

Concealed Spaces Section 413.2

- Separation to be provided by materials on the storage side as required for 1-hour fire-resistance-rated construction.
  - Openings to be protected by self-closing assemblies that are of:
    - Noncombustible construction, or
    - Solid wood core at least 1¾ " in thickness
- Separation and opening protection not required if:
  - Concealed area protected by sprinkler system, or
  - In Group R-3 or U occupancy.

2021 IBC Special Building Types, Features and Hazards 133

133

Use and Storage of Hazardous Materials

Section 414

134

Hazardous Materials Section 414.1

- Provisions of Section 414 applicable to buildings containing hazardous materials for:
  - Manufacturing
  - Processing
  - Dispensing
  - Use
  - Storage
- Provisions applicable to all occupancy classifications

2021 IBC Special Building Types, Features and Hazards 135

135

Group H Classification Section 414.1.1

- Where amount of hazardous materials results in classification as Group H occupancy, buildings to comply with:
  - Section 414
  - Section 415
  - IFC

136

Report and Opinion Section 414.1.3

- Report to be submitted to building official identifying maximum expected quantities of hazardous materials to be:
  - Stored
  - Used in a closed system
  - Used in an open system
- Information to be subdivided to separately address hazardous material classification categories based on Tables 307.1(1) and 307.1(2).

137

TABLE 307.1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, j, m, n, p]

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE[b]			USE-CLOSED SYSTEMS[b]			USE-OPEN SYSTEMS[b]	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (pounds)
Combustible dust	NA	H-2	See Note q	NA	NA	See Note q	NA	NA	See Note q	NA
Combustible fiber[d]	Loose Baled[o]	H-3	(100) (1,000)	NA	NA	(100) (1,000)	NA	NA	(20) (200)	NA
Combustible liquid[e, i]	II IIIA IIIB	H-2 or H-3 H-2 or H-3 NA	NA	$120^{d, e}$ $330^{d, e}$ $13{,}200^{e, f}$	NA	NA	120^{d} 330^{d} $13{,}200^{f}$	NA	NA	30^{d} 80^{d} $3{,}300^{f}$
Cryogenic flammable	NA	H-2	NA	45^{d}	NA	NA	45^{d}	NA	NA	10^{d}
Cryogenic inert	NA	NA	NA	NA	NL	NA	NA	NL	NA	NA
Cryogenic oxidizing	NA	H-3	NA	45^{d}	NA	NA	45^{d}	NA	NA	10^{d}
Explosives	Division 1.1 Division 1.2 Division 1.3 Division 1.4 Division 1.4G Division 1.5 Division 1.6	H-1 H-1 H-1 or H-2 H-3 H-3 H-1 H-1	$1^{c, g}$ $1^{c, g}$ $5^{c, g}$ $50^{c, g}$ $125^{c, l}$ $1^{c, g}$ $1^{c, g}$	$(1)^{c, g}$ $(1)^{c, g}$ $(5)^{c, g}$ $(50)^{c, g}$ NA $(1)^{c, g}$ NA	NA	0.25^{g} 0.25^{g} 1^{g} 50^{g} NA 0.25^{g} NA	$(0.25)^{g}$ $(0.25)^{g}$ $(1)^{g}$ $(50)^{g}$ NA $(0.25)^{g}$ NA	NA	0.25^{g} 0.25^{g} 1^{g} NA NA 0.25^{g} NA	$(0.25)^{g}$ $(0.25)^{g}$ $(1)^{g}$ NA NA $(0.25)^{g}$ NA
Flammable gas	Gaseous Liquefied	H-2	NA	NA $(150)^{d, e}$	$1{,}000^{d, e}$ NA	NA	NA $(150)^{d, e}$	$1{,}000^{d, e}$ NA	NA	NA
Flammable liquid[e]	IA IB and IC	H-2 or H-3	NA	$30^{d, e}$ $120^{d, e}$	NA	NA	30^{d} 120^{d}	NA	NA	10^{d} 30^{d}
Flammable liquid, combination (IA, IB, IC)	NA	H-2 or H-3	NA	$120^{d, e, h}$	NA	NA	$120^{d, h}$	NA	NA	$30^{d, h}$

