

IBC Code Strategies for Light Frame and Mass Timber Construction

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Presented by

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WoodWorks



Image: Celeste, BDE Architecture, Photo courtesy of IMEG

WoodWorks | The 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

Opportunities for light-frame wood and mass timber construction have never been greater, especially now that the International Building Code (IBC) allows up to 18 stories with mass timber. However, selecting the right construction type is crucial to making wood projects pencil, and expanded code options for using wood can make that decision less straightforward. To simplify the process, 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. With an emphasis on the use of wood structural elements in Construction Types III, IV, and V, examples, calculations, and details will be presented to demonstrate how to navigate the various code requirements associated with single occupancy and mixed-use buildings while maximizing building size and meeting fire and life safety needs.

Learning Objectives

1. Understand the differences between Type III, IV, and V construction as defined by the International Building Code (IBC), and how wood can be used in each.
2. Identify potential modifications to the IBC's tabular heights and areas based on code provisions for building frontage, sprinklers, sloping sites, podiums, and mezzanines.
3. Highlight options for determining allowable building size of mixed-use facilities including separated and non-separated occupancies, and incidental uses.
4. Explore constructed wood buildings that were designed using these code provisions.

This Presentation References:



(Unless Otherwise Noted)



What is being enforced in jurisdictions you are working in?

Outline – Part 1

- » Wood Framing Systems
- » Fire and Life Safety in the Code
- » Building Size (Single Occupancy)



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

Wood Construction Terminology



Photo: WoodWorks

Light-Frame Wood



Photo: Benjamin Benschneider

Heavy Timber

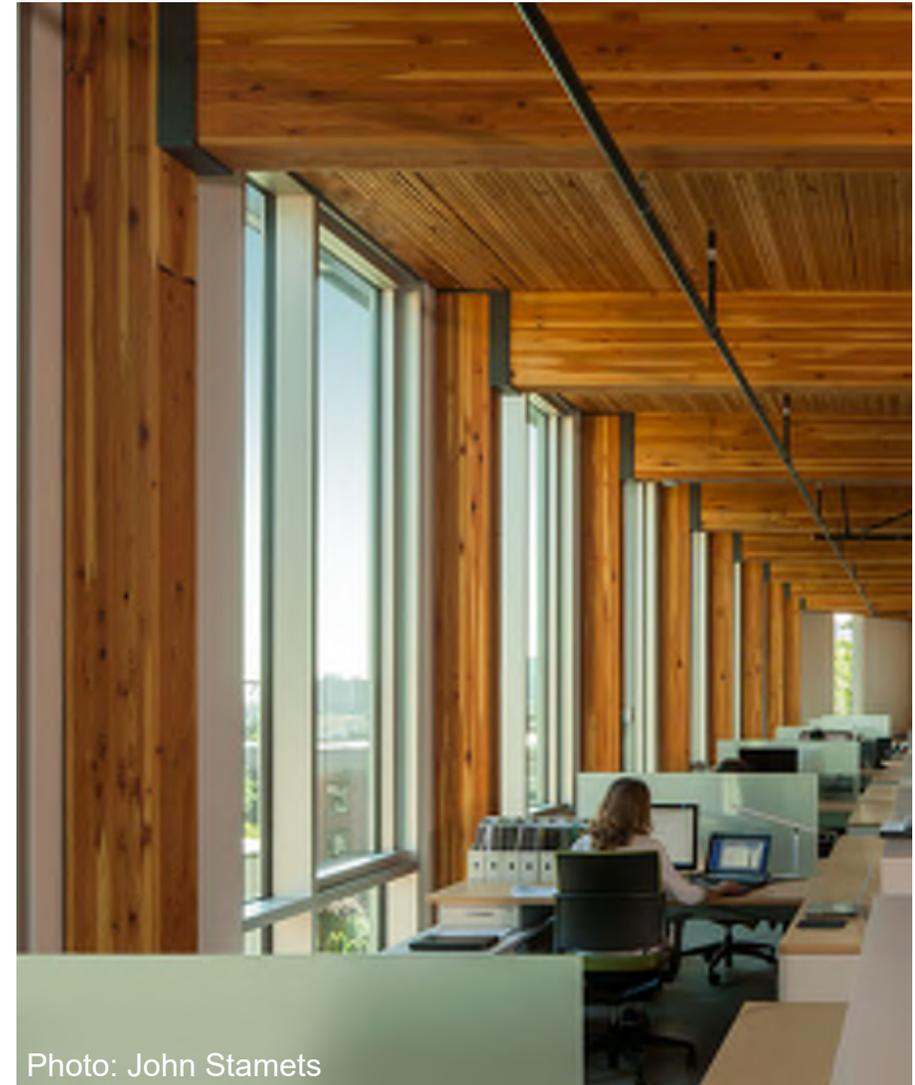


Photo: John Stamets

Mass Timber

Heavy Timber Minimum Dimensions

IBC Section 2304.11:

**TABLE 2304.11
MINIMUM DIMENSIONS OF HEAVY TIMBER STRUCTURAL MEMBERS**

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

Heavy Timber Minimum Dimensions

IBC Section 2304.11:

Floor Panels / Decking

- » CLT: 4" thick (actual)
- » NLT/DLT/GLT: 4" thick (nominal) or Decking: 3" thick (nominal)
 - » Covered with: 1" tongue-and-groove or 15/32" WSP or 1/2" particleboard

Roof Panels/Decking:

- » 3" thick CLT (actual thickness)
- » 3" NLT/DLT/GLT (nominal thickness)
- » 2" thick (nominal) decking



Mass Timber Products

Panels

- » Cross-Laminated Timber / **CLT**
- » Glue-Laminated Timber / **GLT**
- » Dowel-Laminated Timber / **DLT**
- » Nail-Laminated Timber / **NLT**

Columns and Beams

- » Glue-Laminated Timber / **Glulam**
- » Structural Composite Lumber / **SCL**



The Canyons

Kaiser+Path / catena consulting
engineers / R&H Construction
Photo Marcus Kauffman



Glulam beams

Boise Cascade



SCL columns

Weyerhaeuser

Panelized Construction



Prefabricated and Precise

- » Tight fabrication tolerances
- » Computer Numerically Controlled (CNC) connections



Photo: Structurlam



Photo credit: naturally:wood

Don't get boxed in!



[iStock.com/DonNichols](https://www.iStock.com/DonNichols)

Prefabricated Offsite

Site Built (Light-Frame)



Panelized (Light-frame)



Volumetric Modular (Light-frame)



Phot: Zeta Design+Build

Mass Timber



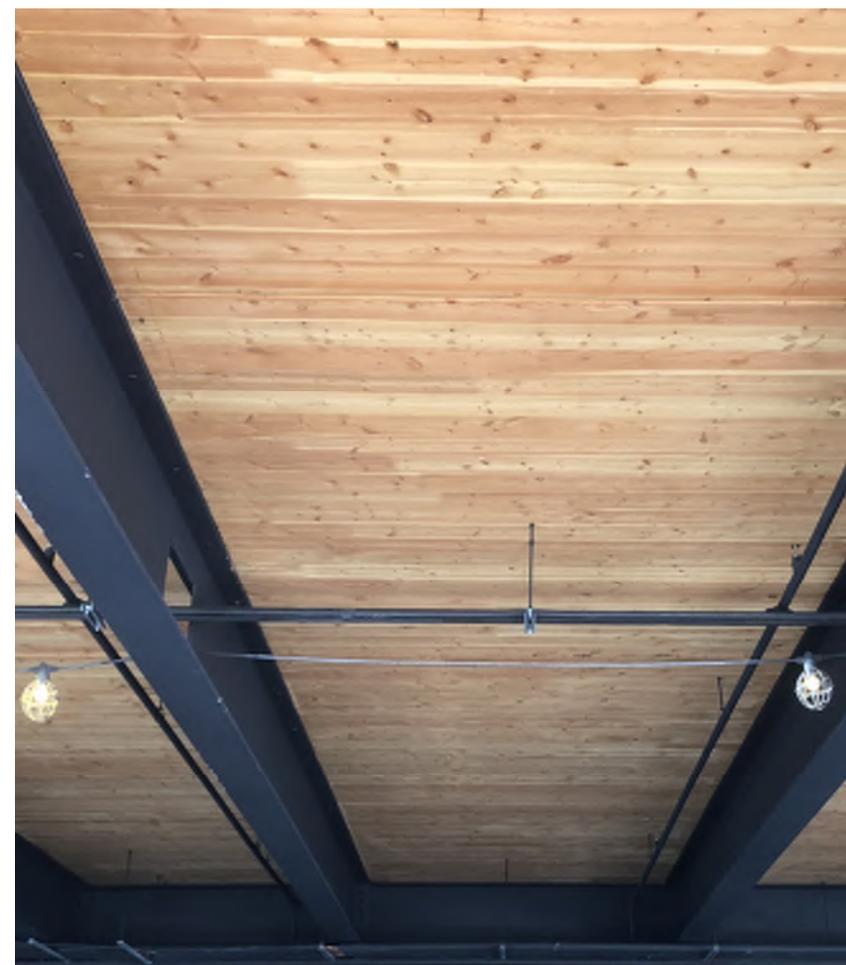
Photo: LendLease

3 to 4 Stories, 167K SF, 33% Schedule Savings



Image: Trumbull-Nelson Construction Company
Source: Wallace Building Products³

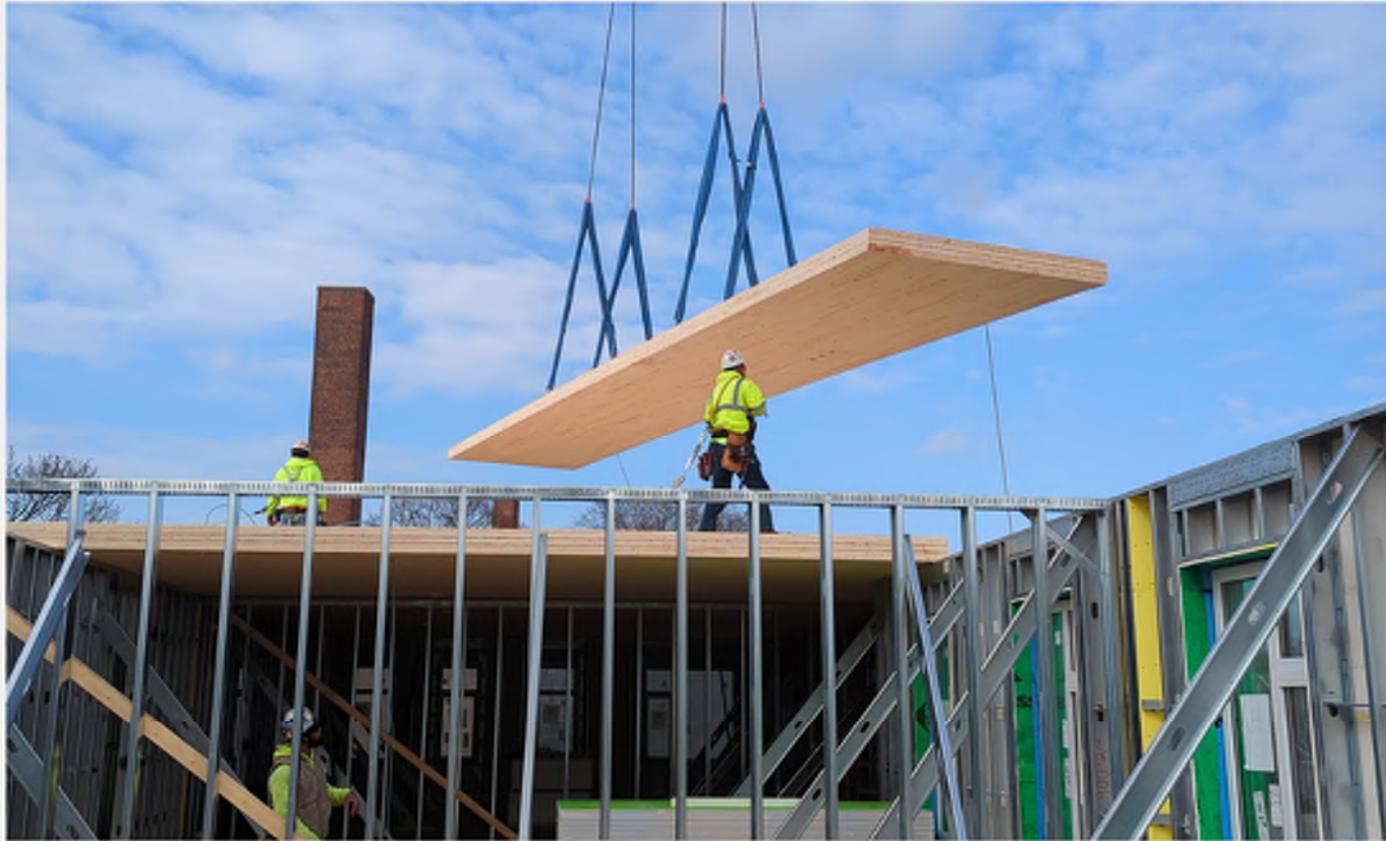
WOODLANDS AT HARVEST HILL | LEBANON, NH



Hybrid: Light-Frame

Hybrid: Steel Framing

CLT on Cold-Formed Steel Stud Bearing Walls: Engineering Tips for Hybrid Construction



Considerations for mass timber floor and roof panels on cold-formed steel (CFS) stud bearing walls

Bunker Hill Housing Redevelopment – Stellata, Stantec, McNamara / Salvia, Leggat McCall Properties

Photo Bryan Maltais

<https://www.woodworks.org/resources/clt-on-cold-formed-steel-stud-bearing-walls/>

Hybrid Design: Mass Timber Floor and Roof Panels Over Light-Frame Wood Walls



Explores construction type and fire-resistance ratings, lateral system options, and acoustic performance

George Fox University – Canyon Commons

Hacker | Photo: Jeremy Bittermann

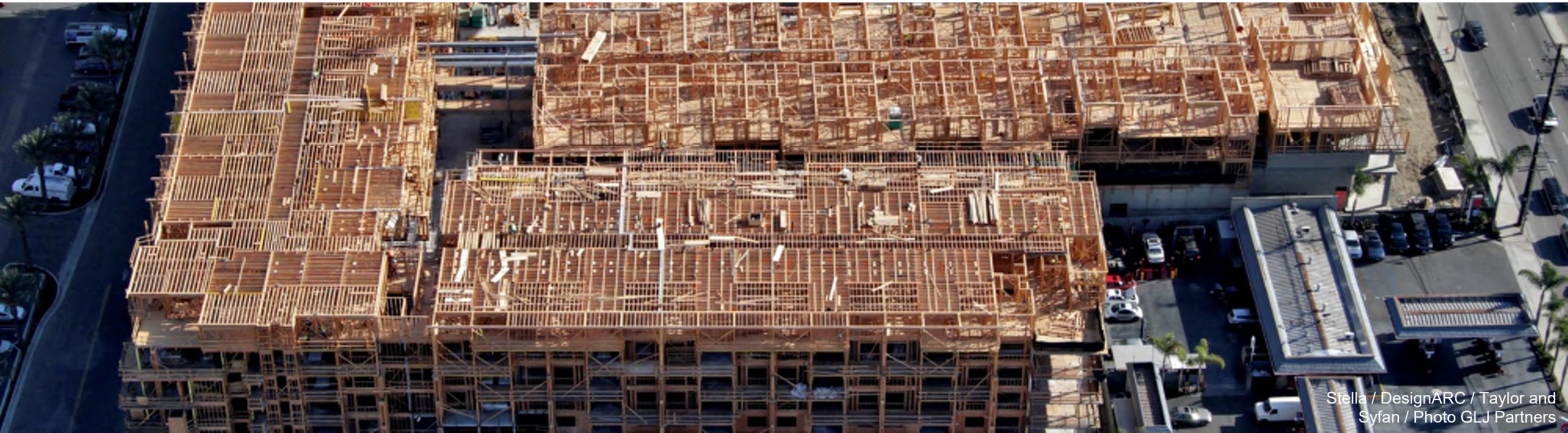




Building Occupancy Options – IBC Ch. 3

Many commercial occupancies can be framed with wood!

- » Hotels
- » K-12/Higher Education
- » Office
- » Retail
- » Restaurants
- » Industrial
- » ...and more!





Melissa Kroskey, AIA, SE
WoodWorks - Wood Products Council

Wood in Industrial Buildings

Systems, Codes, and Design Opportunities

1. Overview

This paper introduces the use of wood structural systems in industrial buildings, focusing on the advantages of light-frame, mass timber, and hybrid approaches. It outlines relevant code considerations—including construction type, allowable height and area, and fire-resistance requirements—to help designers maximize areas of wood warehouses. Through example projects, it illustrates how wood can deliver efficient, environmentally friendly, and visually distinctive designs across a range of industrial buildings.

1.1 Benefits of Wood in Industrial Building Types

From environmental performance to healthier buildings, circularity, and energy efficiency, owners and developers seeking change in the industrial sector are showing interest in wood solutions. Following is a summary of some of the benefits wood can contribute to industrial buildings.

Environmental – Wood typically has a lighter environmental footprint than conventional structural materials such as concrete and steel. This is one of the key reasons developers and owners are turning to timber systems for industrial projects.

Biophilia and wellness – When left exposed on a building's interior, wood offers a visually appealing aesthetic and biophilic benefits. Biophilia refers to the innate human desire to connect with natural materials. Emerging research shows that people in workplaces with a higher portion of visible wood report higher concentration, lower stress levels, and improved overall mood. The appeal of exposed wood is often seen in the way



Amazon, DDU Delivery Station, Elkhart, IN
ZDF Architects / Atlanta, AZ / KXP

Photo: Karol McCaughey



The key is to **OPTIMIZE** for
your project needs and goals

Outline – Part 1

- » Wood Framing Systems
- » **Fire and Life Safety in the Code**
- » Building Size (Single Occupancy)



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

Fire Protection Terminology



← Combustibility



← Fire Resistance



← Fire Protection Systems



IBC 602 – Construction Types

	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Interior Elements												
Exterior Wall Material												

The IBC defines 5 construction types. A building must be classified as one of these.

IBC 602 – Construction Types

Allowed Materials

	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Interior Elements	Non-combustible		Non-combustible								Any materials permitted by code	
Exterior Wall Material	Non-combustible		Non-combustible								Any materials permitted by code	

IBC 602 – Construction Types

Allowed Materials

	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Interior Elements	Non-combustible		Non-combustible		Any materials permitted by code						Any materials permitted by code	
Exterior Wall Material	Non-combustible		Non-combustible		FRTW (LF, MT), NC						Any materials permitted by code	

LF = Light Frame Wood
FRTW = Fire Retardant Treated Wood
MT/HT = Mass / Heavy Timber
CLT = Cross Laminated Timber
NC = Non-Combustible

IBC 602 – Construction Types

Allowed Materials

	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V		
	A	B	A	B	A	B	A	B	C	HT	A	B	
Interior Elements	Non-combustible		Non-combustible		Any materials permitted by code						Heavy/Mass Timber LF (1-hour)	Any materials permitted by code	
Exterior Wall Material	Non-combustible		Non-combustible		FRTW (LF, MT), NC						CLT (protected), FRTW (LF), NC	Any materials permitted by code	

LF = Light Frame Wood
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IBC 602 – Construction Types

Allowed Materials

	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Interior Elements	Non-combustible		Non-combustible		Any materials permitted by code		Heavy/Mass Timber, NC			Heavy/Mass Timber, LF (1-hour)	Any materials permitted by code	
Exterior Wall Material	Non-combustible		Non-combustible		FRTW (LF, MT), NC		CLT (protected), NC			CLT (protected), FRTW (LF), NC	Any materials permitted by code	

LF = Light Frame Wood
FRTW = Fire Retardant Treated Wood
MT/HT = Mass / Heavy Timber
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Tall Mass Timber

2021 IBC: 3 New Tall Mass Timber
Construction Types

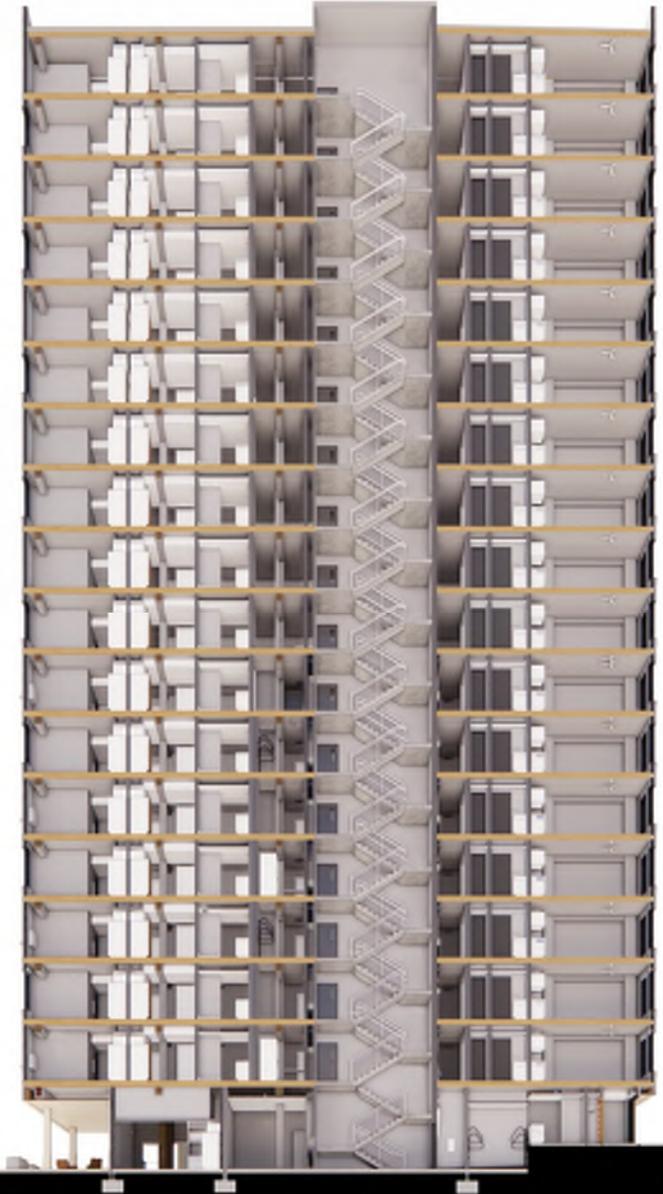
IV-C



IV-B



IV-A



IBC 602 – Construction Types

Which construction types permit wood as the structural system?

	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Interior Elements	Non-combustible		Non-combustible		Any materials permitted by code		Heavy/Mass Timber, NC		Heavy/Mass Timber, LF (1-hour)		Any materials permitted by code	
Exterior Wall Material	Non-combustible		Non-combustible		FRTW (LF, MT), NC		CLT (protected), NC		CLT (protected), FRTW (LF), NC		Any materials permitted by code	

- LF = Light Frame Wood
- FRTW = Fire Retardant Treated Wood
- MT/HT = Mass / Heavy Timber
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- NC = Non-combustible

IBC 602 – Construction Types

Which construction types permit wood as the structural system?

