Key Wood Design Topics: Concealed Spaces and Mixed-Use Building Analysis

August 19 & 26, 2025

Presented by

Mike Romanowski, SE
Senior Regional Director | CA-South, AZ, NM

Image: Long Beach Civic Center – Billie Jean King Main Library / Skidmore Owings & Merrill / Photo Benny Chan

Concealed Spaces in Wood Construction

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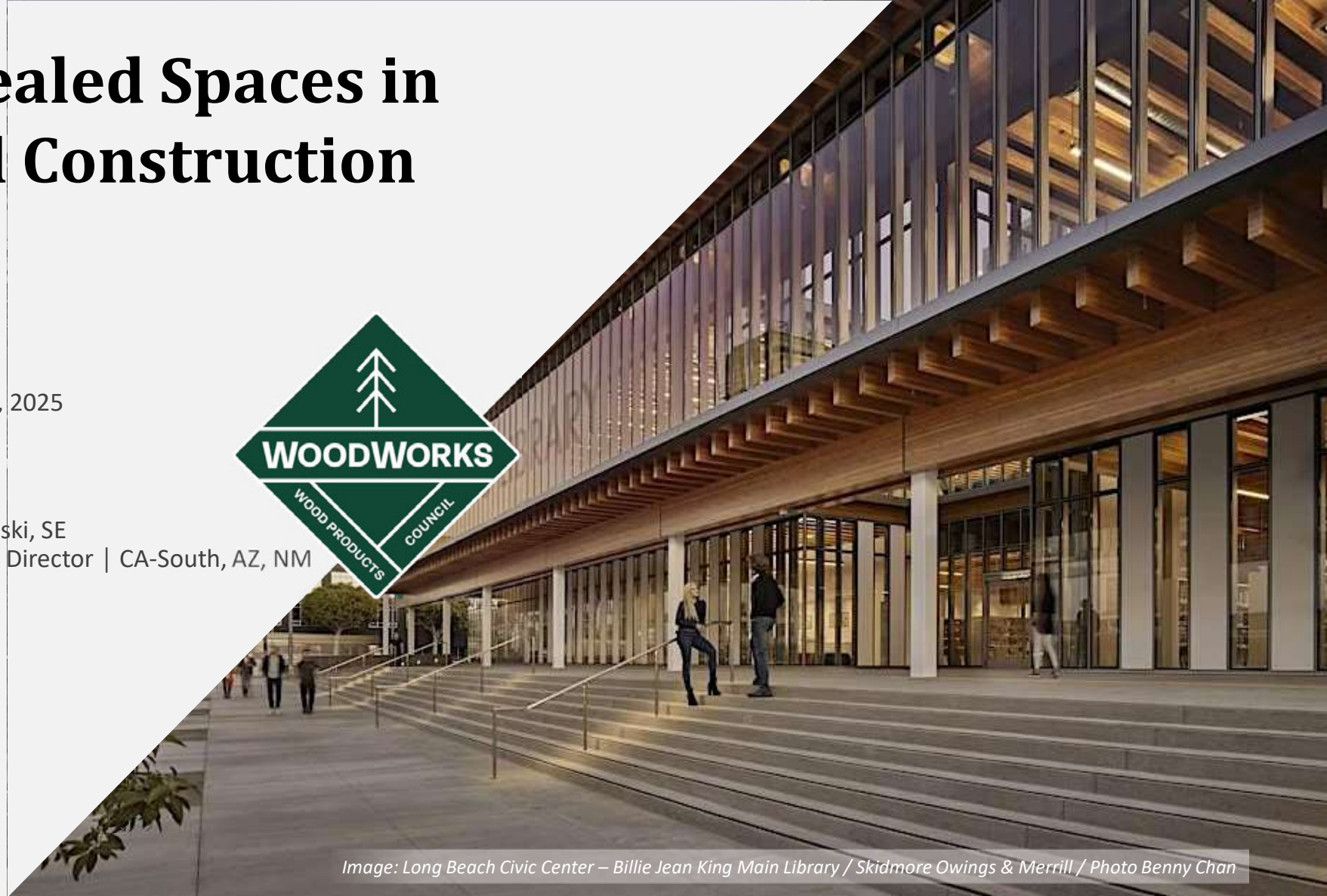

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Course Description

Concealed spaces—e.g., dropped ceilings or soffits—are common in light-frame wood and heavy/mass timber buildings. However, equally common are misunderstandings as to what requirements exist for their fire protection. Do all concealed spaces with combustible materials require sprinkler protection, fireblocking, compartmentalization, or other means of protection? What are the impacts of construction type and building occupancy? How are concealed spaces with heavy/mass timber elements treated differently than cavities in light-frame wood construction? Adding to the perplexity is the fact that some requirements come from the 2022 California Building Code (CBC), while others come from the 2019 NFPA 13 Standard for the Installation of Sprinkler Systems. This presentation will address these questions and provide practical solutions and details for the protection of concealed spaces in multi-family and commercial wood buildings.

Learning Objectives

1. Discuss code requirements for the use of sprinklers in multi-family and commercial buildings, highlighting the fact that sprinkler requirements are independent of structural materials used.

2. Review common methods of protecting combustible framing materials within concealed spaces created by dropped ceilings and soffits.

3. Highlight the 2022 CBC and 2019 NFPA 13 requirements for the protection of light-frame wood and heavy/mass timber elements in concealed spaces.

4. Explore the need for and application of fireblocking and draftstopping in concealed spaces and at the intersection of vertical and horizontal assemblies.

Outline

- Code Requirements for Concealed Spaces
- Light-Frame Wood: Concealed Spaces, Sprinkler Protection and Assembly Impacts
- Heavy/Mass Timber: Concealed Spaces, Dropped Ceilings, Soffits and Raised Access Floor (RAF) systems

Landing Apartments, Russell Scott Steedle & Capione Architects, photo Gregory Folkins

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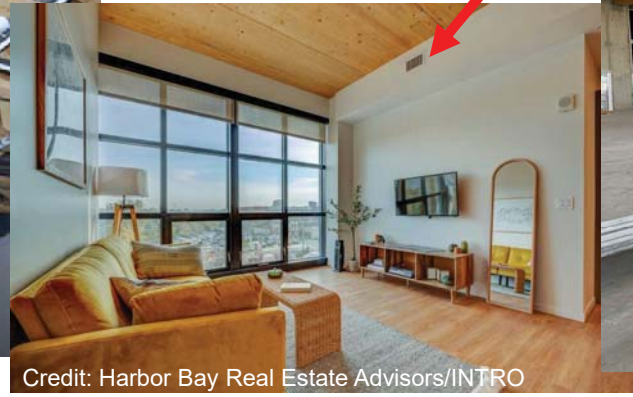
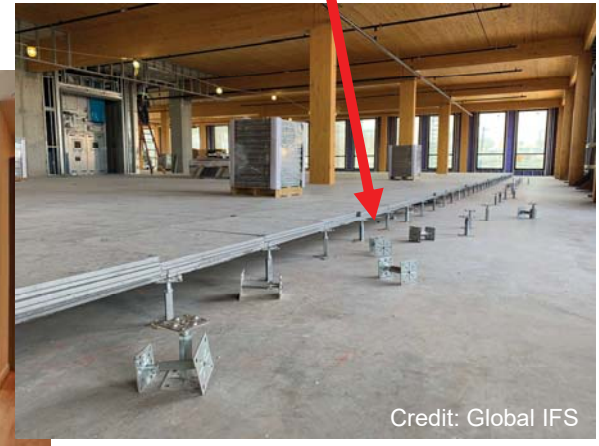
Landing Apartments, Russell Scott Steedle & Capione Architects, photo Gregory Folkins

Concealed Spaces

- Currently, the CBC does not define Concealed Spaces (*even though Section 718 is titled Concealed Spaces*)
- Generally considered to be small, uninhabitable areas of a building created by assemblies or portions of assemblies
- Common examples: dropped ceilings, soffits, plenums, raised access floors



Credit: Harbor Bay Real Estate Advisors/INTRO



Credit: Global IFS

Concealed Spaces

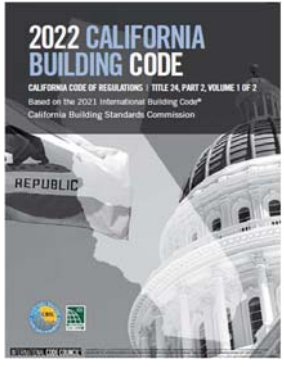
- The main item covered today is how to address the presence of combustible materials within concealed spaces
- The CBC only addresses whether combustible concealed spaces are or are not permitted in Type IV construction
- In all other construction types, concealed spaces are permitted

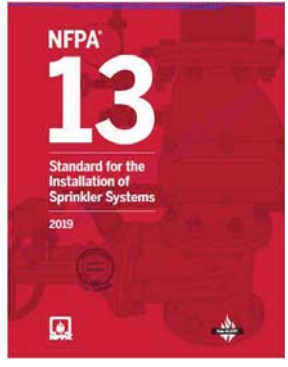
602.4 Type IV.

Combustible concealed spaces are not permitted except as otherwise indicated in Sections 602.4.1 through 602.4.4. Combustible stud spaces within light frame walls of Type IV-HT construction shall not be considered concealed spaces, but shall comply with Section 718.

Concealed Spaces

- When combustible materials are present in a concealed space, the CBC provides fireblocking and draftstopping requirements
- The CBC notes when a building is required to have an automatic sprinkler system
- The NFPA 13 Standard (not the CBC) dictates the requirements for protection of combustible concealed spaces
- Some of the CBC requirements for fireblocking and draftstopping are exempted when the building is equipped throughout with an automatic sprinkler system

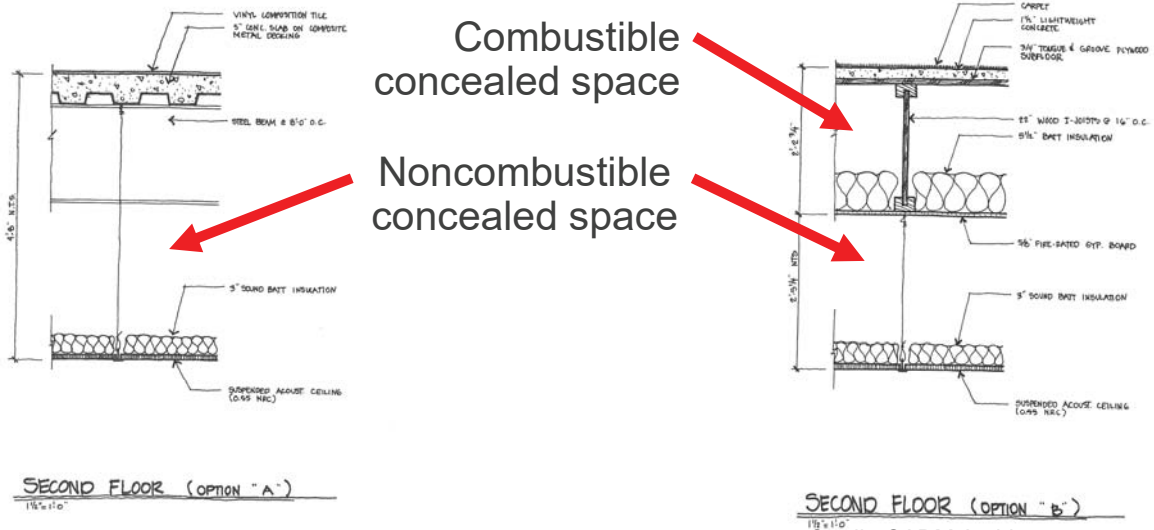




Concealed Spaces: Fireblocking & Draftstopping

From the IBC Commentary to Section 718.1:

The key words in this section are "combustible concealed spaces." This section does not apply to noncombustible construction.



Credit: CADM Architecture

Concealed Spaces: Fireblocking & Draftstopping

CBC Sections 718.2, 718.3 & 718.4:

- Fireblocking: prevents movement of flame and hot gases through small concealed spaces (e.g. wall stud cavities)
- Draftstopping: prevents movement of flame and hot gases through large concealed spaces (e.g. floor cavities or attics)

Concealed Spaces: Fireblocking

CBC Section 718.2.1: What can act as fireblocking?

718.2.1 Fireblocking materials. *Fireblocking* shall consist of the following materials:

1. Two-inch (51 mm) nominal lumber.
2. Two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints.
3. One thickness of 0.719-inch (18.3 mm) *wood structural panels* with joints backed by 0.719-inch (18.3 mm) *wood structural panels.*
4. One thickness of 0.75-inch (19.1 mm) *particleboard* with joints backed by 0.75-inch (19 mm) *particleboard.*
5. One-half-inch (12.7 mm) *gypsum board.*
6. One-fourth-inch (6.4 mm) cement-based millboard.
7. Batts or blankets of *mineral wool*, *mineral fiber* or other *approved* materials installed in such a manner as to be securely retained in place.
8. Cellulose insulation tested in the form and manner intended for use to demonstrate its ability to remain in place and to retard the spread of fire and hot gases.
9. *Mass timber* complying with Section 2304.11.

Concealed Spaces: Fireblocking

CBC Section 718.2.2: Where is fireblocking required?

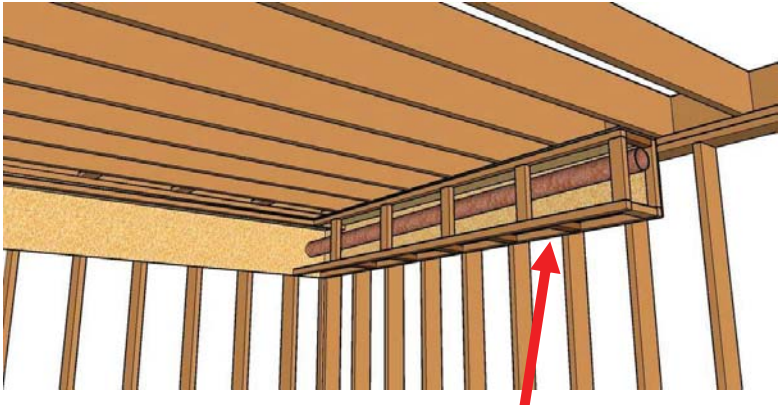
In concealed spaces of stud walls and partitions, including furred spaces, and parallel rows of studs or staggered studs, as follows:

- Vertically at the ceiling and floor levels
- Horizontally at 10 feet max

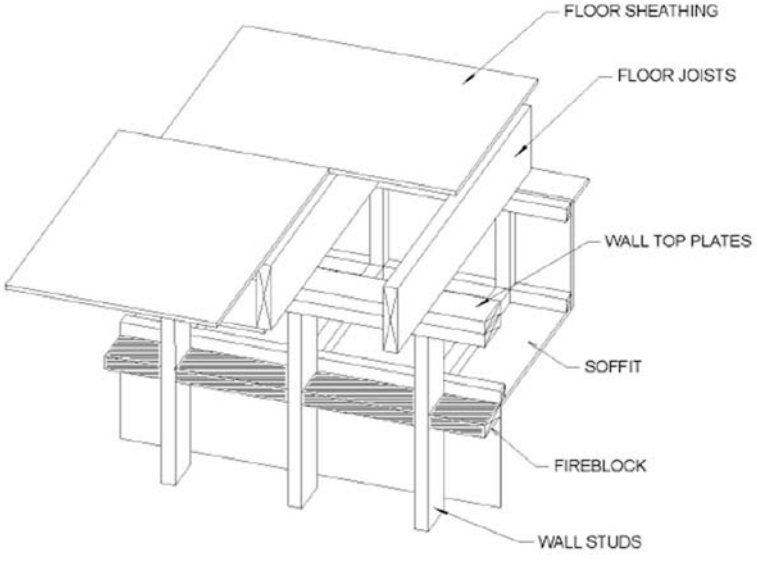
Concealed Spaces: Fireblocking

CBC Section 718.2.3: Where is fireblocking required?

- Between concealed vertical and horizontal spaces such as soffits & drop ceilings



Fireblocking required here

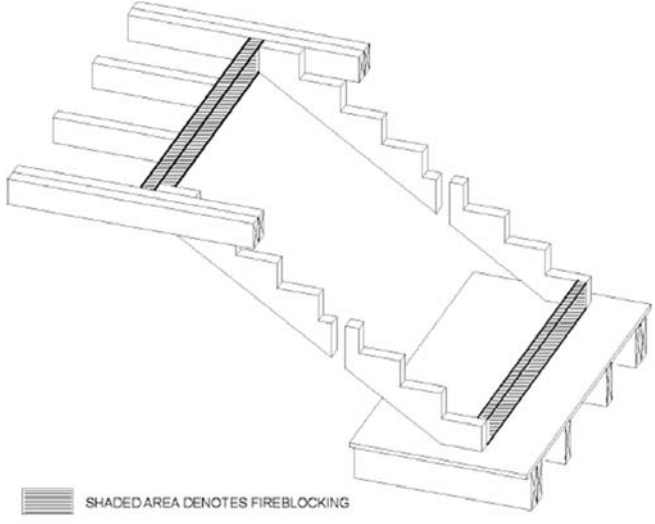


Commentary Figure 718.2.3(1)
FIREBLOCKING—SOFFIT

Concealed Spaces: Fireblocking

CBC Section 718.2.4: Where is fireblocking required?

