

# Concealed Spaces in Wood-Frame and Mass Timber Construction: Dropped Ceilings, Sprinklers, Fireblocking and Draftstopping



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WoodWorks – Wood Products Council

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



# Course Description

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Concealed spaces—e.g., dropped ceilings or soffits—are common in light wood-frame and 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 and mass timber elements treated differently than cavities in light-wood frame construction? Adding to the perplexity is the fact that some requirements come from the International Building Code (IBC) while others come from the NFPA 13 sprinkler standard. This webinar will address these questions and provide practical solutions and details for the protection of concealed spaces in multi-family and commercial wood construction.

# Learning Objectives

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1. Discuss code requirements for the use of sprinklers in commercial and multi-family buildings, highlighting the fact that sprinkler code requirements are independent of structural materials used.
2. Review common methods of protecting combustible framing materials within concealed spaces in dropped ceilings and soffits.
3. Highlight IBC and NFPA 13 requirements for the protection of wood joists, trusses and mass timber panels 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 in multi-family and commercial projects.

# Outline

- » Code Requirements for Concealed Spaces
- » Light Wood-Framing: Concealed Spaces, Sprinkler Protection and Assembly Impacts
- » Mass Timber: Concealed Spaces, Dropped Ceilings, Soffits & RAF



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



# Outline

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

# Concealed Spaces

- Currently, IBC 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 ceiling, soffit, plenum, raised access floor



Credit: Global IFS

Credit: Harbor Bay Real Estate Advisors/INTRO

# Concealed Spaces

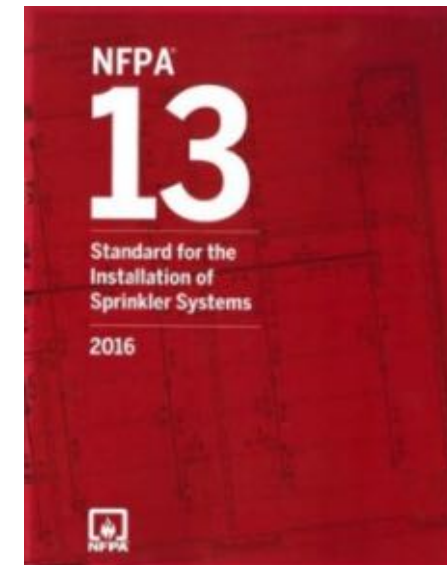
- The main item covered today is how to address the presence of combustible materials within concealed spaces
- IBC only dictates if a concealed space is or isn't permitted in Type IV-HT (*changes in 2021 IBC*)
- In all other construction types, concealed spaces are permitted

**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.



# Concealed Spaces

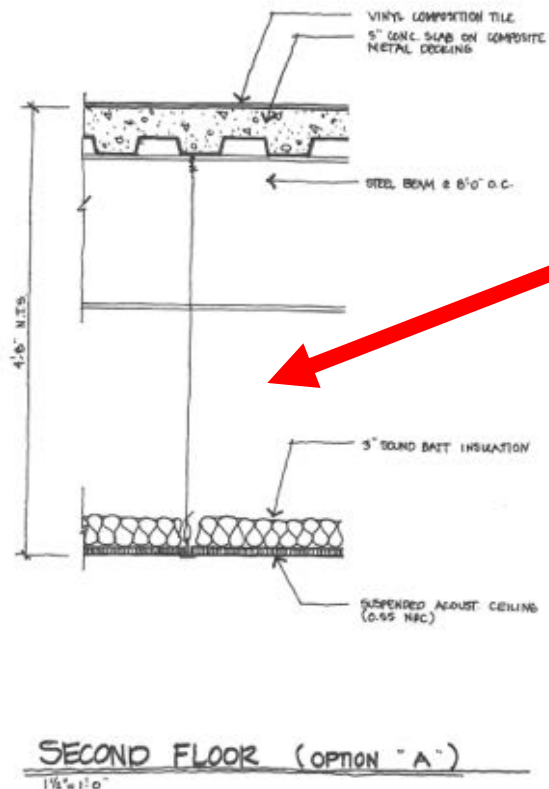
- When combustible materials are present in a concealed space, IBC notes fireblocking and draftstopping requirements
- IBC notes when a building is required to have an automatic sprinkler system
- NFPA (not IBC) dictates the requirements for protection of combustible concealed spaces
- Some of the IBC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



# Concealed Spaces: Fireblocking & Draftstopping

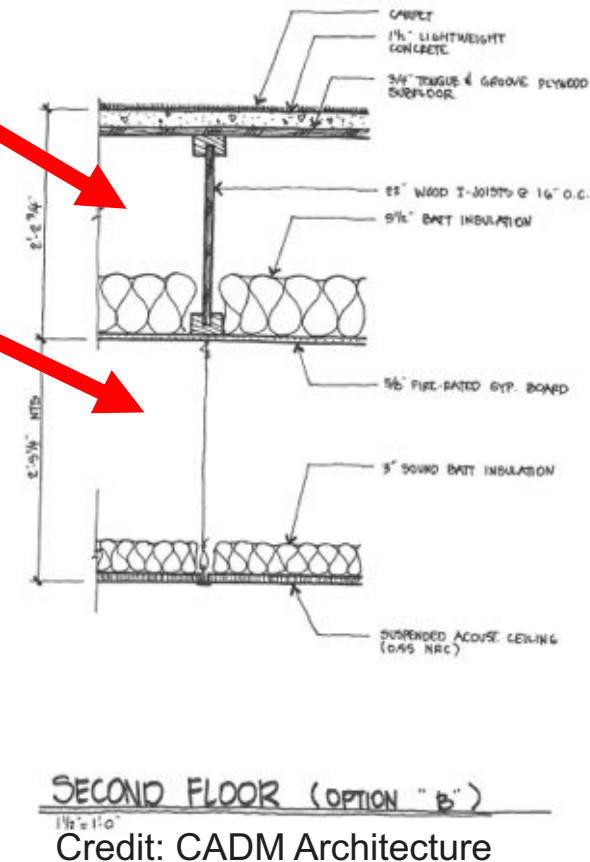
IBC Commentary to Section 718.1:

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



Combustible  
concealed space

Noncombustible  
concealed space



# Concealed Spaces: Fireblocking & Draftstopping

IBC 718.2 & 718.3:

- Fireblocking: prevents movement of flame and hot gases through small concealed space (eg. wall stud cavity)
- Draftstopping: prevents movement of flame and hot gases through large concealed spaces (eg. floor cavity or attic)

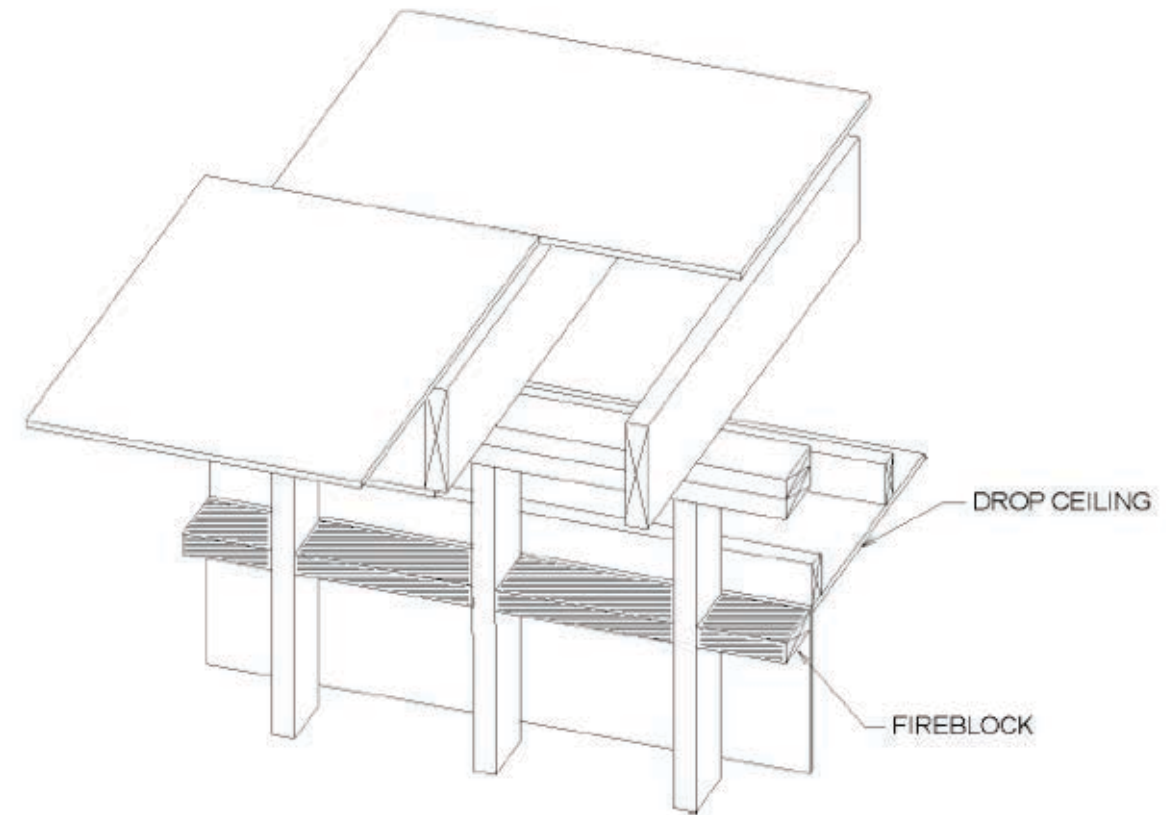


# Concealed Spaces: Fireblocking

## IBC 718.2: 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 installed as tested for the specific application.



Commentary Figure 718.2.3(2)  
FIREBLOCKING—DROP CEILING



# Concealed Spaces: Fireblocking

IBC 718.2: Where is fireblocking required?

- To cut off concealed draft openings (both vertical and horizontal)
- At interconnections between concealed vertical stud wall spaces and concealed horizontal spaces (eg. floor assembly)
- Between membrane penetrations in fire-rated walls

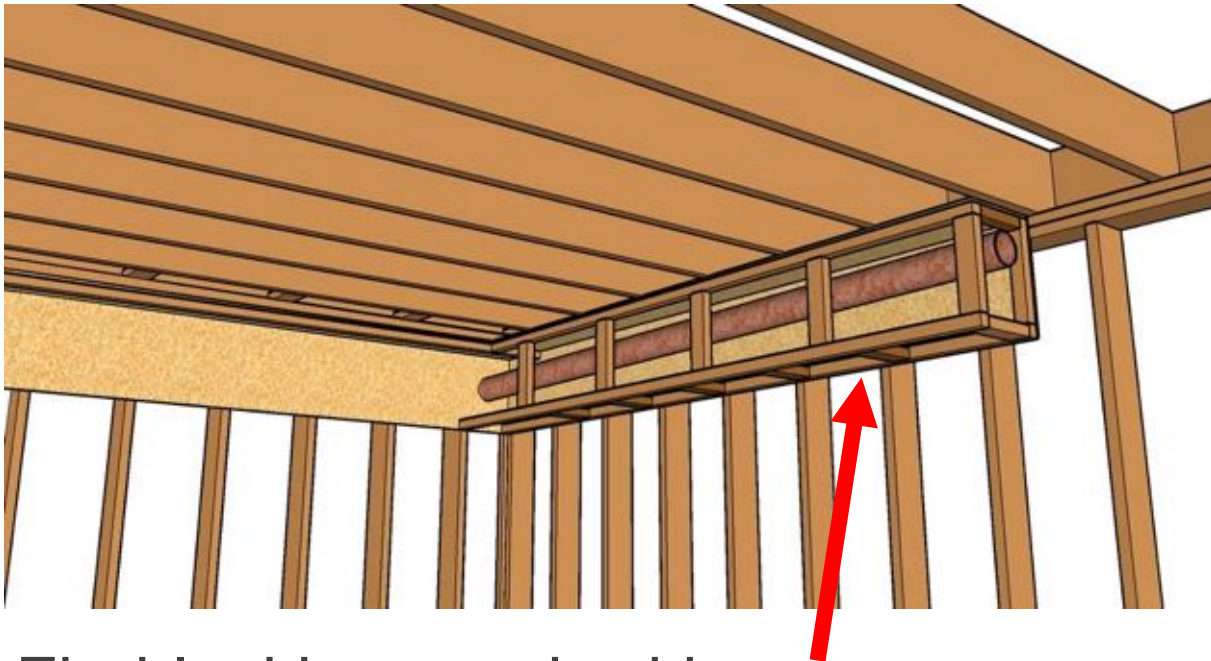


fireblocking

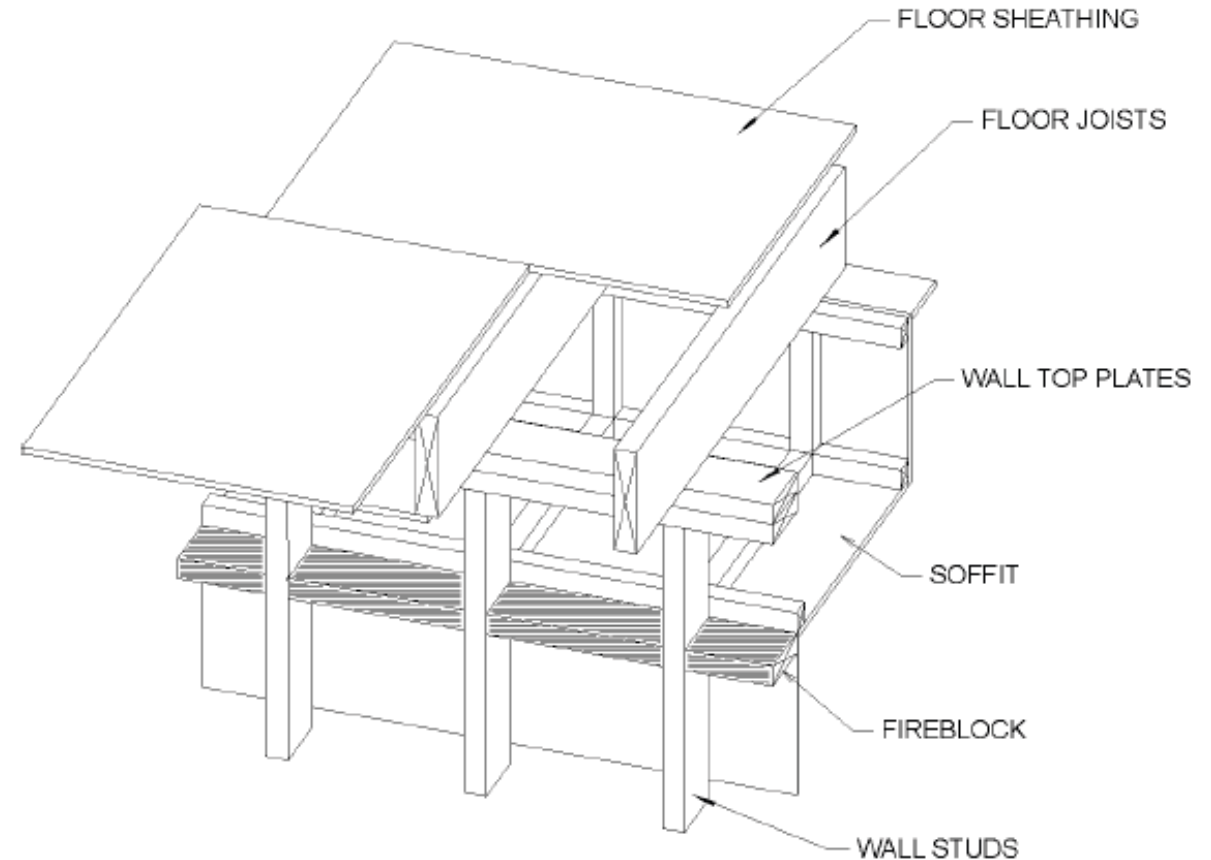
# Concealed Spaces: Fireblocking

IBC 718.2: 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

IBC 718.2: 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

IBC 718.2: Where is fireblocking required?