	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Interior Elements	Non-combustible		Non-combustible		Any materials permitted by code		Heavy/Mass Timber, NC			Heavy/Mass Timber, LF (1-hour)		Any materials permitted by code
Exterior Wall Material	Non-combustible		Non-combustible		FRTW (LF, MT), NC		CLT (protected), NC			CLT (protected), FRTW (LF), NC		Any materials permitted by code

Allowances for wood per IBC Chapter 6

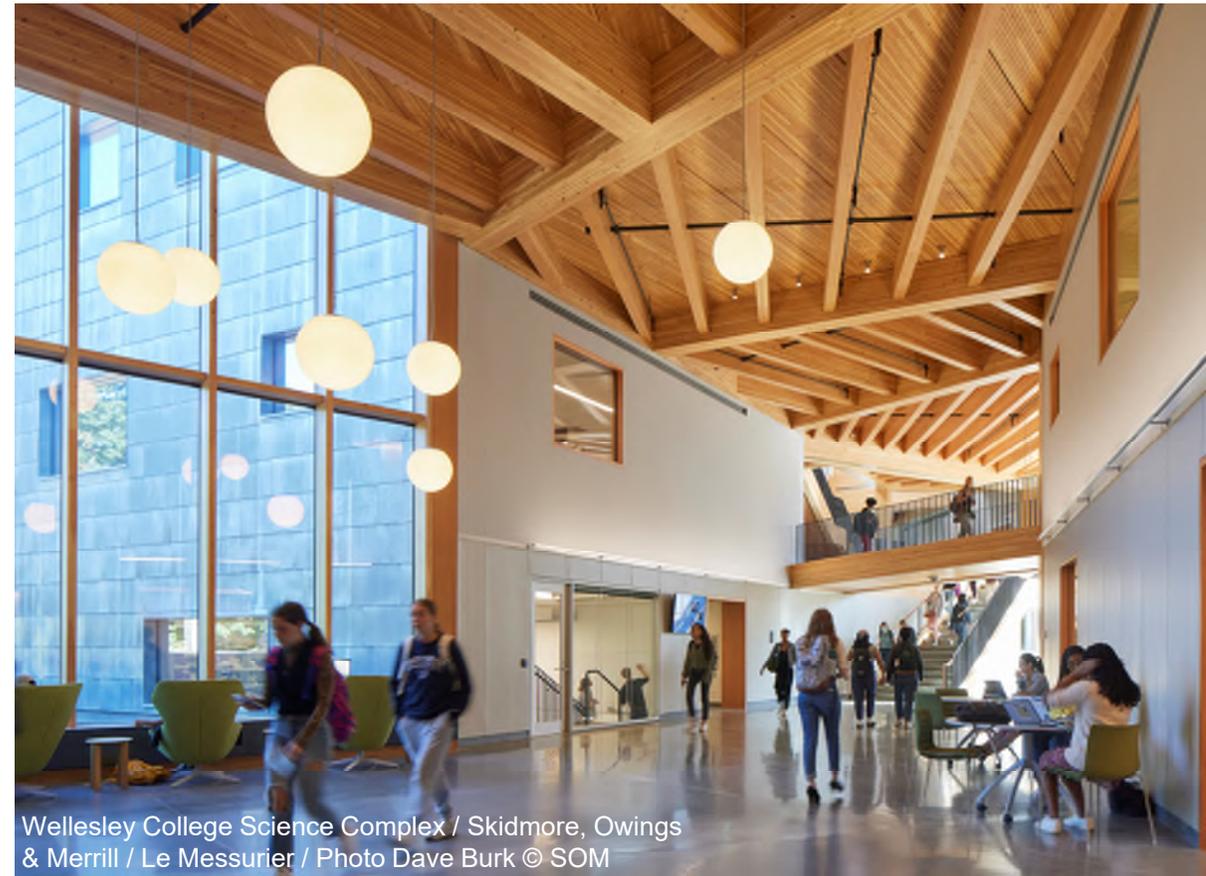
LF = Light Frame Wood
FRTW = Fire Retardant Treated Wood
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Construction Types I-B, II-A, II-B

Mass Timber Roof Construction

- » **IBC Table 601, Footnote c:**
 - » In all occupancies, heavy timber complying with Section 2304.11 shall be allowed for roof construction, including primary structural frame members, where a 1-hour or less fire-resistance rating is required.

Wellesley College, Wellesley, MA



Fire and Life Safety in the Code

Structural fire resistance

- » Maintain structural integrity of building
- » Account for response / participation of building

Fire Resistance

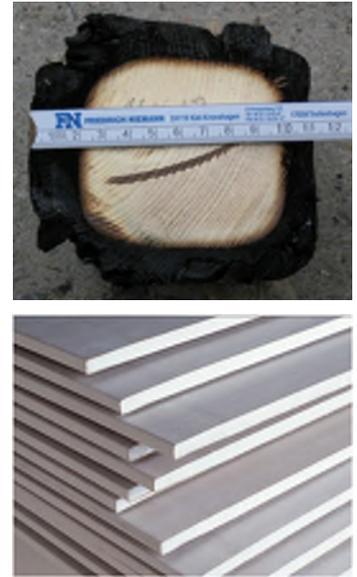
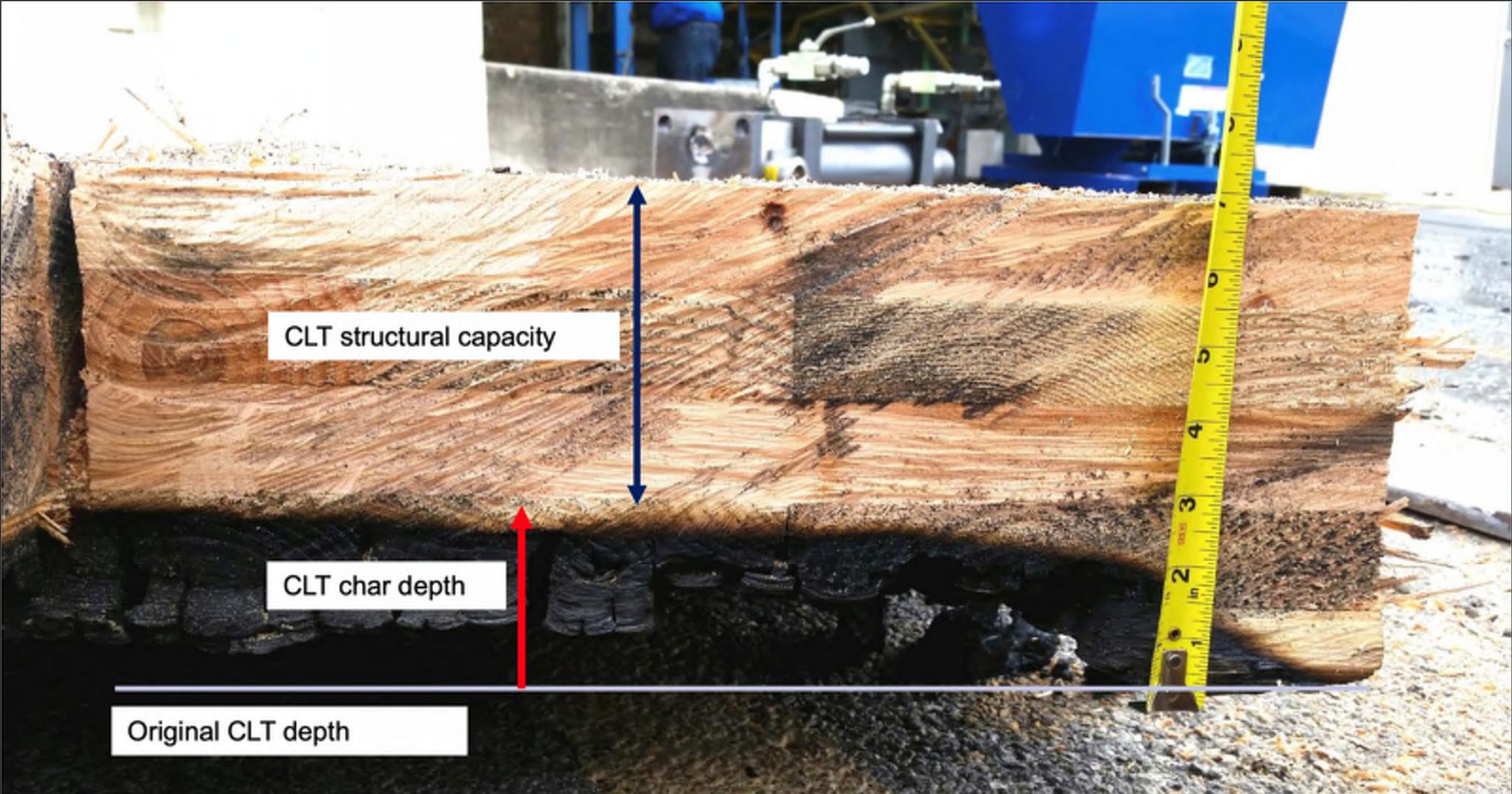


Table 601 (IBC 2021):

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

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

Fire Design of Mass Timber



Credit: David Barber, ARUP

Fire and Life Safety in the Code

Structural fire resistance

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

Fire and Life Safety in the Code

Structural fire resistance

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Bearing walls												
Exterior ^{e,f}	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	3	2	2	1/HT ^g	1	0
Nonbearing walls and partitions Exterior							See Table 705.5					
Nonbearing walls and partitions Interior ^d	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1½ ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	1½	1	1	HT	1 ^{b,c}	0

Fire and Life Safety in the Code

Structural fire resistance

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Bearing walls												
Exterior ^{e,f}	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	3	2	2	1/HT ^g	1	0
Nonbearing walls and partitions Exterior							See Table 705.5					
Nonbearing walls and partitions Interior ^d	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
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Fire and Life Safety in the Code

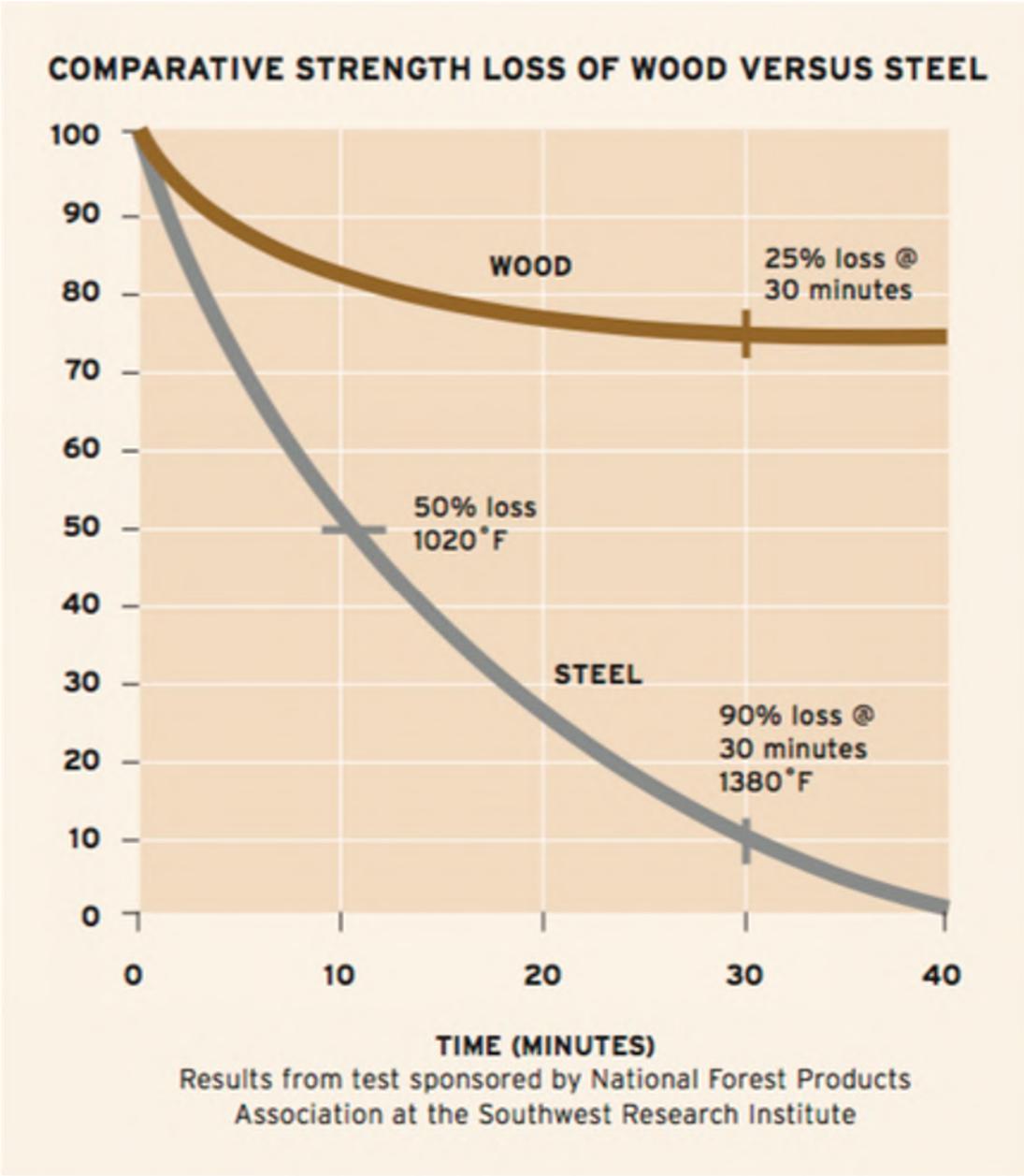
Structural fire resistance

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Bearing walls												
Exterior ^{e,f}	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	3	2	2	1/HT ^g	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior ^d	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 ^{1/2} ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	1 ^{1/2}	1	1	HT	1 ^{b,c}	0

HT = Heavy Timber

Fire Resistance of Heavy Timber



Source: AITC

Fire and Life Safety in the Code

Structural fire resistance

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Bearing walls												
Exterior ^{e,f}	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	3	2	2	1/HT ^g	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
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Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	1 ^{1/2} ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	1 ^{1/2}	1	1	HT	1 ^{b,c}	0

HT = Heavy Timber

Construction Type IV-HT – IBC 2304.11.2

Interior Walls

- » Laminated construction: 4” thick
- » Solid wood construction: Min (2) layers of 1” matched boards
- » Wood stud walls, 1-hour min
- » Non-combustible, 1-hour min

Verify other code requirements for FRR (e.g. interior bearing walls, occupancy separation, etc.)



Fire and Life Safety in the Code

Structural fire resistance

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Interior	3 ^a	2 ^a	1	0	1	0	3	2	2	1/HT ^g	1	0
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ICC Building Valuation Data

ICC Building Valuation Data, August 2025
B Business, office



Construction Type Differences

Allowable Building Size

Building Size	TYPE IV				TYPE III		TYPE V	
	A	B	C	HT	A	B	A	B
	Large areas and heights for new tall mass timber types			Often same heights with larger areas for Type IV-HT		Comparable heights and areas		Smallest heights / areas



 Typically Largest to Smallest

Construction Type Differences

Allowable Building Size

Building Size	TYPE IV			TYPE III		TYPE V		
	A	B	C	HT	A	B	A	B
	Large areas and heights for new tall mass timber types			Often same heights with larger areas for Type IV-HT		Comparable heights and areas		Smallest heights / areas


 Typically Largest to Smallest

Construction Type Differences

Allowable Building Size

Building Size	TYPE IV				TYPE III		TYPE V	
	A	B	C	HT	A	B	A	B
	Large areas and heights for new tall mass timber types			Often same heights with larger areas for Type IV-HT		Comparable heights and areas		Smallest heights / areas

Typically Largest to Smallest

Construction Type Differences

Allowable Building Size

Building Size	TYPE IV				TYPE III		TYPE V	
	A	B	C	HT	A	B	A	B
	Large areas and heights for new tall mass timber types			Often same heights with larger areas for Type IV-HT		Comparable heights and areas		Smallest heights / areas


 Typically Largest to Smallest

Construction Type Differences

Allowable Building Size

Building Size	TYPE IV			TYPE III		TYPE V		
	A	B	C	HT	A	B	A	B
	Large areas and heights for new tall mass timber types			Often same heights with larger areas for Type IV-HT		Comparable heights and areas		Smallest heights / areas


 Typically Largest to Smallest

Designers accustomed to steel and concrete often design buildings of Type IIA or IIB construction.

Nearly identical height and areas can be achieved with wood framing in Type IIIA or IIIB.

Outline – Part 1

- » Wood Framing Systems
- » Fire and Life Safety in the Code
- » **Building Size (Single Occupancy)**



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

Allowable Building Height (ft)

IBC Table 504.3

**TABLE 504.3
 ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE^a**

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
R ^h	NS ^h	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

Don't get boxed in!



Sloped Sites – Chapter 2 Definitions

HEIGHT, BUILDING. The vertical distance from *grade plane* to the average height of the highest roof surface.

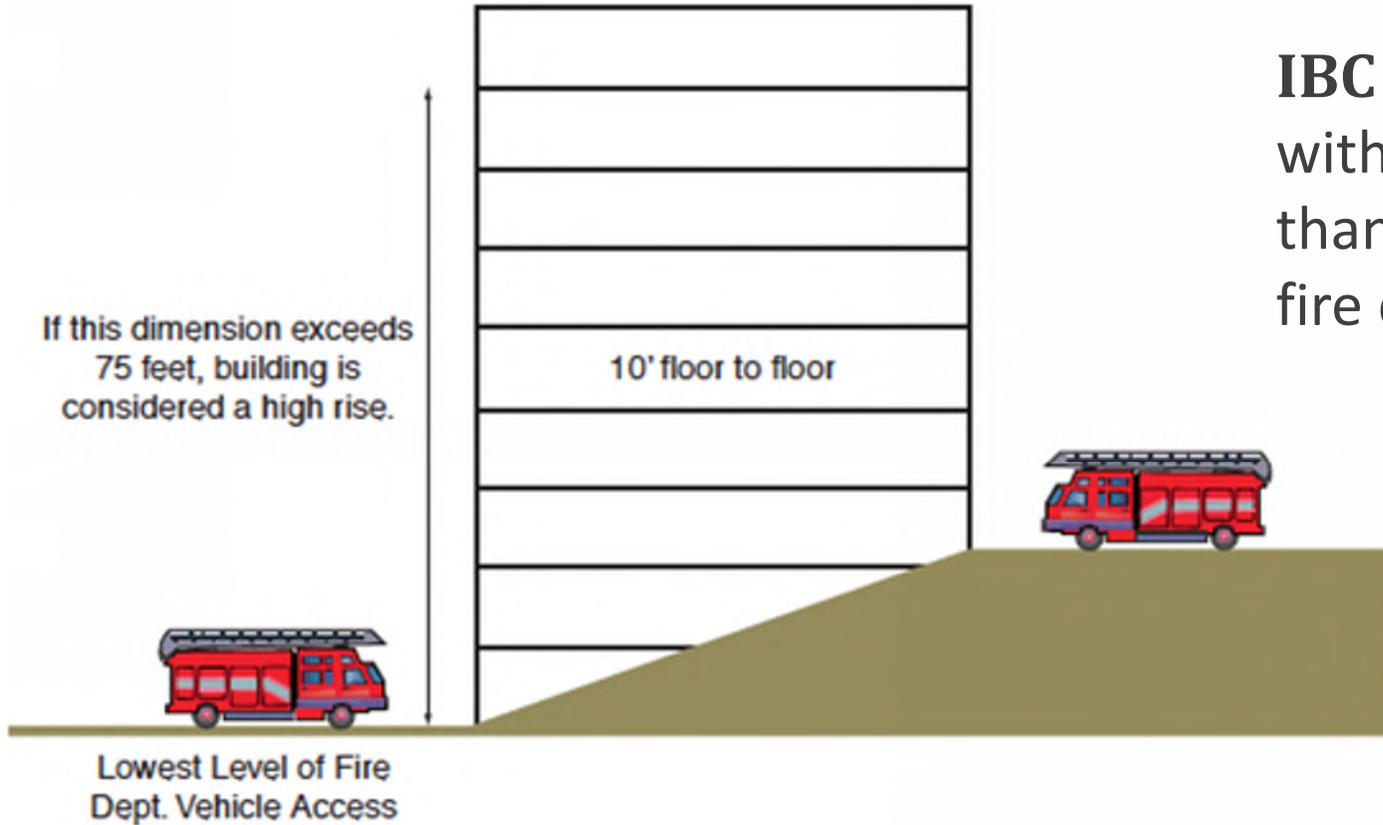
GRADE PLANE. A reference plane representing the average of finished ground level adjoining the building at exterior walls. Where the finished ground level slopes away from the *exterior walls*, the reference plane shall be established by the lowest points within the area between the building and the *lot line* or, where the *lot line* is more than 6 feet (1829 mm) from the building, between the building and a point 6 feet (1829 mm) from the building.



626 Dekalb Avenue, Atlanta, GA
Matt Church - Davis Church Structural Engineers

Mid-Rise vs. High-Rise Definition – 2021 IBC 202

IBC 202: High-Rise Building: A building with an occupied floor located more than 75 feet above the lowest level of fire department vehicle access.



Determination of high-rise building

Allowable Building Height (ft)

IBC Table 504.3

**TABLE 504.3
 ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE^a**

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
R ^h	NS ^d	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

» **NS:** No sprinkler system

» **S13D:** NFPA 13D sprinkler

» **S13R:** NFPA 13R sprinkler system

» **S:** NFPA 13 sprinkler system

Commercial Sprinkler Systems – IBC 903.3.1

» NFPA 13D

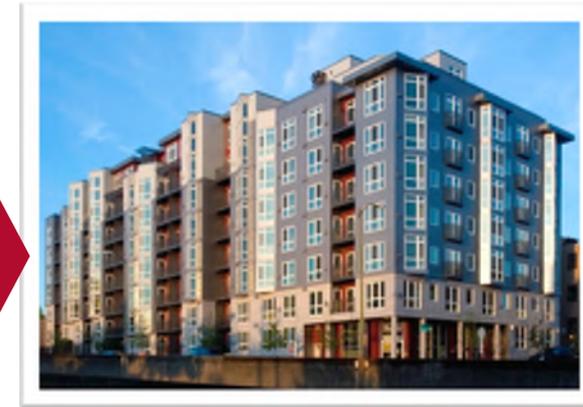
Standard for One- and Two-Family Residences (but allowed in a few commercial occupancies) 903.3.1.3

» NFPA 13R

Residential Occupancies (One- and Two-Family or Low-Rise Multi-Family and Commercial) 903.3.1.2

» NFPA 13

Standard for Commercial Construction 903.3.1.1



NFPA 13 vs. NFPA 13R



NFPA 13

Goal: Provide life safety and property protection

Fully sprinklered system throughout entire building even in unoccupied 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 and limited property protection (to a lesser degree than NFPA 13)

Partially sprinklered system; unoccupied 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

Sprinkler Systems: IBC 903.2

In some cases, sprinklers are required by code depending on occupancy

- » Most new Group R fire areas
- » Group A, E, M, S-1, I fire areas exceeding 1-12k sf

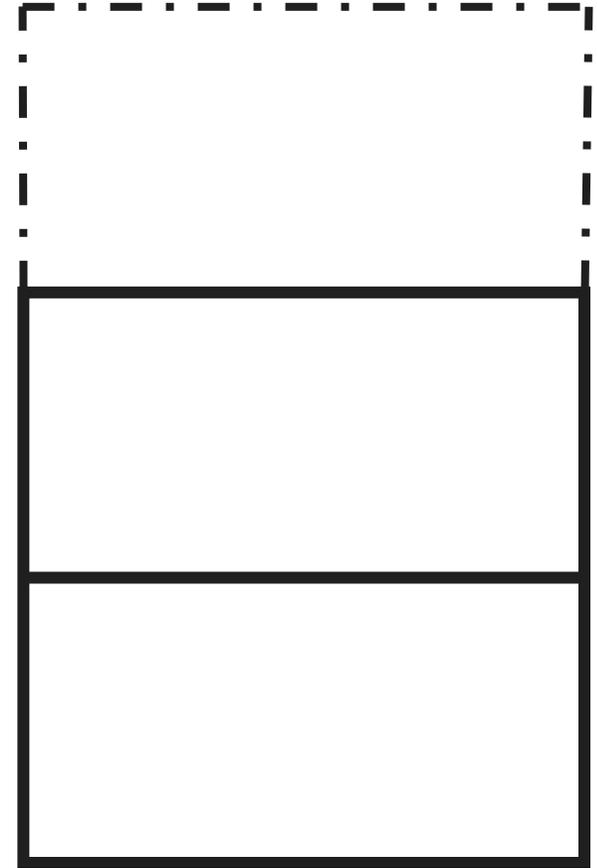


Stella Apartments, DesignARC, Taylor and Syfan, photo Lawrence Anderson

Sprinkled Building Height Increase

- » NFPA 13 or 13R*
 - » **10- to 20-foot increase**
(IBC 2021 Table 504.3)
 - » **1 story increase**
(IBC 2021 Table 504.4)

* NFPA 13R limited to 4 stories and 30 feet from lowest level of fire department vehicle access



Allowable Building Height (ft)

IBC Table 504.3

**TABLE 504.3
 ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE^a**

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS ^b	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
R ¹¹	NS ¹¹	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

» **NS:** No sprinkler system

» **S13D:** NFPA 13D sprinkler

» **S13R:** NFPA 13R sprinkler system

» **S:** NFPA 13 sprinkler system

Allowable Building Height (Stories)

IBC 2021 Table 504.4

**TABLE 504.4
 ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE^{a, b}**

OCCUPANCY CLASSIFICATION	TYPE OF CONSTRUCTION												
	See Footnotes	Type I		Type II		Type III		Type IV			Type V		
		A	B	A	B	A	B	A	B	C	HT	A	B
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
R-1 ^h	NS ^d	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2 ^h	NS ^d	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3

» **NS:** No sprinkler system

» **S13R:** NFPA 13R sprinkler system

» **S:** NFPA 13 sprinkler system

Basements –IBC 506.1.3

A basement is not included in the total allowable building area if it doesn't exceed the area permitted for a building with no more than one story above grade plane.

