



Demystifying Timber Construction Types

March 7, April 11, May 9

3 Part Series 3:30pm-5:30 pm in person at
AIA San Francisco Center for Architecture + Design



March 7

Mid-Rise Design: Optimizing Size, Maximizing Value

April 11

Mid-Rise Mass Timber: Navigating Construction Type Selection

May 9

New Code Provisions for Tall Timber Structures in California



Mid-Rise and Multi-Family Design

Optimizing Size, Maximizing Value

INTRODUCTION TO HEIGHTS AND AREAS
FOR MID-RISE WOOD FRAME BUILDINGS

CHELSEA DRENICK, SE



Designing a wood building? Ask us anything.

FREE PROJECT SUPPORT / EDUCATION / RESOURCES

Nationwide support for the code-compliant design, engineering and construction of non-residential and multi-family wood buildings.

- Allowable Heights/Areas
- Construction Types
- Structural Detailing
- Wood-Framed & Hybrid Systems
- Fire/Acoustic Assemblies
- Lateral System Design
- Alternate Means of Compliance
- Energy-Efficient Detailing
- Building Systems & Technologies

woodworks.org/project-assistance | help@woodworks.org



River Edge, Kitchen & Associates
photo courtesy of McAlvain Construction

Regional Directors: One-on-One Project Support



Questions? Ask me anything.



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Regional Director | CA-North, NV, UT

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chelsea.drenick@woodworks.org

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



Funding Partners



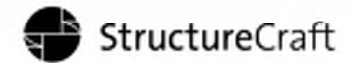
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Resources

WOOD SOLUTION PAPERS

Acoustics and Mass Timber: Room-to-Room Noise Control

Covers key aspects of mass timber acoustical design.
Companion to WoodWorks' Inventory of Acoustically-Tested
Mass Timber Assemblies



Mass Timber Cost and Design Optimization Checklists

Guides coordination between designers and builders (GCs, construction managers, estimators, fabricators, installers, etc.) as they estimate and make cost-related decisions on mass timber projects

Visit woodworks.org/tools-guides/ for many more resources.

Upcoming Events

International Mass Timber Conference 2024

March 26 - 28

Portland, Oregon

Demystifying Timber Construction Types

AIA San Francisco Series

March 7, April 11, May 9

3 Part Series 3:30pm-5:30 pm in person at AIA SF

The Financial Dynamics of Designing with Mass Timber (virtual)

April 17

1.0 AIA/CES HSW LUs, 1.0 PDH credits, 0.10 ICC credits



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



Course Description

As cities seek increased density to address urban population growth, many building designers and developers are looking to mid-rise wood construction as a cost-effective, code-compliant and sustainable solution. This presentation will cover some of the design considerations associated with mid-rise wood-frame buildings, including how to maximize height and area through the use of sprinklers, open frontage, sloping sites, podiums and mezzanines. Construction types will be reviewed, with an emphasis on opportunities for wood use in types III and V.

Learning Objectives

1. In the context of a shift toward increased urban density, learn how mid-rise, wood-frame construction meets housing needs while contributing to vibrant and sustainable communities.
2. Discuss allowable construction types, occupancies, and building heights and areas for wood-frame mid-rise construction per the International Building Code.
3. Identify potential modifications to the IBC's base tabular heights and areas based on code provisions for building frontage, sprinklers, sloping sites, podiums and mezzanines.
4. Highlight constructed buildings that were designed using these code provisions to maximize density.

Outline

- » Terminology
- » Mid-rise Configurations & Construction Types
- » Maximizing Height & Area
- » Special Provisions and the Alternate Materials and Methods Requests (AMMR) Process
- » Summary of Construction Types