- In concealed spaces between stair stringers at the top and bottom of the run

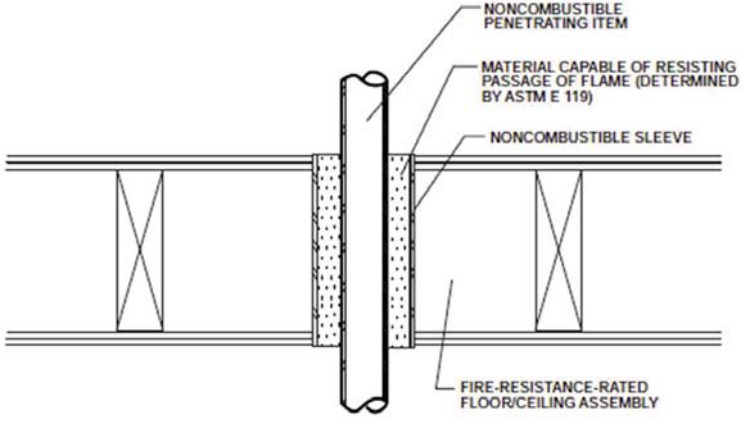


Commentary Figure 718.2.4
FIREBLOCKING—STAIRS

Concealed Spaces: Fireblocking

CBC Section 718.2.5: Where is fireblocking required?

- At the annular space around vents, pipes, ducts, chimneys and fireplaces at ceilings and floor levels



Concealed Spaces: Fireblocking

CBC Section 718.2.6: Where is fireblocking required?

- In concealed spaces of exterior wall coverings (e.g. rainscreen systems)
- Installed at maximum intervals of 20 feet in either dimension so that there will be no concealed space exceeding 100 square feet between fireblocking
- Some exceptions apply

Concealed Spaces: Fireblocking

CBC Section 718.2.7: Where is fireblocking required?

- When wood sleepers are used for laying wood flooring on masonry or concrete fire resistance-rated floors
- Space between the floor slab and underside of wood flooring shall be fireblocked in areas not to exceed 100 sf
- Filled solidly under permanent partitions

Concealed Spaces: Draftstopping

CBC Section 718.3.1: What can act as draftstopping?

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

Concealed Spaces: Draftstopping

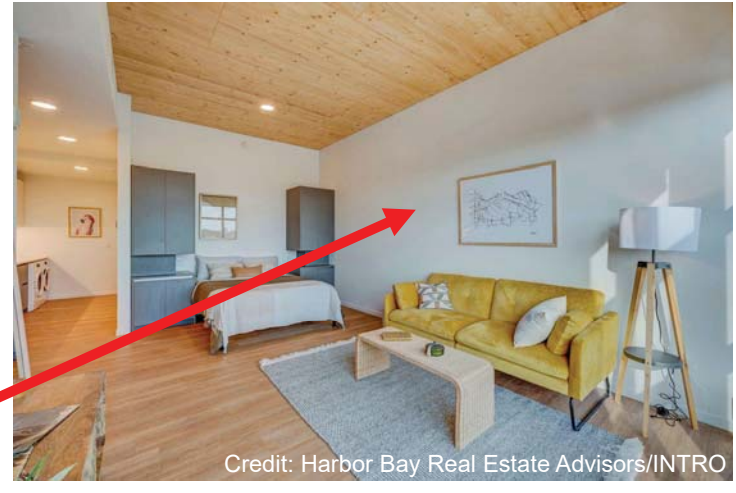
CBC Sections 718.3, 718.4 & 708.4.2: Where is draftstopping required?

- Where horizontal assemblies intersect fire partitions

- Recall common types of fire partitions:

  - Separation walls as required by Section 420.2 for Group R occupancies
  - Corridor walls as required by Section 1020.3
  - Other applications as noted in Section 708.1

Fire partition separating Group R occupancies



Credit: Harbor Bay Real Estate Advisors/INTRO

Concealed Spaces: Draftstopping

CBC Sections 718.3, 718.4 & 708.4.2: Where is draftstopping required?

- When fire partitions extend to the underside of the floor/roof sheathing above, no fireblocking or draftstopping is required

Fire partition extends to the underside of the floor/roof sheathing above

Concealed Spaces: Draftstopping

CBC Sections 718.3, 718.4 & 708.4.2: Where is draftstopping required?

- When fire partitions do not extend to the underside of the floor/roof sheathing above, ***fireblocking or draftstopping*** is required:
- In the space above and along the line of the fire partition up to the underside of the floor/roof sheathing above

Fire partition does not extend to the underside of the floor/roof sheathing above

Concealed Spaces: Draftstopping

CBC Sections 718.3, 718.4 & 708.4.2: Where is draftstopping required?

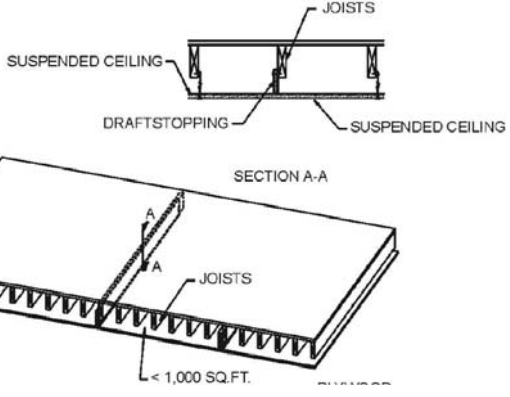
- **Exception:**
- Buildings equipped with an NFPA 13 or 13R sprinkler system with sprinkler protection provided in the space between the top of the fire partition and underside of the floor/roof sheathing do not require fireblocking or draftstopping in this location

Fire partition does not extend to the underside of the floor/roof sheathing above

Concealed Spaces: Draftstopping

CBC Section 718.3: Where is draftstopping required?

- **Floor assemblies in other than Group R occupancy buildings:**
- Draftstopping is required to subdivide combustible floor/ceiling assemblies so that horizontal floor areas do not exceed 1,000 square feet
- Buildings equipped throughout with an NFPA 13 sprinkler system are exempt from this requirement

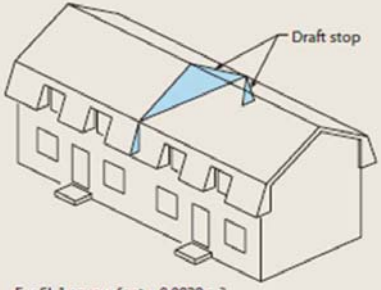


Green Office Building
Wong Logan Architects | Photo: Billy Hustace

Concealed Spaces: Draftstopping

CBC Section 718.5: Where is draftstopping required?

- **Roof assemblies (attics) in other than Group R occupancy buildings:**
- Draftstopping is required to subdivide combustible attic spaces and combustible concealed roof spaces so that horizontal areas do not exceed 3,000 square feet
- Building equipped throughout with an NFPA 13 sprinkler system are exempt from this requirement



	Maximum area
Building not protected with automatic sprinklers	3,000 square feet
Building protected with automatic sprinklers	Not required

For SI: 1 square foot = 0.0929 m².

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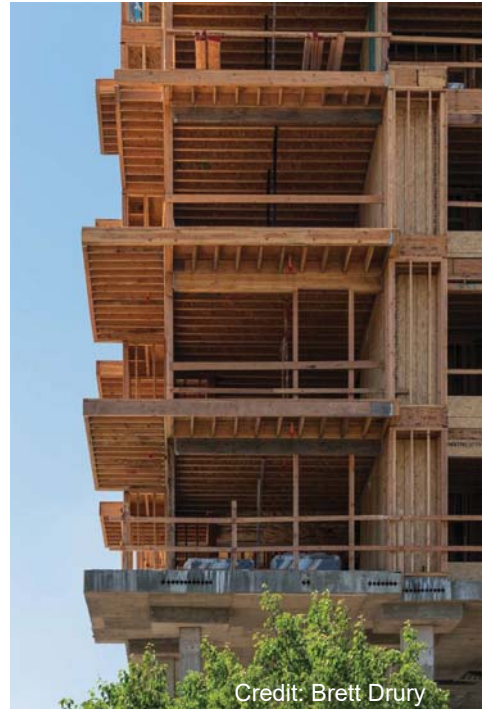
Landing Apartments, Russell Scott Steedle & Capione Architects, photo Gregory Folkins

Construction Types Utilizing Light-Frame Wood

Type III
Exterior walls must be noncombustible (may be FRTW). Interior elements any allowed by code, including light-frame wood and heavy/mass timber

Type V
All building elements are any allowed by code, including light-frame wood and heavy/mass timber

Types III and V are subdivided into A (protected) and B (unprotected)


Credit: Brett Drury

Concealed Spaces: Sprinkler Protection

When does a building require an automatic sprinkler system?

- **CBC Chapter 9 notes sprinkler requirements as a function of occupancy, occupant load, etc.**
- A sprinkler system is required in all new Group R fire areas

Concealed Spaces: Sprinkler Protection

Key differences between NFPA 13 & 13R sprinkler systems

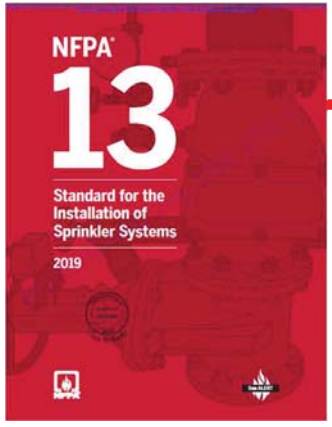
- **In multi-family buildings up to certain heights, either NFPA 13 or 13R systems are valid options in the CBC**

- Allowable building size is smaller with NFPA 13R systems:
- Generally limited to max of 4 stories and 60 ft
- NFPA 13R systems are only allowed when:
  - The floor level of the highest story is 30 feet or less above the lowest level of fire department vehicle access, and
  - The floor level of the lowest story is 30 feet or less below the lowest level of fire department vehicle access

Concealed Spaces: Sprinkler Protection

Key differences between NFPA 13 & 13R sprinkler systems:

- NFPA 13: Standard for Commercial Construction
- NFPA 13R: Residential Occupancies (One and Two-Family or Low-Rise Multi-Family and Commercial)
- NFPA 13D: Standard for One and Two-Family Residences (but allowed in a few commercial occupancies)



Concealed Spaces: Sprinkler Protection

Key differences between NFPA 13 & 13R sprinkler systems:

NFPA 13	NFPA 13R
Goal: Provide life safety and property protection	Goal: Provide life safety only
Fully sprinklered system, throughout entire building even in concealed spaces (closets, attics)	Partially sprinklered system, concealed spaces often don't require sprinklers
Can cost more	Lower levels of water discharge, shorter water supply time can result in smaller pipe sizes, reduce need for storage & pumps
Permitted for many occupancies, buildings of many sizes, allows greater building size increases	Limited applications, mainly for multi-family up to 4 stories, 60 feet

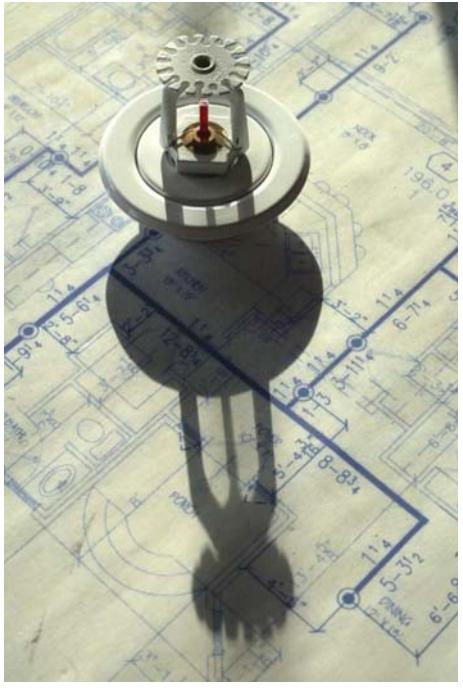
Concealed Spaces: NFPA 13 Sprinkler Systems

When does the NFPA 13 Standard require sprinkler protection of concealed spaces?

Concealed Spaces: NFPA 13 Sprinkler Systems

When does the NFPA 13 Standard require sprinkler protection of concealed spaces?

- Combustible concealed spaces such as floor/ceiling and roof/ceiling assemblies may require sprinkler protection
- NFPA 13 Section 9.2.1 requires combustible concealed spaces to have sprinkler protection unless one of the alternate options are used



Concealed Spaces: NFPA 13 Sprinkler Systems

NFPA 13 system options for omitting sprinklers in concealed spaces:

- When the concealed space is formed by wood joists or similar solid members and the ceiling is directly attached to or within 6” of the framing (NFPA 13 Section 9.2.1.5)

Concealed Spaces: NFPA 13 Sprinkler Systems

NFPA 13 system options for omitting sprinklers in concealed spaces:

- When the concealed space is formed by composite wood joists and the ceiling is attached either directly or to metal channels 1” or less in depth
- Requires that joist cavities are separated into volumes not exceeding 160 ft^3 with materials equivalent to the web construction
- Also requires min 3½” batt insulation at bottom of joist cavities when ceiling is attached to metal channels (NFPA 13 Section 9.2.1.6)

Concealed Spaces: NFPA 13 Sprinkler Systems

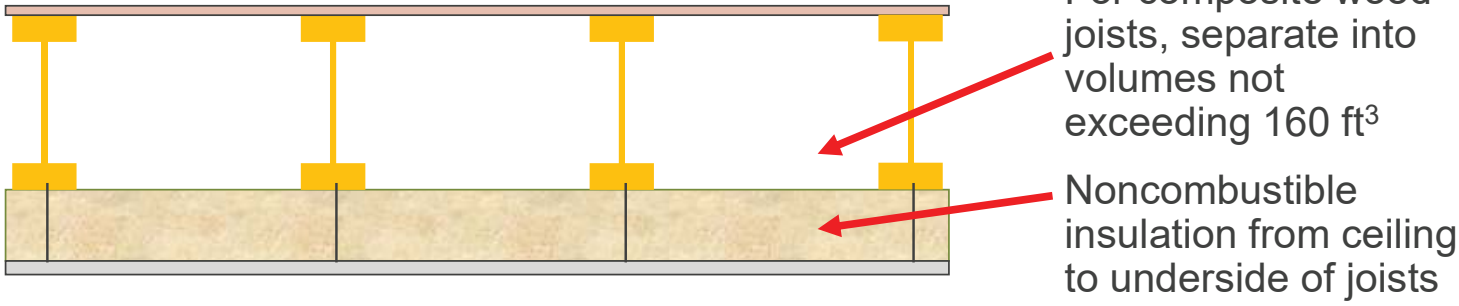
NFPA 13 system options for omitting sprinklers in concealed spaces:

- When the concealed space is formed by any type of combustible framing and is filled with noncombustible insulation to within 2” of the top (NFPA 13 Section 9.2.1.7)

Concealed Spaces: NFPA 13 Sprinkler Systems

NFPA 13 system options for omitting sprinklers in concealed spaces:

- When the concealed space is formed by wood joists (NFPA 13 Section 9.2.1.8) or composite wood joists (NFPA 13 Section 9.2.1.9) with noncombustible insulation filling the space from the ceiling up to the underside of the joists
- Requires that composite joist cavities are separated into volumes not exceeding 160 ft^3 with materials equivalent to the web construction



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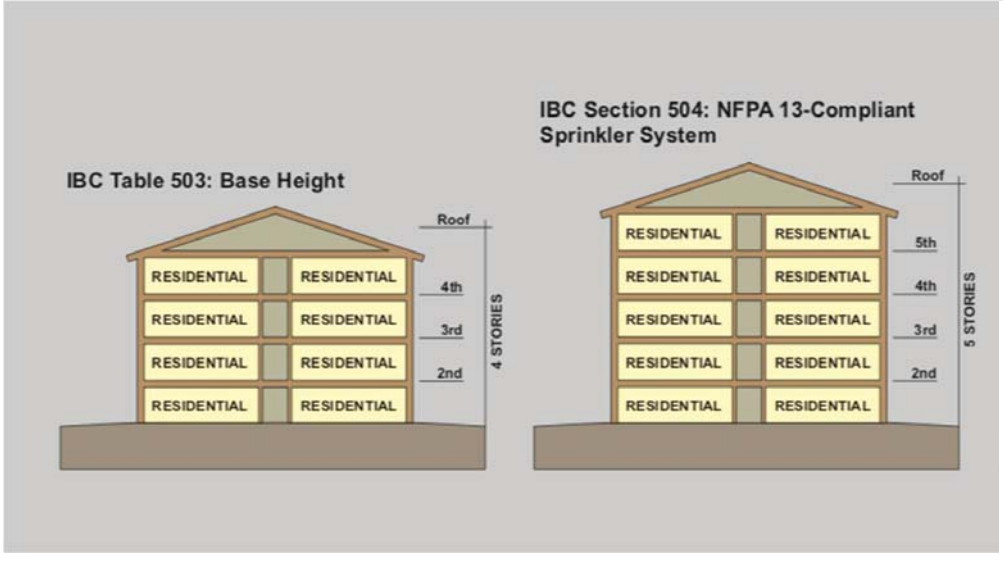
Landing Apartments, Russell Scott Steedle & Capione Architects, photo Gregory Folkins