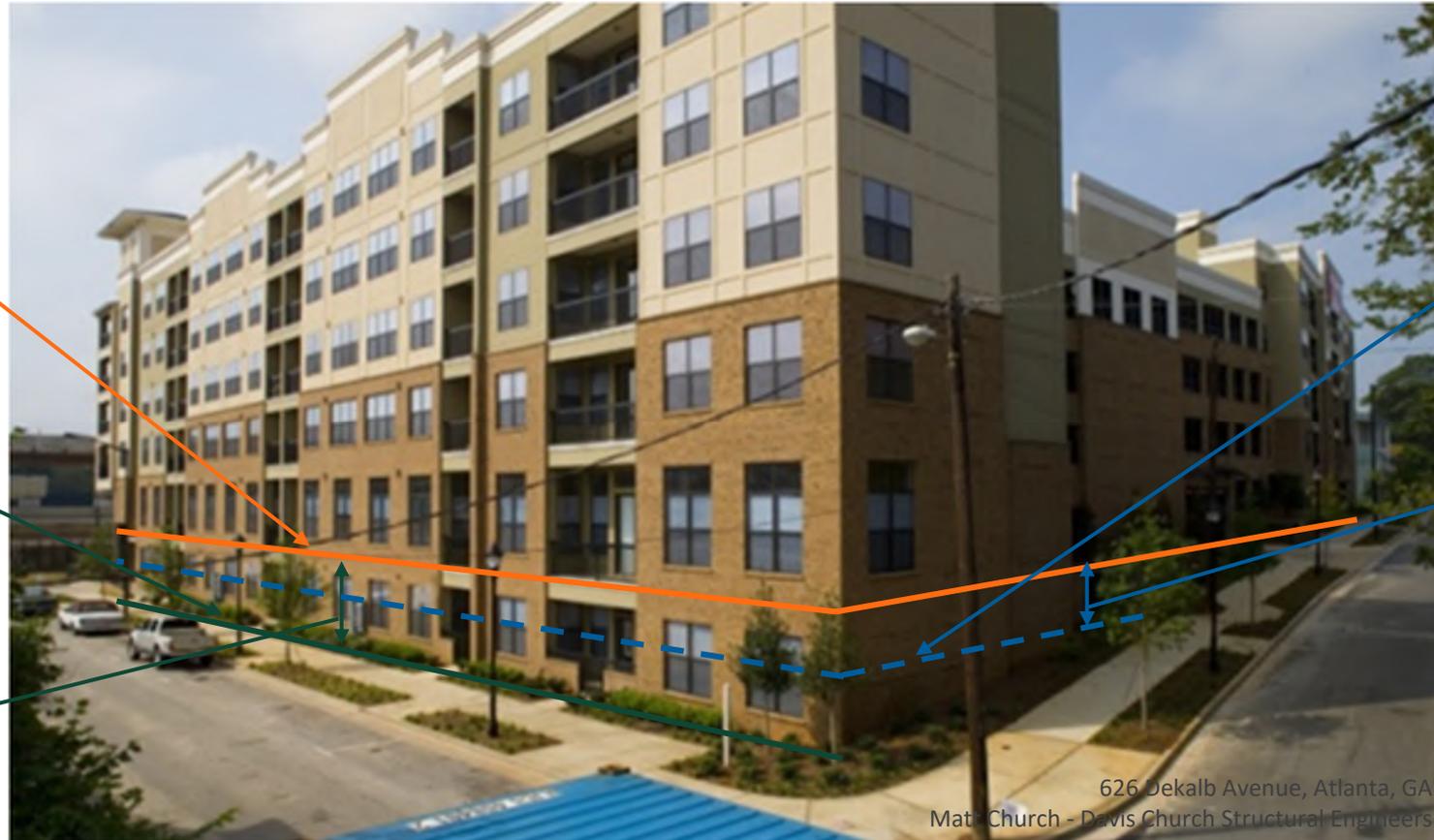
“Basement” is defined as “not a story above grade plane” and has a finished floor surface of the next floor above:

- Less than 6 feet above grade plane; or
- Less than 12 feet above the finished ground level at any point



Basements – IBC 506.1.3

To qualify as a basement (and therefore not be included in building area):



First Story Floor

Grade (Lowest Ground Point)

No more than 12' above grade

Grade Plane (Average Ground Level)

No more than 6' above grade plane

Allowable Building Area

IBC Table 506.2

TABLE 506.2 ALLOWABLE AREA FACTOR (A_f = NS, S1, S13R, S13D or SM, as applicable) IN SQUARE FEET^{a, b}

OCCUPANCY CLASSIFICATION	SEE FOOTNOTES	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV			HT	Type V	
		A	B	A	B	A	B	A	B	C		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
R-2 ^h	NS ^d	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S13R	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000

» **NS:** No sprinkler system

» **S1:** 1-story with NFPA 13 sprinkler

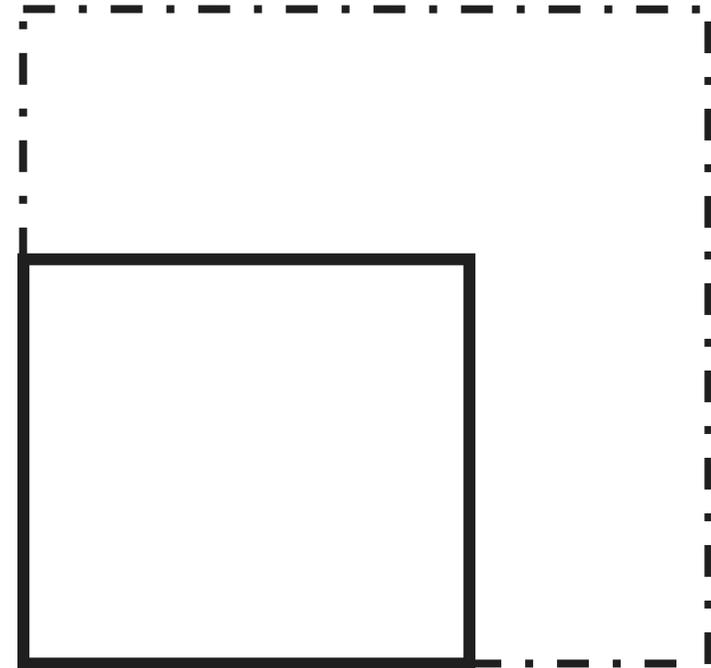
» **SM:** 2+ stories with NFPA 13 sprinkler

» **S13R:** NFPA 13R sprinkler

Sprinkled Building Area Increase

- » NFPA 13
 - » **Single story buildings: 300% increase**
 - » **Multi-story buildings: 200% increase**

(IBC Table 506.2)



IBC 506.3: Frontage Increase for Area Modification

- » Allowable area increase for frontage on:
 - » Streets (public ways)
 - » Open Spaces
- » Frontage provides:
 - » Access by fire service personnel
 - » Temporary refuge for occupants
 - » Reduced exposure to/from adjacent structures



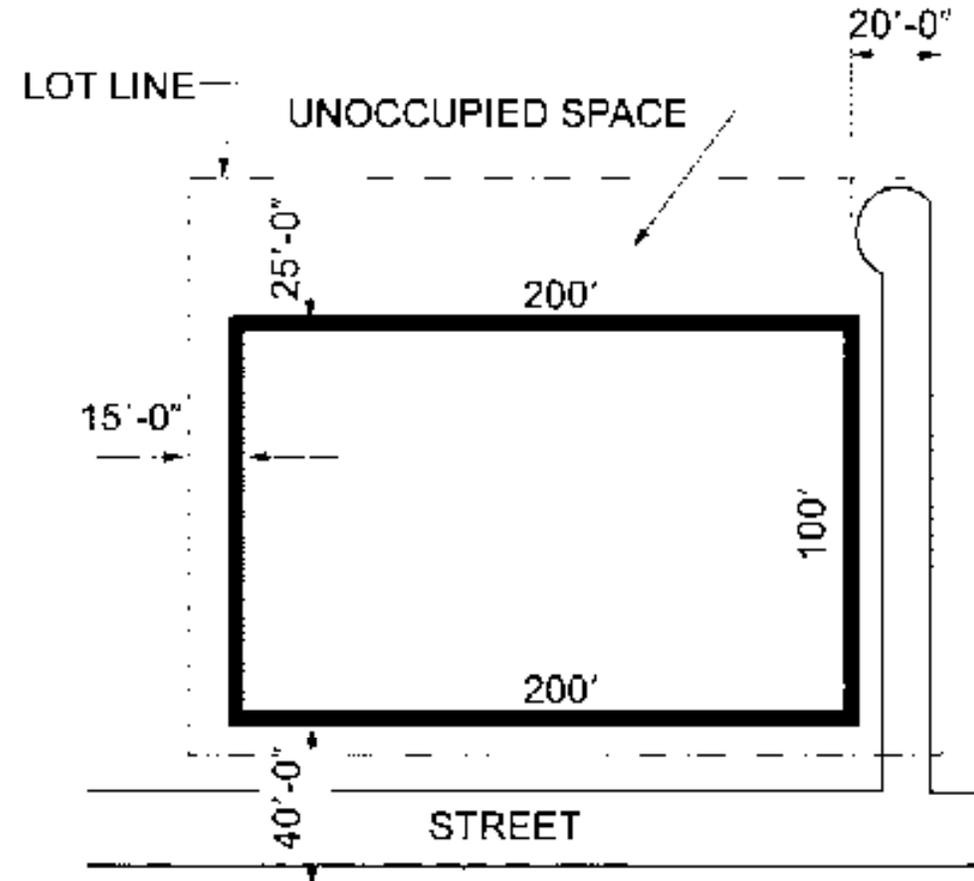
IBC 506.3: Frontage Increase for Area Modification

» Minimum Qualifications:

- » 25% of building perimeter is on a public way or open space with a minimum distance of 20'

» Open space shall be:

- » On the same lot or dedicated for public use
- » Accessed from a street or approved fire lane



 SITE PLAN

Frontage Increases – IBC 506.3

“W” for area increases NOT always the same as Fire Separation Distance (FSD) for purposes of fire resistance ratings of walls and openings



Frontage Increases – IBC 506.3.3

I_f = Area factor increase
due to frontage

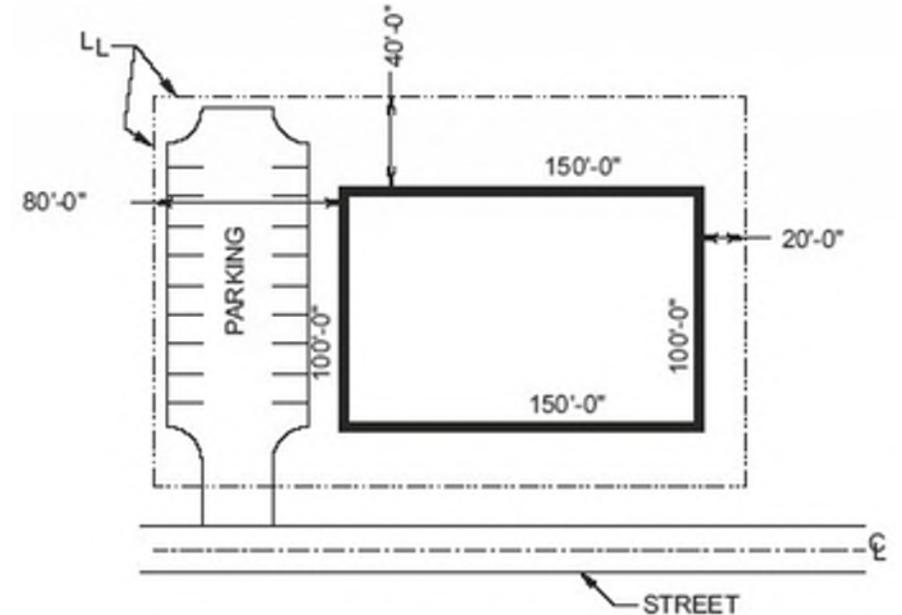


TABLE 506.3.3
FRONTAGE INCREASE FACTOR^a

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

IBC 506.2.1: Single-Occupancy Buildings

Calculate allowable building area per story

$$A_a = A_t + (NS \times I_f)$$

(Equation 5-1)

A_a = Allowable area per story (ft²)

A_t = Tabular allowable area per story per Table 506.2 for **NS, S1, S13R or S13D** (ft²)

NS = Tabular allowable area per story per Table 506.2 for non-sprinklered building (regardless of whether the building is sprinklered)

I_f = Frontage Increase Factor per IBC 506.3, $I_{f, \max} = 0.75$

IBC 506.2.1: Single-Occupancy Buildings

Calculate total allowable building area

$$A_a = [A_t + (NS \times I_f)] \times S_a$$

(Equation 5-2)

S_a = Actual number of building stories above grade plane

$S_{a, \max}$ = 3 where the actual number of stories above grade plane exceeds 3

$S_{a, \max}$ = 4 where the building is equipped throughout with an NFPA 13R (not NFPA 13) automatic sprinkler system

Allowable Building Size

Allowable building area

- » IBC 506.2.1 (NS or NFPA 13)
- » 1-story buildings:
 - » Total area = Area per floor x 1
- » 2-story buildings:
 - » Total area = Area per floor x 2
- » 3-story *or more* buildings:
 - » Total area = Area per floor x 3



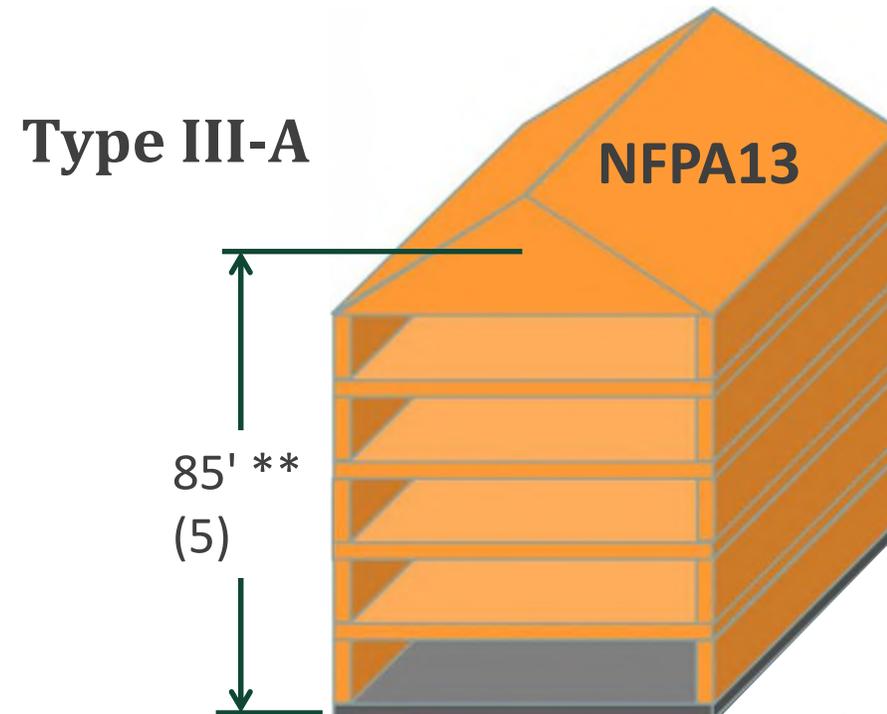
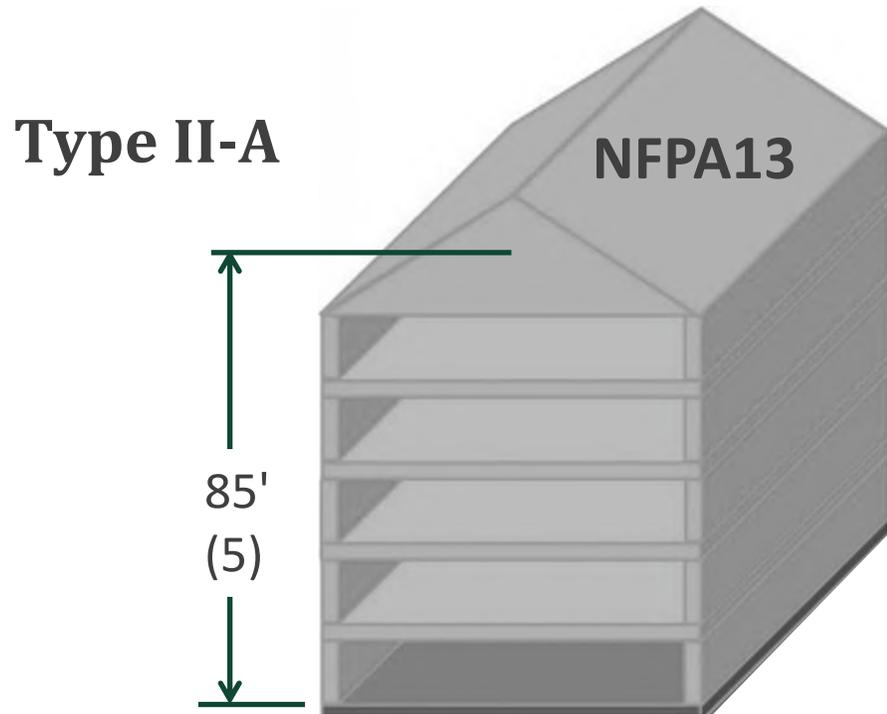
Allowable Building Size

Business (B) occupancies with NFPA 13 sprinklers

<i>B Occupancy with NFPA 13</i>	IV-A	IV-B	IV-C	IV-HT	III-A	III-B	V-A	V-B
Max stories	18	12	9	6	6	4	4	3
Max height (ft)	270	180	85	85	85	75	70	60
Max story area (ft²)	405.0k	270.0k	168.8k	135.0k	106.9k	71.3k	67.5k	33.8k
2-story: Max total area (ft²)	810.0k	540.0k	337.5k	270.0k	213.8k	142.5k	135.0k	67.5k
3+ story: Max total area (ft²)	1,215.0k	810.0k	506.3k	405.0k	320.6k	213.8k	202.5k	101.3k

* Note: areas assumes maximum frontage increase

Increased Height & Story Area



Occupancy	II-A (ft ²)*	III-A (ft ²)*
R-1	72,000 +18,000 (max frontage)	72,000 +18,000 (max frontage)
R-2	72,000 +18,000 (max frontage)	72,000 +18,000 (max frontage)

* Areas reflect PER STORY max. Total building max may limit area further.

** ASCE7-16 Table 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F

Outline – Part 2

- » Mixed Occupancy Buildings
- » How do we go bigger?
 - » Maximizing Areas
 - » Maximizing Heights



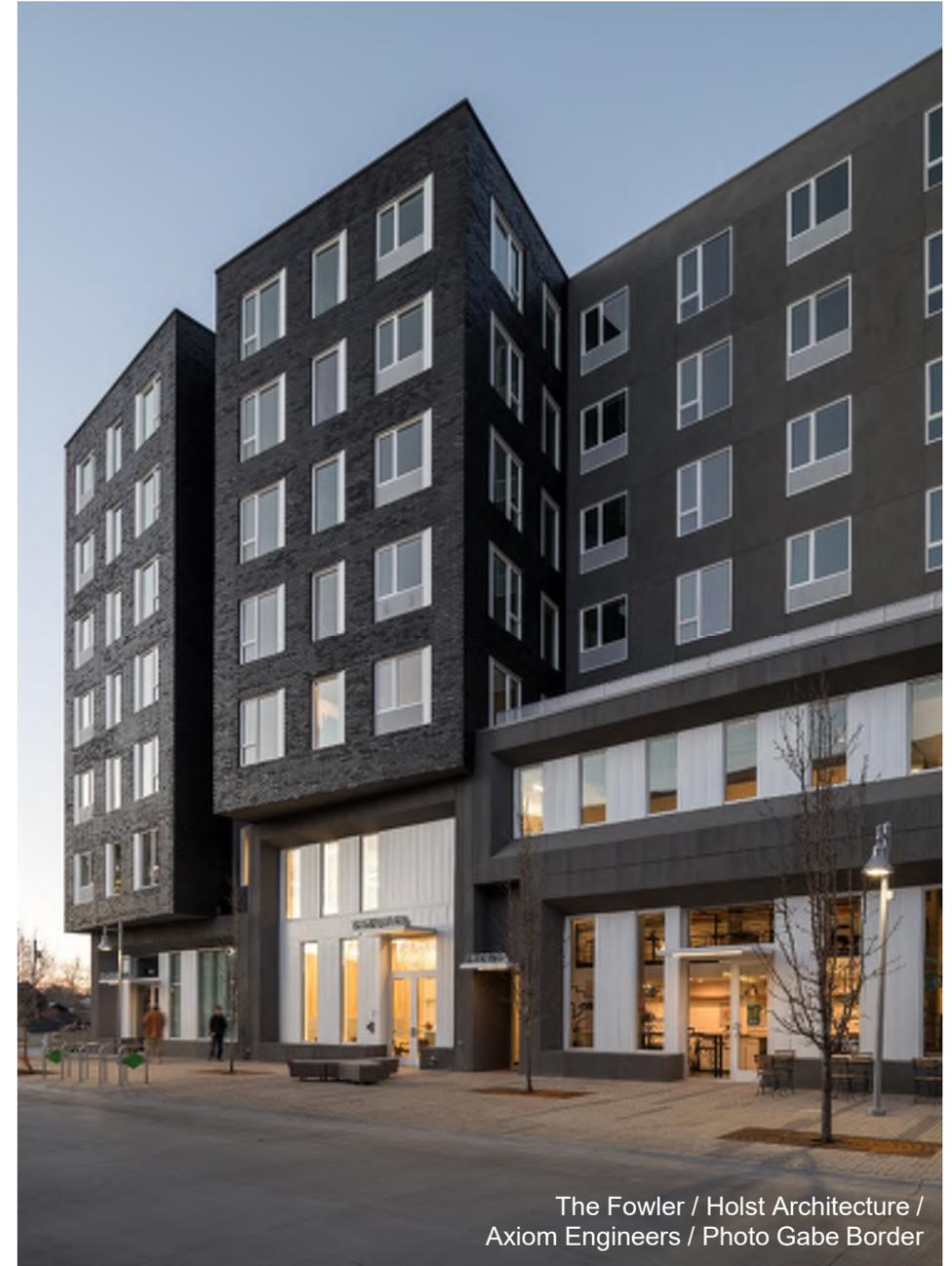
Landing Apartments, Russell Scott Steedle & Capione Architects, photo Gregory Folkins

A building with more than one occupancy group or intended function



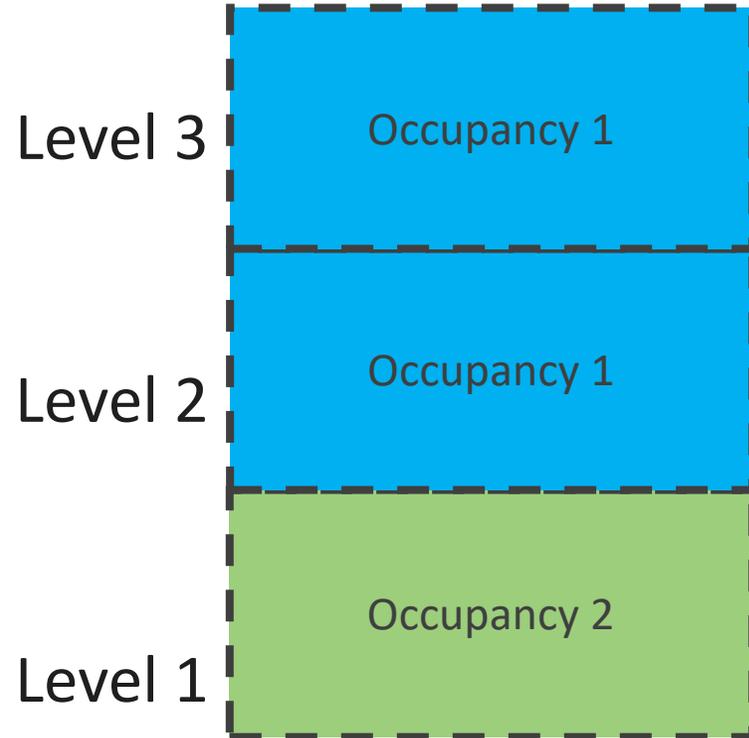
Common Mixed-Use Occupancies

- » **A:** *Assembly:* restaurant, theater, arena, lecture hall
- » **B:** *Business:* office, college, bank
- » **M:** *Mercantile:* retail, sales room
- » **R:** *Residential:* apartment, dormitory, hotel
- » **S:** *Storage:* parking, bulk storage



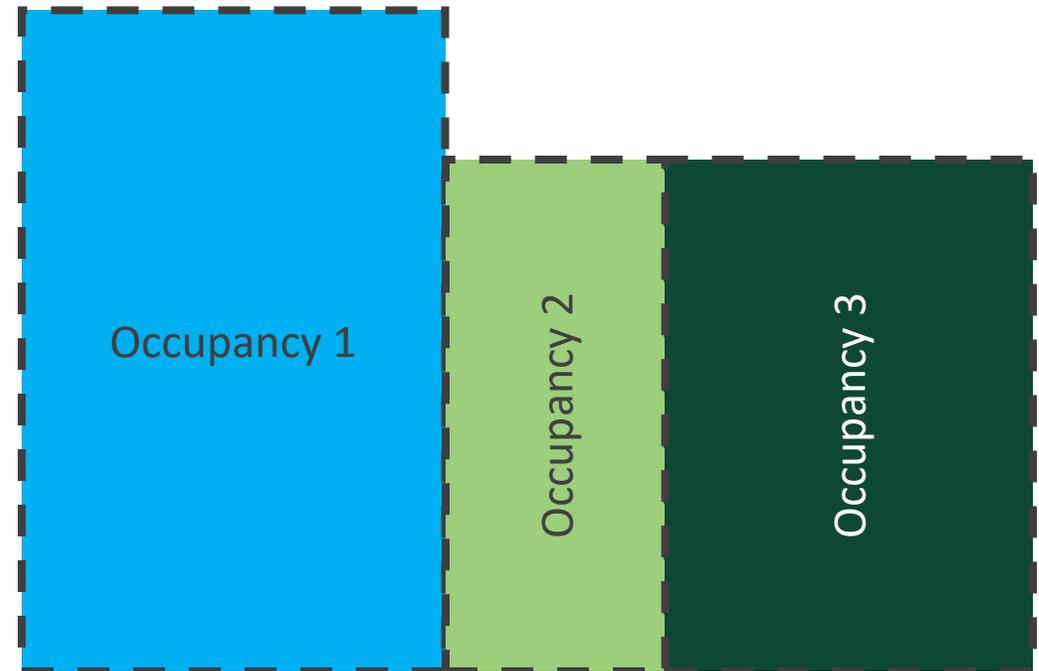
Mixed Occupancy Buildings

» Different occupancies on **different** levels:



Elevation view

» Different occupancies on **same** level:



Plan View

IBC Code Sections Related to Multiple Occupancies

- » Assembly Spaces (303)
- » Accessory Occupancies (508.2)
- » Incidental Uses (509)
- » Non-Separated Occupancies (508.3)
- » Separated Occupancies (508.4)
- » Covered and Open Malls (402)



Outside scope of
presentation

Code Sections Related to Multiple Occupancies

- » **Assembly Spaces (303)**
- » Accessory Occupancies (508.2)
- » Incidental Uses (509)
- » Non-Separated Occupancies (508.3)
- » Separated Occupancies (508.4)
- » Covered and Open Malls (402)

Assembly Spaces (303)

- » **Small buildings and tenant spaces (IBC 303.1.1)**
 - » Group B occupancy if:
 - » For assembly purposes
 - » Number of occupants < 50
- » **Small assembly spaces (IBC 303.1.2)**
 - » Group B or part of Main Occupancy if:
 - » Number of occupants < 50
 - » Area < 750 sf



Assembly Spaces (303)

...in Educational Facilities (IBC 303.1.3)

- » Not a separate occupancy when:
 - » Used for purposes associated with Group E occupancy

Examples:

- » *Gymnasium used for school sports*
- » *Cafeteria used for school meals*



Franklin Elementary School / MSES
Architects / City Construction Company

Assembly Spaces (303)

Educational Spaces in Places of Worship (IBC 303.1.4)

- » Not a separate occupancy when:
 - » Number of occupants < 100



Church of the Incarnation Chapel Parish Hall and Education Addition /
HH Architects / Datum Engineering / Photo HH Architects

Multiple Functions (302.1)

Buildings used for Multiple Functions

- » Room or space to be occupied at different times for different purposes
- » Shall comply with **all** requirements of **each** purpose



Code Sections Related to Multiple Occupancies

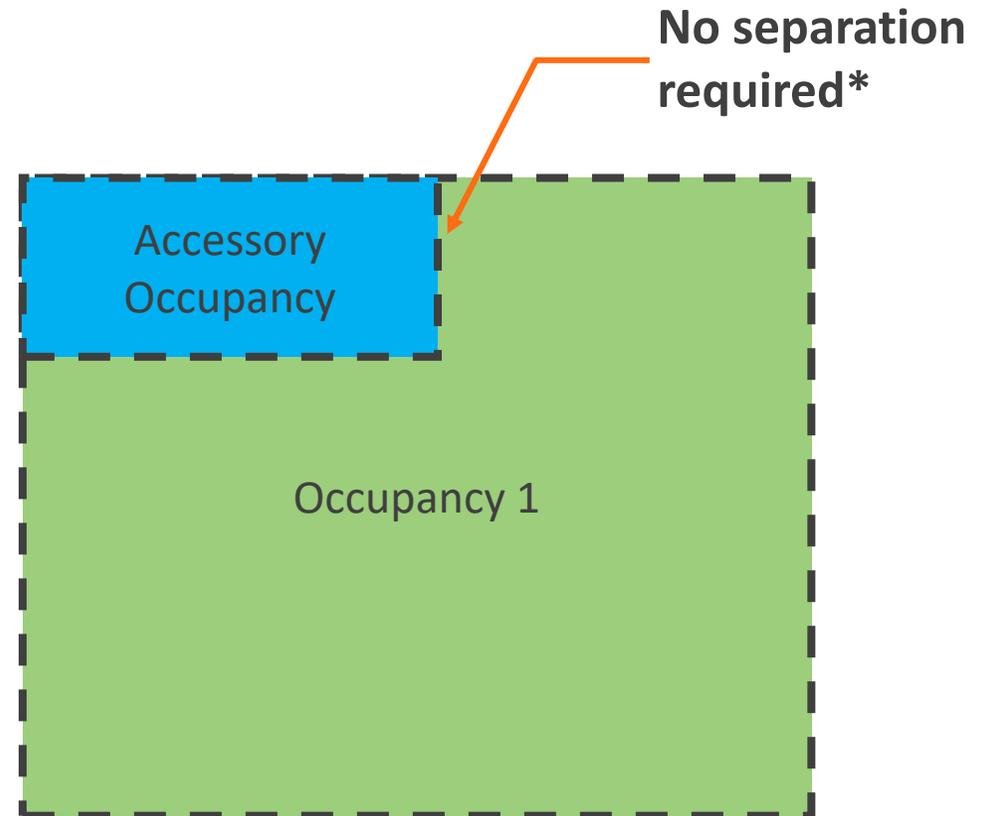
- » Assembly Spaces (303)
- » **Accessory Occupancies (508.2)**
- » **Incidental Uses (509)**
- » Non-Separated Occupancies (508.3)
- » Separated Occupancies (508.4)
- » Covered and Open Malls (402)

Accessory Occupancies (IBC 508.2)

- » Ancillary to the main Occupancy
- » **Aggregate** Accessory Area may not exceed:
 - » 10% of the main Occupancy on same floor
 - » IBC 506 “NS” Allowable Area limit of Accessory Occupancy
- » **Allowable area and height per main occupancy**

*Hazardous occupancies require separation

*Residential separations per Section 420 still apply



Incidental Uses (IBC 509)

- » Ancillary to the main Occupancy
- » ***Poses greater risk*** than main occupancy
- » Examples:
 - » Laundry room over 100 sf
 - » Refrigerant machinery room
 - » Incinerator room
 - » Furnace room
 - » Boiler room
 - » Vocational shop in a school

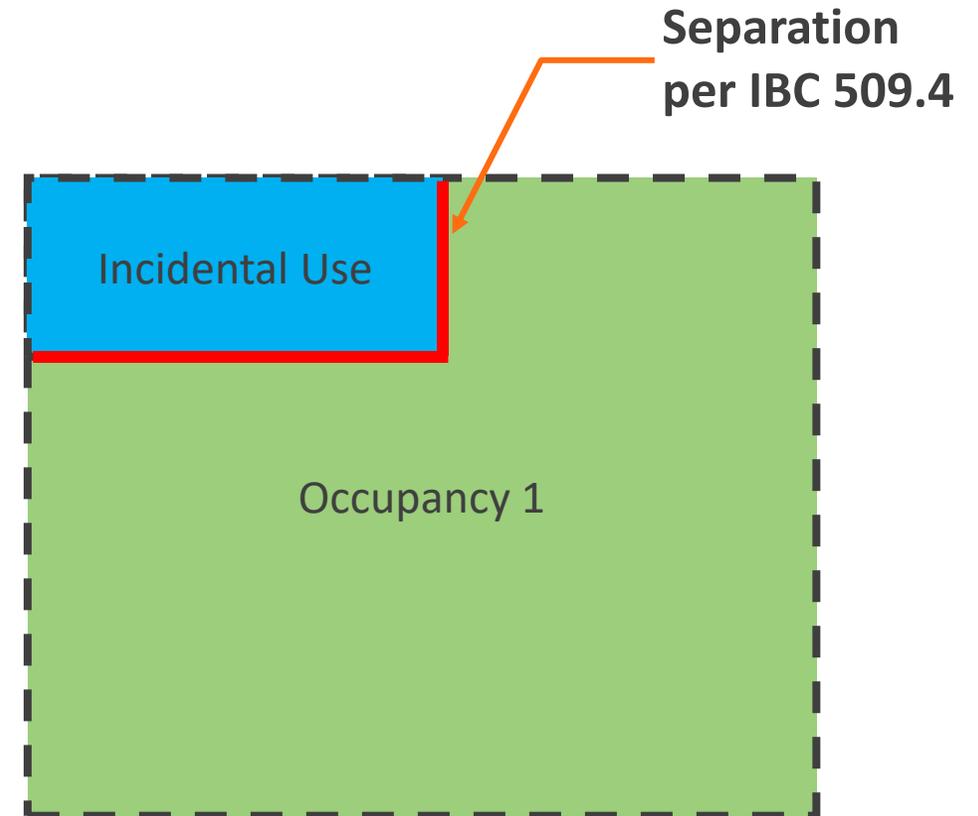


Mixed Occupancy Buildings: **Incidental Uses**

- » **Each** area not more than 10% of story
- » Separation and protection per IBC 509.4 and Table 509
 - » Separated with fire barriers, horizontal assemblies
 - » AND / OR Sprinkler system and smoke separation

Benefits:

- » Not classified as different occupancy
- » **Allowable area and height per main occupancy**

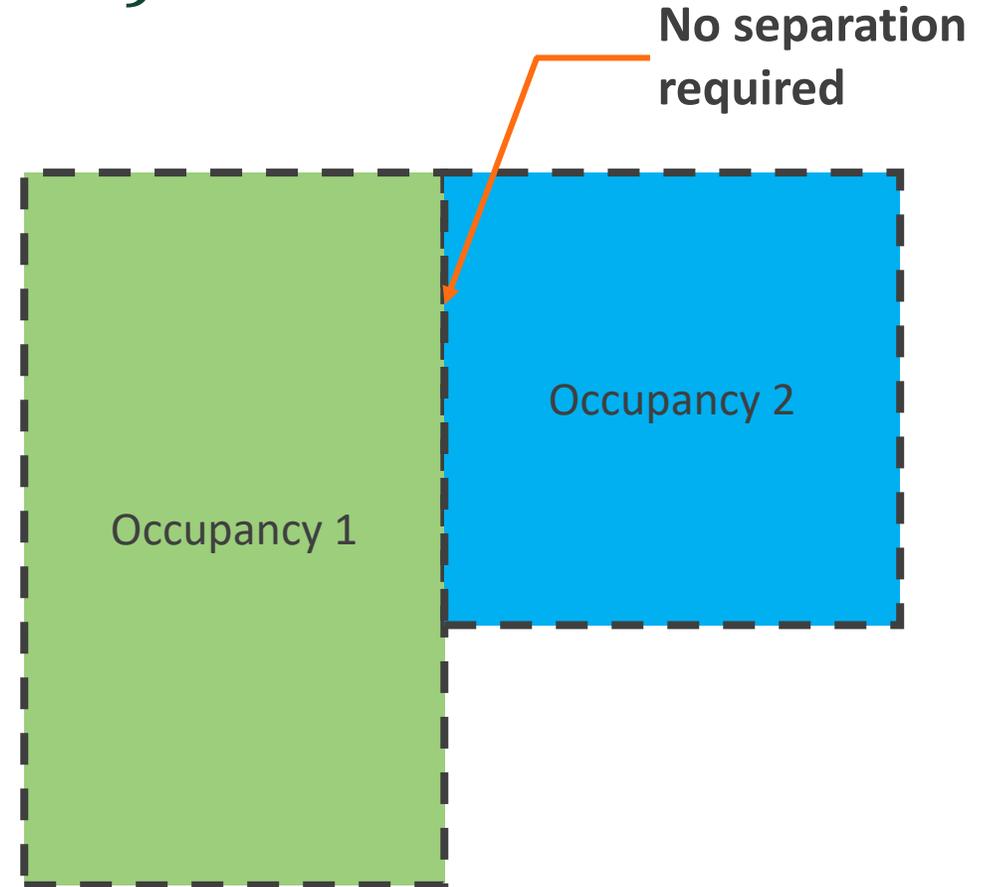


Code Sections Related to Multiple Occupancies

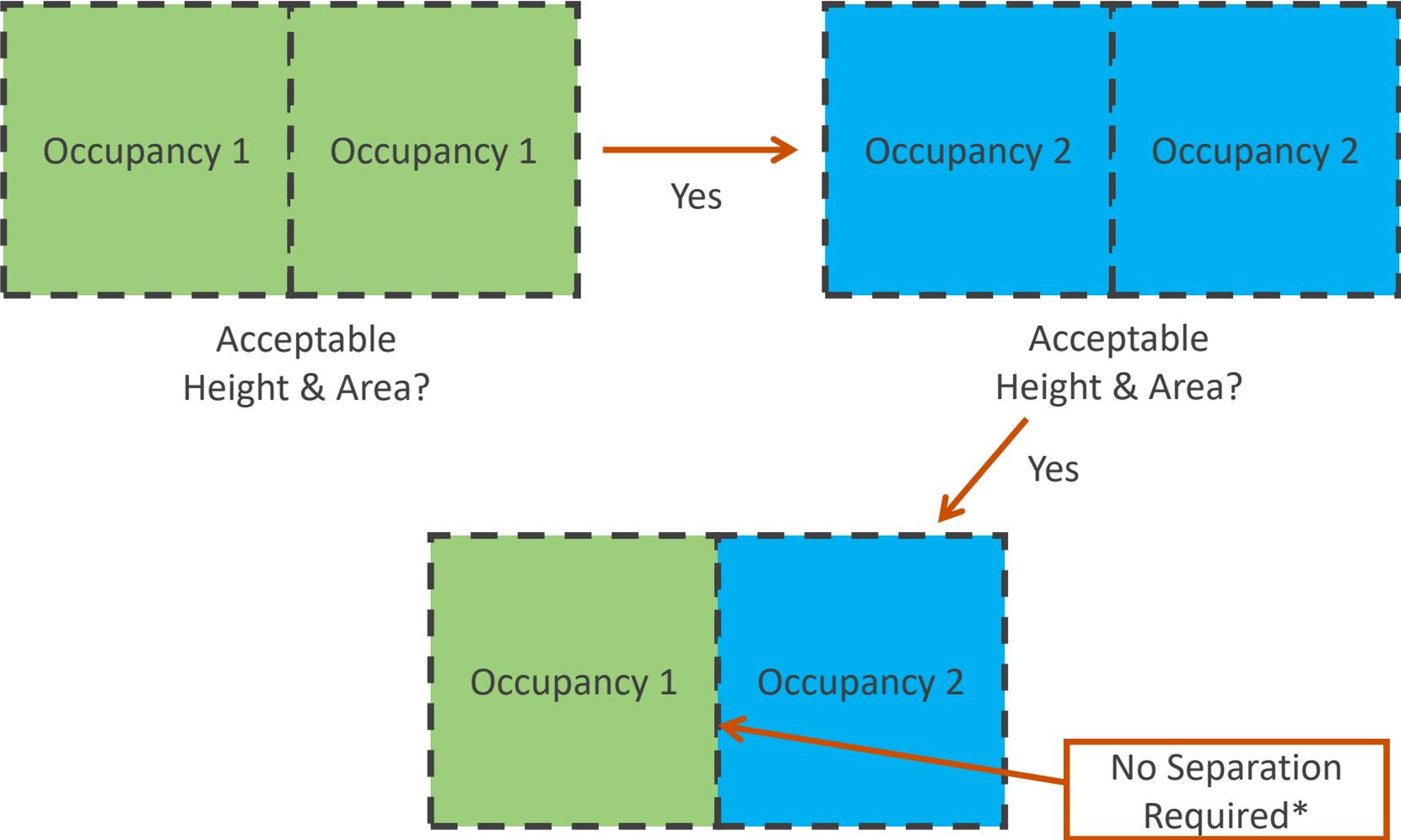
- » Assembly Spaces (303)
- » Accessory Occupancies (508.2)
- » Incidental Uses (509)
- » **Non-Separated Occupancies (508.3)**
- » **Separated Occupancies (508.4)**
- » Covered and Open Malls (402)

Non-Separated Occupancies (508.3)

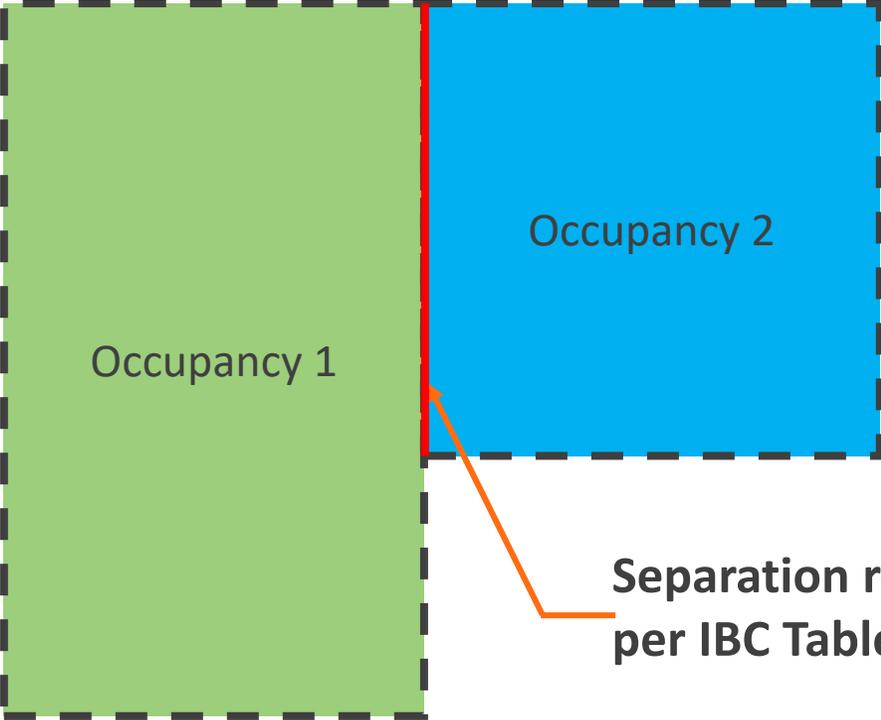
- » Allowable heights, areas and fire protection (Ch. 9) based on ***most restrictive of all occupancies***
- » Other requirements (egress, etc.) based on ***each occupancy***



Non-Separated Occupancies (508.3)



Separated Occupancies (508.4)



**Separation required
per IBC Table 508.4**

Separated Occupancies (508.4)

Occupancy Separation

**TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)¹**

OCCUPANCY	A, E		I-1 ² , I-3, I-4		I-2		R ²		F-2, S-2 ³ , U		B ² , F-1, M, S-1		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
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1 ² , I-3, I-4	1	2	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	2	NP	2	NP	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R ²	1	2	1	NP	2	NP	N	N	1 ²	2 ²	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2 ³ , U	N	1	1	2	2	NP	1 ²	2 ²	N	N	1	2	NP	NP	3	4	2	3	2	NP
B ² , F-1, M, S-1	1	2	1	2	2	NP	1	2	1	2	N	N	NP	NP	2	3	1	2	1	NP
H-1	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	N	NP	NP	NP	NP	NP	NP	NP
H-2	3	4	3	NP	3	NP	3	NP	3	4	2	3	NP	NP	N	NP	1	NP	1	NP
H-3, H-4	2	3	2	NP	2	NP	2	NP	2	3	1	2	NP	NP	1	NP	1 ²	NP	1	NP
H-5	2	NP	2	NP	2	NP	2	NP	2	NP	1	NP	NP	NP	1	NP	1	NP	N	NP

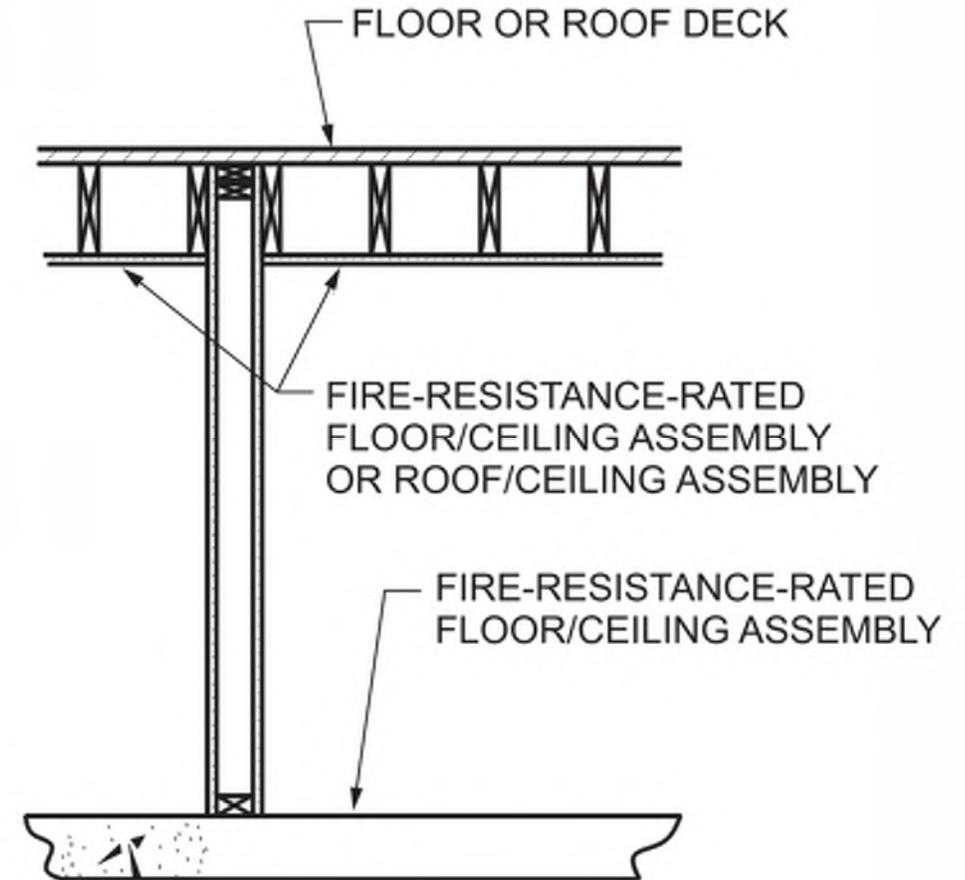
2021 International Building Code
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- » **S:** Sprinklered
- » **NS:** No Sprinklers
- » **1, 2, 3:** FRR protection
- » **NP:** Not Permitted
- » **N:** No Separation Required

Separated Occupancies (508.4)

Walls: *Fire Barrier (IBC 707)*

- » Any materials permitted by the construction type
- » Extent: Top of foundation/floor to underside of floor/roof sheathing, slab or deck above
- » Supporting construction has same FRR



Separated Occupancies (508.4)

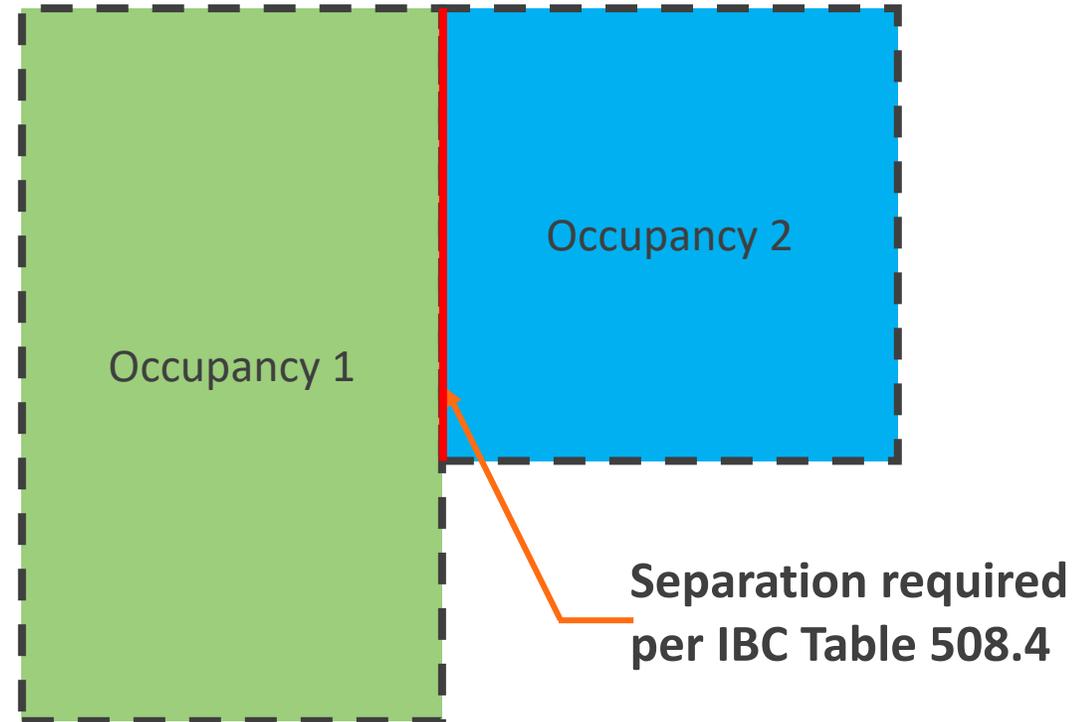
Floors: *Horizontal Assemblies (IBC 711)*

- » Any materials permitted by construction type
- » Continuous, without vertical openings (except as permitted by IBC 712)
- » Supporting construction has same FRR



Separated Occupancies (508.4)