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

OVERVIEW | TERMINOLOGY



Light-Frame Wood
Photo: WoodWorks



Heavy Timber
Photo: Benjamin Benschneider



Mass Timber
Photo: John Stamets

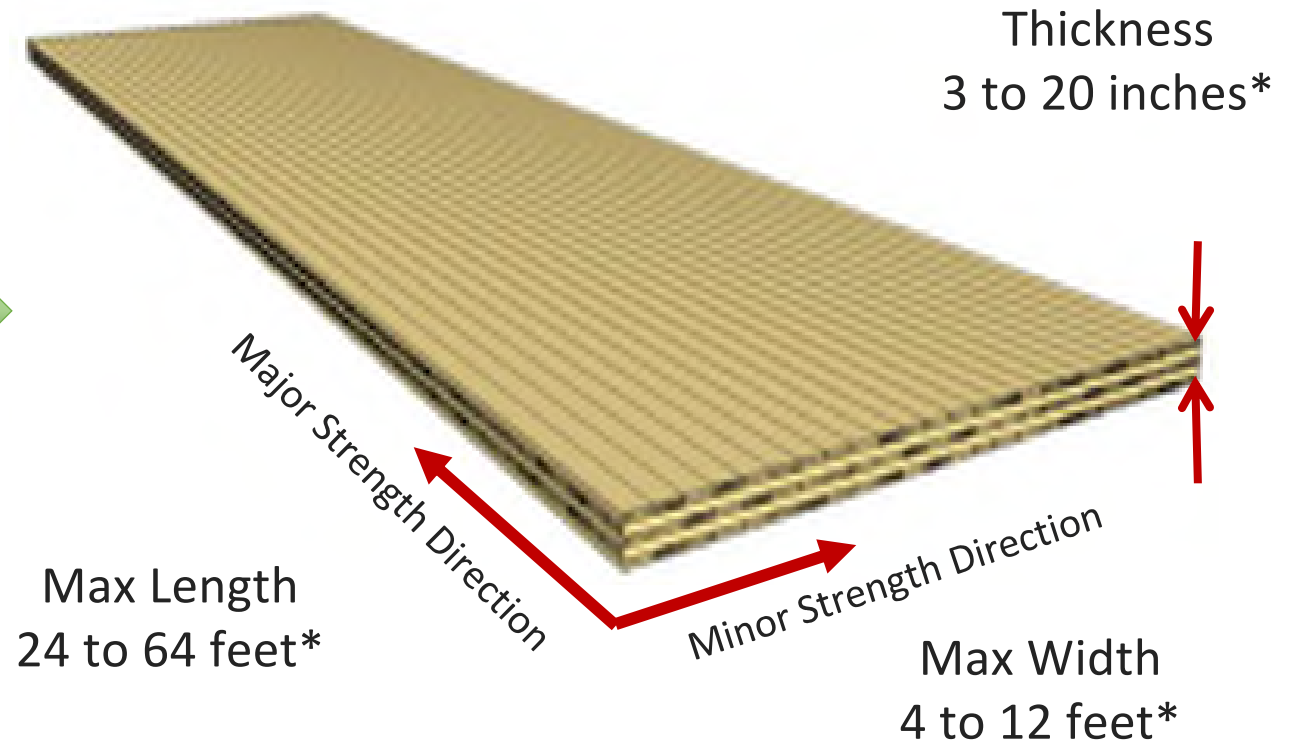
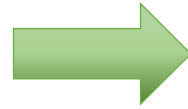
What is Cross Laminated Timber (CLT)?

3+ layers of laminations

Solid Sawn or Structural Composite Lumber Laminations

Cross-Laminated Layup

Glued with Structural Adhesives



*All dimensions are approximate.
Consult with manufacturers

Cross-Laminated Timber (CLT) in the Code

CLT is defined in Chapter 2 Definitions:

[BS] CROSS-LAMINATED TIMBER. A prefabricated engineered wood product consisting of not less than three layers of solid-sawn lumber or *structural composite lumber* where the adjacent layers are cross oriented and bonded with structural adhesive to form a solid wood element.

And is referenced in Chapter 23:

2303.1.4 Structural glued cross-laminated timber. Cross-laminated timbers shall be manufactured and identified in accordance with ANSI/APA PRG 320.



Panelized Construction

AKA Components, Sub-Assemblies

Typically, just structure and sheathing:

- Wall panels – wall framing and sheathing.
- Floor and roof cassettes – floor/roof framing and sheathing.