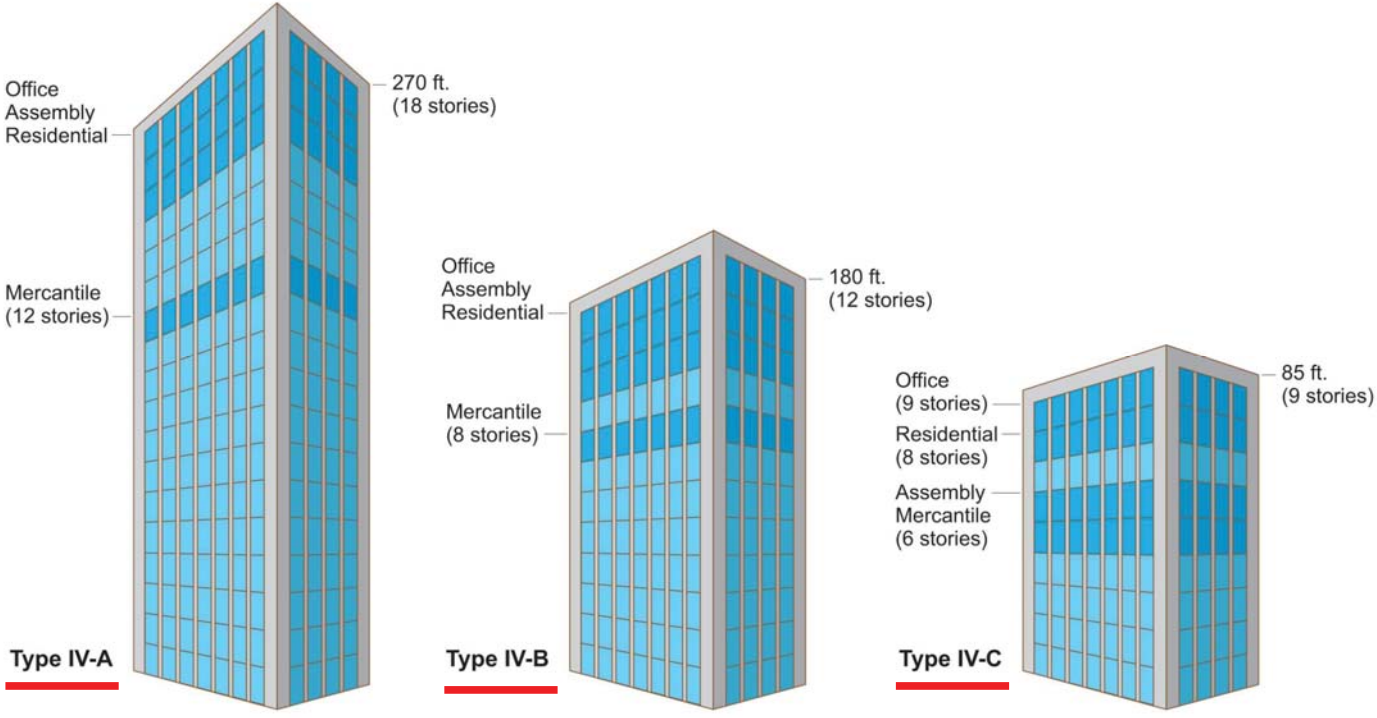
Construction Types Utilizing Heavy/Mass Timber



Type V
4 Stories

Type III & IV-HT
5 Stories

Construction Types Utilizing Heavy/Mass Timber



Glue Laminated Timber (Glulam)
Beams & columns

Cross-Laminated Timber (CLT)
Solid sawn laminations

Cross-Laminated Timber (CLT)
SCL laminations

Photo: Freres Lumber

Photo: StructureCraft

Photo: LendLease

Photo: LEVER Architecture

Dowel-Laminated Timber (DLT)

Photo: StructureCraft

Nail-Laminated Timber (NLT)

Photo: Think Wood

Glue-Laminated Timber (GLT)

Plank orientation

Photo: StructureCraft

Photo: StructureCraft

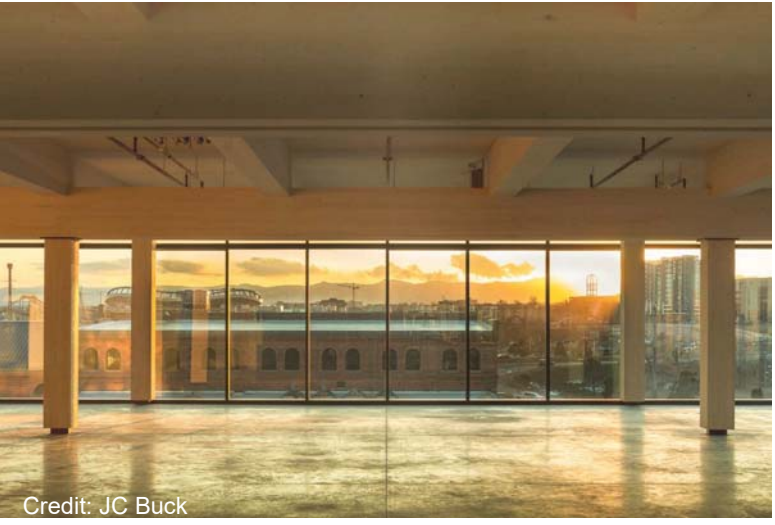
Photo: Ema Peter

Photo: Manasc Isaac Architects/Fast + Epp

Concealed Spaces in Heavy/Mass Timber

MEP Integration Option 1:

- In chases above beams and below MT panels
- Does not create a concealed space


Credit: JC Buck


Credit: KL&A Engineers & Builders

Concealed Spaces in Heavy/Mass Timber

MEP Integration Option 2:

- In gaps between MT panels
- Does create a concealed space if covered

Concealed Spaces in Heavy/Mass Timber

MEP Integration Option 3:

- In raised access floor systems
- Does create a concealed space

Credit: Global IFS

Concealed Spaces in Heavy/Mass Timber

MEP Integration Option 4:

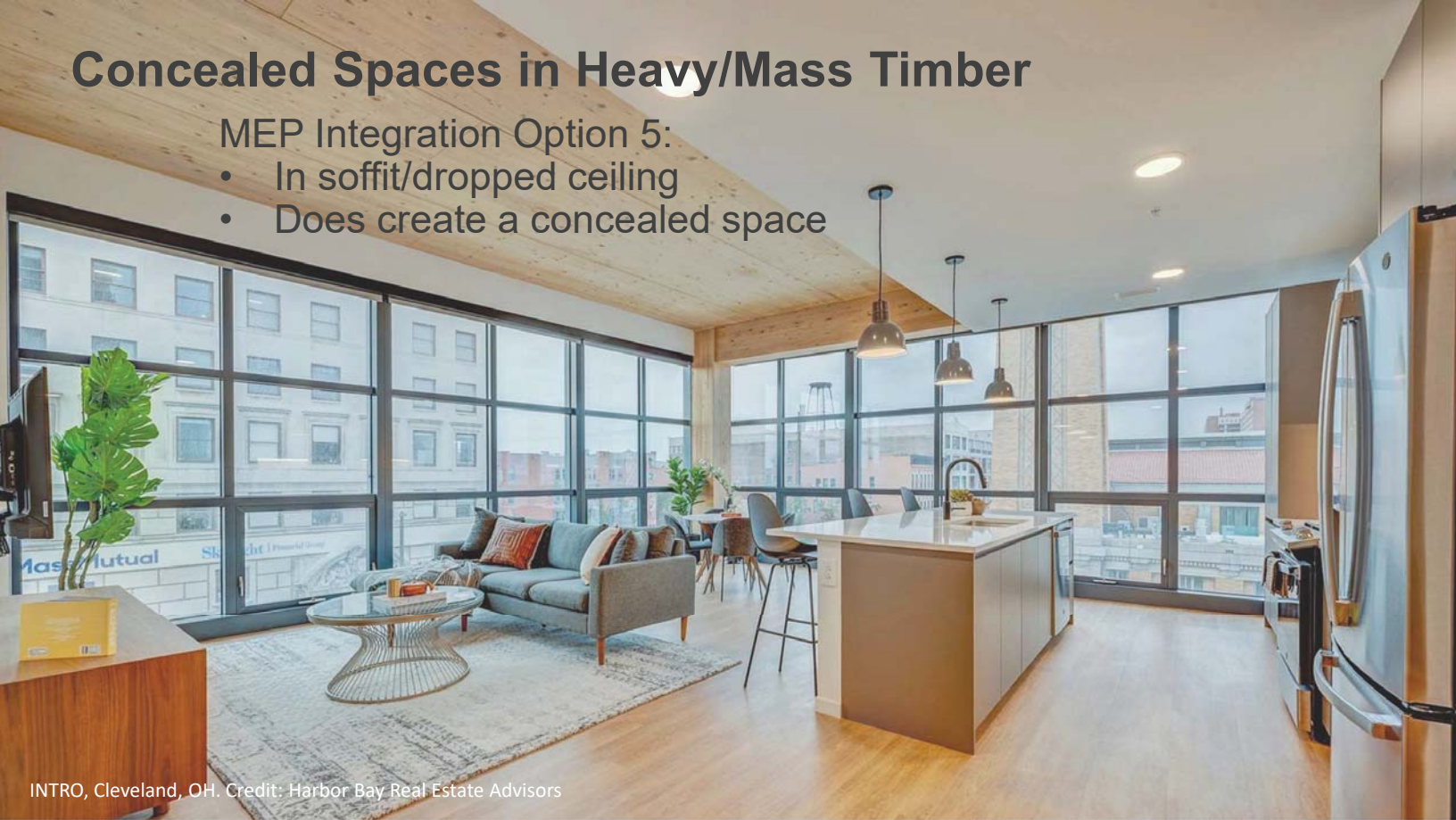
- In topping slab
- Does not create a concealed space

Credit: Alex Schreyer

Concealed Spaces in Heavy/Mass Timber

MEP Integration Option 5:

- In soffit/dropped ceiling
- Does create a concealed space



INTRO, Cleveland, OH. Credit: Harbor Bay Real Estate Advisors

Concealed Spaces in Heavy/Mass Timber

- Construction Types III and V do not have a prescriptive prohibition of concealed spaces
- CBC Section 718 (fireblocking & draftstopping) applies

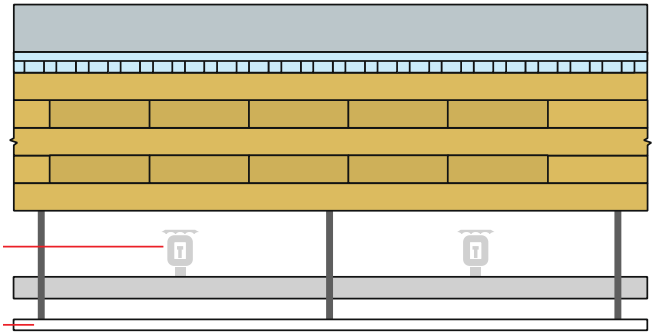
Concealed Spaces in Heavy/Mass Timber

- So how do CBC Section 718 & NFPA 13 requirements for protection of concealed spaces apply when heavy/mass timber is used in Type III & V buildings?
- The same concepts for protection apply as for light-frame wood concealed spaces, though note specific reference to joist construction in the NFPA 13 Standard

Concealed Spaces in Heavy/Mass Timber

Possible solutions for concealed space protection in Type III & V buildings:

- NFPA 13 sprinklers in concealed spaces
- Compartmentalize concealed spaces to volumes NTE 160 ft^3
- Fill concealed spaces with noncombustible insulation
- Cover all heavy/mass timber with noncombustible materials within concealed spaces



Credit: Global IFS

Concealed Spaces in Heavy/Mass Timber

The 2022 CBC now includes 4 subcategories of Type IV construction:

- The original Type IV was renamed Type IV-HT (now allows concealed spaces)
- The new Types IV-A, IV-B & IV-C were introduced (also allow concealed spaces, but different protection requirements than IV-HT)

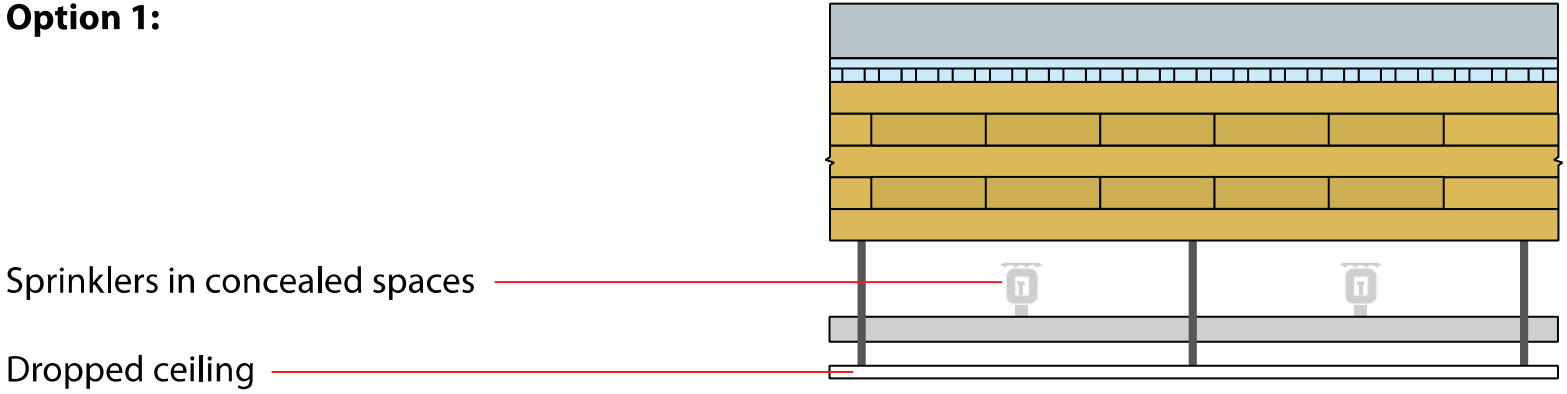
CBC TABLE 601

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B

Concealed Spaces in Heavy/Mass Timber

CONCEALED SPACES: TYPE IV-HT

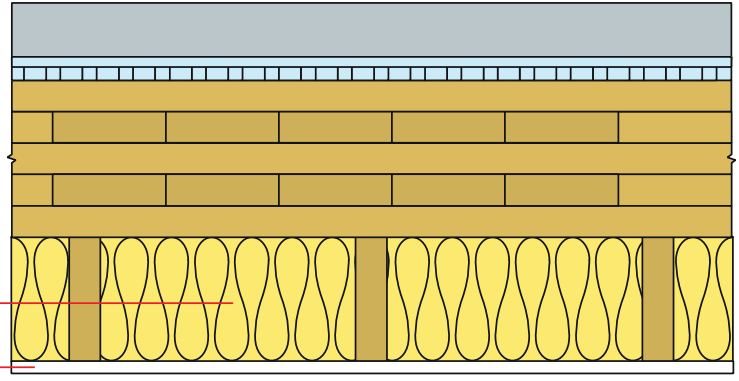
Option 1:



Concealed Spaces in Heavy/Mass Timber

CONCEALED SPACES: TYPE IV-HT

Option 2:



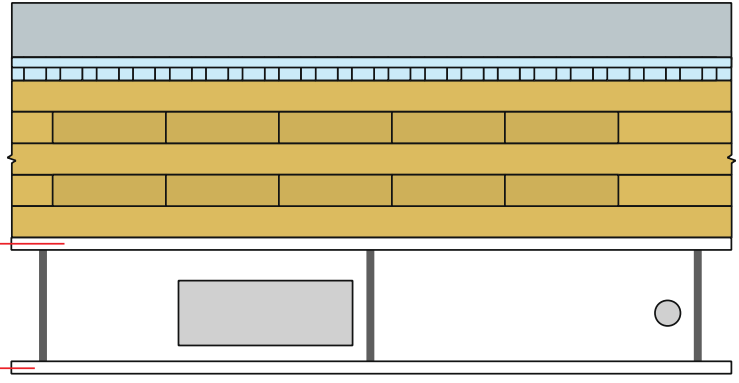
Concealed Spaces in Heavy/Mass Timber

CONCEALED SPACES: TYPE IV-HT

Option 3:

5/8" Type X gypsum on all mass timber surfaces within concealed space

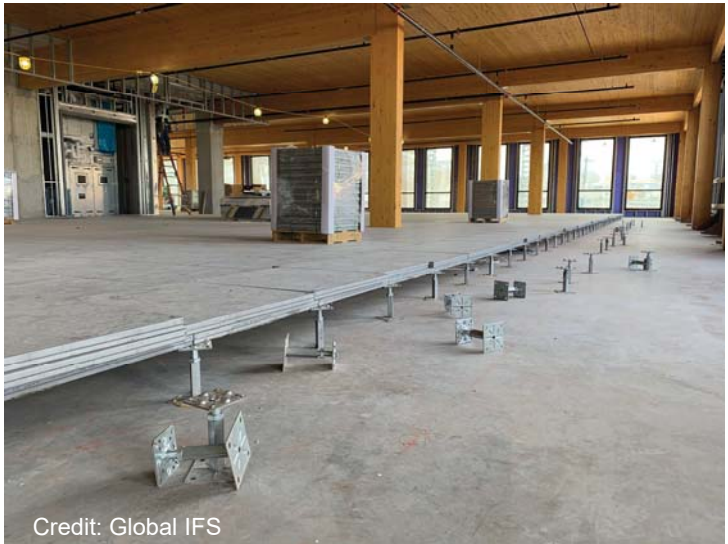
Dropped ceiling



Concealed Spaces in Heavy/Mass Timber

RAF Systems in Construction Type IV-HT:

Possible design route would be to cover the MT deck with a (noncombustible) cementitious topping slab and wrap the glulam columns with ⅝” Type X GWB



Credit: Global IFS

Concealed Spaces in Mass Timber

In Construction Types IV-A and IV-B:

CBC Sections 602.4.1.5 & 602.4.2.5:
Combustible construction forming concealed spaces shall be protected in accordance with Section 602.4.1.2

Required Noncombustible Contribution to FRR

FRR of Building Element (hours)	Minimum from Noncombustible Protection (minutes)
1	40
2	80
3 or more	120

CBC Table 722.7.1(1)

Prescriptive Noncombustible Contributions to FRR

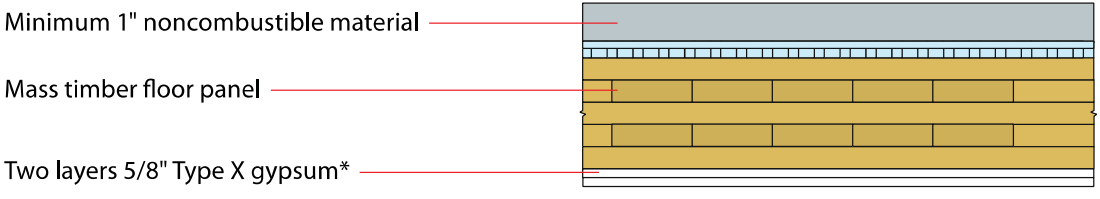
Type of Protection	Contribution per Layer (minutes)
1/2" Type X gypsum board	25
5/8" Type X gypsum board	40

CBC Table 722.7.1(2)

Concealed Spaces in Mass Timber

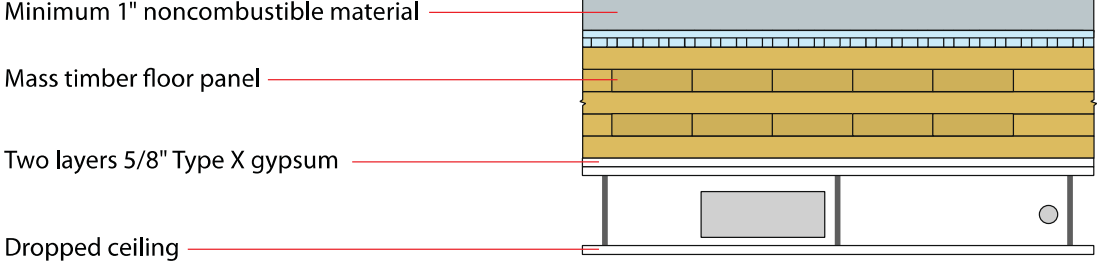
In Construction Types IV-A and IV-B:

Without Dropped Ceiling



**Applicable to most locations; limited exposed mass timber permitted in IV-B*

With Dropped Ceiling



Concealed Spaces in Mass Timber

In Construction Type IV-C:

CBC Section 602.4.3.5:
Combustible construction forming concealed spaces shall be protected with noncombustible protection with a minimum assigned time of 40 minutes, as specified in CBC Table 722.7.1(2)

Prescriptive Noncombustible Contributions to FRR

Type of Protection	Contribution per Layer (minutes)
1/2" Type X gypsum board	25
5/8" Type X gypsum board	40

CBC Table 722.7.1(2)

Concealed Spaces in Mass Timber

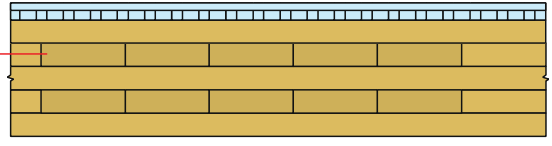
In Construction Type IV-C:

Without Dropped Ceiling

Noncombustible material not required

Mass timber floor panel

Noncombustible material not required



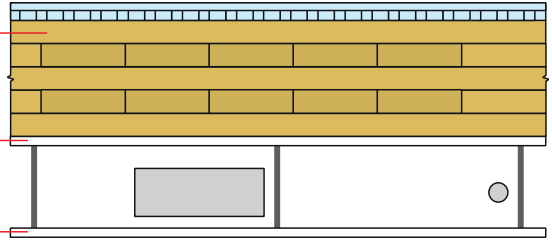
With Dropped Ceiling

Noncombustible material not required

Mass timber floor panel

One layer 5/8" Type X gypsum covering all mass timber surfaces within concealed space

Dropped ceiling



Concealed Spaces in Mass Timber

RAF Systems in Construction Types IV-A, IV-B and IV-C:

Prescriptive option within the CBC of 80 minutes or 40 minutes of protection time could be met with a cementitious topping slab or other noncombustible board products

Credit: Global IFS

Richard McLain, PE, SE
Senior Technical Director – Tall Wood
WoodWorks – Wood Products Council

Updated May 2022

Concealed Spaces in Mass Timber and Heavy Timber Structures

Concealed spaces, such as those created by a dropped ceiling in a floor/ceiling assembly or by a stud wall assembly, have unique requirements in the International Building Code (IBC) to address the potential of fire spread in non-visible areas of a building. Section 718 of the 2018 IBC includes prescriptive requirements for protection and/or compartmentalization of concealed spaces through the use of draft stopping, fire blocking, sprinklers and other means. For information on these requirements, see the WoodWorks expert tip, *Sprinkler Requirements for Concealed Spaces in Light-Frame Projects.*[1]

For mass timber building elements, the choice of construction type can have a significant impact on concealed space requirements. Because mass timber products such as cross-laminated timber (CLT) are prescriptively recognized for Type IV construction, there is a common misperception that exposed mass timber building elements cannot be used or exposed in other construction types. This is not the case. Structural mass timber elements—including CLT, glue-laminated timber (glulam), nail-laminated timber (NLT), structural composite lumber (SCL), and tongue-and-groove (T&G) decking—can also be utilized and exposed in the following construction types, whether or not a fire-resistance rating (FRR) is required:

- **Type III –** Floors, roofs and interior walls may be any material permitted by code, including mass timber. Exterior walls are required to be noncombustible; however, framing and sheathing are permitted to be fire retardant-treated wood.
- **Type V –** Floors, roofs, interior walls and exterior walls where the required FRR does not exceed one hour; exterior columns and arches when 20 feet or more of horizontal

Allowances and Requirements for Concealed Spaces

Low-Rise and Mid-Rise Structures

For low-rise and mid-rise buildings, mass timber is typically used in Type III, IV or V construction. Up to and including the 2018 IBC, Type IV buildings were not allowed to have concealed spaces:

2018 IBC Section 602.4 Type IV. *Type IV 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 wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces...*

Although several Type IV buildings have received alternate methods approval for concealed spaces, the lack of prescriptive opportunity has steered some designers toward the use of Type III or V construction for their mass timber projects. Neither has a prescriptive limit on the use of concealed spaces; however, Type III and V buildings must still comply with the protection

Concealed Space Protection in Heavy/Mass Timber

Taking the Guesswork out of Mixed-Use Building Analysis

August 19 & 26, 2025

Presented by

Mike Romanowski, SE
Senior Regional Director | CA-South, AZ, NM

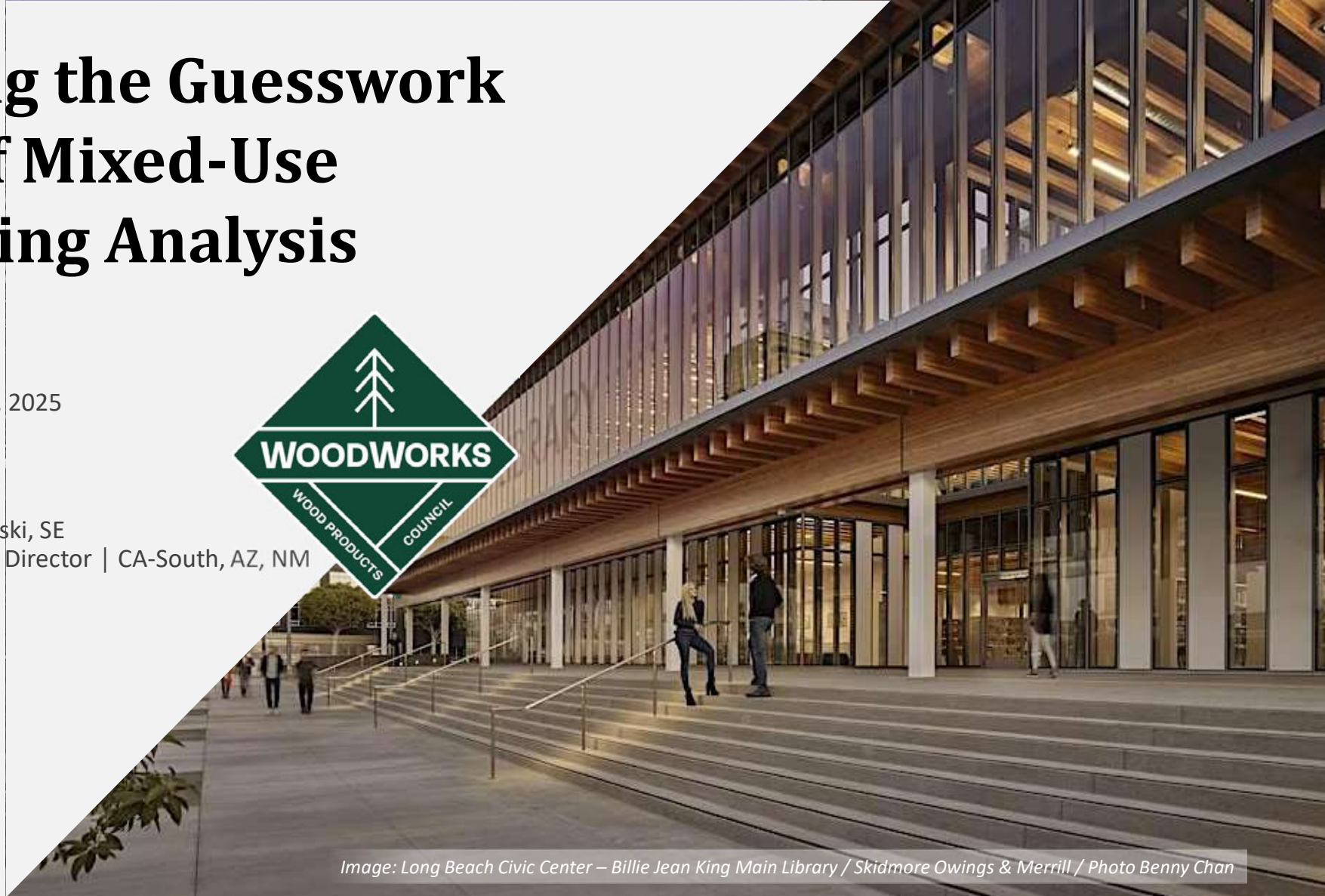


Image: Long Beach Civic Center – Billie Jean King Main Library / Skidmore Owings & Merrill / Photo Benny Chan

Course Description

While mixed-use buildings – which combine multiple occupancy types and/or functions in a single structure – are common, determining how to apply their unique mix of code requirements can be a daunting task. To simplify code analysis associated with these buildings, this presentation covers logical, code-compliant steps for a number of topics, including determining allowable building size, separation needs, detailing requirements, and the application of special provisions under the 2022 California Building Code (CBC). With an emphasis on the use of wood framing in Construction Types III and V, examples, calculations, and details will be presented to demonstrate how to navigate the various code requirements associated with mixed-use buildings while maximizing building size and meeting fire and life safety needs.

Learning Objectives

1. Review the basic fire and life safety requirements associated with mixed-use, wood-frame structures.

2. Become familiar with the differences between Construction Types III and V as defined by the 2022 CBC.

3. Highlight options for determining allowable building size of mixed-use facilities, including separated and nonseparated occupancies, incidental uses and podiums.

4. Demonstrate how to achieve separation of occupancies with fire barriers, fire walls and horizontal assemblies.

MIXED-USE BUILDINGS

TODAY'S AGENDA

1. CODE HISTORY: FIRE & LIFE SAFETY
2. ALLOWABLE BUILDING SIZE
3. MIXED-USE BUILDINGS
4. ACHIEVING FIRE SEPARATION (WHEN NECESSARY)
5. BUILDING CONFIGURATION OPTIONS

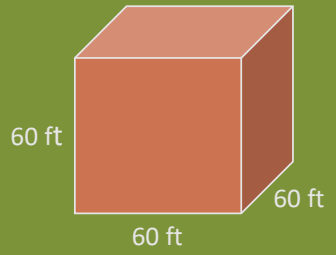
HISTORICAL LIMITATIONS

Many of the current building size limits are based on historical fire department access limitations.

1050. What is practically the highest maximum to which water can be thrown with effect by a steam engine?—That is a question which very seldom arises with us, but it can be thrown to 80 or 90 feet, although not with good effect.

1051. What is the extreme height to which fire escapes and ladders can be reasonably carried for the protection of life and the saving of life?—About 50 feet.

1120. What limit, according to you, would be a fair and safe limit to impose?—I should say that the limit applied in Liverpool is about the best for this country; 60 to 65 feet.



With a well organized and properly equipped fire brigade it is found that sixty feet is the greatest height at which a building can be quickly protected, and that the cube of 60, or 216,000 cubic feet, is the largest cubical capacity which can be protected with reasonable hope of success after a fire has once come to a head.

SOURCES:

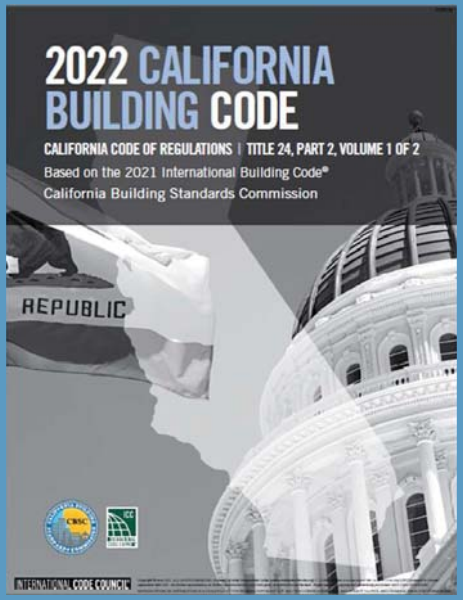
E.M. SHAW, FIRE SURVEYS 1872: E. WILSON

GREAT BRITAIN. PARLIAMENT. HOUSE OF COMMONS, REPORTS FROM COMMITTEES. 1874.