(continued)

138

NL = Not Limited; NA = Not Applicable; UD = Unclassified Detonable.

a. For use of control areas, see Section 414.2.
b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.
c. The quantities of alcoholic beverages in retail and wholesale sales occupancies shall not be limited provided the liquids are packaged in individual containers not exceeding 1.3 gallons. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs or consumer products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.
e. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, day boxes, gas cabinets, gas rooms or exhausted enclosures or in listed safety cans in accordance with Section 5003.9.10 of the *International Fire Code*. Where Note d also applies, the increase for both notes shall be applied accumulatively.
f. Quantities shall not be limited in a building equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
g. Allowed only in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
h. Containing not more than the maximum allowable quantity per control area of Class IA, IB or IC flammable liquids.
i. The maximum allowable quantity shall not apply to fuel oil storage complying with Section 603.3.2 of the *International Fire Code*.
j. Quantities in parentheses indicate quantity units in parentheses at the head of each column.
k. A maximum quantity of 220 pounds of solid or 22 gallons of liquid Class 3 oxidizers is allowed when such materials are necessary for maintenance purposes, operation or sanitation of equipment when the storage containers and the manner of storage are approved.
l. Net weight of the pyrotechnic composition of the fireworks. Where the net weight of the pyrotechnic composition of the fireworks is not known, 25 percent of the gross weight of the fireworks, including packaging, shall be used.
m. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2 of the *International Fire Code*.
n. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 414.2.5, see Tables 414.2.5(1) and 414.2.5(2).
o. Densely packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.
p. The following shall not be included in determining the maximum allowable quantities:
   1. Liquid or gaseous fuel in fuel tanks on vehicles.
   2. Liquid or gaseous fuel in fuel tanks on motorized equipment operated in accordance with the *International Fire Code*.
   3. Gaseous fuels in piping systems and fixed appliances regulated by the *International Fuel Gas Code*.
   4. Liquid fuels in piping systems and fixed appliances regulated by the *International Mechanical Code*.
   5. Alcohol-based hand rubs classified as Class I or II liquids in dispensers that are installed in accordance with Sections 5705.5 and 5705.5.1 of the *International Fire Code*. The location of the alcohol-based hand rub (ABHR) dispensers shall be provided in the construction documents.
q. Where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 414.1.3.

139

[F] TABLE 307.1(2)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIAL POSING A HEALTH HAZARD[a, c, f, h, i]

MATERIAL	STORAGE[b]			USE-CLOSED SYSTEMS[b]			USE-OPEN SYSTEMS[b]	
	Solid pounds[d, e]	Liquid gallons (pounds)[d, e]	Gas cubic feet at NTP (pounds)[g]	Solid pounds[d]	Liquid gallons (pounds)[d]	Gas cubic feet at NTP (pounds)[g]	Solid pounds[d]	Liquid gallons (pounds)[d]
Corrosives	5,000	500	Gaseous 810[g] Liquefied (150)	5,000	500	Gaseous 810[g] Liquefied (150)	1,000	100
Highly Toxic	10	(10)	Gaseous 20[g] Liquefied (4)[g]	10	(10)	Gaseous 20[g] Liquefied (4)[g]	3	(3)
Toxic	500	(500)	Gaseous 810[g] Liquefied (150)[g]	500	(500)	Gaseous 810[g] Liquefied (150)[g]	125	(125)

For SI: 1 cubic foot = 0.028 m^3, 1 pound = 0.454 kg, 1 gallon = 3.785 L.

a. For use of control areas, see Section 414.2.
b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.
c. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs or consumer products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an *approved automatic sprinkler system* in accordance with Section 903.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.
e. Maximum allowable quantities shall be increased 100 percent where stored in approved storage cabinets, gas cabinets or exhausted enclosures as specified in the *International Fire Code*. Where Note d also applies, the increase for both notes shall be applied accumulatively.
f. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 414.2.5, see Tables 414.2.5(1) and 414.2.5(2).
g. Allowed only where stored in approved exhausted gas cabinets or exhausted enclosures as specified in the *International Fire Code*.
h. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.
i. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2 of the *International Fire Code*.

