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.

Source: 2021 IBC

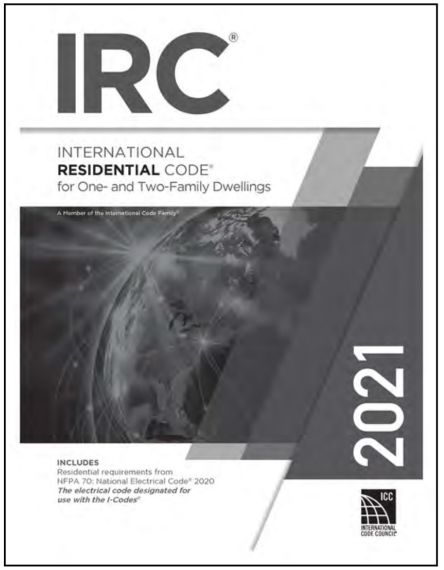
Introduction

- The provisions of the International Building Code shall apply to the *construction, alteration, relocation, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition* of every building or structure or any appurtenances connected or attached to such buildings or structures.

Source: 2021 IBC: IBC 101.2, Exception

Introduction: Exception

- Detached one- and two-family dwellings and multiple single-family dwellings (town- houses) not more than three stories above grade plane in height with a separate means of egress, and their accessory structures not more than three stories above grade plane in height, shall comply with the IBC or the International Residential Code.



Source: 2021 IBC: IBC 101.2, Exception

IBC Appendix

- Provisions in the appendices shall not apply unless specifically adopted.

Appendix A	**Employee Qualifications**
Appendix B	**Board of Appeals**
Appendix C	**Group U — Agricultural Buildings**
Appendix D	**Fire Districts**
Appendix E	**Supplementary Accessibility Requirements**
Appendix F	**Rodentproofing**
Appendix G	**Flood-Resistant Construction**
Appendix H	**Signs**
Appendix I	**Patio Covers**
Appendix J	**Grading**
Appendix K	**Administrative Provisions**
Appendix L	**Earthquake Recording Instrumentation**
Appendix M	**Tsunami-Generated Flood Hazard**
Appendix N	**Replicable Buildings**
Appendix O	**Performance-Based Application**

Source: 2021 IBC: **Reference:** IBC 101.2.1

Conflicts between IBC and referenced codes

Provisions of the appendix do not apply unless _____.

a. specified in the code
b. applicable to unique conditions
c. specifically adopted
d. relevant to fire or life safety

Source: 2021 IBC **Reference:** IBC 102.4

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

Source: 2021 IBC: **Reference:** IBC 101.2.1

103 Code Compliance Agency

The _____ is considered by the code as the term to describe the individual in charge of the code compliance agency.

a. building official
b. code official
c. code administrator
d. chief building inspector

Source: 2021 IBC: IBC 103

104.1 Duties and Powers of Building Official

The building official has the authority to _____ the provisions of the code.

a. ignore
b. waive
c. violate
d. interpret

Source: 2021 IBC: IBC 104.1

104.11 Duties and Powers of Building Official

In order for an alternative material, design or method of construction to be considered acceptable, it must be equivalent to the code based on all but which of the following criteria?

a. durability
b. practicality
c. strength
d. fire resistance

Source: 2021 IBC: IBC 104.11

104.11.1 Duties and Powers of Building Official

Tests performed by _____ may be required by the building official where there is insufficient evidence of code compliance.

a. the owner
b. the contractor
c. an approved agency
d. a design professional

Source: 2021 IBC: IBC 104.11.2

105.1-2 Permits: Work exempt

Work exempt from permit:

- One-story detached accessory buildings where limited to 120 square feet in floor area
- Fences not over 7 feet high
- Oil derricks
- Retaining walls limited to 4 feet in height, unless supporting a surcharge or impounding Class I, II or III-A liquids
- Water tanks supported directly on grade, limited to capacity of 5,000 gallons and a ratio of height to diameter not exceeding 2 to 1
- Sidewalks and driveways limited to 30 inches above grade, not over any basement or story below, and not part of an accessible route
- Painting, papering, carpeting, cabinets, counter tops and similar finish work
- Temporary motion picture, television and theater stage sets and scenery
- Prefabricated swimming pools accessory to a Group R-3 occupancy when capacity is limited to 5,000 gallons, depth limited to 24 inches and installed entirely above ground
- Shade cloth structures used for nursery or agricultural purposes
- Swings and other playground equipment accessory to detached one- and two-family dwellings
- Window awnings supported by an exterior wall in Groups R-3 and U, where the maximum projection is 54 inches
- Movable fixtures, racks, cases, counters and partitions limited to 5 feet 9 inches in height

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Whether or not a building permit is required by the code, it is intended that all work be done in accordance with the code requirements. The owner is responsible for all construction being done properly and safely.

Source: 2021 IBC: IBC 105.1, 105.2

108 Temporary Structures and Uses

Unless extended by the building official, what is the maximum time period allowed to be granted for a permit issued on a temporary structure?

a. 90 days

b. 180 days

c. 1 year

d. 2 years

Source: 2021 IBC

109 Permit Fees

The final permit valuation shall be set by the _____ .

a. owner

b. building official

c. design professional

d. general contractor

Source: 2021 IBC

110.1 Required Inspections

- Footing and foundation
- Concrete slab or under-floor
- Lowest floor elevation
- Frame
- Types IV-A, IV-B and IV-C connection protection
- Lath, gypsum board and gypsum-panel product
- Weather-exposed elevated walking surfaces waterproofing
- Fire and smoke resistant penetrations
- Energy efficiency
- Others as required by the building official
- Special inspections
- Final

Source: 2021 IBC

110.1 Required Inspections

Who is responsible for ensuring that the work is accessible and exposed for inspection purposes?

a. owner or owner's authorized agent

b. contractor

c. permit applicant or their authorized agent

d. design professional

Source: 2021 IBC

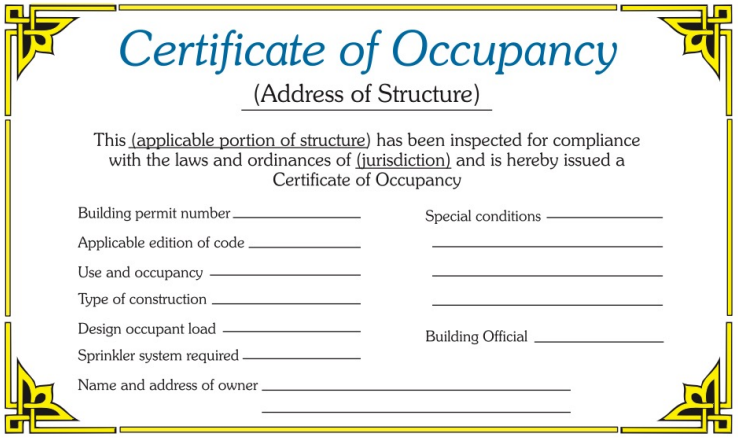
110.6 Inspections

- Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the building official. The building official, upon notification, shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed, or notify the permit holder or his or her agent wherein the same fails to comply with the IBC. Any portions that do not comply shall be corrected and such portions shall not be covered or concealed until authorized by the building official.

Source: 2021 IBC

110.6 Certificate of Occupancy

- A building or structure shall not be used or occupied in whole or in part, and a change of occupancy of a building or structure or portion thereof shall not be made, until the building official has issued a certificate of occupancy therefor as provided herein. Issuance of a certificate of occupancy shall not be construed as an approval of a violation of the provisions of the IBC or of other ordinances of the jurisdiction. See the exception for work exempt from permits.



Certificate of Occupancy

(Address of Structure)

This (applicable portion of structure) has been inspected for compliance with the laws and ordinances of (jurisdiction) and is hereby issued a Certificate of Occupancy

Building permit number _____

Applicable edition of code _____

Use and occupancy _____

Type of construction _____

Design occupant load _____

Sprinkler system required _____

Name and address of owner _____

Special conditions _____

Building Official _____

Sample of Certificate of Occupancy

Source: 2021 IBC

Chapter 35 Standards

The referenced standard dealing with accessible buildings is _____.

a. ASME A17.1—CSA 19/CSA B44-19

b. DOC PS 1—19

c. ICC A117.1—17

d. FEMA 4880—2017

Source: 2021 IBC

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

Source: 2021 IBC

302.1 Occupancy Classification

- Occupancy classification is the formal designation of the primary purpose of the building, structure or portion thereof. Where a structure is proposed for a purpose which is not specifically listed in Section 302.1, such structure shall be classified in the occupancy it most nearly resembles, based on the fire safety and relative hazard.
- Occupancy groupings are divided into two general categories: those related to people and those related to content.
  - People-related hazards include the number and density of the occupants, their age and mobility, and their awareness of surrounding conditions.
  - Content-related hazards include the storage and use of hazardous materials, as well as the presence of large quantities of combustible materials

Source: 2021 IBC

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

Source: 2021 IBC

302.1 Occupancy Classification

1. An institutional occupancy is typically considered Group _____ .

a. A
b. B
c. I
d. R

Source: 2021 IBC

302.1 Occupancy Classification

2. A Group _____ occupancy is the general classification for miscellaneous and utility structures.

a. A
b. M
c. S
d. U

Source: 2021 IBC

302.1 Occupancy Classification

3. Accessory religious educational rooms need not be considered separate occupancies where the occupant load is less than _____ occupants.

a. 100
b. 150
c. 200
d. 300

Source: 2021 IBC

302.1 Occupancy Classification

- Assembly Group A occupancy includes, among others, the use of a building or structure, or a portion thereof, for the gathering of persons for purposes such as civic, social or religious functions, recreation, food or drink consumption or awaiting transportation. See other classification allowances for assembly buildings and assembly spaces with an occupant load of less than 50, accessory assembly spaces less than 750 square feet in floor area, and those assembly spaces associated with Group E occupancies.

Source: 2021 IBC

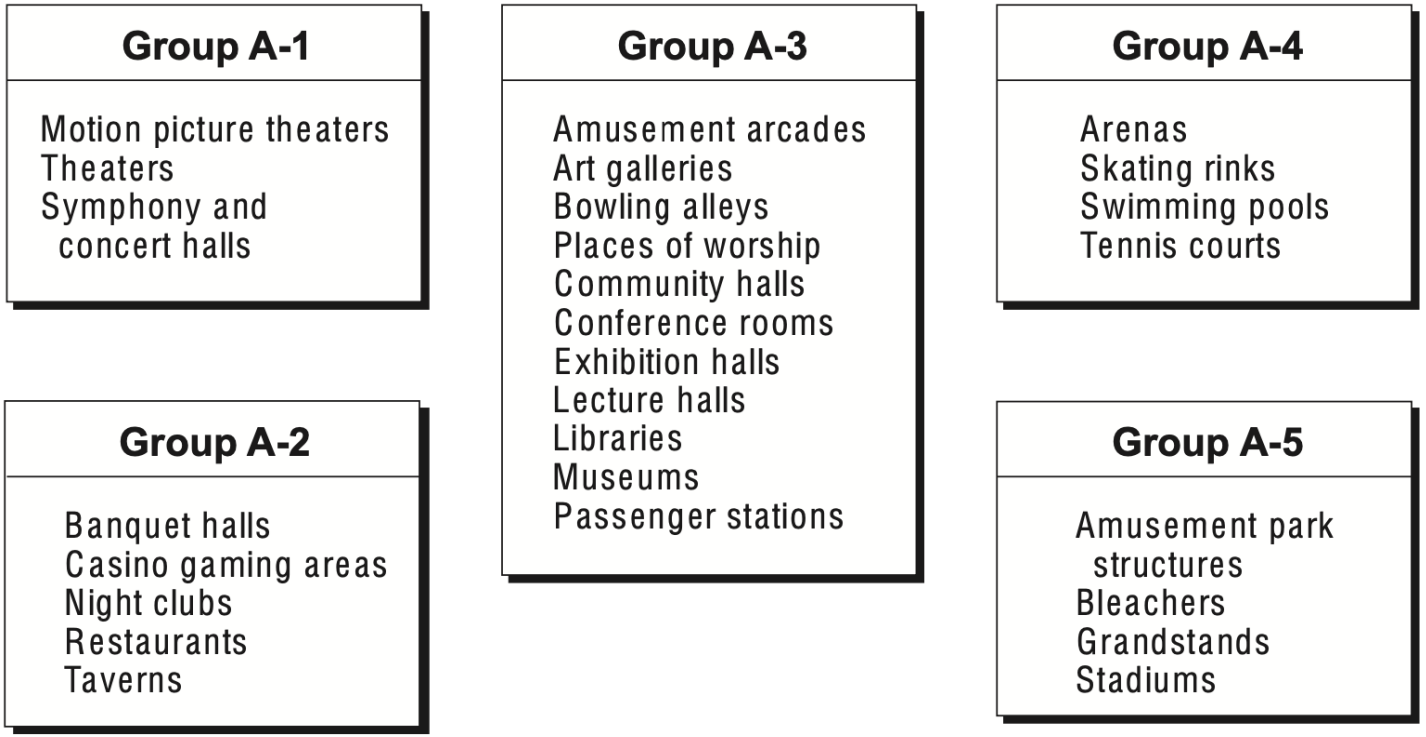
302.1 Occupancy Classification

4. An accessory assembly area may be classified as a Group B occupancy where the floor area is a maximum of _____ square feet.

a. 120
b. 399
c. 749
d. 1,000

Source: 2021 IBC

303.1 Occupancy Classification



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.

Source: 2021 IBC

303.1 Occupancy Classification A-2

The gaming floor of a large casino shall be classified as a Group _____ occupancy.

a. A-2
b. A-3
c. B
d. M

Source: 2021 IBC

303.1 Occupancy Classification A-4

Which of the following uses is typically considered a Group A-4 occupancy?

a. restaurant with a dance floor
b. school library
c. outdoor football stadium
d. indoor hockey arena

Source: 2021 IBC

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 ≤ 2,500 sf
Laboratories; testing and research
Motor vehicle showrooms
Post offices
Print shops
Professional services
Radio and television stations
Training and skill development

Source: 2021 IBC

304.1 Occupancy Classification: Group B

Which of the following uses is not considered a Group B occupancy?

a. convenience store
b. motor vehicle showroom
c. car wash
d. ambulatory care facility

Source: 2021 IBC

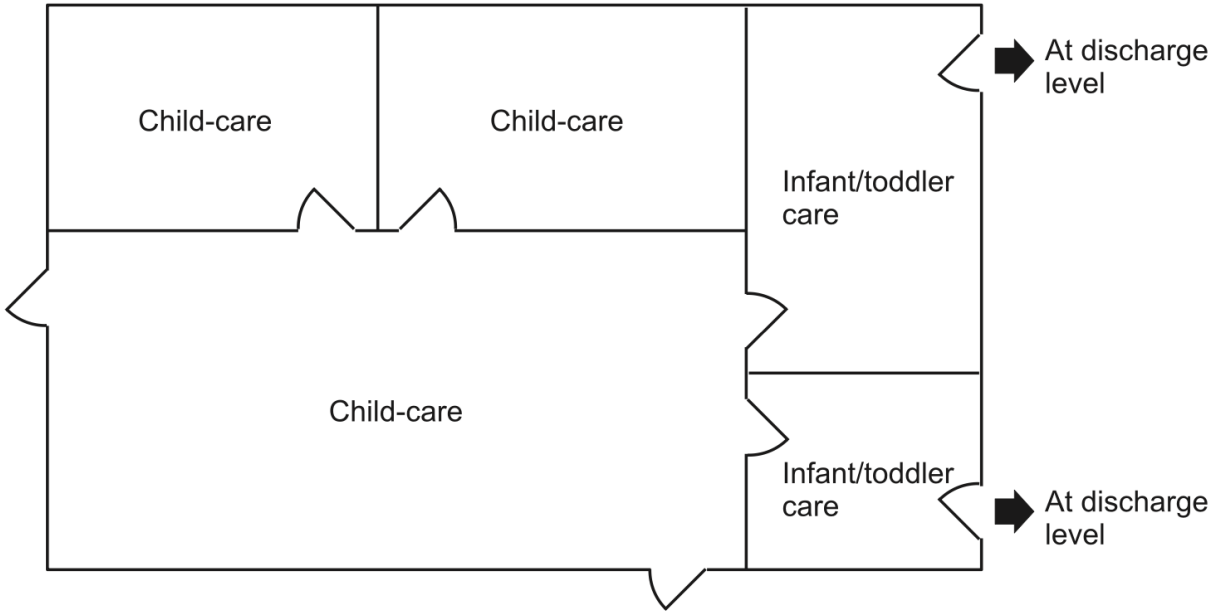
305.1 Occupancy Classification: Group E

- 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 21/2 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.

Source: 2021 IBC

305.1 Occupancy Classification: Group E

Entire building can be considered a Group E occupancy



Although a child-care facility that provides care for infants and toddlers (children $2^1/_2$ years of age or less) is generally considered a Group I-4 occupancy, Section 308.5.1 permits a Group E classification under specific conditions.

Source: 2021 IBC

305.1 Occupancy Classification: Group E

5. In a Group E middle school, an assembly area associated with the Group E shall be classified as what occupancy?
   a. Group E
   b. Group A-5
   c. Group I-1
   d. Group U

Source: 2021 IBC

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.

Source: 2021 IBC

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 allow- able 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.

Source: 2021 IBC

307.1 Occupancy Classification: Group H

Where hazardous materials and processes are involved.

Although the *International Building Code* is limited to general construction regulations and occupancy-specific requirements, the *International Fire Code*® (IFC®) sets forth special detailed provisions relating to hazardous materials and the specific conditions of their storage, use and handling.

Source: 2021 IBC

307.1 Occupancy Classification: Group H

A Group _____ occupancy classification is to be assigned to a facility where combustible dusts are generated in a manner that creates a fire or explosion hazard.

a. H-1
b. H-2
c. H-4
d. H-5

Source: 2021 IBC

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.

Source: 2021 IBC

307.1 Occupancy Classification: Exceptions to Group H

GIVEN: A fully sprinklered Group F-1 storage building housing Class II combustible liquids. The Class II liquids are all stored in approved safety cans. The entire building is a single control area.

DETERMINE: The maximum allowable quantity of the Class II liquids in storage in order to maintain the Group F-1 classification.

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[q]	Loose	H-3	(100)	NA	NA	(100)	NA	NA	(20)	NA
	Baled[o]		(1,000)			(1,000)			(200)	
Combustible liquid[c, i]	II	H-2 or H-3	NA	120[d, e]	NA	NA	120[d]	NA	NA	30[d]
	IIIA	H-2 or H-3		330[d, e]			330[d]			80[d]
	IIIB	NA		13,200[e, f]			13,200[f]			3,300[f]

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

ce: 2021 IBC

307.1 Occupancy Classification: Exceptions to Group H

GIVEN: A fully sprinklered Group F-1 storage building housing Class II combustible liquids. The Class II liquids are all stored in approved safety cans. The entire building is a single control area.

DETERMINE: The maximum allowable quantity of the Class II liquids in storage in order to maintain the Group F-1 classification.

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[q]	Loose	H-3	(100)	NA	NA	(100)	NA	NA	(20)	NA
	Baled[o]		(1,000)			(1,000)			(200)	
Combustible liquid[c, i]	II	H-2 or H-3		120[d, e]			120[d]			30[d]
	IIIA	H-2 or H-3	NA	330[d, e]	NA	NA	330[d]	NA	NA	80[d]
	IIIB	NA		13,200[e, f]			13,200[f]			3,300[f]

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

ce: 2021 IBC

307.1 Occupancy Classification: Exceptions to Group H

GIVEN: A fully sprinklered Group F-1 storage building housing Class II combustible liquids. The Class II liquids are all stored in approved safety cans. The entire building is a single control area.

DETERMINE: The maximum allowable quantity of the Class II liquids in storage in order to maintain the Group F-1 classification.

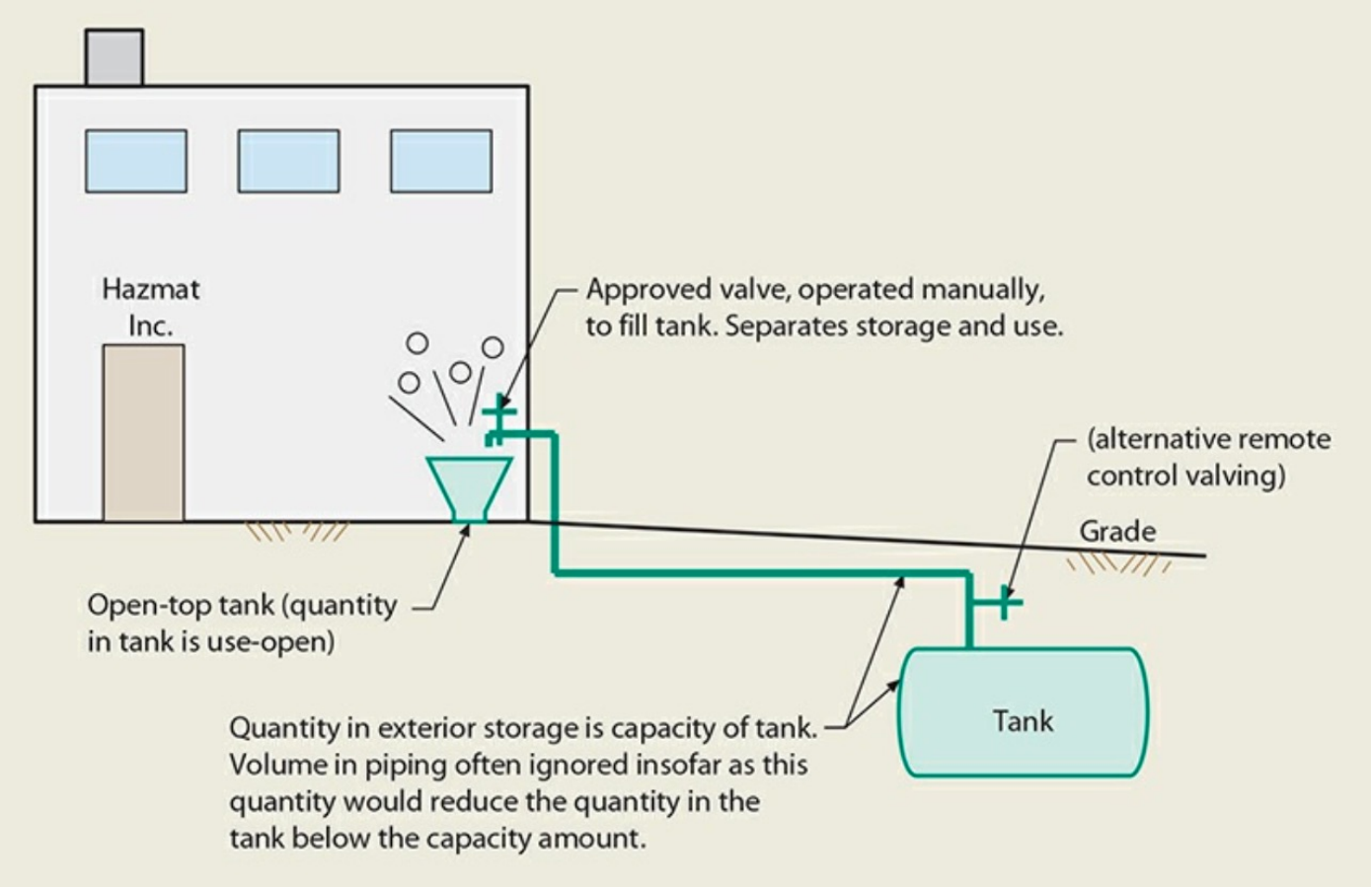
SOLUTION:

Basic MAQs per Table 307.1(1)	120 gallons
Sprinkler increase per Footnote d (100%)	+ 120 gallons
	240 gallons
Safety can increase per Footnote e (100%)	+ 240 gallons
Total of maximum permitted for Group F-1 classification	480 gallons

Source: 2021 IBC

307.1 Occupancy Classification: Storage

- The maximum allowable quantities in the code are based on three potential situations: storage, use-closed, and use-open.



Source: 2021 IBC

307.1 Occupancy Classification: Storage

Buildings containing materials that present a detonation hazard are typically considered _____ occupancies.

a. Group H-1
b. Group H-2
c. Group H-3
d. Group H-5

Source: 2021 IBC

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

Source: 2021 IBC

308.1 Occupancy Classification: Group I

A foster-care facility providing care on a 24-hour basis to six or more infants/toddlers ($2^1/_2$ years of age or less) is classified as a Group _____ occupancy.

a. E
b. I-1
c. I-2
d. R-4

Source: 2021 IBC

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

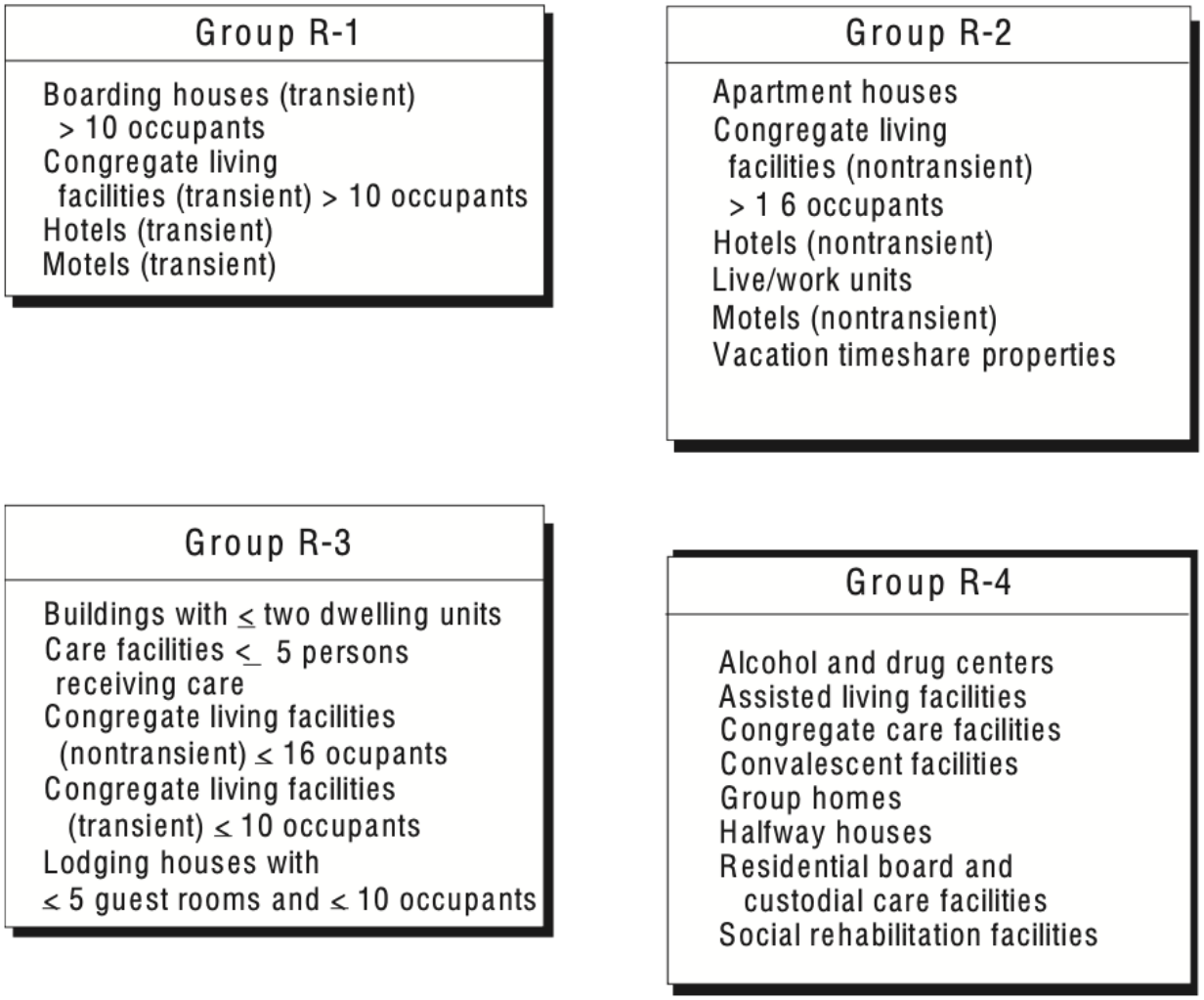
Source: 2021 IBC

310 Occupancy Classification: Group R

- Residential Group R occupancy includes, among others, the use of a building or structure, or a portion thereof, for sleeping purposes when not classified as an Institutional Group I or when not regulated by the International Residential Code.
- Residential occupancies are characterized by: (1) their use by people for living and sleeping purposes, (2) a relatively low potential fire severity, and (3) the worst fire record of all structure types. Because occupants of these types of buildings spend up to one-third of each day sleeping, there is a high potential of a fire to rage out of control before the occupants awaken. After awakening, the residents will typically be disoriented for a short period of time, further decreasing the opportunity for immediate egress. A major difference between the Group R-1 and R-2 occupancy classifications is the transient nature of the use. “Transient” is defined as occupancy of a dwelling unit or sleeping unit for not more than 30 days.

Source: 2021 IBC

310 Occupancy Classification: Group R



Source: 2021 IBC

Occupancy Classification: Group R

Live/work units are to be classified as _____ occupancies.

a. Group B
b. Group R-2
c. accessory
d. mixed

Source: 2021 IBC

311 Occupancy Classification: Group S

- Storage Group S occupancy includes among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.
- Where a warehouse or other storage facility does not contain significant amounts of hazardous commodities (as determined by Section 307), it should be considered a Group S occupancy. A facility used for the storage of combustible goods is classified as Group S- 1, whereas a Group S-2 occupancy shall be used only for the storage of noncombustible materials. If it is reasonable to believe that a storage building will house combustible goods for any significant period of time, it would be appropriate to consider the structure a Group S-1 occupancy, designed and constructed accordingly. Motor-vehicle-related uses are also included in the Group S category, with repair garages classified as Group S- 1 and parking garages (both open and enclosed) as Group S-2 occupancies.

Source: 2021 IBC

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

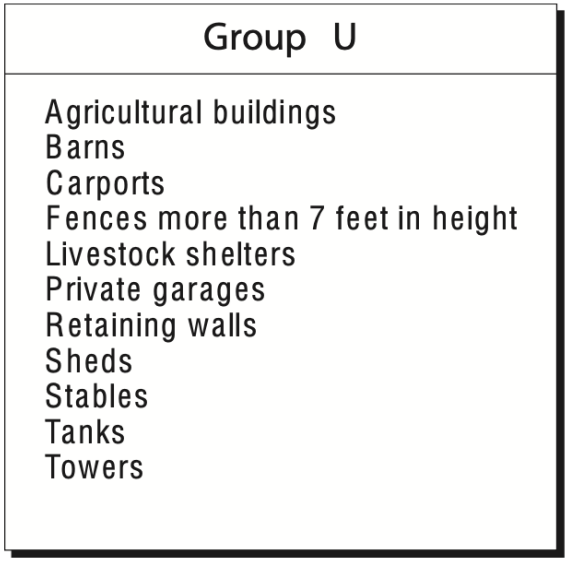
Source: 2021 IBC

312 Occupancy Classification: Group U

- Buildings and structures of an accessory character and miscellaneous structures not classified in any specific occupancy shall be constructed, equipped and maintained to conform to the requirements of the IBC commensurate with the fire and life hazard incidental to their occupancy.
- Those structures not ordinarily occupied by the general public are typically classified as Group U occupancies. The fire load in these structures varies considerably but is usually not excessive. Because these types of uses are not normally occupied, the concern for fire severity is not very great, and as a group they constitute a low hazard. Several of the structures regulated as Group U occupancies are never occupied, such as fences, towers and tanks.

Source: 2021 IBC

312 Occupancy Classification: Group U



Source: 2021 IBC

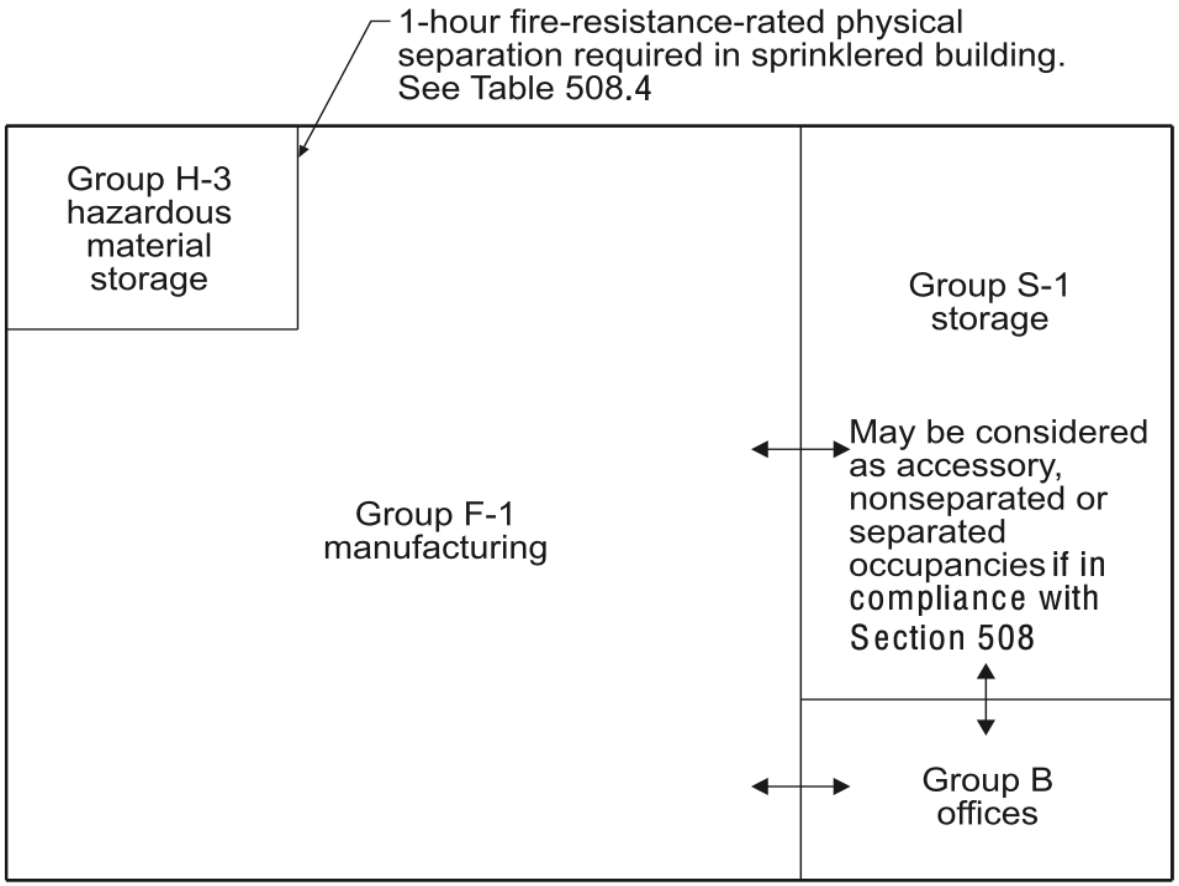
508.1 Occupancy Classification: Mixed Occupancies

- 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.

Source: 2021 IBC

508.1 Occupancy Classification: Mixed Occupancies



Source: 2021 IBC

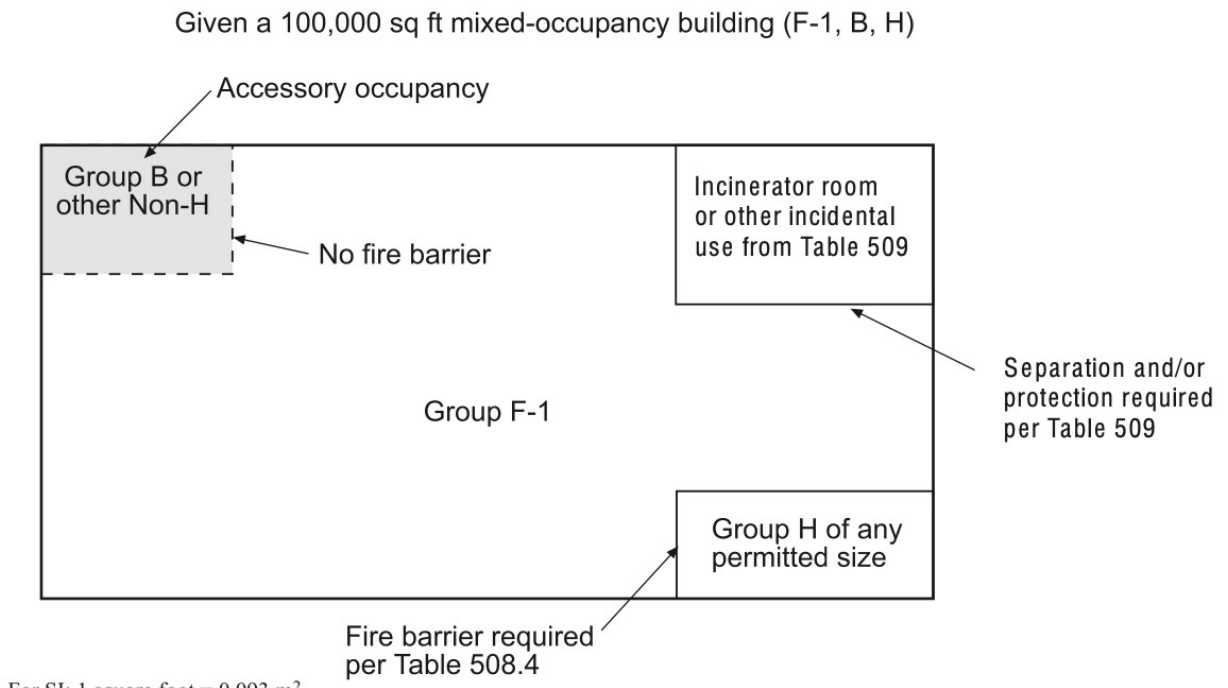
508.2/3 Accessory Occupancy

- Accessory occupancies are those occupancies that are ancillary to the main occupancy of the building or portion thereof. Aggregate accessory occupancies shall not occupy more than 10 percent of the area of the story in which they are located and shall not exceed the tabular values for nonsprinklered buildings in Table 506.2 for each such accessory occupancy.
- The mixed-occupancy method of “Accessory Occupancies” is one of the three design options that the code provides when dealing with mixed-occupancy buildings. This approach is only applicable where one or more of the occupancies is quite small in relationship to the major occupancy in the building. The aggregate floor area of all accessory occupancies is limited to 10 percent of the floor area of the story in which the accessory occupancies are located. In addition, the aggregate floor area of the accessory occupancies cannot exceed the allowable floor area taken from Table 506.2 for a nonsprinklered building.