**718.2.2 Concealed wall spaces.** *Fireblocking shall be provided in concealed spaces of stud walls and partitions, including furred spaces, and parallel rows of studs or staggered studs, as follows:*

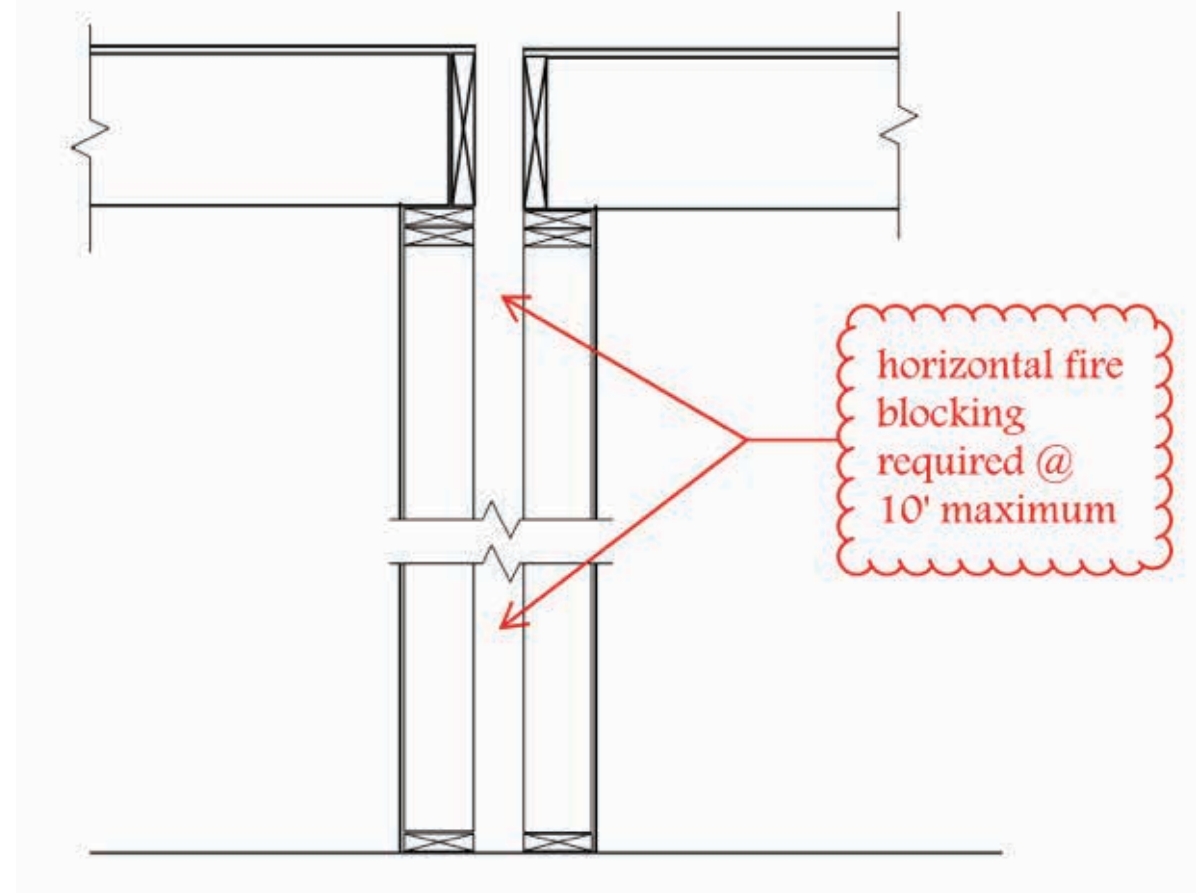
1. Vertically at the ceiling and floor levels.
2. Horizontally at intervals not exceeding 10 feet (3048 mm).



# Concealed Spaces: Fireblocking

IBC 718.2: Where is fireblocking required?

- In the space between the wall and floor assembly
- This is often done with mineral wool so the acoustical performance is not affected.



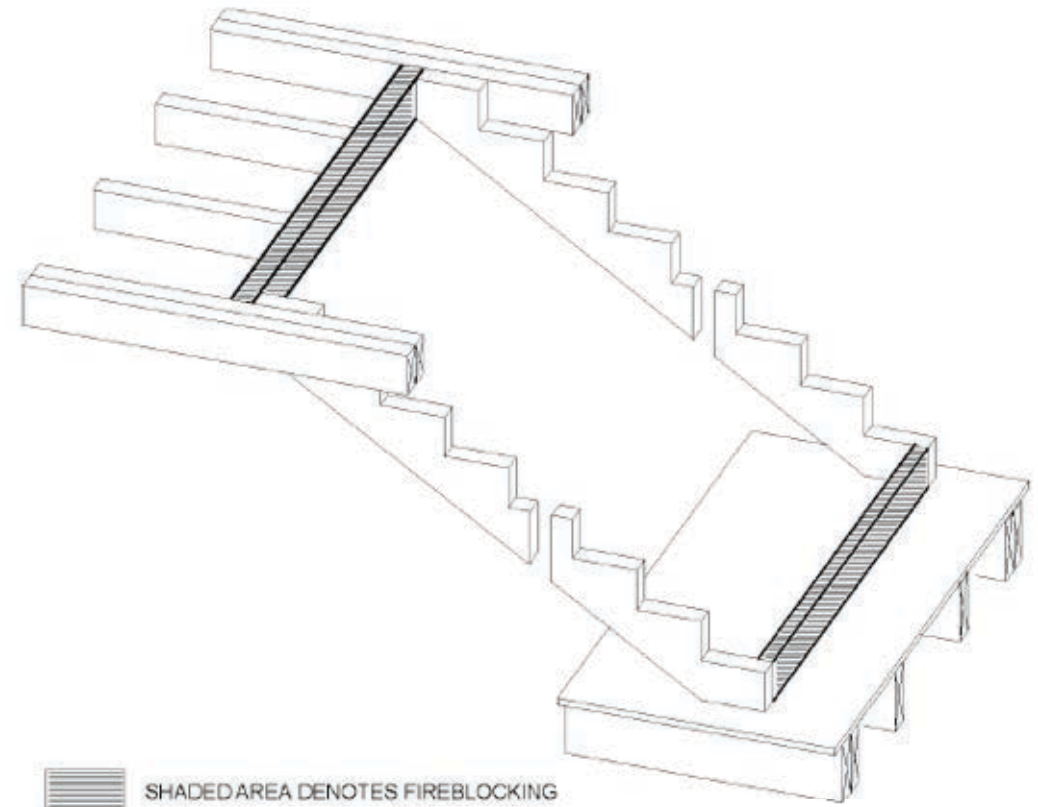
# Concealed Spaces: Fireblocking

IBC 718.2: Where is fireblocking required?

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



Fireblocking required here

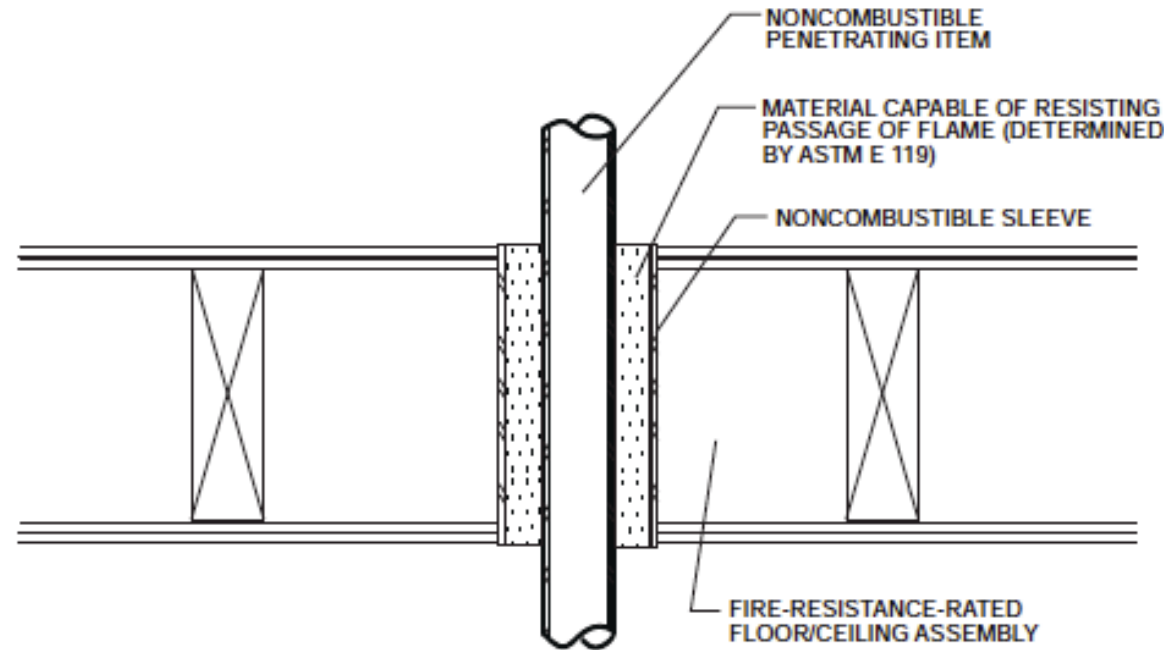


Commentary Figure 718.2.4  
FIREBLOCKING—STAIRS

# Concealed Spaces: Fireblocking

IBC 718.2: Where is fireblocking required?

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



EXAMPLE  
ANNULAR SPACE PROTECTION  
• SECTION 712.4.1, EXCEPTION 1

# Concealed Spaces: Fireblocking

IBC 718.2: Where is fireblocking required?

- In concealed spaces of exterior wall coverings (eg. rainscreen)
- 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 per 718.2.6

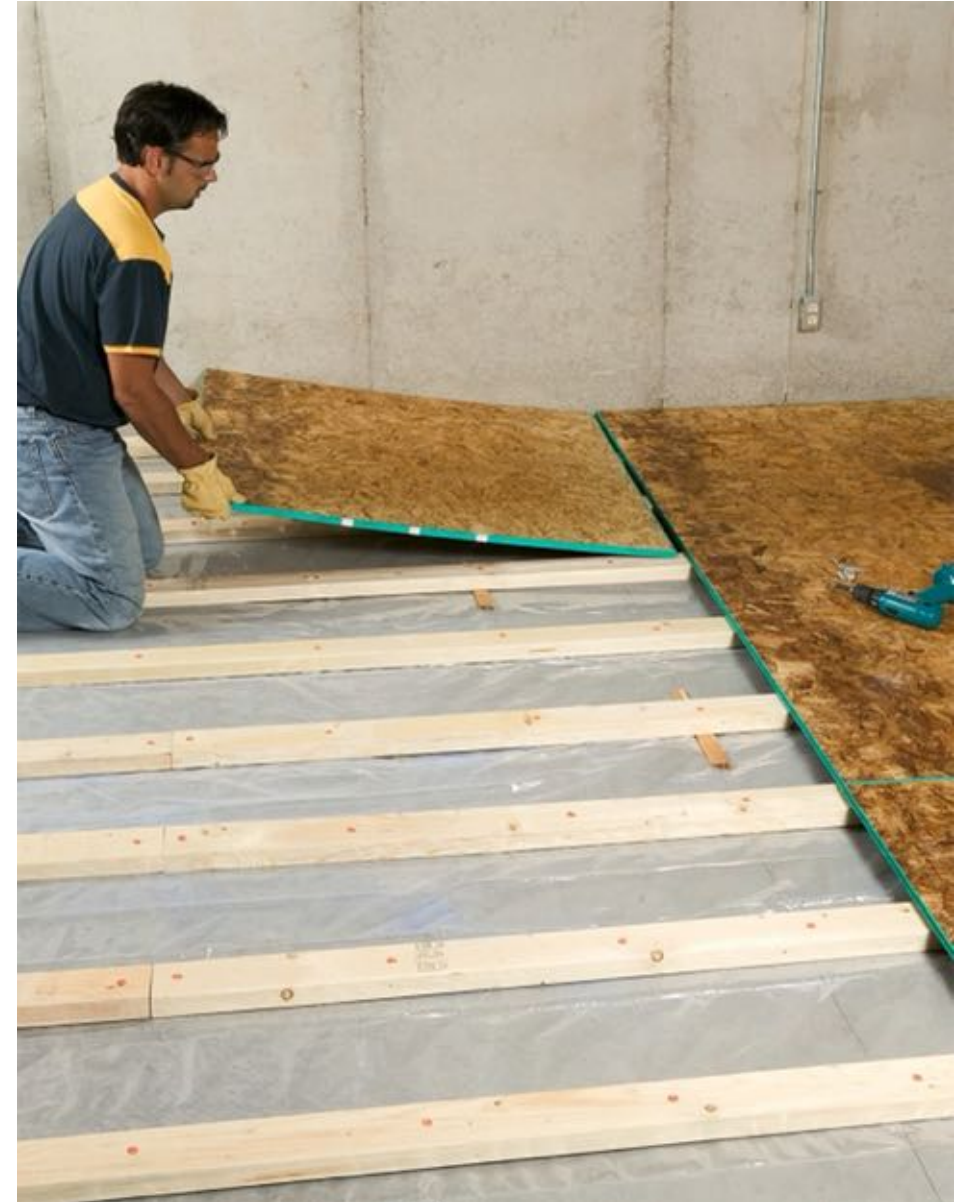




# Concealed Spaces: Fireblocking

IBC 718.2: Where is fireblocking required?

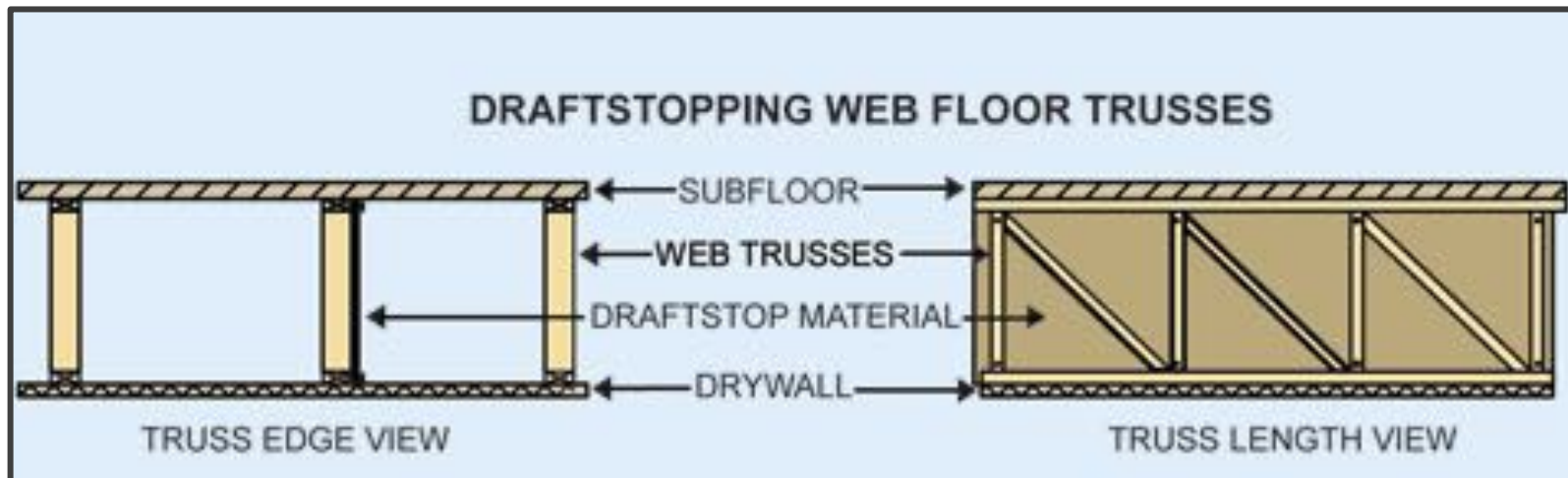
- When wood sleepers are used for laying wood flooring on masonry or concrete fire resistance-rated floors
- Space between the floor slab and underside of wood flooring shall be fireblocked in areas not to exceed 100 sf
- Filled solidly under permanent partitions



# Concealed Spaces: Draftstopping

IBC 718.3: What can act as draftstopping?