Panelized Construction

Shear wall hold downs and panel-to-panel stitching installed in field.



Image: Entekra



Floor and Roof Cassettes

Typically fabricated in single-bay lengths, 8'-12' widths.



Modular Construction (aka Volumetric Modular)

Multi-Family Units:

- » Hotel Rooms
- » Apartments
- » Condos
- » Workforce Housing
- » Student Housing



Image: Zeta Design+Build

Modular Construction (aka Volumetric Modular)

Significant Differences from Prefabricated Construction.

Volumetric Shipping & Erection Foundation Requirements.



Mid-Rise Construction

Where **wood** is a viable option, it's likely the most appropriate choice.

- » Senior Living
- » Apartments/Condos
- » Mixed Use
- » Student Housing
- » Affordable Housing
- » Hotels



Why Wood?

Using wood helps reduce environmental impact
Wood products play significant role in modern economy

Wood Costs Less

Wood is Versatile

Wood Meets Code

Wood is Durable

Wood is Renewable



Photo courtesy OFRI



The Gibson, Hummel Architects, KPFF Consulting Engineers, photo Leo A. Geis

Carbon Case Study



V **Volume of wood used:**
5,200 cubic meters / 183,600 cubic feet
of lumber and sheathing

🌲 **U.S. and Canadian forests grow
this much wood in:**
15 minutes

C **Carbon stored in the wood:**
3,970 metric tons of CO₂

🌍 **Avoided greenhouse gas emissions:**
8,440 metric tons of CO₂

✅ **TOTAL POTENTIAL CARBON BENEFIT:**
12,410 metric tons of CO₂

EQUIVALENT TO:

Source: US EPA



2,370 cars off the road for a year



Energy to operate a home for 1,050 years

For information on the calculations in this chart, visit [woodworks.org](https://www.woodworks.org)
Note: CO₂ on this chart refers to CO₂ equivalent.

WoodWorks Resources

<https://www.woodworks.org/why-wood/sustainability/>

Whole Building Life Cycle Assessment (WBLCA)

- » Introduction to Whole Building Life Cycle Assessment: The Basics
 - » Worksheet for Structural WBLCA of Mass Timber Buildings
 - » WBLCA of Built Projects

Expert articles on topics such as:

- » Biogenic Carbon in LCA Tools
 - » Long-Term Biogenic Carbon Storage
- » What Net Zero Means in Building Construction
 - » Environmental Product Declarations (EPDs)