Source: 2021 IBC

508.2/3 Accessory Occupancy

Example:



For SI: 1 square foot = 0.093 m^2.

It is possible to have more than one space or occupancy designated an accessory occupancy. Under such circumstances, the 10 percent and tabular area limitations, per story, are to be based upon the aggregate floor area of all of the accessory occupancies.

Source: 2021 IBC

508.2.1 Nonseparated Occupancy

Given: A nonsprinklered Type VB building contains both Group B and Group E occupancies.

Determine: The height and area limitations if the occupancies are not separated under the nonseparated occupancies provisions of Section 508.3.

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2

Source: 2021 IBC

508.2.1 Nonseparated Occupancy

Given: A nonsprinklered Type VB building contains both Group B and Group E occupancies.

Determine: The height and area limitations if the occupancies are not separated under the nonseparated occupancies provisions of Section 508.3.

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2

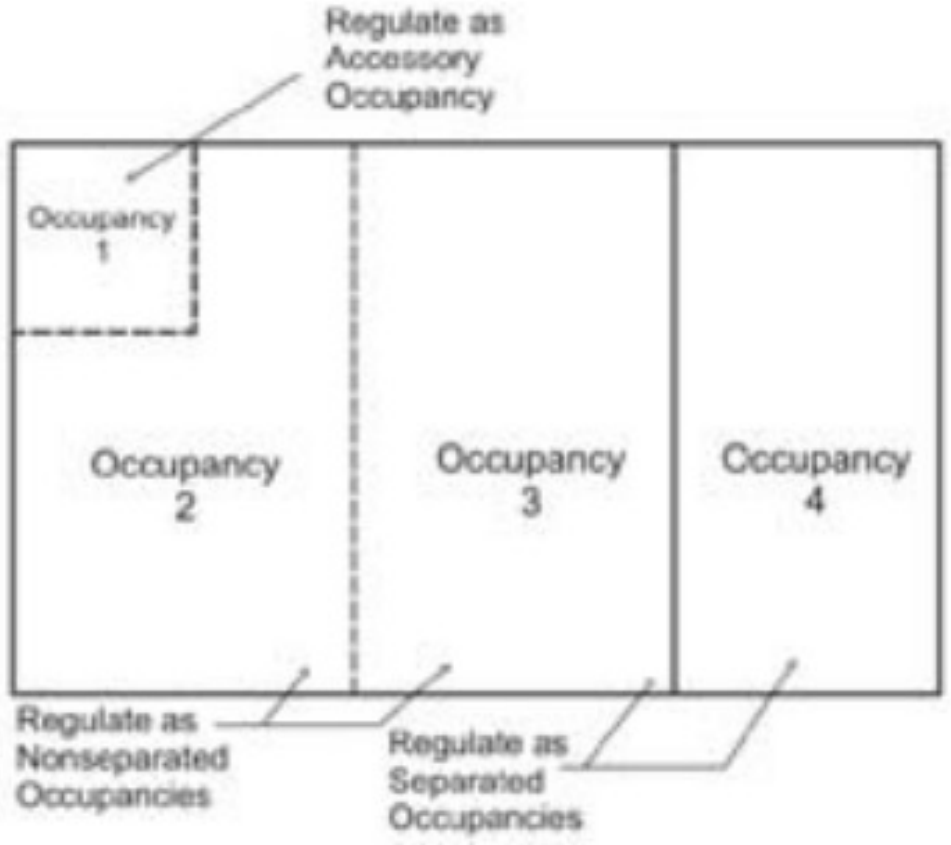
Source: 2021 IBC

508.2.1 Nonseparated Occupancy

Example:

Given: A nonsprinklered Type VB building contains both Group B and Group E occupancies.

Determine: The height and area limitations if the occupancies are not separated under the nonseparated occupancies provisions of Section 508.3.



Source: 2021 IBC

508.2.1 Nonseparated Occupancy

Example:

Given: A nonsprinklered Type VB building contains both Group B and Group E occupancies.

Determine: The height and area limitations if the occupancies are not separated under the nonseparated occupancies provisions of Section 508.3.

OCCUPANCY	ALLOWABLE HEIGHT[1]	ALLOWABLE AREA[2]
Group B[2]	2 stories	9,000 square feet
Group E[3]	1 story	9,500 square feet

1 Based on Table 504.4

2 Based on Table 506.2 assuming no frontage increase.

3 Most restrictive fire protection requirements of Chapter 9 also applicable to entire building.

ˆThus, for nonseparated occupancies, the maximum building size would be 1 story and 9,000 square feet.

Nonseparated Occupancies

The use of the nonseparated occupancies method is not applicable to high-hazard occupancies. Those areas or spaces classified as Group H occupancies must be isolated from other occupancies within the building by fire barriers and/or horizontal assemblies in accordance with Table 508.4 for occupancy separations.

Source: 2021 IBC

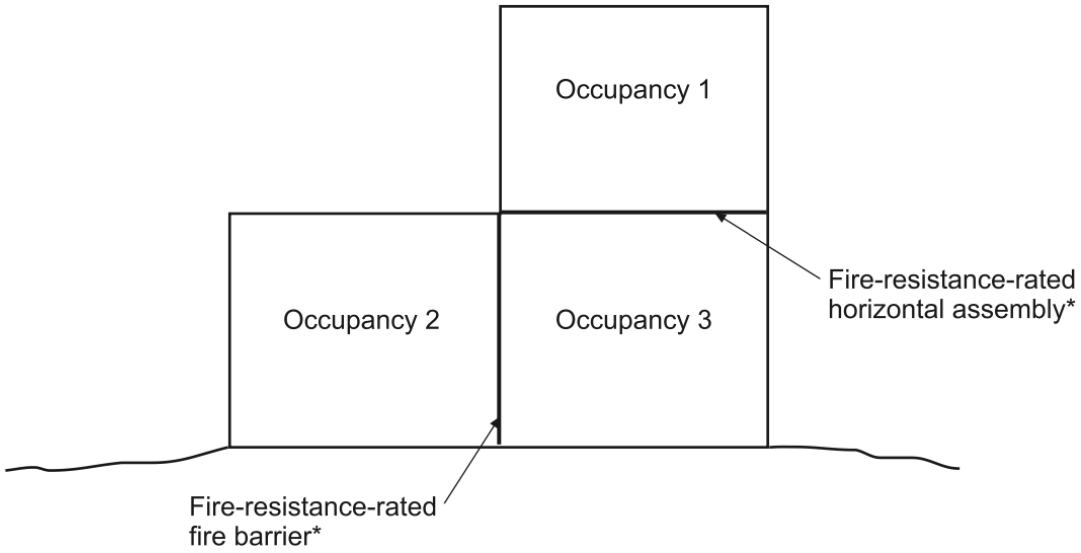
508.4 Separated Occupancy

- Separated occupancies shall be individually classified in accordance with Section 302.1. Each separated space shall comply with the IBC based on the occupancy classification of that portion of the building.

- Under the provisions for “Separated Occupancies,” each of the distinct uses is to be individually classified as to occupancy. This approach is consistent with that for accessory occupancies and nonseparated occupancies. The concept of separated occupancies provides for a fire-resistance-rated separation in order to isolate the hazards associated with a specific occupancy from other portions of the building.

Source: 2021 IBC

508.4 Nonseparated Occupancy



*Minimum fire-resistance rating based on Table 508.4

For those mixed-occupancy buildings containing a Group H occupancy, the separated occupancy provisions will always need to be applied. Any Group H occupancy must be physically and fire-resistively separated from other occupancies within the same structure.

Source: 2021 IBC

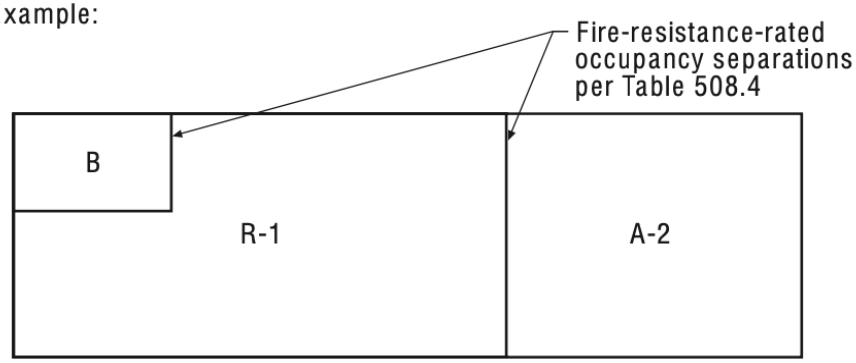
508.4.2/3 Separated Occupancy

- In each story, the building area shall be such that the sum of the ratios of the actual building area of each separated occupancy divided by the allowable area of each separated occupancy shall not exceed 1. Each separated occupancy shall comply with the building height limitations and story limitations based on the type of construction of the building in accordance with Section 503.1. See exception where Section 510 is applied.
- The approach to separated occupancies mandates that the ratios of the actual and allow- able floor areas be calculated in order to determine compliance. Often known as the “unity formula,” this calculation recognizes the relationship between the permitted sizes of the various occupancies involved. The unity formula is only applicable where the separated occupancy method is utilized and does not apply to accessory occupancies or non-separated occupancies.

Source: 2021 IBC

508.4.2/3 Separated Occupancy

Example:



Allowable height per Section 504 for each individual occupancy

$$\frac{\text{Actual area A-2}}{\text{Allowable area A-2}} + \frac{\text{Actual area B}}{\text{Allowable area B}} + \frac{\text{Actual area R-1}}{\text{Allowable area R-1}} \leq 1.0$$

The height limitations for separated occupancies are based upon the general provisions of Section 504. The height limit, in both feet and stories, is to be measured from the grade plane, and the measurement must include all intervening fire areas.

Source: 2021 IBC

508.4.2/3 Separated Occupancy

GIVEN: A one-story nonsprinklered building housing day care classified as Group E, Group B offices, and a Group A-3 conference room. The building is of Type VA construction. Insufficient open space is available for area increase purposes. Floor areas are as follows:

Office (B)	4,500 square feet
Assembly (A-3)	1,000 square feet
Day care (E)	6,000 square feet

DETERMINE: If the building area is within the allowable area under the "separated occupancies" provisions.

TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET[a, b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500

Source: 2021 IBC

508.4.2/3 Separated Occupancy

GIVEN: A one-story nonsprinklered building housing day care classified as Group E, Group B offices, and a Group A-3 conference room. The building is of Type VA construction. Insufficient open space is available for area increase purposes. Floor areas are as follows:

Office (B)	4,500 square feet
Assembly (A-3)	1,000 square feet
Day care (E)	6,000 square feet

DETERMINE: If the building area is within the allowable area under the "separated occupancies" provisions.

TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET[a, b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-3	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-4	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000
A-5	NS	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
	S1												
	SM												
B	NS	UL	UL	37,500	23,000	28,500	19,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	114,000	76,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	85,500	57,000	324,000	216,000	135,000	108,000	54,000	27,000
E	NS	UL	UL	26,500	14,500	23,500	14,500	76,500	51,000	31,875	25,500	18,500	9,500
	S1	UL	UL	106,000	58,000	94,000	58,000	306,000	204,000	127,500	102,000	74,000	38,000
	SM	UL	UL	79,500	43,500	70,500	43,500	229,500	153,000	95,625	76,500	55,500	28,500
	NS	UL	UL	25,000	15,500	19,000	12,000	100,500	67,000	41,875	33,500	14,000	8,500

Source: 2021 IBC

508.4.2/3 Separated Occupancy

GIVEN: A one-story nonsprinklered building housing day care classified as Group E, Group B offices, and a Group A-3 conference room. The building is of Type VA construction. Insufficient open space is available for area increase purposes. Floor areas are as follows:

Office (B)	4,500 square feet
Assembly (A-3)	1,000 square feet
Day care (E)	6,000 square feet

DETERMINE: If the building area is within the allowable area under the "separated occupancies" provisions.

SOLUTION: In accordance with Section 508.4.2:

$$\frac{\text{Actual area of office}}{\text{Allowable area of office}} + \frac{\text{Actual area of assembly}}{\text{Allowable area of assembly}} + \frac{\text{Actual area of E}}{\text{Allowable area of E}} \le 1$$

$$\frac{4{,}500}{18{,}000} + \frac{1{,}000}{11{,}500} + \frac{6{,}000}{18{,}500} \overset{?}{\le} 1$$

$$0.25 + 0.09 + 0.32 \overset{?}{\le} 1$$

$0.66 \le 1$, therefore OK

Building is within the allowable area.

For SI: 1 square foot = 0.093 m^2.

Source: 2021 IBC

508.4.2/3 Separated Occupancy

In the determination of allowable building area for a mixed occupancy building, the _____ occupancies method requires the sum of the ratios of the actual building area of each occupancy divided by the allowable building area of each occupancy to be not greater than 1.0.

a. accessory
b. incidental
c. nonseparated
d. separated

Source: 2021 IBC

Class 3:
Chapter 6
Type of Construction

Source: 2021 IBC

History

- In order to build a structure bigger, it must be built better
- Fire-resistance requirements were developed by specifying the type and thickness of materials used.
- Herbert Hoover, then Secretary of Commerce (1921 –28)
  - Concepts in previous building codes that have carried over to today.
- Pre 1920s "The building codes of this country have not been developed on scientific data, but rather on compromise; they are not uniform in practice and in many instances involve an additional cost of construction without assuring more useful or more durable buildings."

Source: 2021 IBC

602.1 Construction Types

- Buildings and structures erected or to be erected, altered or extended in height or area shall be classified in one of the five construction types defined in Sections 602.2 through 602.5.
- Protected, where the major structural elements are provided with some degree of fire resistance.
- Unprotected, where no fire protection of the building elements is typically mandated. Protected construction is further distinguished in Type I buildings where the required protection for many structural elements exceeds a 1-hour fire-resistance rating.

Source: 2021 IBC

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	C	HT
		V	A	B		

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

1. The Five Basic Construction Types

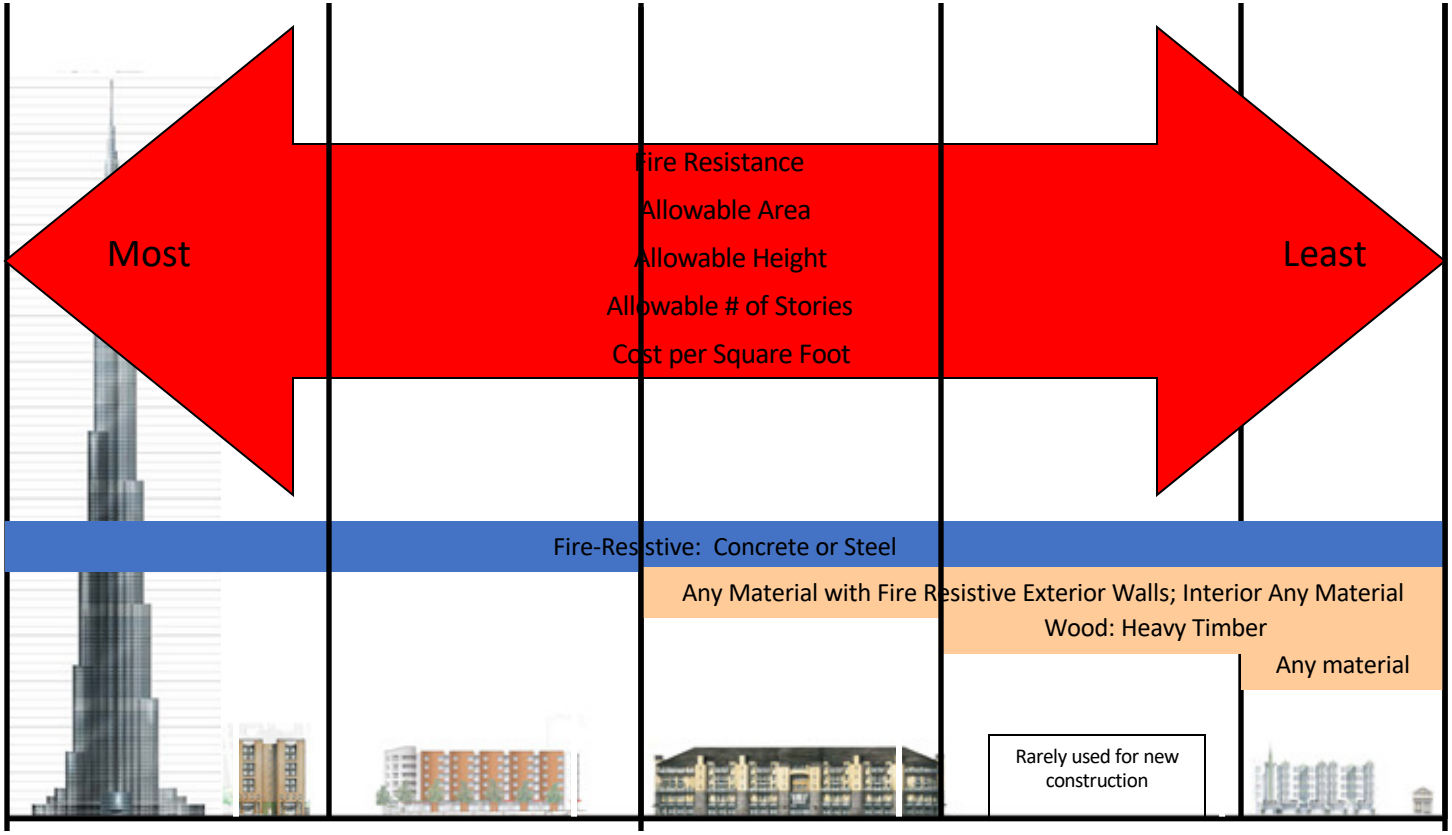
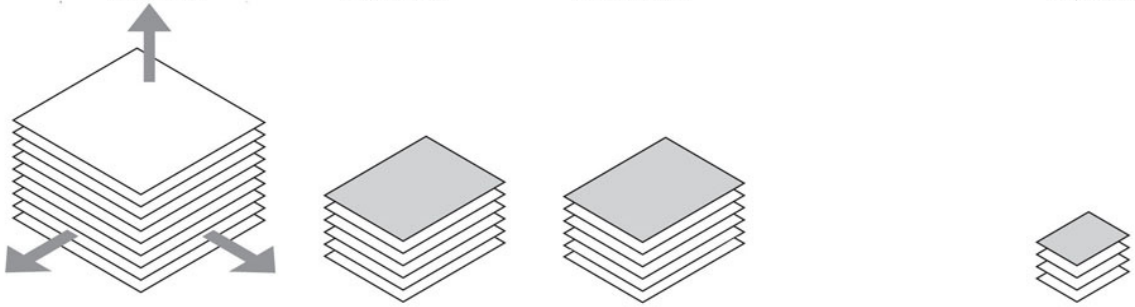


TABLE 503

Excerpt from IBC Table 503 Showing allowable building heights (with and without sprinklers) number of stories (with sprinklers) and proportionate floor areas per story)

Construction Type	Type I Fire-Resistive Construction	Type II Fire-Resistive Construction	Type III Fire-Resistive Exterior Walls Only	Type IV Heavy Timber	Type V
R-2 (Apartment)	Unlimited Unlimited	65/85 ft., 5 Stories 24,000 s.f.	65/85 ft., 5 stories 24,000 s.f.		50/70 ft., 4 stories 12,000 s.f.
Exterior Bearing Walls Rating	3 HR	1 HR	2 HR		1 HR
Fire Walls Rating	3 HR	2 HR	3 HR		2 HR



Sprinklered Buildings: + 20 ft./ 1Story, OR + Area

Allowable area may be increased depending on fire-fighting access.

Wood and hours

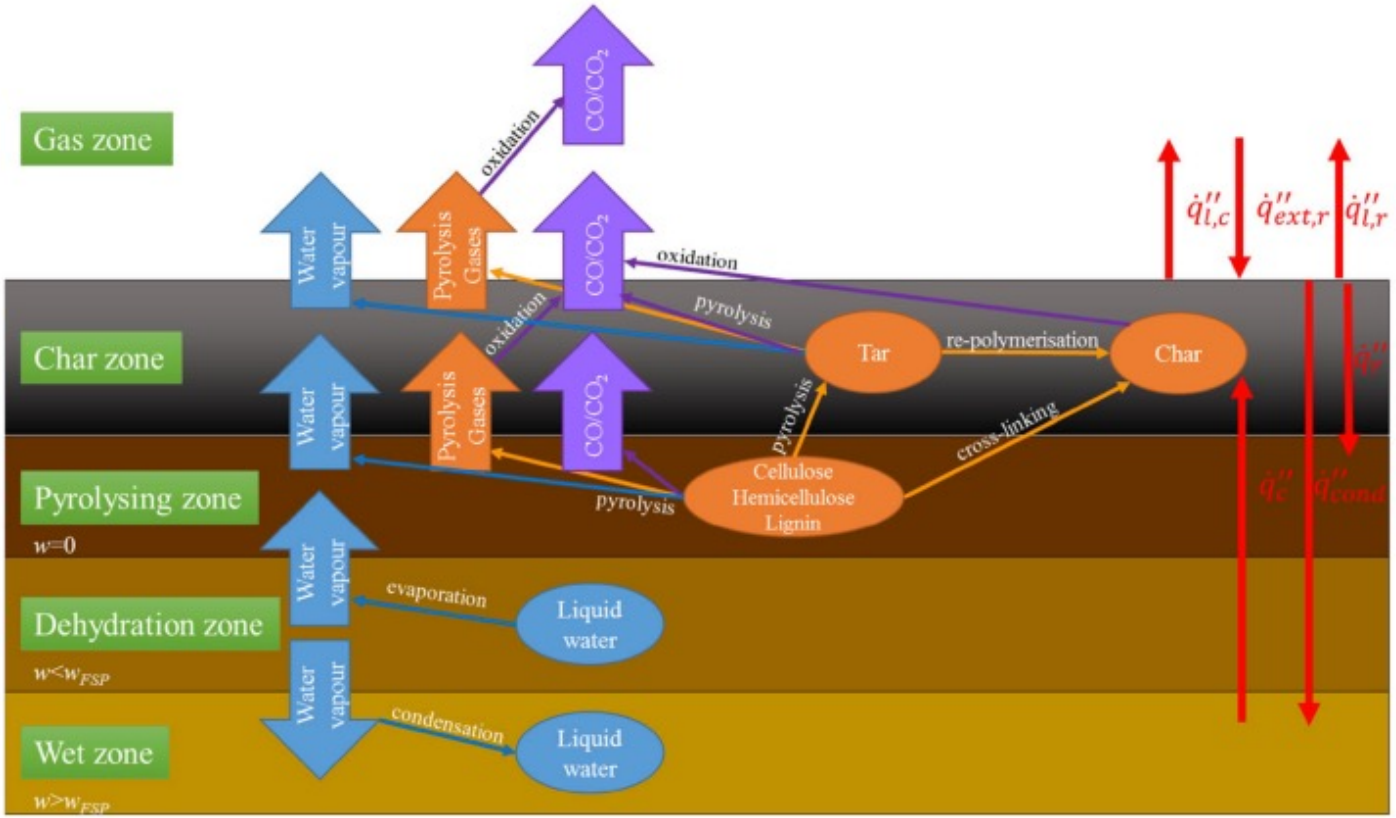


Figure 1. Chemical and physical processes within a burning timber sample; $\dot{q}''_{l,c}$ is the surface heat losses by convection, $\dot{q}''_{l,r}$ is the surface heat losses by radiation, $\dot{q}''_{ext,r}$ is the external heat flux, $\dot{q}''_r$ is in-depth radiation, $\dot{q}''_{cond}$ is conduction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

Source: 2021 IBC

Wood and hours

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

Source: 2021 IBC

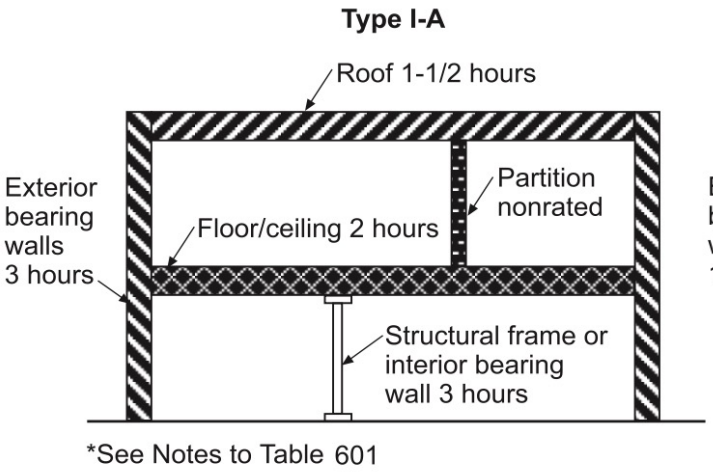
RELATIVE CONSTRUCTION COSTS – Based on Construction Type

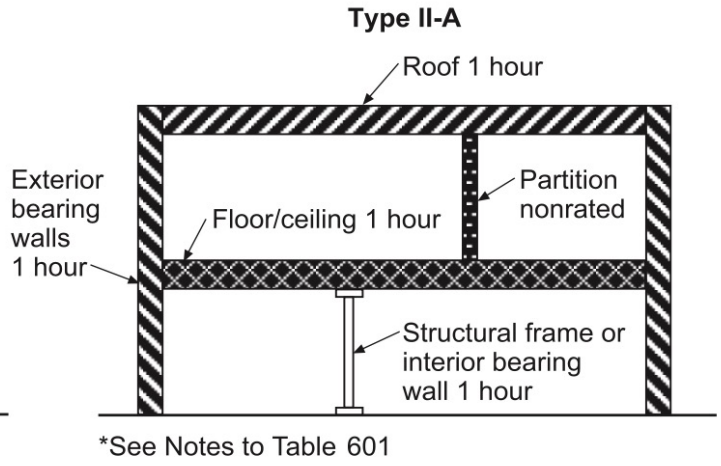
	CONSTRUCTION TYPE		# OF RES. STORIES	RELATIVE COST / SF	WHY
RESIDENTIAL FLOORS	TYPE V:	WOOD	4 MAX	1.00	
		METAL (plywood deck)		1.04	
	TYPE III: *	WOOD	5 MAX	1.03	+ fire-treated lumber framing at exterior walls
		METAL (plywood deck)		1.07	+ metal
	TYPE II:	METAL (metal deck)	5 MAX	1.10	+ metal deck w/ concrete topping
	TYPE I:	MID-RISE (concrete)	8 MAX	1.25	+ concrete frame
		HIGH-RISE (concrete)	UNLIMITED	1.30	+ fire safety features
				+ 1% per floor over 9	
GARAGE/UNFINISHED T.I. SPACE	TYPE I:	GARAGE ON GRADE (multi-level)		0.40	most efficient
		GARAGE ON GRADE (single level)		0.50	
		GARAGE BELOW GRADE		0.60	+ shoring, waterproofing

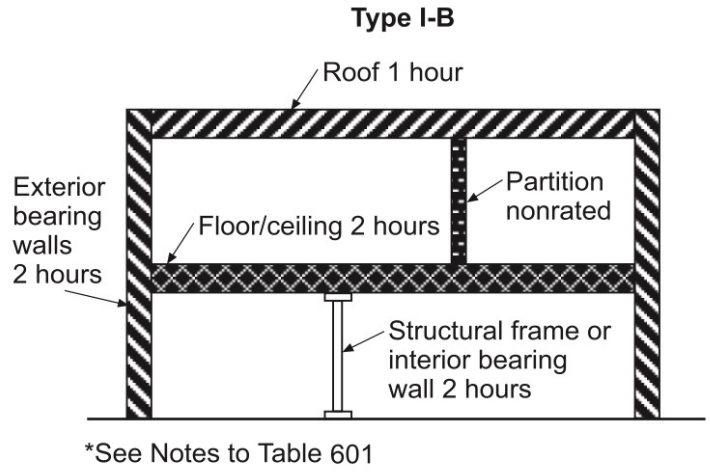
* Man lift and possibly tower crane needed for buildings over 60'. Cost per square foot varies.

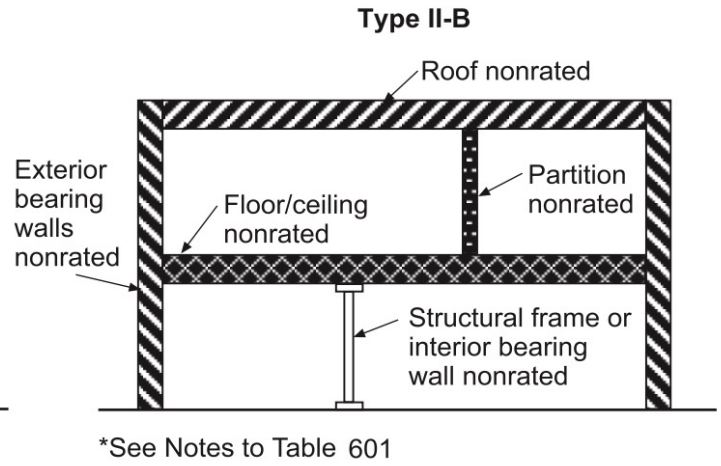
Relative costs courtesy of Scott Smith of the James E. Roberts-Obayashi Corporation

602.2 Types I and II Construction Difference









Steel, iron, concrete, masonry and aluminum are considered those types of noncombustible materials used as building elements or components of building elements in Type I or II buildings. Section 703.5.2 also recognizes gypsum board as a noncombustible material.

Source: 2021 IBC

601, Note b Roof Construction

9. In a building of Type IB construction, what is the minimum required fire-resistance rating of the floor construction?

a. 3 hours
b. 2 hours
c. 1 hour
d. 0 hours (no rating required)

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of this code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
f. Not less than the fire-resistance rating as referenced in Section 704.10.
g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

Source: 2021 IBC

602.3 Type III Construction

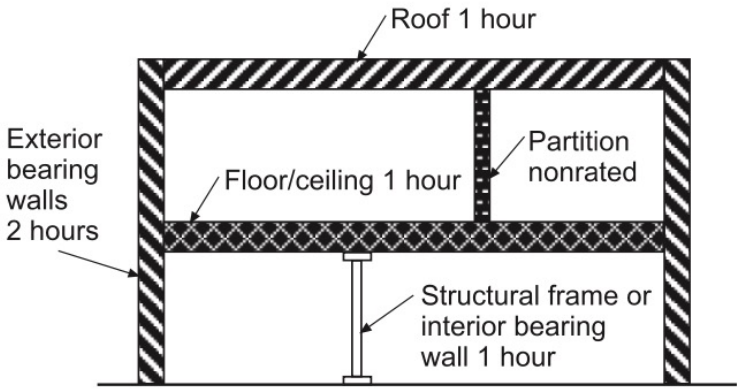
1. What types of construction are considered “noncombustible”?

   a. I, II
   b. I, II, III, IV
   c. III, IV
   d. III, IV, V

Source: 2021 IBC

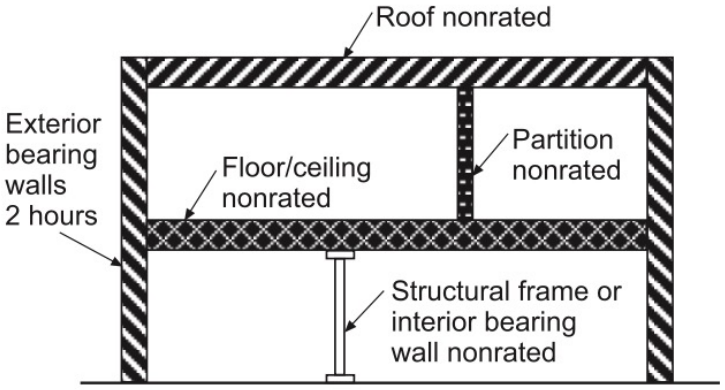
602.3 Type III Construction

Type III-A



*See Notes to Table 601

Type III-B



*See Notes to Table 601

A-211

Source: 2021 IBC

Historically referred to as “ordinary masonry construction,” Type III buildings usually consist of concrete or masonry exterior walls with wood floor and roof systems. However, the IBC permits such walls to contain fire-retardant-treated wood as an element of the exterior wall construction.

602.3 Type III Construction

2. Type III buildings are constructed with _____ or fire-retardant-treated wood exterior walls and interior elements _____.
    a. fire-resistant, of noncombustible materials
    b. noncombustible, of noncombustible materials
    c. noncombustible, of any material permitted by the code
    d. fire-resistant, of any material permitted by the code

Source: 2021 IBC

602.3 Type III Construction

2. Type III buildings are constructed with _____ or fire-retardant-treated wood exterior walls and interior elements _____.
    a. fire-resistant, of noncombustible materials
    b. noncombustible, of noncombustible materials
    c. noncombustible, of any material permitted by the code
    d. fire-resistant, of any material permitted by the code

Source: 2021 IBC

602.3 Type III Construction

4. In buildings of Type III construction, under what condition is fire-retardant-treated wood framing permitted within an exterior wall assembly?
    a. the wall has a 2-hour rating or less
    b. the fire separation distance exceeds 10 feet
    c. wood columns of heavy-timber sizes are used
    d. the wall is a nonbearing element

Source: 2021 IBC

602.3 Type III Construction

4. In buildings of Type III construction, under what condition is fire-retardant-treated wood framing permitted within an exterior wall assembly?

   a. the wall has a 2-hour rating or less
   b. the fire separation distance exceeds 10 feet
   c. wood columns of heavy-timber sizes are used
   d. the wall is a nonbearing element

Source: 2021 IBC

602.3 Type IV Construction

- Type IV construction is that type of construction in which the building elements are mass timber or noncombustible materials and have fire-resistance ratings in accordance with Table 601. Mass timber elements shall meet the fire-resistance rating requirements of Section 602.4 based on either the fire-resistance rating of the noncombustible protection, the mass timber, or a combination of both and shall be determined in accordance with Section 703.2.
- Mass timber is defined as those structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross-section dimensions of Type IV construction. The term “mass timber” represents the large wood building elements permitted for heavy timber (Type IV-HT) construction and is deemed to meet fire-resistance requirements based solely on the required minimum dimensions of the wood element. It also represents construction Types IV-A, IV-B and IV-C, which are required to have a fire-resistance rating, in many cases provided by both the mass timber element itself and noncombustible protection applied to the mass timber element.

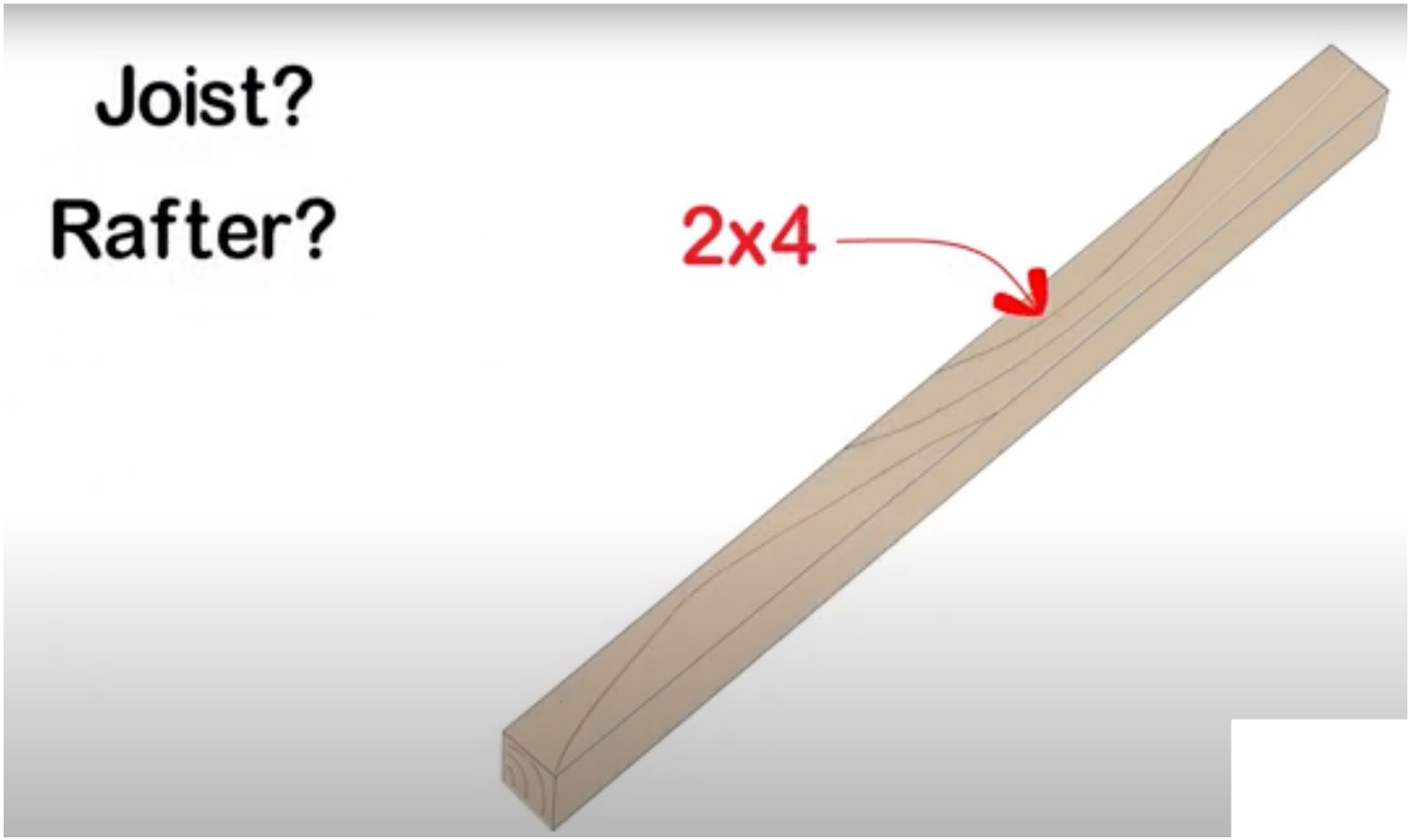
Source: 2021 IBC

602.1 Construction Types

While mass timber can be fully exposed in Type IV-C construction and partially exposed in Type IV-B construction, it must in other cases be protected with a noncombustible material, such as gypsum board. It must also have a protection time assigned based on testing that is prescribed elsewhere in the code.