- $\frac{1}{2}$ " gypsum board
- $\frac{3}{8}$ " wood structural panel or particleboard
- 1" nominal lumber
- Cement fiberboard
- Batts or blankets of mineral wool or glass fiber



# Concealed Spaces: Draftstopping

IBC 718.3, 718.4 & 708.4.2: Where is draftstopping required?

- Where horizontal assemblies intersect fire partitions
- Recall common types of fire partitions:
  - Dwelling unit separation walls for Group I-1 or Group R occupancies
  - Corridor walls
  - Other applications as noted in 708.1

Example fire partition



Credit: Harbor Bay Real Estate Advisors/INTRO



# Concealed Spaces: Draftstopping

IBC 718.3 & 708.4.2: Where is draftstopping required?

- Where horizontal assemblies intersect fire partitions
- When the fire partition extends to the underside of floor/roof sheathing above, no additional draftstopping is required



Fire partition extends to underside of floor sheathing

No fireblocking or draftstopping required



# Concealed Spaces: Draftstopping

IBC 718.3 & 708.4.2: Where is draftstopping required?

- When the fire partition does not extend to the underside of the floor/roof sheathing, 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



Fireblocking or draftstopping required above fire partition, up to underside of floor sheathing

Fire partition does not extend to underside of floor sheathing

# Concealed Spaces: Draftstopping

IBC 718.3 & 708.4.2: Where is draftstopping required?

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



Fireblocking or draftstopping not required if sprinkler protection within concealed space above fire partition and underside of floor sheathing

Fire partition does not extend to underside of floor sheathing

# Concealed Spaces: Draftstopping

IBC 718.3 & 708.4.2: Where is draftstopping required?

- **Summary: for floor/roof to fire partition intersections:**
- Extend the fire partition to the underside of the floor/roof sheathing, or
- If the fire partition does not extend to the underside of the floor/roof sheathing, either:
  - Provide fireblocking or draftstopping in line with the fire partition to the underside of the floor/roof sheathing, or
  - Provide sprinkler protection for the concealed space between the top of fire partition and underside of floor/roof sheathing





# Concealed Spaces: Draftstopping

IBC 718.3 & 708.4.2: Where is draftstopping required?

- **Other exceptions:**
  - Fireblocking/draftstopping not required above fire partitions in:
  - Group R-2 occupancies with fewer than 4 dwelling units
  - Group R-3 occupancies with fewer than 3 dwelling units
- 
- Other exception: In Group R-2 occupancies, no more than four stories and 60 feet, attic space may be subdivided by draftstopping into areas not exceeding 3,000 square feet, or above every two dwelling units, whichever is smaller.

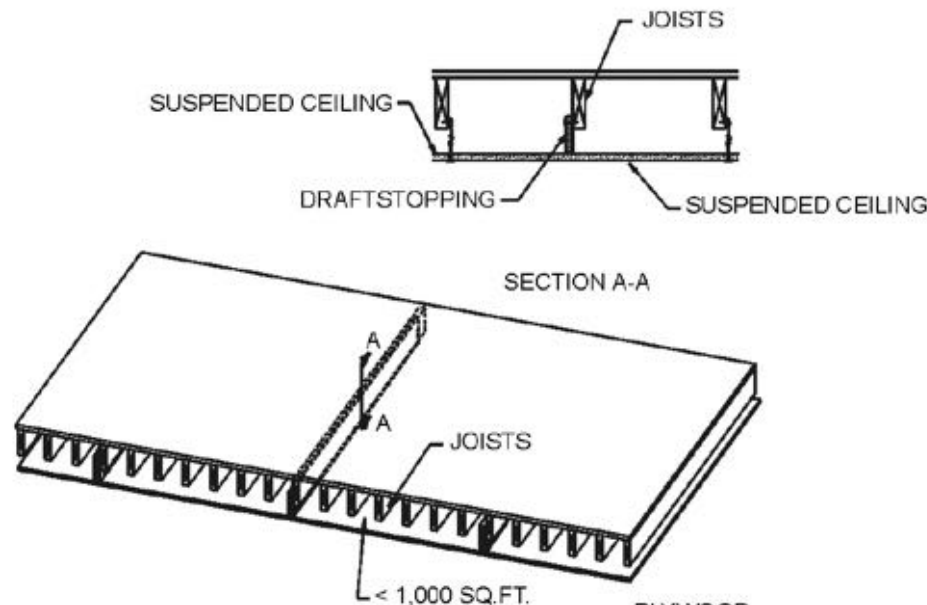




# Concealed Spaces: Draftstopping

IBC 718.3 & 708.4.2: Where is draftstopping required?

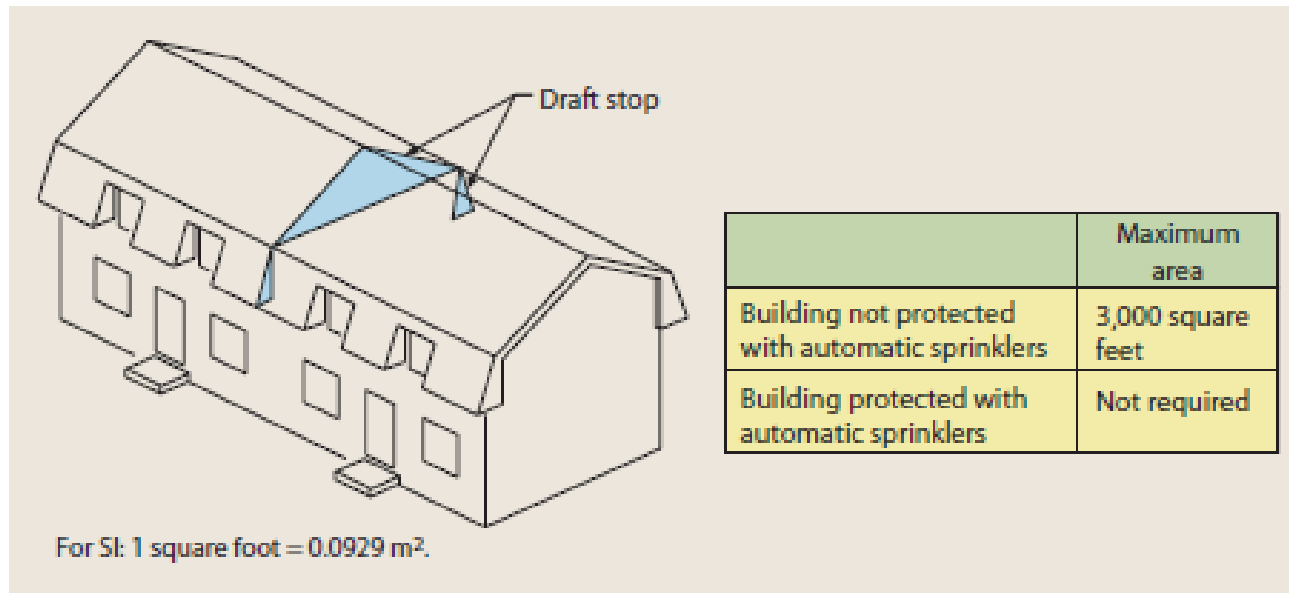
- **Floor assemblies in other than Group R occupancy buildings:**
- Draftstopping required to subdivide combustible floor/ceiling assemblies so that horizontal floor areas do not exceed 1,000 square feet
- Buildings equipped with an NFPA 13 sprinkler system are exempt from this requirement



# Concealed Spaces: Draftstopping

IBC 718.3 & 708.4.2: Where is draftstopping required?

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



# Outline

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



# Concealed Spaces: Sprinkler Protection

When does a building require an automatic sprinkler system?

- **IBC 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

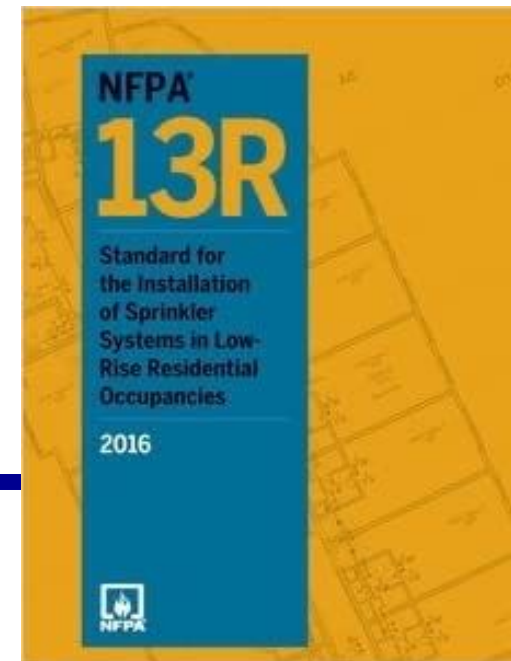
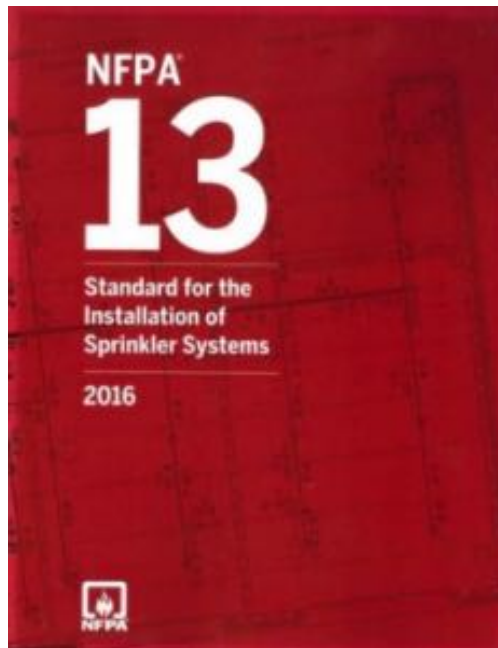
- **In multi-family buildings up to certain heights, either NFPA 13 or 13R are valid options per IBC**
- Allowable building size is smaller with NFPA 13R:
- Generally limited to max of 4 stories and 60 ft
- 2021 IBC revised to only allow the use of NFPA 13R systems when:
  - The floor level of the highest 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

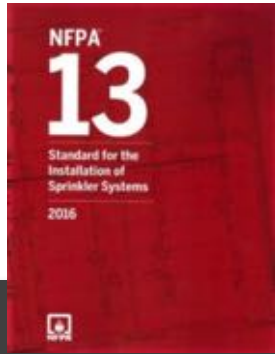
Key differences between NFPA 13 & 13R

- 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



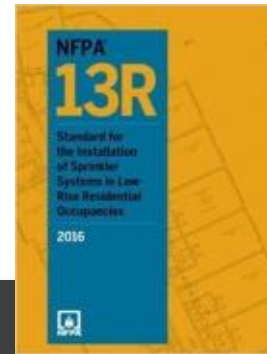
### NFPA 13

Goal: Provide life safety and property protection

Fully sprinklered system, throughout entire building even in concealed spaces (closets, attics)

Can cost more

Permitted for many occupancies, buildings of many sizes, allows greater building size increases



### NFPA 13R

Goal: Provide life safety only

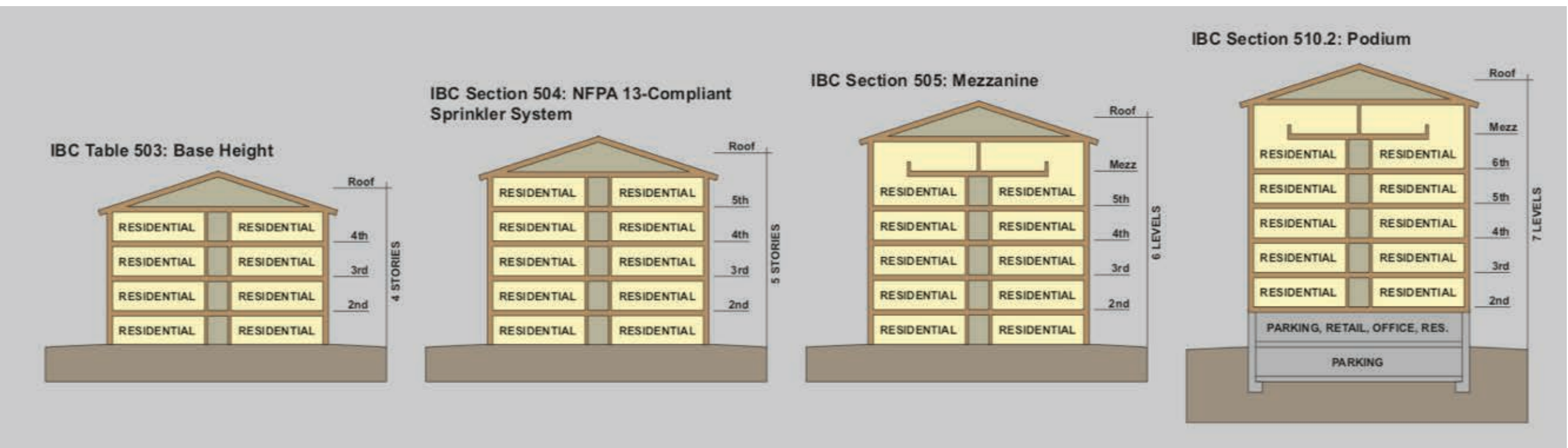
Partially sprinklered system, concealed spaces often don't require sprinklers

Lower levels of water discharge, shorter water supply time can result in smaller pipe sizes, reduce need for storage & pumps

Limited applications, mainly for multi-family up to 4 stories, 60 feet

# Concealed Spaces: Sprinkler Protection

## Common Construction Types for Light-Wood Frame Multi-Family



Type V  
4 Stories

Type III  
5 Stories

Type III  
5 Stories +  
Mezz.