- » Code requirements for each portion based on occupancy of that portion (except Ch. 9 requirements*)
 - » ***Separation for fire area limits defined by Section 901.7**
- » **Allowable area:** Ratios of allowable area used to check each story

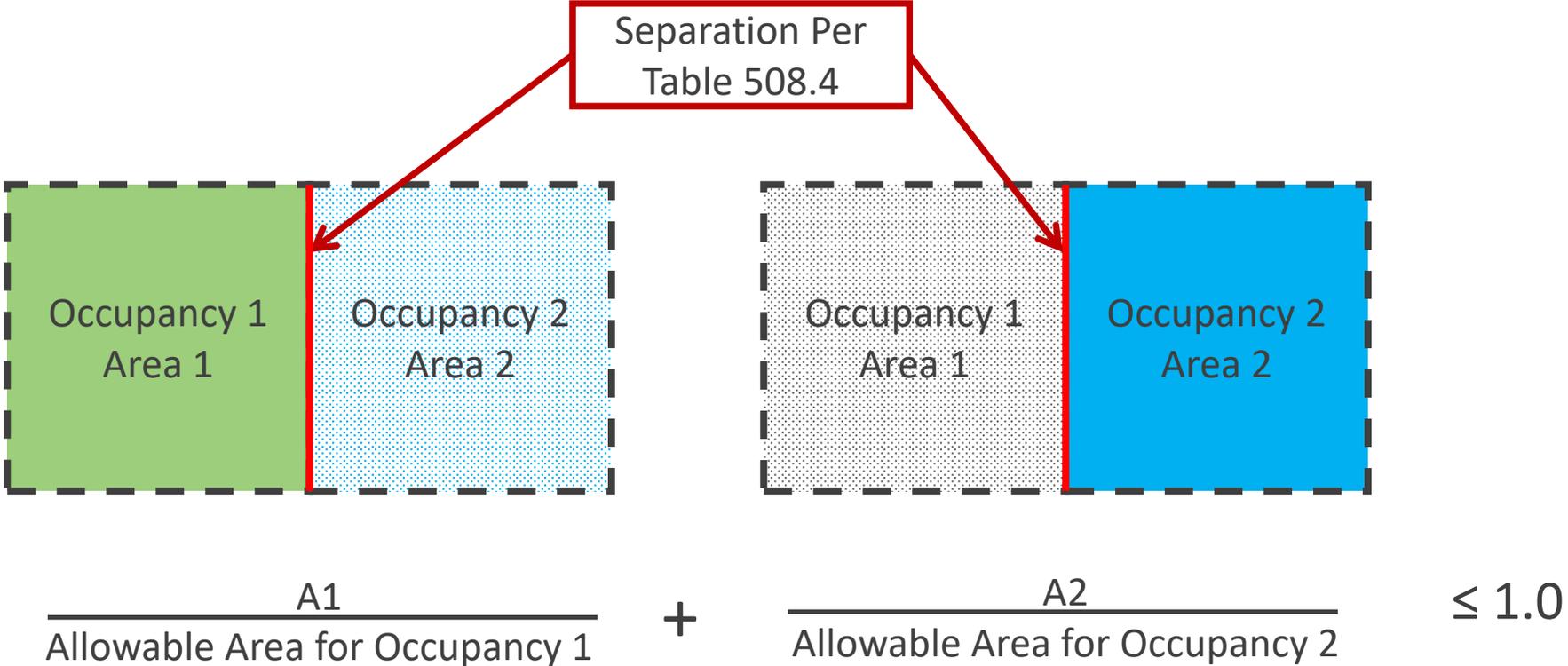


Separated Occupancies (508.4)

Story Area: $\sum \frac{A_i}{A_{a,i}} \leq 1.0$

A_i = Actual area of Occupancy i at a given story (ft²)

$A_{a,i}$ = Allowable area per story of Occupancy i (ft²)



Separated Occupancies (508.4)

$$\text{Story Area: } \sum \frac{A_i}{A_{a,i}} \leq 1.0$$

A_i = Actual area of Occupancy i at a given story (ft²)

$A_{a,i}$ = Allowable area per story of Occupancy i (ft²)

$$\frac{A_1}{\text{Allowable Area for Occupancy 1}} + \frac{A_2}{\text{Allowable Area for Occupancy 2}} \leq 1.0$$

$$\text{Total Building Area: } \sum \frac{A_i}{A_{a,i}} \leq S_a$$

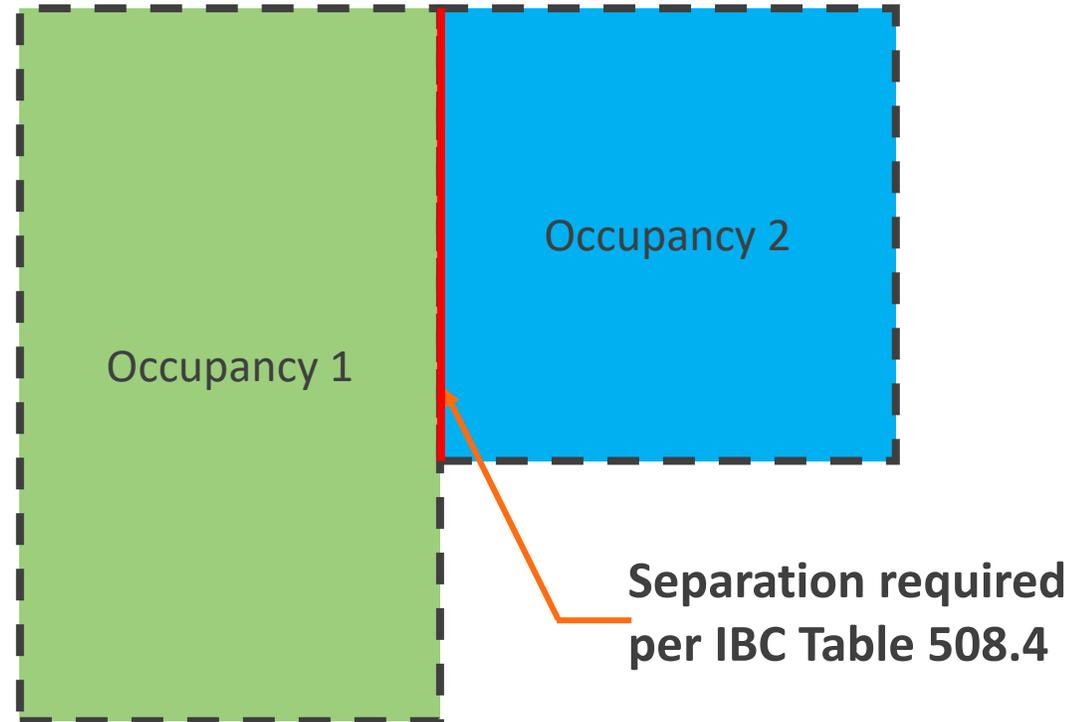
S_a = Actual number of building stories above grade plane

$S_{a, \max}$ = 3 where the actual number of stories above grade plane exceeds 3

$S_{a, \max}$ = 4 where the building is equipped throughout with an NFPA 13R (not NFPA 13) automatic sprinkler system

Separated Occupancies (508.4)

- » Code requirements for each portion based on occupancy of that portion (except ch. 9 requirements*)
 - » ***Separation for fire area limits defined by Section 901.7**
- » Allowable area: Ratios of allowable area used to check each story
- » **Allowable height:** Based on construction type and occupancy



Mixed Use Early Decision Example

4-story building on college campus

- » Mostly Group B occupancy, some assembly (A-3) space
- » NFPA 13 sprinklers throughout
- » Owner originally desires events space on top (4th) floor
 - » Requires Construction **Type IIIA**

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE^{a, b}

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

Mixed Use Early Decision Example

4-story building on college campus

- » Mostly Group B occupancy, some assembly (A-3) space
- » NFPA 13 sprinklers throughout
- » Owner originally desires events space on top (4th) floor
 - » Requires Construction **Type IIIA**

What if owner permits moving events space to a lower floor?

TABLE 504.4
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE^{a, b}

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

Mixed Use Early Decision Example

4-story building on college campus

Location of Event Space	4 th Floor	3 rd Floor (or lower)
Construction Type	III-A	III-B
Fire Resistive Rating	1-Hr	0-Hr
Connections	Concealed	Exposed
CLT Panel Thickness	5-Ply	3-Ply



Source: PCL Construction

Mixed Use Design Solutions Paper

Free to Download at
www.woodworks.org



Taking the Guesswork out of Mixed-Use Building Requirements

Mixed-Use Occupancy Design for Low- and Mid-Rise Wood Buildings

Mixed-use buildings, which combine multiple occupancies within a single structure, are common, but determining how to apply their unique set of code requirements can be a daunting task. To simplify code analysis, this document provides logical, code-compliant steps for key elements of design—such as determining allowable building size, fire separation needs, detailing requirements and the application of special provisions. With an emphasis on light wood-frame construction in Type III and V buildings, it also includes examples, calculations and sample details demonstrating how to navigate the various code requirements associated with mixed-use projects while maximizing building size and meeting fire and life safety requirements.

Mixed-use buildings come in many shapes, sizes and configurations. Although this term might have different meanings to different people, “mixed-use” in this document refers to a building with more than one occupancy group or more than one intended use. Examples include a low-rise commercial building with a shoe store, insurance agency, restaurant and warehouse storage space adjacent to one another; a mid-rise building with parking on the first story and multiple stories of residential apartments on the upper stories; and a high-rise building with combinations of office space, retail space, residential units and parking.

Fire and Life Safety – Building Size, Occupancy

type as well as the presence or absence of active fire sprinkler systems. Unless noted otherwise, references in this document refer to the 2018 version of the IBC.

Occupancy considerations include the number and mobility of occupants, and the presence and amount of combustible and/or potentially hazardous material stored within the building. Construction type defines the extent to which combustible structural building materials are allowed. The combustibility of these materials, and the combustibility of the building’s contents as determined by occupancy, combine to determine the building’s total fuel load. Allowable building size is based on this fuel load as well as the hazard associated with the intended use of the building. For example, a building that is used to store a large volume of combustible contents or where indoor welding takes place poses a greater fire hazard than a typical office building.

Fire-resistance rating (FRR) requirements for different building elements are typically dictated by construction type or separation requirements and define the duration



Mixed-Use Code Strategies: Part 1 & Part 2



*Considerations
for mixed-use
mass timber and
light-frame wood
buildings*

RDH Building Science Inc./111 East Grand
/ Neumann Monson Architects / Raker
Rhodes Engineering / StructureCraft /
Photo Mike Sinclair

Part 1: <https://www.woodworks.org/resources/mixed-use-code-strategies-part-1-incidental-uses-accessory-occupancies-and-small-spaces/>

Part 2: <https://www.woodworks.org/resources/mixed-use-code-strategies-part-2-nonseparated-occupancies-and-fire-limits/>

Heights and Areas Calculator—free tool

Calculates:

Maximum heights and areas

Code Editions:

2006 to 2021 IBC

Inputs:

- Building geometry
- Site conditions (e.g., open frontage)
- Type of construction
- Single and Mixed-Use Occupancy

HEIGHTS & AREAS CALCULATOR

Project

Analysis Mode: Basic Advanced

Project Name:

Building Code and Edition: 2021 IBC 2018 IBC 2015 IBC 2012 IBC 2009 IBC 2006 IBC 2019 CA

Type of Construction: IA IB IIA IIB IIIA IIIB IVA IVB IVC IVHT VA VB

Sprinklers System: None NFPA 13

Building Height:

Stories above grade plane:

Separated Occupancies: YES

Sec 507 compliant except 60' yardage: NO

Increase Factor Table Interpolation: YES

Outline – Part 2

- » Mixed Occupancy Buildings
- » **How do we go bigger?**
 - » **Maximizing Areas**
 - » **Maximizing Heights**



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

Unlimited Area Buildings

IBC Section 507 gives Unlimited Area Building routes for Type III, IV and/or V Construction for the following occupancies (typically 1 or 2 story max)

Assembly
Education

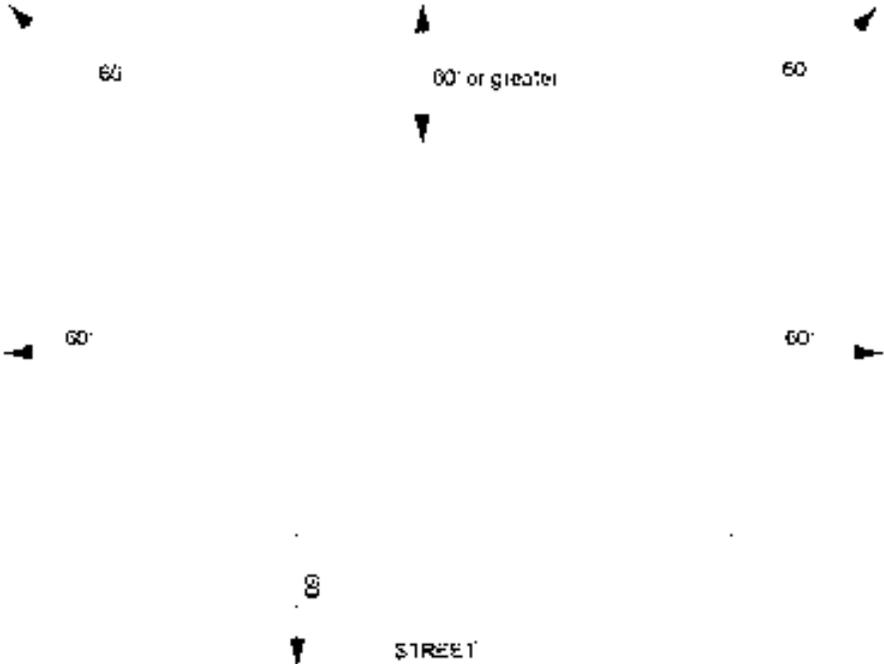
Business
Factory

Mercantile
Storage



Unlimited Area Buildings

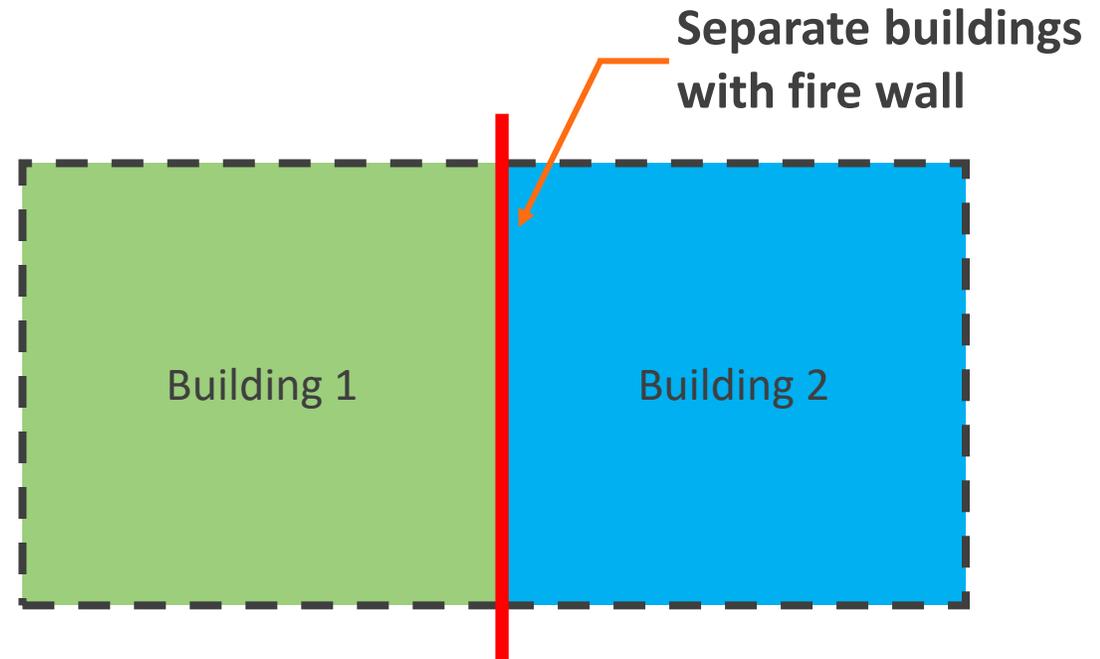
Provisions for unlimited area buildings rely on 60ft open space surrounding building (IBC 507) – *Some options for smaller open space*



REQUIRED SEPARATION FOR UNLIMITED AREA BUILDINGS

Separate Buildings – Fire Walls (706)

- » Each portion of a building separated by one or more *fire walls* shall be considered to be a separate building
- » Hourly ratings per Table 706.4



Fire Walls: Fire-Resistance (IBC Table 706.4)

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

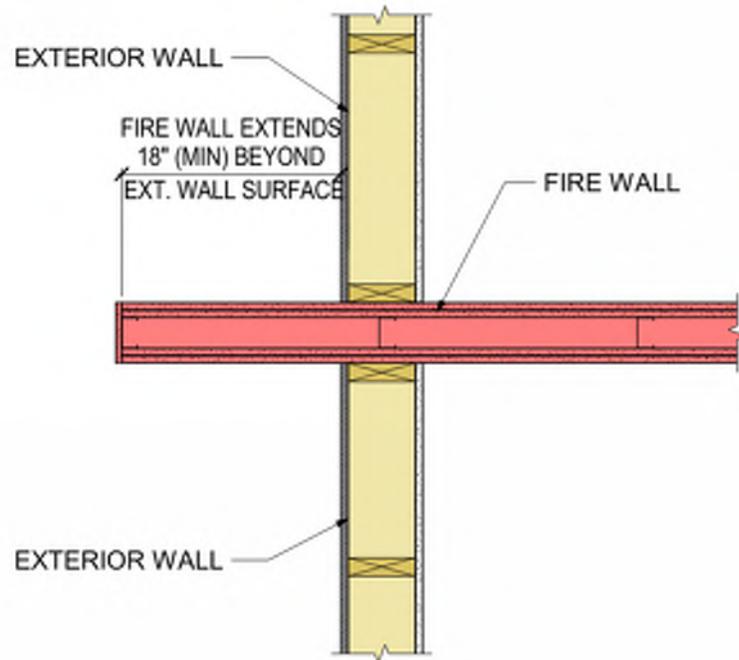
GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3 ^a
F-1, H-3 ^b , H-5, M, S-1	3
H-1, H-2	4 ^b
F-2, S-2, R-3, R-4	2

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

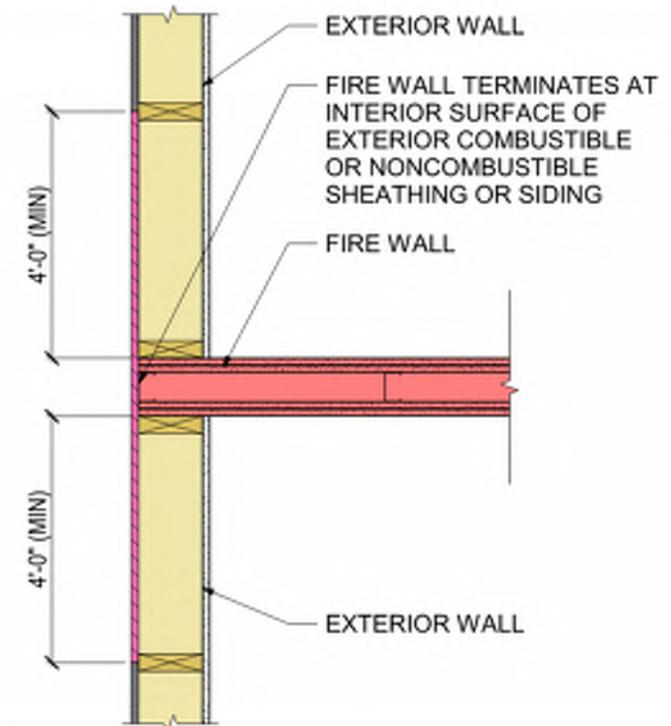
b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.7 and 415.8.

Fire Walls: Horizontal Continuity (706.5)

- » Fire walls continuous from exterior wall to exterior wall



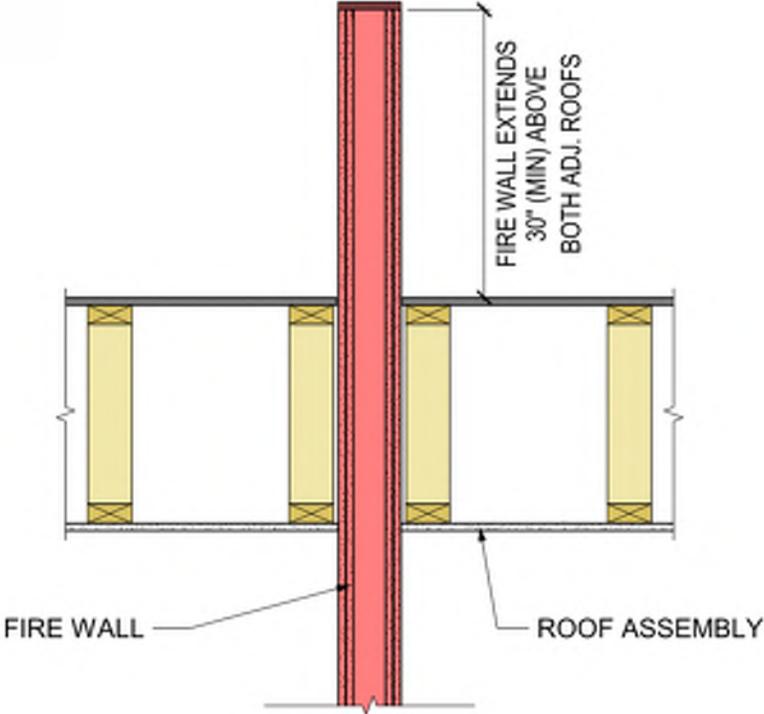
FIRE WALL TO EXTERIOR WALL: OPTION 1



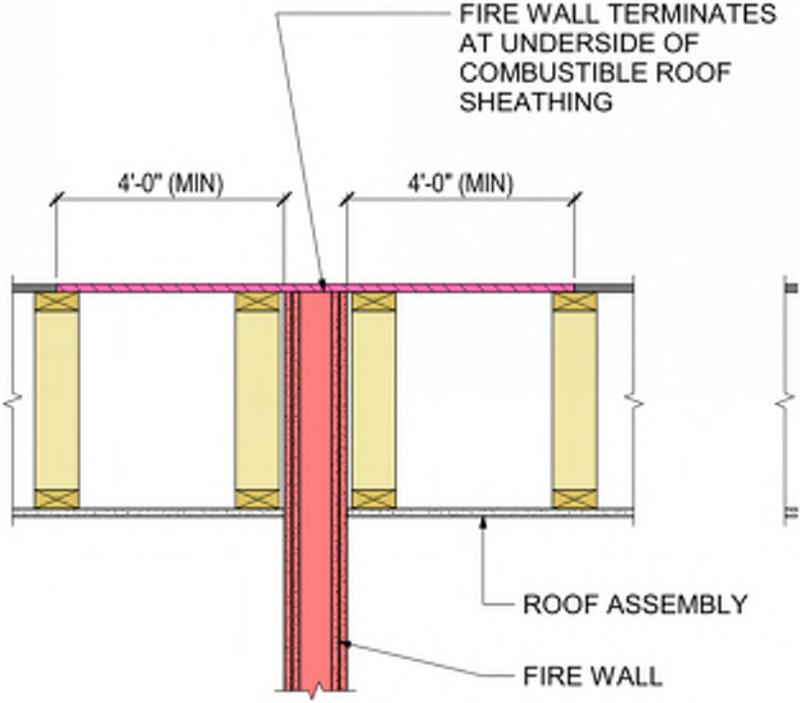
FIRE WALL TO EXTERIOR WALL: OPTION 2

Fire Walls: Vertical Continuity (706.6)

» Fire walls continuous from foundation to roof



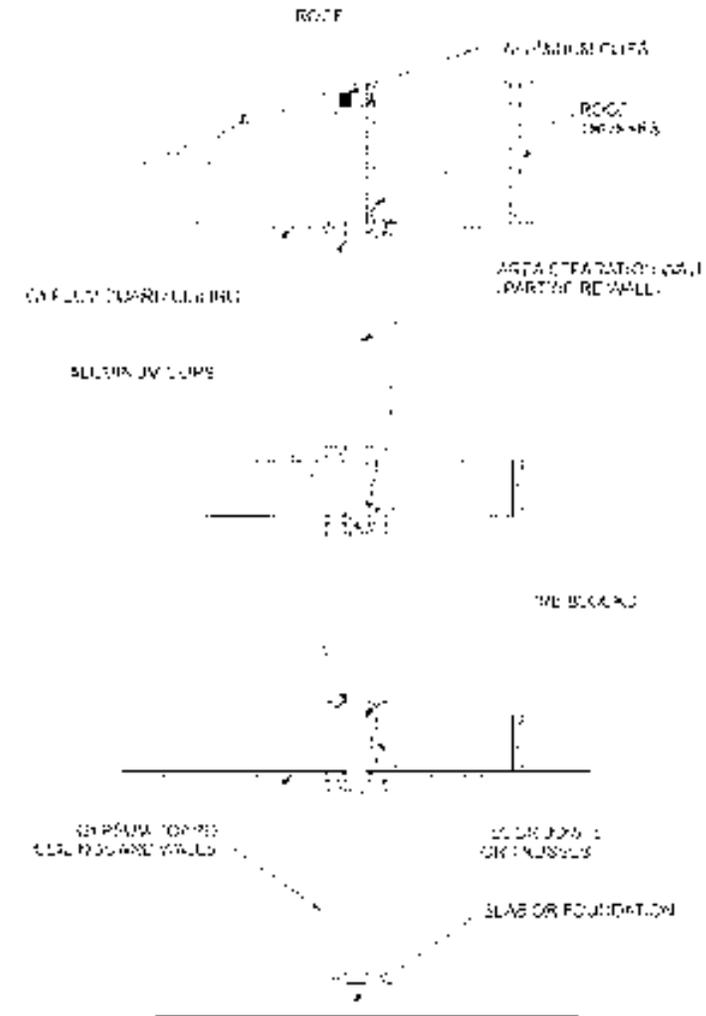
FIRE WALL TO ROOF: OPTION 1



FIRE WALL TO ROOF: OPTION 2

Fire Walls: Structural Stability (IBC 706.2)