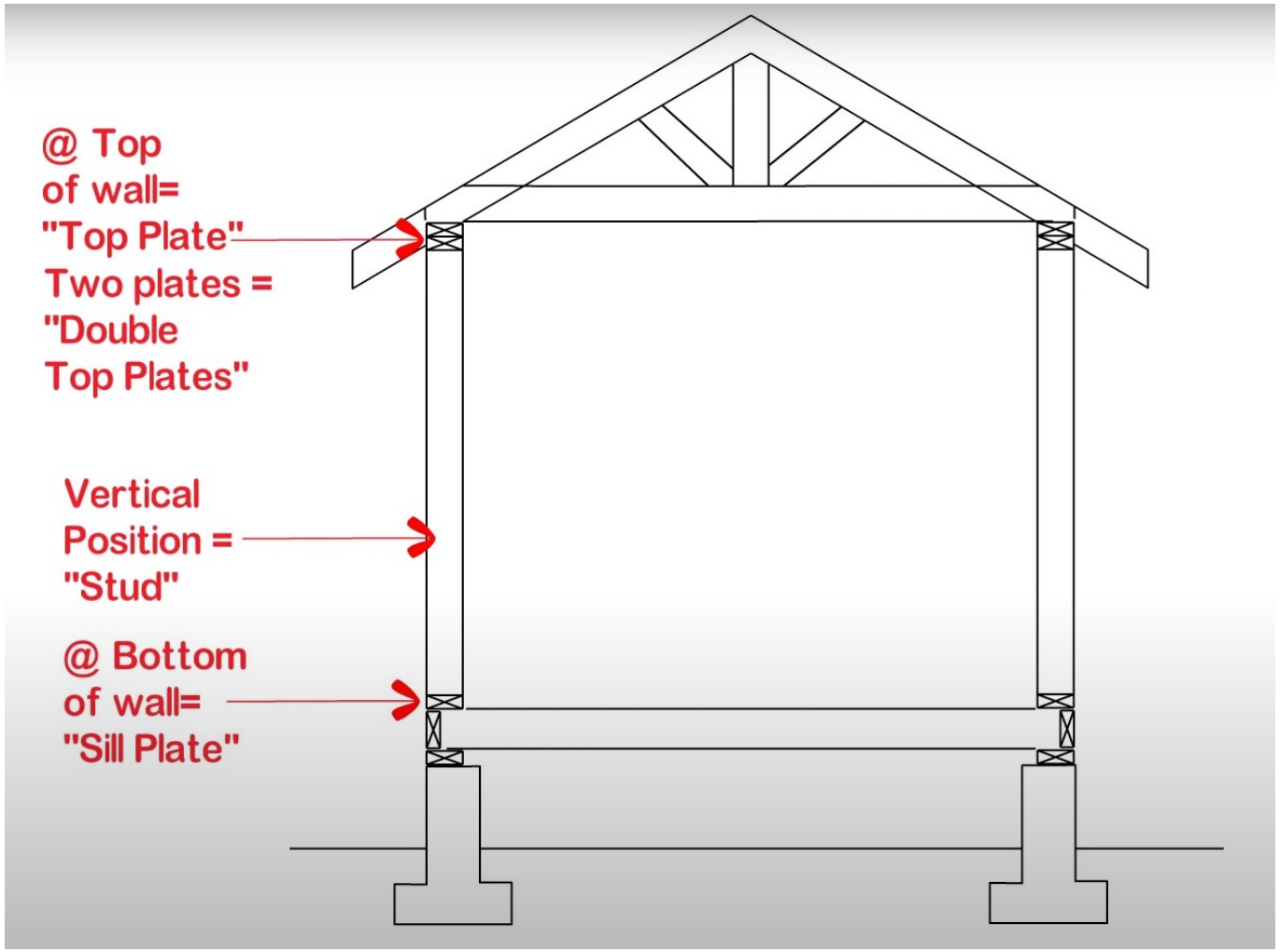
Source: 2021 IBC

T601, 202 Primary Structural Frames



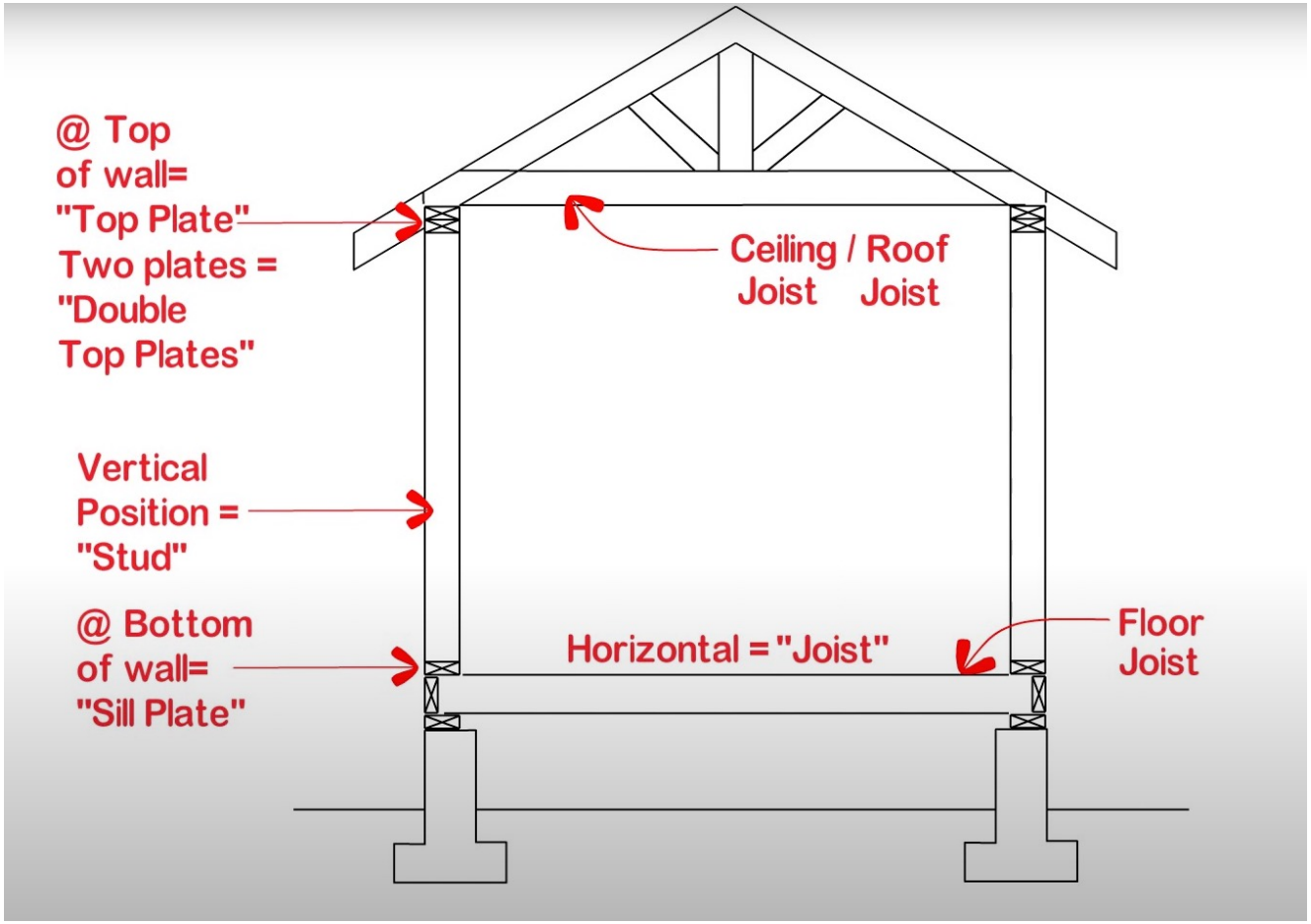
Source: 2021 IBC

T601, 202 Primary Structural Frames



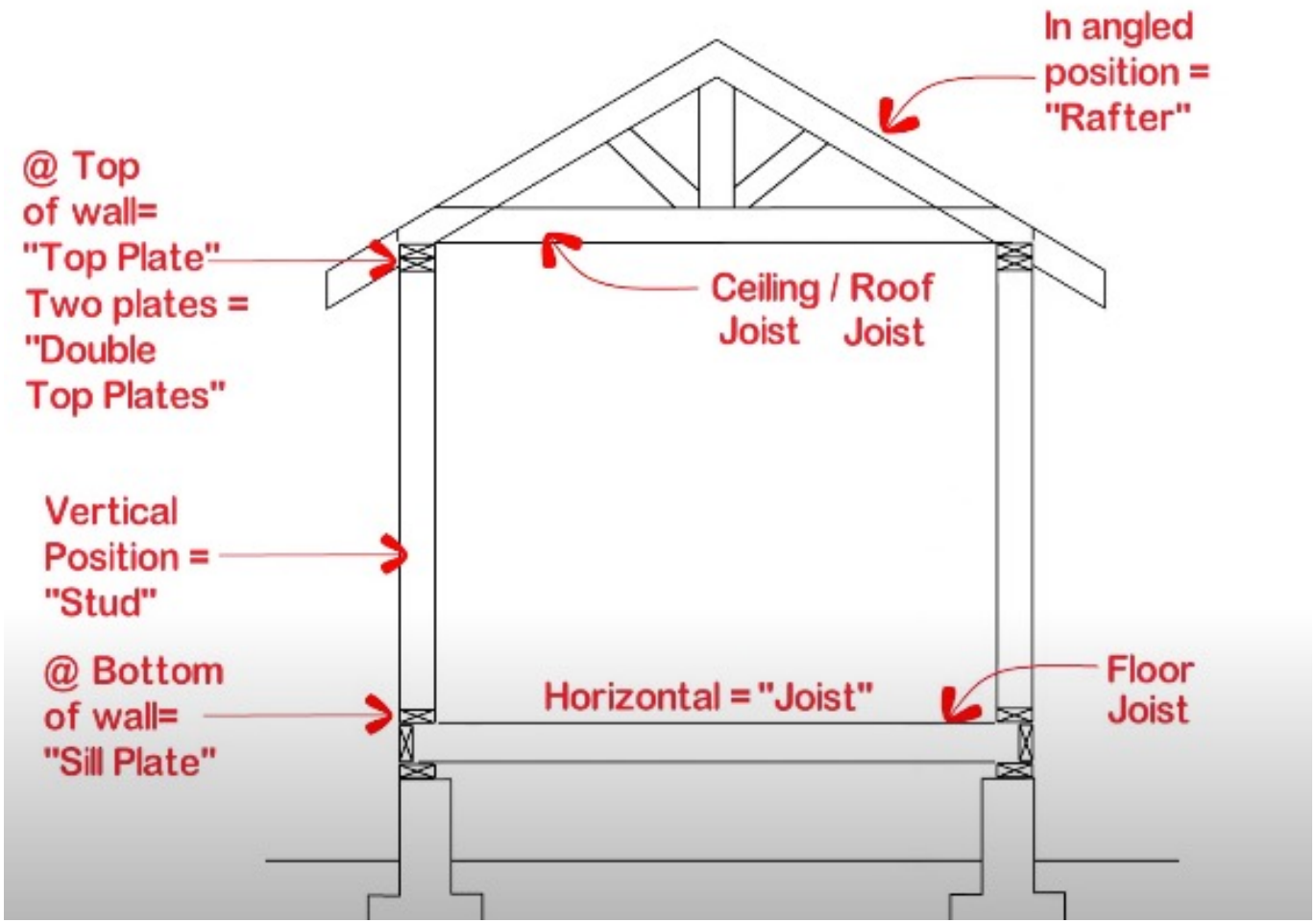
Source: 2021 IBC

T601, 202 Primary Structural Frames



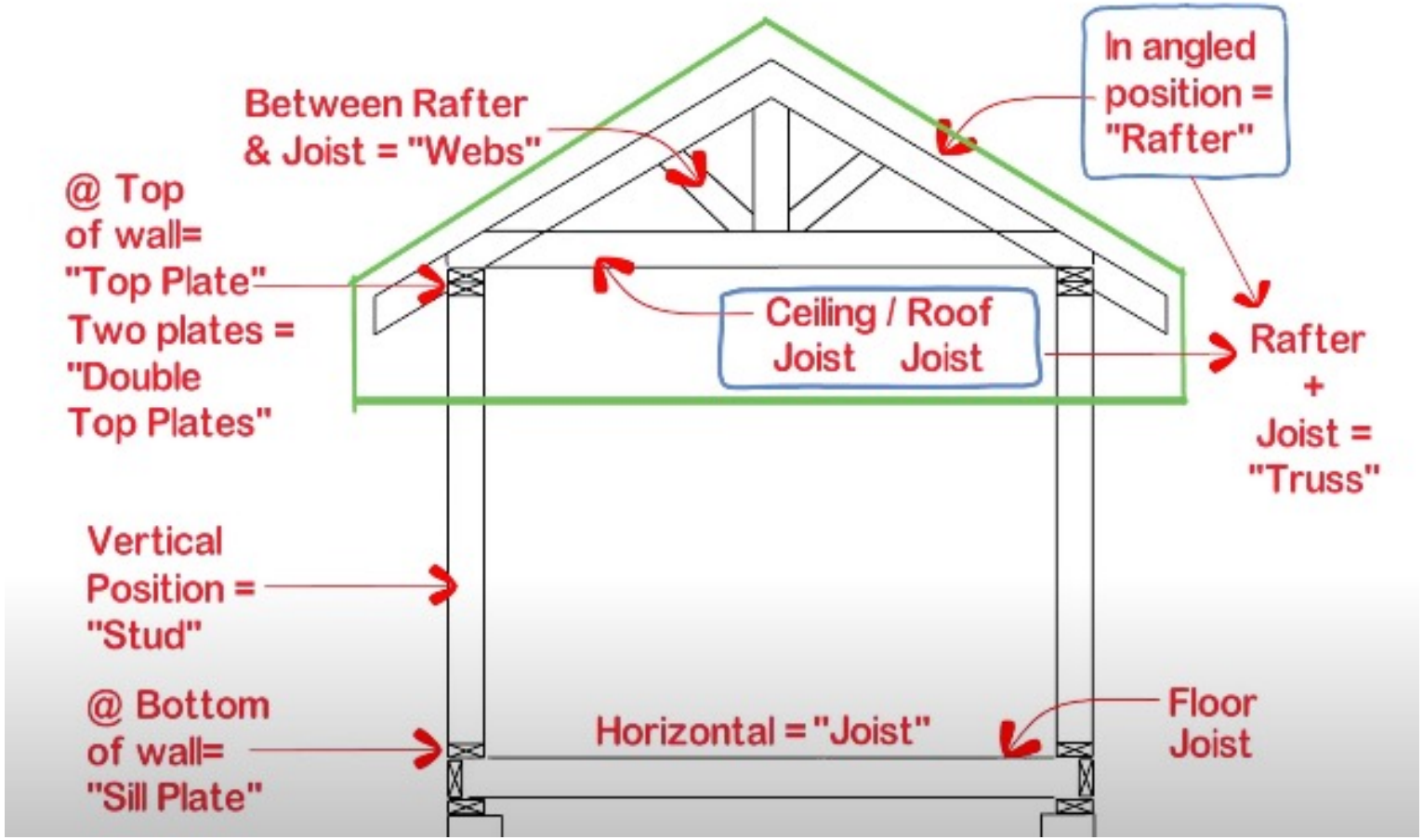
Source: 2021 IBC

T601, 202 Primary Structural Frames



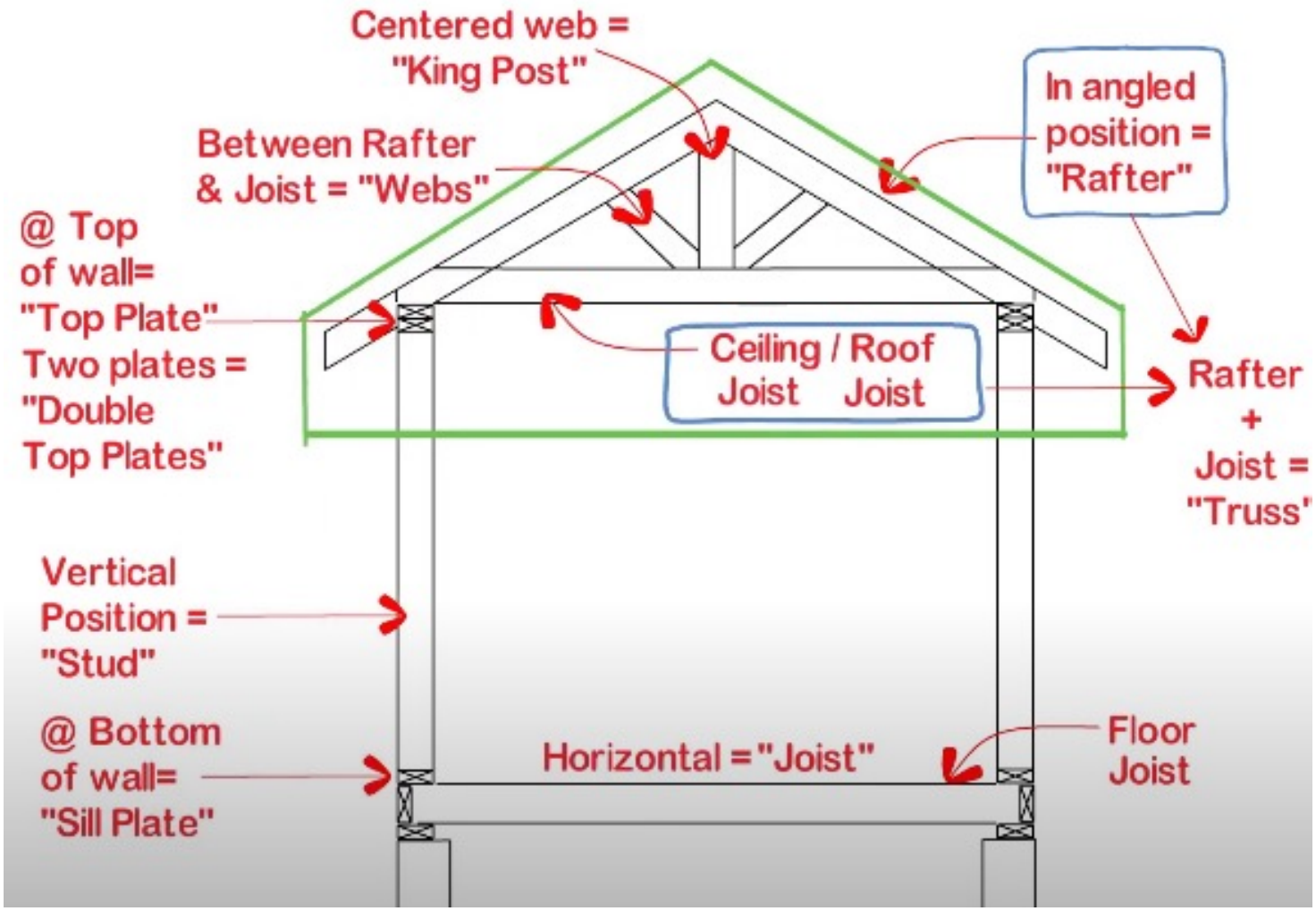
Source: 2021 IBC

T601, 202 Primary Structural Frames



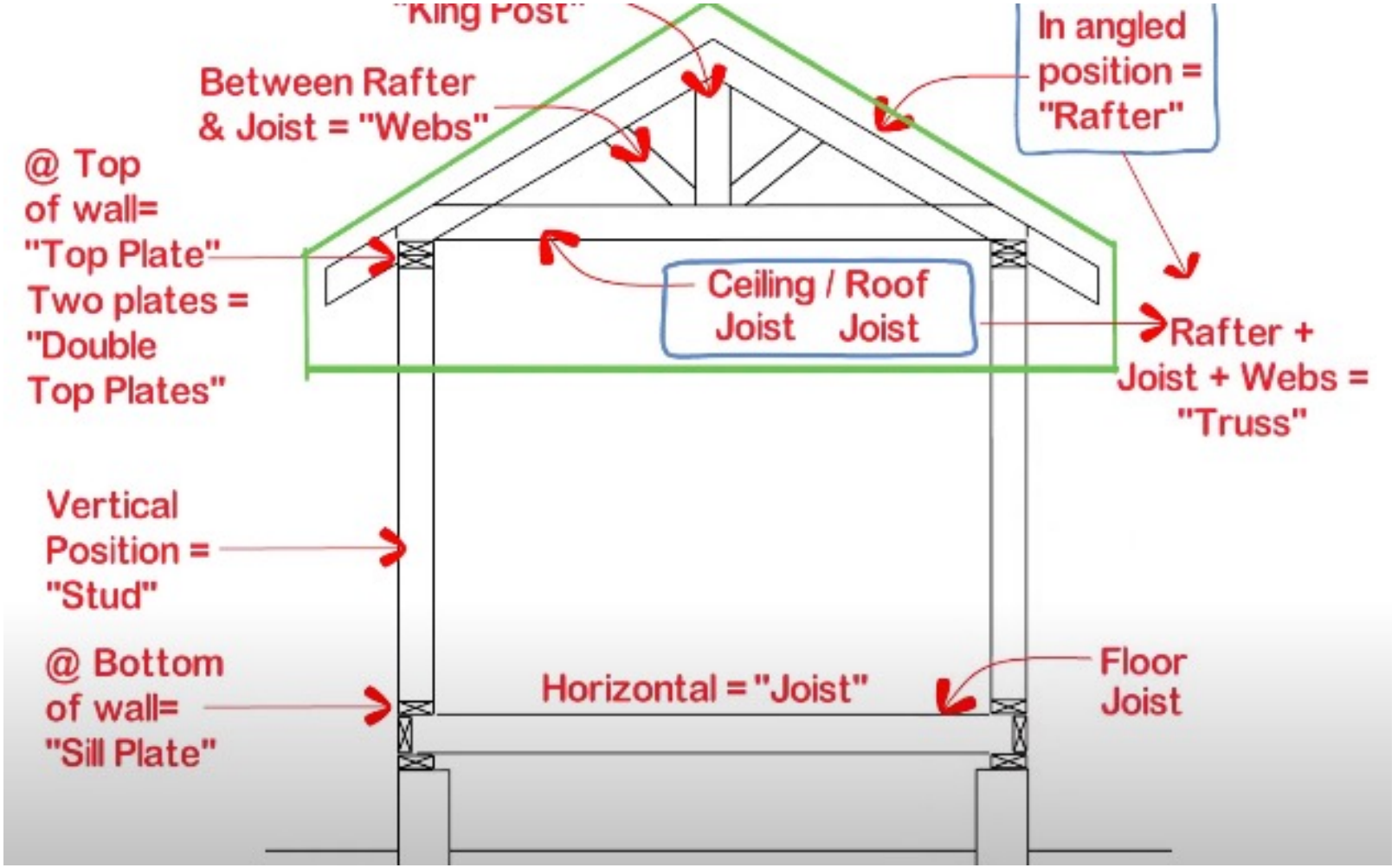
Source: 2021 IBC

T601, 202 Primary Structural Frames



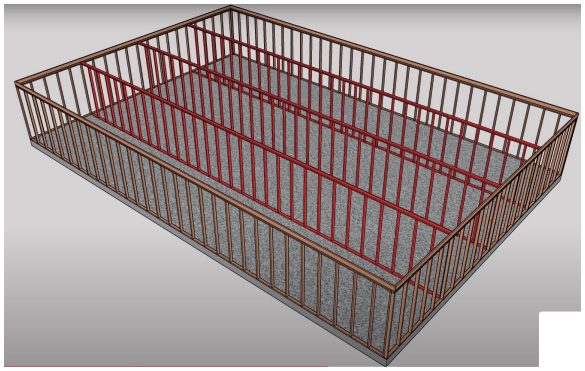
Source: 2021 IBC

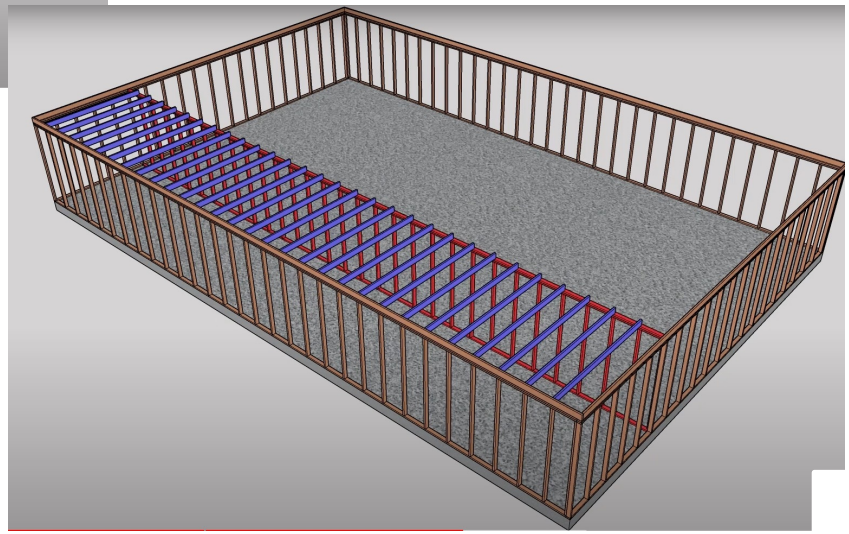
T601, 202 Primary Structural Frames



Source: 2021 IBC

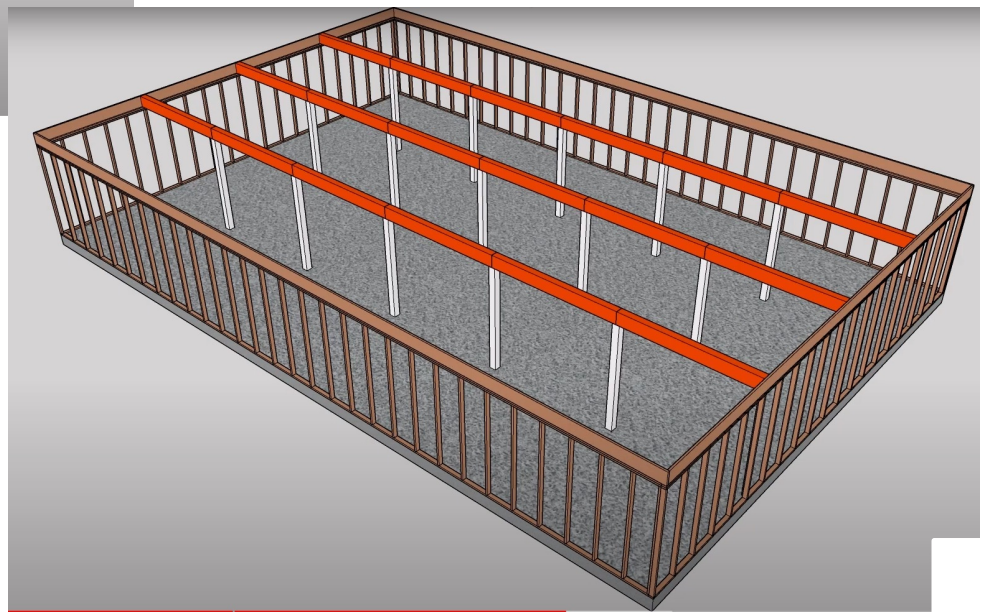
T601, 202 Primary Structural Frames (joist - wall)





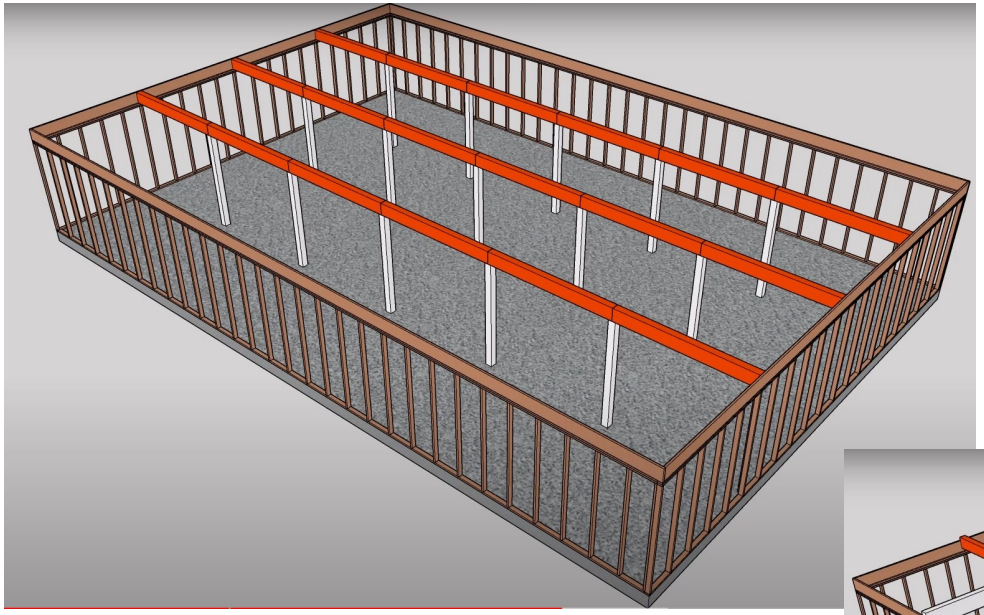
Source: 2021 IBC

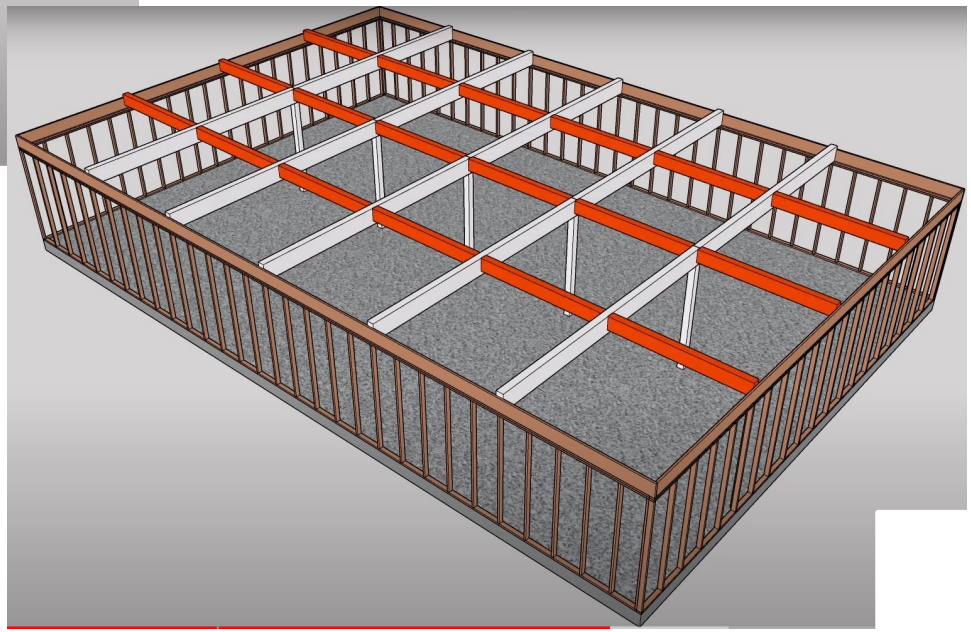
T601, 202 Primary Structural Frames (Walls = Beams –Column)



Source: 2021 IBC

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





602.4.1 Type IV-A Construction

7. Combustible concealed spaces in buildings of Type _____ construction must be protected.

a. I
b. III
c. IV
d. V

Source: 2021 IBC

Type IVA Table 601

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of this code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
f. Not less than the fire-resistance rating as referenced in Section 704.10.
g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

Source: 2021 IBC

602.4.1 Type IV-A Construction

- The outside face of exterior walls of mass timber construction shall be protect with non-combustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mass timber roofs, shall be protected with materials complying with Section 703.3. The floor assembly shall contain a noncombustible materials not less than 1 inch (25 mm) in thickness above the mass timber. The interior surfaces of roof assemblies shall be protected in accordance with Section 602.4.1.2 (consistent with protection of interior walls).

TABLE 722.7.1(1)
PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER TABLE 601 AND TABLE 705.5 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(2)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
$^1/_2$-inch Type X gypsum board	25
$^5/_8$-inch Type X gypsum board	40

Source: 2021 IBC

602.4.1 Type IV-A Construction

- The outside face of exterior walls of mass timber construction shall be protect with non-combustible protection with a minimum assigned time of 40 minutes, as specified in Table 722.7.1(1). Interior faces of all mass timber elements, including the inside faces of exterior mass timber walls and mass timber roofs, shall be protected with materials complying with Section 703.3. The floor assembly shall contain a noncombustible materials not less than 1 inch (25 mm) in thickness above the mass timber. The interior surfaces of roof assemblies shall be protected in accordance with Section 602.4.1.2 (consistent with protection of interior walls).
- Type IV-A construction is composed of mass timber elements that are completely protected with noncombustible materials. The contribution of the noncombustible protection to the overall fire-resistance rating of a mass timber member or assembly is established through a performance path set forth in Section 703.6. In addition, noncombustible assemblies such as those of light-gage steel are also permitted. However, light-frame combustible assemblies, including those consisting of wood studs, joists or furring, are specifically prohibited.

Source: 2021 IBC

Wood and hours

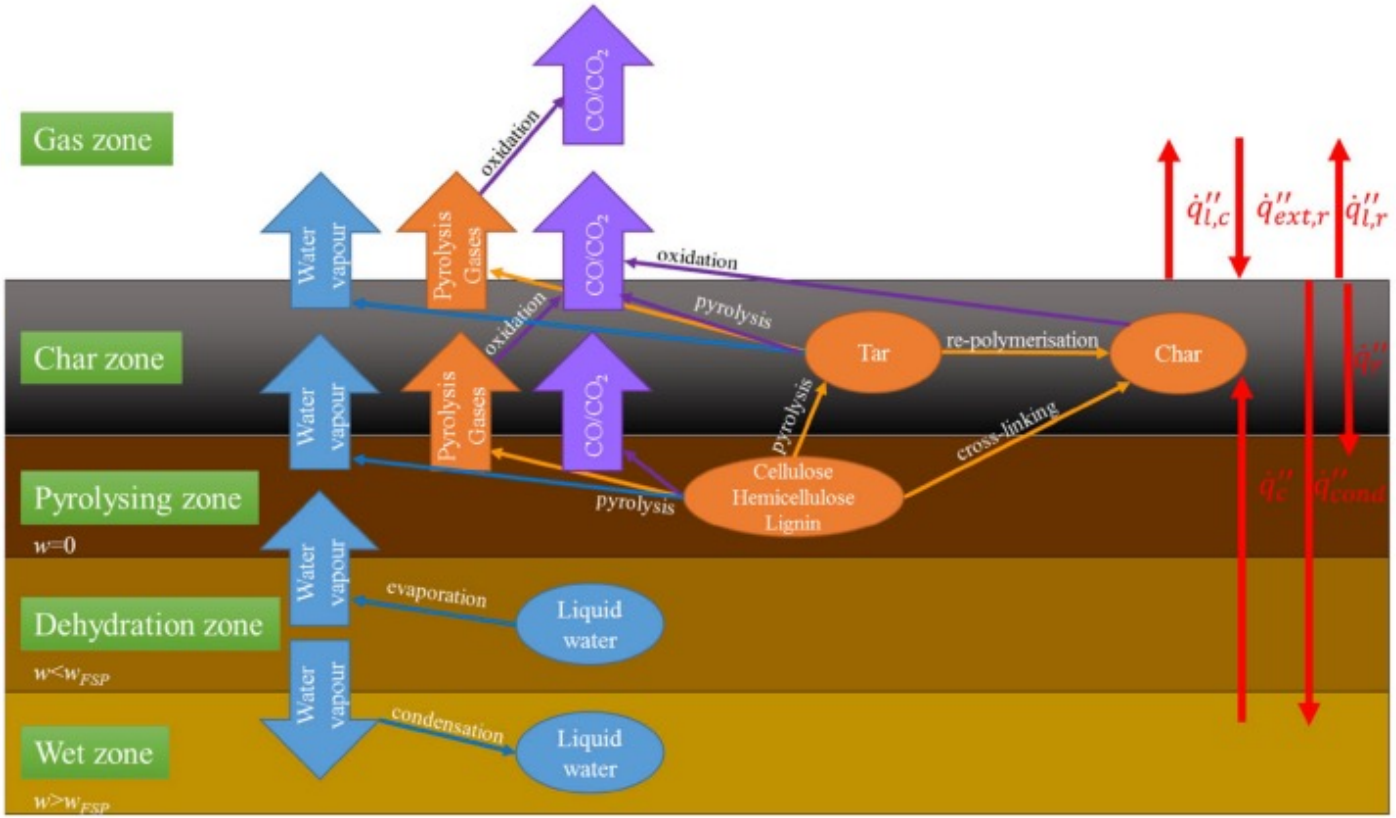


Figure 1. Chemical and physical processes within a burning timber sample; $\dot{q}''_{l,c}$ is the surface heat losses by convection, $\dot{q}''_{l,r}$ is the surface heat losses by radiation, $\dot{q}''_{ext,r}$ is the external heat flux, $\dot{q}''_r$ is in-depth radiation, $\dot{q}''_{cond}$ is conduction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

Source: 2021 IBC

602.4 Construction Type

3. The type of construction where building elements are mass timber or noncombustible is _____.

a. Type I
b. Type II
c. Type III
d. Type IV

Source: 2021 IBC

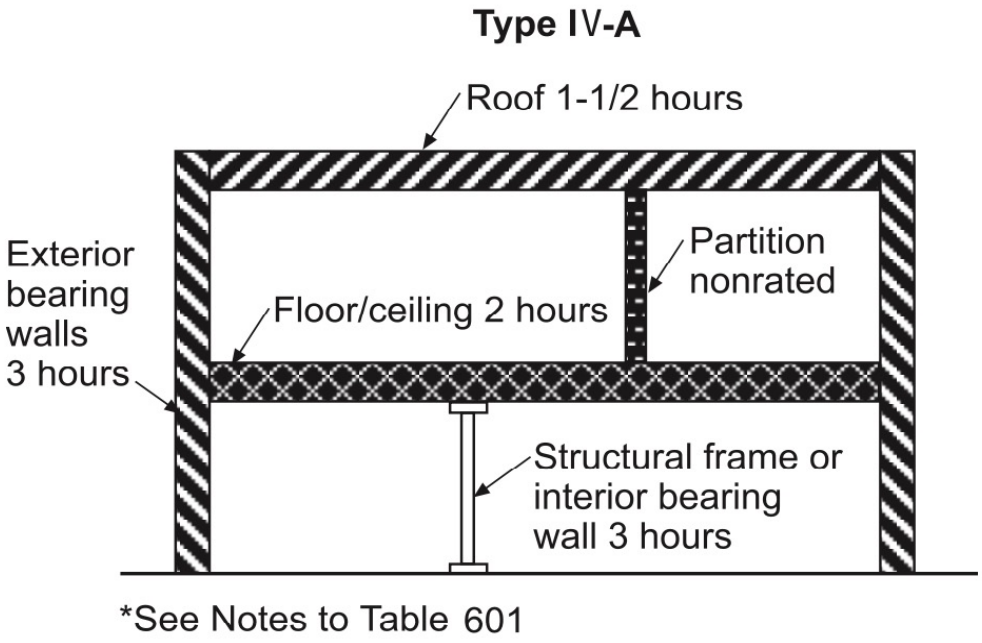
602.4 Construction Type

3. The type of construction where building elements are mass timber or noncombustible is _____.

a. Type I
b. Type II
c. Type III
d. Type IV

Source: 2021 IBC

602.4.1 Type IV-A Construction



Construction adhesive or other sealant is required at joint and intersections to prevent air flow. Where a wall or horizontal assembly serves as the separation between two atmospheres, it is necessary to properly seal any voids that could serve as a conduit for air movement during a fire.