Type III  
5 Stories +  
Mezz. +  
Podium



# Concealed Spaces: Sprinkler Protection

## Common Construction Types for Light-Wood Frame Multi-Family

### Type III

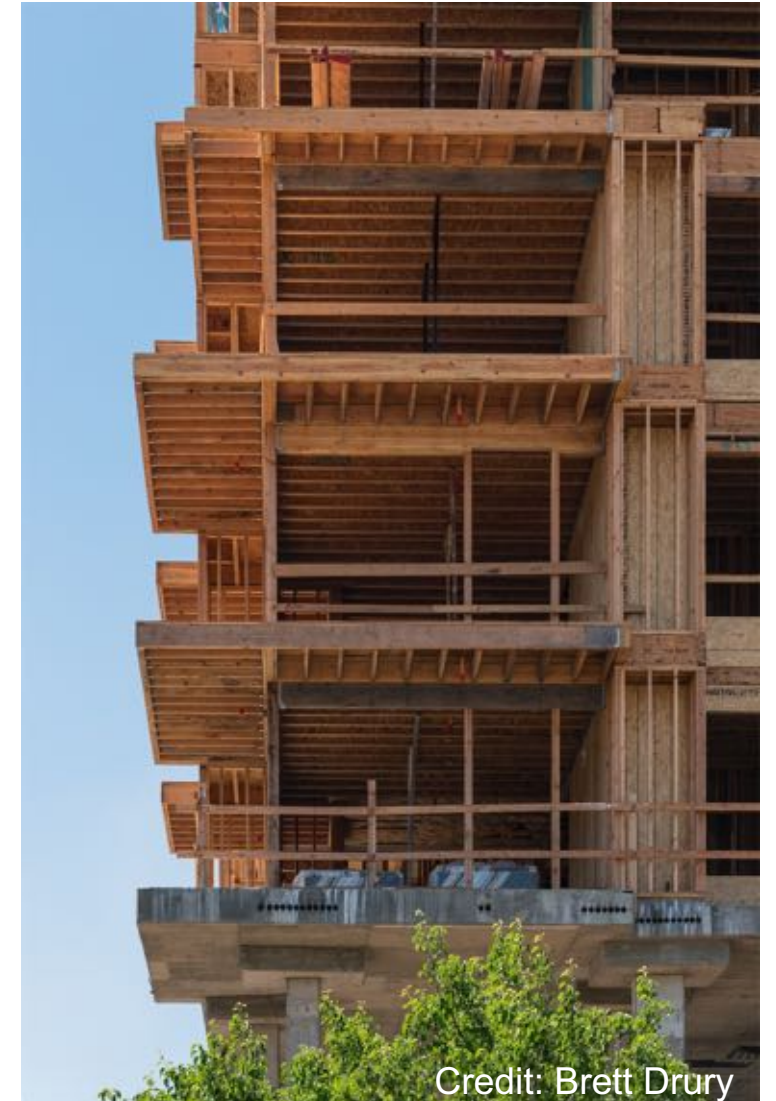
Exterior walls non-combustible (may be FRTW)

Interior elements any allowed by code, including light wood framing and mass timber

### Type V

All building elements are any allowed by code, including light wood framing and mass timber

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



Credit: Brett Drury

# Concealed Spaces: Sprinkler Protection

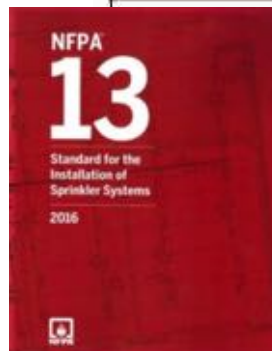
## Allowable Building Sizes for Light-Wood Frame Multi-Family

**TABLE 504.3<sup>a</sup>**  
**ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE**

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R	NS <sup>d, b</sup>	UL	160	65	55	65	55	65	50	40
	S13R	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	85	70	60

**TABLE 504.4<sup>a, b</sup>**  
**ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE**

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R-2	NS <sup>d, b</sup>	UL	11	4	4	4	4	4	3	2
	S13R	4	4	4	4	4	4	4	4	3
	S	UL	12	5	5	5	5	5	4	3

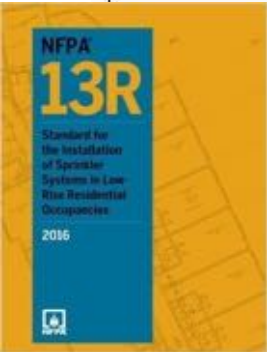


# Concealed Spaces: Sprinkler Protection

## Allowable Building Sizes for Light-Wood Frame Multi-Family

TABLE 504.3 <sup>a</sup> ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE										
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	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R	NS <sup>d, b</sup>	UL	160	65	55	65	55	65	50	40
	S13R	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	85	70	60

TABLE 504.4 <sup>a, b</sup> ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE										
OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION									
	SEE FOOTNOTES	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R-2	NS <sup>d, b</sup>	UL	11	4	4	4	4	4	3	2
	S13R	4	4	4		4	4		4	3
	S	UL	12	5	5	5	5	5	4	3



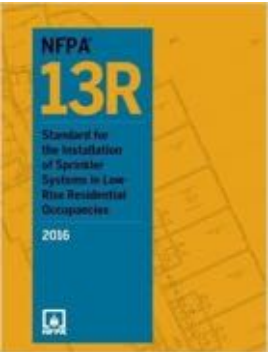
NFPA 13R Height Increase  
Capped at 4 Stories, 60 ft

# Concealed Spaces: Sprinkler Protection

## Allowable Building Sizes for Light-Wood Frame Multi-Family

**TABLE 506.2<sup>a, b</sup>**  
**ALLOWABLE AREA FACTOR ( $A_t$  = NS, S1, S13R, or SM, as applicable) IN SQUARE FEET**

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
R-1	NS <sup>d, h</sup>	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
	S13R									
	S1	UL	UL	96,000	64,000	96,000	64,000	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	61,500	36,000	21,000
R-2	NS <sup>d, h</sup>	UL	UL	24,000	16,000	24,000	16,000	20,500	12,000	7,000
	S13R									
	S1	UL	UL	96,000	64,000	96,000	64,000	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	61,500	36,000	21,000



No area increase  
with NFPA 13R





# Concealed Spaces: NFPA 13

When does NFPA 13 require protection of concealed spaces?

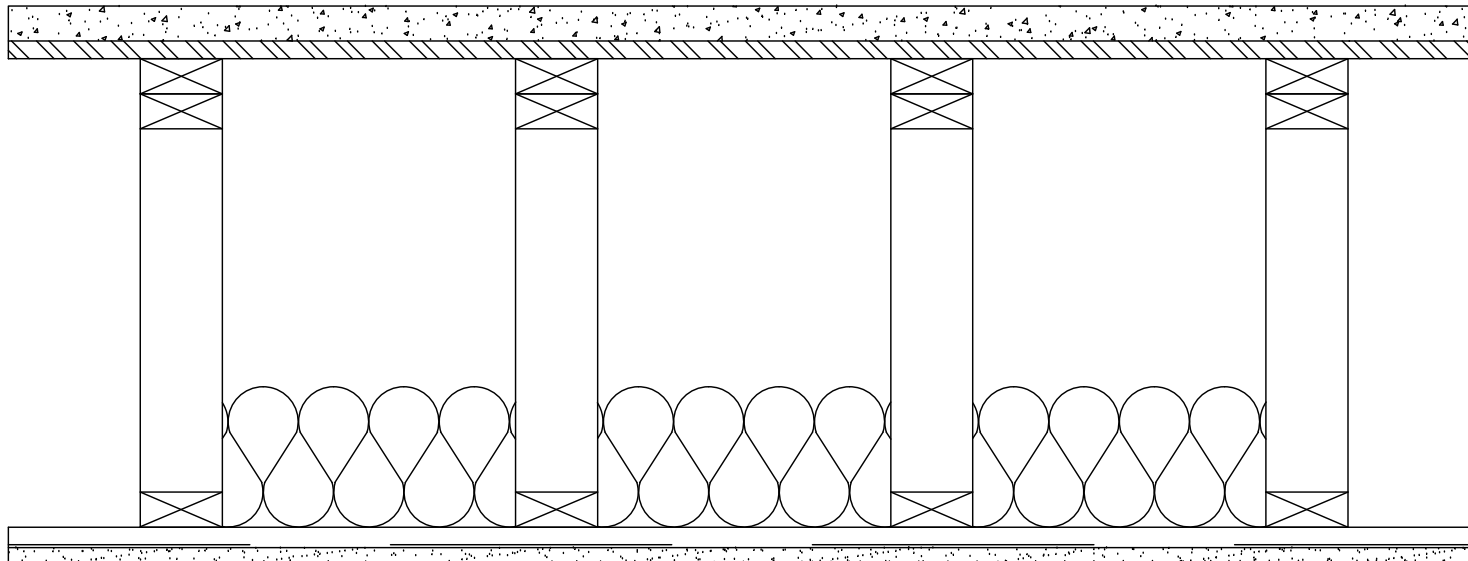


Credit: Armstrong Ceilings

# Concealed Spaces: NFPA 13

When does NFPA 13 require for protection of concealed spaces?

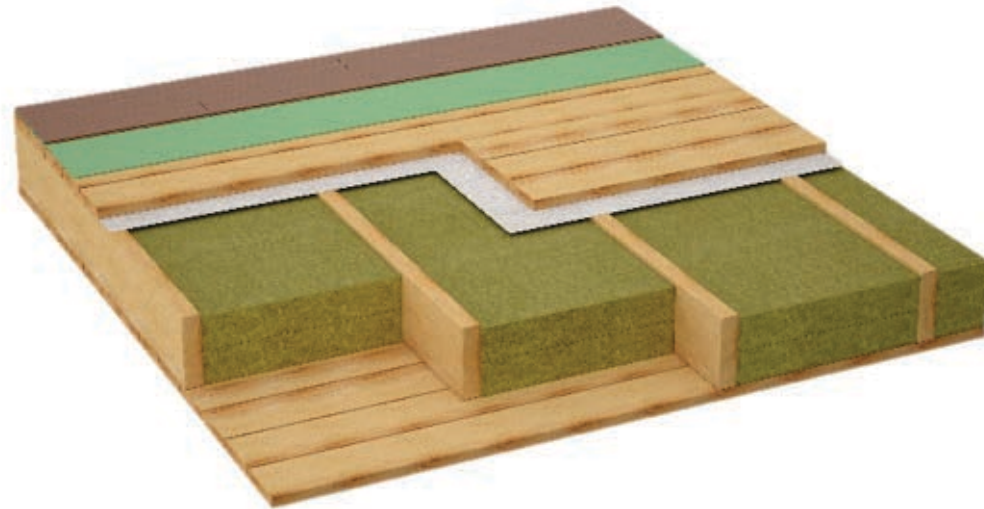
- Combustible concealed spaces such as floor/ceiling and roof/ceiling assemblies may require sprinkler protection per NFPA 13
- NFPA 13 section 8.15.1.1 requires combustible concealed spaces to have sprinkler protection unless one of the alternate options are used



# Concealed Spaces: NFPA 13

## NFPA 13 options for omitting sprinklers in concealed spaces

- When assembly includes bar joists and there is less than 6" from floor/roof deck and ceiling (NFPA 8.15.1.2.4)
- When assembly includes wood joists or similar solid members and ceiling is directly attached to or within 6" of joists (NFPA 8.15.1.2.5)





# Concealed Spaces: NFPA 13

## NFPA 13 options for omitting sprinklers in concealed spaces

- Composite wood joists with ceiling directly attached or attached to metal channels 1" or less in depth
- Requires that joist cavities are firestopped into volumes not exceeding 160 ft<sup>3</sup> with materials equivalent to web construction
- Also requires min. 3.5" batt insulation at bottom of joist cavities when ceiling is attached to metal channels (NFPA 8.15.1.2.6)





# Concealed Spaces: NFPA 13

NFPA 13 options for omitting sprinklers in concealed spaces

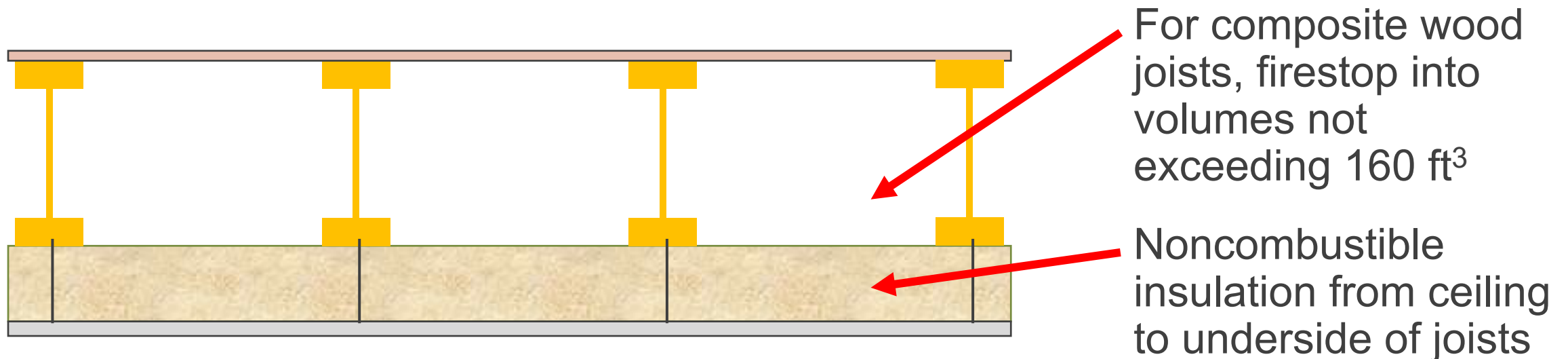
- Concealed spaces filled with noncombustible insulation (2" air gap at top of space is permitted) (NFPA 8.15.1.2.7)



# Concealed Spaces: NFPA 13

## NFPA 13 options for omitting sprinklers in concealed spaces

- Concealed spaces with wood joists or composite wood joists, with noncombustible insulation filling the space from ceiling to underside of joists.
- Requires that composite joist cavities are firestopped into volumes not exceeding 160 ft<sup>3</sup> with materials equivalent to web construction (NFPA 8.15.1.2.8)



# Concealed Spaces: NFPA 13

## NFPA 13 options for omitting sprinklers in concealed spaces

- Concealed spaces with noncombustible or limited combustible ceilings suspended from wood joists or composite wood joists with max. nominal chord width of 2".
- Requires that space from ceiling to underside of joists, and between joists, be filled with noncombustible insulation. Max. 2" air gap allowed at top of insulation (NFPA 8.15.1.2.17)



Noncombustible  
insulation from ceiling  
to within 2" of  
underside of  
sheathing

# Concealed Spaces: NFPA 13

## NFPA 13 options for omitting sprinklers in concealed spaces

- Concealed spaces over small isolated compartments not exceeding 55 ft<sup>2</sup> (8.15.1.2.9)
- Concealed spaces where exposed materials meet specific flame spread requirements or are fire-retardant treated wood (FRTW) (8.15.1.2.10 and 8.15.1.2.11)
- Combustible insulation permitted in some noncombustible concealed spaces (8.15.1.2.12)
- Others as noted in NFPA 8.15





# Balconies – IBC 705.2.3.1

Balconies of combustible construction and not FRT shall be:

- Rated in accordance w/ Table 601 for floors or be of Type IV construction
- shall not exceed 50% of building perimeter



**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	HT	A	B
Primary structural frame <sup>f</sup> (see Section 202)	3 <sup>a, b</sup>	2 <sup>a, b</sup>	1 <sup>b</sup>	0	1 <sup>b</sup>	0	HT	1 <sup>b</sup>	0
Bearing walls									
Exterior <sup>a, f</sup>	3	2	1	0	2	2	2	1	0
Interior	3 <sup>a</sup>	2 <sup>a</sup>	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602								
Exterior									
Nonbearing walls and partitions									
Interior <sup>d</sup>	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1½ <sup>b</sup>	1 <sup>b, c</sup>	1 <sup>b, c</sup>	0 <sup>c</sup>	1 <sup>b, c</sup>	0	HT	1 <sup>b, c</sup>	0

# Balconies – IBC 705.2.3.1

Balconies of combustible construction and not FRT shall be rated in accordance with Table 601 or be of Type IV construction

- Exceptions-
  - Balconies in Type III, IV and V can be of type V construction and shall not require fire resistance rating if sprinkler protection provided
  - Untreated wood is permitted for rails and guardrails



Dry Pendent Sprinkler Illustration: Courtesy of Victaulic

# Balconies – IBC 705.2.3.1

So....