Urban Infill Development



Seattle, WA



Photo: Matt Todd/PB Architects

College Park, MD



Photo: Matt Church

Normal, IL



Image: OKW Architects

Los Angeles, CA



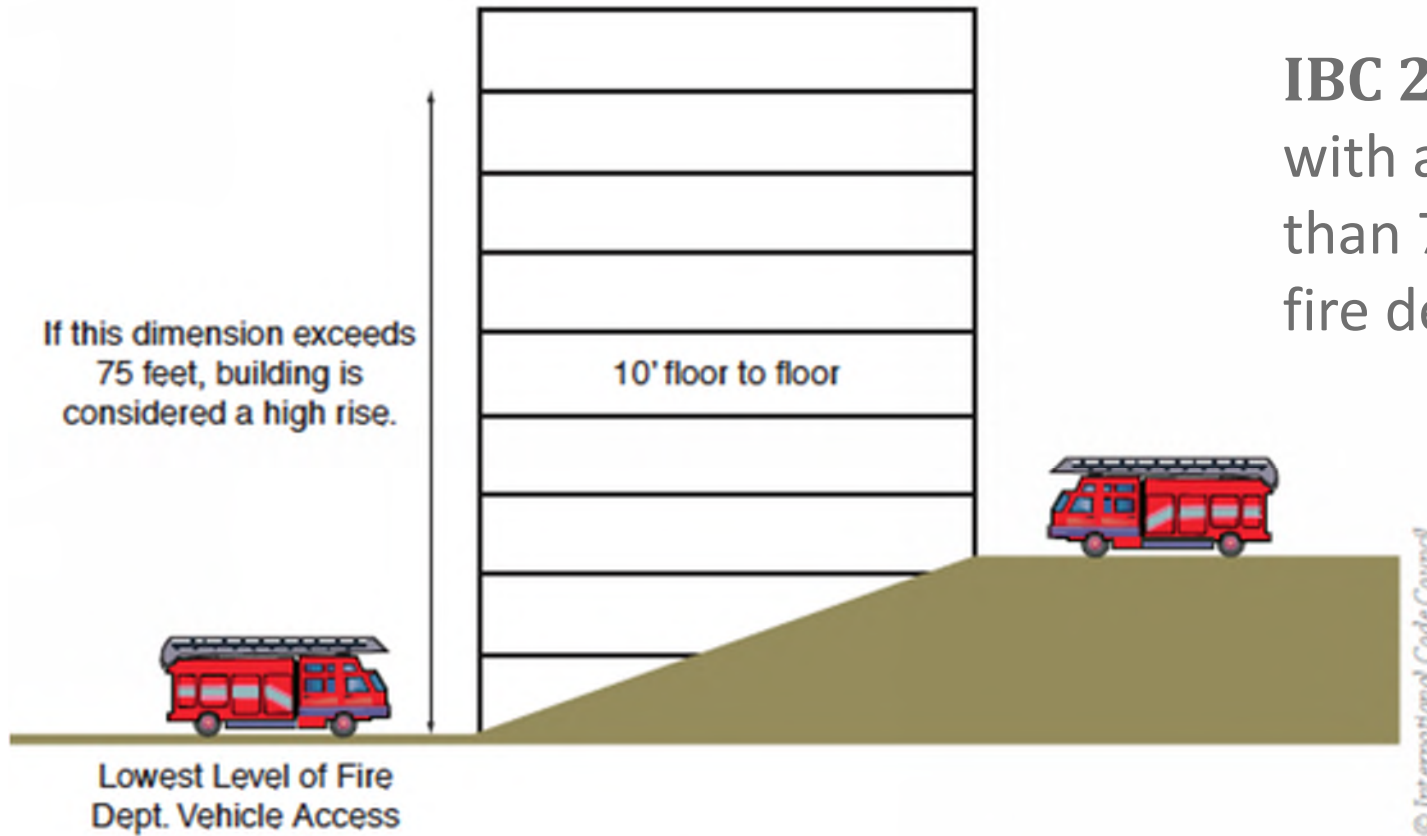
Photo: Lawrence Anderson/Esto

Atlanta, GA



LORD · AECK · SARGENT Image: Lord Aeck Sargent

Mid-Rise vs. High-Rise Definition – 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

Light-Frame Wood Mid-Rise Construction

6 stories for Offices,
5 stories for Residential
+ Mezzanine
+ Multi-Story Podium



Walk-up / Tuck Under

First floor walk up units with private garage

Benefits:

- » Eliminates need for S-2 parking garage
- » Can be all wood
- » Least expensive overall but lowest densification rates (20-35 units/acre)



Wrap-Around

Walk up units surround parking structure

Benefits:

- » Enhanced security
- » Centralized access to parking
- » Visual appeal from street
- » More expensive than walk/up tuck-under
- » 5 story yields 60-80 units/acre



Podium

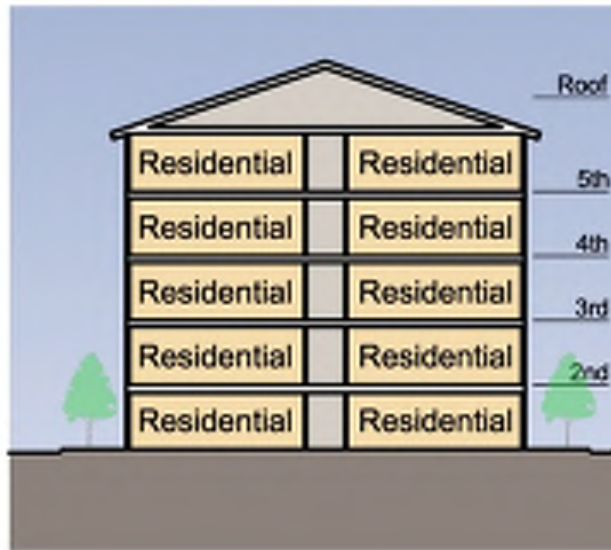
Multiple stories of wood over an elevated concrete deck