Source: 2021 IBC

602.4.2/3 Type IV-B/C Construction

- In Type IV-B construction, interior faces of all mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, shall be protected, as required by Section 602.4.2.2, with materials complying with Section 707.3. Unprotected portions of mass timber ceilings and walls are permitted when complying with Section 602.4.2.2.4 (separation distance between unprotected mass timber elements) and the following: [see allowances for unprotected portions of mass timber ceilings (limited to 20 percent of floor area in any dwelling unit or fire area) and mass timber walls (limited to 40 percent of floor area in any dwelling unit or fire area)]. In Type IV-C construction, mass timber elements (interior walls, ceilings, columns and beams) are permitted to be unprotected.
- Type IV-B construction permits portions of interior mass timber surfaces to be exposed. The amount of exposed surface permitted, as well as the required separation between unprotected portions, is regulated to limit potential contribution of the structure to an interior fire. Type IV-C construction permits fully exposed mass timber on the interior of the building except in specific areas such as concealed spaces, shafts, elevator hoistways and interior exit stairway enclosures.

Source: 2021 IBC

602.4.2/3 Type IV-B/C Construction

707.3 Fire-resistance rating. The *fire-resistance rating* of *fire barriers* shall comply with this section.

707.3.1 Shaft enclosures. The *fire-resistance rating* of the *fire barrier* separating building areas from a *shaft* shall comply with Section 713.4.

707.3.2 Interior exit stairway and ramp construction. The *fire-resistance rating* of the *fire barrier* separating building areas from an *interior exit stairway* or *ramp* shall comply with Section 1023.1.

707.3.3 Enclosures for exit access stairways. The *fire-resistance rating* of the *fire barrier* separating building areas from an *exit access stairway* or *ramp* shall comply with Section 713.4.

707.3.4 Exit passageway. The *fire-resistance rating* of the *fire barrier* separating building areas from an *exit passageway* shall comply with Section 1024.3.

707.3.5 Horizontal exit. The *fire-resistance rating* of the separation between building areas connected by a *horizontal exit* shall comply with Section 1026.1.

Source: 2021 IBC

707.3.6 Atriums. The *fire-resistance rating* of the *fire barrier* separating *atriums* shall comply with Section 404.6.

707.3.7 Incidental uses. The *fire barrier* separating incidental uses from other spaces in the building shall have a *fire-resistance rating* of not less than that indicated in Table 509.1.

707.3.8 Control areas. *Fire barriers* separating *control areas* shall have a *fire-resistance rating* of not less than that required in Section 414.2.4.

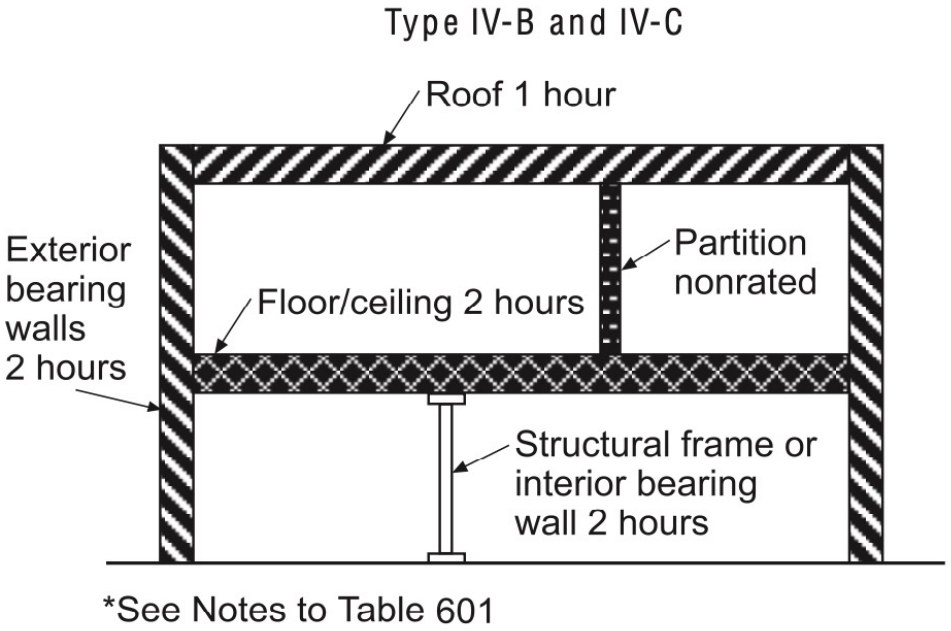
707.3.9 Separated occupancies. Where the provisions of Section 508.4 are applicable, the *fire barrier* separating mixed occupancies shall have a *fire-resistance rating* of not less than that indicated in Table 508.4 based on the occupancies being separated.

707.3.10 Fire areas. The *fire barriers*, *fire walls*, *horizontal assemblies* or combinations thereof separating a single occupancy into different *fire areas* shall have a *fire-resistance rating* of not less than that indicated in Table 707.3.10. The *fire barriers*, *fire walls*, *horizontal assemblies* or combinations thereof separating *fire areas* of mixed occupancies shall have a *fire-resistance rating* of not less than the highest value indicated in Table 707.3.10 for the occupancies under consideration.

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

602.4.2/3 Type IV-B/C Construction



Exterior walls are required to be protected in the same manner for Types IV-A, IV-B and IV-C construction, which requires noncombustible protection of at least 40 minutes on the exterior side of exterior mass timber walls and prohibits all combustible materials on the exterior side of mass timber walls other than the water-resistive barrier.

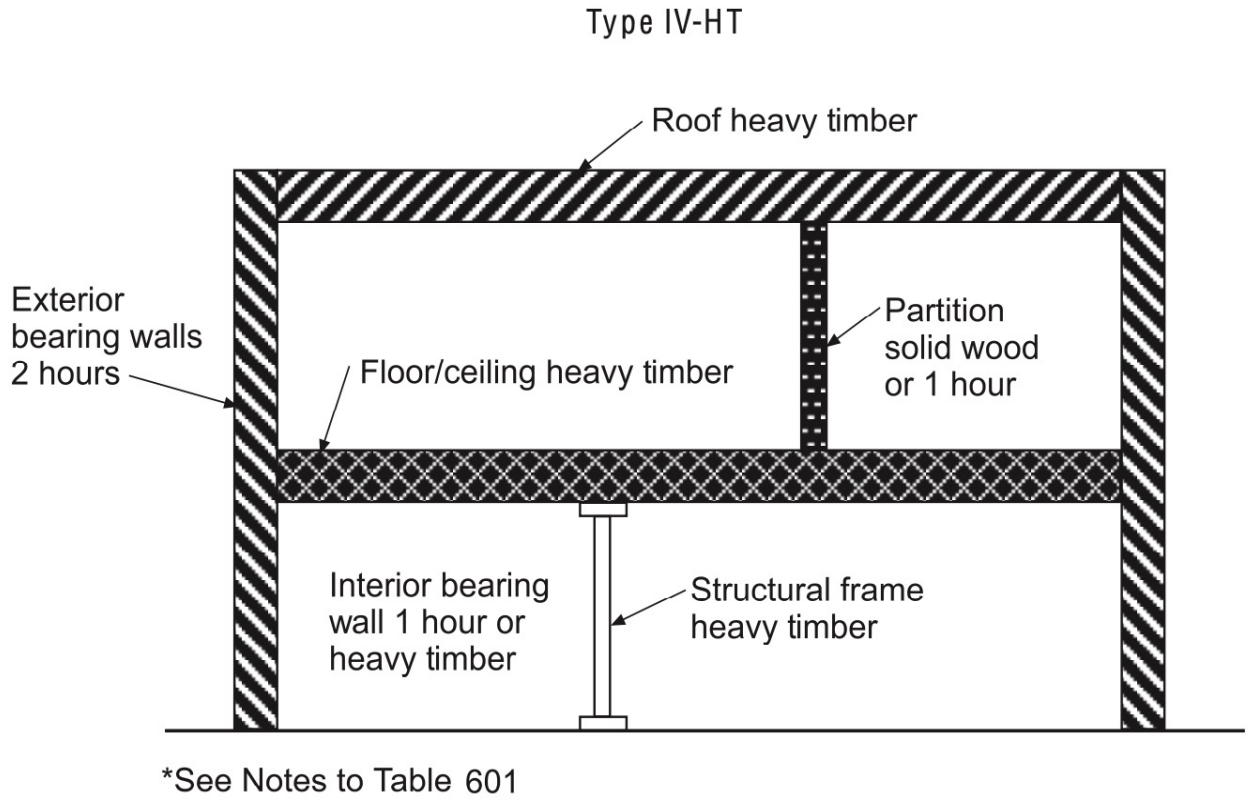
Source: 2021 IBC

602.4.4 Type IV-HT Construction

- Type IV-HT (Heavy Timber) construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated heavy timber or structural composite lumber (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials shall comply with the provisions of Section 602.3.3 and Section 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming to Section 2304.11.2.2 shall be permitted.
- Historically referred to as “heavy-timber,” buildings of Type IV-HT construction are essentially Type III buildings with an interior of wood members of significant mass. To conform to Type IV-HT construction, building members must be of substantial thickness. Given the characteristics of massive wood members, there is little chance for sudden structural collapse during or after a fire.

Source: 2021 IBC

602.4.4 Type IV-HT Construction



Although it is generally viewed that heavy-timber construction and 1-hour fire-resistance-rated construction are equivalent, they are typically not interchangeable. Although heavy-timber roof construction is permitted in Type IB, II, III and VA buildings, 1-hour construction can only be substituted for heavy-timber construction in interior bearing walls of Type IV buildings.

Source: 2021 IBC

2304.11 Heavy-Timber Construction

5. Where supporting floor loads, solid sawn wood columns of Type IV-HT construction shall be of what minimum nominal size?

   a. 5 inches by 5 inches
   b. 6 inches by 6 inches
   c. 6 inches by 8 inches
   d. 8 inches by 8 inches

TABLE 2304.11
MINIMUM DIMENSIONS OF HEAVY TIMBER STRUCTURAL MEMBERS

		MINIMUM NOMINAL SOLID SAWN SIZE		MINIMUM GLUED-LAMINATED NET SIZE		MINIMUM STRUCTURAL COMPOSITE LUMBER NET SIZE	
SUPPORTING	HEAVY TIMBER STRUCTURAL ELEMENTS	Width, inch	Depth, inch	Width, inch	Depth, inch	Width, inch	Depth, inch
Floor loads only or combined floor and roof loads	Columns; Framed sawn or glued-laminated timber arches that spring from the floor line; Framed timber trusses	8	8	$6^{3}/_{4}$	$8^{1}/_{4}$	7	$7^{1}/_{2}$
	Wood beams and girders	6	10	5	$10^{1}/_{2}$	$5^{1}/_{4}$	$9^{1}/_{2}$
Roof loads only	Columns (roof and ceiling loads); Lower half of: wood-frame or glued-laminated arches that spring from the floor line or from grade	6	8	5	$8^{1}/_{4}$	$5^{1}/_{4}$	$7^{1}/_{2}$
	Upper half of: wood-frame or glued-laminated arches that spring from the floor line or from grade	6	6	5	6	$5^{1}/_{4}$	$5^{1}/_{2}$
	Framed timber trusses and other roof framing;[a] Framed or glued-laminated arches that spring from the top of walls or wall abutments	4[b]	6	3[b]	$6^{7}/_{8}$	$3^{1}/_{2}$[b]	$5^{1}/_{2}$

For SI: 1 inch = 25.4 mm.

a. Spaced members shall be permitted to be composed of two or more pieces not less than 3 inches nominal in thickness where blocked solidly throughout their intervening spaces or where spaces are tightly closed by a continuous wood cover plate of not less than 2 inches nominal in thickness secured to the underside of the members. Splice plates shall be not less than 3 inches nominal in thickness.

b. Where protected by approved automatic sprinklers under the roof deck, framing members shall be not less than 3 inches nominal in width.

Source: 2021 IBC

2304.11 Heavy-Timber Construction

5. Where supporting floor loads, solid sawn wood columns of Type IV-HT construction shall be of what minimum nominal size?

   a. 5 inches by 5 inches
   b. 6 inches by 6 inches
   c. 6 inches by 8 inches
   d. 8 inches by 8 inches

Source: 2021 IBC

2304.11 Heavy-Timber Construction

6. Where used in floor framing, solid sawn wood beams of Type IV-HT construction shall be of what minimum nominal size?

   a. 4 inches by 8 inches
   b. 4 inches by 10 inches
   c. 6 inches by 10 inches
   d. 8 inches by 10 inches

TABLE 2304.11
MINIMUM DIMENSIONS OF HEAVY TIMBER STRUCTURAL MEMBERS

		MINIMUM NOMINAL SOLID SAWN SIZE		MINIMUM GLUED-LAMINATED NET SIZE		MINIMUM STRUCTURAL COMPOSITE LUMBER NET SIZE	
SUPPORTING	HEAVY TIMBER STRUCTURAL ELEMENTS	Width, inch	Depth, inch	Width, inch	Depth, inch	Width, inch	Depth, inch
Floor loads only or combined floor and roof loads	Columns; Framed sawn or glued-laminated timber arches that spring from the floor line; Framed timber trusses	8	8	$6^{3}/_{4}$	$8^{1}/_{4}$	7	$7^{1}/_{2}$
	Wood beams and girders	6	10	5	$10^{1}/_{2}$	$5^{1}/_{4}$	$9^{1}/_{2}$
Roof loads only	Columns (roof and ceiling loads); Lower half of: wood-frame or glued-laminated arches that spring from the floor line or from grade	6	8	5	$8^{1}/_{4}$	$5^{1}/_{4}$	$7^{1}/_{2}$
	Upper half of: wood-frame or glued-laminated arches that spring from the floor line or from grade	6	6	5	6	$5^{1}/_{4}$	$5^{1}/_{2}$
	Framed timber trusses and other roof framing;[a] Framed or glued-laminated arches that spring from the top of walls or wall abutments	4[b]	6	3[b]	$6^{7}/_{8}$	$3^{1}/_{2}$[b]	$5^{1}/_{2}$

For SI: 1 inch = 25.4 mm.

a. Spaced members shall be permitted to be composed of two or more pieces not less than 3 inches nominal in thickness where blocked solidly throughout their intervening spaces or where spaces are tightly closed by a continuous wood cover plate of not less than 2 inches nominal in thickness secured to the underside of the members. Splice plates shall be not less than 3 inches nominal in thickness.

b. Where protected by approved automatic sprinklers under the roof deck, framing members shall be not less than 3 inches nominal in width

Source: 2021 IBC

2304.11 Heavy-Timber Construction

6. Where used in floor framing, solid sawn wood beams of Type IV-HT construction shall be of what minimum nominal size?

a. 4 inches by 8 inches
b. 4 inches by 10 inches
c. 6 inches by 10 inches
d. 8 inches by 10 inches

Source: 2021 IBC

2304.11 Heavy-Timber Construction

- Where a structure, portion thereof or individual structural elements are required by provisions of the IBC to be of heavy timber, the building elements therein shall comply with the applicable provisions of Sections 2304.11.1 through 2304.11.4. Minimum dimensions of heavy timber shall comply with the applicable requirements in Table 2304.11 based on roofs or floors supported and the configuration of each structural element, or in Sections 2304.11.2 through 2304.11.4.
- Solid-sawn wood members, glued-laminated timbers and structural composite lumber are manufactured with different methods and procedures: therefore, they do not have the same dimensions. However, they both have the same inherent fire-resistive capability that has been long recognized in the code.

Source: 2021 IBC

602.4.4.2 / 2304.11 Cross – Laminate Timer

- Cross-laminated timber (CLT) not less than 4 inches (102 mm) in thickness complying with Section 2303.1.4 shall be permitted within exterior wall assemblies with a 2-hour rating or less, provided the exterior surface of the cross-laminated timber and heavy timber elements are protected by (1) fire-retardant-treated wood not less than 15/32 inch (12 mm) thick, (2) gypsum board not less than 1/2 inch (12.7 mm) thick, or (3) a noncombustible material. Cross-laminated timber floors shall be not less than 4 inches (102 mm) in actual thickness. Cross-laminated timber roofs shall be not less than 3 inches (76 mm) nominal in thickness.
- Cross-laminated timber (CLT) is a prefabricated engineered wood product consisting of not less than three layers of solid-sawn lumber or structural composite lumber where the adjacent layers are cross oriented and bonded with structural adhesive to form a solid wood element. First developed in Europe, CLT has been used extensively there for a large section of structural lumber. When of the specified size, it is considered as Type IV heavy-timber construction.

Source: 2021 IBC

602.4.4.2 / 2304.11 Cross – Laminate Timer

Cross-laminated timber floors regulated as Type IV heavy-timber construction must be continuous from support to support and mechanically fastened to one another. Unlike sawn or glued-laminated plank floors, CLT is permitted to be connected to walls without a shrinkage gap if swelling or shrinking is considered in the design.

: 2021 IBC

602.5 Cross – Type V Construction

7. Combustible concealed spaces in buildings of Type _____ construction must be protected.

a. I
b. III
c. IV
d. V

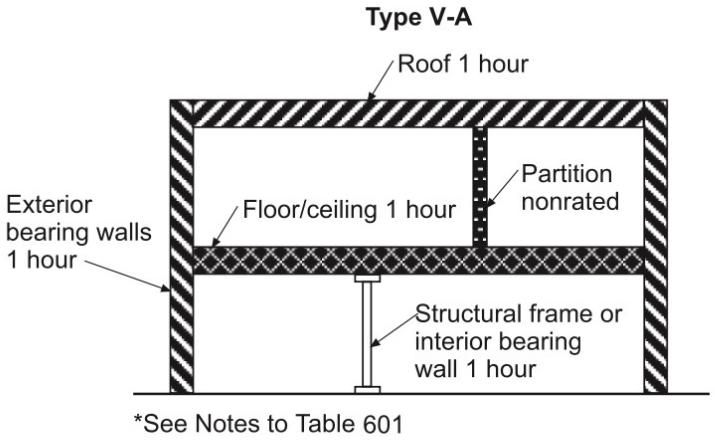
Source: 2021 IBC

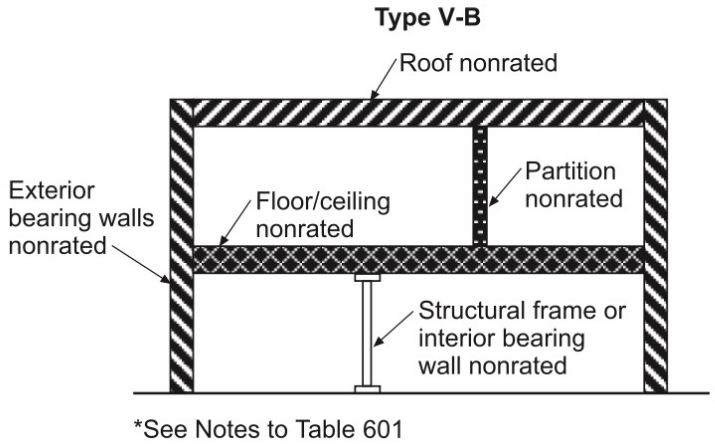
602.5 Cross – Type V Construction

- Type V construction is that type of construction in which the structural elements, exterior walls and interior walls are of any materials permitted by the IBC.
- Type V buildings are essentially construction systems that will not fit into any of the other higher types of construction specified by the IBC. Although the construction normally considered Type V is the conventional light-frame wood building, any combination of approved materials can be considered Type V construction. Section 602.1.1 indicates that a building is not required to conform to the details of a type of construction higher than the type that meets the minimum requirements based on occupancy, even though certain features of such a building actually conform to a higher construction type.

Source: 2021 IBC

602.5 Cross – Type V Construction





In the design and review of a building for type of construction requirements, it is wise to determine first if the structure can be built as a Type VB building, based on occupancy, location on the lot, height and floor area. If so, any other building type is also permitted.

Source: 2021 IBC

602.1 Fire-Resistance Ratings

8. Which of the following materials is permitted in a building of Type VB construction?

a. wood
b. steel
c. masonry
d. all of the above

Source: 2021 IBC

602.1 Fire-Resistance Ratings

- The building elements shall have a fire-resistance rating not less than that specified in Table 601. The protection of openings, ducts and air transfer openings in building elements shall not be required unless required by other provisions of the IBC.
- The building elements regulated by Table 601 for types of construction include primary structural frame members, such as columns, girders and trusses; bearing walls, both interior and exterior; floor construction, including supporting beams and joists; and roof construction, consisting of supporting beams, joists, rafters and other members. The required fire-resistance rating for each of these elements is based on the specific type of construction assigned to the building. The required fire-resistance rating can be as high as a 3-hour or as little as a 0-hour (no fire-resistance rating required).

Source: 2021 IBC

602.1 Fire-Resistance Ratings

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b, c]	1[b, c]	0[c]	1[b, c]	0	$1^1/_2$	1	1	HT	1[b, c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of this code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
f. Not less than the fire-resistance rating as referenced in Section 704.10.
g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

Where a structure is separated by one or more fire walls, the code treats those individual compartments created by the fire walls as separate buildings for the purpose of classification by type of construction.

Source: 2021 IBC

T601, 202 Primary Structural Frames

- The primary structural frame shall include all of the following structural members: (1) the columns; (2) structural members having direct connections to the columns, including girders, beams, trusses and spandrels; (3) members of the floor construction and roof construction having direct connections to the columns; and (4) members that are essential to the vertical stability of the primary structural frame under gravity loading.
- To maintain stability of the building as a whole, the major structural elements are regulated for endurance when subjected to a fire. In addition to the columns, beams and girders, both interior bearing walls and exterior bearing walls are regulated to a level of fire resistance equal to or greater than that of other structural elements. Secondary members, such as floor joists, roof joists or rafters, are protected within the rated floor-ceiling or roof-ceiling assemblies.

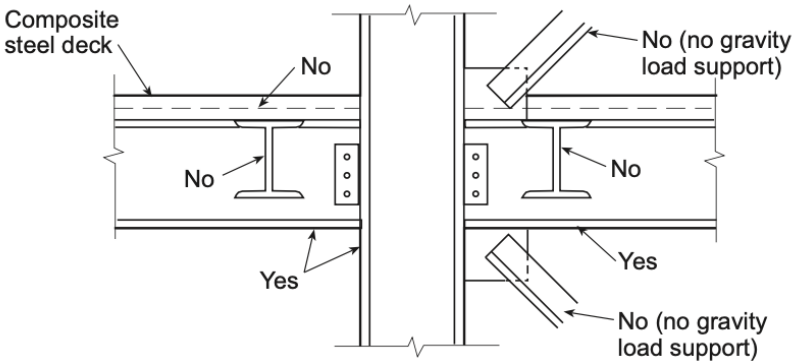
Source: 2021 IBC

T601, 202 Primary Structural Frames

- **Columns**
- **Girders**
- **Beams**
- **Trusses**
- **Spandrels**
- **Floor Construction**
- **Roof Construction**

Having direct connection to the columns

- **Members essential to vertical stability of primary structural frame under gravity loading**



Components of primary structural frame

Lateral force bracing is not considered part of the structural frame where it serves no other purpose than to resist the lateral loads. For example, lateral load bracing within exterior nonbearing walls or interior partitions would be protected by the wall or partition construction. Such bracing elements would be considered secondary members.

Source: 2021 IBC

T601, 202 Primary Structural Frames

10. Which one of the following members is not considered to be a part of the primary structural frame?

    a. columns supporting only a roof load

    b. girders supporting no more than a floor and a roof

    c. members essential to the vertical stability of the frame under gravity loads

    d. floor joists not having direct connections to the columns

Source: 2021 IBC

601, Note b Roof Construction

- Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of primary structural frame members, roof framing and decking, where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
- Where there is limited potential for a fire to be of a severe nature at the roof structure due to its height above the floor below, an elimination of the required fire-resistance rating of the roof construction is permitted in construction of Types I, IIA, IIIA and VA. Elimination of the required fire resistance is not allowed where combustible or hazardous materials are located adjacent to the roof.

Source: 2021 IBC

202 Primary Structural Frames

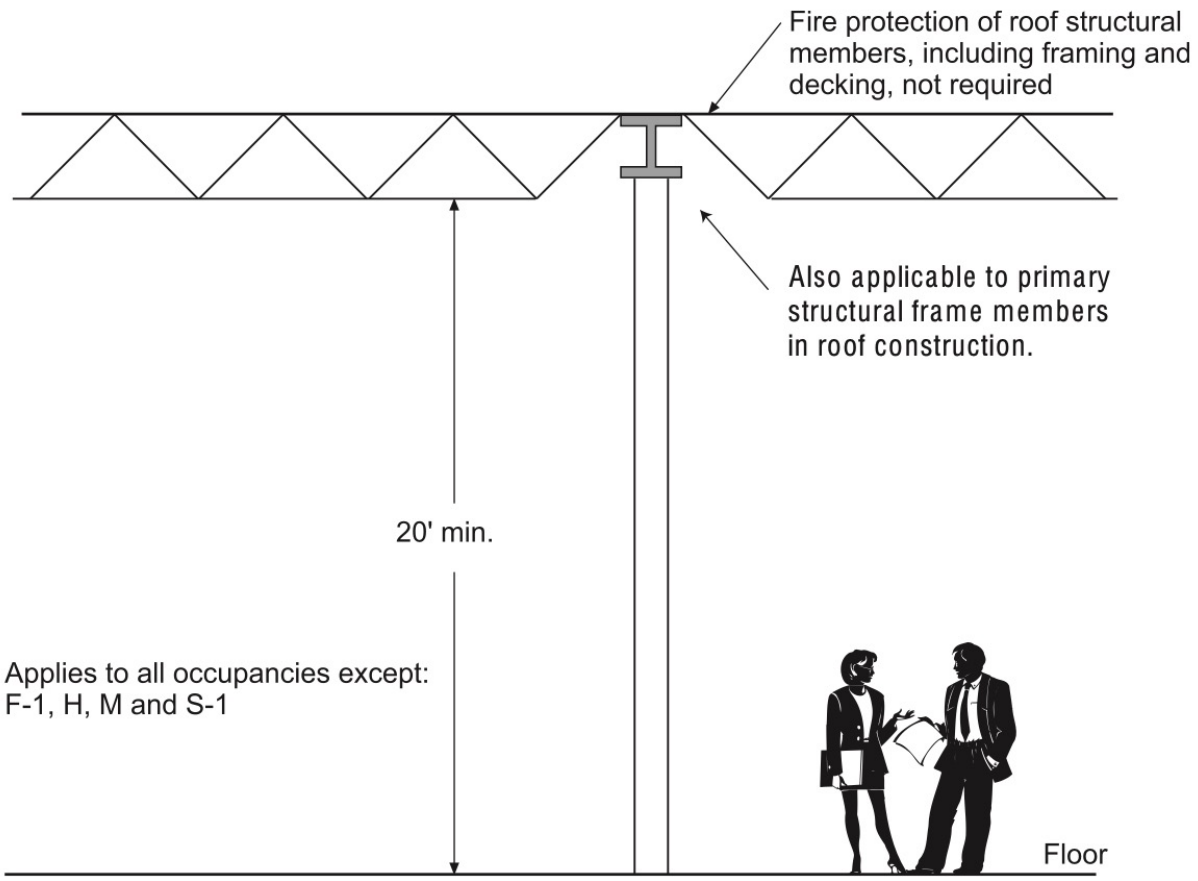
11. In a building of Type IIB construction, what is the minimum required fire-resistance rating of the roof construction?

a. 0 hours (no rating required) b. 1 hour

c. $1^1/_2$ hours d. 2 hours

Source: 2021 IBC

601, Note b Roof Construction



For SI: 1 foot = 304.8 mm.

Applicable to all construction types

It is important to note that the entire roof construction must be located at a height of at least 20 feet above the floor in order for the provision to apply. It is not intended that only those portions of a sloping roof less than 20 feet above the floor be protected.

Source: 2021 IBC

603.1 Allowable Uses

- Combustible materials shall be permitted in buildings of Type I and II construction in the following applications: (27 applications listed).
- Materials used in the construction of buildings classified as either Type I or Type II are intended to be noncombustible, thereby not increasing the potential fire loading (fuel contribution). There are, however, a number of applications where the presence of combustible building materials is desirable in otherwise noncombustible structures. Such materials are typically permitted where they are adequately protected, limited in use or amount, or installed in accordance with the International Fire Code, International Mechanical Code®, or other provisions of the International Building Code.

Source: 2021 IBC

603.1 Allowable Uses

Combustible materials permitted in buildings of Type I and Type II construction in the following applications:

- Fire-retardant-treated wood in
  - Roof construction of most buildings.
  - Nonbearing partitions with fire-resistance rating ≤ 2 hours.
  - Nonbearing exterior walls requiring no fire rating.
- Thermal and acoustical insulation with limited flame spread.
- Foam plastics per Chapter 26.
- A, B or C roof coverings.
- Interior floor finish, trim, millwork such as, doors, frames, etc.
- Stages and platforms per Section 410.
- Blocking for handrails, fixtures, windows and door frames, etc.
- Light-transmitting plastics per Chapter 26.
- Nailing or furring strips per Section 803.15.
- Heavy timber for specific components.
- Additional applications as specified.

In Type I and II construction, the use of fire-retardant-treated wood is permitted in roof construction of all Type IB and II buildings and those buildings of Type IA construction that do not exceed two stories or have a top-story height of at least 20 feet.

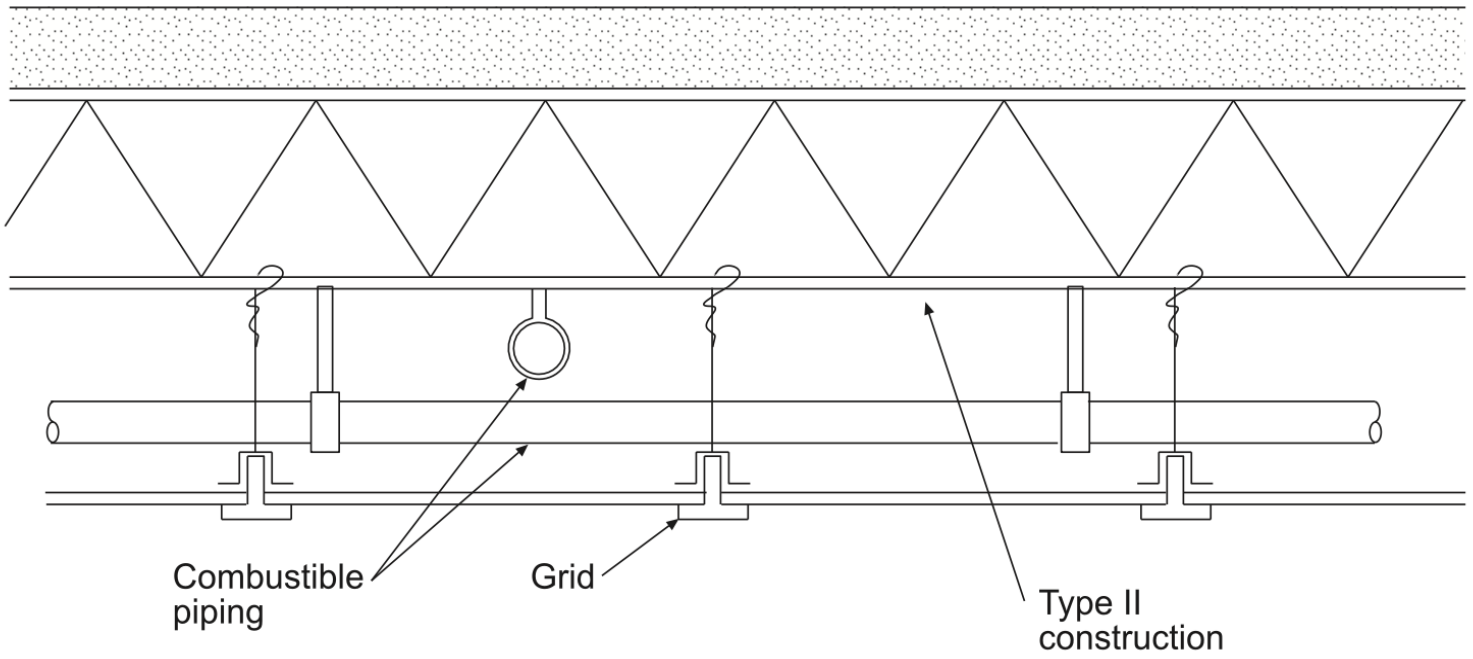
Source: 2021 IBC

603.1.1/3 Ducts, Piping and Electrical

- Combustible materials shall be permitted in buildings of Type I or II construction in accordance with Sections 603.1.1 through 603.1.3. The use of nonmetallic ducts shall be permitted when installed in accordance with the limitations of the International Mechanical Code. The use of combustible piping materials shall be permitted when installed in accordance with the limitations of the International Mechanical Code and the International Plumbing Code. The use of electrical wiring methods with combustible insulation, tubing, raceways and related components shall be permitted when installed in accordance with the limitations of the IBC.
- The IMC contains requirements for nonmetallic ducts that address the issues of flammability, flame spread and smoke development. The IPC regulates the use of combustible piping materials, such as plastic, and also addresses those same characteristics applicable to nonmetallic ducts. Similar regulations apply to combustible wiring materials. These provisions in Chapter 6 clarify that such combustible materials are acceptable for installation in buildings of Type I and II construction, provided they meet the limitations set forth in the appropriate code.

Source: 2021 IBC

603.1.1/3 Ducts, Piping and Electrical



Additional allowances for combustible mechanical and plumbing materials in Type I and II buildings are established by Exception 24 of Section 603. Specified combustible materials are permitted in concealed spaces under the provisions of Section 718.5.

Source: 2021 IBC

Class 4:
Chapter 5, General Building Heights and Areas

Source: 2021 IBC

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.

Source: 2021 IBC

502.1 Address Identification

- *New and existing buildings shall be provided with approved address identification. Each character shall be a minimum of 4 inches (102 mm) high with a minimum stroke width of 1/2 inch (12.7 mm). Where required by the fire code official, address identification shall be provided in additional approved locations to facilitate emergency response. Where access is by means of a private road and the building address cannot be viewed from the public way, a monument, pole or other approved sign or means shall be used to identify the structure. Address identification shall be maintained.*
- Buildings must be provided with plainly visible and legible address numbers posted on the building or in such a place on the property that the building may be identified by emergency services such as fire, medical and police.

Source: 2021 IBC

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.

Source: 2021 IBC

502.1 Address Identification

1. Premises must be identified by numbers or addresses visible from the street, with a minimum character height of at least _____ inches.

   a. three
   b. four
   c. six
   d. eight

Source: 2021 IBC

502.1 Address Identification

1. Premises must be identified by numbers or addresses visible from the street, with a minimum character height of at least _____ inches.

a. three
b. four
c. six
d. eight

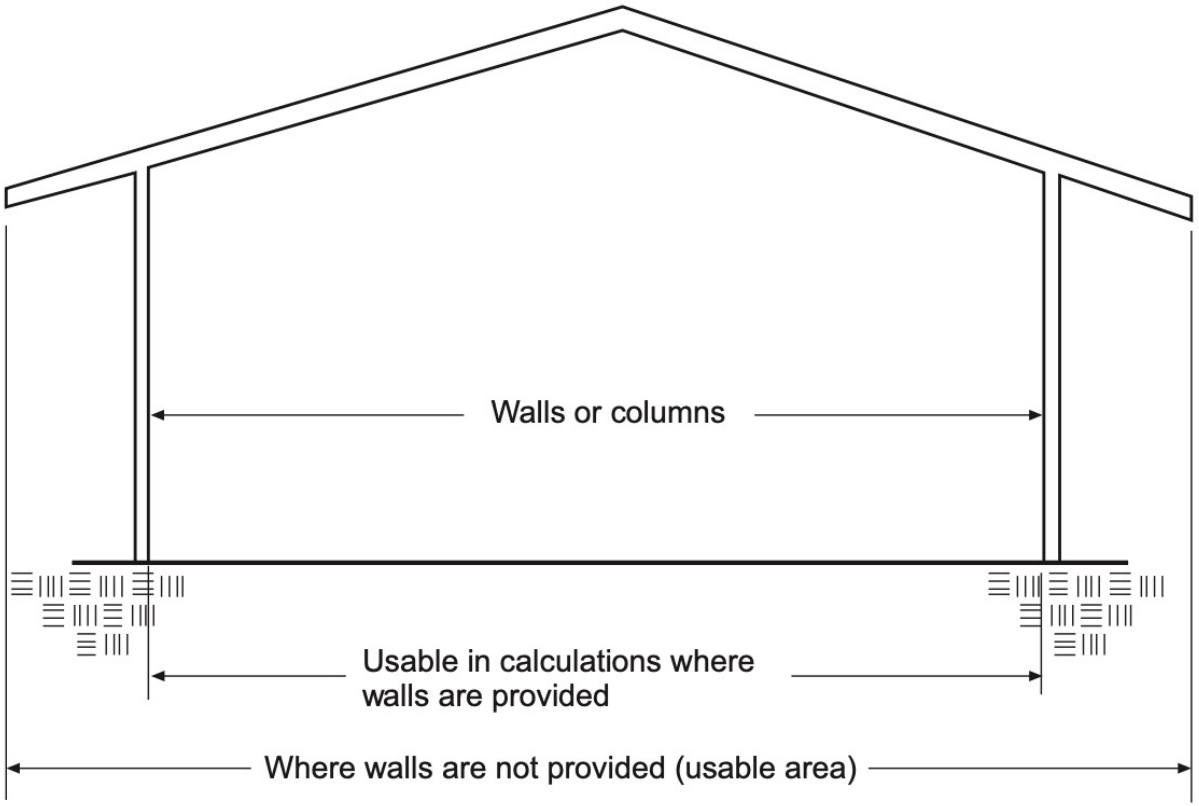
Source: 2021 IBC

503.1, 202 Building Area

- *Building area is the area included within surrounding exterior walls (or exterior walls and fire walls) exclusive of vent shafts and courts. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.*
- The building area must be determined in order to verify that it does not exceed the maximum allowable area as determined by Section 503.1. The building area is considered, in very general terms, the “footprint” of the building, excluding those unroofed areas and any projections that may extend beyond the exterior walls. Where complying mezzanines are located within a building, they are not assumed to contribute to the building area.