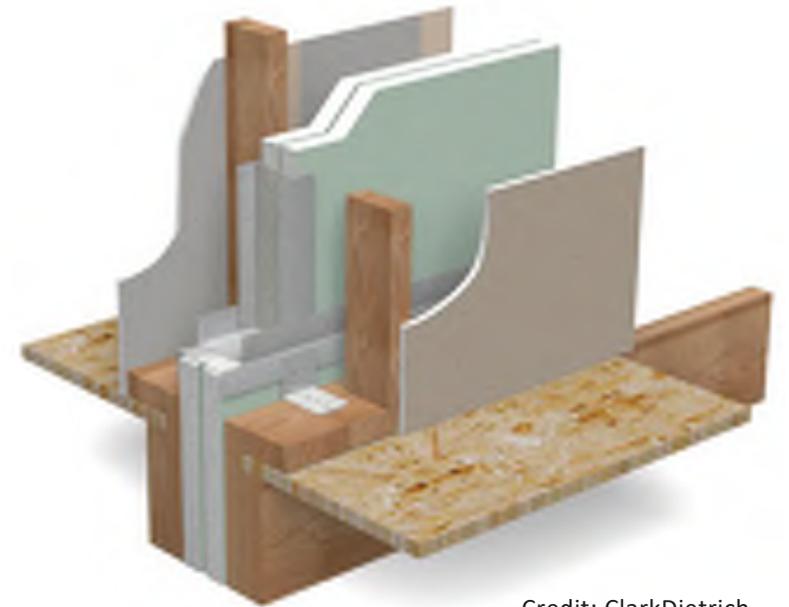
- » In event of fire, structure on either side of wall can collapse without causing structure on opposite side to collapse
- » Common options (NFPA 221):
 - » Cantilever walls
 - » Single tied walls
 - » Double walls



Fire Walls: Structural Stability (IBC 706.2)

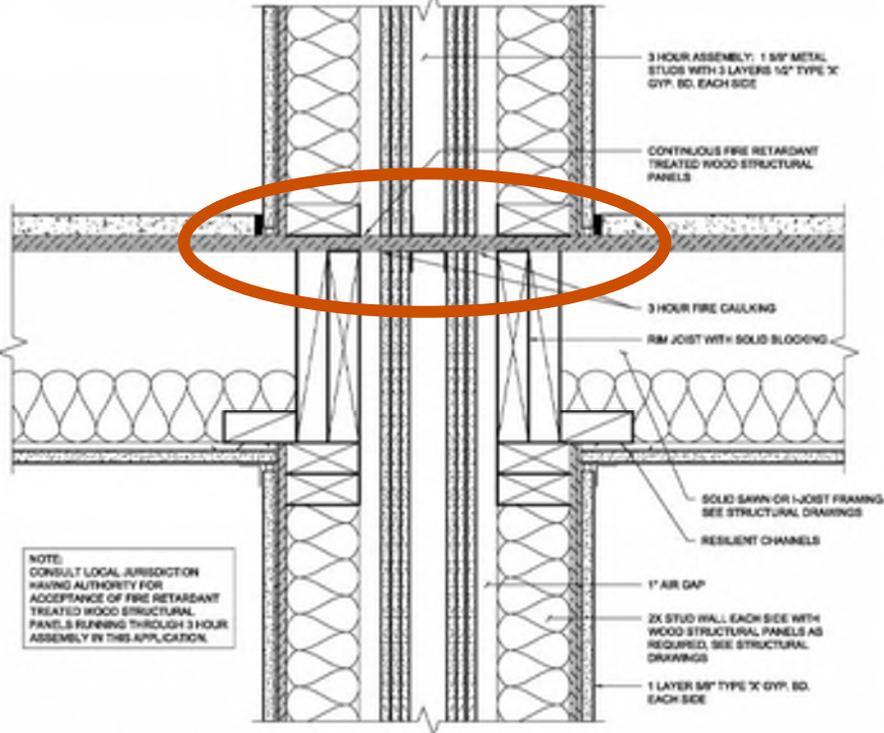
Can fire walls be wood framed?

- » Permitted in Type V construction
- » Noncombustible materials required for Types III and IV construction
- » Opportunity for wood frame bearing walls on each side of fire wall to meet structural stability requirements

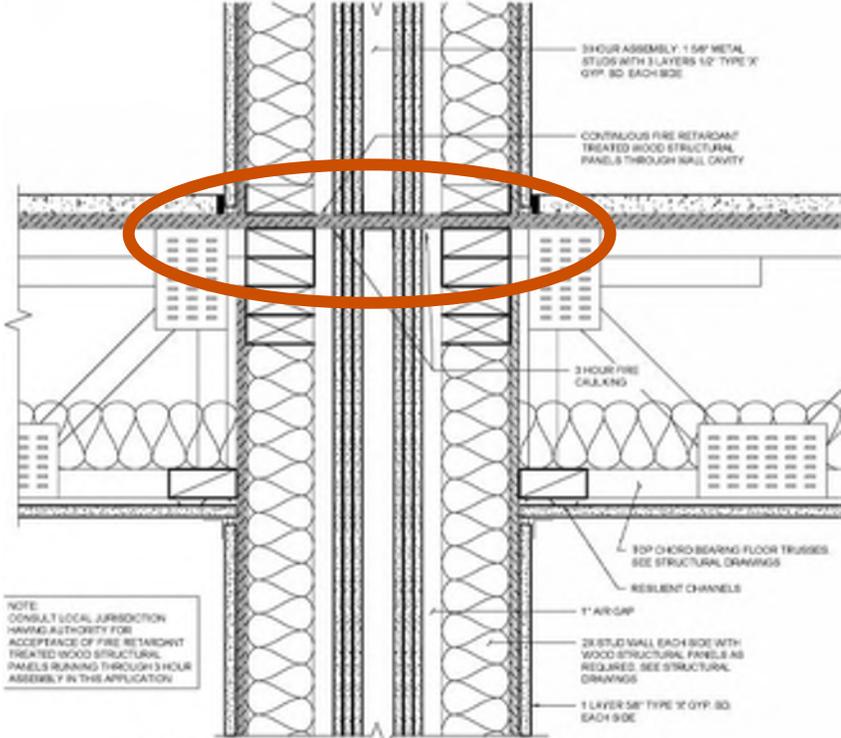


Credit: ClarkDietrich

Fire Walls: Seismic Diaphragm Continuity (706.2)



3 HOUR FIRE WALL AT FLOOR WITH WSP
 FLOOR FRAMING WITH WOOD STRUCTURAL PANEL DIAPHRAGM
 RUNNING THROUGH FIRE WALL
 3" = 1'-0"



3 HOUR FIRE WALL AT TRUSS FLOOR WITH WSP
 WOOD TRUSS FRAMING WITH WOOD STRUCTURAL PANEL DIAPHRAGM
 RUNNING THROUGH FIRE WALL
 3" = 1'-0"

Fire Walls: Seismic Diaphragm Continuity (706.2)



SEAOSC

SEAOSC LIGHT-FRAMING CONSTRUCTION COMMITTEE STRUCTURAL ENGINEERS ASSOCIATION OF SOUTHERN CALIFORNIA SEISMOLOGY OPINION

DATE: March 21, 2008

Continuity of Plywood Diaphragm Sheathing in 2 hr and 3hr Fire Walls:

Opinion: The continuity of plywood diaphragm sheathing should be maintained across the air gap commonly encountered in double stud Firewalls of 2 or 3 hour construction. The intent is to ensure that structural continuity is not significantly reduced in the roof and floor diaphragms.

Commentary:

This opinion is prepared to address the issue of diaphragm continuity as it relates to recent changes in 2007 CBC and 2006 IBC model code. Specifically the outgoing UBC provisions for Area-Separation walls have more or less been replaced by the Fire wall provisions of the IBC. Such walls are encountered in light-frame multifamily or mixed-use construction and are often constructed as a double studwall when occurring at partywall locations. The double stud walls are typically separated by an airspace of a one to four inches.

Mixed Use Occupancy Fire Wall Example



- » T- and L-shaped buildings
- » Common in hotels
- » Often large floor areas

Hyatt Place Hotel – Greensboro NC / R4
Architecture / photo Greg Folkins

Mixed Use Occupancy Fire Wall Example

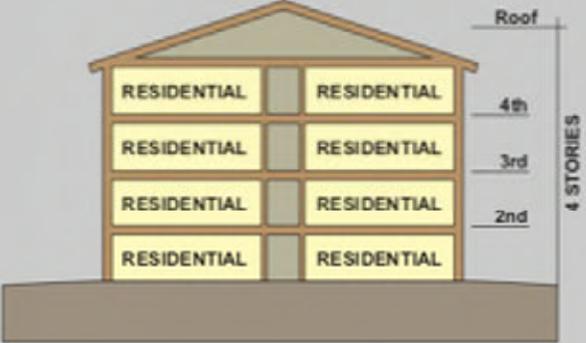


- » T- and L-shared buildings
- » May work well with firewalls at building intersections
- » Minimize length and impact of firewall
- » Maximize allowable building area
- » May allow lower construction type (i.e., III-B instead of III-A)

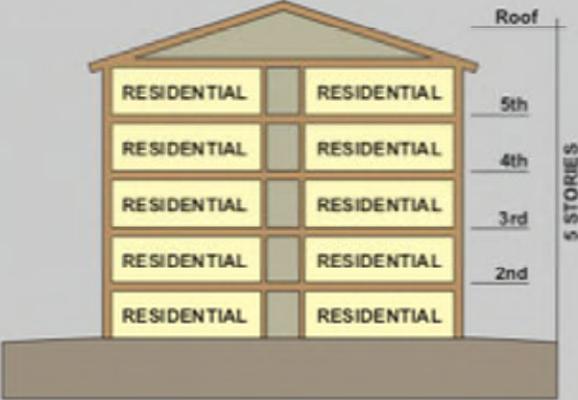
Hyatt Place Hotel – Greensboro NC / R4
Architecture / photo Greg Folkins

How do we go taller?

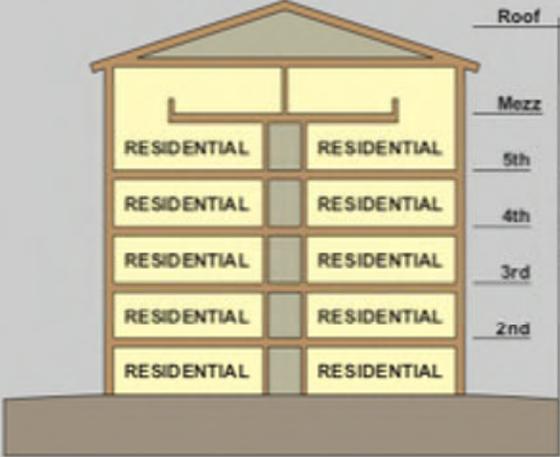
IBC Table 503: Base Height



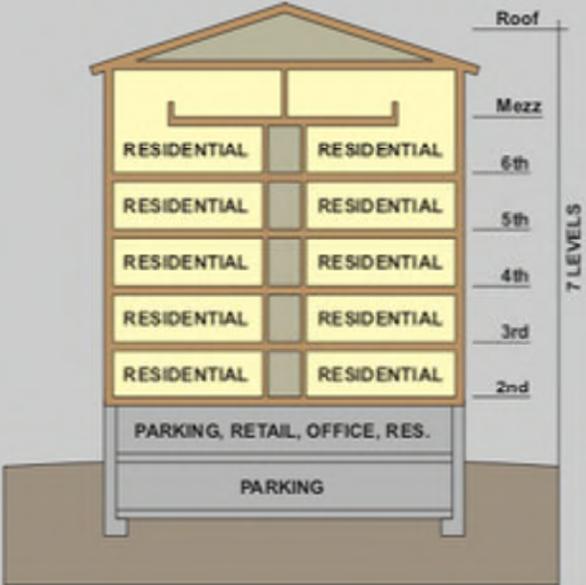
IBC Section 504: NFPA 13-Compliant Sprinkler System



IBC Section 505: Mezzanine



IBC Section 510.2: Podium



Source: WoodWorks

Mezzanines – (IBC 505)

Not counted toward building area* or number of stories if:

- » Maximum 1/3 floor area of *room* or *space* where located
- » Special egress provisions apply
- » Must be open and unobstructed to room in which it's located
(walls \leq 42" allowed)
 - » Several exceptions
- » Slightly different for equipment platforms

*Does count toward fire area with regard to fire protection in Chapter 9

Rooftop Decks – (IBC 503.1)

- » Typically not included in height or number of stories checks
- » Not classified as a story per **story** definition (IBC 202)
- » Clarified in 2021 IBC 503.1.4
- » Egress requirements (IBC 1006.3)
- » Occupancy requirements
 - » Verify occupancy permitted for story immediately below*

*Further exceptions for sprinklered buildings exist



Alvera / DJR Architects / Sandman Structural
Engineers / Photo Korey Kevin Studio

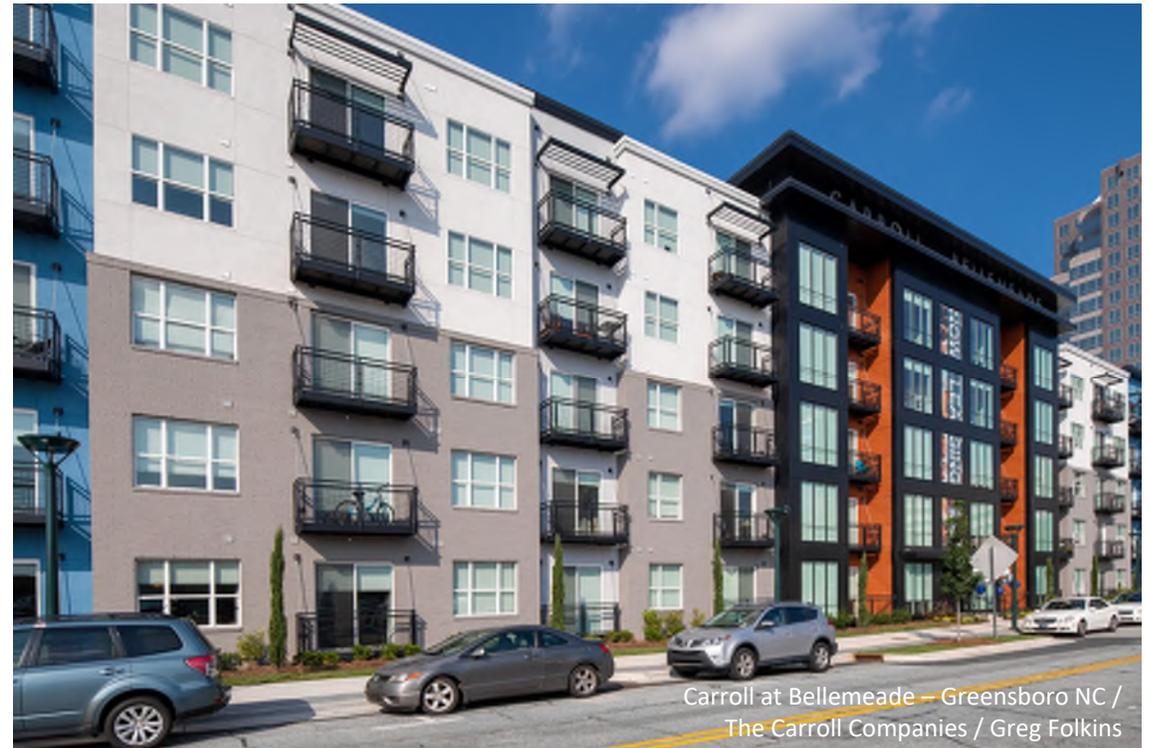
Special Provisions

IBC 510.2

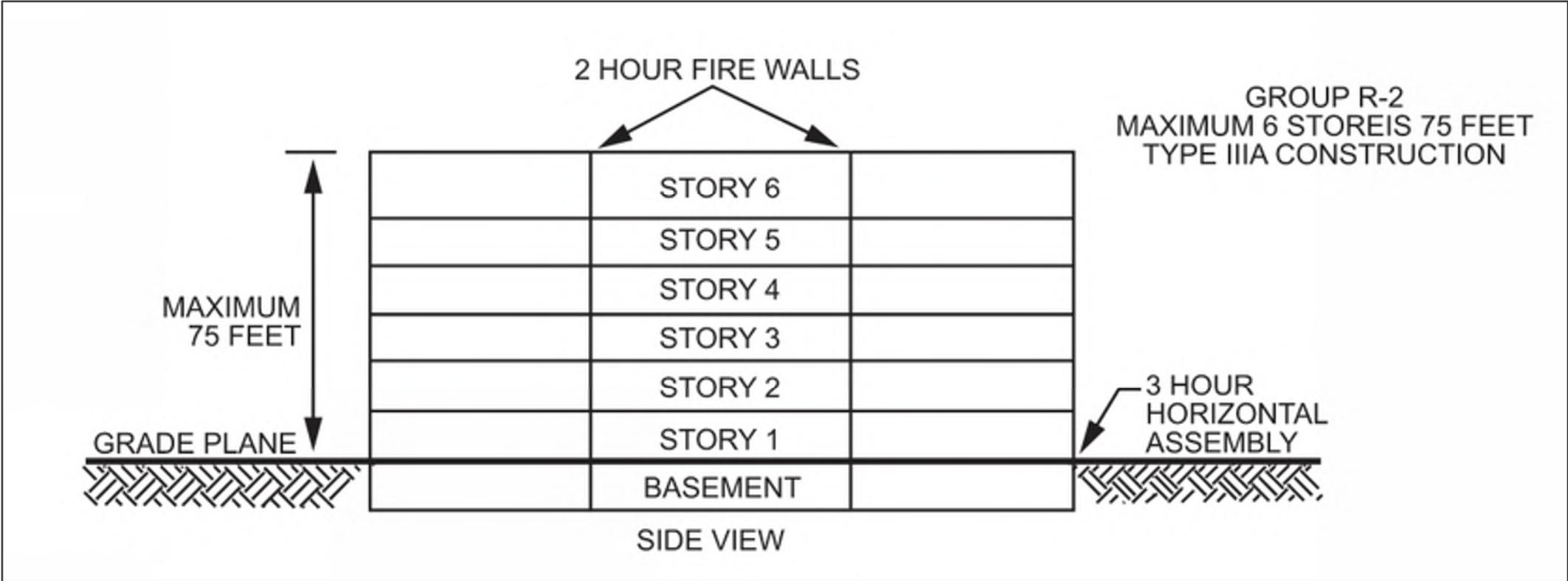


Group R-1/R-2, Type III-A height/story increase (510.5)

- » **1-story / 10-foot height increase *if*:**
 - » Building above is Type III-A and Groups R-1/R-2
 - » Basement and above-grade construction separated by 3-hr FRR horizontal assembly
 - » Floor areas subdivided into areas $\leq 3,000$ sf using 2-hr FRR fire walls



Group R-1/R-2, Type III-A height/story increase (510.5)

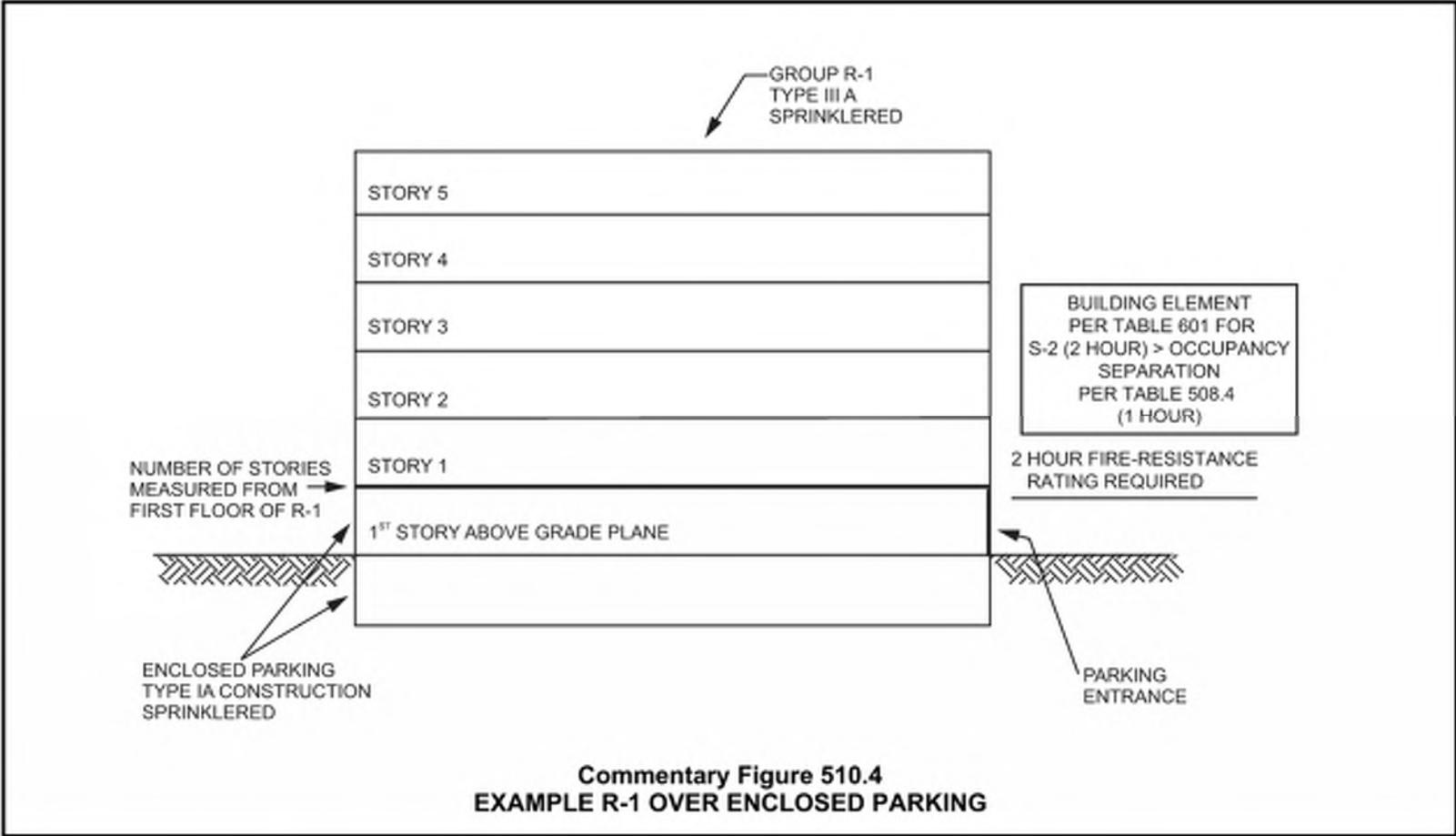


Parking beneath Group R (510.4)

- » **Group R building stories measured from podium *if*:**
 - » Lowest above grade level is parking (S-2)
 - » Lowest level and floor above is Type I or IV construction
 - » Horizontal assembly between parking and residential per IBC 508.4 (mixed occupancy separation)



Parking Beneath Group R – (510.4)



Horizontal Separation

SEAO 2012 CONVENTION PROCEEDINGS



All-wood Podiums in Mid-rise Construction

Michelle Kam-Biron, S.E.
WoodWorks
Newbury Park, CA

Karyn Beebe, P.E., LEED AP
APA
San Diego, CA

Abstract

Concern for the environment and climate change as well as the economic downturn of the past few years have created a demand for sustainable multi-family housing. According to the Washington, D.C.-based National Association of Home Builders Multifamily Production Index (MPI), a leading indicator for the multi-family market, the apartment and condominium housing market has shown steady improvement for six consecutive quarters. However, today's economic and environmental realities have led the building industry to re-evaluate the way we design and build multi-story buildings.