Benefits:

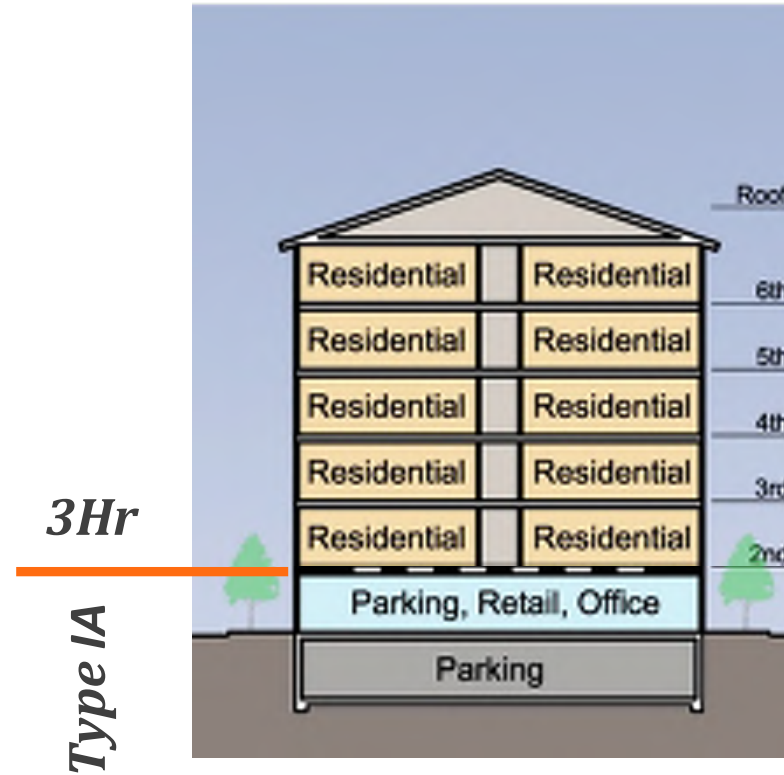
- » Increased number of stories
- » Accommodates mixed-use occupancies
- » Most expensive but can allow increased density
- » 4 stories over podium: 60-80 units/acre
- » 5 stories over podium: 100-120 units/acre
- » 5 stories with mezzanine + residential podium: 125-145 units/acre



IBC Podium Provisions



5 story Type III Building



5 story Type III Building
On Top of a Type IA Podium

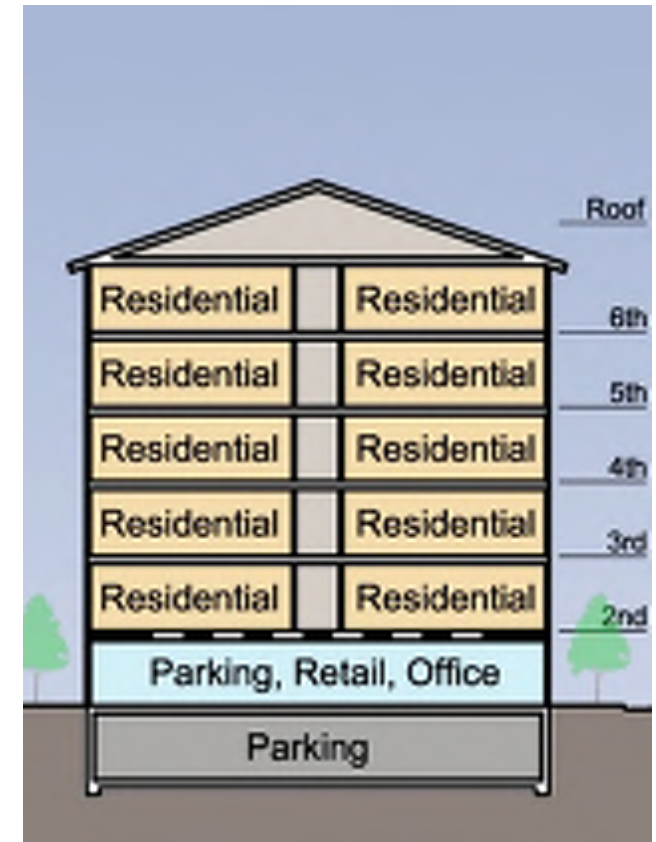
Special Provisions for Podiums in IBC 510.2