Source: 2021 IBC

503.1, 202 Building Area



Do not include vent shafts or courts

Definition of Building Area

Basements are usually considered to be unoccupied spaces and, as such, do not pose a high degree of hazard. Therefore, under all conditions, a single basement does not contribute to a building's allowable height or area. However, it cannot exceed the size permitted for a one-story above grade plane building.

Source: 2021 IBC

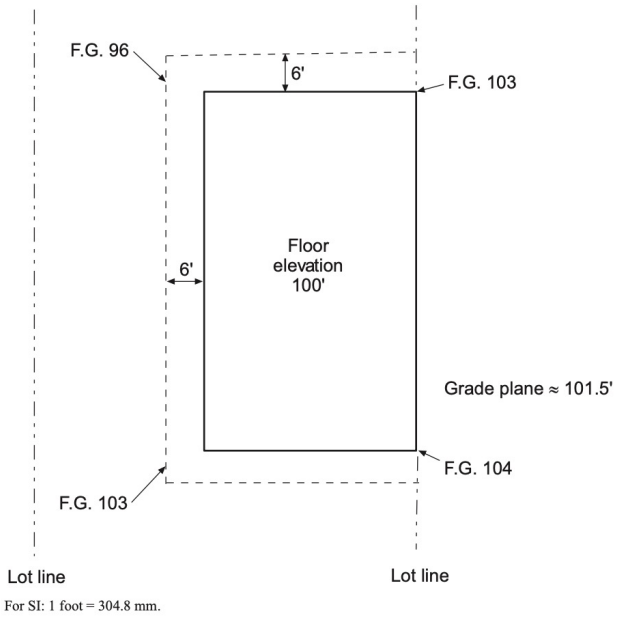
503.1, 202 Story Above Grade/Basement

- *A "story above grade plane" is any story having its finished floor surface entirely above grade plane, or in which the finished surface of the floor next above is (1) more than 6 feet (1829 mm) above grade plane, or (2) more than 12 feet (3658 mm) above the finished ground level at any point. A "basement" is a story that is not a story above grade plane.*
- A number of provisions in the IBC are applicable based on the location of the floor under consideration, relative to the exterior ground level. Therefore, it is necessary to define specifically the circumstances under which a floor level is considered a story above grade plane.

Source: 2021 IBC

503.1, 202 Story Above Grade/Basement

- *A “story above grade plane” is any story having its finished floor surface entirely above grade plane, or in which the finished surface of the floor next above is (1) more than 6 feet (1829 mm) above grade plane, or (2) more than 12 feet (3658 mm) above the finished ground level at any point. A “basement” is a story that is not a story above grade plane.*



The “grade plane” is defined as a reference plane representing the average of finished ground level adjoining the building at exterior walls. It is measured at the lowest point between the building and the lot line, though never more than 6 feet from the building.

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

5. Basements do not need to be included in the total allowable area of a single-occupancy building, provided the total area of such basements do not exceed _____.

    a. one-third the floor area permitted for any single story

    b. the area permitted for a one-story above grade plane building

    c. twice the area permitted for a single story

    d. the tabular area based on construction type and occupancy group

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

5. Basements do not need to be included in the total allowable area of a single-occupancy building, provided the total area of such basements do not exceed _____.

   a. one-third the floor area permitted for any single story

   b. the area permitted for a one-story above grade plane building

   c. twice the area permitted for a single story

   d. the tabular area based on construction type and occupancy group

Source: 2021 IBC

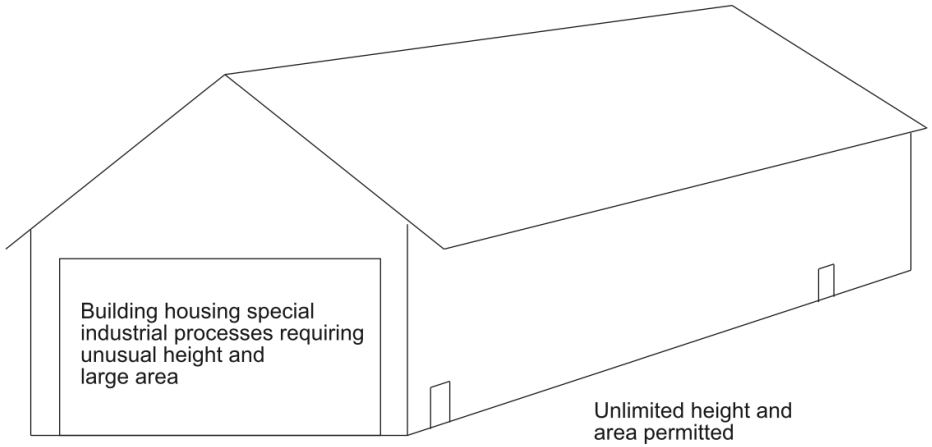
503.1.1 Special Industrial Occupancies

- *Buildings and structures designed to house special industrial processes that require large areas and unusual building heights to accommodate craneways or special machinery and equipment, including among others, rolling mills; structural metal fabrication shops and foundries; or the production and distribution of electric, gas or steam power, shall be exempt from the building height, number of stories and building area limitations specified in Sections 504 and 506.*
- A limited number of buildings that house special industrial processes need extensive heights and/or areas for their operations. The activities that occur are generally of moderate to low hazard, and the buildings are not typically accessible to the public. Therefore, it has been deemed appropriate that no type of construction limitations should be placed on these unique structures.

Source: 2021 IBC

503.1.1 Special Industrial Occupancies

- *Buildings and structures designed to house special industrial processes that require large areas and unusual building heights to accommodate craneways or special machinery and equipment, including among others, rolling mills; structural metal fabrication shops and foundries; or the production and distribution of electric, gas or steam power, shall be exempt from the building height, number of stories and building area limitations specified in Sections 504 and 506.*



The special processes addressed by this provision are limited to those having a low or moderate degree of hazard, commonly designated as Group F-1 or S-1 occupancies. Where the processes under consideration would necessitate a Group H classification because of the high hazards involved, the application of this provision is inappropriate.

Source: 2021 IBC

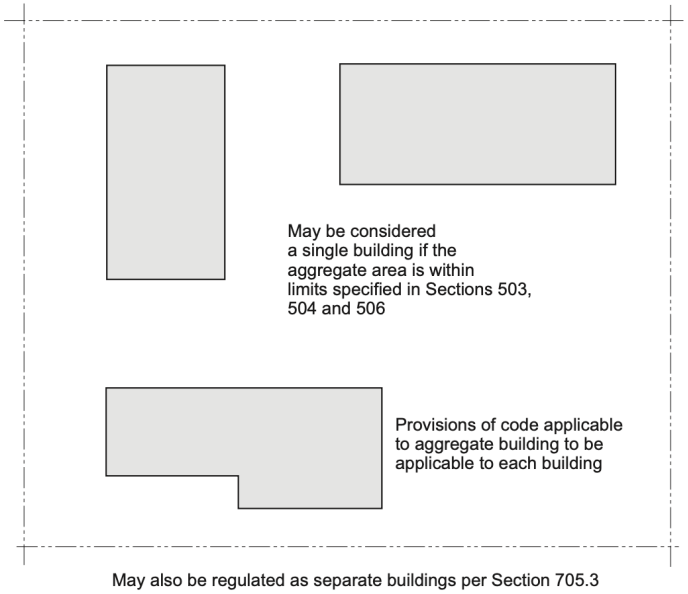
503.1.2 Buildings on the Same Lot

- *Two or more buildings on the same lot shall be regulated as separate buildings or shall be considered as portions of one building where the building height, number of stories of each building and the aggregate building area of the buildings are within the limitations specified in Sections 504 and 506. The provisions of the IBC applicable to the aggregate building shall be applicable to each building.*
- In general, the provisions of Section 705.3 require an assumed imaginary line to be located between two buildings on the same site to regulate exterior wall and opening protection, as well as projection and roof-covering requirements. This method would provide protection equivalent to that of buildings on adjoining lots.

Source: 2021 IBC

503.1.2 Buildings on the Same Lot

- *Two or more buildings on the same lot shall be regulated as separate buildings or shall be considered as portions of one building where the building height, number of stories of each building and the aggregate building area of the buildings are within the limitations specified in Sections 504 and 506. The provisions of the IBC applicable to the aggregate building shall be applicable to each building.*



If the multiple buildings can be constructed as a single facility under one roof and can meet the height and area requirements based on occupancy and type of construction, then an imaginary line need not be assumed. The buildings will simply be regulated as a single structure.

Source: 2021 IBC

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.*
- The allowable height of a building in feet is based on three fundamental aspects of building classification and fire protection: occupancy classification, type of construction classification and the presence of an automatic sprinkler system. The limitation on building height recognizes the concern of property damage, along with the concerns of dealing with egress and fire department access. Table 504.3 typically reflects an increased allowable height for sprinklered buildings of 20 feet over the height permitted for nonsprinklered buildings. Also reflected in the table is the allowance for unlimited height in most buildings of Type IA construction.

Source: 2021 IBC

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[a]

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	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	65	50	40
	S	UL	180	85	75	85	75	270	180	85	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												
H-4	NS[c, d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d, e]	UL	160	65	55	65	55	65	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, e, f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d, g]	UL	160	65	55	65	55	65	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	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	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 903.3.1.1; 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

504.3, Table 504.3 Allowable Height Determination

8. What is the maximum allowable height in feet above grade plane for a fully sprinklered single-occupancy Type IIA building housing a Group A-2 occupancy?

   a. 55 feet
   b. 65 feet
   c. 75 feet
   d. 85 feet

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	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	65	50	40
	S	UL	180	85	75	85	75	270	180	85	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												

Source: 2021 IBC

504.3, Table 504.3 Allowable Height Determination

8. What is the maximum allowable height in feet above grade plane for a fully sprinklered single-occupancy Type IIA building housing a Group A-2 occupancy?

a. 55 feet
b. 65 feet
c. 75 feet
d. 85 feet

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	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	65	50	40
	S	UL	180	85	75	85	75	270	180	85	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												

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

- The maximum number of stories of a building shall not exceed the limits specified in Table 504.4.
- The maximum number of stories permitted in a building is generally represented in Table 504.4. However, the table only regulates the number of stories that are considered above grade plane. Basements are selectively permitted under various provisions throughout the code and regulated accordingly. The conditions that affect the allowable number of stories are consistent with those for the allowable height in feet: occupancy classification, type of construction classification and sprinkler protection. Table 504.4 typically reflects an increased allowable number of stories for sprinklered buildings of one story above the number permitted for nonsprinklered buildings. Also reflected in the table is the allowance for an unlimited number of stories in most buildings of Type IA construction.

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

- The maximum number of stories of a building shall not exceed the limits specified in Table 504.4.

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
A-2	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-3	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-4	NS	UL	11	3	2	3	2	3	3	3	3	2	1
	S	UL	12	4	3	4	3	18	12	6	4	3	2
A-5	NS	UL	UL	UL	UL	UL	UL	1	1	1	UL	UL	UL
	S	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	NS	UL	11	5	3	5	3	5	5	5	5	3	2
	S	UL	12	6	4	6	4	18	12	9	6	4	3
E	NS	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
F-1	NS	UL	11	4	2	3	2	3	3	3	4	2	1
	S	UL	12	5	3	4	3	10	7	5	5	3	2
F-2	NS	UL	11	5	3	4	3	5	5	5	5	3	2
	S	UL	12	6	4	5	4	12	8	6	6	4	3
H-1	NS[c, d]	1	1	1	1	1	1	NP	NP	NP	1	1	NP
	S							1	1	1			
H-2	NS[c, d]	UL	3	2	1	2	1	1	1	1	2	1	1
	S							2	2	2			
H-3	NS[c, d]	UL	6	4	2	4	2	3	3	3	4	2	1
	S							4	4	4			
H-4	NS[c, d]	UL	7	5	3	5	3	5	5	5	5	3	2
	S	UL	8	6	4	6	4	8	7	6	6	4	3
H-5	NS[c, d]	4	4	3	3	3	3	2	2	2	3	3	2
	S							3	3	3			
I-1 Condition 1	NS[d, e]	UL	9	4	3	4	3	4	4	4	4	3	2
	S	UL	10	5	4	5	4	10	7	5	5	4	3
I-1 Condition 2	NS[d, e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d, f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d, e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2
I-4	NS[d, g]	UL	5	3	2	3	2	3	3	3	3	1	1
	S	UL	6	4	3	4	3	9	6	4	4	2	2
M	NS	UL	11	4	2	4	2	4	4	4	4	3	1
	S	UL	12	5	3	5	3	12	8	6	5	4	2

(continued)

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 an allowable number of stories above grade plane of four or less for buildings of any occupancy classification and construction type.

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

9. What is the maximum allowable number of stories above grade plane for a fully-sprinklered single-occupancy IIIB building housing a Group I-2 occupancy?

   a. 0, it is not permitted b. 1

   c. 2 d. 3

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
I-1 Condition 2	NS[d, e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d, f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d, e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

9. What is the maximum allowable number of stories above grade plane for a fully-sprinklered single-occupancy IIIB building housing a Group I-2 occupancy?

a. 0, it is not permitted
b. 1
c. 2
d. 3

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	5	3	2	3	2	3	3	3	3	2	1
	S	UL	6	4	3	4	3	9	6	4	4	3	2
I-1 Condition 2	NS[d, e]	UL	9	4	3	4	3	3	3	3	4	3	2
	S	UL	10	5				10	6	4			
I-2	NS[d, f]	UL	4	2	1	1	NP	NP	NP	NP	1	1	NP
	S	UL	5	3				7	5	1			
I-3	NS[d, e]	UL	4	2	1	2	1	2	2	2	2	2	1
	S	UL	5	3	2	3	2	7	5	3	3	3	2

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

3. The tabular allowable building height for a fully-sprinklered single-occupancy Type IB building housing a Group I-2 occupancy is _____ stories and _____ feet.

   a. 4, 160
   b. 3, 85
   c. 5, 180
   d. unlimited, unlimited

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	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	65	50	40
	S	UL	180	85	75	85	75	270	180	85	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												
H-4	NS[c, d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d, e]	UL	160	65	55	65	55	65	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, e, f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

3. The tabular allowable building height for a fully-sprinklered single-occupancy Type IB building housing a Group I-2 occupancy is _____ stories and _____ feet.

a. 4, 160
b. 3, 85
c. 5, 180
d. unlimited, unlimited

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

4. What is the tabular allowable height, in feet, for a single-occupancy nonsprinklered Group B building of Type IIA construction?

   a. 50 b. 55

   c. 65 d. 85

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	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	65	50	40
	S	UL	180	85	75	85	75	270	180	85	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												
H-4	NS[c, d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d, e]	UL	160	65	55	65	55	65	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, e, f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									

Source: 2021 IBC

504.4, Table 504.4 Allowable Height in Stories

4. What is the tabular allowable height, in feet, for a single-occupancy nonsprinklered Group B building of Type IIA construction?

a. 50 b. 55

c. 65 d. 85

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a]

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	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	65	50	40
	S	UL	180	85	75	85	75	270	180	85	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												
H-4	NS[c, d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d, e]	UL	160	65	55	65	55	65	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, e, f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									

Source: 2021 IBC

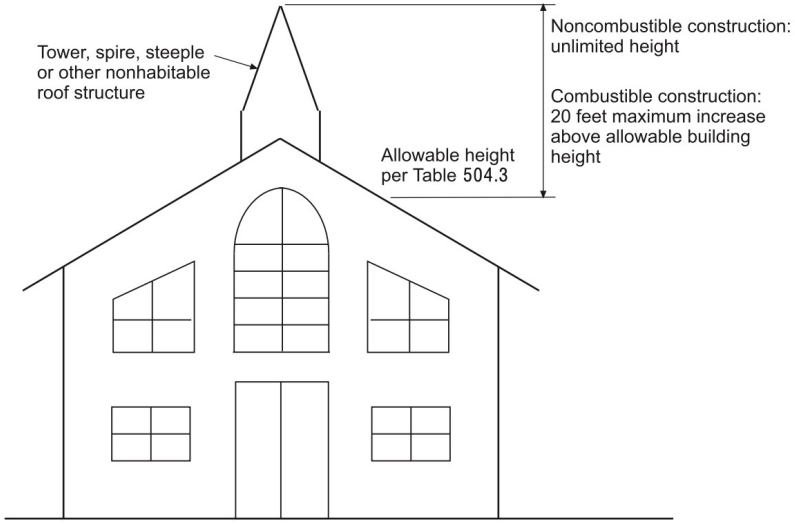
504.3, Exception Roof Structures

- Towers, spires, steeples and other roof structures shall be constructed of materials consistent with the required type of construction of the building except where other construction is permitted by Section 1511.2.4. Such structures shall not be used for habitation or storage. The structures shall be unlimited in height if of noncombustible materials and shall not extend more than 20 feet (6096 mm) above the allowable building height if of combustible materials (see Chapter 15 for additional requirements).
- The types of structures addressed by this provision are intended to be unoccupied with no significant fire loading. It would seem logical that the height of such structures could be increased over that required for typical buildings. The only limitation occurs where the structure is of combustible materials, which would create a higher hazard.

Source: 2021 IBC

504.3, Exception Roof Structures

- Towers, spires, steeples and other roof structures shall be constructed of materials consistent with the required type of construction of the building except where other construction is permitted by Section 1511.2.4. Such structures shall not be used for habitation or storage. The structures shall be unlimited in height if of noncombustible materials and shall not extend more than 20 feet (6096 mm) above the allowable building height if of combustible materials (see Chapter 15 for additional requirements).



For SI: 1 foot = 304.8 mm.

The provisions of Section 1511 regulate the type of construction for towers, spires and similar rooftop structures based on the height above the roof surface, the height above grade and the largest cross-sectional dimension. Penthouses and equipment screening are also addressed.

Source: 2021 IBC

504.3, Exception Roof Structures

10. Combustible steeples are limited to a maximum height of _____ feet above the allowable building height.

    a. 15
    b. 20
    c. 30
    d. 40

Source: 2021 IBC

504.3, Exception Roof Structures

10. Combustible steeples are limited to a maximum height of _____ feet above the allowable building height.

a. 15
b. 20
c. 30
d. 40

Source: 2021 IBC

505.2.1, 202 Mezzanines Definition

- A mezzanine is an intermediate level or levels between the floor and ceiling of any story and in accordance with Section 505. The aggregate area of a mezzanine or mezzanines within a room shall not exceed one-third of the floor area of that room or space in which they are located. See the exceptions that allow for increased mezzanine sizes in (1) special industrial occupancies of Type I or II construction, (2) fully sprinklered Type I or II buildings provided with an approved emergency voice/alarm communication system, and (3) dwelling units.
- Because of size limitation and openness (a mezzanine is open to the room in which it is located, with exceptions), an intermediate floor level within a room adds minimal hazard to the building and its occupants. The occupants of the mezzanine by means of sight, smell or hearing will be able to determine if there is some emergency or fire taking place either on the mezzanine or in the room in which the mezzanine is located.

Source: 2021 IBC

505.2.1, 202 Mezzanines Definition

Source: 2021 IBC

505.2.1, 202 Mezzanines Definition

6. A story is considered a story above grade plane where the finished surface of the floor above is more than _____ feet above grade plane.

   a. 3
   b. 4
   c. 5
   d. 6

Source: 2021 IBC

505.2.1, 202 Mezzanines Definition

6. A story is considered a story above grade plane where the finished surface of the floor above is more than _____ feet above grade plane.

a. 3
b. 4
c. 5
d. 6

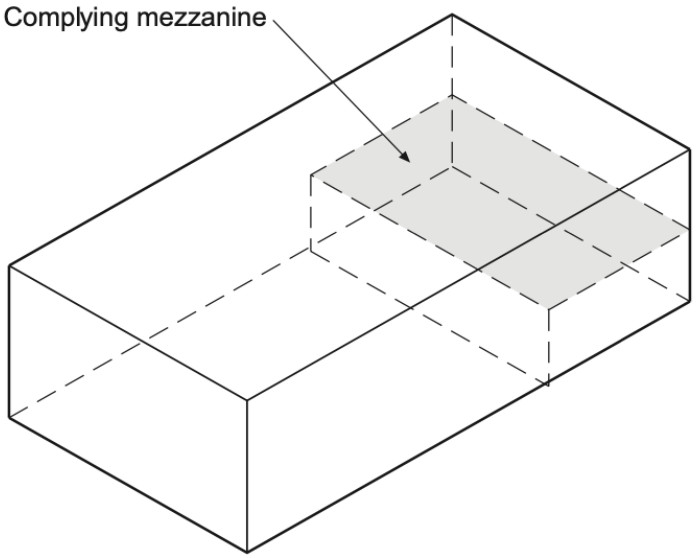
Source: 2021 IBC

505.2 Mezzanines Scope

- A mezzanine or mezzanines in compliance with Section 505.2 shall be considered a portion of the story below. Such mezzanines shall not contribute to either the building area or number of stories as regulated by Section 503.1. The area of a mezzanine shall be included in determining the fire area.
- There are two distinct benefits derived from the qualification of a floor level as a mezzanine. One, the mezzanine is not considered in the allowable number of stories, and two, for allowable area purposes, the mezzanine floor area does not increase the building area of the story in which it is located. However, in the determination of fire area size for sprinkler requirements, the floor area must be considered. The requirements for sprinkler systems are generally based on the fire load expected in an occupancy; thus, an increased floor area would increase the potential fire loading.

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 m^2

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.

Source: 2021 IBC

505.2 Mezzanines Scope

11. The area of a mezzanine is not to be included in the determination of the _____.

a. fire area
b. building area
c. occupant load
d. plumbing fixture count

Source: 2021 IBC

505.2 Mezzanines Scope

11. The area of a mezzanine is not to be included in the determination of the _____.

a. fire area
b. building area
c. occupant load
d. plumbing fixture count

Source: 2021 IBC

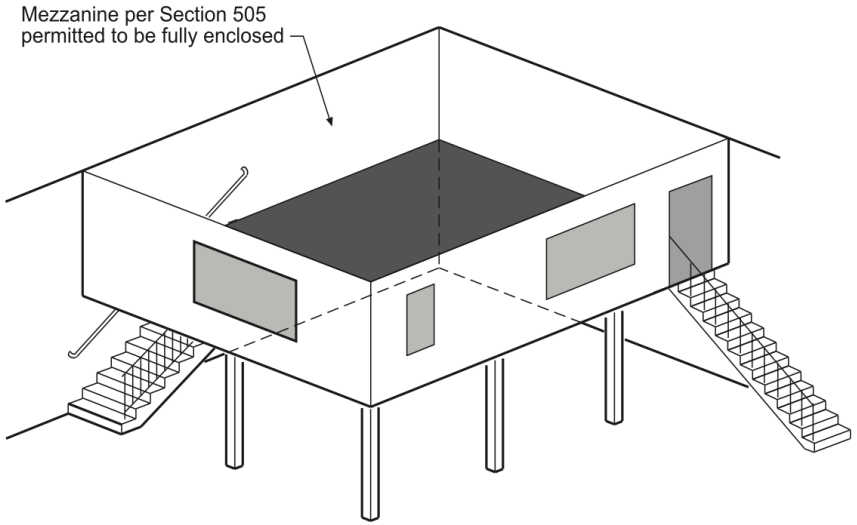
505.2.3 Mezzanines Openness

- A mezzanine shall be open and unobstructed to the room in which such mezzanine is located except for walls not more than 42 inches high, columns and posts. See the exceptions addressing mezzanines, including (1) where the enclosed area has a maximum occupant load of 10, (2) having two or more means of egress, (3) where the aggregate floor area of the enclosed space does not exceed 10 percent of the mezzanine area, and (4) in industrial facilities.
- By definition, a mezzanine is intended to be open to the room or space below. This common environment allows individuals on either floor level to be aware of the conditions and hazards that may affect their safety. The IBC, through the application of one of the exceptions, permits the mezzanine to be enclosed when it has been determined that the enclosure creates little, if any concern.

Source: 2021 IBC

505.2.3 Mezzanines Openness

- A mezzanine shall be open and unobstructed to the room in which such mezzanine is located except for walls not more than 42 inches high, columns and posts. See the exceptions addressing mezzanines, including (1) where the enclosed area has a maximum occupant load of 10, (2) having two or more means of egress, (3) where the aggregate floor area of the enclosed space does not exceed 10 percent of the mezzanine area. and (4) in industrial facilities.



A common exception used to permit the enclosing of a mezzanine is based on egress conditions. If a minimum of two means of egress are provided from the mezzanine level, then the mezzanine is not required to be open to the room or space below.

Source: 2021 IBC

505.2.3 Mezzanines Openness

14. Portions of a mezzanine need not be open to the room in which the mezzanine is located, provided the enclosed space is limited in size to a maximum of _____ of the mezzanine area.

a. 10 percent
b. 25 percent
c. $33^{1}/_{3}$ percent
d. 50 percent

Source: 2021 IBC

505.2.3 Mezzanines Openness

14. Portions of a mezzanine need not be open to the room in which the mezzanine is located, provided the enclosed space is limited in size to a maximum of _____ of the mezzanine area.

a. 10 percent
b. 25 percent
c. $33^{1}/_{3}$ percent
d. 50 percent

Source: 2021 IBC

506.2.1 Single-occupancy Buildings

The allowable area of each story of a single-occupancy building shall be determined in accordance with Equation 5-1:

$A_a = A_t + (NS \times I_f)$ *where:*

A_a = *Allowable area (square feet)*

A_t = *Tabular allowable area factor (NS, S1, S13R or S13D value, as applicable) in accordance with Table 506.2.*

NS = *Tabular allowable area factor in accordance with Table 506.2 for nonsprinklered building (regardless of whether the building is sprinklered).*

I_f = *Area factor increase due to frontage (percent) as calculated in accordance with Section 506.3.*

The allowable building areas determined in accordance with Section 506.2 are based on the allowable area factors of Table 506.2, along with any available frontage increase as calculated by Section 506.3. The presence of sufficient open space adjacent to a building provides for an increase above the tabular value. The protection afforded by an automatic sprinkler system, as addressed in Table 506.2, justifies a significant allowable area increase.

Source: 2021 IBC

506.2.1 Single-occupancy Buildings

GIVEN: A fully sprinklered Group A-2 restaurant in a building of Type VB construction. Building has two stories above grade plane with 8,500 square feet per story. A 25% increase is permited due to open frontage.

DETERMINE: If in compliance with maximum allowable building area.

$A_a = A_t + (NS \times I_f)$ *where:*

A_a = *Allowable area (square feet)*

A_t = *Tabular allowable area factor (NS, S1, S13R or S13D value, as applicable) in accordance with Table 506.2.*

NS = *Tabular allowable area factor in accordance with Table 506.2 for nonsprinklered building (regardless of whether the building is sprinklered).*

I_f = *Area factor increase due to frontage (percent) as calculated in accordance with Section 506.3.*

TABLE 506.2
ALLOWABLE AREA FACTOR (A_t = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET[a, b]

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A-1	NS	UL	UL	15,500	8,500	14,000	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	56,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	42,000	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	14,000	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	56,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	42,000	28,500	135,000	90,000	56,250	45,000	34,500	18,000

Source: 2021 IBC

506.2.1 Single-occupancy Buildings

EXAMPLE:

GIVEN: A fully sprinklered Group A-2 restaurant in a building of Type VB construction. Building has two stories above grade plane with 8,500 square feet per story. A 25% increase is permited due to open frontage.

DETERMINE: If in compliance with maximum allowable building area.

2021 IBC Procedure for Determining Allowable Area and Compliance Review:

Step 1: Review and apply applicable provisions of Section 503 for general building area determination.

Step 2: Review and apply applicable provisions of Section 506 regarding the determination of allowable area.

Step 3: Determine allowable building area factor (A_t) as established in Table 506.2, based upon SM value (sprinklered, multi-story condition).

Allowable area factor in square feet from Table 506.2: $A_t = 18{,}000$ square feet

Step 4: Determine applicable allowable area frontage increase as established in Section 506.3.

Frontage increased based on example: $I_f = 0.25$

Step 5: Determine maximum building allowable area using Equation 5-2, $A_a = [A_t + (NS \times I_f)] \times S_a$

$[18{,}000 + (6{,}000 \times 0.25)] \times 2 = (18{,}000 + 1{,}500) \times 2 = 39{,}000$ square feet OK

Step 6: Determine maximum allowable area per story using Equation 5-2, with $S_a = 1$

$[18{,}000 + (6{,}000 \times 0.25)] \times 1 = (18{,}000 + 1{,}500) \times 1 = 19{,}500$ square feet OK

Specific methods of determining allowable area are also established for mixed-occupancy buildings.

Source: 2021 IBC

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

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.
- It is assumed that every building will adjoin a street, alley or yard on at least one side. Therefore, no frontage increase is given where less than 25 percent of a building's perimeter is open. Credit is provided, however, where additional frontage is considered open (20 feet or more in width). The benefit of increased allowable building area is accrued based on better access for the fire department, as well as decreased exposure to adjoining properties. 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

506.3 Frontage Increase

16. An allowable area increase for frontage is not permitted unless a minimum of _____ of the building perimeter is sufficiently open.

a. 10 percent
b. 25 percent
c. $33^{1}/_{3}$ percent
d. 40 percent

Source: 2021 IBC

506.3 Frontage Increase

16. An allowable area increase for frontage is not permitted unless a minimum of _____ of the building perimeter is sufficiently open.

a. 10 percent
b. 25 percent
c. $33^{1}/_{3}$ percent
d. 40 percent

Source: 2021 IBC

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.

TABLE 506.3.3
FRONTAGE INCREASE FACTOR[a]

PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)			
	0 to less than 20	20 to less than 25	25 to less than 30	30 or greater
0 to less than 25	0	0	0	0
25 to less than 50	0	0.17	0.21	0.25
50 to less than 75	0	0.33	0.42	0.50
75 to 100	0	0.50	0.63	0.75

TABLE 506.3.3.1
SECTION 507 BUILDINGS[a]

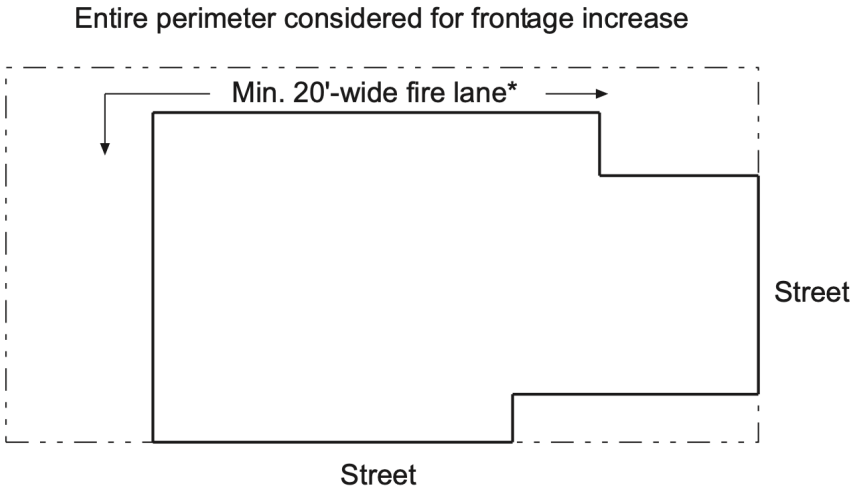
PERCENTAGE OF BUILDING PERIMETER	OPEN SPACE (feet)					
	30 to less than 35	35 to less than 40	40 to less than 45	45 to less than 50	50 to less than 55	55 to less than 60
0 to less than 25	0	0	0	0	0	0
25 to less than 50	0.29	0.33	0.38	0.42	0.46	0.50
50 to less than 75	0.58	0.67	0.75	0.83	0.92	1.00
75 to 100	0.88	1.00	1.13	1.25	1.38	1.50

a. Interpolation is permitted.

Source: 2021 IBC

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.



Open space to be on same lot or dedicated for public use, and accessed from a street or approved fire lane

*Fire lane need only be provided to within 150 feet of exterior wall per Section 503.1.1 of the IFC.

Access must be provided from a street or an approved fire lane for any open space that is used for a frontage increase in allowable floor area. The *International Fire Code* mandates that a fire lane for fire apparatus be maintained with an unobstructed width of at least 20 feet.

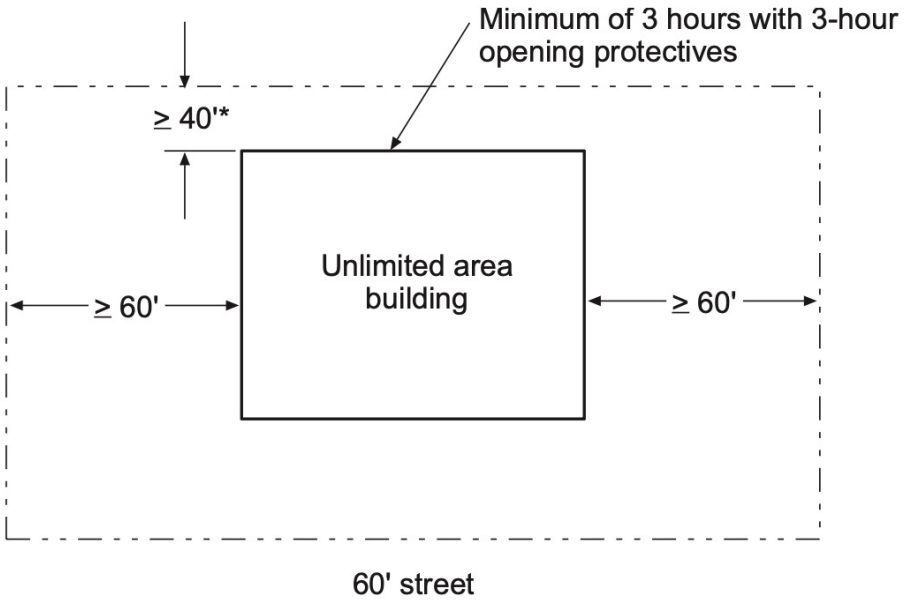
Source: 2021 IBC

507.2.1 Reduced Open Space

- The public ways or yards of 60 feet (18 288 mm) in width required in Sections 507.3, 507.4, 507.5, 507.6 and 507.12 shall be permitted to be reduced to not less than 40 feet (12 192 mm) in width provided all of the following requirements are met: (1) the reduced open space shall not be allowed for more than 75 percent of the perimeter of the building, (2) the exterior walls facing the reduced open space shall have a minimum fire-resistance rating of not less than 3 hours, and (3) openings in the exterior walls facing the reduced open space shall have opening protectives with a minimum fire-resistance rating of not less than 3 hours.
- When it is necessary or desirable to reduce the open space around the perimeter of an unlimited area building, the code provides an alternative. An equivalent level of protection can be provided by increasing the level of exterior wall and opening protection.

Source: 2021 IBC

507.2.1 Reduced Open Space



*Reduced open space permitted:

- Up to 75% of building perimeter
- Where exterior wall facing reduced open space has minimum 3-hour fire-resistance rating
- Openings in such walls are protected for 3 hours

For SI: 1 foot = 304.8 mm.

This provision is designed for warehouses, factories, retail stores, office buildings, Group A-3 uses and movie theaters where fire resistance at the exterior wall is easily accomplished. The reduction does not apply to other buildings permitted to be unlimited in area, such as educational uses and aircraft paint hangars.

Source: 2021 IBC

507.4 One-Story, Sprinklered Buildings

- The area of a Group A-4 building no more than one story above grade plane of other than Type V construction, or the area of a Group B, F, M or S building no more than one story above grade plane of any construction type, shall not be limited when the building is provided with an automatic sprinkler system throughout in accordance with Section 903.3.1.1, and is surrounded and adjoined by public ways or yards not less than 60 feet (18 288 mm) in width. Provisions also apply to two-story buildings of such occupancies other than Group A-4.
- It is often beneficial to have very large, undivided floor areas for facilities such as arenas, office buildings, factories, retail centers and warehouses. The unlimited area provisions allow for an alternative to the higher types of construction that would normally be required. The installation of a sprinkler system and sufficient open space around the building reduce the potential fire severity to a reasonable level in these moderate-hazard occupancies.