FIRE AND LIFE SAFETY

MINIMUM PROVISIONS TO ACHIEVE FIRE & LIFE SAFETY

- FIRE DETECTION, NOTIFICATION & SUPPRESSION SYSTEMS
- ADEQUATE MEANS OF EGRESS
- LIMITATION OF FIRE SPREAD
- STRUCTURAL FIRE RESISTANCE



FIRE AND LIFE SAFETY

THE BUILDING CODE:

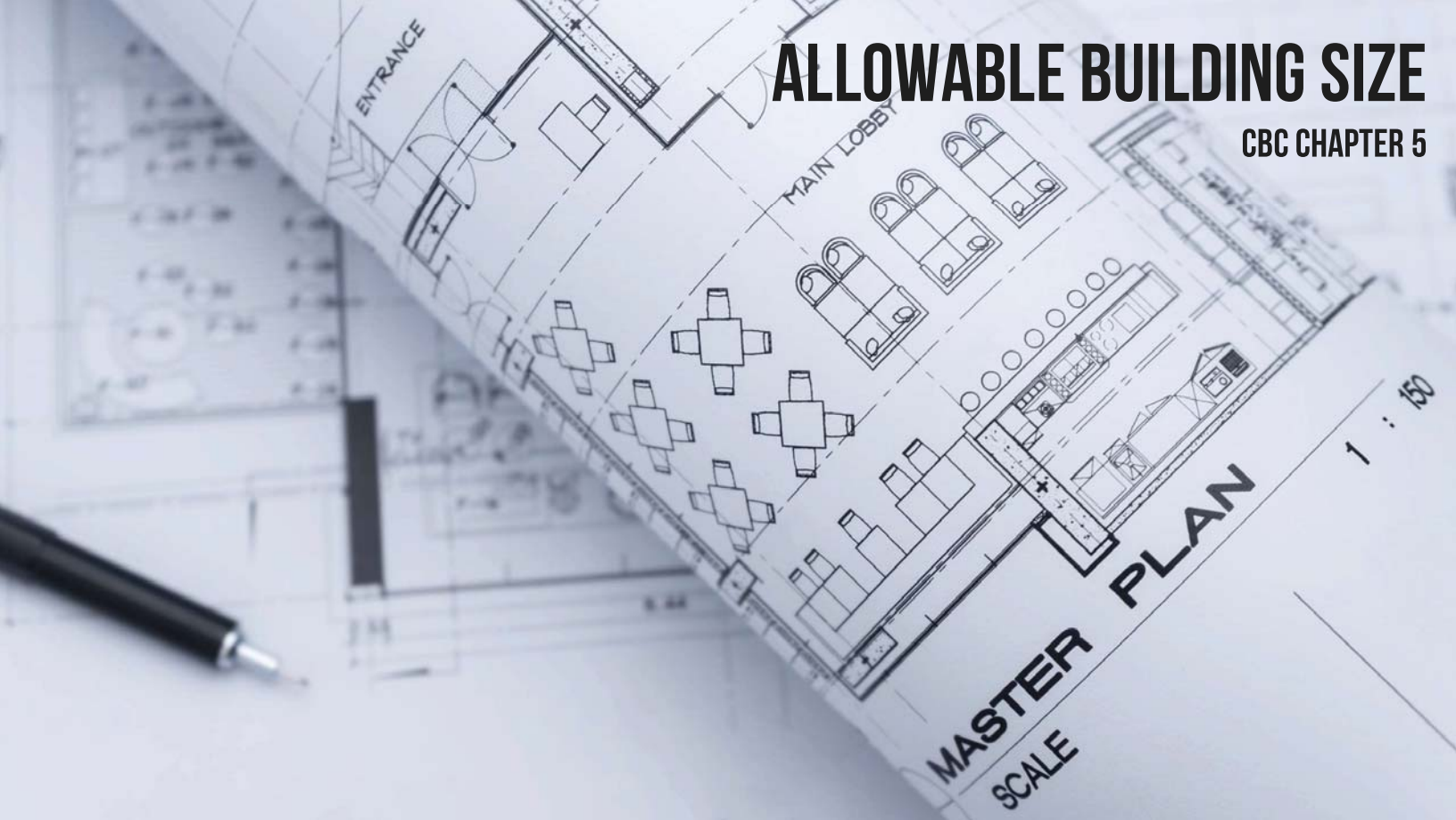
- CONTROLS BUILDING SIZE
- REGULATES TYPE OF MATERIALS USED
- STIPULATES FIRE RESISTANCE

BUT…

THE CODE STILL ALLOWS FLEXIBILITY IN BUILDING DESIGN, CONFIGURATION, CONSTRUCTION TYPE, MATERIALS AND OTHER CHOICES

ALLOWABLE BUILDING SIZE

CBC CHAPTER 5



ALLOWABLE BUILDING SIZE

CBC CHAPTER 5

ALLOWABLE BUILDING SIZE IS A FUNCTION OF:

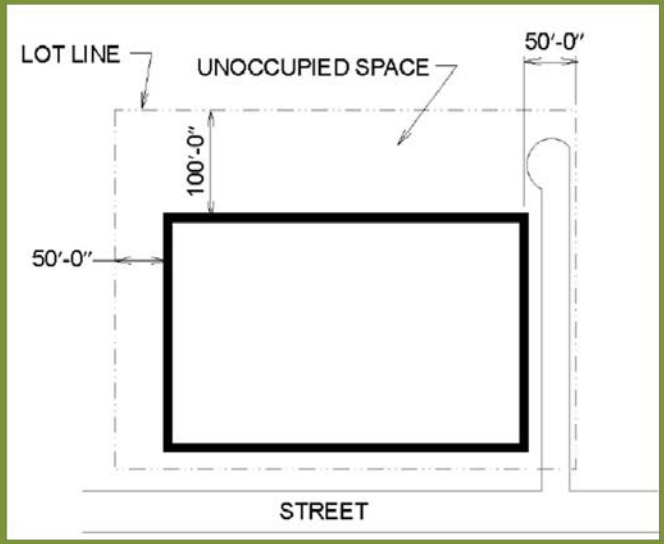
- CAPABILITY OF FIRE DEPARTMENT TO ACCESS BUILDING
- LEVEL OF SPRINKLER PROTECTION
- TYPE OF CONSTRUCTION
- USE OF BUILDING

FIRE DEPARTMENT ACCESS

CBC 506

FRONTAGE

Frontage provides access to the structure by fire service personnel, a temporary refuge area for occupants as they leave the building in a fire emergency and a reduced exposure to and from adjacent structures. Larger building areas are possible with a certain minimum amount of frontage.



SPRINKLER REQUIREMENTS

CBC 903.2

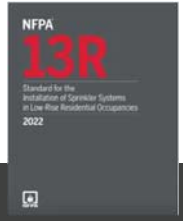
- NFPA 13 OR 13R SPRINKLER SYSTEM REQUIRED IN ALL NEW GROUP R FIRE AREAS
- NFPA 13 SPRINKLER SYSTEM REQUIRED IN MOST COMMERCIAL FACILITIES OF ANY SIZE REGARDLESS OF CONSTRUCTION TYPE OR MATERIALS USED

  EXAMPLE: OCCUPANCY GROUP A-2 (RESTAURANT, CASINO, BANQUET HALL)

  - IF FIRE AREA EXCEEDS 5,000 SF, OR
  - IF OCCUPANT LOAD IS 100 OR MORE

SPRINKLER DIFFERENCES

CBC 903.3



NFPA 13	NFPA 13R
GOAL: PROVIDE LIFE SAFETY AND PROPERTY PROTECTION	GOAL: PROVIDE LIFE SAFETY ONLY
FULL COVERAGE SYSTEM, SPRINKLER PROTECTION REQUIRED EVEN IN UNOCCUPIED SPACES (CLOSETS, ATTICS)	CERTAIN UNOCCUPIED SPACES DO NOT REQUIRE SPRINKLER PROTECTION
TYPICALLY COSTS MORE	LOWER LEVELS OF WATER DISCHARGE, SHORTER WATER SUPPLY TIME CAN RESULT IN SMALLER PIPE SIZES, REDUCE NEED FOR STORAGE & PUMPS
REQUIRED FOR MOST OCCUPANCIES, BUILDINGS OF MANY SIZES, ALLOWS GREATER BUILDING SIZE INCREASES	APPLICATION IS LIMITED MAINLY TO MULTI-FAMILY UP TO 4 STORIES, 60 FEET

CONSTRUCTION TYPES

CBC CHAPTER 6

TYPE III

Exterior walls non-combustible (may be FRTW).
Interior elements any allowed by code.

TYPE V

All building elements are any allowed by code.

Types III and V are subdivided into A (protected) and B (unprotected).

OCCUPANCY GROUPS

CBC CHAPTER 3

COMMON EXAMPLES INCLUDE:

A: ASSEMBLY: RESTAURANTS, THEATERS, ARENAS, LECTURE HALLS
B: BUSINESS: OFFICES, COLLEGES, BANKS
M: MERCANTILE: RETAIL STORES, SALES ROOMS
R: RESIDENTIAL: APARTMENTS, HOTELS
S: STORAGE: PARKING GARAGES, BULK MATERIAL STORAGE AREAS

ALLOWABLE BUILDING HEIGHT

CBC TABLES 504.3 & 504.4

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

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
B, 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
A, E	*NS[b]*	*UL*	*160*	*65*	*55*	*65*	*55*	*65*	*65*	*65*	*65*	*50*	*40*
	S (without area increase)	*UL*	*180*	*85*	*75*	*85*	*75*	*270*	*180*	*85*	*85*	*70*	*60*
	S (with area increase)	*UL*	*160*	*65*	*55*	*65*	*55*	*250*	*160*	*65*	*65*	*50*	*40*

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

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
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 (without area increase)	UL	6	4	3	4	3	9	6	4	4	2	2
	S (with area increase)	UL	5	3	2	3	2	8	7	3	3	1	1

ALLOWABLE AREA FACTOR

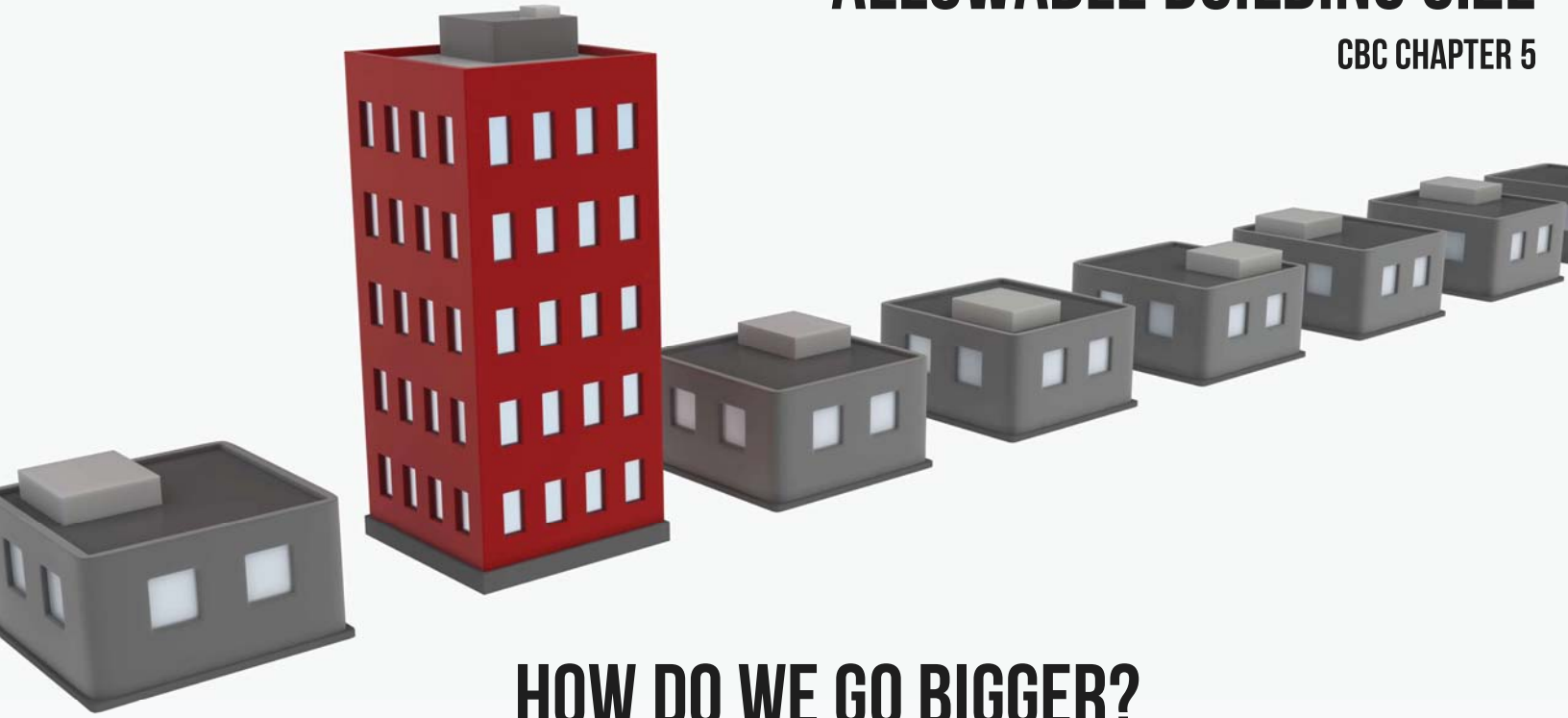
CBC TABLE 506.2

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

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
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 *(without height increase)*	UL	UL	79,500	43,500	70,500	43,500	*229,500*	*153,000*	*95,625*	76,500	55,500	28,500
	SM (with height increase)	*UL*	*UL*	*26,500*	*14,500*	*23,500*	*14,500*	*76,500*	*51,000*	*31,875*	*25,500*	*18,500*	*9.500*

ALLOWABLE BUILDING SIZE

CBC CHAPTER 5



HOW DO WE GO BIGGER?

ALLOWABLE BUILDING HEIGHT

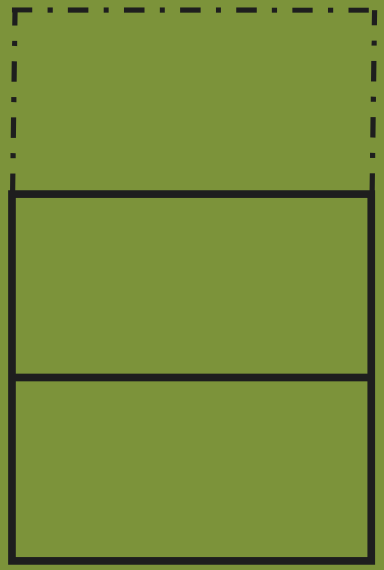
CBC TABLES 504.3 & 504.4

SPRINKLER INCREASE

Buildings equipped throughout with an NFPA 13 or 13R sprinkler system:

Can typically add 20 ft and 1 story to CBC Table 504.3 and 504.4 non-sprinklered base heights*

*NFPA 13R limited to 60 ft & 4 stories

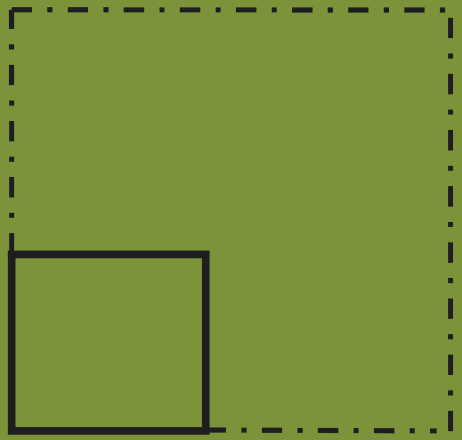


ALLOWABLE FLOOR AREA

CBC TABLE 506.2

SPRINKLER INCREASE

Buildings equipped throughout with an NFPA 13 sprinkler system:
Can add 300% (single story buildings) or 200% (multi-story buildings) to CBC Table 506.2 non-sprinklered base floor area factors

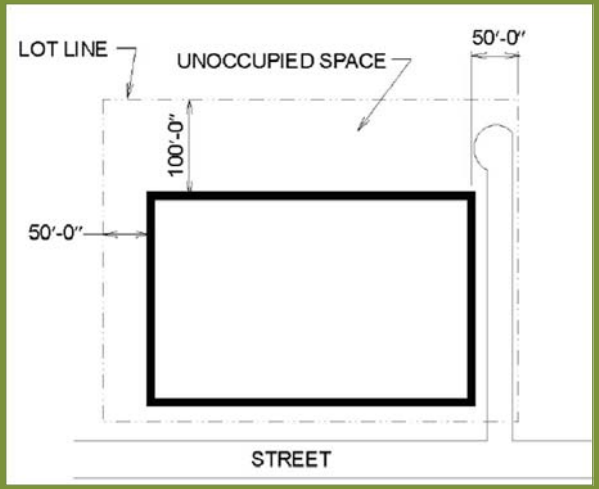


ALLOWABLE FLOOR AREA

CBC 506.3

FRONTAGE INCREASE

Buildings with minimum levels of open frontage can add up to 75% to CBC Table 506.2 non-sprinklered base floor area factors



ALLOWABLE BUILDING AREA

CBC 506.2.1

SINGLE-OCCUPANCY, MULTISTORY BUILDINGS

Total allowable building area = allowable area per floor multiplied by:

2 for 2-story buildings, 3 for 3 or more story buildings (2 for 3 or more story buildings of Group A, E, H, I, L and R occupancies)

ALLOWABLE BUILDING SIZE

IN LOW- TO MID-RISE BUILDING TYPES, MANY DESIGNERS ACCUSTOMED TO STEEL & CONCRETE DEFAULT TO TYPE II CONSTRUCTION

However, nearly identical building sizes can be achieved with wood framing in Type IIIA or IIIB construction

Additionally, market data analysis has shown that the majority of commercial & multi-family buildings can be Type V construction

Why is the construction type selection so important?