Mid-rise podium construction, consisting of two to four stories of wood framing above a concrete first story (the "podium") and often incorporating additional subterranean concrete levels, is common throughout North America and in

levels of residential units built on top of one or two levels of parking or other non-residential occupancies below. In this paper, we are defining wood podium as the level (or transfer level) between the two or more stories of wood-framed residential occupancy and the lower non-residential occupancy which is traditionally constructed of concrete. In an article titled, "What to Build Now," by Michael Russo, Dan Withee, AIA, LEED AP, and partner with Withee Malcolm Architects LLP in Torrance, CA states, "Wood podium is basically tuck-under apartments on steroids."

The projects described in this paper have parking, retail, and restaurant space on their first level. The podium is composed of gypsum concrete (or light weight concrete) topping over wood structural panels supported by I-joists and glued laminated (glulam) beams. Both design teams made a conscientious effort to not utilize concrete or steel framing.

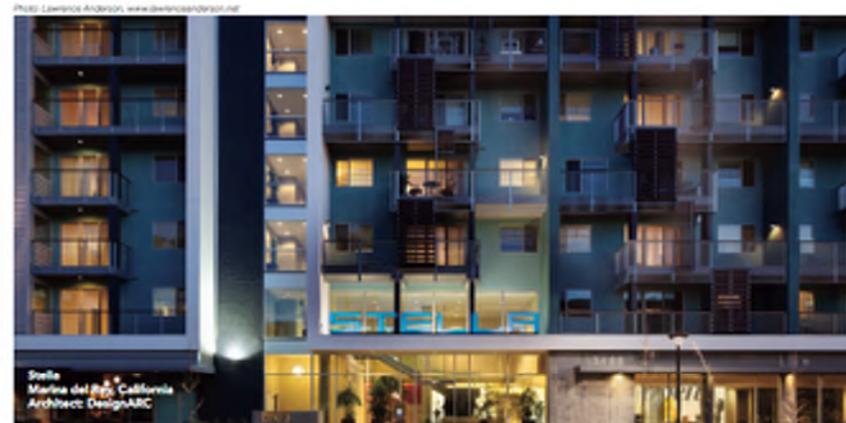
ALL-WOOD PODIUMS

Although a podium structure typically refers to wood-frame construction over concrete, a handful of designers have lowered their costs even further by designing the podium in wood.

"When determining the cost of a structure, there are a lot of variables, including most notably time, materials and labor," said Karyn Beebe, P.E., of APA. "Using wood instead of concrete lowers the mass of the building, which results in more economical podium shear walls and foundations. Using the same material for the entire structure may also mean lower design costs, and the construction team experiences savings in the form of fewer trades on site, which means less mobilization time, greater efficiency because framing is repeated on all of the levels, easier field modifications, and a faster schedule."

Architect Dan Withee, AIA, LEED AP, of Withee Malcolm Architects designed an 85-unit wood podium project in San Diego. He estimated that a concrete podium can cost \$15,000 per parking space compared to \$9,500 for wood podium.⁴

Horizontal Wood Assemblies are effectively used to transition from Residential units above to Retail/Parking below



Multi-Story Wood Construction

A cost-effective and sustainable solution for today's changing housing market

Sponsored by reThink Wood and WoodWorks

Cost-effective, code-compliant and sustainable, mid-rise wood construction is gaining the attention of design professionals nationwide, who see it as a way to achieve higher density housing at lower cost—while reducing the carbon footprint of their projects. Yet, many familiar with wood construction for two- to four-story residential structures are not aware that the International Building Code (IBC) allows wood-frame construction for five stories and more in building occupancies that range from business and mercantile to multi-family, military, senior, student and affordable housing.

but its benefits are equally applicable to other occupancy types." Among their benefits, wood buildings typically offer faster construction and reduced installation costs. For example, after completing the first phase of a developer-funded five-story student housing project using steel construction, OKW Architects in Chicago switched to wood. "The 12-gauge steel panels were expensive, very heavy and difficult to install, and welding and screwing the shear strap bracing was very time consuming," says project architect Eileen Schoeb. "Using wood was far more economical for the second phase." Farooq Mania, president

CONTINUING EDUCATION

EARN ONE AIA/CES HSW LEARNING UNIT (LU)

EARN ONE GBCI CE HOUR FOR LEED CREDENTIAL MAINTENANCE

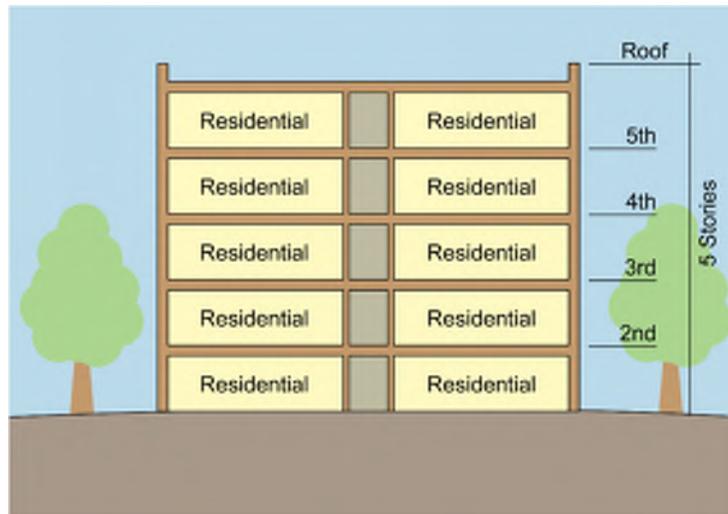
Learning Objectives

- After reading this article, you should be able to:
1. Identify the sustainability and economic benefits of using wood construction for mid-rise buildings.
 2. Summarize building code requirements and provisions for mid-rise multi-family

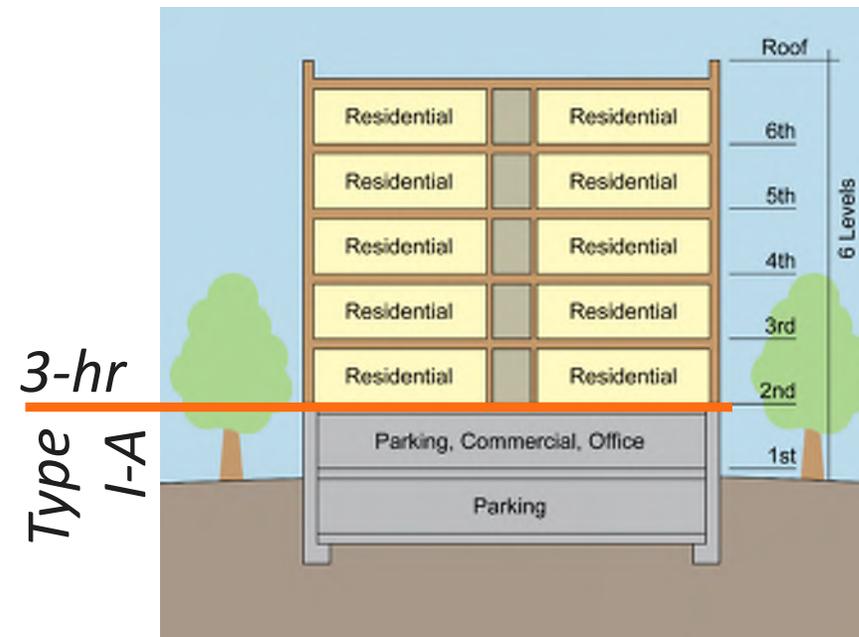
Horizontal Building Separation – IBC 510.2

“Podium Provision”

5-story Type III building:



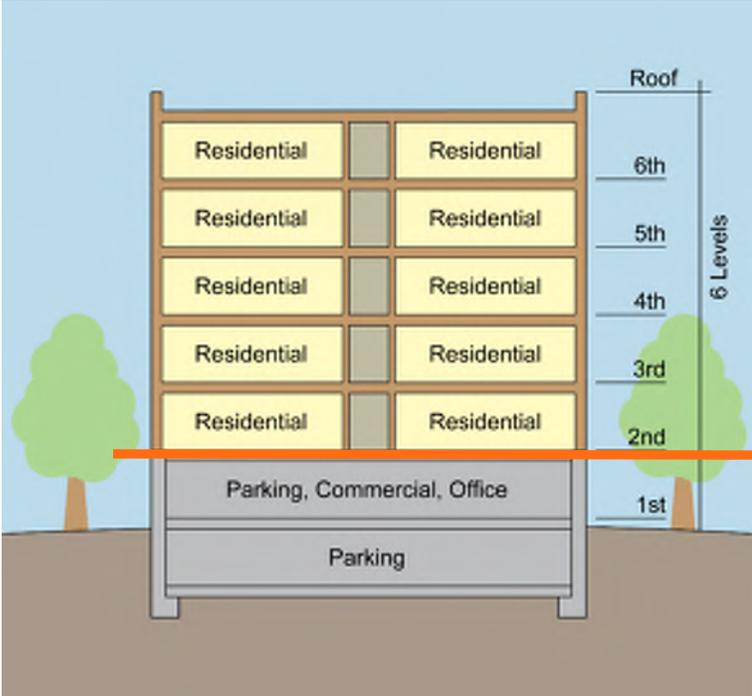
5-story Type III building
over Type I-A podium:



Note: Increases allowable stories... not allowable building height

Horizontal Building Separation – IBC 510.2

“Podium Provision”



3-hr

Type I-A

IBC	2006	2009	2012	2015	2018	2021
Section	509.2	509.2	510.2	510.2	510.2	510.2
Upper Occupancy	A, B, M, R or S					
Lower Occupancy	S-2 Parking	A, B, M, R or S-2 Parking	Any Except H			
Podium Height	1 Story			No Restriction		

Office Podium

7 stories office:

6-story Type III or IV
over 1-story podium:



T3 Minneapolis, MGA | Michael Green
Architecture, DLR Group, StructureCraft,
Magnusson Klemencic Associates, Photo Ema
Peter

Residential Podium

7 stories:

5-story Type III over
2-story podium



Marselle Condominiums / PB
Architects / Yu & Trochalakis / Matt
Todd Photography

Residential Podium

5 stories for Residential
+ Mezzanine
+ Multi-Story Podium



Marselle Condominiums / PB
Architects / Yu & Trochalakis / Matt
Todd Photography

CASE STUDY
Thomas Logan



Wood-frame urban podium project fills need
for affordable downtown housing

Thomas Logan

Boise, ID

65,625 sf, 7 stories (5-over-2)

Type V-A

Multi-Family

Completed 2022

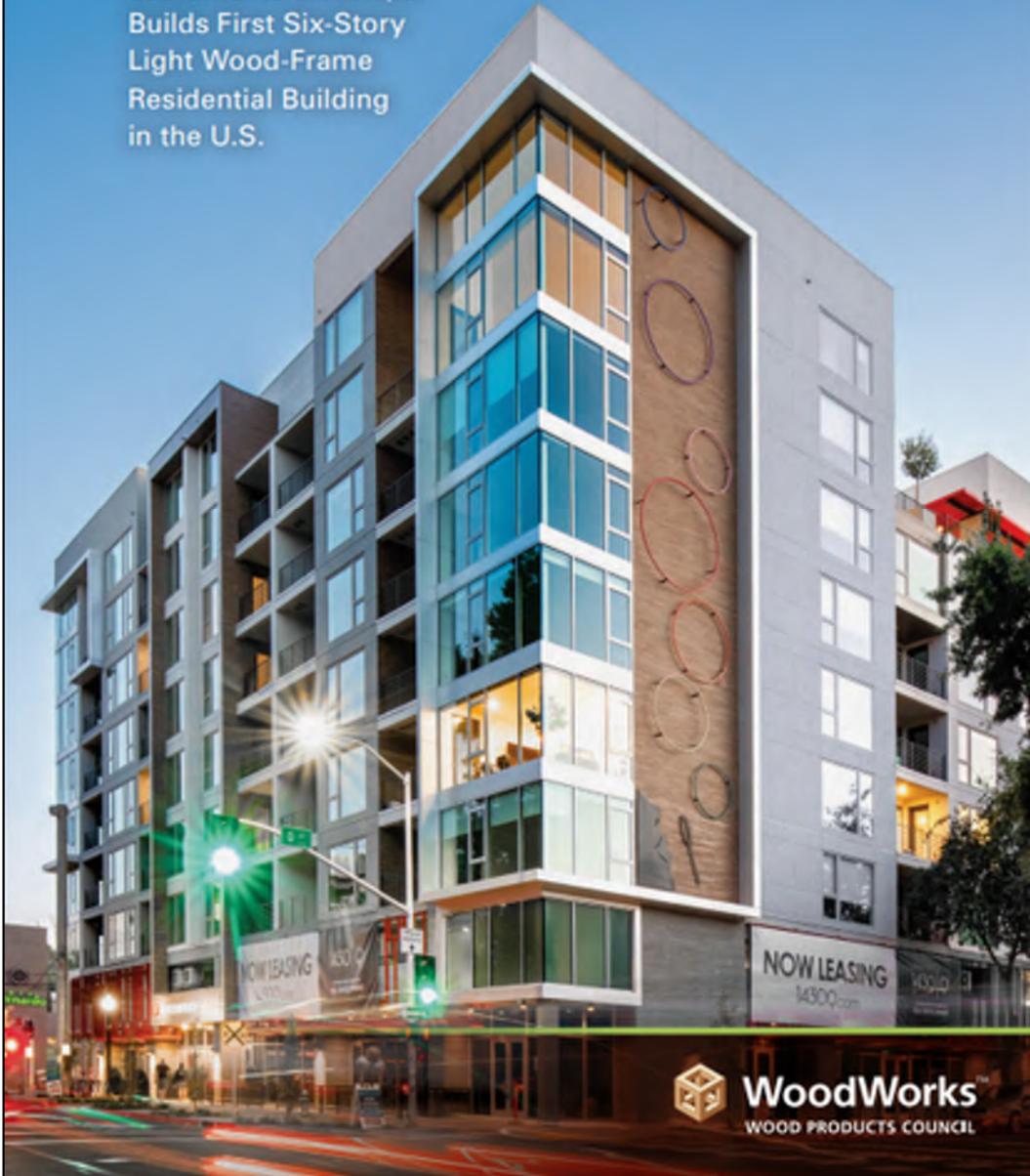


Pivot North Architects
Engineer: Axiom
Photo: Chad Case Visuals

Don't get boxed in!



Sacramento Developer
Builds First Six-Story
Light Wood-Frame
Residential Building
in the U.S.



1430 Q Street

Sacramento, CA

162,700 sf, 8 stories (6-over-2)

Type III-A

Mixed-Use

Completed 2020



HRG Architects
Buehler Engineering, Inc
Photo: Gregory Folkins Photography

Alternate Materials and Methods Requests (AMMR) Solutions Paper

Free to Download at
www.woodworks.org

Getting to Yes: Making Effective Use of the Alternate Means Process

Michael F. Malnowski, AIA, Applied Architecture Inc. • Andrew Klein, PE, CEM, A S Klein Engineering, PLLC

Introduction

Arguably, one of the most important sections of the International Building Code (IBC) is not used for most construction projects. This section opens up countless performance-based paths for the successful design and construction of buildings and equipment. Codified in Section 104.11 of the IBC, it is most commonly referenced as the provision for AMMRs—shorthand for Alternate Materials and Methods Requests.

The AMMR provisions permit a Building Official to consider the intent of prescriptive code provisions when deliberating on new or existing technologies in materials, design and methods that are not explicitly addressed in the code. In this way, the code can provide the flexibility to address new concepts, innovations, and developments that may not have been recognized or even existed during the code's formal development process. The AMMR code section can also prove helpful in addressing code compliance paths that are by nature complex, since it creates a framework for a specific approval process, with appropriate consideration and documentation, so that in the future it is possible to retrace the logical steps that were associated with a particular permit process. For this reason, sometimes the AMMR process is used in situations where there is simply a complex enough situation that it is the preference of either the applicant or code official that it be part of the permit approval process, even though the project may not actually be incorporating newly developed materials or methods.

The IBC is not alone in its allowance of AMMRs. The legacy codes (developed by Building Officials Code Administrators International, Southern Building Conference International, and International Conference of Building Officials) had similar provisions, as do the National Fire Protection Agency (NFPA) standards and codes, which allow a designer to depart from the prescriptive wording of the code and focus instead on the performance of the building based on the code's intent. Similar



The structural system of the new Integrated Design Building at the University of Massachusetts Amherst required a variance for structural equivalency under the Massachusetts Building Code.

Credit: Alexander Schreyer, University of Massachusetts

To fully understand the implications of IBC Section 104.11, it's worth considering several attributes of the code:

- Code compliance is not necessarily the highest bar for determining the standard of care for design professionals. This is because there are so many variables that can affect how a building performs, particularly during emergency situations.
- Code compliance does not alone ensure that buildings are safe. The term 'safe' is relational and, in practical application, codes balance practical considerations such as economics and buildability.
- A building code is not design- and style-neutral because it is

Other Opportunities

STAIR FRAMING WITHIN TYPES III, IV & V

Section 1011.7:

Stairways shall be built of materials consistent with the types permitted for the type of construction of the building.

Commentary:

“... Any structure supporting the stairway and the stairway enclosure must be fire-resistance rated consistent with the construction type; however, the stairway components inside the enclosure need only comply with the material limits for the type of construction.”



Other Opportunities

STAIR FRAMING WITHIN PODIUM LEVELS



2021 IBC allows stairs within podium levels to be framed with wood if:

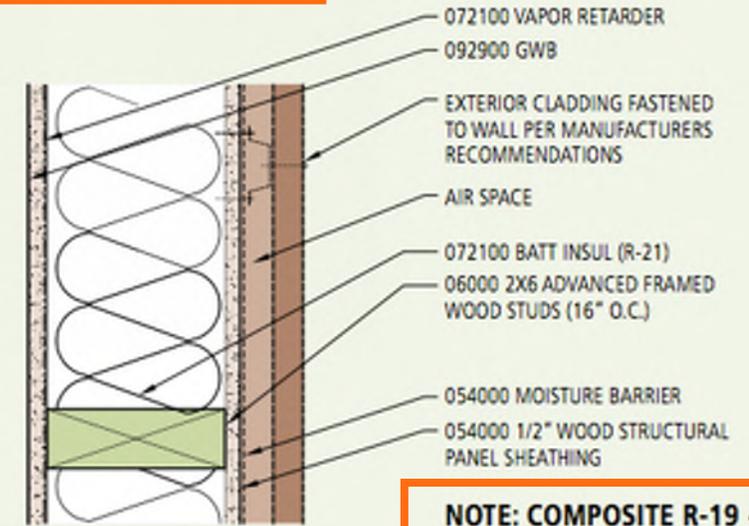
- » Building above is Type III, IV or V
- » Shaft enclosure has 3-hr rating

Other Opportunities

WALL FRAMING WITHIN PODIUM LEVELS



2X6 WOOD STUDS W/ R-21 BATT INSULATION



2X6 MTL STUDS W/ R-21 BATT INSULATION

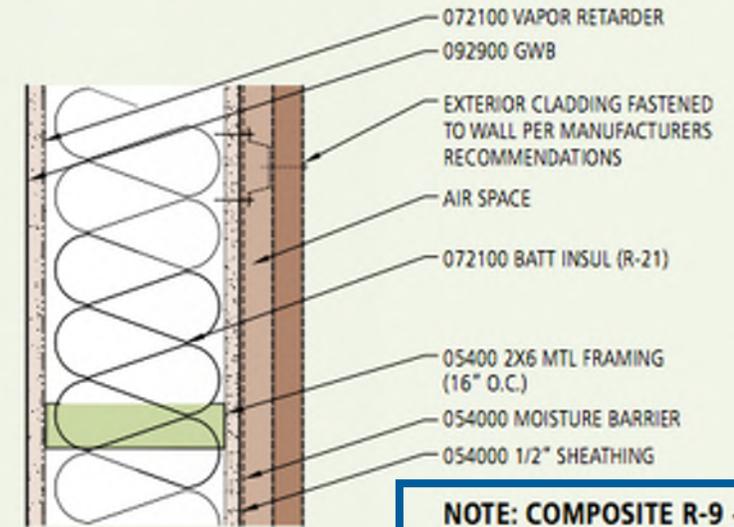
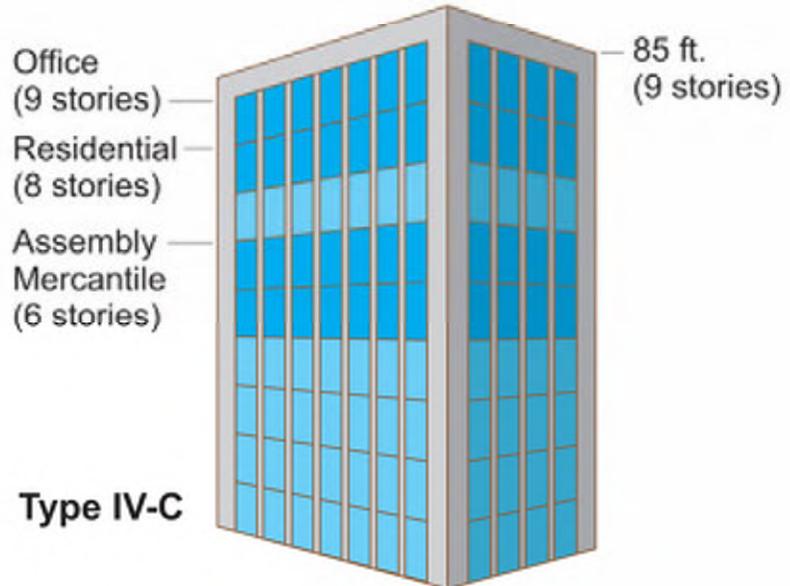
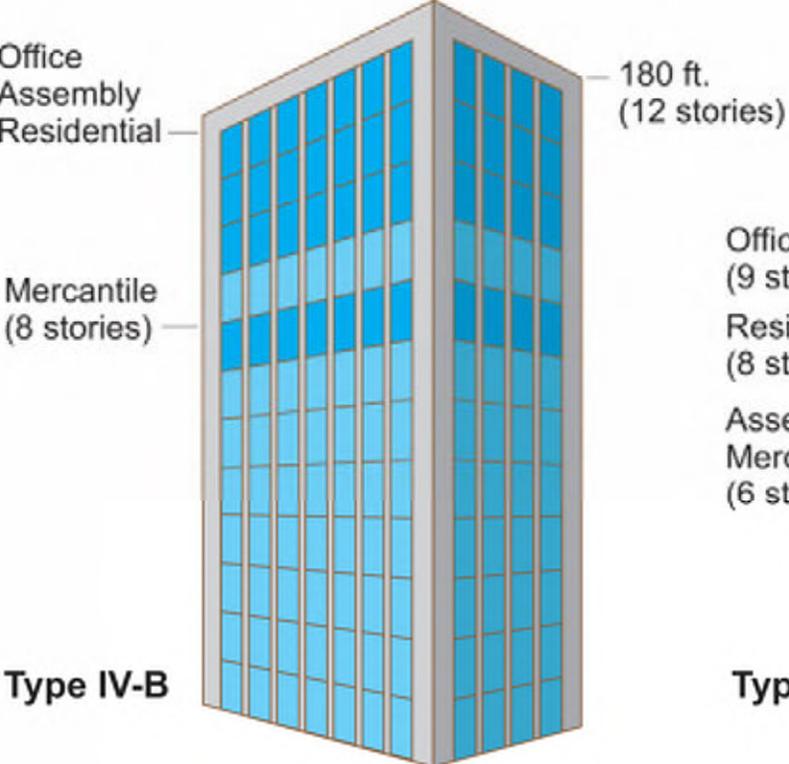
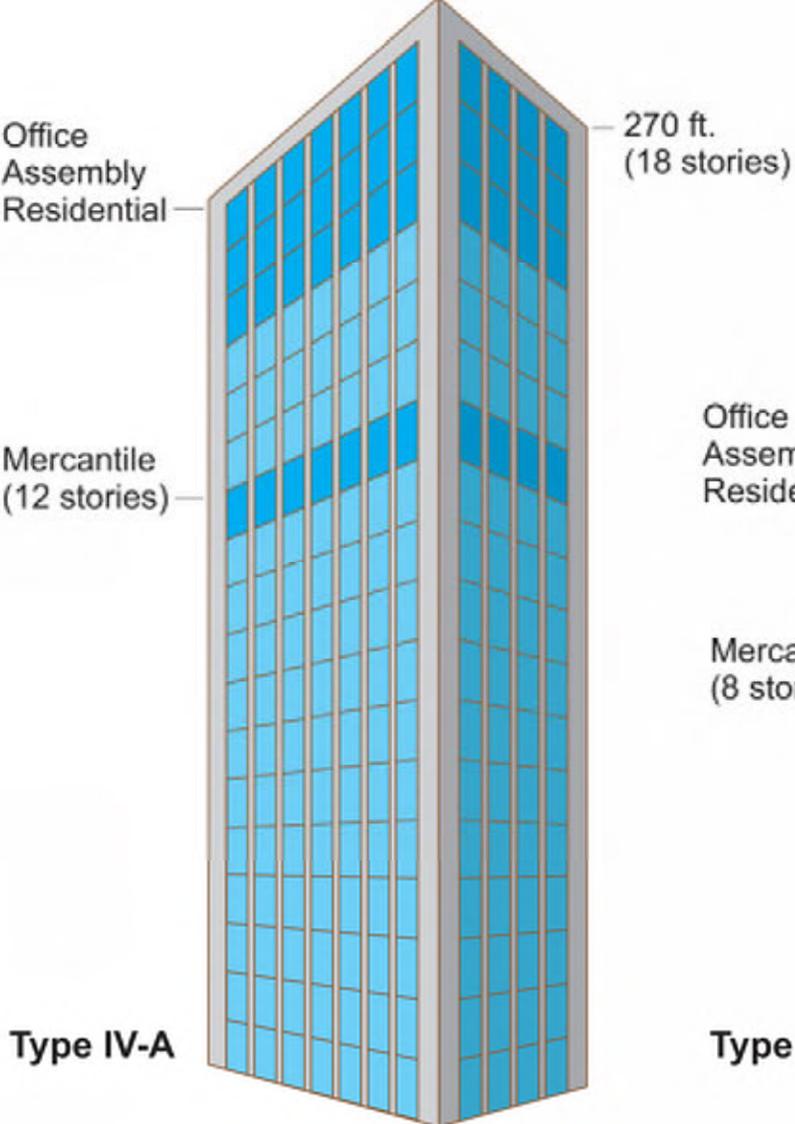