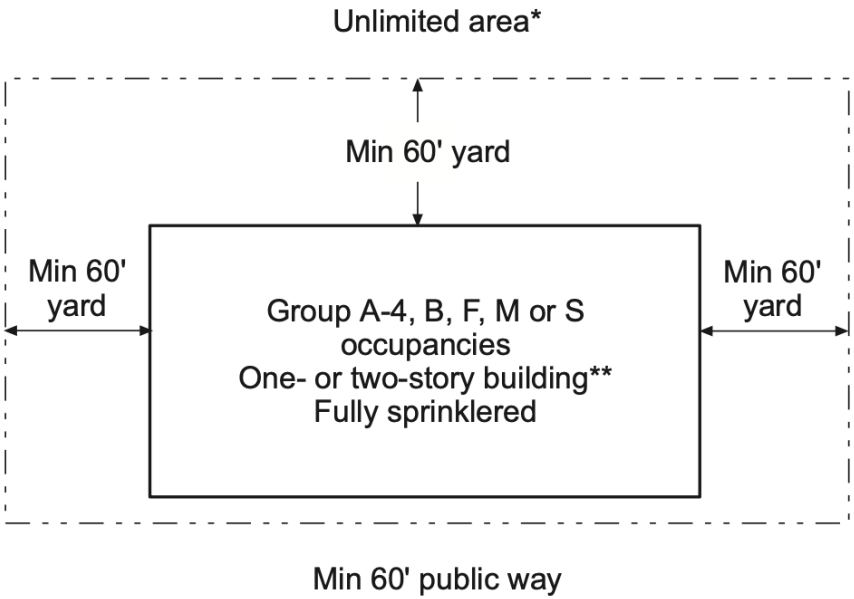
Source: 2021 IBC

507.4 One-Story, Sprinklered Buildings (Exception)

- Buildings and structures of Type I or II construction for rack storage facilities that do not have access by the public shall not be limited in height, provided that such buildings conform to the requirements of Sections 507.4 and 903.3.1.1 and Chapter 32 of the International Fire Code.
- The automatic sprinkler system shall not be required in areas occupied for indoor participant sports, such as tennis, skating, swimming and equestrian activities in occupancies in Group A-4, provided that the following criteria are met:
  - Exit doors directly to the outside are provided for occupants of the participant sports areas.
  - The building is equipped with a fire alarm system with manual fire alarm boxes installed in accordance with Section 907.
  - An automatic sprinkler system is provided in storage rooms, press boxes, concession booths or other spaces ancillary to the sport activity space.

Source: 2021 IBC

507.4 One-Story, Sprinklered Buildings



*Any type of construction permitted (other than Type V for Group A-4)

**Limited to one story for Group A-4

For SI: 1 foot = 304.8 mm.

Low-hazard manufacturing and storage occupancies of any construction type are permitted to be unlimited in area where they are only one story in height and are provided on all sides with public ways or yards at least 60 feet in width. Installation of an automatic sprinkler system is not required.

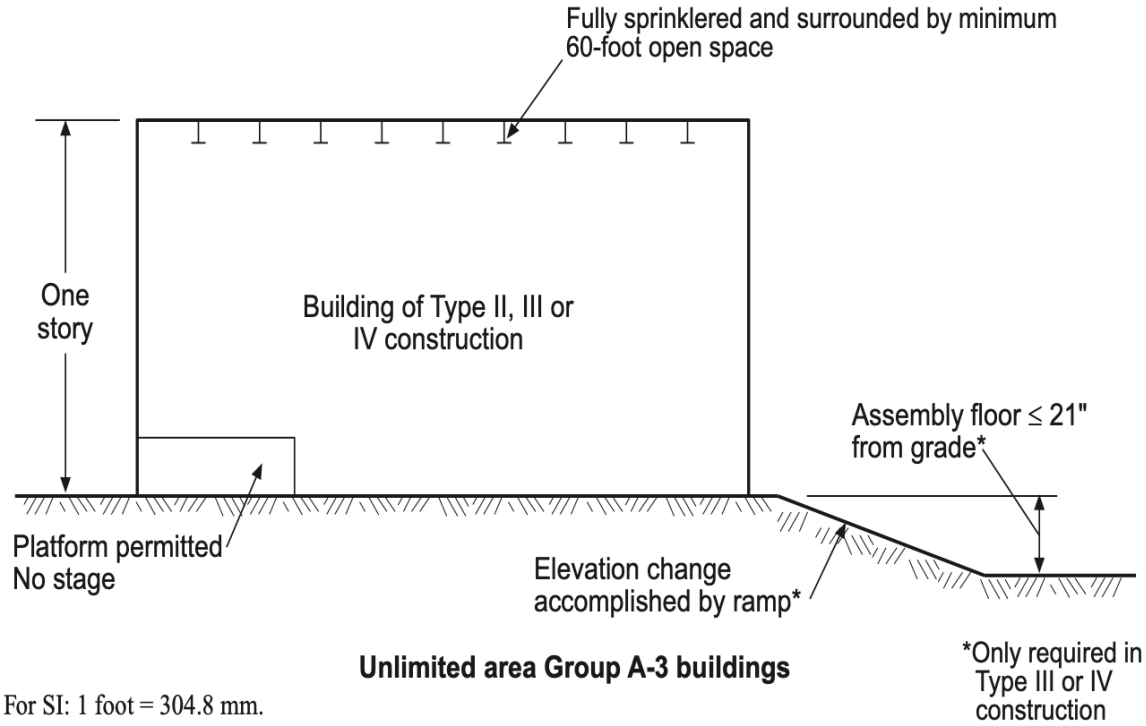
Source: 2021 IBC

507.6, 507.7 Group A-3 Buildings

- The area of a Group A-3 building no more than one story above grade plane used as a place of religious worship, community hall, dance hall, exhibition hall, gymnasium, lecture hall, indoor swimming pool or tennis court of Type II construction, shall not be limited when all of the following criteria are met: See three conditions for allowance of unlimited area. The provisions are also applicable to buildings of Type III and IV construction, provided four conditions are met.
  - The building shall not have a stage other than a platform.
  - The building shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.
  - The building shall be surrounded and adjoined by public ways or yards not less than 60 feet (18 288 mm) in width.
- The Group A-3 occupancy classification includes the most diverse types of assembly uses assigned by the code. Traditionally, the allowable area of Group A occupancies is greatly limited as compared to most other occupancy groups. However, those assembly uses expected to have a relatively low fire load are permitted in unlimited area buildings subject to the special conditions prescribed by the code.

Source: 2021 IBC

507.6, 507.7 Group A-3 Buildings



Unlimited area Group A-3 buildings

For SI: 1 foot = 304.8 mm.

As the primary concern in a Group A occupancy is the high number and concentration of occupants, it is important that egress be accomplished in an efficient and unobstructed manner. The requirement for only flat or limited ramp travel in Type III and IV buildings assists in gaining an effective egress system.

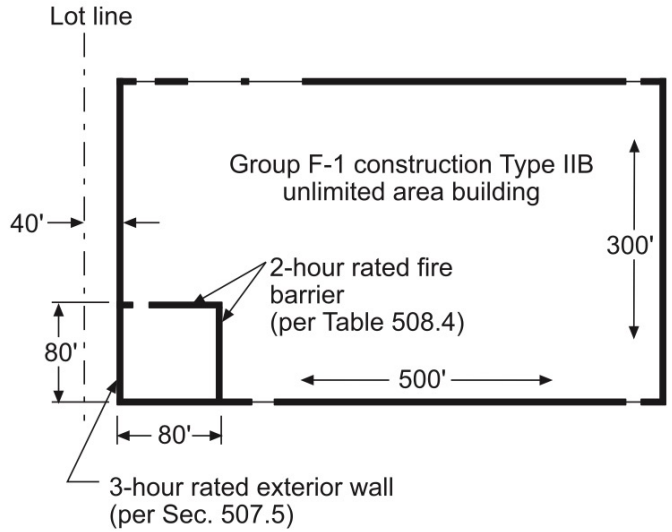
Source: 2021 IBC

507.8 High-Hazard Occupancies

- Group H-2, H-3 and H-4 occupancies shall be permitted in unlimited area buildings containing Group F or S occupancies, in accordance with Sections 507.4 and 507.5 and the provisions of Sections 507.8.1 through 507.8.4. The aggregate floor area of the Group H occupancies located in an unlimited area building shall not exceed 10 percent of the area of the building or the area limitations for the Group H occupancies as specified in Section 506, based upon the perimeter of each Group H floor area that fronts on a public way or open space. The aggregate floor area of Group H occupancies not located at the perimeter of the building shall not exceed 25 percent of the area limitations for the Group H occupancies as specified in Section 506.
- The aggregate allowable area of the permitted Group H occupancies in a factory or warehouse regulated as an unlimited area building is dependent on the type of construction of the building and the location of the Group H occupancies in the building.

Source: 2021 IBC

507.8 High-Hazard Occupancies



For **SI:** 1 inch = 25.4 mm, 1 foot = 304.8 mm
1 square foot = 0.0929 m^2

- Group H-2
- Per Table 506.3.3
  50% of perimeter
  Open space of 40'
  I_f = 0.50
- Allowable area for H-2 = 7,000 + (0.50)(7,000)
  = 10,500 sq ft
- Check 10% of floor area criterium:
  (500)(300) = 150,000 sq ft
  150,000/10 = 15,000 sq ft
  15,000 >10,500, ∴ 10,500 maximum allowable
- Actual area = 6,400, which is less than 10,500, therefore OK

Group H-2 at the corner of an unlimited area Group F or S building

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More ready access to the Group H from the exterior of the building provides the fire department with an opportunity to respond more effectively to an incident. As such, the allowable floor area of the Group H can be far greater than where completely surrounded by the Group F or S use.

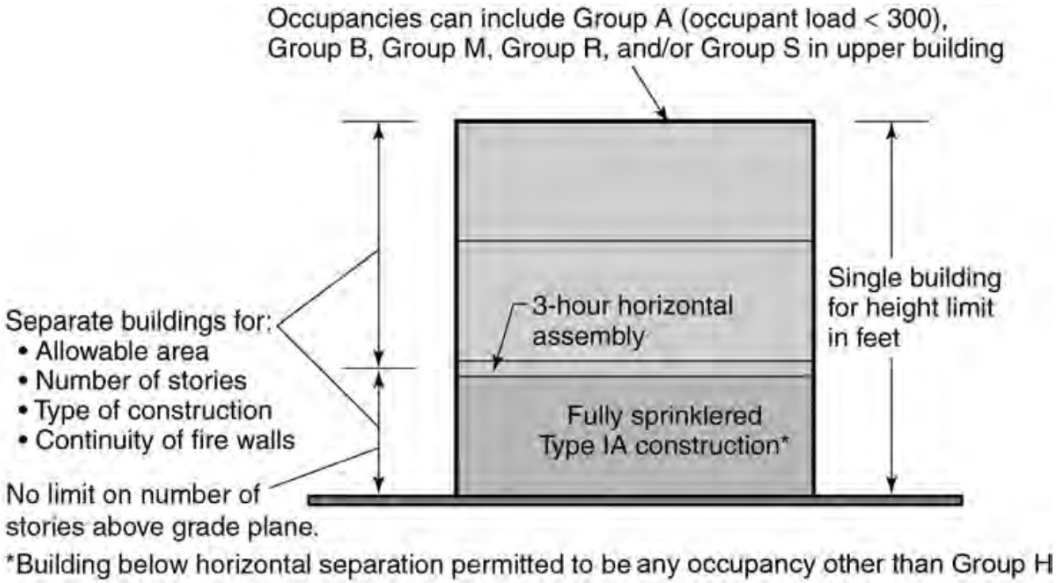
Source: 2021 IBC

510.2 Horizontal Building Separation

- A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories and type of construction where all of the following conditions are met: See the list of seven criteria.
- The special provisions of Section 510 are intended to modify the specific requirements of Chapter 5 regarding allowable heights and areas of buildings. The allowances granted in Section 510.2 address those structures typically referred to as “podium” or “pedestal” buildings. Compliance with the multiple conditions results in consideration of the structure as two separate and distinct buildings for four distinct issues. Similar provisions are established in Sections 510.3, 510.4, 510.7 and 510.8 where complying horizontal separations, along with other requirements, permit modifications to the general allowable height and area limitations.

Source: 2021 IBC

510.2 Horizontal Building Separation



Although this provision is often utilized where the lower building contains a parking garage, such parking facilities are not required to take advantage of the benefits. A variety of uses are permitted both above and below the fire-resistance-rated horizontal separation.

Source: 2021 IBC

510.2 Horizontal Building Separation

Where using the special provisions of Section 510.2 for the horizontal building separation allowance, the horizontal separation between buildings shall be provided with a horizontal assembly having a minimum _____ fire-resistance rating.

a. 1-hour
b. 2-hour
c. 3-hour
d. 4-hour

Source: 2021 IBC

510.2 Horizontal Building Separation

Where using the special provisions of Section 510.2 for the horizontal building separation allowance, the horizontal separation between buildings shall be provided with a horizontal assembly having a minimum _____ fire-resistance rating.

a. 1-hour
b. 2-hour
c. 3-hour
d. 4-hour

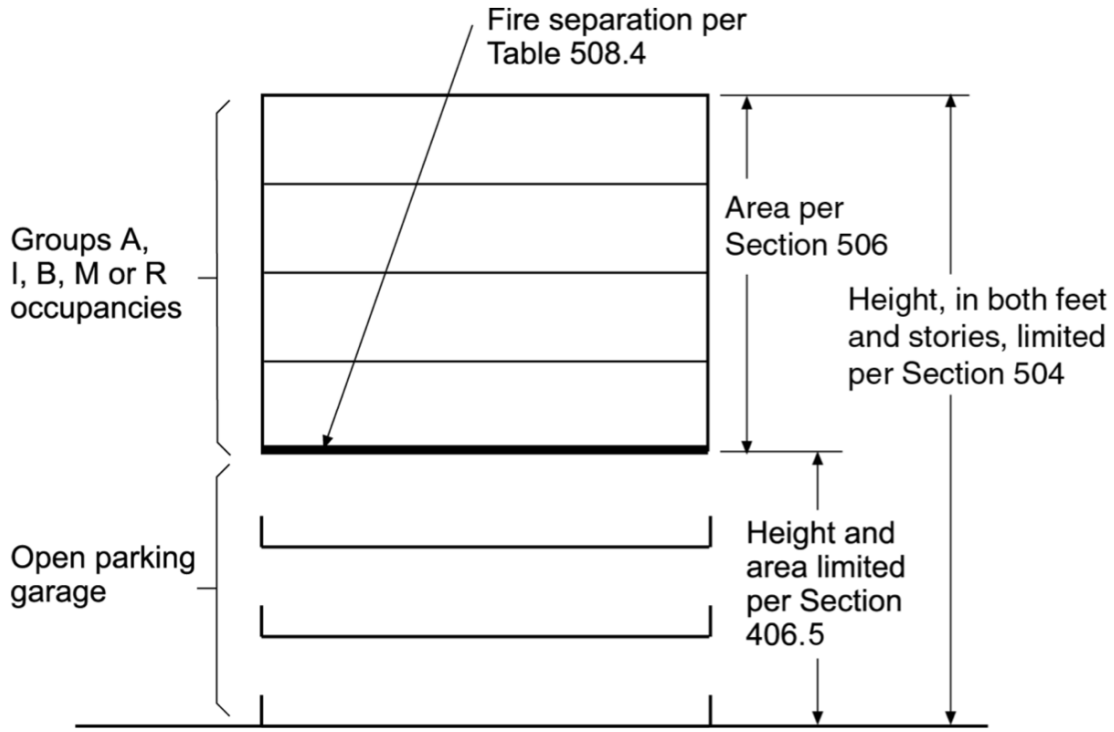
Source: 2021 IBC

510.7 Open Parking Garages

- Open parking garages constructed under Groups A, I, B, M and R shall not exceed the height and area limitations permitted under Section 406.5. The height and area of the portion of the building above the open parking garage shall not exceed the limitations in Section 503 for the upper occupancy. The height, in both feet and stories, of the portion of the building above the open parking garage shall be measured from grade plane and shall include both the open parking garage and the portion of the building above the parking garage.
- In the more common types of occupancies, it is desirable at times to provide tiers of parking below the major use of the building. In this special mixed-use condition, two different types of construction are permitted for determining the maximum allowable height and area. This special allowance is just one of several special provisions established in Section 510 that modify the general requirements of the code.

Source: 2021 IBC

510.7 Open Parking Garages



It is important to address the appropriate fire separation issues when using this provision. In addition, the structural members supporting the upper occupancy must be protected by the more restrictive fire-resistant assemblies of all of the occupancies involved.

Source: 2021 IBC

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

Source: 2021 IBC

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.

Source: 2021 IBC

701.1 Scope

- The provisions of Chapter 7 shall govern the materials, systems and assemblies used for structural fire resistance and fire-resistance-rated construction separation of adjacent spaces to safeguard against the spread of fire and smoke within a building and the spread of fire to or from buildings.
- There are basically two reasons for the protection of various building elements with construction resistant to fire. One, structural elements such as columns, girders, bearing walls and other load-bearing members are often required by the code to maintain their structural integrity under fire conditions for a prescribed time period. Two, horizontal and vertical assemblies are used to create compartments, including control areas, or to isolate portions of the building, such as exitways, through fire-resistant construction.

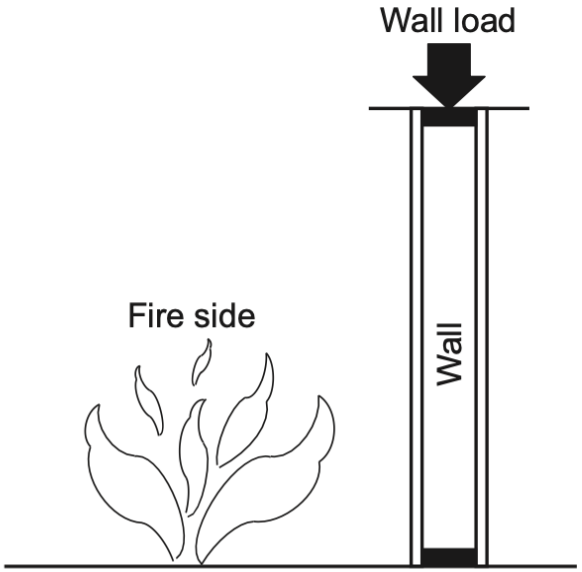
Source: 2021 IBC

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.

Source: 2021 IBC

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.

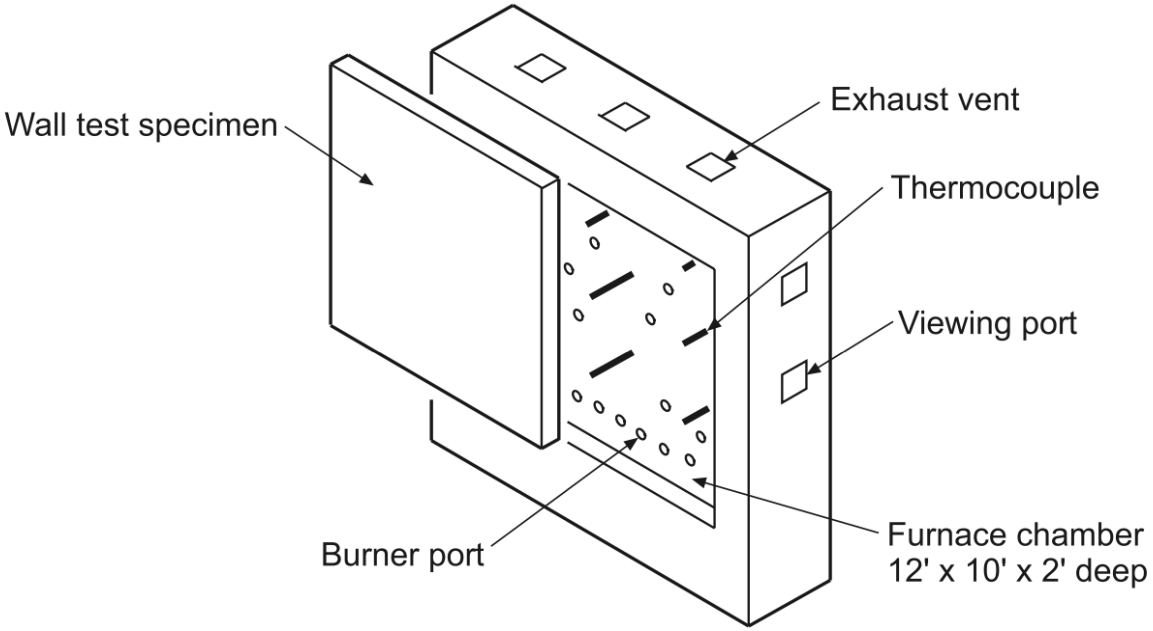
Source: 2021 IBC

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.

Source: 2021 IBC

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.

Source: 2021 IBC

703.2 Analytical Methods

9. Where a fire-resistance rating of building elements, components or assemblies is determined by test procedures, the procedures set forth in ASTM E119 or_____ shall be applicable.

   a. ANSI Z 97.1
   b. ASCE 5
   c. UL 263
   d. UL 555

Source: 2021 IBC

703.2.1 202 Materials and Systems

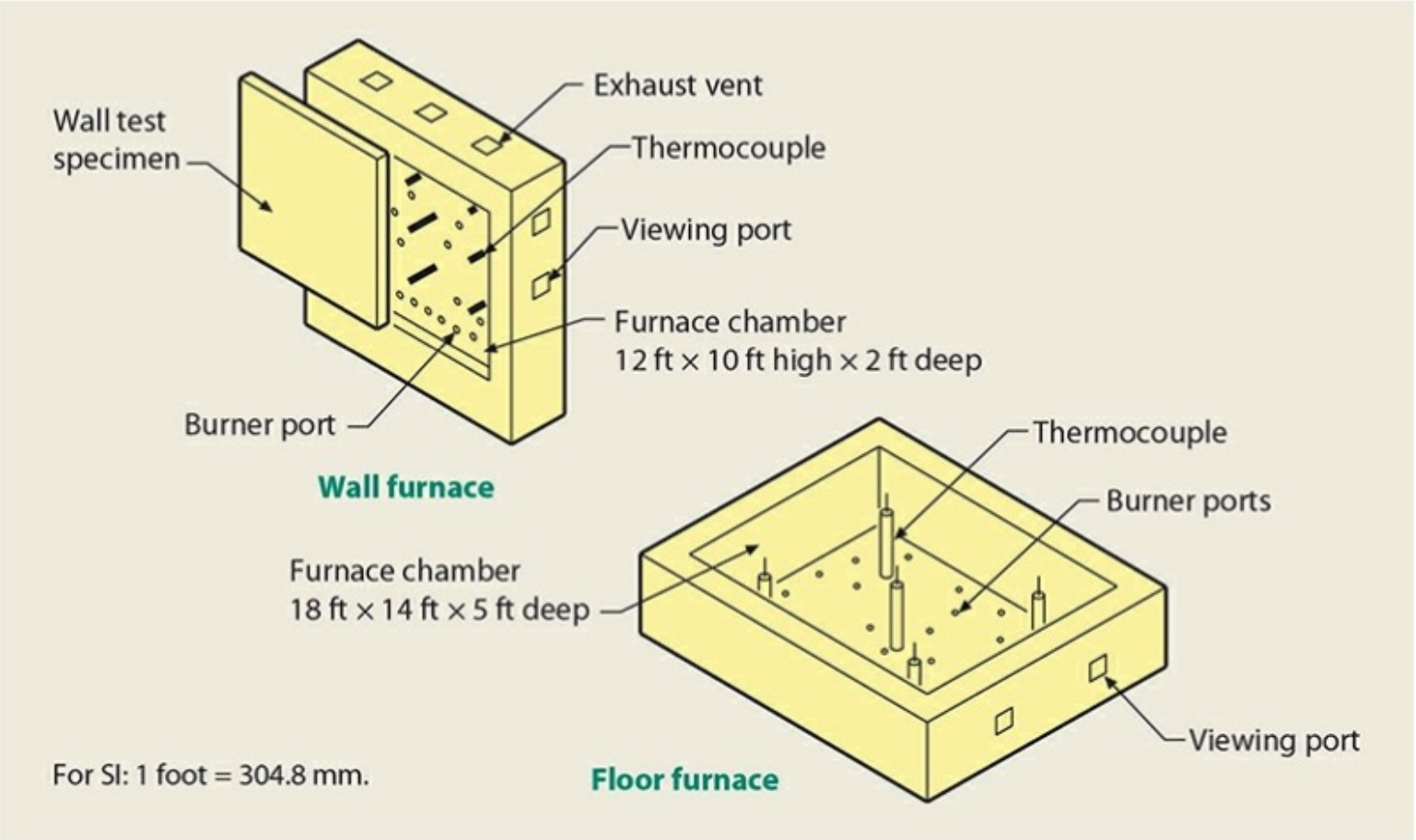


Figure 703-1 Test furnaces.

Source: 2021 IBC

703.2.1 202 Materials and Systems

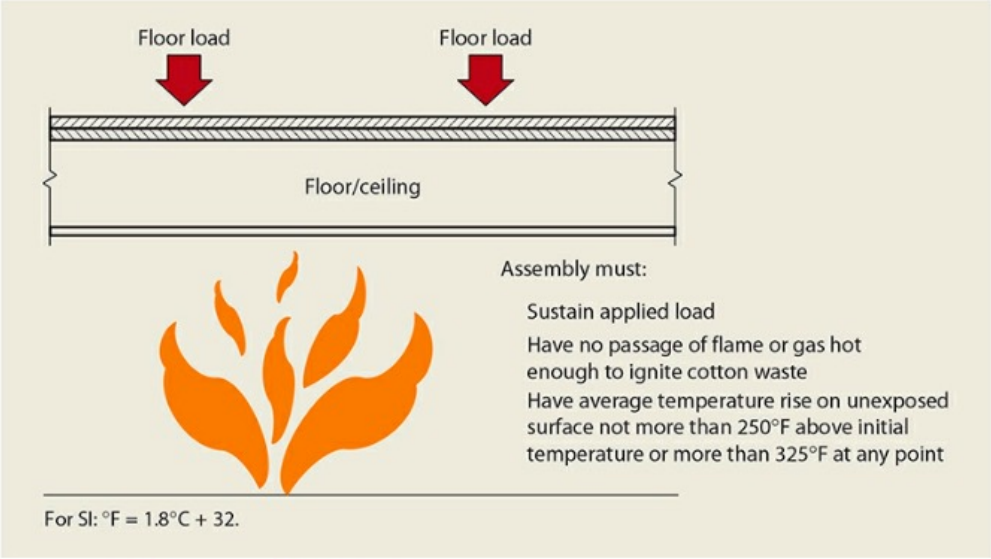


Figure 703-2 **Floor assembly fire test.**

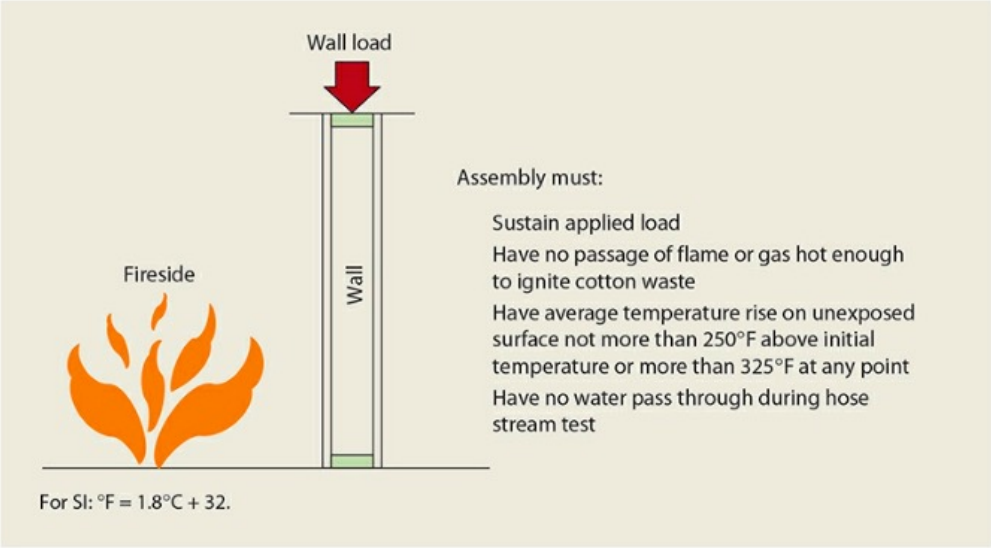


Figure 703-3 **Conditions of acceptance—wall fire test.**

Source: 2021 IBC

703.2.1 202 Materials and Systems

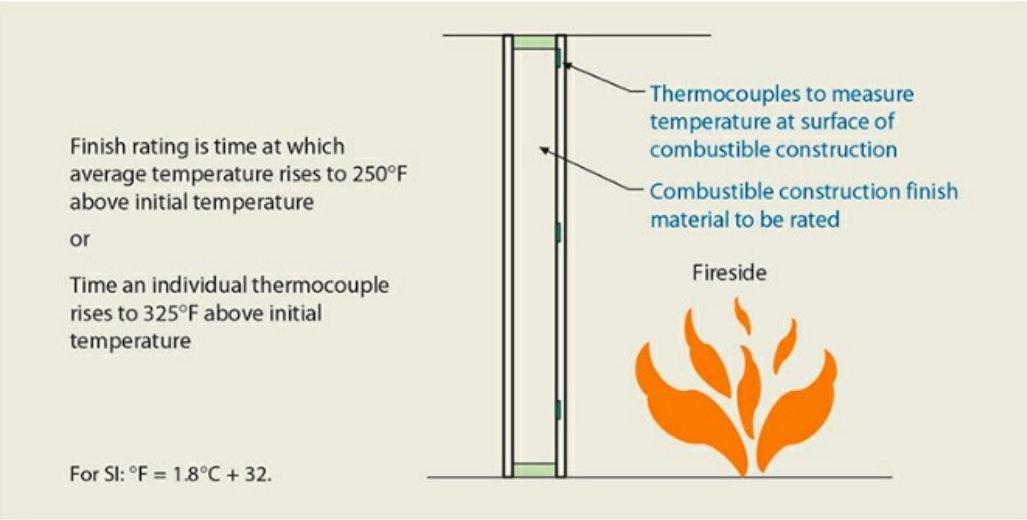


Figure 703-4 **Combustible assembly for determining finish rating.**

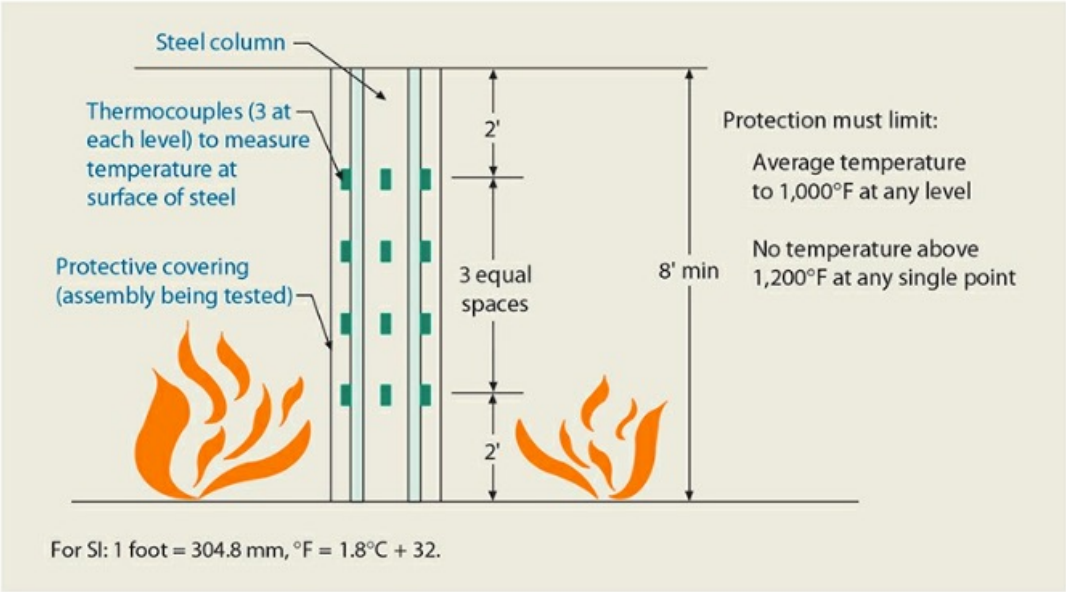


Figure 703-5 **Alternative fire test of steel column protection.**

Source: 2021 IBC

703.2.1 202 Materials and Systems

- https://www.icc-nta.org/services/testing/astm-e119/

Source: 2021 IBC

721.1 Scope

- The provisions of Section 721 contain prescriptive details of fire-resistance-rated building elements. The materials of construction listed in Tables 721.1(1), 721.1(2) and 721.1(3) shall be assumed to have the fire-resistance ratings prescribed therein. Where materials that change the capacity for heat dissipation are incorporated into a fire-resistance-rated assembly, fire test results or other substantiating data shall be made available to the building official to show that the required fire-resistance rating time period is not reduced.
- The tables in Section 721 provide the details for obtaining desired fire-resistance ratings for structural parts, walls and partitions, and floor and roof systems. The methods and materials found in the tables are to be used in the same manner as any listed assembly.

Source: 2021 IBC

721.1 Scope: Structural Parts

TABLE 721.1(1)
MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS NONCOMBUSTIBLE INSULATING MATERIALS[m]

STRUCTURAL PARTS TO BE PROTECTED	ITEM NUMBER	INSULATING MATERIAL USED	MINIMUM THICKNESS OF INSULATING MATERIAL FOR THE FOLLOWING FIRE-RESISTANCE PERIODS (inches)			
			4 hours	3 hours	2 hours	1 hour
1. Steel columns and all of primary trusses (continued)	1-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete, members 6" × 6" or greater (not including sandstone, granite and siliceous gravel).[a]	2 1/2	2	1 1/2	1
	1-1.2	Carbonate, lightweight and sand-lightweight aggregate concrete, members 8" × 8" or greater (not including sandstone, granite and siliceous gravel).[a]	2	1 1/2	1	1
	1-1.3	Carbonate, lightweight and sand-lightweight aggregate concrete, members 12" × 12" or greater (not including sandstone, granite and siliceous gravel).[a]	1 1/2	1	1	1
	1-1.4	Siliceous aggregate concrete and concrete excluded in Item 1-1.1, members 6" × 6" or greater.[a]	3	2	1 1/2	1
	1-1.5	Siliceous aggregate concrete and concrete excluded in Item 1-1.1, members 8" × 8" or greater.[a]	2 1/2	2	1	1
	1-1.6	Siliceous aggregate concrete and concrete excluded in Item 1-1.1, members 12" × 12" or greater.[a]	2	1	1	1
	1-2.1	Clay or shale brick with brick and mortar fill.[a]	3 3/4	—	—	2 1/4
	1-3.1	4" hollow clay tile in two 2" layers; 1/2" mortar between tile and column; 3/8" metal mesh 0.046" wire diameter in horizontal joints; tile fill.[a]	4	—	—	—
	1-3.2	2" hollow clay tile; 3/4" mortar between tile and column; 3/8" metal mesh 0.046" wire diameter in horizontal joints; limestone concrete fill[a]; plastered with 3/4" gypsum plaster.	3	—	—	—
	1-3.3	2" hollow clay tile with outside wire ties 0.08" diameter at each course of tile or 3/8" metal mesh 0.046" diameter wire in horizontal joints; limestone or trap-rock concrete fill[a] extending 1" outside column on all sides.	—	—	3	—
	1-3.4	2" hollow clay tile with outside wire ties 0.08" diameter at each course of tile with or without concrete fill; 3/4" mortar between tile and column.	—	—	—	2
	1-4.1	Cement plaster over metal lath wire tied to 3/4" cold-rolled vertical channels with 0.049" (No. 18 B.W. gage) wire ties spaced 3" to 6" on center. Plaster mixed 1:2 1/2 by volume, cement to sand.	—	—	2 1/2 [b]	7/8

Source: 2021 IBC

721.1 Scope: Walls and Partitions

TABLE 721.1(2)
RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS [a, o, p]

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE[b] (inches)			
			4 hours	3 hours	2 hours	1 hour
1. Brick of clay or shale	1-1.1	Solid brick of clay or shale.[c]	6	4.9	3.8	2.7
	1-1.2	Hollow brick, not filled.	5.0	4.3	3.4	2.3
	1-1.3	Hollow brick unit wall, grout or filled with perlite vermiculite or expanded shale aggregate.	6.6	5.5	4.4	3.0
	1-2.1	4" nominal thick units not less than 75 percent solid backed with a hat-shaped metal furring channel $^3/_4$" thick formed from 0.021" sheet metal attached to the brick wall on 24" centers with approved fasteners, and $^1/_2$" Type X gypsum wallboard attached to the metal furring strips with 1"-long Type S screws spaced 8" on center.	—	—	5[d]	—
2. Combination of clay brick and load-bearing hollow clay tile	2-1.1	4" solid brick and 4" tile (not less than 40 percent solid).	—	8	—	—
	2-1.2	4" solid brick and 8" tile (not less than 40 percent solid).	12	—	—	—
3. Concrete masonry units	3-1.1[f, g]	Expanded slag or pumice.	4.7	4.0	3.2	2.1
	3-1.2[f, g]	Expanded clay, shale or slate.	5.1	4.4	3.6	2.6
	3-1.3[f]	Limestone, cinders or air-cooled slag.	5.9	5.0	4.0	2.7
	3-1.4[f, g]	Calcareous or siliceous gravel.	6.2	5.3	4.2	2.8
4. Solid concrete[h, i]	4-1.1	Siliceous aggregate concrete.	7.0	6.2	5.0	3.5
		Carbonate aggregate concrete.	6.6	5.7	4.6	3.2
		Sand-lightweight concrete.	5.4	4.6	3.8	2.7
		Lightweight concrete.	5.1	4.4	3.6	2.5

Source: 2021 IBC

721.1 Scope: Floor and Roof Systems

TABLE 721.1(3)
MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS[a, q]

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (inches)				MINIMUM THICKNESS OF CEILING (inches)			
			4 hours	3 hours	2 hours	1 hour	4 hours	3 hours	2 hours	1 hour
1. Siliceous aggregate concrete	1-1.1	Slab (ceiling not required). Minimum cover over nonprestressed reinforcement shall be not less than $^3/_4$".[b]	7.0	6.2	5.0	3.5	—	—	—	—
2. Carbonate aggregate concrete	2-1.1		6.6	5.7	4.6	3.2	—	—	—	—
3. Sand-light-weight concrete	3-1.1		5.4	4.6	3.8	2.7	—	—	—	—
4. Lightweight concrete	4-1.1		5.1	4.4	3.6	2.5	—	—	—	—
5. Reinforced concrete	5-1.1	Slab with suspended ceiling of vermiculite gypsum plaster over metal lath attached to $^3/_4$" cold-rolled channels spaced 12" on center. Ceiling located 6" minimum below joists.	3	2	—	—	1	$^3/_4$	—	—
	5-2.1	$^5/_8$" Type X gypsum wallboard[c] attached to 0.018 inch (No.25 carbon sheet steel gage) by $^7/_8$" deep by $2^5/_8$" hat-shaped galvanized steel channels with 1"-long No. 6 screws. The channels are spaced 24" on center, span 35" and are supported along their length at 35" intervals by 0.033" (No. 21 galvanized sheet gage) galvanized steel flat strap hangers having formed edges that engage the lips of the channel. The strap hangers are attached to the side of the concrete joists with $^5/_{32}$" by $1^1/_4$"-long power-driven fasteners. The wallboard is installed with the long dimension perpendicular to the channels. End joints occur on channels and supplementary channels are installed parallel to the main channels, 12" each side, at end joint occurrences. The finished ceiling is located approximately 12" below the soffit of the floor slab.	—	—	$2^1/_2$	—	—	—	$^5/_8$	—

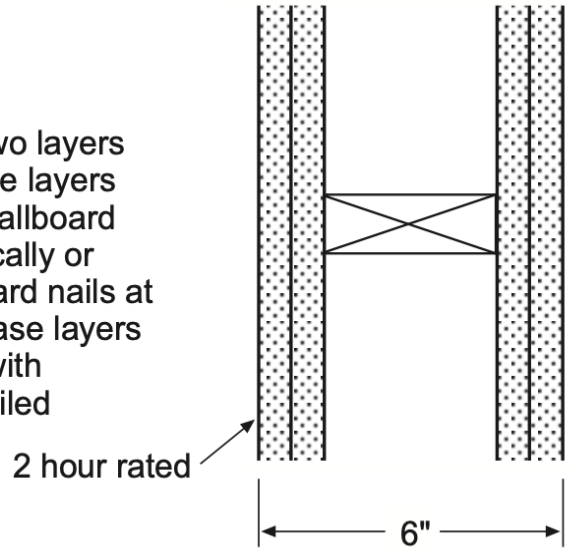
Source: 2021 IBC

721.1 Scope

Table 721.1(2)
Interior partition: Item 14-1.5

2 in. by 4 in. wood studs 16 in. on center with two layers $^{5}/_{8}$ in. Type X gypsum wallboard each side. Base layers applied vertically and nailed with 6d cooler or wallboard nails at 9 in. on center. Face layer applied vertically or horizontally and nailed with 8d cooler or wallboard nails at 7 in. on center. For nail-adhesive application, base layers are nailed 6 in. on center. Face layers applied with coating of approved wallboard adhesive and nailed 12 in. on center.