ICC Building Valuation Data, **R-2 occupancies**, February 2025

MIXED-USE BUILDINGS

START WITH THE LOWEST COMMON DENOMINATOR OPTION & WORK UP. DON'T ASSUME THAT A CERTAIN CONSTRUCTION TYPE, OCCUPANCY SEPARATION, ETC. WILL BE REQUIRED SIMPLY BASED ON USE OF CERTAIN MATERIALS OR PRESENCE OF CERTAIN OCCUPANCIES

IMAGE CREDIT: NEO STUDIO

MIXED-USE BUILDINGS

CBC 508

SPECIFICALLY, START WITH NONSEPARATED OCCUPANCIES, USE SPECIAL PROVISIONS AND/OR OTHER SPECIAL DESIGN ALLOWANCES AS NEEDED AND WORK UP FROM THERE

MIXED-USE BUILDINGS

CBC 508

- INCIDENTAL USES (509)
- ACCESSORY OCCUPANCIES (508.2)
- UNIQUE ASSEMBLY OCCUPANCY COMBINATIONS (303)
- SPECIAL PROVISIONS (510)
- NONSEPARATED OCCUPANCIES (508.3)
- SEPARATED OCCUPANCIES (508.4)
- SEPARATE BUILDINGS – FIRE WALLS (503.1 & 706)

CREDIT: BOYE ARCHITECTURE

INCIDENTAL USES

CBC 509

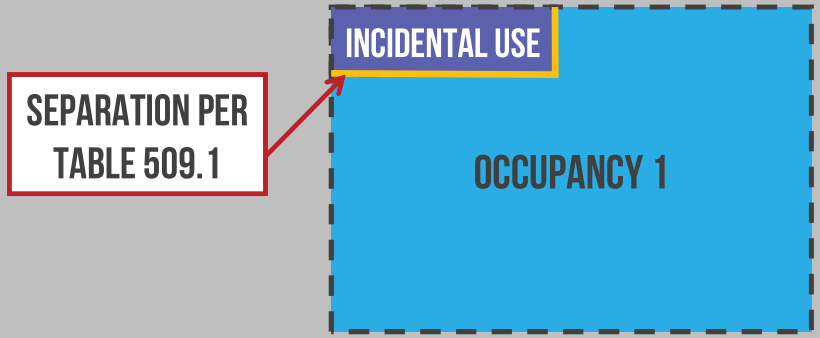
- ANCILLARY FUNCTION ASSOCIATED WITH AN OCCUPANCY
- POSE GREATER RISK THAN THE OCCUPANCY
- EXAMPLES (FROM TABLE 509.1):
  - LAUNDRY ROOM OVER 100 SF
  - REFRIGERANT MACHINERY ROOM
  - INCINERATOR ROOM
  - FURNACE ROOM
  - BOILER ROOM

INCIDENTAL USES

CBC 509

LIMITATIONS:

- Aggregate incidental use area not more than 10% of area of story
- Must have fire resistance rated separation (fire barrier or horizontal assembly), smoke separation and/or sprinkler systems per Table 509.1 and Section 509.4
  - Many permit use of sprinklers in lieu of rated separation
- NOT classified as a different occupancy
- Allowable height and building area per main occupancy



INCIDENTAL USES

CBC 509

INCIDENTAL USES EXAMPLE:

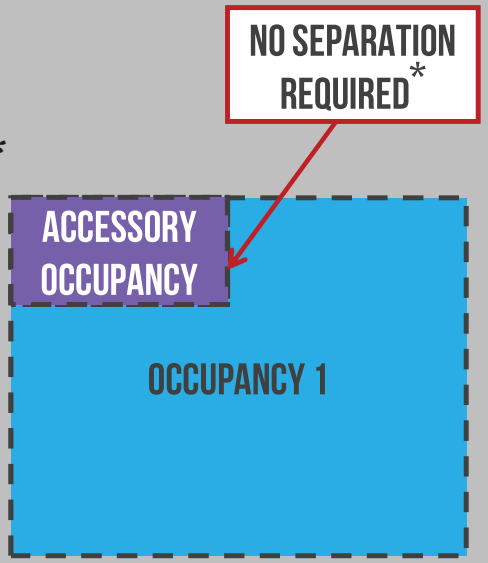
- NFPA 13 sprinklered, 4-story, Type VA building, neglect frontage
- Upper 3 floors: 18,000 sf apartments (R-2)
- 1st floor: 16,400 sf apartments plus 800 sf laundry room & 800 sf boiler room
- Total building area = 72,000 sf
- Table 506.2: allowable building area w/sprinkler increase = 72,000 sf; no floor greater than 36,000 sf. OK
- Allowable incidental use area = 18,000×0.10 = 1,800 sf > 1,600 sf: OK. Can classify laundry room & boiler room as R-2
- Table 509.1: walls and floor separating laundry room & boiler room from R-2: no hourly rating required since building is sprinklered, but smoke resistance is required in conjunction with sprinklers per Section 509.4.2

ACCESSORY OCCUPANCIES

CBC 508.2

- Ancillary to the main occupancy
- Aggregate accessory area not greater than:
  - 10% of the floor area of the story in which it is located
  - Table 506.2 non-sprinklered allowable area limit of accessory occupancy
- No separation between occupancies required*
- Allowable height and building area per main occupancy

*Hazardous occupancies require separation
*Residential separations per Section 420 still apply

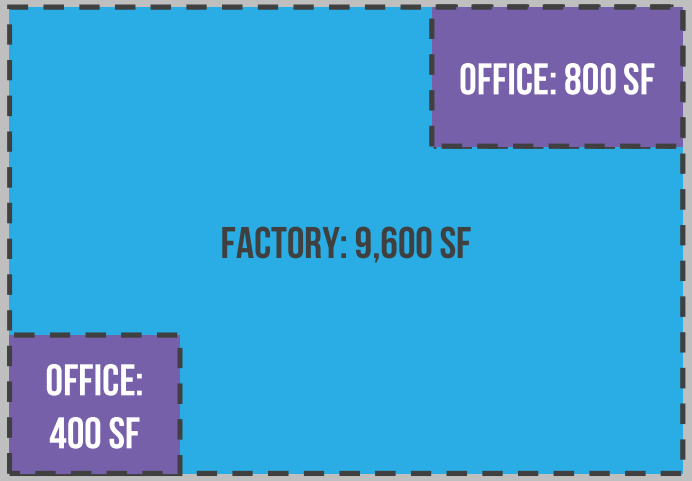


ACCESSORY OCCUPANCIES

CBC 508.2

ACCESSORY OCCUPANCIES EXAMPLE:

- Non-sprinklered, 1-story, Type VA building, neglect frontage
- Factory (F-1) 9,600 sf
- Two office (B) spaces: 400 sf and 800 sf
- Table 506.2: allowable area = 14,000 sf
- Total floor area = 10,800 sf < 14,000 sf: OK
- Aggregate accessory use areas = 1,200 sf
- Max. allowable aggregate accessory use area = 10,800×0.10 = 1,080 sf: N.G.
- Can't classify offices as accessory occupancies
- Solution: reduce office area, increase factory area or analyze as a mixed-use building



SMALL ASSEMBLY SPACES

CBC 303.1.1 & 303.1.2

303.1.1 SMALL BUILDINGS AND TENANT SPACES:

- A building or tenant space used for assembly purposes with an occupant load of less than 50 persons shall be classified as a Group B occupancy

Example: small cafe

303.1.2 SMALL ASSEMBLY SPACES (ACCESSORY TO OTHER OCCUPANCIES):

- Occupant load less than 50 persons or less than 750 sf in area - can be classified as a Group B occupancy or as part of main occupancy

Examples:

- Conference room in office building
- Fitness center in hotel

PHOTO CREDIT: ARDEN PHOTOGRAPHY

SPECIAL PROVISIONS

CBC 510

CONSTRUCTION TYPES

CBC 602.1 REQUIRES THAT EACH BUILDING BE CLASSIFIED IN ONE OF FIVE CONSTRUCTION TYPES

CBC SECTION 510 CONTAINS SPECIAL PROVISIONS THAT IN SOME CASES ALLOW MULTIPLE CONSTRUCTION TYPES IN THE SAME BUILDING OR MULTIPLE "BUILDINGS" STACKED ON TOP OF EACH OTHER

HORIZONTAL BUILDING SEPARATION

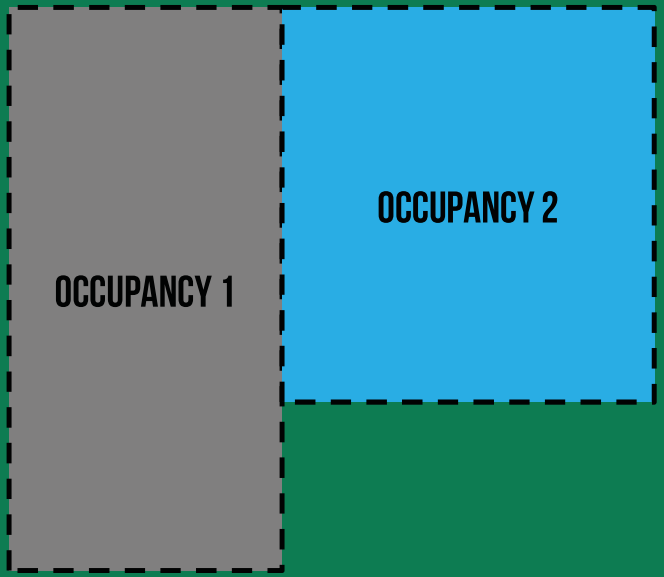
CBC 510.2

OFTEN CALLED "PODIUM" PROVISIONS

- Considered separate buildings above and below for purposes of determining allowable number of stories and area calculations
- Overall height in feet (from grade plane) is still limited to minimum of either building
- 3-hr rated horizontal assembly
- Building below is Type 1A with sprinklers
- Occupancy restrictions above and below

NONSEPARATED OCCUPANCIES

CBC 508.3



Most restrictive requirements of all occupancies apply for:

- Fire protection systems (Chapter 9)
- Allowable height and area

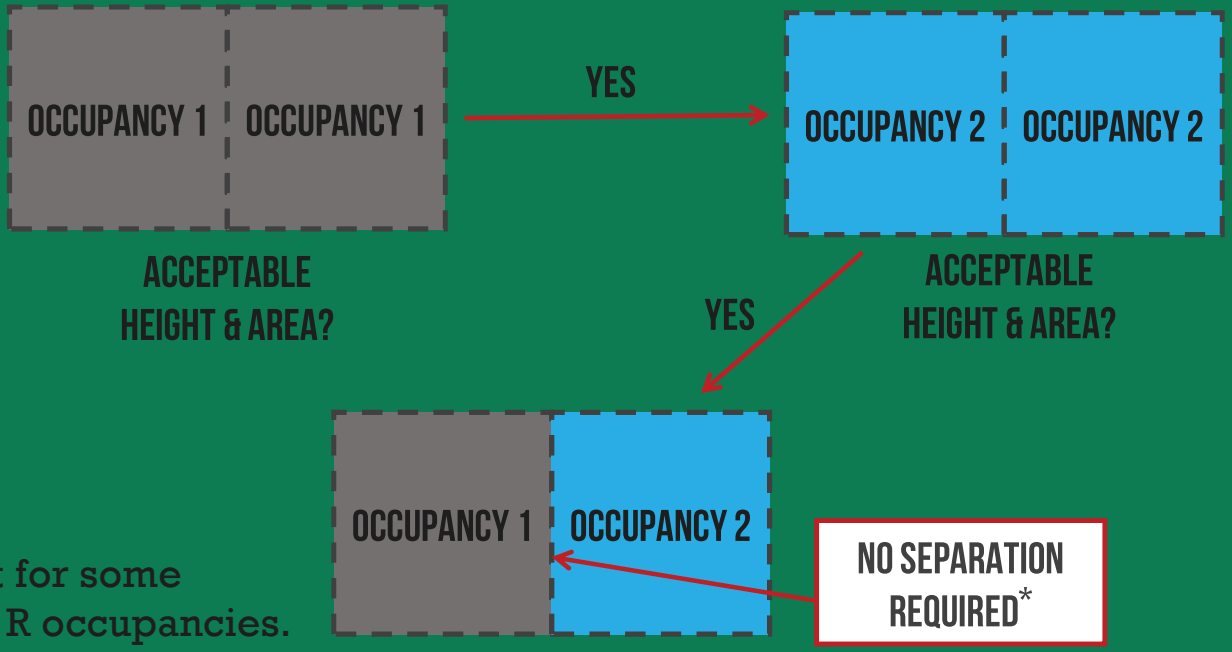
Other requirements for each portion based upon occupancy of that portion (i.e. egress, others)

No fire separation between occupancies required*

*Except for some H, I, L & R occupancies.

NONSEPARATED OCCUPANCIES

CBC 508.3

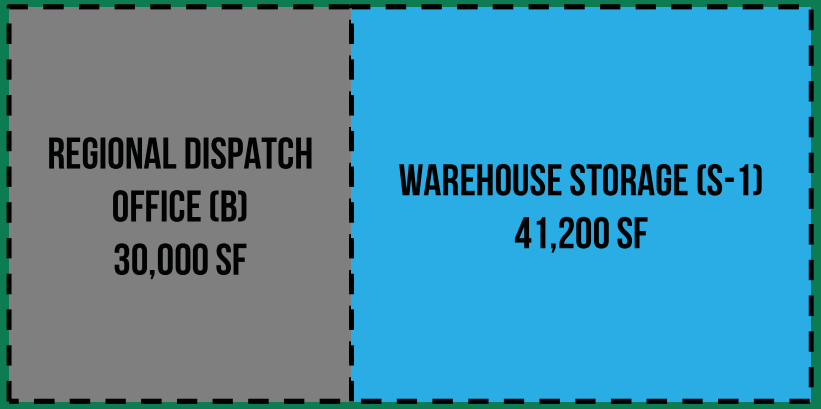


*Except for some H, I, L & R occupancies.

NONSEPARATED OCCUPANCIES

CBC 508.3

SINGLE-STORY NONSEPARATED OCCUPANCIES EXAMPLE

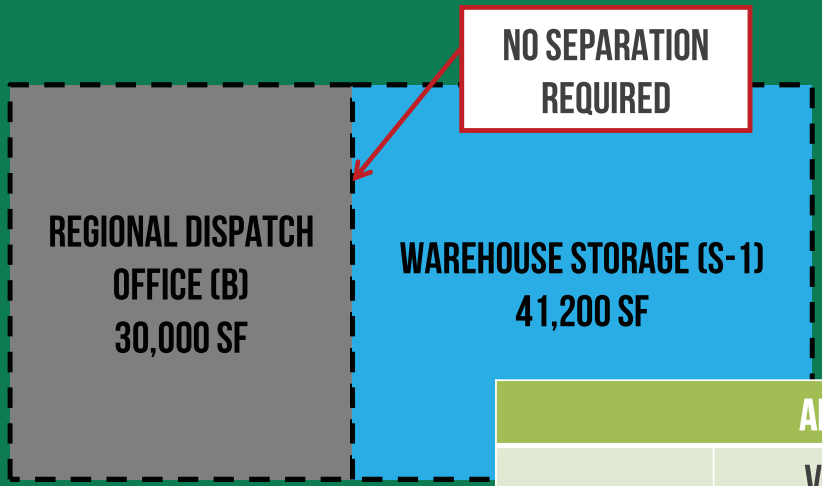


- 1-story building
- Total building area = 71,200 sf
- CBC section 903 does not require an automatic sprinkler system in group B buildings, but it does for S-1 buildings with fire area > 12,000 sf (903.2.9): NFPA 13 sprinkler system required throughout building
- Neglect frontage

NONSEPARATED OCCUPANCIES

CBC TABLE 506.2

SINGLE-STORY NONSEPARATED OCCUPANCIES EXAMPLE (CONT.'D)



CONSTRUCTION TYPE OPTIONS

- VB: N.G. FOR BOTH
- VA: OK FOR B, N.G. FOR S-1
- IIIB: OK FOR B, N.G. FOR S-1
- IIIA: OK FOR BOTH, USE TYPE IIIA

ALLOWABLE 1 STORY BUILDING AREA				
	VB	VA	IIIB	IIIA
GROUP B	36,000 SF	72,000 SF	76,000 SF	114,000 SF
GROUP S-1	36,000 SF	56,000 SF	70,000 SF	104,000 SF

NONSEPARATED OCCUPANCIES

CBC 508.3

MULTI-STORY NONSEPARATED OCCUPANCIES EXAMPLE

IMAGE CREDIT: WARE MALCOMB

- 3-STORY BUILDING ON COLLEGE CAMPUS
- GRADE TO MEAN ROOF HEIGHT = 36 FT.
- TOTAL BUILDING AREA = 61,200 SF
- NFPA 13 SPRINKLER SYSTEM USED THROUGHOUT BUILDING
- NEGLECT FRONTAGE
- 1ST FLOOR: (2)-700 SF COFFEE/SNACK BARS, 13,700 SF OF CLASSROOMS, 1,900 SF ADMIN., 3,400 SF OFFICES
- 2ND & 3RD FLOORS: 20,400 SF OF OFFICES

NONSEPARATED OCCUPANCIES

CBC 508.3

MULTI-STORY NONSEPARATED OCCUPANCIES EXAMPLE (CONT.'D)

IMAGE CREDIT: WARE MALCOMB

- COFFEE/SNACK BARS: GROUP A-2 OCCUPANCY
  - USE SMALL ASSEMBLY SPACES PROVISION (CBC 303.1.2) – GROUP B OCCUPANCY
- CLASSROOMS FOR HIGHER THAN 12TH GRADE: GROUP B OCCUPANCY
- ADMIN. & OFFICES: GROUP B OCCUPANCY

NONSEPARATED OCCUPANCIES

CBC 508.3

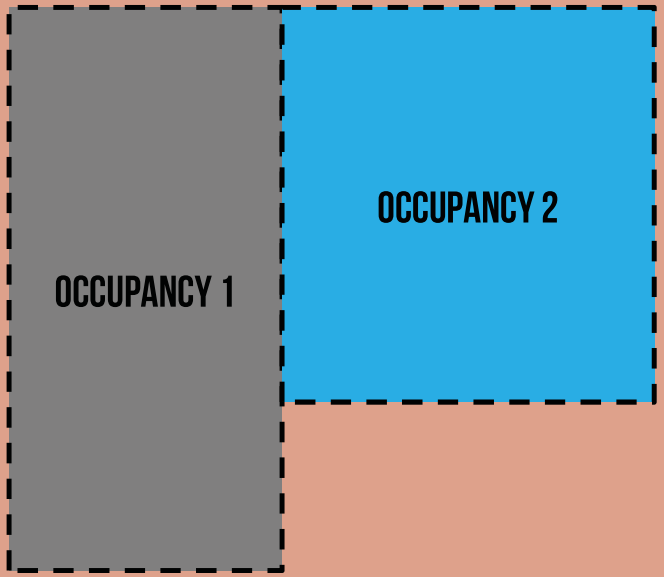
MULTI-STORY NONSEPARATED OCCUPANCIES EXAMPLE (CONT.'D)