140

Report and Opinion (cont.) Section 414.3

- Methods of protection from such hazards to be indicated in report and on construction documents, including:
  - Control areas
  - Fire protection systems
  - Group H occupancies
- Opinion and report to be prepared by qualified person, firm or corporation approved by building official.

141

Inside Storage, Dispensing & Use Section 414.5

- Where storage, dispensing and/or use of hazardous materials occurs within building, the following areas are addressed:
  - Explosion control
  - Emergency or standby power
  - Spill control, drainage and containment

142

Explosion Control Section 414.5.1

- Explosion control required in accordance with IFC as required by IBC Table 414.5.1 where:
  - Quantities of hazardous materials specified in Table 307.1(1) exceed maximum allowable quantities, or
  - Structure is occupied for purposes involving explosion as required by IBC Section 415 and IFC.

143

Emergency or Standby Power Section 414.5.2

- Where required by IBC or IFC, emergency or standby power to be provided for the following systems:
  - Mechanical ventilation (with exceptions)
  - Treatment (exception if fail-safe system installed)
  - Temperature control (exception for fail-safe system)
  - Alarm
  - Detection
  - Other electrically-operated

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Spill Control and Drainage Section 414.5.3

- Where required by IFC, rooms, buildings or areas occupied for storage of solid and liquid hazardous materials to be provided with means to:
  - Control spillage, and
  - Contain or drain off spillage and fire protection water discharged in the storage area.
- Method of spill control established in IFC.

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Outdoor Storage, Dispensing & Use Section 414.6

- Outdoor storage, dispensing and use of hazardous materials to comply with IFC.
- Where weather protection is provided for sheltering of outdoor storage or use areas, such areas to be considered as "outdoor storage" where structure complies with Sections 414.6.1.1 through 414.6.1.3:
  - Walls
  - Separation distance
  - Noncombustible construction

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Control Areas and Laboratory Suites

Section 414.2, 428

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Control Areas
Section 202

- Control area is *a space within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, use or handled.*
- Control areas are regulated in Section 414.2 and applicable to all facilities other than college and university buildings and similar Group B educational occupancies.

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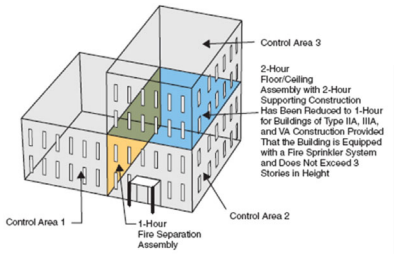
Control Areas
Section 414.2, Table 414.2.2



The fire-resistance rating of floor assemblies supporting control areas in some buildings is now permitted to be 1 hour.

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Higher Education Laboratories
Section 202

- Laboratory suite is *a fire-rated, enclosed laboratory area providing one or more laboratory spaces within a Group B educational occupancy that includes ancillary uses such as offices, bathrooms and corridors that are contiguous with the laboratory area, and are constructed in accordance with Section 428.*

150

Control Areas & Laboratory Suites Sections 414.2, 428

- Both control areas and laboratory suites allow for an increase in the quantities of hazardous materials in a building without requiring classification as a Group H occupancy.
- Additional quantities are permitted in non-Group H buildings if they are properly distributed in control areas complying with Section 414.2.

151

Limitations Section 414.2, Table 414.2.2

- Control areas:
  - Must be separated from each other by fire barriers and horizontal assemblies as set forth in Table 414.2.2 and Section 414.2.4.
  - Are limited to a specified percentage of maximum allowable quantities based upon the floor level under consideration per Table 414.2.2.
  - Are limited to a maximum number per floor as established by Table 414.2.2.
- Similar limits applied to laboratory suites.

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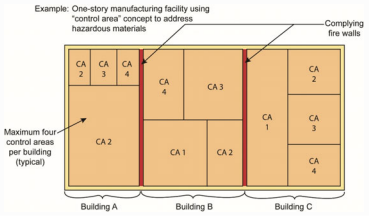
Limitations on Number Section 414.2.3

- For the purpose of determining the number of control areas established within a building, each portion of a building separated by one or more fire walls shall be considered as a separate building.