For SI: 1 inch = 25.4 mm.



When insulation or a similar material is added to a fire-resistance-rated assembly, it may change the assembly's capacity to dissipate heat. Particularly in noncombustible horizontal assemblies, the fire-resistance rating may be diminished to some degree.

Source: 2021 IBC

722.1 Scope

- The provisions of Section 722 contain procedures by which the fire resistance of specific materials or combinations of materials is established by calculations. The procedures apply only to the information contained in Section 722 and shall not be otherwise used.
- Another method used to obtain the necessary fire-resistance ratings mandated by the code is calculation. The provisions for calculating fire resistance are applicable to concrete assemblies, concrete masonry, clay brick and tile masonry, steel assemblies, wood assemblies and mass timber elements.

Source: 2021 IBC

722.1 Scope

TABLE 722.6.2(1)
TIME ASSIGNED TO WALLBOARD MEMBRANES[a, b, c, d]

DESCRIPTION OF FINISH	TIME[e](minutes)
3/8-inch wood structural panel bonded with exterior glue	5
15/32-inch wood structural panel bonded with exterior glue	10
19/32-inch wood structural panel bonded with exterior glue	15
3/8-inch gypsum wallboard	10
1/2-inch gypsum wallboard	15
5/8-inch gypsum wallboard	30
1/2-inch Type X gypsum wallboard	25
5/8-inch Type X gypsum wallboard	40
Double 3/8-inch gypsum wallboard	25
1/2-inch + 3/8-inch gypsum wallboard	35
Double 1/2-inch gypsum wallboard	40

For SI: 1 inch = 25.4 mm.

a. These values apply only when membranes are installed on framing members which are spaced 16 inches o.c. or less.

b. Gypsum wallboard installed over framing or furring shall be installed so that all edges are supported, except 5/8-inch Type X gypsum wallboard shall be permitted to be installed horizontally with the horizontal joints staggered 24 inches each side and unsupported but finished.

c. On wood frame floor/ceiling or roof/ceiling assemblies, gypsum board shall be installed with the long dimension perpendicular to framing members and shall have all joints finished.

d. The membrane on the unexposed side shall not be included in determining the fire resistance of the assembly. When dissimilar membranes are used on a wall assembly, the calculation shall be made from the least fire-resistant (weaker) side.

e. The time assigned is not a finished rating.

TABLE 722.6.2(2)
TIME ASSIGNED FOR CONTRIBUTION OF WOOD FRAME [a, b, c]

DESCRIPTION	TIME ASSIGNED TO FRAME (minutes)
Wood studs 16 inches o.c.	20
Wood floor and roof joists 16 inches o.c.	10

For SI: 1 inch = 25.4 mm.

a. This table does not apply to studs or joists spaced more than 16 inches o.c.

b. All studs shall be nominal 2 × 4 and all joists shall have a nominal thickness of at least 2 inches.

c. Allowable spans for joists shall be determined in accordance with Sections 2308.8, 2308.10.2 and 2308.10.3.

Applicable to both load-bearing and nonload-bearing assemblies, the calculated fire resistance for wood-framed walls, floor/ceiling assemblies and roof/ceiling assemblies is limited to a 1-hour rating.

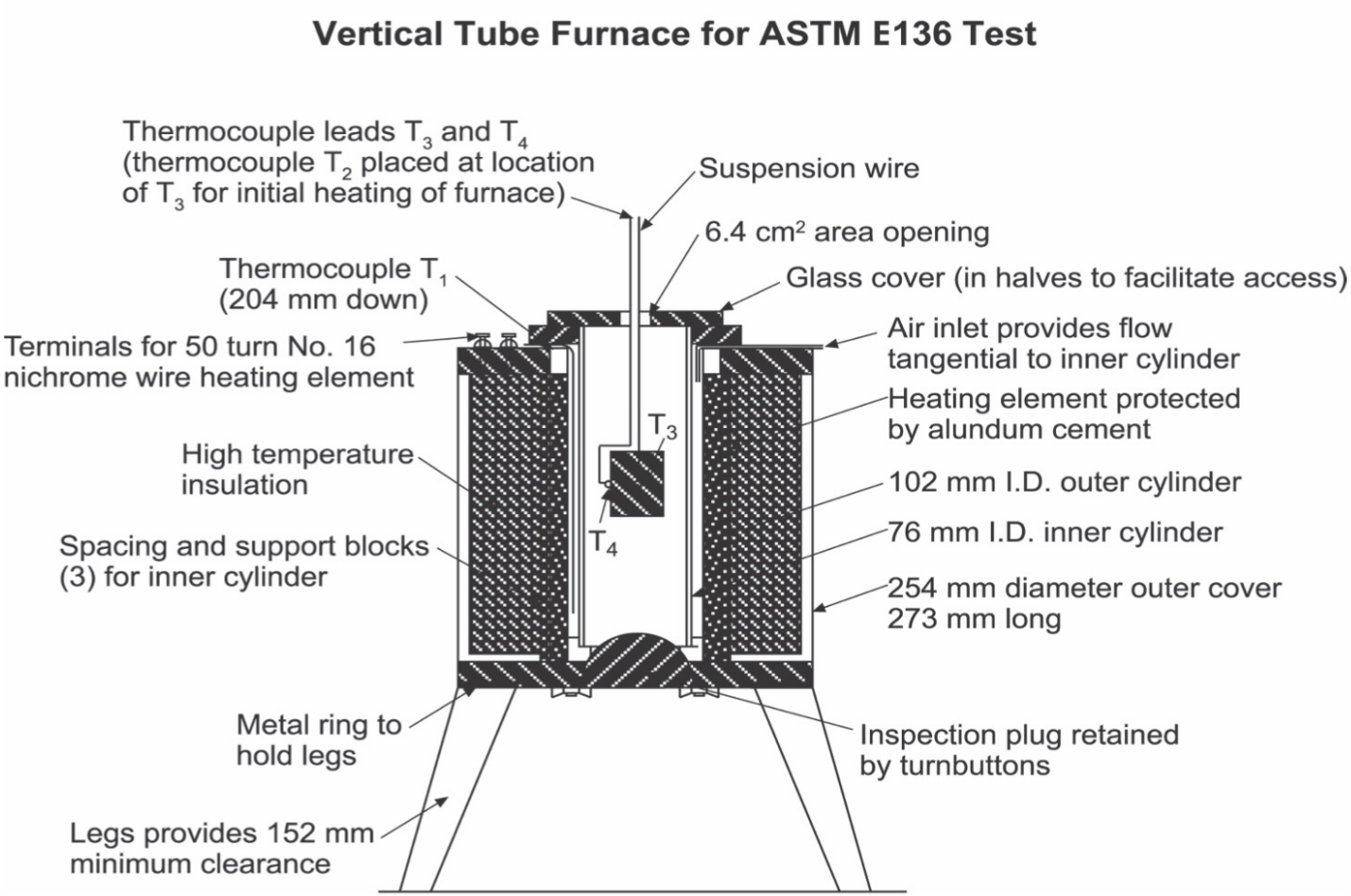
Source: 2021 IBC

703.3 Noncombustibility Tests

- The term “noncombustible” does not apply to the flame spread characteristics of interior finish or trim materials. A material shall not be classified as a noncombustible building construction material if it is subject to an increase in combustibility or flame spread beyond the limitations herein established through the effects of age, moisture, or other atmospheric conditions.
- In buildings of Types I, II, III and IV construction, specific elements are required to be constructed of noncombustible materials. Such materials are desirable because they do not aid combustion, nor do they add appreciable heat to an ambient fire. Under conditions of the test, a material may have a limited amount of combustible content and still qualify as noncombustible. Materials required to be noncombustible are to be tested in accordance with ASTM E136, or ASTM E2652 using the acceptance criteria of ASTM E136.

Source: 2021 IBC

703.3 Noncombustibility Tests



Gypsum wallboard and similar products are also acceptable as noncombustible materials. They must have a structural base of noncombustible materials, a surface material no more than $^1/_8$-inch in thickness and a maximum flame-spread index of 50.

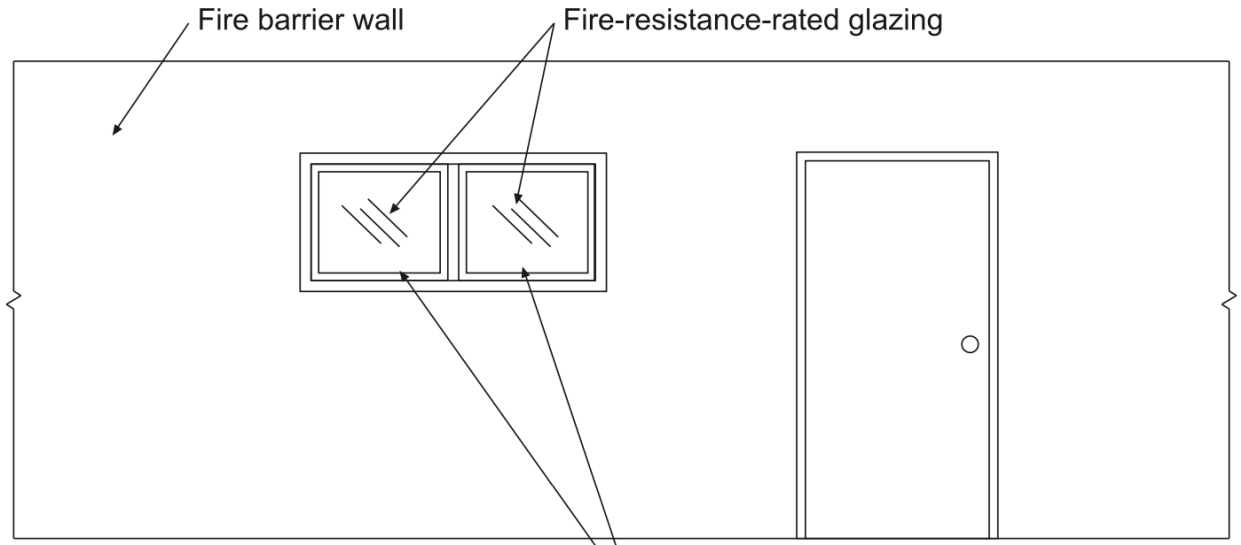
Source: 2021 IBC

703.4 Fire-Resistance Rated Glazing

- Fire-resistance-rated glazing, when tested in accordance with ASTM E119 or UL 263 and complying with the requirements of Section 707, shall be permitted. Fire-resistance-rated glazing shall bear a label marked in accordance with Table 716.1(1) issued by an agency and shall be permanently identified on the glazing.
- Under the provisions of Table 716.1(3), fire windows are not permitted in fire walls and most fire barriers having a required fire-resistance rating of 1 hour or greater. Therefore, glazing in such fire separations must either be protected by complying fire shutters or be in compliance with the requirements of Section 703.4. The fire-resistance-rated glazing permitted by this section is acceptable because it is tested to the same criteria as any fire wall or fire barrier.

Source: 2021 IBC

703.4 Fire-Resistance Rated Glazing



*XXX = fire-resistance rating in minutes

In the identifier, the “W” indicates that the glazing meets the requirements of ASTM E119 or UL 263, thus qualifying the glazing to be used as a wall element. It also indicates that the glazing meets the fire-resistance, hose-stream and temperature-rise requirements of the test standard.

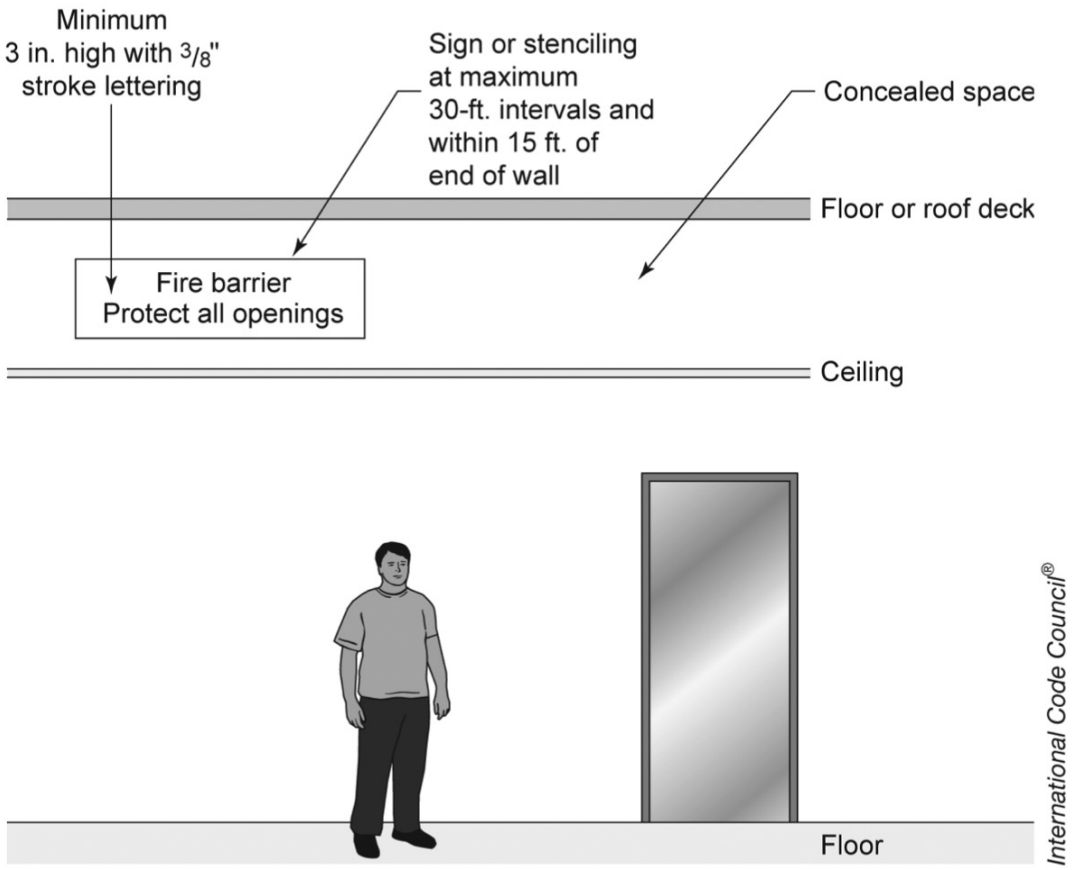
Source: 2021 IBC

703.5 Marking and Identification

- Where there is an accessible concealed floor, floor-ceiling or attic space, fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling in the concealed space.
- The integrity of fire and/or smoke separation walls is subject to compromise during the life of a building. During maintenance and remodel activities, it is not uncommon for new openings and penetrations to be installed in a fire separation wall without recognition that the integrity of the construction must be maintained or that some type of fire or smoke protective is required. Provisions mandating the appropriate identification of such walls under certain conditions have been established to better ensure that tradespeople, maintenance workers and inspectors will recognize the required level of protection that must be maintained.

Source: 2021 IBC

703.5 Marking and Identification



Identification sign for fire barrier

The identification sign or stencil is to have lettering at least 3 inches in height in a contrasting color stating “FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS,” or other wording and shall be located at maximum 30-foot intervals.

Source: 2021 IBC

703.5 Marking and Identification

10. Where a fire barrier is required to be identified by signage in an accessible concealed attic space, the identification shall occur at maximum intervals of _____ feet measured horizontally along the wall.

a. 15
b. 20
c. 30
d. 40

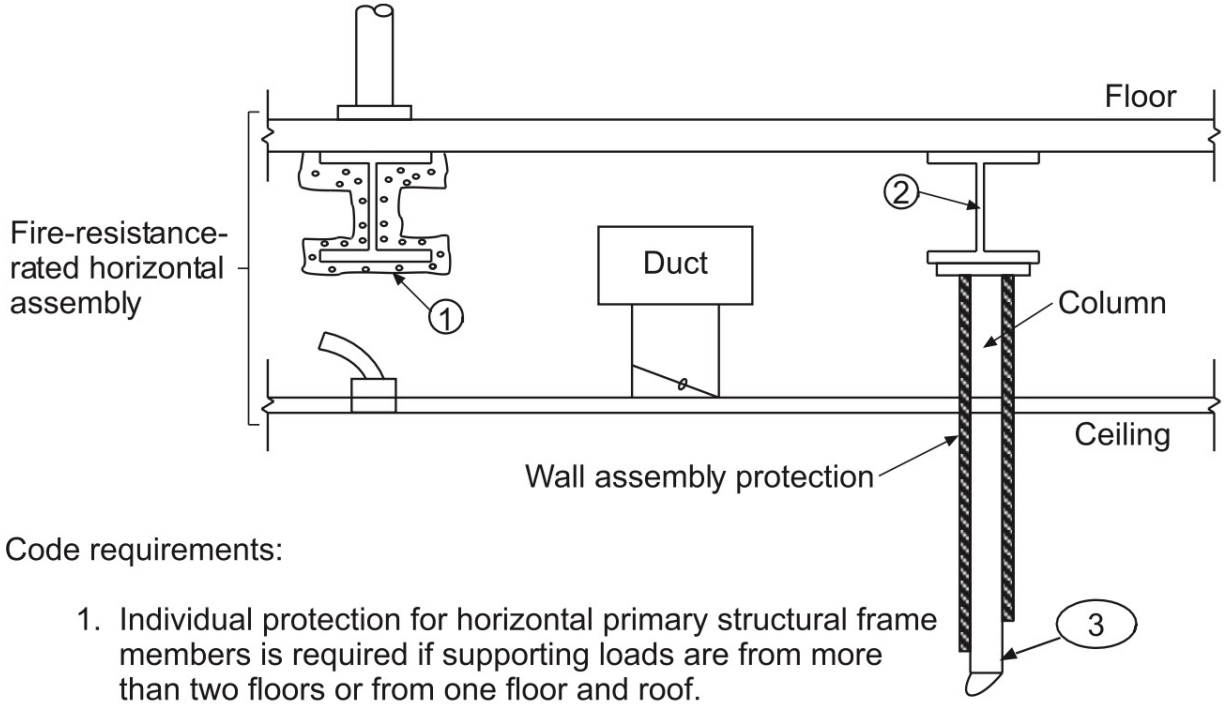
Source: 2021 IBC

704.3, 704.4 Individual Protection

- Members of the primary structural frame other than columns that are required to have protection to achieve a fire-resistance rating and support more than two floors or one floor and roof, or support a load-bearing wall or a nonload-bearing wall more than two stories high, shall be provided individual encasement protection by protecting them on all sides for their full length, including connections to other structural members, with materials having the required fire-resistance rating. Secondary members that are required to have protection to achieve a fire-resistance rating shall be protected by individual encasement protection. Light-frame construction elements and horizontal assemblies are permitted to be protected by membrane protection.
- Because of the differences in both the testing procedure and the conditions of acceptance, primary structural frame members carrying significant portions of the structure cannot simply be protected by enclosure within a fire-resistance-rated wall, floor/ceiling or roof/ ceiling assembly. Therefore, under specific conditions, individual encasement is required.

Source: 2021 IBC

704.3, 704.4 Individual Protection



Code requirements:

1. Individual protection for horizontal primary structural frame members is required if supporting loads are from more than two floors or from one floor and roof.

2. Otherwise, protection may be by individual encasement, membrane or ceiling protection per Sec. 711, or combination of both.

3. Columns must always be individually encased and protected for full height (Sec. 704.2) unless in compliance with Section 704.4.1 when within walls of light-frame construction.

When a column requires a fire-resistance rating, it must always be fully protected by individual encasement, including its connections to beams or girders. If the column extends above a ceiling, the fire protection must continue through the above-ceiling space to the top of the column.

Source: 2021 IBC

704.10, Exterior Members

- Load-bearing structural members located within the exterior walls or on the outside of a building or structure shall be provided with the highest fire-resistance rating as deter- mined in accordance with the following: (1) as required by Table 601 for the type of building element based on the type of construction of the building, (2) as required by Table 601 for exterior bearing walls based on the type of construction, and (3) as required by Table 705.5 for exterior walls based on the fire separation distance.
- Structural frame members such as columns that are placed inside an exterior wall assembly, or are located on the outside of a building, must be evaluated for fire-resistance purposes. Three criteria are to be evaluated, with the minimum required fire-resistance rating of the structural members based on the highest rating of the three criteria.

Source: 2021 IBC

704.10, Exterior Members

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of this code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
f. Not less than the fire-resistance rating as referenced in Section 704.10.
g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

Source: 2021 IBC

704.10, Exterior Members

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R[i], S-2, U[h]
$X < 5$[b]	All	3	2	1
$5 \leq X < 10$	IA, IVA	3	2	1
	Others	2	1	1
$10 \leq X < 30$	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
$X \geq 30$	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.3.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.
i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

Source: 2021 IBC

704.10, Exterior Members

36. In a Type IIB building housing a Group I-2 occupancy, what is the minimum required rating for an exterior nonbearing wall located with a fire separation distance of 8 feet?

    a. 3 hours
    b. 2 hours
    c. 1 hour
    d. 0 hours (no rating required)

    Reference _____

37. In a Type IIA building housing a Group R-2 occupancy, what is the minimum required rating for an exterior nonbearing wall located with a fire separation distance of 3 feet?

    a. 3 hours
    b. 2 hours
    c. 1 hour
    d. 0 hours (no rating required)

    Reference _____

38. Where an exterior bearing wall of a Group M occupancy of Type IIB construction is located 3 feet from an interior lot line, the wall must have a minimum fire-resistance rating of _____ hour(s).

    a. 0 hours (no rating required)
    b. 1
    c. 2
    d. 3

Source: 2021 IBC

704.10, Exterior Members

GIVEN: An exterior nonbearing wall in a Type IIIB building housing a Group M occupancy. The wall has a fire separation distance of 15 feet to an interior lot line.

DETERMINE: The minimum required fire-resistance rating for structural columns located within the exterior wall.

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of this code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
f. Not less than the fire-resistance rating as referenced in Section 704.10.
g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

704.10, Exterior Members

GIVEN: An exterior nonbearing wall in a Type IIIB building housing a Group M occupancy. The wall has a fire separation distance of 15 feet to an interior lot line.

DETERMINE: The minimum required fire-resistance rating for structural columns located within the exterior wall.

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members in roof construction shall not be required, including protection of primary structural frame members, roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
c. In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.
d. Not less than the fire-resistance rating required by other sections of this code.
e. Not less than the fire-resistance rating based on fire separation distance (see Table 705.5).
f. Not less than the fire-resistance rating as referenced in Section 704.10.
g. Heavy timber bearing walls supporting more than two floors or more than a floor and a roof shall have a fire resistance rating of not less than 1 hour.

704.10, Exterior Members

GIVEN: An exterior nonbearing wall in a Type IIIB building housing a Group M occupancy. The wall has a fire separation distance of 15 feet to an interior lot line.

DETERMINE: The minimum required fire-resistance rating for structural columns located within the exterior wall.

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R[i], S-2, U[h]
$X < 5^b$	All	3	2	1
$5 \le X < 10$	IA, IVA	3	2	1
	Others	2	1	1
$10 \le X < 30$	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
$X \ge 30$	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.3.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.
i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

Source: 2021 IBC

704.10, Exterior Members

GIVEN: An exterior nonbearing wall in a Type IIIB building housing a Group M occupancy. The wall has a fire separation distance of 15 feet to an interior lot line.

DETERMINE: The minimum required fire-resistance rating for structural columns located within the exterior wall.

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R[i], S-2, U[h]
$X < 5^b$	All	3	2	1
$5 \le X < 10$	IA, IVA	3	2	1
	Others	2	1	1
$10 \le X < 30$	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
$X \ge 30$	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.3.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.
i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

Source: 2021 IBC

704.10, Exterior Members

GIVEN: An exterior nonbearing wall in a Type IIIB building housing a Group M occupancy. The wall has a fire separation distance of 15 feet to an interior lot line.

DETERMINE: The minimum required fire-resistance rating for structural columns located within the exterior wall.

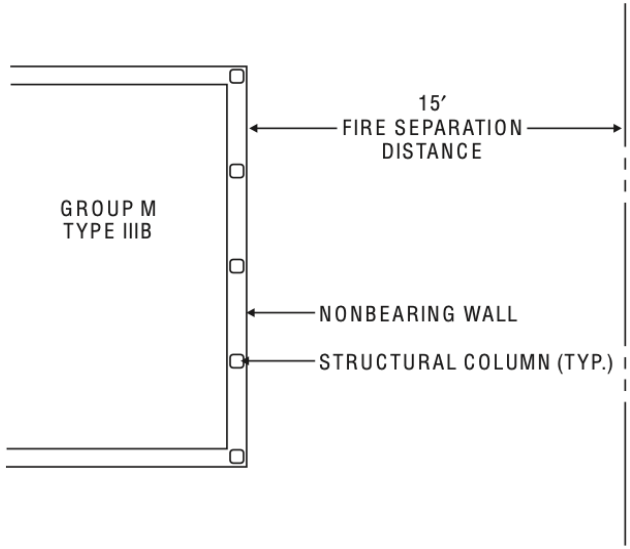
SOLUTION:

Per Table 601 for structural frame members, a minimum of 0 hours

Per Table 601 for exterior bearing walls, a minimum of 2 hours

Per Table 705.5 for a FSD of 15 feet, a minimum of 1 hour

∴ The columns shall have a minimum fire-resistance rating of 2 hours



Any structural frame members located within, or on the outside of, an exterior wall should never have a lower fire-resistance rating than that required to protect the members from an internal fire. However, if the exposure hazard from an external source is so great as to require exterior wall protection, a higher rating may be required.

Source: 2021 IBC

705.2, Extent of Projections

- Cornices, eave overhangs, exterior balconies and similar projections extending beyond the exterior wall shall conform to the requirements of Sections 705 and 1405. Exterior egress balconies and exterior exit stairways and ramps shall also comply with Sections 1021 and 1027, respectively. Projections shall not extend any closer to the line used to determine the fire separation distance than shown in Table 705.2. See the exception for projections beyond opposing walls of two buildings on the same lot.
- Where a building projection is located in close proximity to another building, either on the same lot or an adjoining lot, there is significant potential under fire conditions for convected heat to be trapped. The requirement for some degree of physical separation between any adjacent building and the edge of a projection allows for open space to assist in the heat's dissipation.

Source: 2021 IBC

705.2, Extent of Projections

TABLE 705.2
MINIMUM DISTANCE OF PROJECTION

FIRE SEPARATION DISTANCE-FSD (feet)	MINIMUM DISTANCE FROM LINE USED TO DETERMINE FSD
0 to less than 2	Projections not permitted
2 to less than 3	24 inches
3 to less than 5	Two-thirds of FSD
5 or greater	40 inches

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

The allowable projection length is based upon the fire separation distance related to the exterior wall. Where the fire separation distance is less than 2 feet, no projection is permitted. If the fire separation distance is at least 2 feet, some amount of projection is allowed up to the limit established by Table 705.2.

Source: 2021 IBC

705.2, Extent of Projections

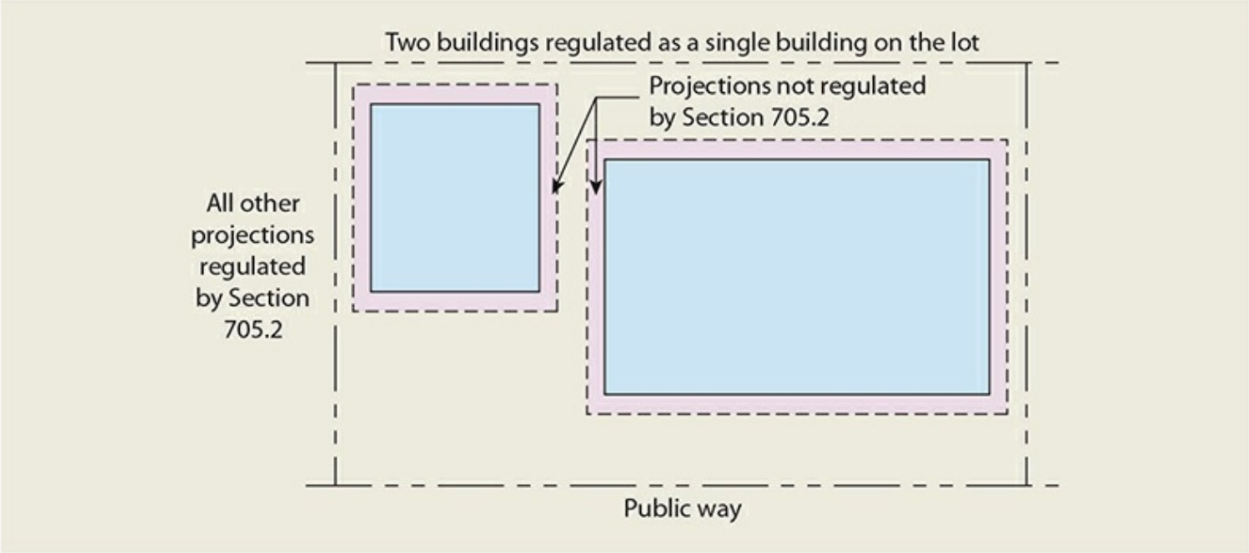


Figure 705-1 **Two buildings regulated as a single building on the lot.**

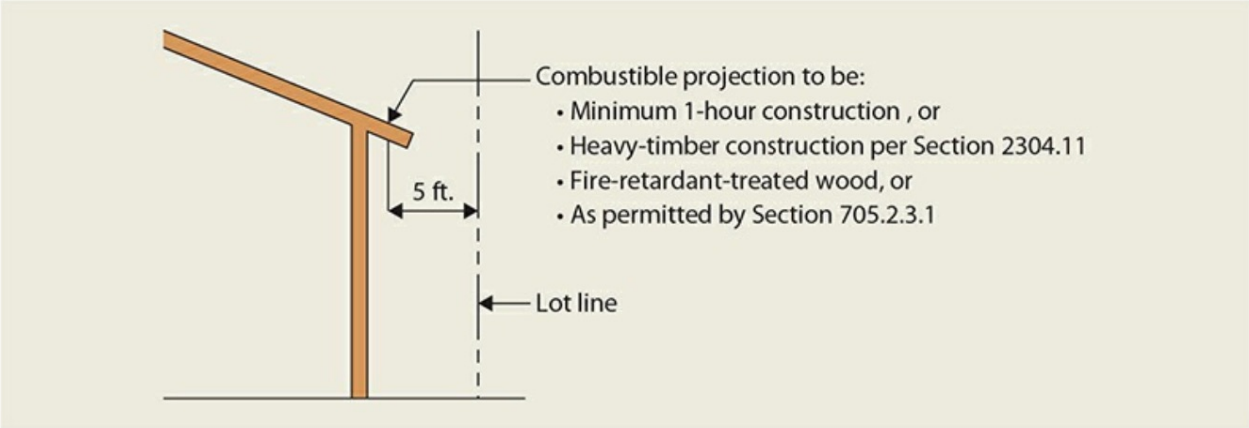


Figure 705-2 **Protection of combustible projections.**

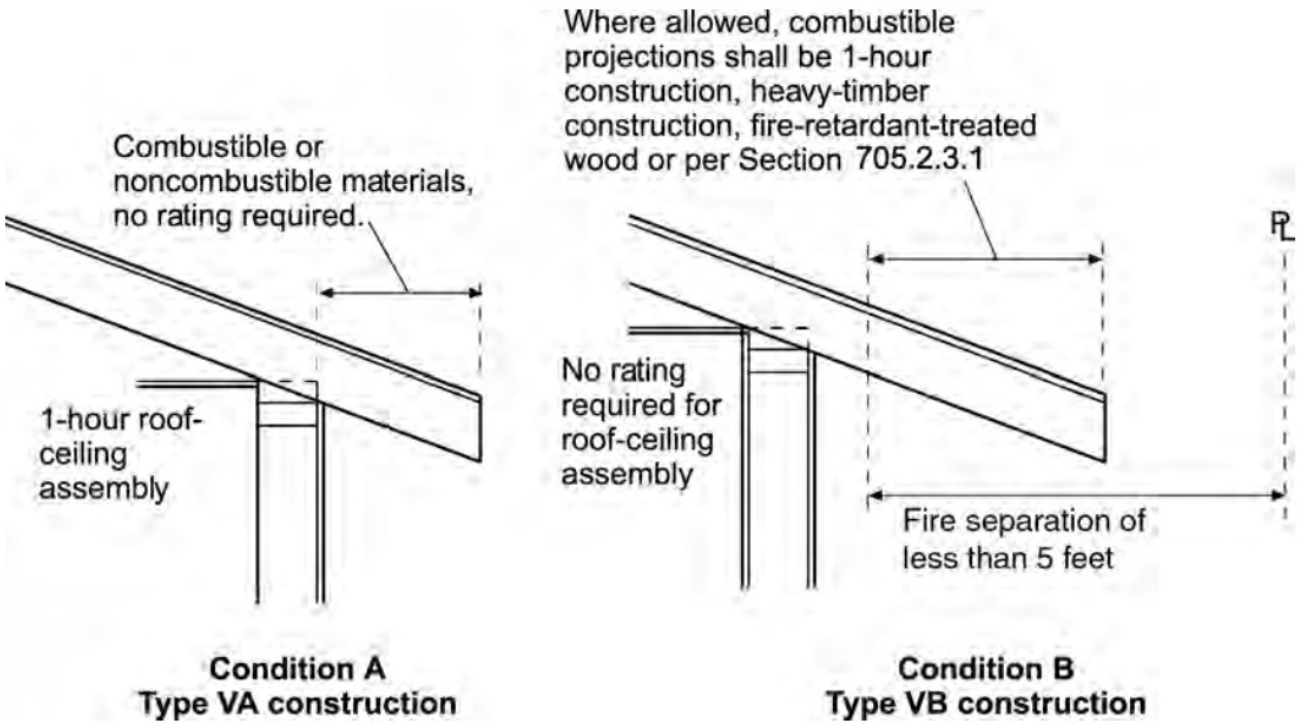
ce: 2021 IBC

705.2.1, 705.2.2, 705.2.3 Construction of Projections

- Projections from walls of Type I or II construction shall be of noncombustible materials or combustible materials as allowed by Sections 705.2.3.1 and 705.2.4. Projections from walls of Type III, IV or V construction shall be of any approved material. Projections extending to within 5 feet (1524 mm) of the line used to determine the fire separation distance shall be of one of the following: noncombustible materials, combustible materials of not less than 1-hour fire-resistance-rated construction, heavy timber construction, fire- retardant-treated wood or as permitted by Section 705.2.3.1. See the exception for Group R-3 and U occupancies.
- In noncombustible buildings, those of Type I and II construction, projections must also be noncombustible in order to maintain the limited fire loading created by the building's construction features. In buildings where combustible construction is permitted—Types III, IV and V—combustible projections typically pose no greater hazard than the other combustible elements in the building.

Source: 2021 IBC

705.2.1, 705.2.2, 705.2.3 Construction of Projections



Where a combustible projection is located relatively close to the lot line, the potential for severe fire exposure may exist. Accordingly, such a projection must be of minimum 1-hour construction, of heavy-timber construction, of fire-retardant-treated wood or regulated by Section 705.2.3.1 for combustible materials on exterior walls.

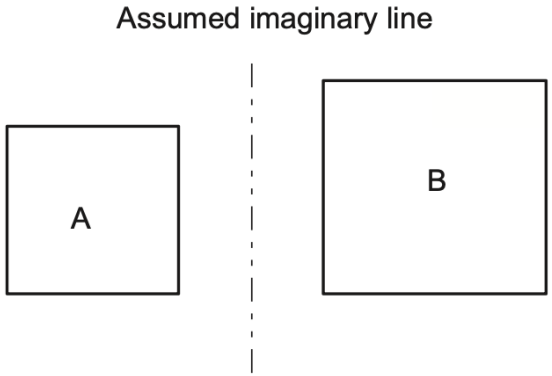
Source: 2021 IBC

705.3 Buildings on the same lot

- For the purposes of determining the required wall and opening protection, projections and roof-covering requirements, buildings on the same lot shall be assumed to have an imaginary line between them. See the exception where aggregate area of multiple buildings is within limits specified in Chapter 5 for a single building.
- Where two or more buildings are placed on the same piece of property, their exterior walls and openings must be regulated in the same manner as if they were on separate lots. However, if the buildings could be constructed as a single structure under one roof and meet the size requirements based on occupancy and type of construction, then an assumed imaginary line is not required.