IMAGE CREDIT: WARE MALCOMB

Entire building is group B occupancy and can use **Type VB construction**: allowed 3 stories, 60 ft, 27,000 sf per floor, 81,000 sf total area

SEPARATED OCCUPANCIES

CBC 508.4



Requirements of code for each portion based upon occupancy of that portion

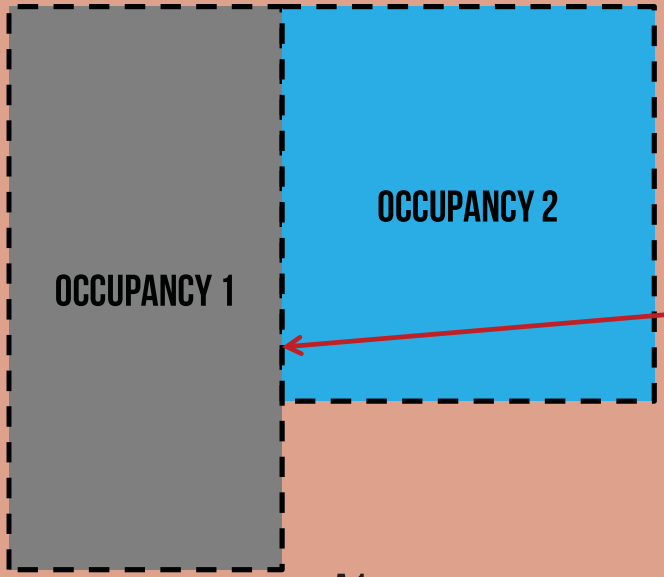
Allowable height of each occupancy based upon construction type and occupancy

Allowable area of each story:

Sum of actual area over allowable area of each occupancy ≤ 1

SEPARATED OCCUPANCIES

CBC 508.4



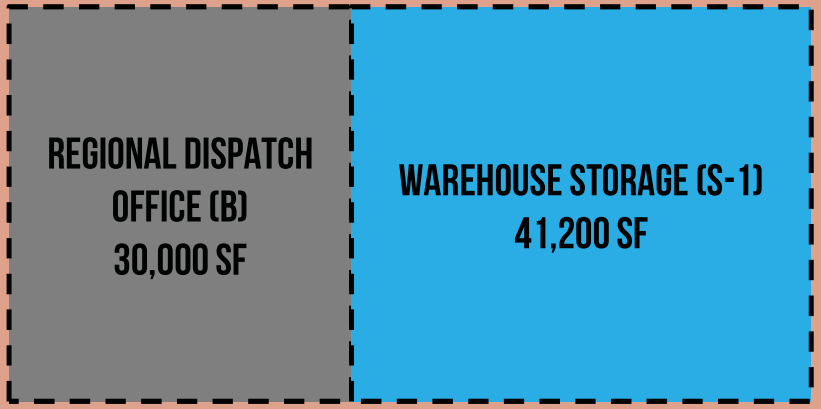
$$\frac{A1}{\text{ALLOWABLE AREA FOR OCCUPANCY 1}} + \frac{A2}{\text{ALLOWABLE AREA FOR OCCUPANCY 2}} \leq 1$$

CHECK PERFORMED FOR EACH STORY,
SEPARATION BY FIRE BARRIERS AND HORIZONTAL ASSEMBLIES

SEPARATED OCCUPANCIES

CBC 508.4

SINGLE-STORY SEPARATED OCCUPANCIES EXAMPLE

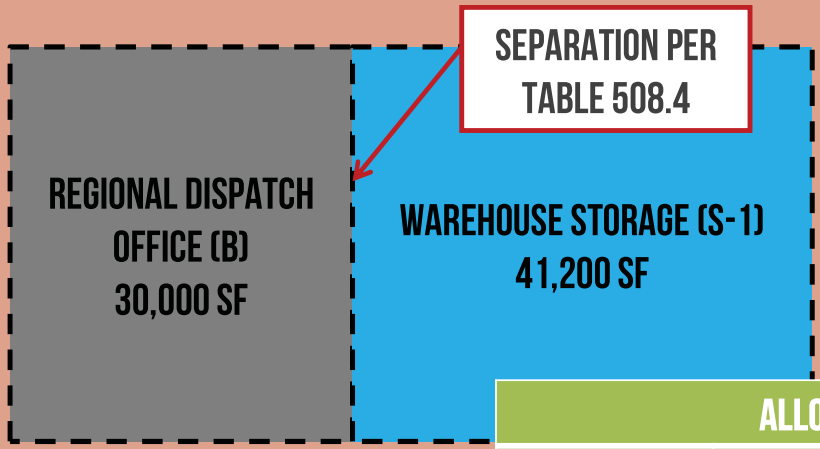


- 1-story building
- Total building area = 71,200 sf
- CBC section 903 does not require an automatic sprinkler system in group B buildings, but it does for S-1 buildings with fire area > 12,000 sf (903.2.9): NFPA 13 sprinkler system required throughout building
- Neglect frontage

SEPARATED OCCUPANCIES

CBC TABLE 506.2

SINGLE-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)



CONSTRUCTION TYPE OPTIONS

- VB: 30,000/36,000 + 41,200/36,000 = 0.83 + 1.15 = 1.98 > 1 - N.G.
- VA: 30,000/72,000 + 41,200/56,000 = 0.42 + 0.73 = 1.15 > 1 - N.G.
- IIIB: 30,000/76,000 + 41,200/70,000 = 0.39 + 0.59 = 0.98 ≤ 1 - OK: <u>USE TYPE IIIB</u>

ALLOWABLE SINGLE-STORY BUILDING AREA				
	VB	VA	IIIB	IIIA
GROUP B	36,000 SF	72,000 SF	76,000 SF	114,000 SF
GROUP S-1	36,000 SF	56,000 SF	70,000 SF	104,000 SF

SEPARATED OCCUPANCIES

CBC TABLE 508.4

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

OCCUPANCY	A, E		I-4, *R-2.1*		I-2, *I-2.1*		*I-3*		R-*1*, *R-2*, *R-3*, *R-3.1*, *R-4*		F-2, S-2[b], U		B[f], F-1[a, f], M, S-1		*L*		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	*S*	*NS*	S	NS	S	NS	S	NS	*S*	*NS*	S	NS	S	NS	S	NS	S	NS
A, E	N	N	2	2	2	NP	*2*	*NP*	1	2	N	1	1	2	*2*	*NP*	NP	NP	3	4	2	3	2	NP
I-4, *R-2.1*	—	—	*1*[c]	*NP*	2	NP	*2*	*NP*	1	NP	1	2	1	2	*2*	*NP*	NP	NP	*4*	*NP*	*4*	*NP*	*4*	*NP*
I-2, *I-2.1*	—	—	—	—	N	*NP*	*2*	*NP*	2	NP	2	NP	2	NP	*2*	*NP*	NP	NP	*4*	*NP*	*4*	*NP*	*4*	*NP*
I-3	—	—	—	—	—	—	*N*	*NP*	*2*	*NP*	*2*	*2*	*2*	*2*	*2*	*NP*	*NP*	*NP*	*4*	*NP*	*4*	*NP*	*4*	*NP*
R-*1*, *R-2*, *R-3*, *R-3.1*, *R-4*	—	—	—	—	—	—	—	—	N	N	1[c]	2[c]	1	2	*4*	*NP*	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	—	—	—	—	—	—	—	—	—	—	N	N	1	2	*1*	*NP*	NP	NP	3	4	2	3	2	NP
B, F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	—	—	N	N	*1*	*NP*	NP	NP	2	3	1	2	1	NP
L	—	—	—	—	—	—	—	—	—	—					*1*	*NP*	*NP*	*NP*	*2*	*NP*	*1*	*NP*	*1*	*NP*
H-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1[d]	NP	1	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP

FOR THIS EXAMPLE, NO SEPARATION REQUIRED

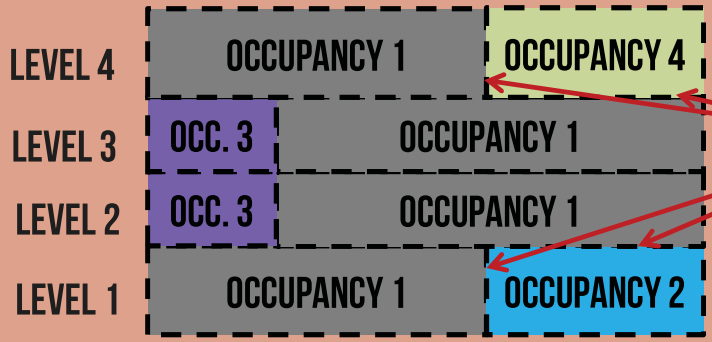
NP = NOT PERMITTED

N = NO SEPARATION REQUIREMENT

SEPARATED OCCUPANCIES

CBC 506.2.4 & 508.4

MULTI-STORY SEPARATED OCCUPANCY BUILDINGS



ELEVATION VIEW

SEPARATION PER TABLE 508.4

ALSO BTWN. OCC. 1 & OCC. 3

SUM OF RATIOS OF ACTUAL AREA/ALLOWABLE AREA FOR ALL OCCUPANCIES AT ALL FLOORS:

$\leq$ 1 FOR 1-STORY BUILDING

$\leq$ 2 FOR 2-STORY BUILDING

$\leq$ 3 FOR 3 OR MORE STORY BUILDING*

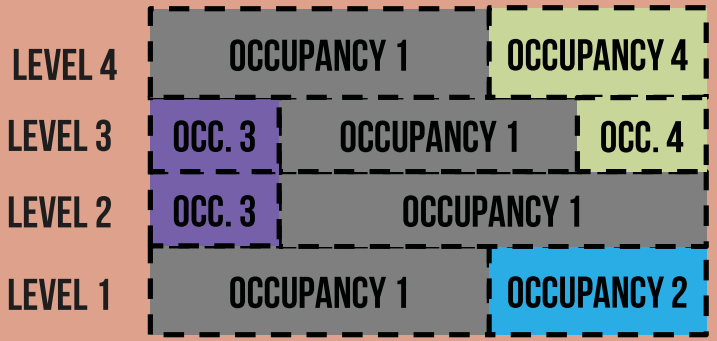
(*2 FOR GROUP A, E, H, I, L & R OCC.)

NO FLOOR CAN HAVE AN AREA RATIO > 1

SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE



ELEVATION VIEW

- 4-story building, grade to mean roof height = 48 ft.
- Total building area = 120,000 sf
- Occupancy 1: apartments (R-2)
- Occupancy 2: retail (M)
- Occupancy 3: restaurant (A-2)
- Occupancy 4: offices (B)
- CBC section 903.2.8 requires an automatic sprinkler system in group R buildings: NFPA 13 sprinkler system required throughout building
- Neglect frontage

SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)

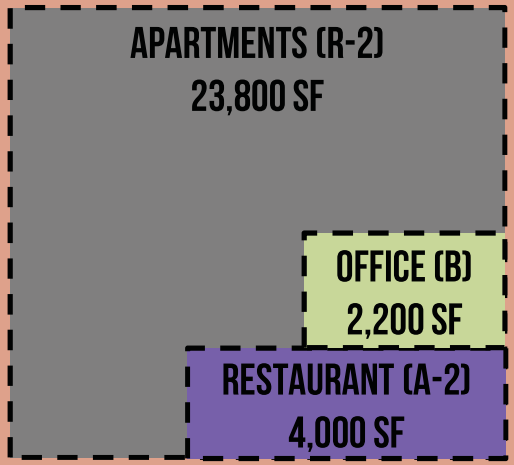
LEVEL 1 FLOOR PLAN

LEVEL 2 FLOOR PLAN

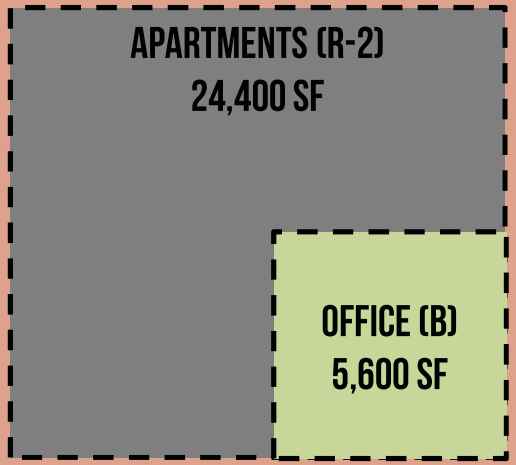
SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)



LEVEL 3 FLOOR PLAN



LEVEL 4 FLOOR PLAN

SEPARATED OCCUPANCIES

CBC TABLES 504.4 & 506.2

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)

ALLOWABLE FLOOR AREA / # OF STORIES				
	VB	VA	IIIB	IIIA
GROUP A-2	6,000 SF / 2	11,500 SF / 3	9,500 SF / 3	42,000 SF / 3
GROUP B	27,000 SF / 3	54,000 SF / 4	57,000 SF / 4	85,500 SF / 6
GROUP M	27,000 SF / 2	42,000 SF / 4	37,500 SF / 3	55,500 SF / 5
GROUP R-2	7,000 SF / 3	36,000 SF / 4	48,000 SF / 4	72,000 SF / 4

SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)

LEVEL 1 FLOOR PLAN

TRY CONSTRUCTION TYPE IIIB:

SUMMATION OF AREA RATIOS:

21,000/48,000 + 9,000/37,500 =

0.44 + 0.24 = 0.68 $\leq$ 1 - OK

ALLOWABLE HEIGHT & STORIES:

R-2: 55 FT, 4 STORIES - OK

M: 75 FT, 3 STORIES - OK

SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)

LEVEL 2 FLOOR PLAN

TRY CONSTRUCTION TYPE IIIB:

SUMMATION OF AREA RATIOS:

26,000/48,000 + 4,000/9,500 =

0.54 + 0.42 = 0.96 $\leq$ 1 - OK

ALLOWABLE HEIGHT & STORIES:

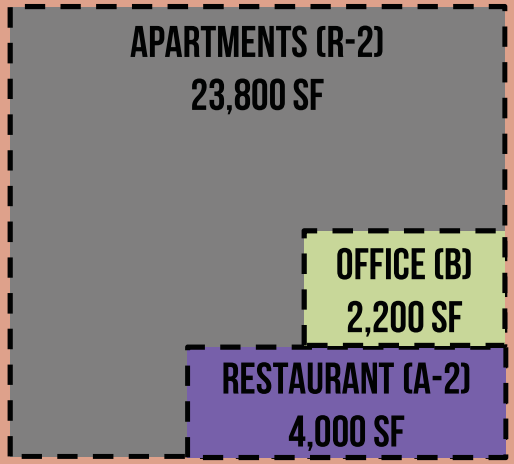
R-2: 55 FT, 4 STORIES - OK

A-2: 75 FT, 3 STORIES - OK

SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)



LEVEL 3 FLOOR PLAN

<u>TRY CONSTRUCTION TYPE IIIB:</u>

SUMMATION OF AREA RATIOS:

23,800/48,000 + 4,000/9,500 + 2,200/57,000 = 0.50 + 0.42 + 0.04 = 0.96 $\leq$ 1 - OK

ALLOWABLE HEIGHT & STORIES:

R-2: 55 FT, 4 STORIES - OK

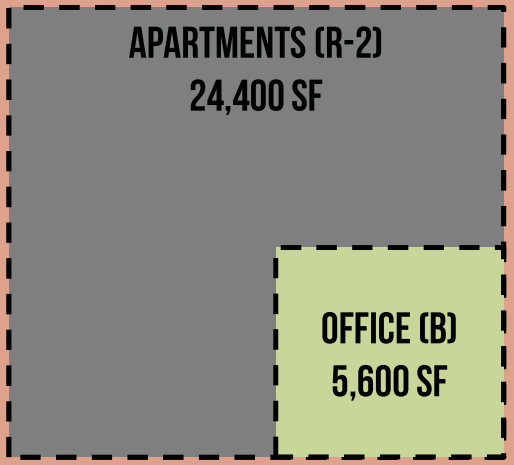
A-2: 75 FT, 3 STORIES - OK

B: 75 FT, 4 STORIES - OK

SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)



LEVEL 4 FLOOR PLAN

TRY CONSTRUCTION TYPE IIIB:

SUMMATION OF AREA RATIOS:

24,400/48,000 + 5,600/57,000 =

0.51 + 0.10 = 0.61 $\leq$ 1 - OK

ALLOWABLE HEIGHT & STORIES:

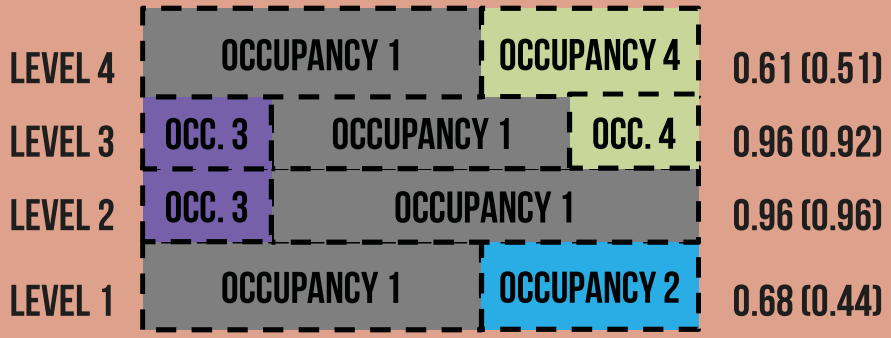
R-2: 55 FT, 4 STORIES - OK

B: 75 FT, 4 STORIES - OK

SEPARATED OCCUPANCIES

CBC 508.4

MULTI-STORY SEPARATED OCCUPANCIES EXAMPLE (CONT.'D)



ELEVATION VIEW

SUM OF AREA RATIOS FOR ALL OCCUPANCIES: 0.61 + 0.96 + 0.96 + 0.68 = 3.21 > 3 - N.G.