Increases allowable stories... not allowable building height

Horizontal Building Separation – 510.2

Considered separate buildings above and below for purposes of area calculations if:

- » Overall height is still limited to minimum of either building construction type
- » 3hr rated horizontal assembly
- » Building below is Type 1A with sprinklers
- » Enclosures penetrating horizontal assembly are 2hr rated
- » Occupancy above is A (occupant load <300), B, M, R or S
- » Occupancy below is any except H



Construction Types

IBC defines 5 construction types (chapter 6): I, II, III, IV, V

A building must be classified as one of these

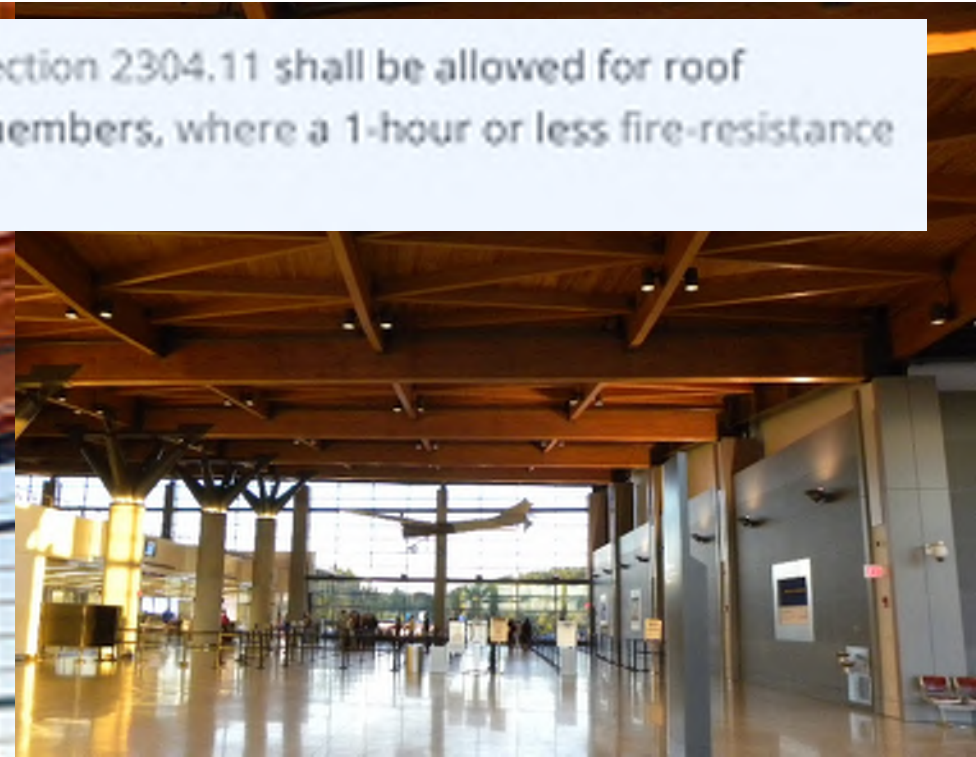
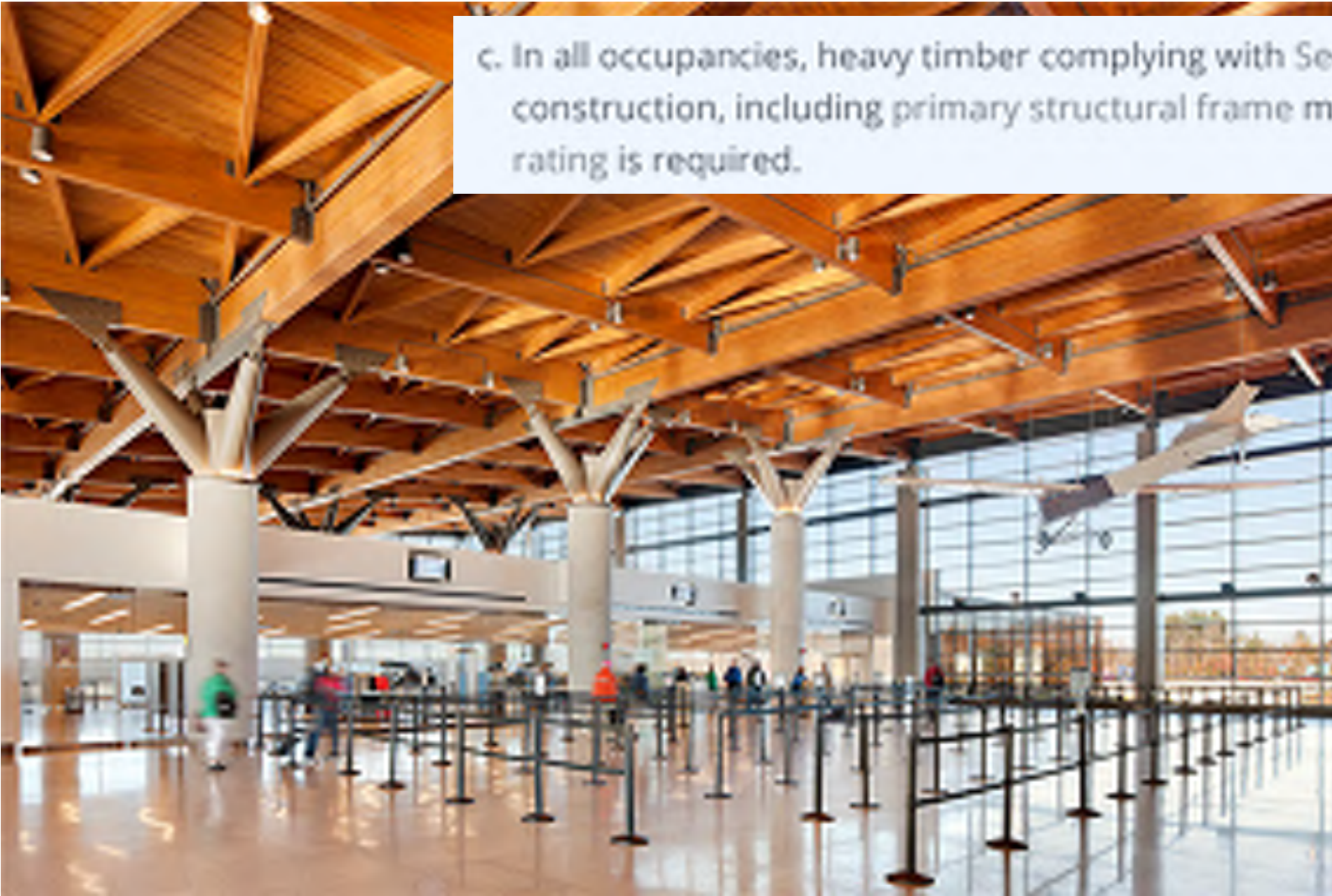
Construction Types I & II:

All elements required to be non-combustible materials

However, there are exceptions including for mass timber

Construction Type IB, IIA, IIB (IBC Table 601 footnote c)

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.