For Type III or V balcony options are:

- **Non-combustible**: no sprinklers, no fire rating
- **FRT**: no fire sprinklers, no fire rating
- **Type IV**: no fire sprinklers, no fire rating
- Non-treated: **with fire sprinkler**, no fire rating
- Non-treated: no sprinkler, **fire rated per 601 & 602**



# IBC Requirements: Cantilevers and Roof Overhangs

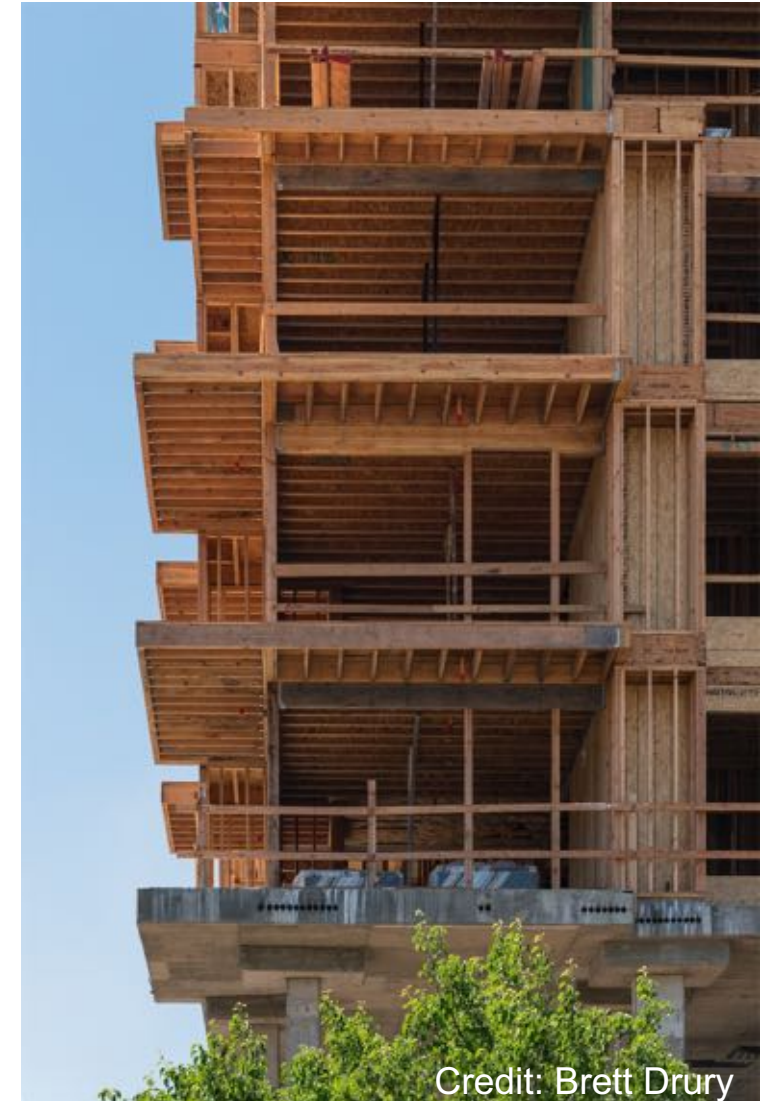
## **705.2.2 Type III, IV or V construction.**

Projections from walls of Type III, IV or V construction shall be of any *approved* material.

## **705.2.3 Combustible projections.**

Combustible projections extending to within 5 feet (1524 mm) of the line used to determine the fire separation distance shall be of not less than 1-hour fire-resistance-rated construction, heavy timber construction, complying with Section 2304.11, FRT wood or as permitted by Section 705.2.3.1.

Type IV construction does not allow any concealed spaces (2018 or earlier IBC), including soffits.



Credit: Brett Drury



# Cantilevers and Roof Overhangs

## NFPA 13-16: 8.15.7 - Exterior Projections

Sprinklers shall be installed under exterior projections exceeding 4' in width.

Exceptions:

Exterior Projection must be constructed with non-combustible, limited-combustible, or FRT material

-or-

Constructed so that exposed finish material is non-combustible, limited-combustible, or FRTW

Either option must be in conjunction with one of the following

- Projection contains only sprinklered concealed spaces
- Combustible concealed spaces filled entirely with non-combustible insulation
- Combustible concealed spaces limited to volume not exceeding 160 ft<sup>3</sup>
- Concealed spaces over small exterior projections not exceeding 55ft<sup>2</sup>



IMAGE CREDIT: BOISE PUBLIC LIBRARY & IDAHO STATESMAN

# Outline

- » Code Requirements for Concealed Spaces
- » Light Wood-Framing: Concealed Spaces, Sprinkler Protection and Assembly Impacts
- » Mass Timber: Concealed Spaces, Dropped Ceilings, Soffits & RAF



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



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



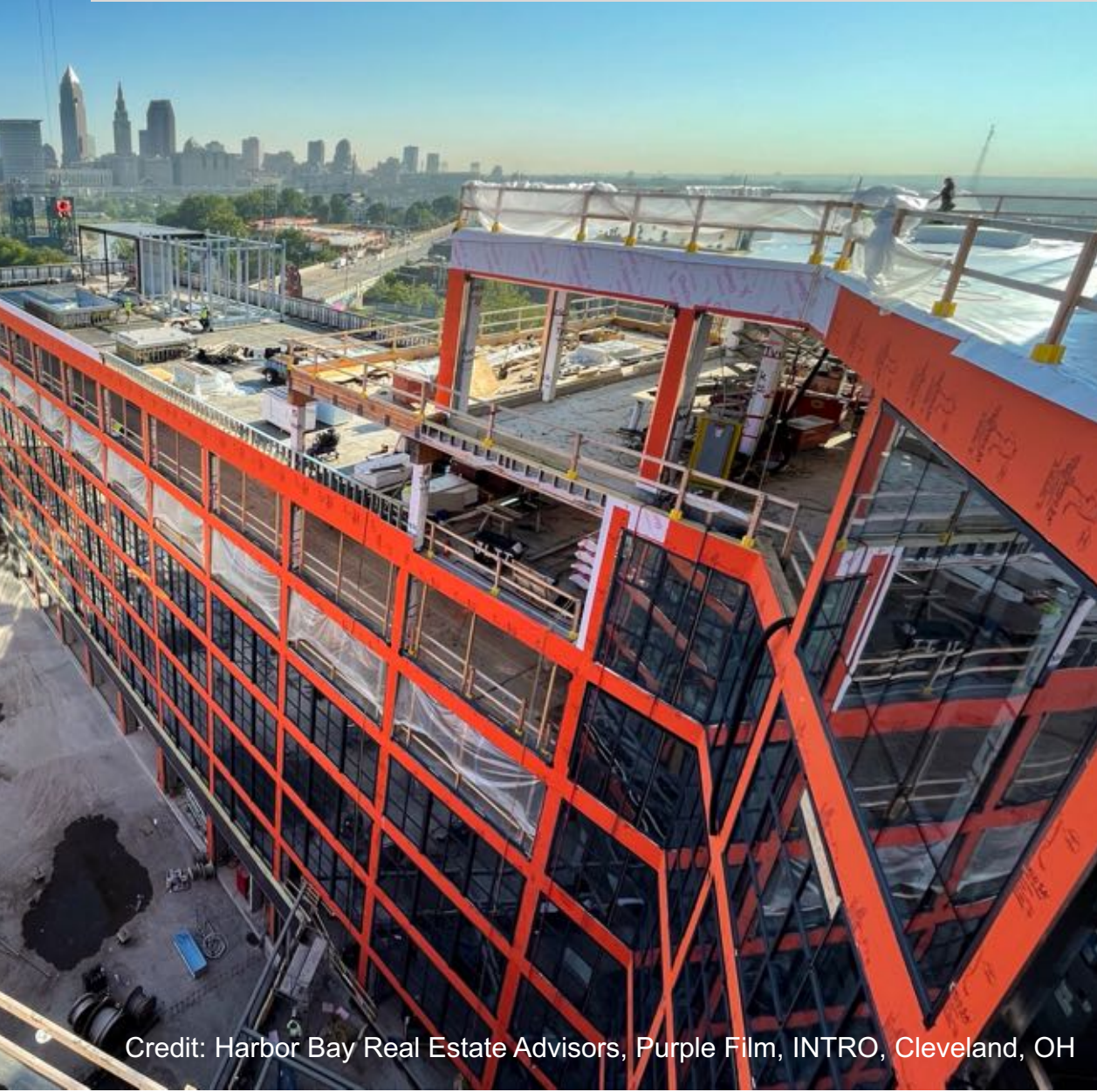
Photo: Ema Peter



Photo: Manasc Isaac  
Architects/Fast + Epp



# Concealed Spaces in Mass Timber Projects

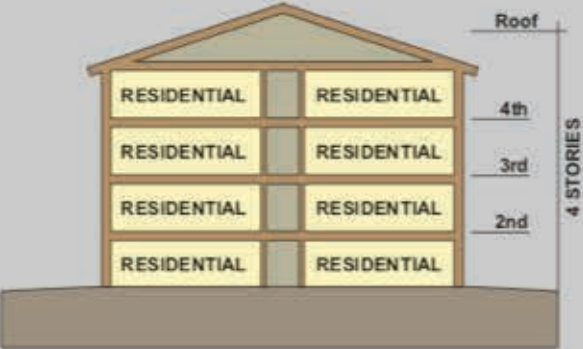


Credit: Harbor Bay Real Estate Advisors, Purple Film, INTRO, Cleveland, OH



# Mass Timber Construction Types

IBC Table 503: Base Height



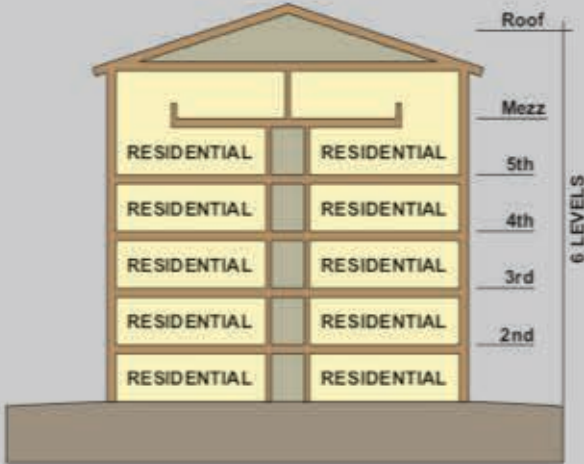
Type V  
4 Stories

IBC Section 504: NFPA 13-Compliant Sprinkler System



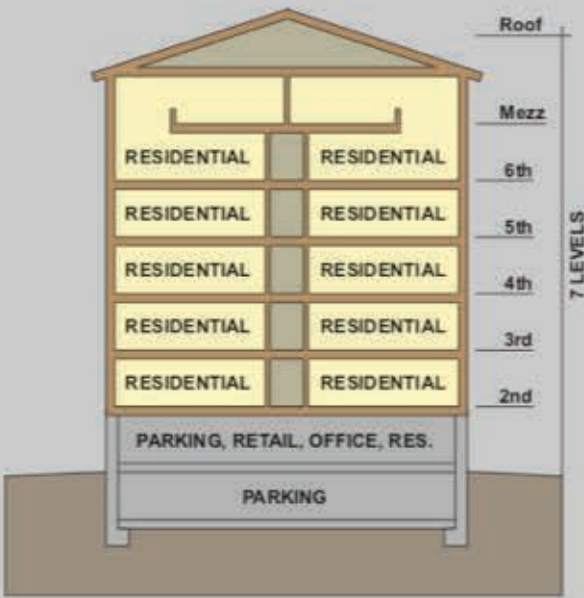
Type III & IV-HT  
5 Stories

IBC Section 505: Mezzanine



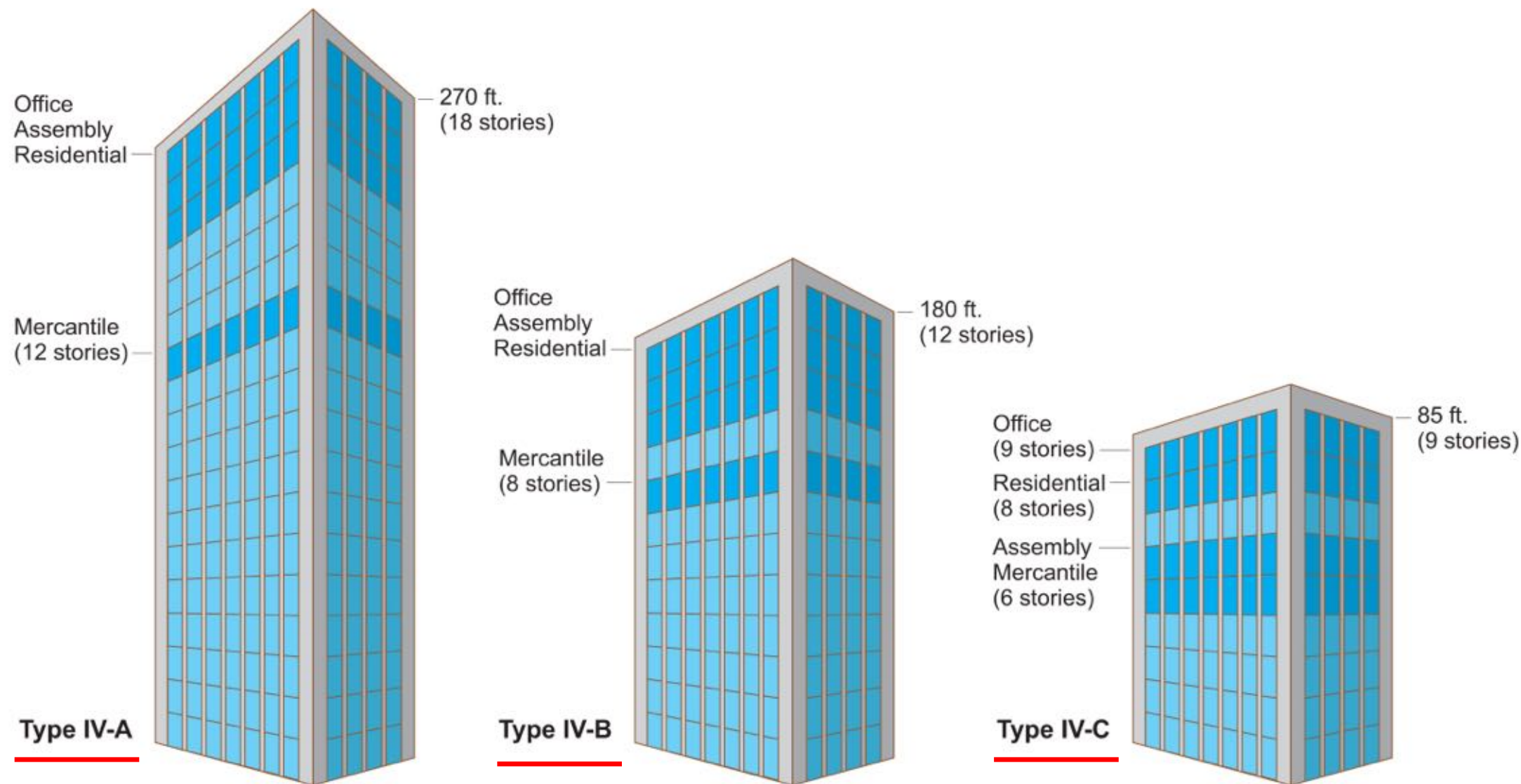
Type III & IV-HT  
5 Stories +  
Mezz.