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Control Areas
Table 414.2.2

[F] TABLE 414.2.2
DESIGN AND NUMBER OF CONTROL AREAS

STORY		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA[a]	NUMBER OF CONTROL AREAS PER STORY	FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS[b]
Above grade plane	Higher than 9	5	1	2
	7–9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade plane	1	75	3	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.1(1) and 307.1(2), with all increases allowed in the notes to these tables.
b. Separation shall include fire barriers and horizontal assemblies as necessary to provide separation from other portions of the building.

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Laboratory Suites
Table 428.3

TABLE [F] 428.3
DESIGN AND NUMBER OF LABORATORY SUITES PER FLOOR

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER LAB SUITE[a]	NUMBER OF LAB SUITES PER FLOOR	FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS[b]
Above Grade Plane	21+	Not allowed	Not Permitted	Not Permitted
	16-20	25	1	2[c]
	11-15	50	1	2[c]
	7-10	50	2	2[c]
	4-6	75	4	1
	3	100	4	1
	1-2	100	6	1
Below Grade Plane	1	75	4	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.1(1) and 307.1(2), with all increases allowed in the footnotes to those tables.
b. Fire barriers shall include walls, floors and ceilings necessary to provide separation from other portions of the building.
c. Vertical fire barriers separating laboratory suites from other spaces on the same floor shall be permitted to be 1-hour fire-resistance rated.

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Control Area Example
Section 414.2

Given: 2-story fully-sprinklered manufacturing building with Class II combustible liquids in use on 2nd floor.

Determine: Maximum quantity of materials permitted for classification as Group F-1.

- Base MAQ — 30 gallons — Table 307.1(1)
- Sprinkler increase (100%) — 30 gallons — Note d
- Total MAQ — 60 gallons

- % of MAQ/control area (75%) — 45 gallons — Table 414.2.2
- # of control areas per story — x 3 — Table 414.2.2
- Total MAQ for 2nd story — 135 gallons*

- *Assumes required fire-resistive separation between 1st and 2nd stories, or no Class II liquids on 1st story.

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Higher Education Laboratories vs. Control Areas

LABORATORY SUITES VS. CONTROL AREAS*						
STORY	MAXIMUM AMOUNT PER CONTROL AREA or LABORATORY SUITE (gallons)		MAXIMUM AMOUNT PER STORY (gallons)		MINIMUM FIRE BARRIER SEPARATION (hours)	
	Laboratory Suite	Control Area	Laboratory Suite	Control Area	Laboratory Suite	Control Area
1	60	60	360	240	1	1
2	60	45	360	135	1	1
4	45	7.5	180	15	1	2
7	30	3	60	6	2	2
11	30	3	30	3	N/A	N/A

*Assuming fully-sprinklered building with Class II combustible liquids in use-open system condition. Tabular allowance of 30 gallons per control area/laboratory suite increased by 100% to 60 gallons based on Table 307.1(1) and note d.

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Spray Application of Flammable Finishes

Section 416

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Spraying of Flammable Finishes Section 416.1

- Provisions of Section 416 apply to construction, installation and use of buildings, or parts thereof, for spray application of flammable finishes.
- Three types of spraying operations addressed:
  - Spray rooms
  - Spraying spaces
  - Spray booths
- *International Fire Code* also regulates:
  - Operations
  - Equipment

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Spray Rooms
Section 416.2

- Defined in Section 202 as *a room designed to accommodate spraying operations*.
- Spray rooms to be enclosed with minimum 1-hour fire barriers, horizontal assemblies, or both.
- Floors to be waterproofed and drained in an approved manner.
- Automatic sprinkler system or fire-extinguishing system required per Chapter 9.
- Spray rooms further regulated for construction, surfaces and ventilation.

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Spray Rooms
Section 416.2

- Walls and ceilings to be:
  - Constructed of noncombustible materials, or
  - Interior surface to be completely covered with noncombustible materials.
- Aluminum is not to be used.
- Interior surfaces to be smooth and constructed to:
  - Permit free passage of exhaust air, and
  - Facilitate washing and cleaning.
- Mechanical ventilation and interlocks with spraying operation to comply with IMC and IFC.