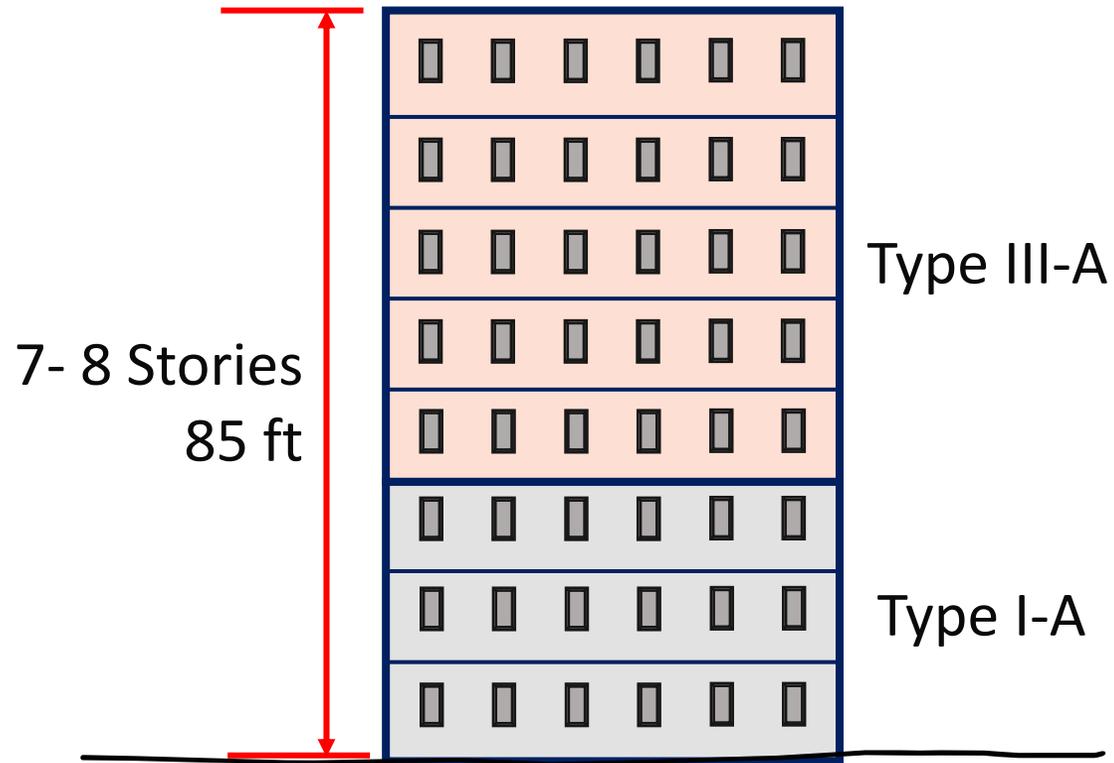
Image: Mahlum Architects

Tall Mass Timber

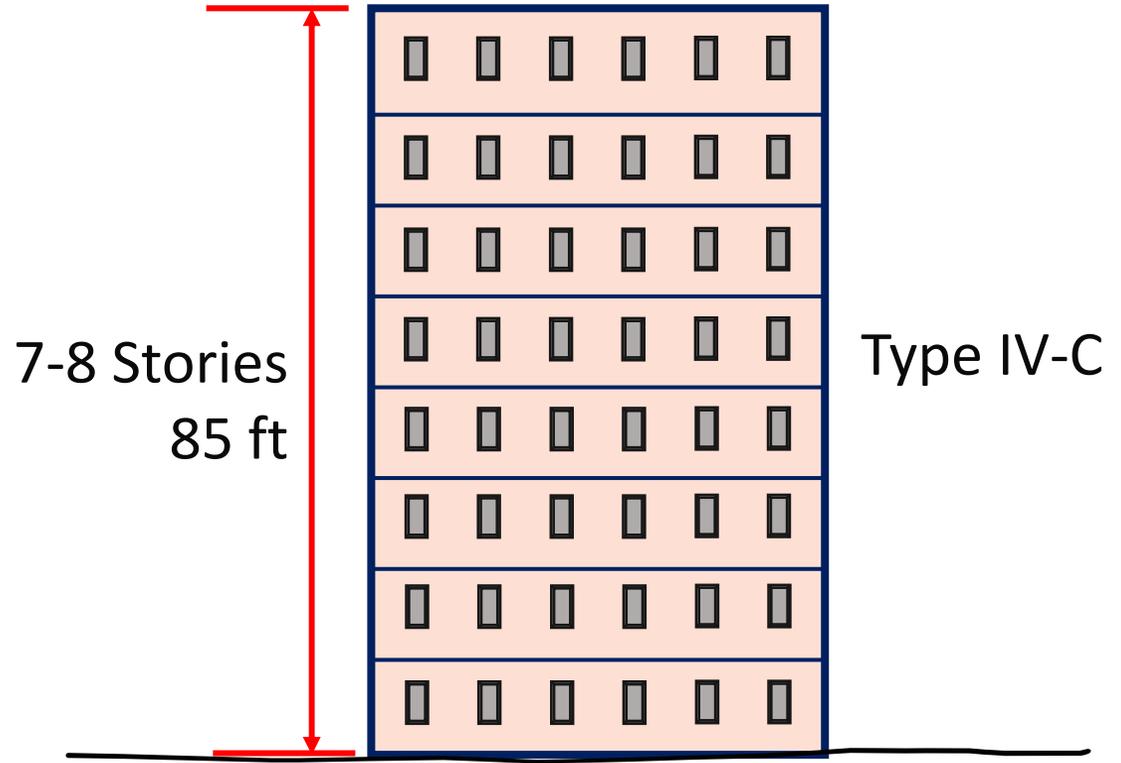
2021 IBC: 3 New Tall Mass Timber Construction Types



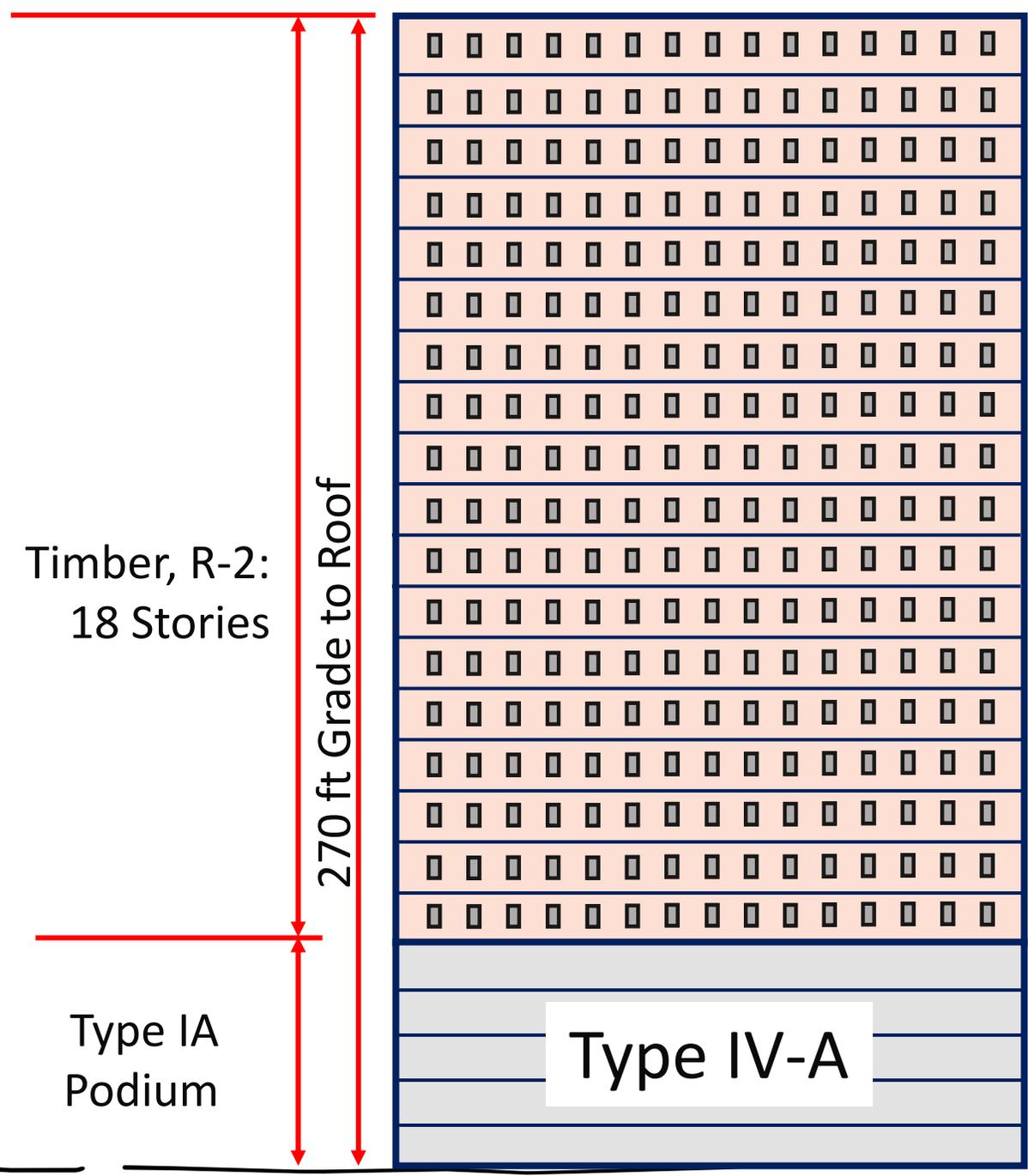
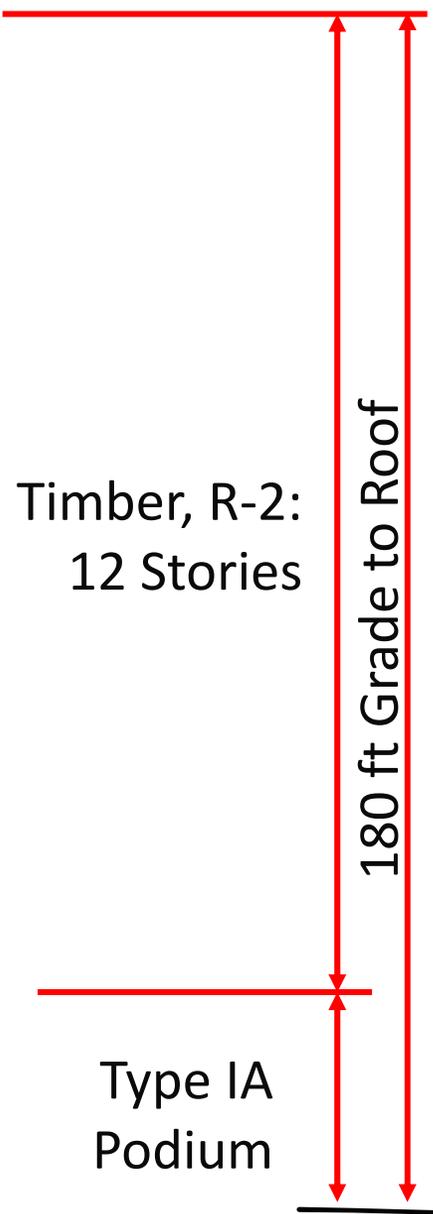
R-2 Occupancy, Type III-A vs Type IV-C



Type III-A



Type IV-C



1510 Webster

Whole Building Life Cycle Assessment

Comparative WBLCA of a Type IV-A Mass Timber Building
and Type I-A Concrete Building



CASE STUDY
1510 Webster



16 stories of mass timber change
the game for affordable housing

1510 Webster

Oakland, CA

193,290 sf, 18 stories (16-over-2)

Type IV-A

Mixed Use

Completed 2024



oWow
DCI Engineers
Photo: Flor Projects

WoodWorks is supporting 236 tall wood projects in design and 20 projects under construction or built.

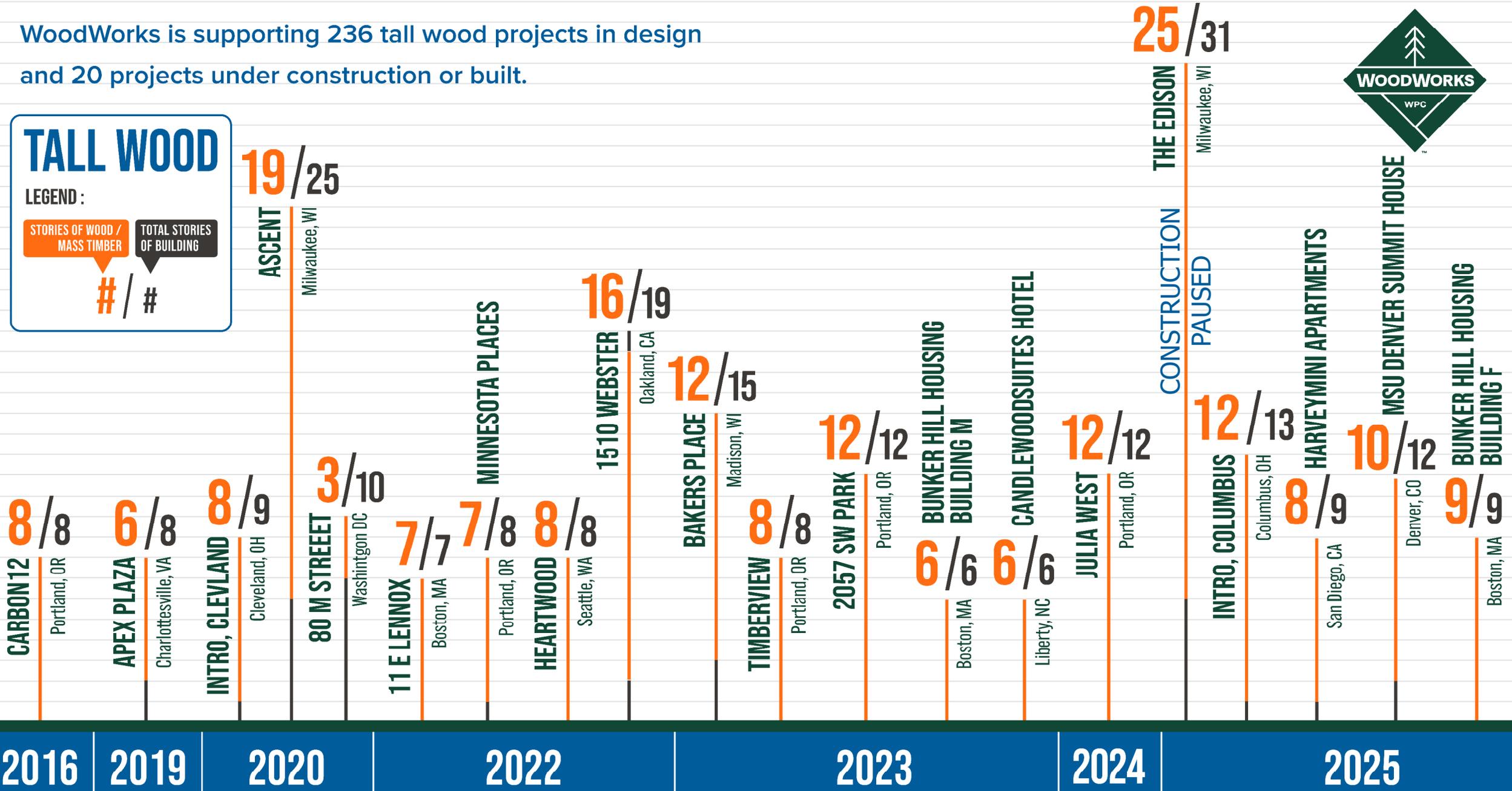
TALL WOOD

LEGEND:

STORIES OF WOOD / MASS TIMBER

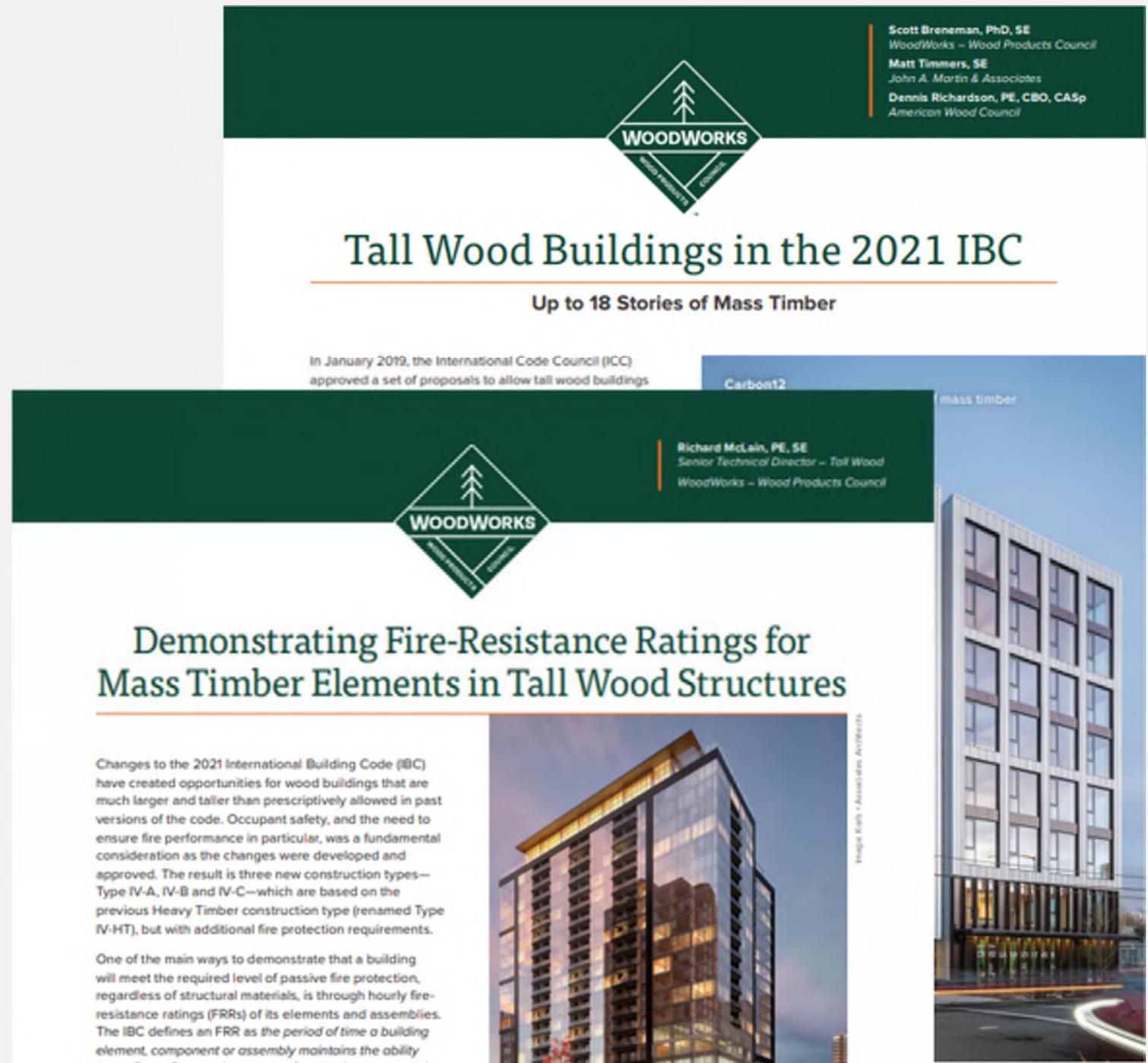
TOTAL STORIES OF BUILDING

/



Tall Mass Timber Solutions Papers

Free to Download at
www.woodworks.org



WOODWORKS
WOOD PRODUCTS COUNCIL

Scott Breneman, PhD, SE
WoodWorks – Wood Products Council
Matt Timmers, SE
John A. Martin & Associates
Dennis Richardson, PE, CBO, CASp
American Wood Council

Tall Wood Buildings in the 2021 IBC

Up to 18 Stories of Mass Timber

In January 2019, the International Code Council (ICC) approved a set of proposals to allow tall wood buildings

Carbon12
mass timber

WOODWORKS
WOOD PRODUCTS COUNCIL

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

Demonstrating Fire-Resistance Ratings for Mass Timber Elements in Tall Wood Structures

Changes to the 2021 International Building Code (IBC) have created opportunities for wood buildings that are much larger and taller than prescriptively allowed in past versions of the code. Occupant safety, and the need to ensure fire performance in particular, was a fundamental consideration as the changes were developed and approved. The result is three new construction types—Type IV-A, IV-B and IV-C—which are based on the previous Heavy Timber construction type (renamed Type IV-HT), but with additional fire protection requirements.

One of the main ways to demonstrate that a building will meet the required level of passive fire protection, regardless of structural materials, is through hourly fire-resistance ratings (FRRs) of its elements and assemblies. The IBC defines an FRR as the period of time a building element, component or assembly maintains the ability

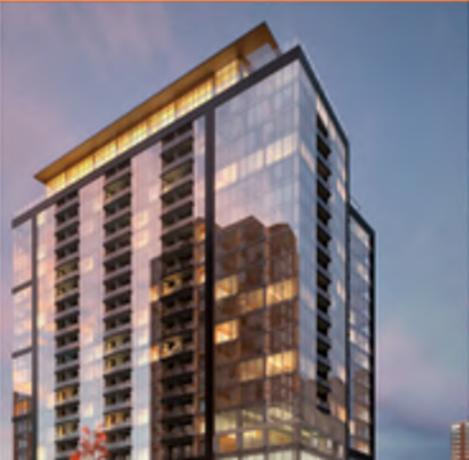


Image: Kelly + Associates Architects

2021 Code Conforming Wood

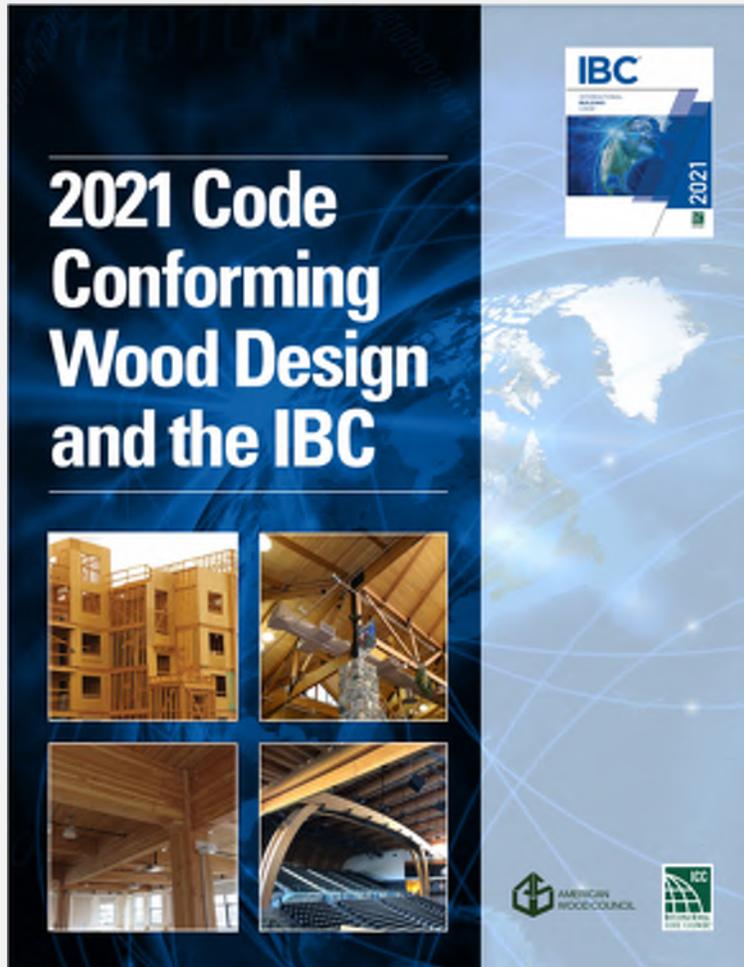


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Questions? Ask us anything.



Please take our survey!

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