IBC Section 510.2: Podium

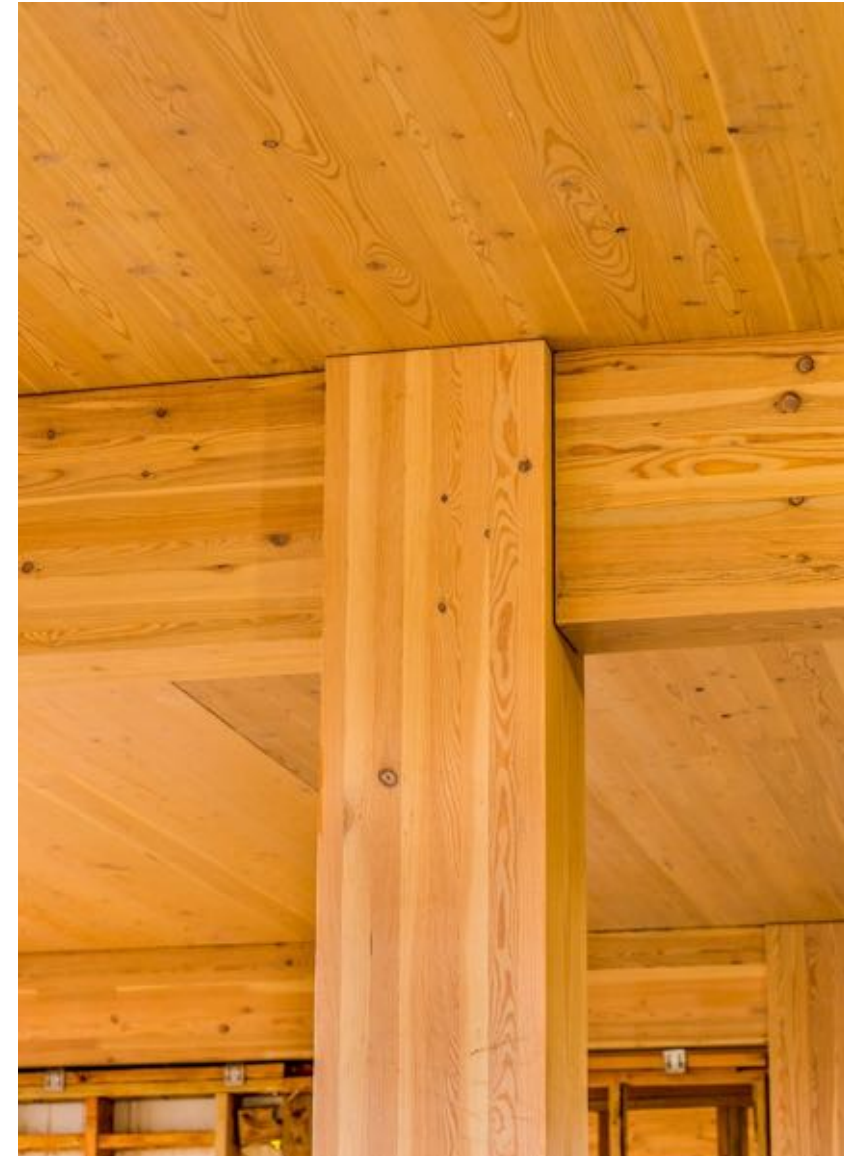


Type III & IV-HT  
5 Stories +  
Mezz. +  
Podium

# Mass Timber Construction Types



# Concealed Spaces in Mass Timber



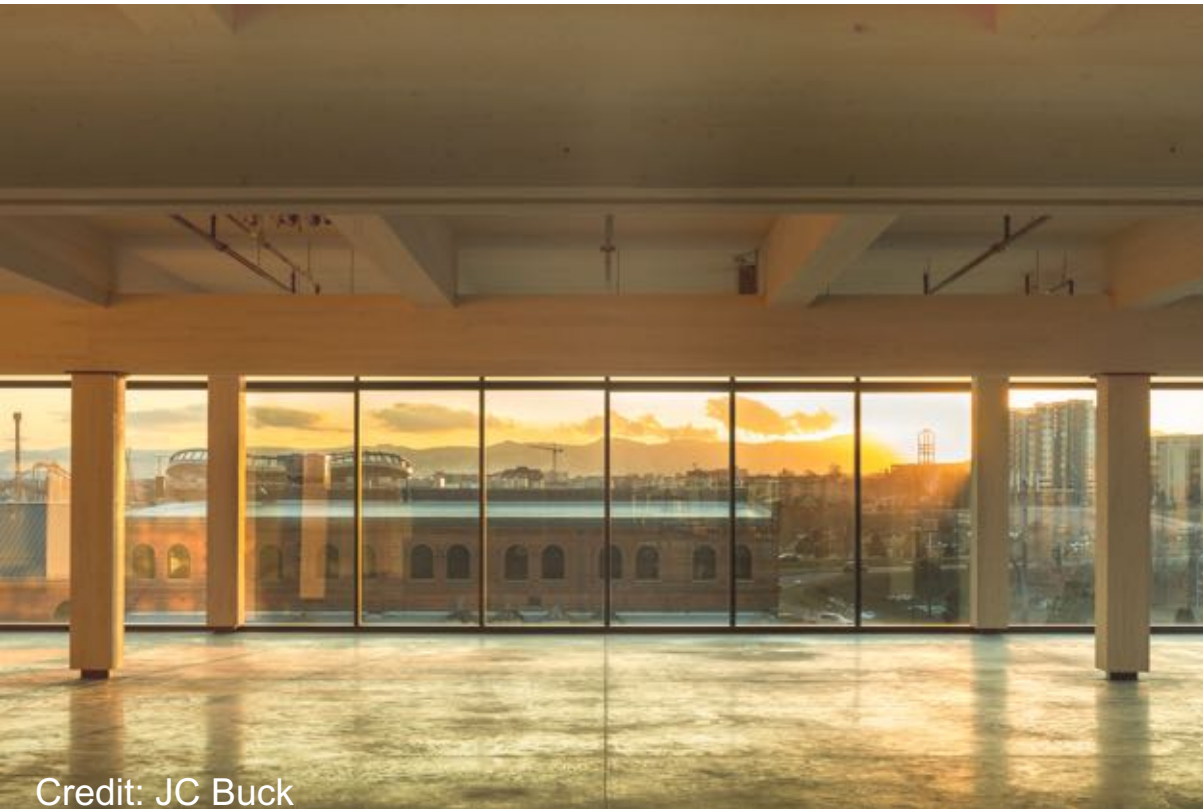
Photos: Baumberger Studio/PATH Architecture/Marcus Kauffman | Architect: Kaiser + PATH



# Concealed Spaces in Mass Timber

## MEP Integration Option 1:

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



Credit: JC Buck



Credit: KL&A Engineers & Builders

# Concealed Spaces in Mass Timber

## MEP Integration Option 2:

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



Credit: Ema Peter/MGA

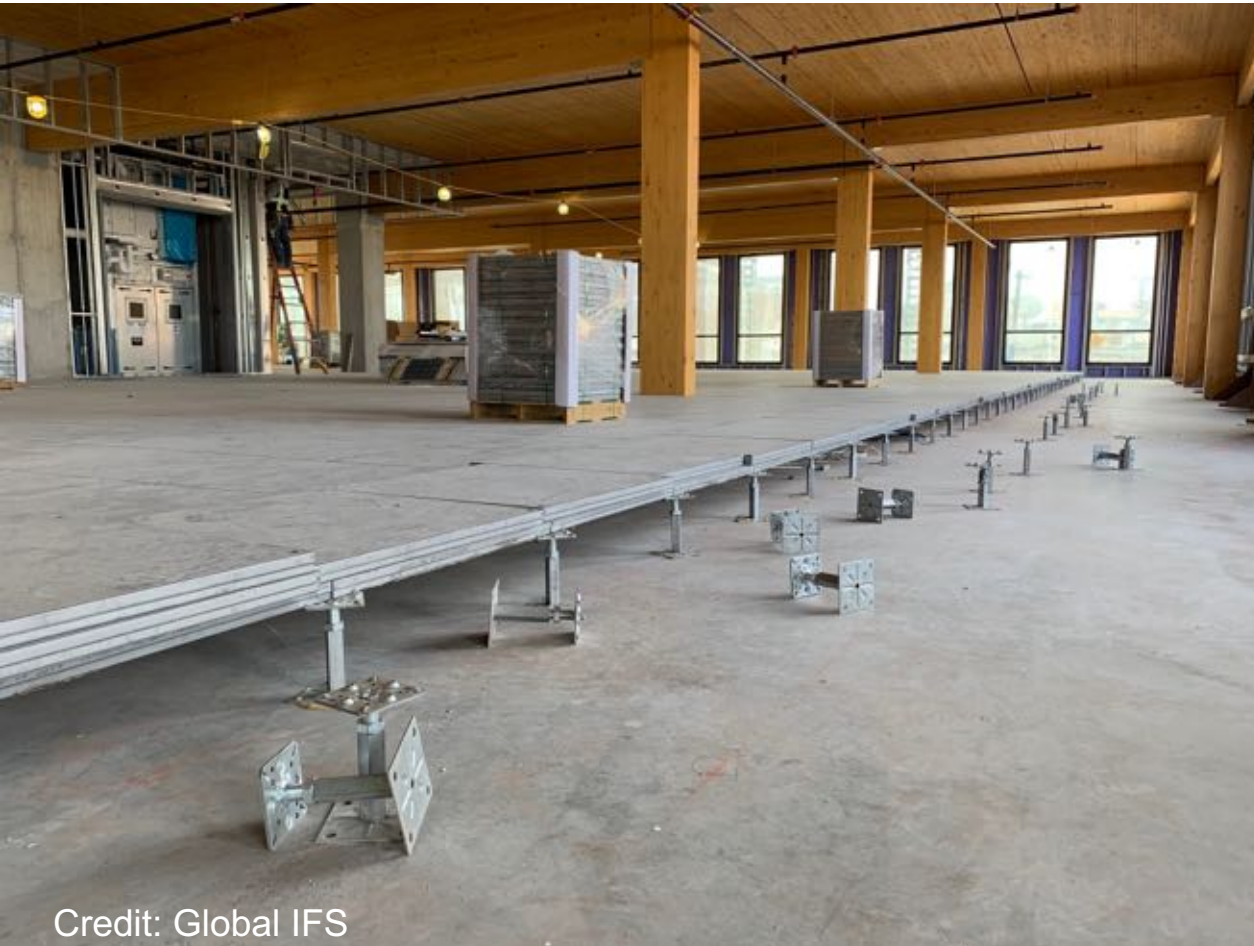




# Concealed Spaces in Mass Timber

## MEP Integration Option 3:

- In raised access floor
- Does create a concealed space



Credit: Global IFS





# Concealed Spaces in Mass Timber

## MEP Integration Option 4:

- In topping slab
- Does not create a concealed space



Credit: Alex Schreyer



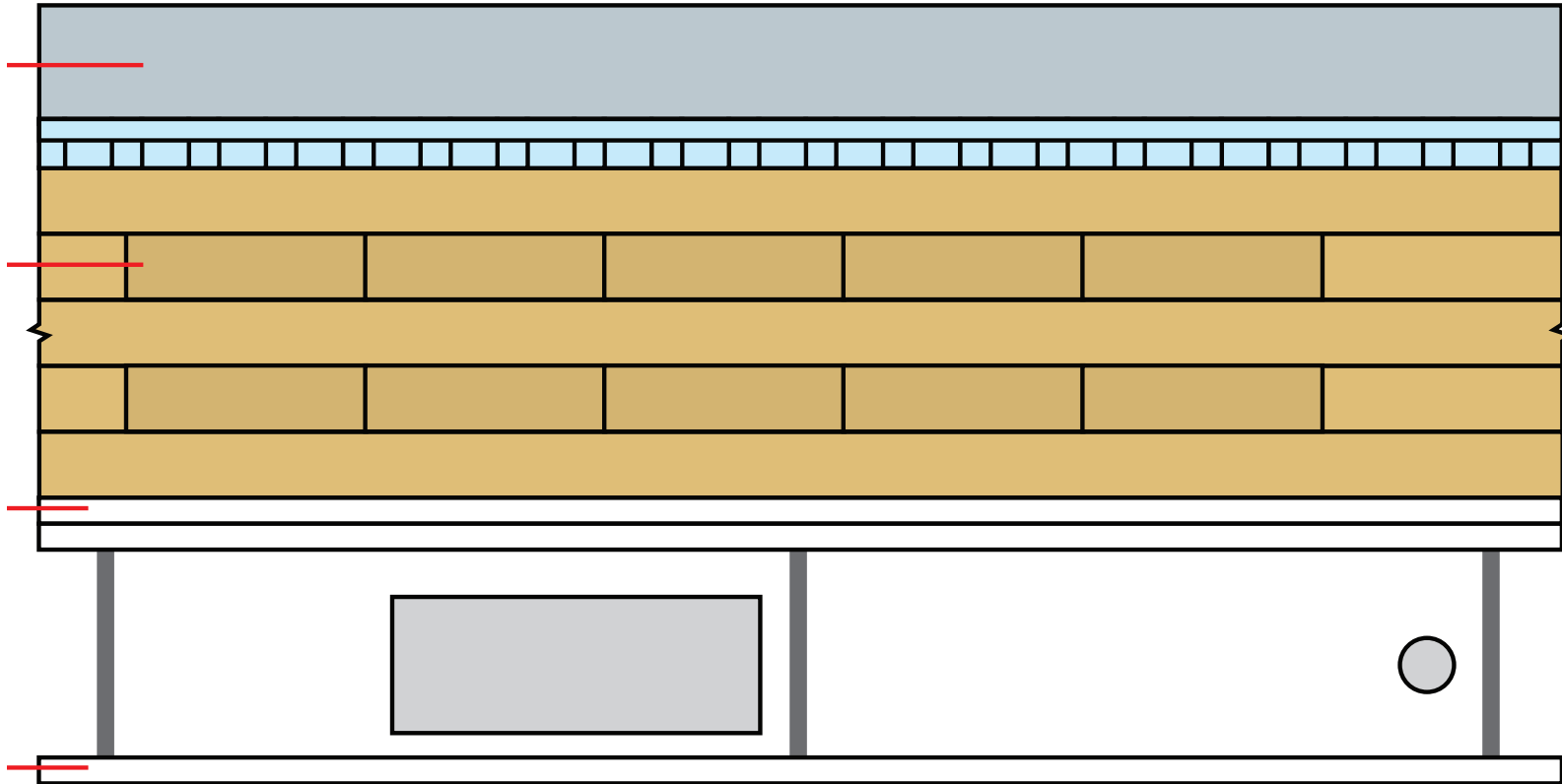
# Concealed Spaces in Mass Timber

## MEP Integration Option 5:

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



# Concealed Spaces in Mass Timber



Code allowances vary with construction type and IBC edition

# Concealed Spaces in Mass Timber

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



Credit: Marcus Kauffman



# Concealed Spaces in Mass Timber

- How are IBC 718 & NFPA 13 requirements for protection of concealed spaces with mass timber realized in Type III & V buildings?
- The same concepts for protection apply as for light-wood frame assemblies, though note specific reference to joist construction in NFPA