Source: 2021 IBC

705.3 Buildings on the same lot



Case I: an assumed imaginary line between buildings

A. Fire resistance and opening protection for walls adjacent to the imaginary line must comply with the code

B. Imaginary line may be placed to take best advantage of wall and opening protection

Case II: as a single building

A. Allowable area and type of construction are based on the most restrictive requirements for the occupancies housed

B. Total floor area may not exceed that allowed for a single building

Buildings on the same lot

Where a new building is to be constructed on the same lot as an existing building, the assumed imaginary line must be placed in a location where it will not cause the exterior wall and opening protection of the existing building to become noncompliant.

Source: 2021 IBC

705.5 Table 705.5 Fire Separation Distance

- Exterior walls shall be fire-resistance rated in accordance with Table 601, based on the type of construction, and Table 705.5, based on the fire separation distance.
- The rationale behind exterior wall protection is that an owner has no control over what occurs on an adjacent lot. The lot line concept provides a convenient means of protecting one building from another insofar as radiant heat could potentially be transmitted from one building to another during a fire. The requirements are based on “fire separation distance,” which must be considered for all exterior walls. Where such walls are also bearing walls, the provisions of Table 601 also apply, governed by the more restrictive of the hourly ratings.

Source: 2021 IBC

705.5 Table 705.5 Fire Separation Distance

Table 705.5 Regulates Exterior Walls Only

- Table 705.5 used in conjunction with Table 601 for fire resistance of exterior bearing walls
- Only Table 705.5 used for nonbearing exterior walls
- Based on occupancy and type of construction
- Highest required rating for exterior wall is 3 hours
- Final threshold at ≥ 30'
- Additional provisions for exterior walls and openings throughout Section 705

TABLE 705.5
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R[i], S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IVA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.3.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.
i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

In addition to establishing the required fire-resistive rating of exterior walls due to their location on the lot, the “fire separation distance” is also often utilized in the regulation of two or more buildings on the same lot, projections beyond the exterior wall, and parapet requirements.

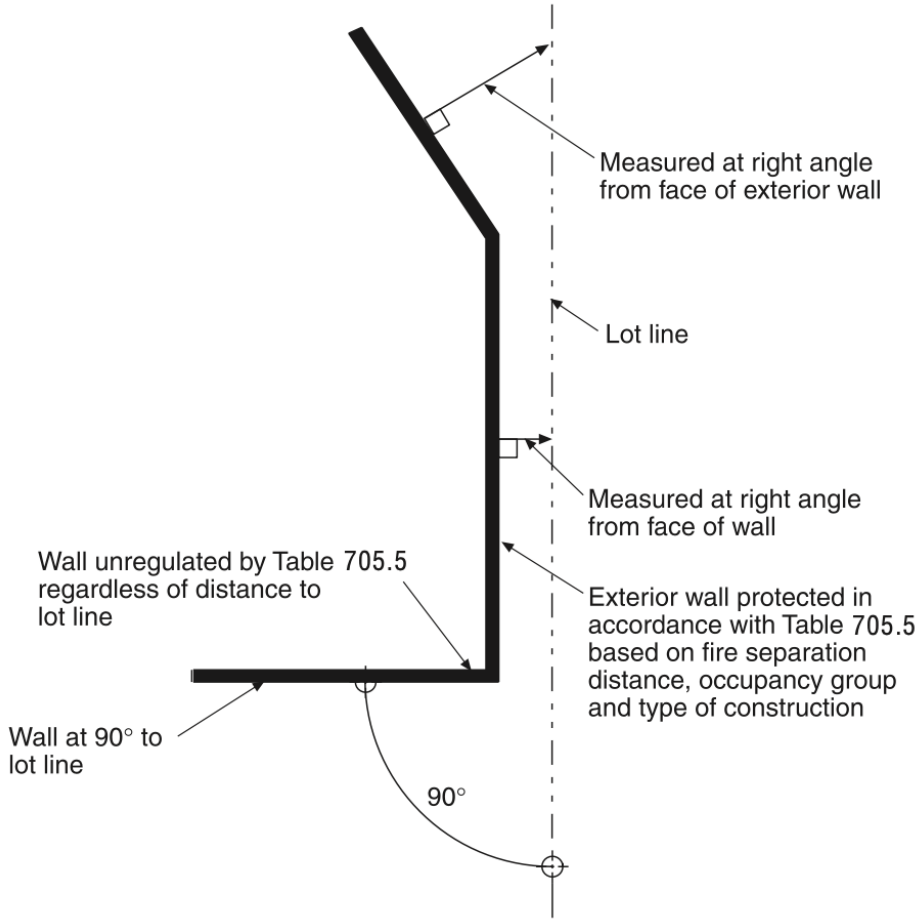
Source: 2021 IBC

Table 705.5, 202 Fire Separation Distance

- Fire separation distance is the distance measured from the building face to one of the following: (1) the closest interior lot line; (2) to the centerline of a street, alley or public way; or (3) to an imaginary line between two buildings on the lot. The distance shall be measured at right angles from the face of the wall.
- The atmospheric separation provided between a building and an adjoining structure provides resistance to fire spread due to radiant heat transfer. Many provisions throughout the IBC, such as those regulating projections and parapets, are based upon the degree of separation provided. A measurement at a right angle from the building face addresses heat transfer from the building of fire incident toward other structures and properties.

Source: 2021 IBC

Table 705.5, 202 Fire Separation Distance



Protection of walls adjacent to lot lines

The measurement of fire separation distance is theoretically taken at an infinite number of points along the exterior wall. In reality, zones are created adjacent to the building under consideration, with higher degrees of regulation mandated for those zones closest to the building.

Source: 2021 IBC

Table 705.5, Note a Fire-Resistance Ratings

- The minimum fire-resistance rating for exterior bearing walls shall be not less than the fire-resistance rating based on fire separation distance. In addition to the fire-resistance rating requirements for exterior walls based on fire separation distance, load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
- When analyzing an exterior wall for its required level of fire resistance, it is necessary to use both Tables 601 and 705.5. Table 601 addresses the potential need for structural stability of exterior bearing walls under fire conditions. Exterior nonbearing walls are not regulated by this table. The concern of radiant heat transfer from an adjoining burning building results in Table 705.5 regulating the exterior wall rating based upon its fire separation distance (typically the distance from the building face to the lot line). This concern exists for both bearing and nonbearing exterior walls.

Source: 2021 IBC

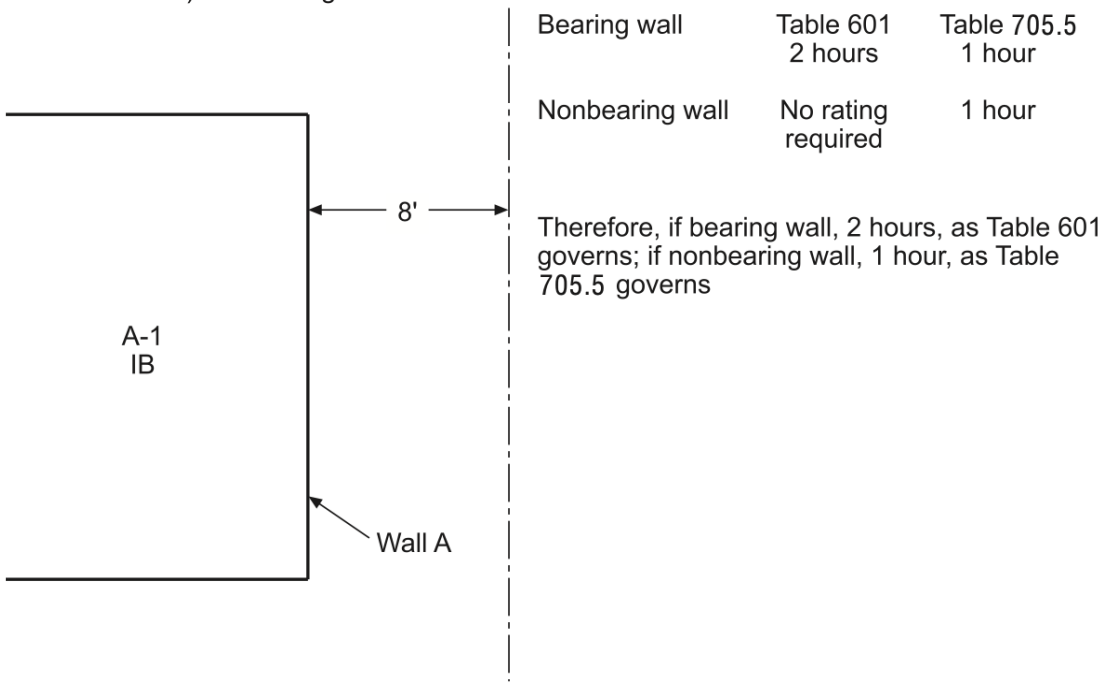
Table 705.5, Note a Fire-Resistance Ratings

Given: A-1 Occupancy, Type IB construction, fire separation distance of 8 ft

Determine: Minimum exterior wall rating of Wall A

if 1) bearing

2) nonbearing



Fire-resistance of exterior walls

The provisions of Section 704.10 regulate the fire resistance of structural frame members located within nonbearing exterior walls. The required fire rating is based on the highest of ratings found in Table 601 (structural frame, exterior bearing wall) and Table 705.5 (fire separation distance).

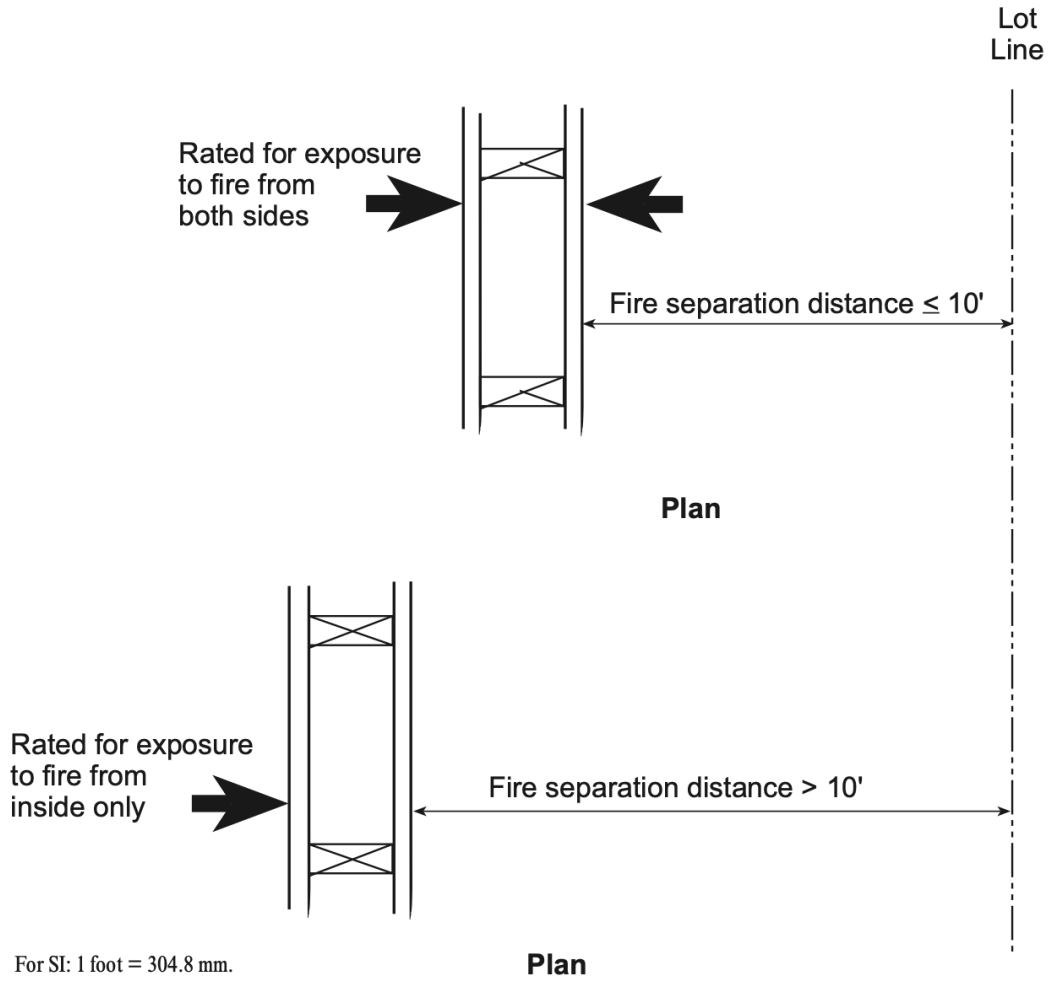
Source: 2021 IBC

Table 705.5 Fire-Resistance Ratings

- Exterior walls shall be fire-resistance rated in accordance with Table 601, based on the type of construction, and Table 705.5, based on fire separation distance. The required fire-resistance rating of exterior walls with a fire separation distance of greater than 10 feet (3048 mm) shall be rated for exposure to fire from the inside. The required fire-resistance rating of exterior walls with a fire separation distance of less than or equal to 10 feet (3048 mm) shall be rated for exposure to fire from both sides.
- Exposure of the exterior wall to an interior fire does not vary based on the distance of the wall from the lot line. However, exterior fire exposure decreases with an increase in the distance between the lot line and the exterior wall (fire separation distance). A fire separation distance of 10 feet is considered by the IBC to be a reasonable limit of flame impingement (direct exterior fire exposure) from an adjacent building.

Source: 2021 IBC

Table 705.5 Fire-Resistance Ratings



The determination of the minimum fire-resistance-rating for an exterior wall is typically based on two conditions: (1) the type of construction of the building, and (2) the fire separation distance. The higher of the two ratings regulates the minimum level of fire resistance.

Source: 2021 IBC

705.8.1, 705.8.4 Allowable Area of Openings

- The maximum area of unprotected and protected openings permitted in an exterior wall in any story shall not exceed the percentages specified in Table 705.8 based on the fire separation distance of each individual story. See the exceptions for (1) openings on the first story, and (2) stories where the exterior wall is not required to have a fire-resistance rating. Where both unprotected and protected openings are located in the exterior wall in any story of a building, the total area of the openings shall comply with the following formula: $A_p/a_p + A_u/a_u \leq 1$.
- Based on the fire separation distance, the amount of openings in an exterior wall is regulated on a floor-by-floor basis. Where all of the exterior openings are protected, a higher percentage of the exterior wall surface may be provided with openings, whereas a lesser amount is permitted if all openings are unprotected. The IBC also permits both protected and unprotected openings in an exterior wall, provided they comply with the unity formula. In a fully-sprinklered building, the maximum allowable area of unprotected openings is the same as that allowed for protected openings.

Source: 2021 IBC

705.8.1, 705.8.4 Allowable Area of Openings

TABLE 705.8
MAXIMUM AREA OF EXTERIOR WALL OPENINGS BASED ON FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION

FIRE SEPARATION DISTANCE (feet)	DEGREE OF OPENING PROTECTION	ALLOWABLE AREA[a]
0 to less than 3[b, c]	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S)[i]	Not Permitted
	Protected (P)	Not Permitted
3 to less than 5[d, e]	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S)[i]	15%
	Protected (P)	15%
5 to less than 10[e, f]	Unprotected, Nonsprinklered (UP, NS)	10%[h]
	Unprotected, Sprinklered (UP, S)[i]	25%
	Protected (P)	25%
10 to less than 15[e, f, g]	Unprotected, Nonsprinklered (UP, NS)	15%[h]
	Unprotected, Sprinklered (UP, S)[i]	45%
	Protected (P)	45%
15 to less than 20[f, g]	Unprotected, Nonsprinklered (UP, NS)	25%
	Unprotected, Sprinklered (UP, S)[i]	75%
	Protected (P)	75%

If a building's exterior wall is not required to be fire-resistance rated by Table 705.5, then an unlimited percentage of unprotected openings is permitted regardless of fire separation distance.

Source: 2021 IBC

705.8.1, 705.8.4 Allowable Area of Openings

GIVEN: A nonsprinklered Group S-1 building of Type IIIB construction. The exterior wall shown is located 12 feet from an interior lot line.

DETERMINE: The maximum area permitted for unprotected openings.

SOLUTION:

$(A_p/a_p) + (A_u/a_u) \leq 1$ **(Equation 7-2)**

A_p = Actual area of protected openings, or the equivalent area of protected openings, A_e (see Section 705.7).

a_p = Allowable area of protected openings.

A_u = Actual area of unprotected openings.

a_u = allowable area of unprotected openings.

TABLE 705.8
MAXIMUM AREA OF EXTERIOR WALL OPENINGS BASED ON FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION

FIRE SEPARATION DISTANCE (feet)	DEGREE OF OPENING PROTECTION	ALLOWABLE AREA[a]
0 to less than 3[b, c]	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S)[i]	Not Permitted
	Protected (P)	Not Permitted
3 to less than 5[d, e]	Unprotected, Nonsprinklered (UP, NS)	Not Permitted
	Unprotected, Sprinklered (UP, S)[i]	15%
	Protected (P)	15%
5 to less than 10[e, f]	Unprotected, Nonsprinklered (UP, NS)	10%[h]
	Unprotected, Sprinklered (UP, S)[i]	25%
	Protected (P)	25%
10 to less than 15[e, f, g]	Unprotected, Nonsprinklered (UP, NS)	15%[h]
	Unprotected, Sprinklered (UP, S)[i]	45%
	Protected (P)	45%
15 to less than 20[f, g]	Unprotected, Nonsprinklered (UP, NS)	25%
	Unprotected, Sprinklered (UP, S)[i]	75%
	Protected (P)	75%

If a building's exterior wall is not required to be fire-resistance rated by Table 705.5, then an unlimited percentage of unprotected openings is permitted regardless of fire separation distance.

Source: 2021 IBC

705.8.1, 705.8.4 Allowable Area of Openings

GIVEN: A nonsprinklered Group S-1 building of Type IIIB construction. The exterior wall shown is located 12 feet from an interior lot line.

DETERMINE: The maximum area permitted for unprotected openings.

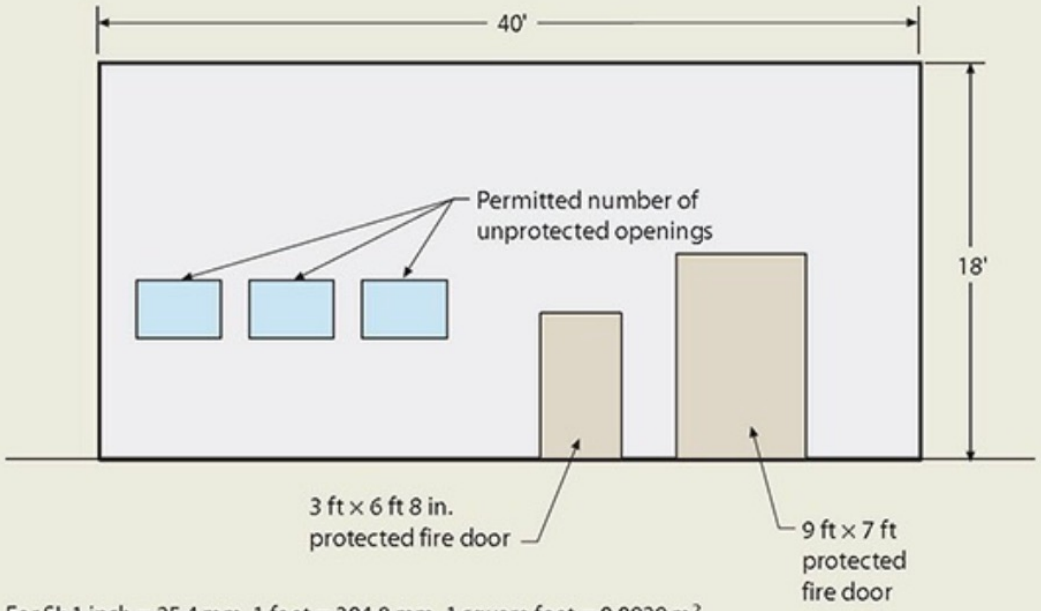
SOLUTION:

$$\frac{A_p}{a_p}+\frac{A_u}{a_u}\le 1.0$$

$$\frac{83}{(45\%)(18\times 40)}+\frac{A_u}{(15\%)(18\times 40)}=1.0$$

$$\frac{83}{324}+\frac{A_u}{108}=1.0$$

$$0.25+\frac{81}{108}=1.0$$



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

81 square feet of unprotected openings are permitted

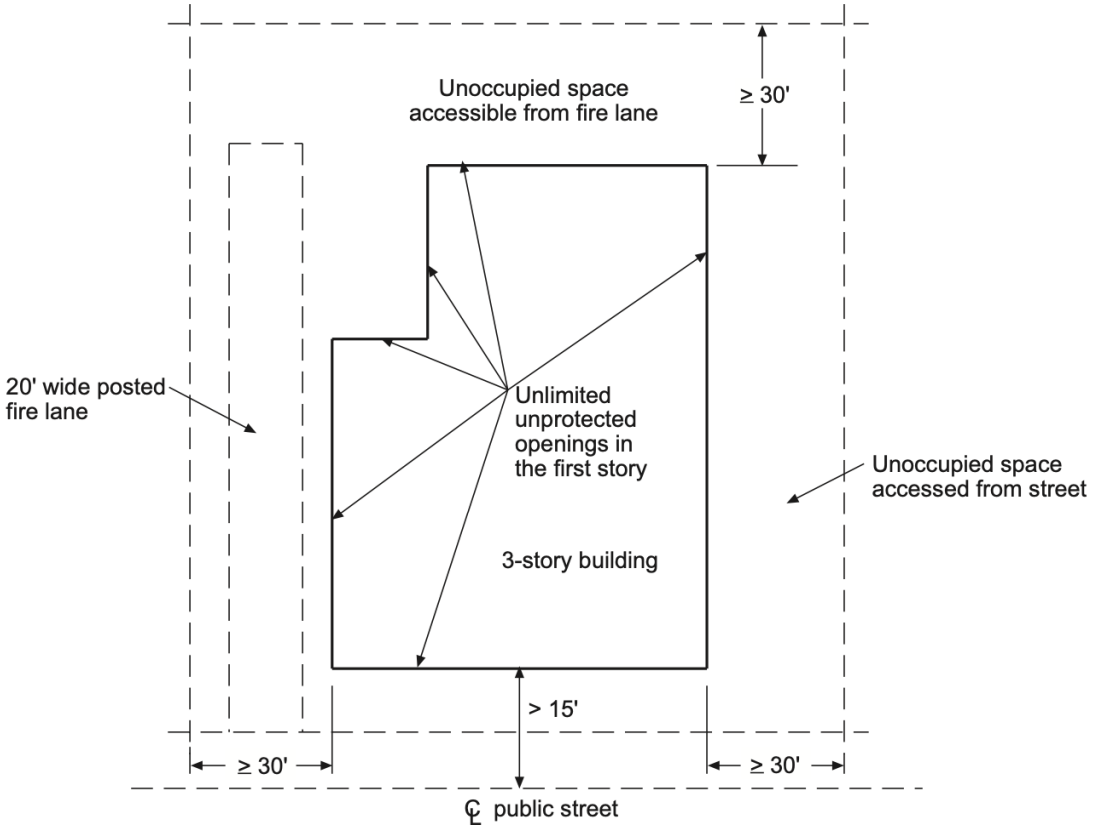
Source: 2021 IBC

705.8.1, Exc.1 First-Story Walls

- In other than Group H occupancies, unlimited unprotected openings are permitted in the first story above grade either: (1.1) where the wall faces a street and has a fire separation distance of more than 15 feet (4572 mm), or (1.2) where the wall faces an unoccupied space. The unoccupied space shall be on the same lot or dedicated for public use, shall not be less than 30 feet (9144 mm) in width and shall have access from a street by a posted fire lane in accordance with the International Fire Code.
- Because the first story of a building is generally readily available for fire department access and manual suppression efforts, unprotected openings are not restricted, provided a moderate amount of open space is provided adjacent to the exterior wall. It is expected that the fire department can quickly mitigate the potential radiant heat exposure to surrounding buildings or structures.

Source: 2021 IBC

705.8.1, Exc.1 First-Story Walls



Unlimited openings in the first story exterior wall

For SI: 1 foot = 304.8 mm.

As the primary allowance for unlimited unprotected openings is the ability of the fire service to easily access and suppress at the ground level, it is critical that adequate open space be available for such purposes. Where not accessed directly from a street, a fire lane must be provided.

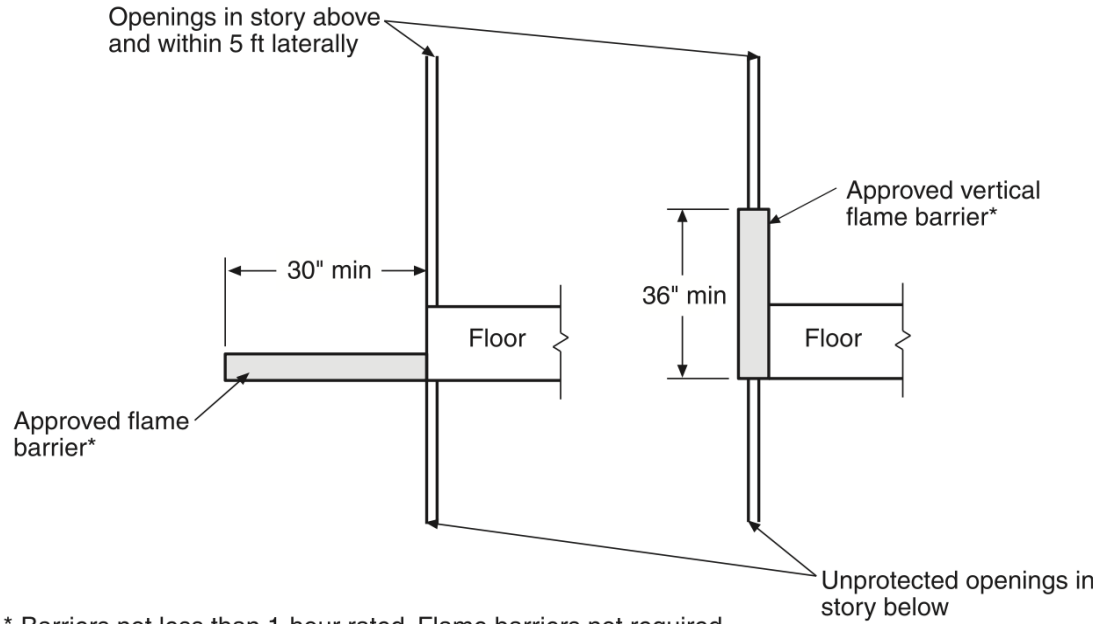
Source: 2021 IBC

705.8.5, Vertical Separation of Openings

- Openings in exterior walls in adjacent stories shall be separated vertically to protect against fire spread on the exterior of the buildings where the openings are within 5 feet (1524 mm) of each other horizontally and the opening in the lower story is not a protected opening with a fire protection rating of not less than 3/4 hour. Such openings shall be separated vertically not less than 3 feet (914 mm) by spandrel girders, exterior walls or other similar assemblies that have a fire-resistance rating of not less than 1 hour or by flame barriers than extend horizontally not less than 30 inches (762 mm) beyond the exterior wall. Flame barriers shall have a fire-resistance rating of not less than 1 hour. See the exceptions for buildings no more than three stories in height, buildings that are fully sprinklered and open parking garages.
- Where unprotected openings occur in adjacent stories, a fire that breaks out of an opening in a lower story can spread vertically to upper stories of the building. Two methods of flame resistance are available to restrict such fire spread.

Source: 2021 IBC

705.8.5, Vertical Separation of Openings



Flame barriers

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

Protection is not required for buildings three stories or less in height. This exception is based on a limited building height, which allows for more effective fire-fighting operations from the building's exterior.

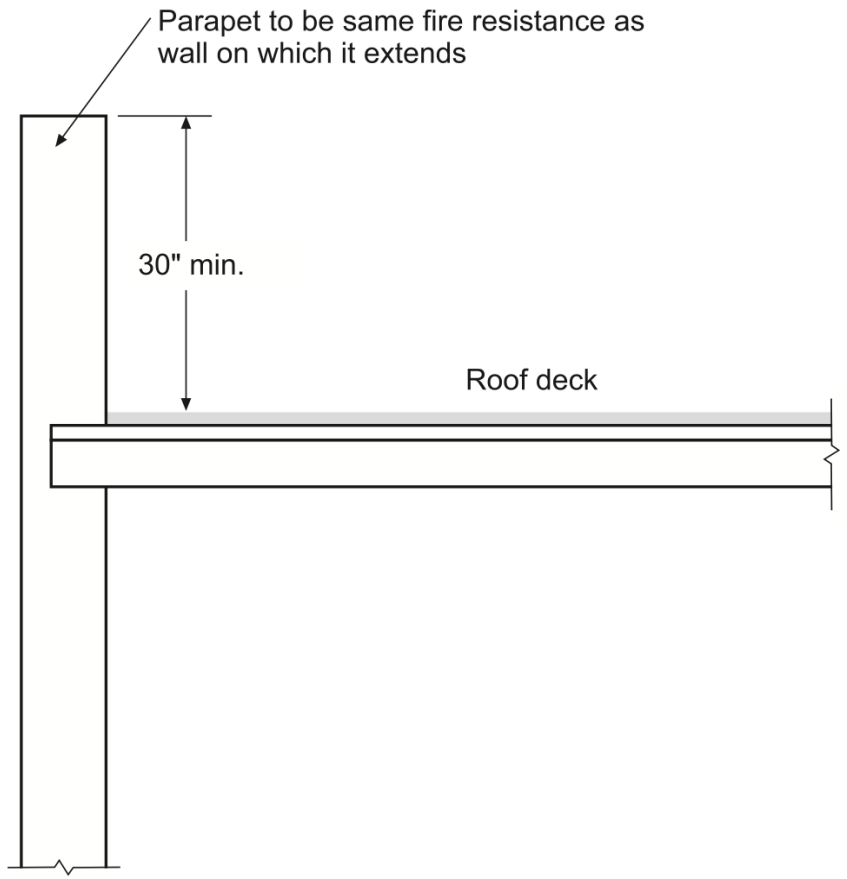
Source: 2021 IBC

705.11, 705.11.1 Parapets

- Parapets shall be provided on exterior walls of buildings. See the six exceptions for construction methods or locations that would eliminate the requirement for parapets. Parapets shall have the same fire-resistance rating as that required for the supporting wall, and on any side adjacent to a roof surface, shall have noncombustible faces for the uppermost 18 inches (457 mm), including counterflashing and coping materials. The height of the parapet shall not be less than 30 inches (762 mm) above the point where the roof surface and the wall intersect.
- A parapet wall is defined as the part of any wall entirely above the roof line. Its purpose is to prevent the spread of fire from the roof of the subject building to an adjacent building and to protect the roof of a building from exposure to a fire in an adjacent building.

Source: 2021 IBC

705.11, 705.11.1 Parapets

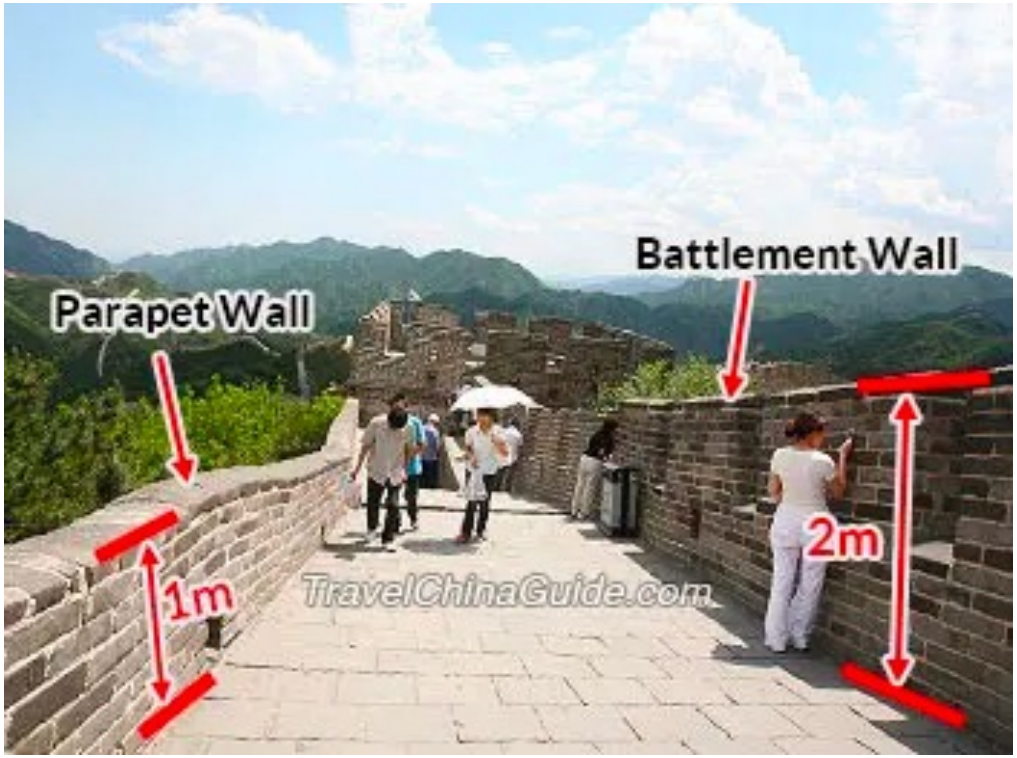


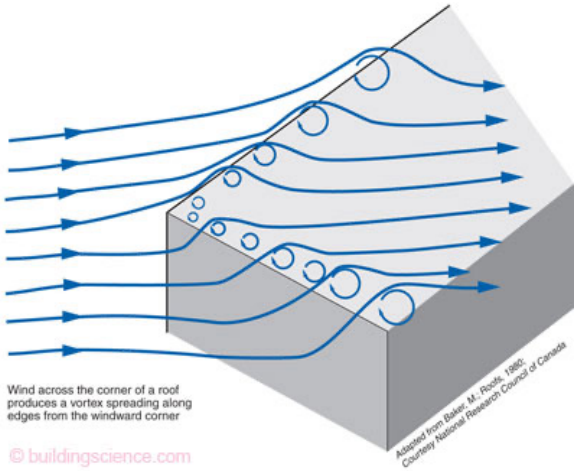
For SI: 1 inch = 25.4mm

As very few buildings actually provide exterior parapet walls for fire protection, it is evident that the exceptions are widely used. In many situations, a parapet is provided only to hide the roof slope or to screen rooftop equipment, in which case the requirements do not apply.

Source: 2021 IBC

705.11, 705.11.1 Parapets





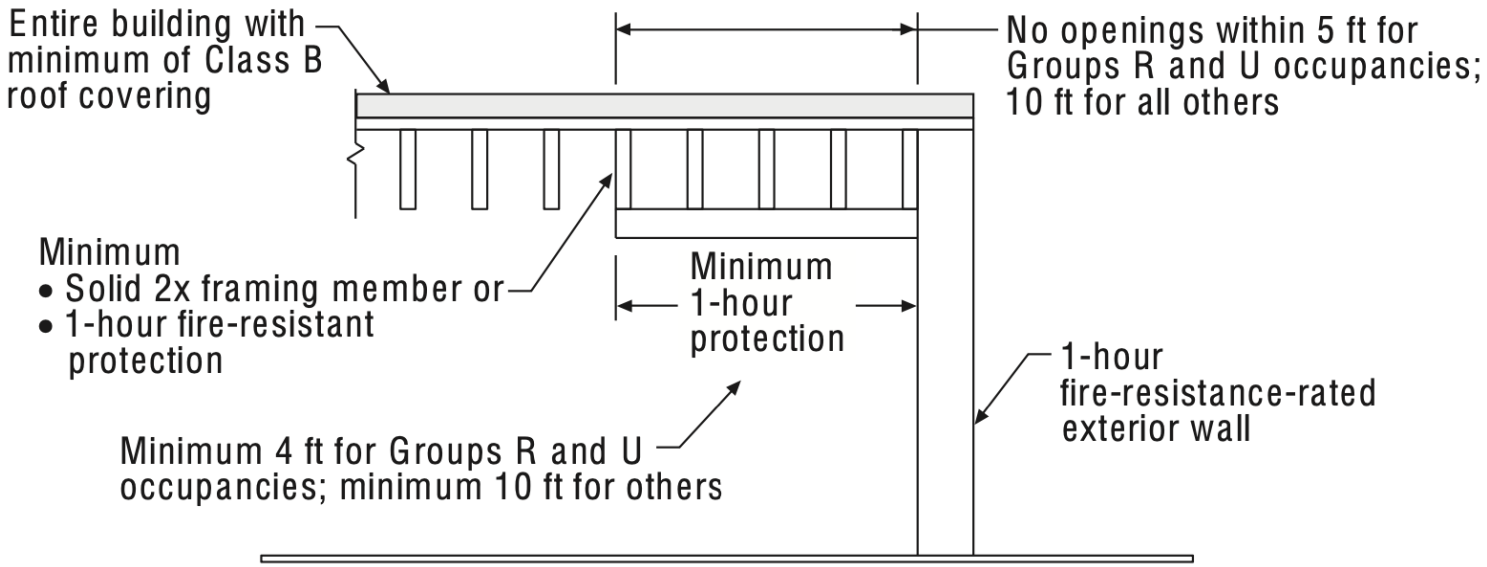
Source: 2021 IBC

705.11, Exception 4 Parapet Exceptions

- A parapet need not be provided on an exterior wall where 1-hour fire-resistance-rated exterior walls terminate at the underside of the roof sheathing, deck or slab, provided: four conditions are met.
- Limited to walls having a 1-hour fire-resistance rating, Exception 4 permits exterior walls to terminate at the underside of the roof sheathing as an alternative to the use of parapets. Protection of the roof construction is provided from the interior of the building rather than at the exterior side. In addition to the restrictions on roof covering materials and openings in the roof, roof framing elements are addressed where installed parallel or perpendicular to their supporting walls.

Source: 2021 IBC

705.11, Exception 4 Parapet Exceptions



Roof/ceiling framing parallel to wall

For SI: 1 foot = 304.8 mm.

Other parapet exceptions are applicable where (1) the wall is not required to be fire-resistance-rated by Table 602; (2) no story exceeds 1,000 square feet in floor area; (3) the wall terminates at a minimum 2-hour fire-resistance-rated roof; (4) the roof is constructed of noncombustible materials, including the deck and supporting construction; (5) the wall is permitted to have a minimum of 25 percent unprotected openings per Section 705.8; or (6) in Groups R-2 and R-3, a number of special conditions are met.

Source: 2021 IBC