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Spraying Spaces
Section 416.3

- Defined in the IFC as *an area in which dangerous quantities of flammable vapors or combustible residues, dusts or deposits are present due to the operation of spraying processes. The fire code official is authorized to define the limits of the spraying space in any specific case.*

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Spraying Spaces
Section 416.3

- Spraying spaces to be ventilated with an exhaust system to prevent accumulation of flammable mist or vapors per IMC.
- Where such spaces not separately enclosed, noncombustible spray curtains to be provided to restrict spread of flammable vapors.

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Spraying Spaces
Section 416.3.1

- Interior surfaces of spraying spaces to be:
  - Smooth
  - Constructed to permit free passage of exhaust air from all parts of interior
  - Constructed to facilitate washing and cleaning
  - Designed to confine residues within spraying space
- Aluminum shall not be used.

164

Spray Booths
Section 416.4

- Spray booths to be designed, constructed and operated in accordance with IFC.
- Automatic sprinkler system or fire-extinguishing system required per Chapter 9.

165

Spray Booths
Section 416.4

- Spray booths design and construction regulated by IFC Section 2404.3.3 for:
  - Construction
  - Surfaces
  - Floor
  - Means of egress
  - Clear space
  - Size

166

Medical Gas Storage Rooms

Section 427

167

Medical Gas Systems
Section 427.1

- Provisions of Section 427 applicable to storage of medical gases at health care-related facilities intended for:
  - Patient care, or
  - Veterinary care.
- Such facilities to also comply with Chapter 53 of *International Fire Code*.

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Medical Gas Systems Section 427.1

- IBC provisions limited to those applicable to design and construction of medical gas storage rooms and gas cabinets.
- IFC requirements in Chapter 53 *"Compressed Gases"* address:
  - General provisions for containers, cylinders and tanks
  - Upright storage
  - Use and handling
  - Medical gases (also found in IBC Section 427)

169

Interior Supply Location Section 427.2

- Medical gases to be located in areas dedicated to gas storage without other storage or uses.
- Where containers in quantities greater than the permit amount located inside buildings, they shall be stored in a:
  - One-hour exterior room,
  - One-hour interior room, or
  - Gas cabinet.

170

Quantities Exceeding MAQs Section 427.2

- Where storage or use of medical gas occurs in quantities that exceed maximum allowable quantity (MAQ) per control area, room or area to be classified as Group H occupancy.

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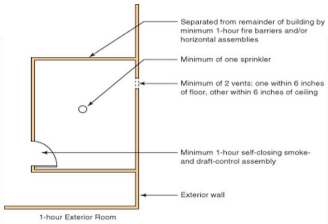
One-Hour Exterior Rooms Section 427.2.1

Exterior room to have at least one exterior wall that is provided with at least two vents



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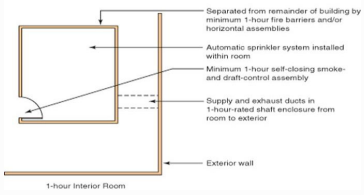
One-Hour Interior Rooms Section 427.2.2

- Where exterior room cannot be provided, an interior room or enclosure to be provided.
  - Room to be exhausted through duct to the exterior.



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Gas Cabinets Section 427.2.3

- Gas cabinets to be constructed in accordance with IFC Section 5003.8.6,including:
  - Construction
  - Ventilation
  - Maximum number of cylinders per cabinet
- In addition, IBC Section 427.2.3 requires:
  - Cabinets exhausted to exterior through dedicated exhaust duct system comply with IMC
  - Supply and exhaust ducts enclosed in 1-hour shaft enclosure from cabinet to exterior
  - Cabinets to be provided with internal sprinkler system

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Final Reflection

- This slide will help the learner to reflect on the day and what they will take back to the job and apply.
- What? What happened and what was observed in the training?
- So what? What did you learn? What difference did this training make?
- Now what? How will you do things differently back on the job as a result of this training?

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