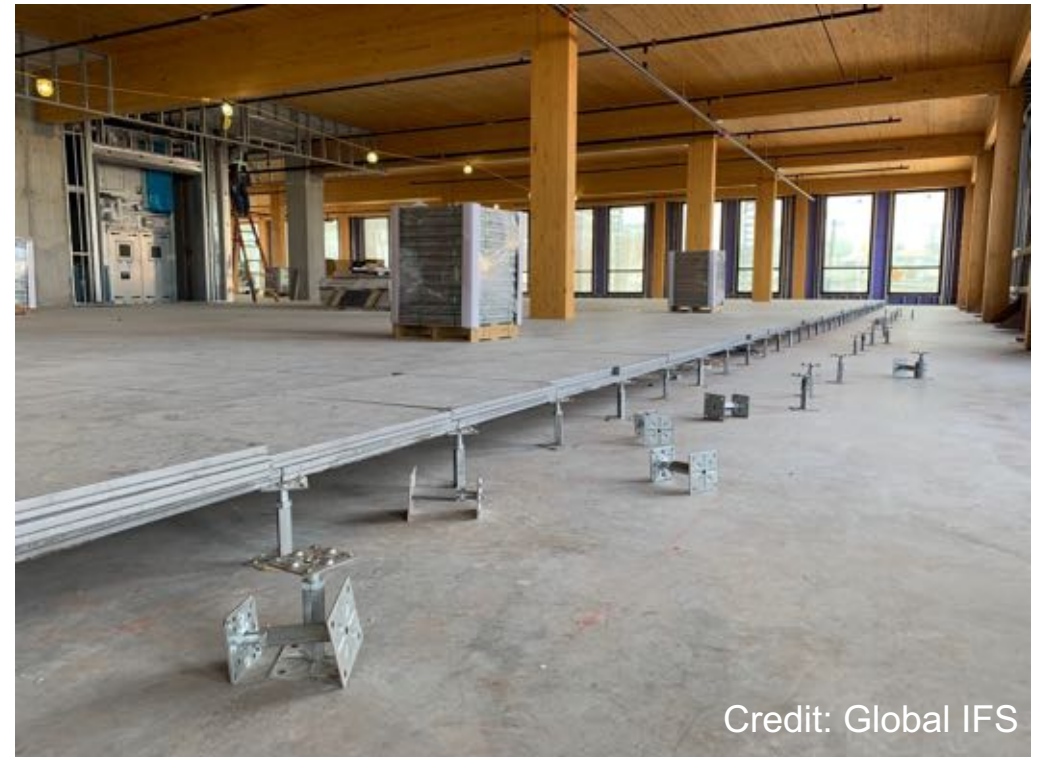
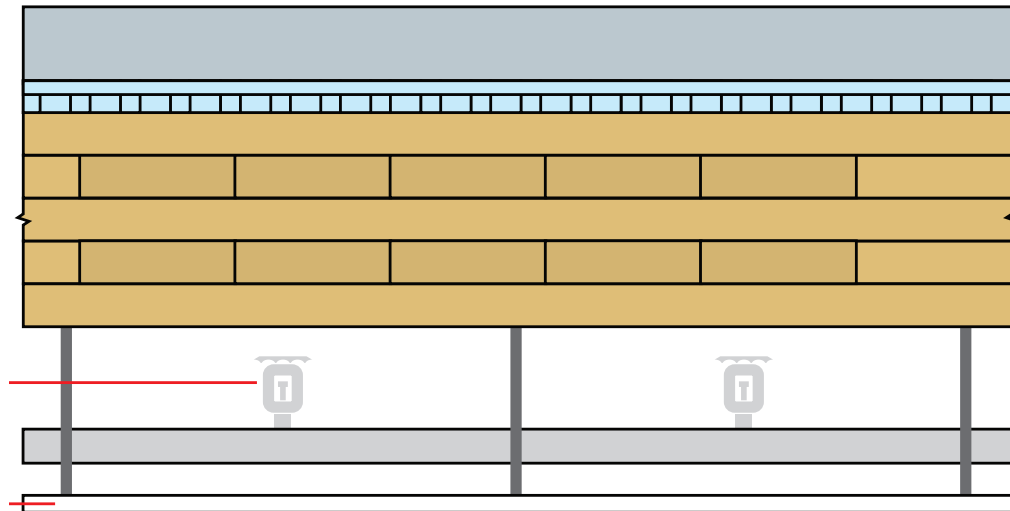




# Concealed Spaces in Mass Timber

Possible solutions for concealed space protection in Type III & V

- Sprinkler concealed spaces
- Compartmentalize concealed spaces to volumes NTE 160 ft<sup>3</sup>
- Fill concealed spaces with noncombustible insulation
- Cover all mass timber with noncombustible materials within concealed spaces



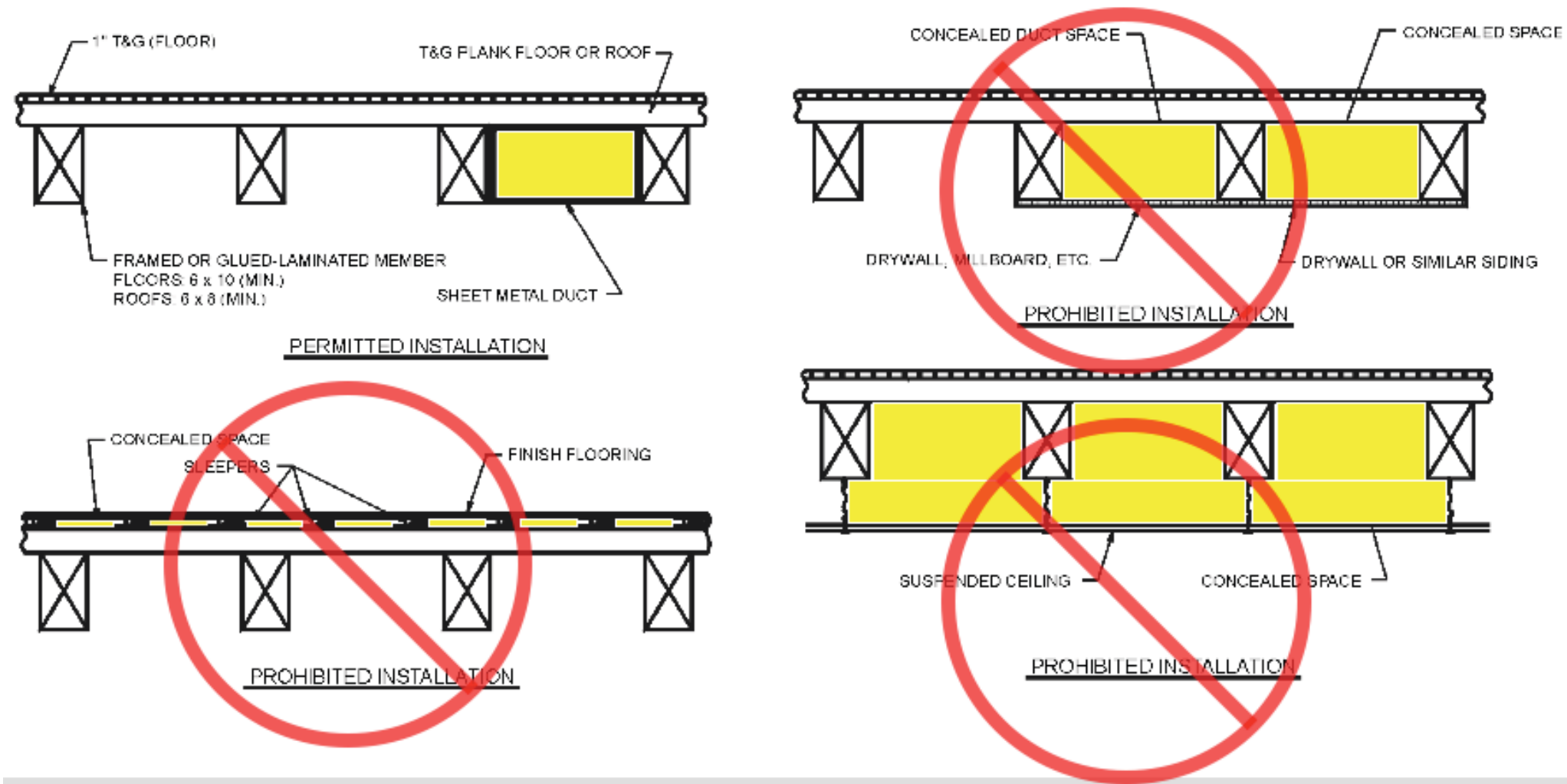
Credit: Global IFS

# Concealed Spaces in Mass Timber

Under the 2018 IBC & previous editions, Type IV provisions prohibited concealed spaces

**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.

# Concealed Spaces in Mass Timber





# Concealed Spaces in Mass Timber

Projects can pursue concealed spaces in Type IV under an AMMR



The John W. Olver Design Building at UMass Amherst includes exposed wood structure in some areas and dropped ceilings in others. Architect: Leers Weinzapfel Associates

# Concealed Spaces in Mass Timber

Under the 2021 IBC:

- Type IV renamed Type IV-HT, now allows concealed spaces
- Types IV-A, IV-B, IV-C introduced, also allow concealed spaces (but differently than IV-HT)

IBC 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



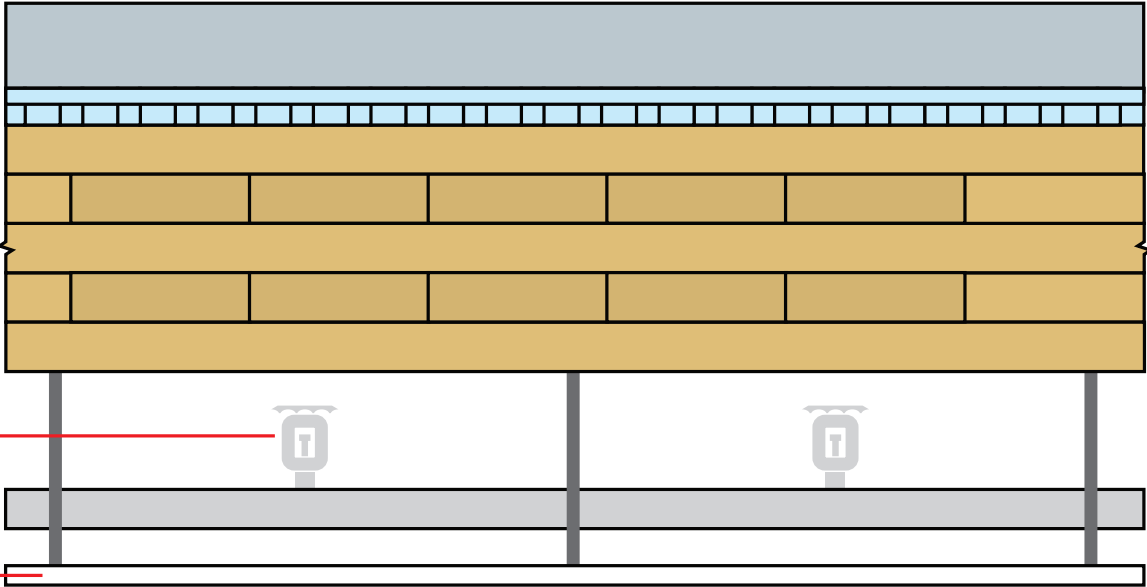
# Concealed Spaces in Mass Timber

## CONCEALED SPACES: TYPE IV-HT

Option 1:

Sprinklers in concealed spaces

Dropped ceiling

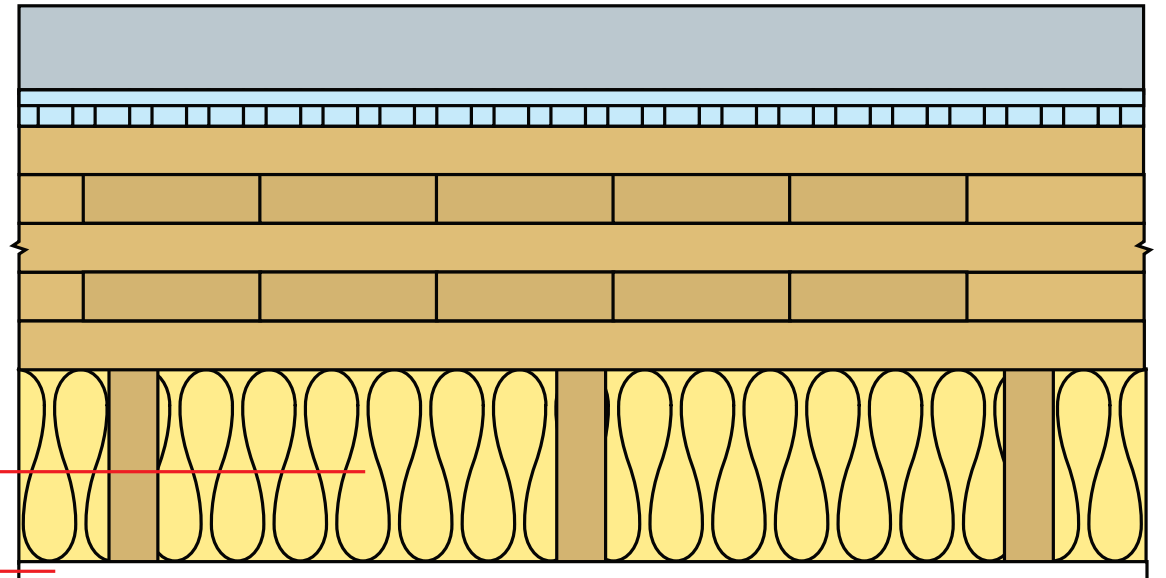




## CONCEALED SPACES: TYPE IV-HT

## Noncombustible insulation

## Dropped ceiling



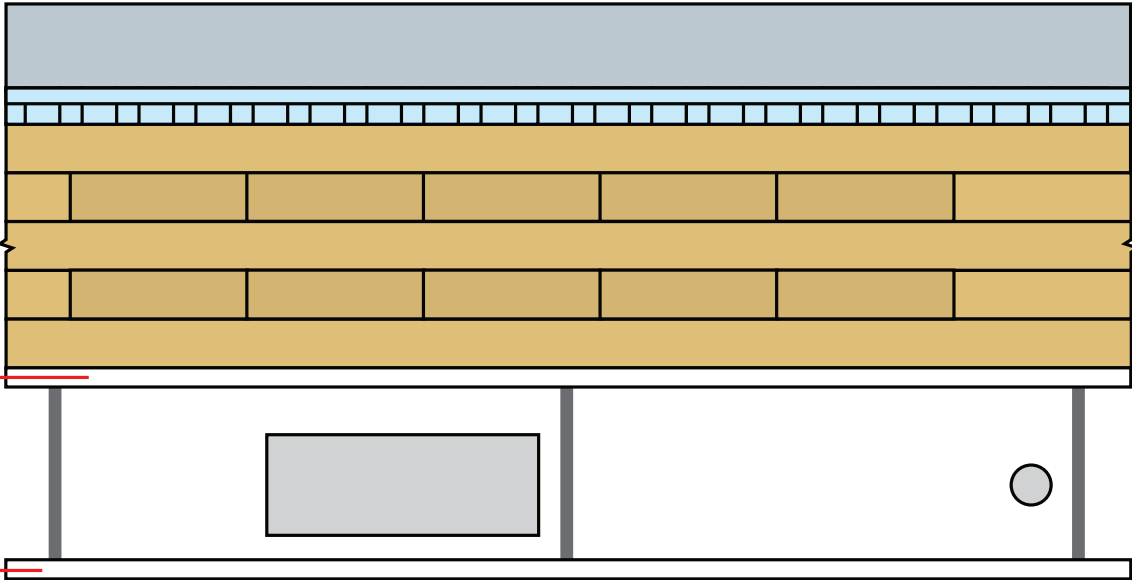
# Concealed Spaces in Mass Timber

## CONCEALED SPACES: TYPE IV-HT

Option 3:

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

Dropped ceiling

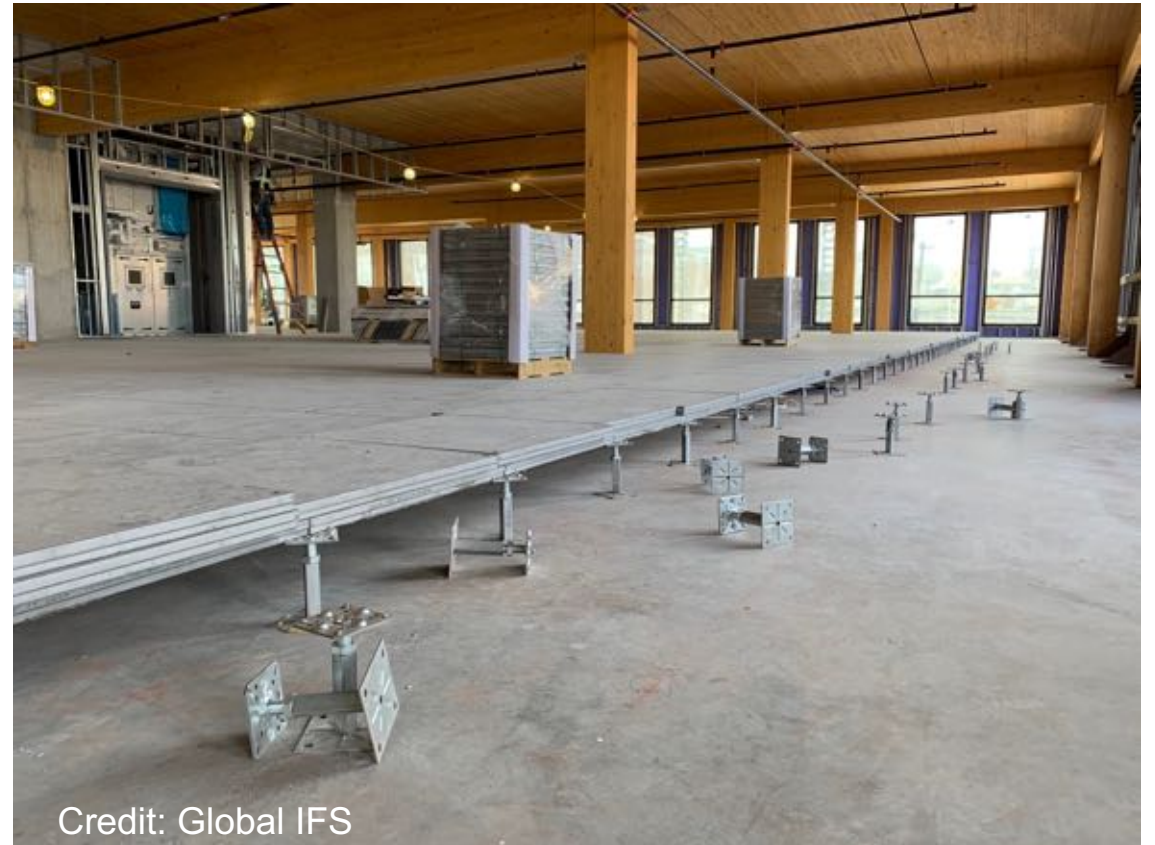


# Concealed Spaces in Mass Timber

## Raised Access Floors in Construction Type IV-HT

Prescriptive option within IBC of gypsum wallboard protection not practical for protection of top side of mass timber when using raised access floor.

*Possible* design route would be to cover the top side of the mass timber with a noncombustible material that can provide at least the same fire protection performance as that of the code prescriptive option



Credit: Global IFS



# Concealed Spaces in Mass Timber

In Construction Types IV-A and IV-B

IBC 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

Source: 2021 IBC Section 722.7

Prescriptive Noncombustible Contributions to FRR

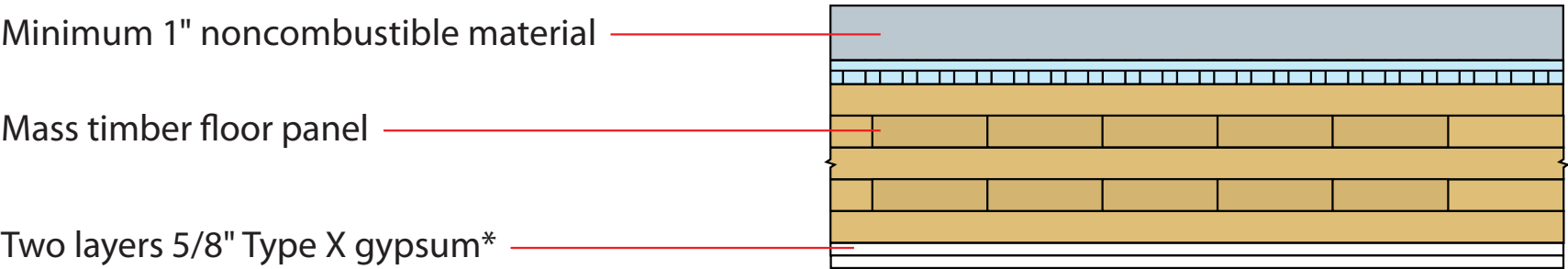
Type of Protection	Contribution per Layer (minutes)
1/2" Type X gypsum board	25
5/8" Type X gypsum board	40

Source: 2021 IBC Section 722.7.1

# Concealed Spaces in Mass Timber

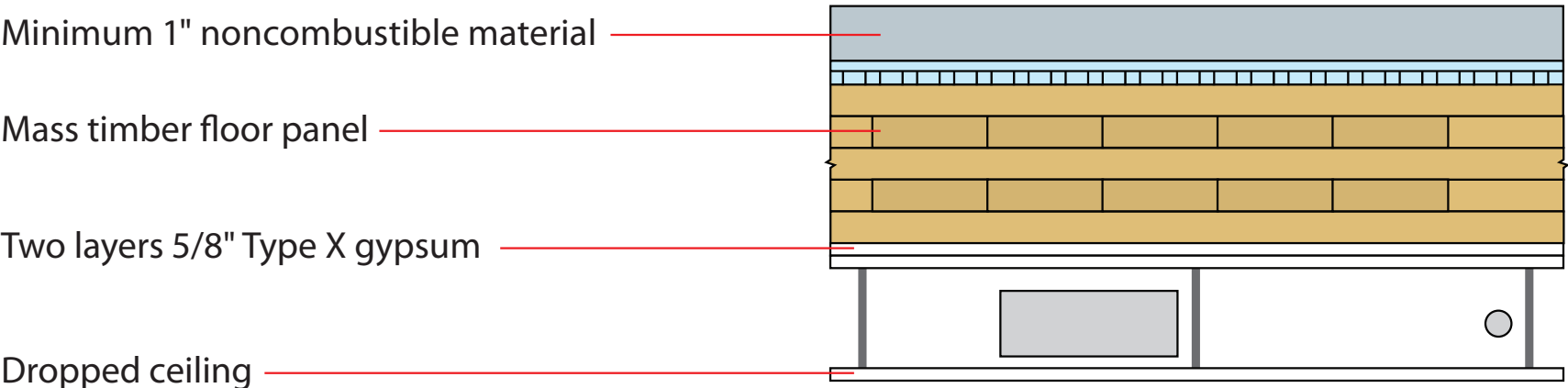
## In Construction Types IV-A and IV-B

### 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

IBC 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 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

Source: 2021 IBC Section 722.7.1



# Concealed Spaces in Mass Timber

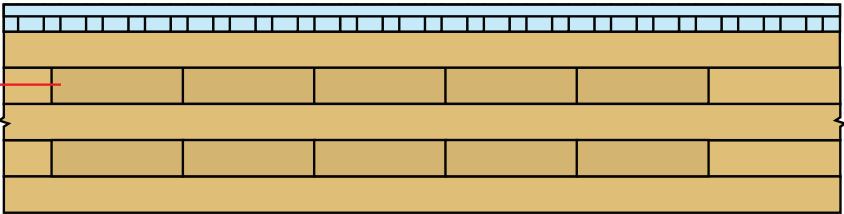
## In Construction Type IV-C

### Without Dropped Ceiling

Noncombustible material not required

Mass timber floor panel

Noncombustible material not required



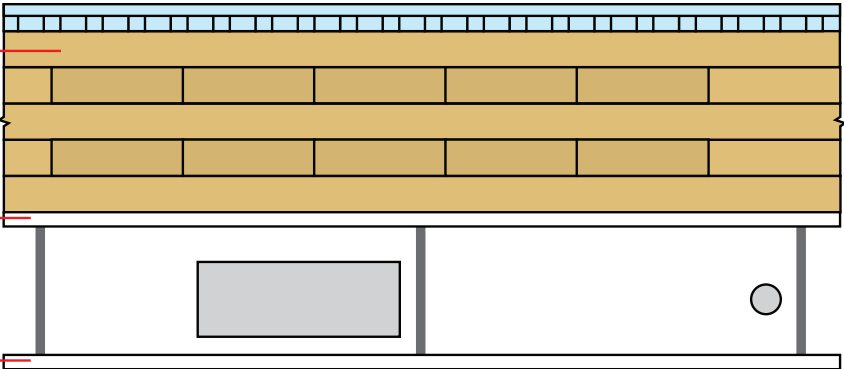
### With Dropped Ceiling

Noncombustible material not required

Mass timber floor panel

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

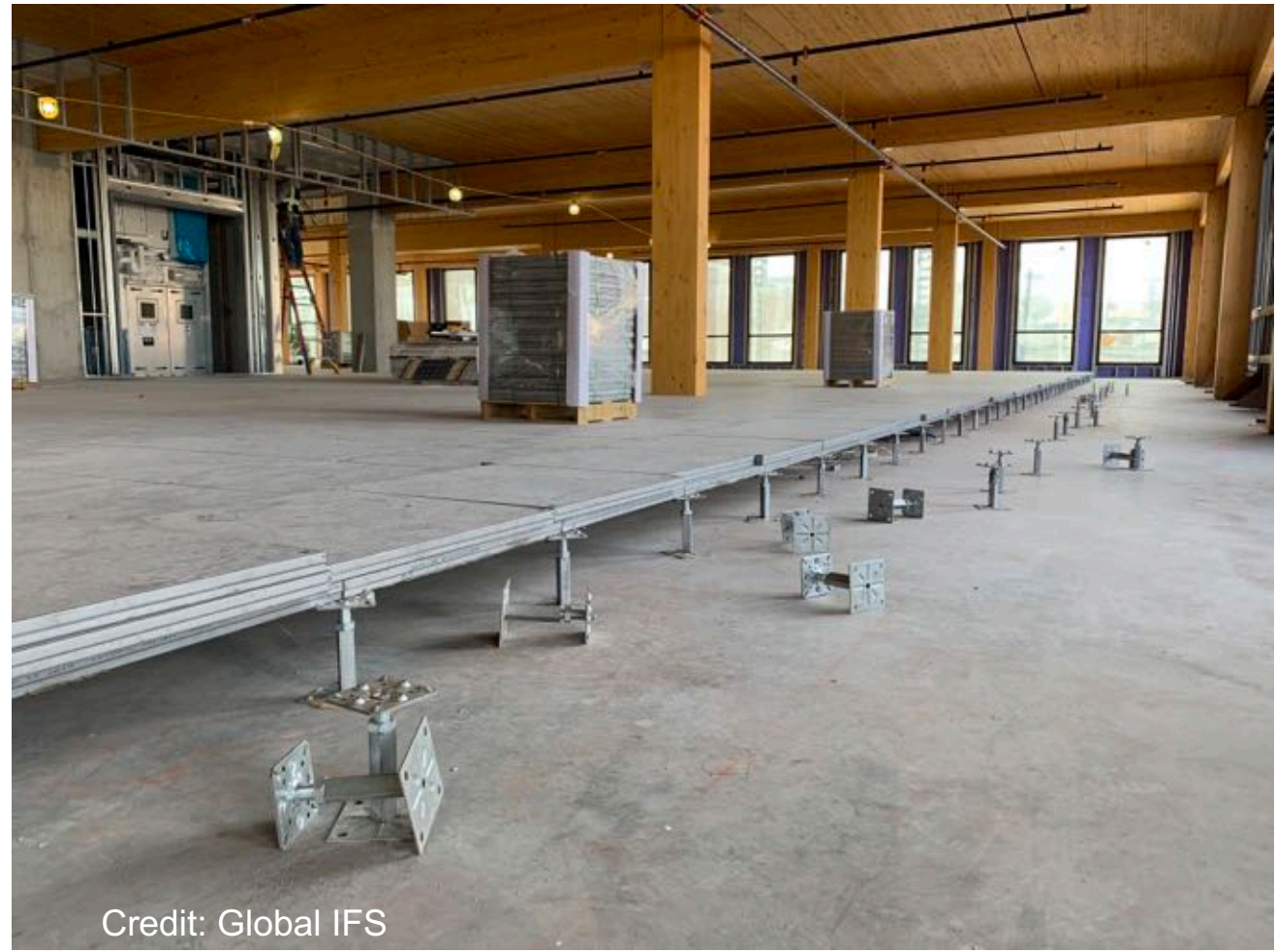
Dropped ceiling



# Concealed Spaces in Mass Timber

## Raised Access Floors in Construction Types IV-A, IV-B and IV-C

Prescriptive option within IBC of 80 minutes or 40 minutes of protection could be met with poured topping or other noncombustible board products. Note specific testing requirements within IBC 703.6



Credit: Global IFS

# Concealed Spaces in Mass Timber

## Mechanical Plenums in Mass Timber Buildings

Concealed spaces shall not contain combustibles other than electrical, mechanical, fire protection, or plumbing materials and equipment permitted in plenums in accordance with Section 602 of the International Mechanical Code, and shall comply with all applicable provisions of Section 718.





# Concealed Spaces in Mass Timber

## Mechanical Plenums in Mass Timber Buildings

Section 602 of the IMC requires that materials in plenums be either noncombustible or have a flame spread index of not more than 25 and a smoke developed index of not more than 50.

*Table 8*

Flame spread classes according with IBC

Class	Flame Spread Index	Smoke Development Index
A	0-25	0-450
B	26-75	0-450
C	76-200	0-450

# Concealed Spaces in Mass Timber

## Mechanical Plenums in Mass Timber Buildings

**Table 1**      **Reported Flame Spread Indices of Solid Wood Products**

<b>Material<sup>1</sup></b>	<b>ASTM E84 Flame Spread Index</b>	<b>Flame Spread Class</b>	<b>ASTM E84 Smoke Devel- oped Index</b>	<b>Source<sup>2</sup></b>
Alder	80	C	165	HPVA T-14189 (2013)
Aspen	105	C	45	Exova 15-002-475(C1) (2015)
Birch, Yellow	NA <sup>4</sup>	C <sup>4</sup>	NA	UL527 (1971)
Cedar, Alaska	40	B	140	HPVA T-15591 (2017)
Cedar, Alaska Yellow	50	B	115	HPVA T-12704 (2008)
Cedar, Eastern White	40	B	200	HPVA T-15318 (2017)
Cedar, Incense	45	B	150	HPVA T-15204 (2016)
Cedar, Port Orford	60	B	150	HPVA T-12694 (2008)
Cedar, Western Red	45	B	125	HPVA T-15172 (2016)
Cottonwood	NA <sup>4</sup>	C <sup>4</sup>	NA	UL527 (1971)
Cypress	75	B	200	HPVA T-14530 (2014)
Douglas-fir	70	B	80	HPVA T-14253 (2013)
Fir, Balsam	45	B	105	HPVA T-15557 (2017)
Fir, White	40	B	80	HPVA T-15088 (2016)
Gum, Red	NA <sup>4</sup>	C <sup>4</sup>	NA	UL527 (1971)
Hem-Fir Species Group <sup>3</sup>	60	B	70	HPVA T-10602 (2001)
Hemlock, Eastern	35	B	175	HPVA T-15320 (2017)



## 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*.<sup>1</sup>

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

### 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 Mass Timber

where the required FRR does not exceed one hour; exterior columns and arches when 20 feet or more of horizontal



# > QUESTIONS?

This concludes The American Institute  
of Architects Continuing Education  
Systems Course

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