SUM OF AREA RATIOS FOR A, E, H, I, L & R OCCUPANCIES: 0.51 + 0.92 + 0.96 + 0.44 = 2.83 > 2 - N.G.

TYPE IIIB WON'T WORK: USE TYPE IIIA

SEPARATED OCCUPANCIES

CBC TABLE 508.4

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

OCCUPANCY	A, E		I-4, *R-2.1*		I-2, *I-2.1*		*I-3*		*R-1, R-2, R-3, R-3.1, R-4*		F-2, S-2[b], U		B[f], F-1[a, f], M, S-1		*L*		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	2	2	2	NP	2	NP	1	2	N	1	1	2	2	NP	NP	NP	3	4	2	3	2	NP
I-4, *R-2.1*	—	—	1[e]	NP	2	NP	2	NP	1	NP	1	2	1	2	2	NP	NP	NP	4	NP	4	NP	4	NP
I-2, *I-2.1*	—	—	—	—	N	NP	2	NP	2	NP	2	NP	2	NP	2	NP	NP	NP	4	NP	4	NP	4	NP
I-3	—	—	—	—	—	—	N	NP	2	NP	2	2	2	2	2	NP	NP	NP	4	NP	4	NP	4	NP
R-1, R-2, R-3, R-3.1, R-4	—	—	—	—	—	—	—	—	N	N	1[c]	2[c]	1	2	4	NP	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	—	—	—	—	—	—	—	—	—	—	N	N	1	2	1	NP	NP	NP	3	4	2	3	2	NP
B, F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	—	—	N	N	1	NP	NP	NP	2	3	1	2	1	NP
L	—	—	—	—	—	—	—	—	—	—					1	NP	NP	NP	2	NP	1	NP	1	NP
H-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1[d]	NP	1	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP

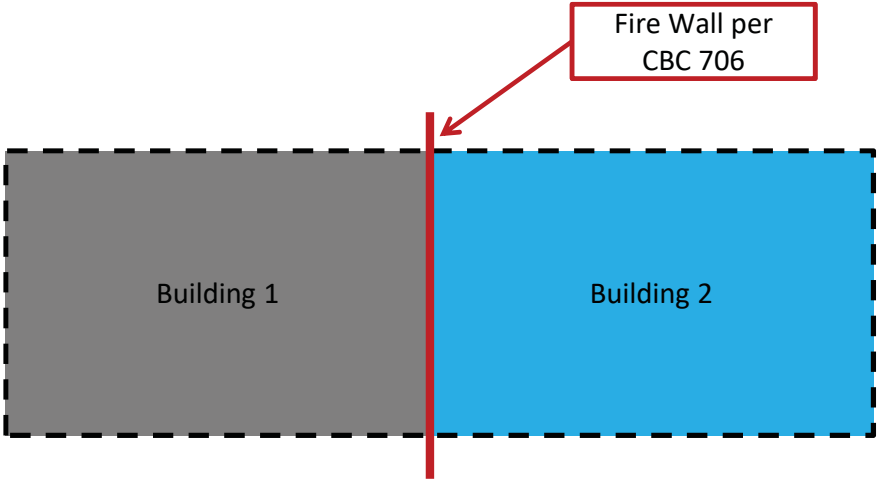
NP = NOT PERMITTED
N = NO SEPARATION REQUIREMENT

A-2 TO R-2, B; R-2 TO B, M: 1-HR WALLS AND FLOORS
A-2 TO M: 1-HR FLOOR

FIRE WALLS

CBC 706

SEPARATE BUILDINGS – FIRE WALLS



EACH PORTION OF A BUILDING SEPARATED BY ONE OR MORE FIRE WALLS SHALL BE CONSIDERED TO BE A SEPARATE BUILDING

FIRE WALLS

CBC 706

- MATERIALS: NONCOMBUSTIBLE (EXCEPT TYPE V)
- HOURLY RATINGS PER TABLE 706.4
- PROTECTED OPENINGS
- HORIZONTAL & VERTICAL CONTINUITY FOUNDATION TO ROOF
- STRUCTURAL STABILITY

IF FIRE WALL IS SEPARATING 2 DIFFERENT OCCUPANCIES, USE MOST RESTRICTIVE FIRE RATING FROM TABLE

TABLE 706.4
FIRE WALL FIRE-RESISTANCE RATINGS

GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, *R-2.1*, U, *L*	3[a]
F-1, H-3[b], H-5, M, S-1	3
H-1, H-2	4[b]
F-2, S-2, R-3, R-4	2

a. In Type II or V construction, walls shall be permitted to have a 2-hour fire-resistance rating.

b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.7 and 415.8.

SEPARATED OCCUPANCIES

CBC TABLE 508.4

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

OCCUPANCY	A, E		I-4, *R-2.1*		I-2, *I-2.1*		*I-3*		R-*1*, *R-2*, *R-3*, *R-3.1*, *R-4*		F-2, S-2[b], U		B[f], F-1[a, f], M, S-1		*L*		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	*S*	*NS*	S	NS	S	NS	S	NS	*S*	*NS*	S	NS	S	NS	S	NS	S	NS
A, E	N	N	2	2	2	NP	*2*	*NP*	1	2	N	1	1	2	*2*	*NP*	NP	NP	3	4	2	3	2	NP
I-4, *R-2.1*	—	—	*1[e]*	*NP*	2	NP	*2*	*NP*	1	NP	1	2	1	2	*2*	*NP*	NP	NP	*4*	*NP*	*4*	*NP*	*4*	*NP*
I-2, *I-2.1*	—	—	—	—	N	*NP*	*2*	*NP*	2	NP	2	NP	2	NP	*2*	*NP*	NP	NP	*4*	*NP*	*4*	*NP*	*4*	*NP*
I-3	—	—	—	—	—	—	*N*	*NP*	*2*	*NP*	*2*	*2*	*2*	*2*	*2*	*NP*	*NP*	*NP*	*4*	*NP*	*4*	*NP*	*4*	*NP*
R-*1*, *R-2*, *R-3*, *R-3.1*, *R-4*	—	—	—	—	—	—	—	—	N	N	1[c]	2[c]	1	2	*4*	*NP*	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	—	—	—	—	—	—	—	—	—	—	N	N	1	2	*1*	*NP*	NP	NP	3	4	2	3	2	NP
B, F-1, M, S-1	—	—	—	—	—	—	—	—	—	—	—	—	N	N	*1*	*NP*	NP	NP	2	3	1	2	1	NP
L	—	—	—	—	—	—	—	—	—	—					*1*	*NP*	*NP*	*NP*	2	*NP*	*1*	*NP*	*1*	*NP*
H-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	NP	NP	NP	NP	NP	NP
H-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP	1	NP	1	NP
H-3, H-4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1[d]	NP	1	NP
H-5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N	NP

NP = NOT PERMITTED

N = NO SEPARATION REQUIREMENT

SEPARATION ACCOMPLISHED WITH:

WALLS: FIRE BARRIERS (CBC 707)

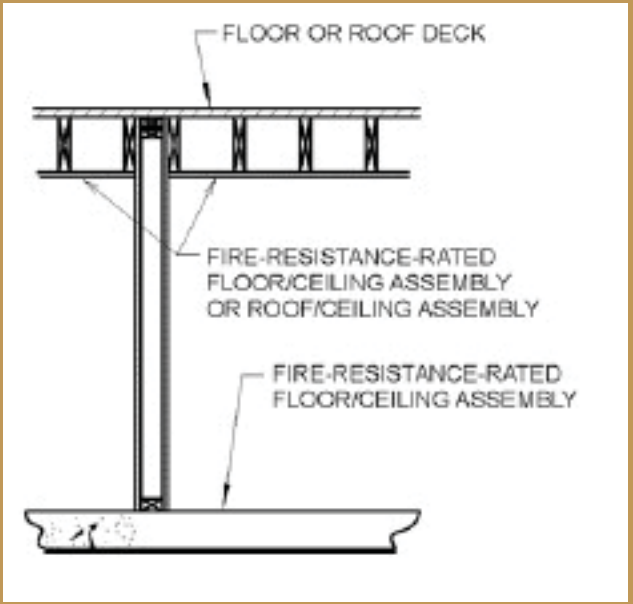
FLOORS: HORIZONTAL ASSEMBLIES (CBC 711)

FIRE BARRIERS

CBC 707

WHAT IS A FIRE BARRIER?

- May be constructed with any materials permitted by the construction type
- Occupancy separation: Fire resistance ratings per CBC Table 508.4
- Required to extend from top of the foundation/floor below to underside of floor/roof sheathing, slab or deck above
- Supporting construction required to have same fire-resistance rating as the fire barrier being supported (with exceptions per CBC 707.5.1)
- Other requirements for openings, penetrations, joints



HORIZONTAL ASSEMBLIES

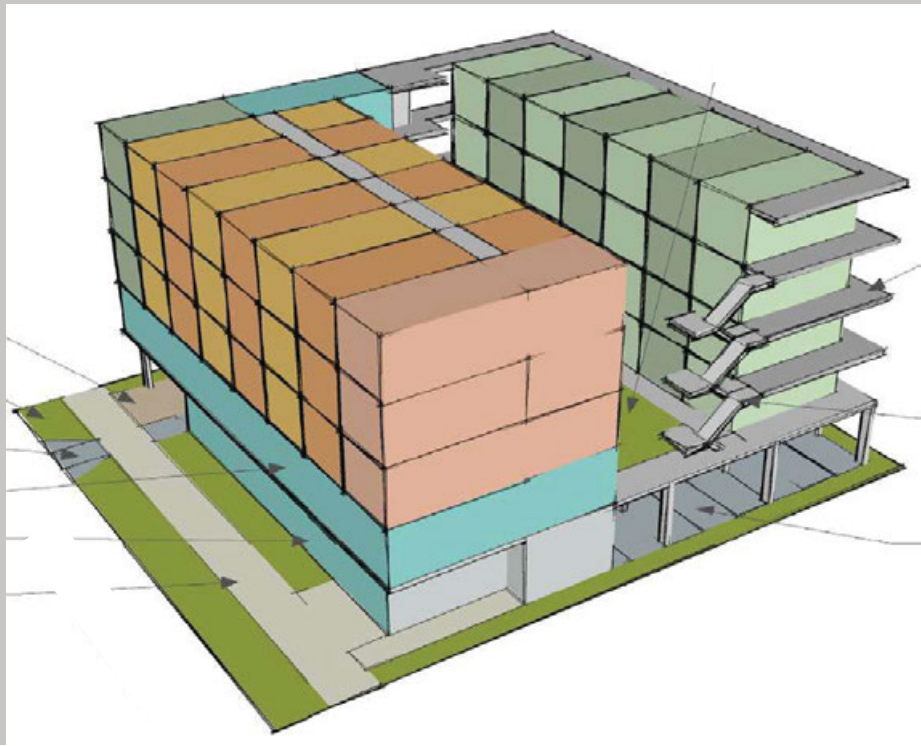
CBC 711

WHAT IS A HORIZONTAL ASSEMBLY?

- A floor or roof assembly required to have a fire resistance rating such as for occupancy separations and fire area separations
- May be constructed with any materials permitted by the construction type
- Occupancy separation: Fire resistance ratings per CBC Table 508.4
- Required to be continuous without vertical openings except as permitted in CBC 712
- Supporting construction required to have same fire-resistance rating as the horizontal assembly being supported (with exceptions per CBC 711.2.3)
- Other requirements for openings, penetrations, joints

BUILDING CONFIGURATION OPTIONS

THERE ARE MULTIPLE WAYS TO CLASSIFY A BUILDING. CHALLENGE TRADITION AND CONSIDER ALL OPTIONS IN AN EFFORT TO ACHIEVE THE MOST COST EFFECTIVE SOLUTION



BUILDING CONFIGURATION OPTIONS

EXAMPLE:

5-story building

1st floor: mixed-use, retail

2nd-5th floors residential

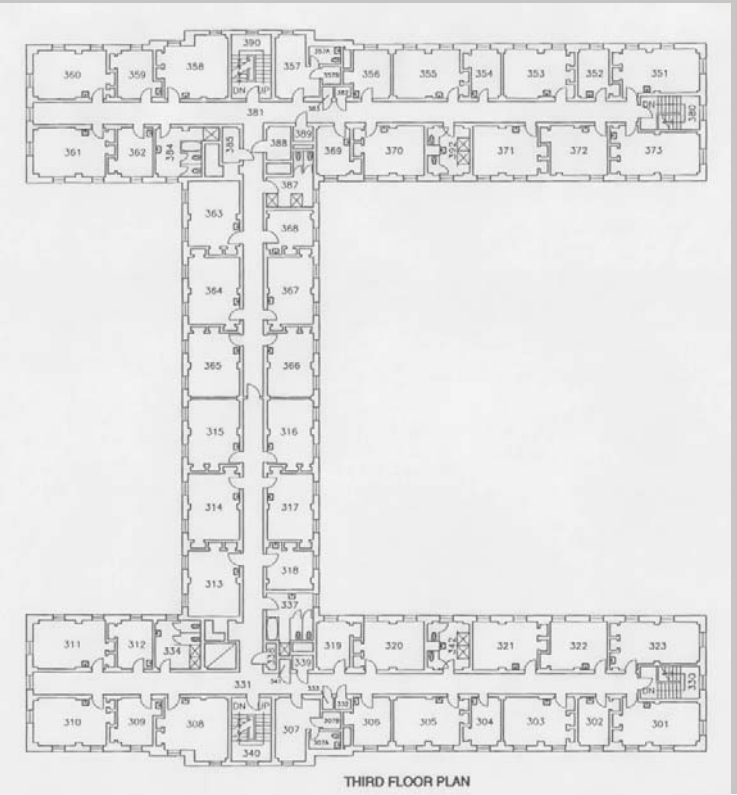
Options:

4 stories of Type VA over a 1-story Type IA podium (CBC 510.2)

5 stories of Type IIIA, no fire wall, separated occupancies

5 stories of Type IIIB with fire wall(s), separated occupancies

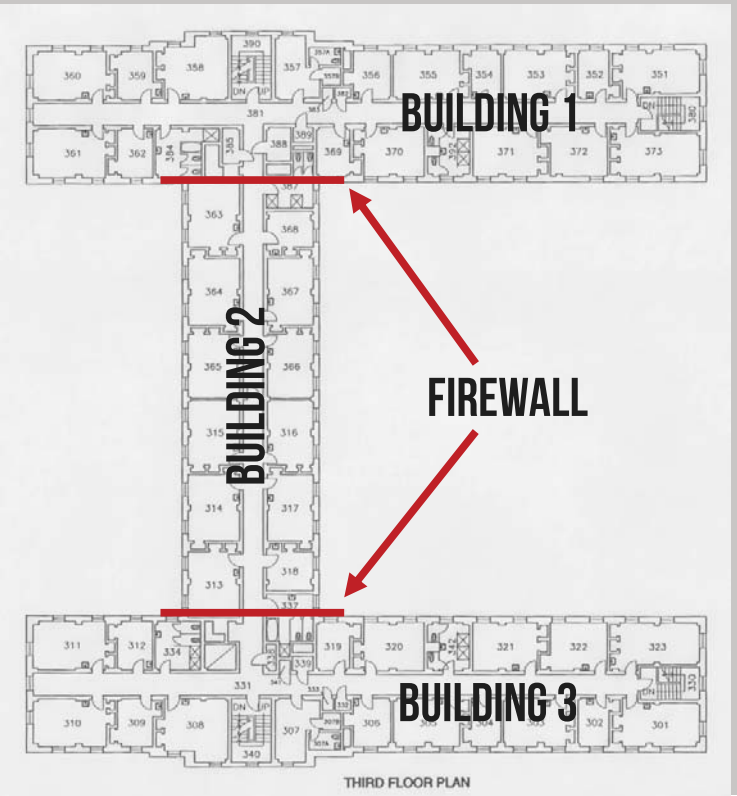
BUILDING CONFIGURATION OPTIONS



EXAMPLE:

T- AND L-SHAPED BUILDINGS – COMMON IN HOTELS, OFTEN WITH LARGE FLOOR AREAS

BUILDING CONFIGURATION OPTIONS



These building configurations may lend themselves well to use of fire walls at building intersections.

Minimize length/impact of fire walls while maximizing allowable building area, which may allow lower construction type (i.e. Type VA instead of IIIA)

Questions? Ask me anything.

Mike Romanowski, SE

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Please take our survey!

901 East Sixth, Thoughtbarn-Delineate Studio, Leap!Structures, photo Casey Dunn