Construction Type IB Exposed Timber Roof Decking and Framing

Portland International Jetport

- LEED Gold
- Completed 2012

Design Team: Gensler, Oest Associates

Photo Credit: DeStafano & Chamberlain, Inc, Robert Benson Photography

Mid-Rise Timber Construction Types

Type V (70 ft, 4 stories residential)

- » All building elements are any allowed by code

Type III (85 ft, 5 stories residential)

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

Types III and V can be subdivided to A (protected) or B (unprotected)

Type IV-HT (85 ft, 5 stories residential)

- » Exterior walls non-combustible (may be FRTW or CLT)
- » Interior elements qualify as Heavy Timber

Type V Construction

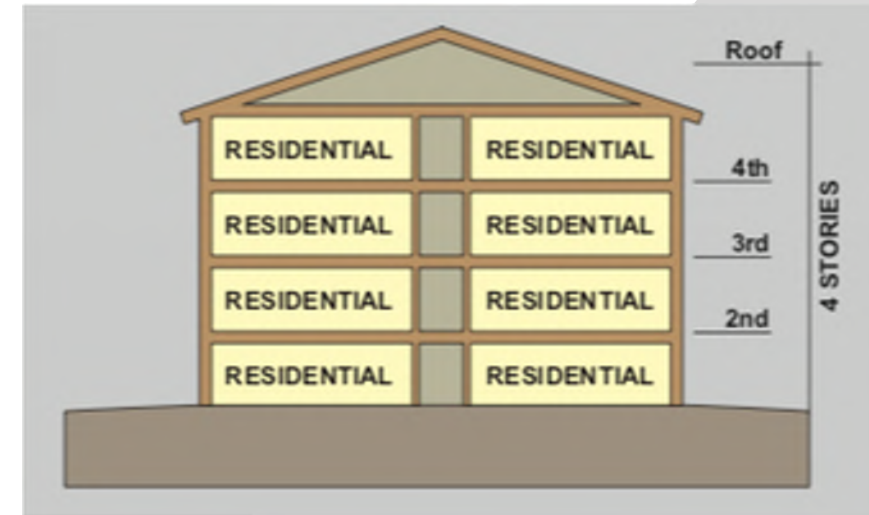
All building elements are any allowed by code:

- » Light-frame wood construction
- » Mass Timber
- » Hybrid

Multi-Family Occupancies (R-1, R-2, R-4):

- » 4 stories
- » 36,000 SF Per Floor
- » 108,000 SF Total Bldg

Assumes V-A Construction (IBC), NFPA13 Sprinklers



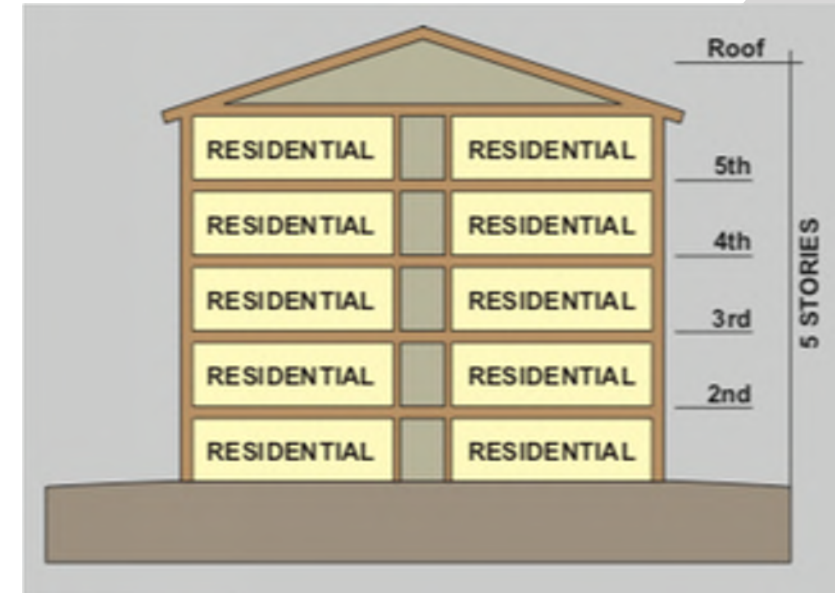
Type III Construction

- » Interior building elements are any allowed by code
- » Exterior walls are fire-retardant treated wood (not CLT)

Multi-Family Occupancies (R-1, R-2, R-4):

- » 5 stories
- » 72,000 SF Per Floor
- » 216,000 SF Total Bldg

Assumes III-A Construction (IBC), NFPA13 Sprinklers



Fire Resistance Ratings

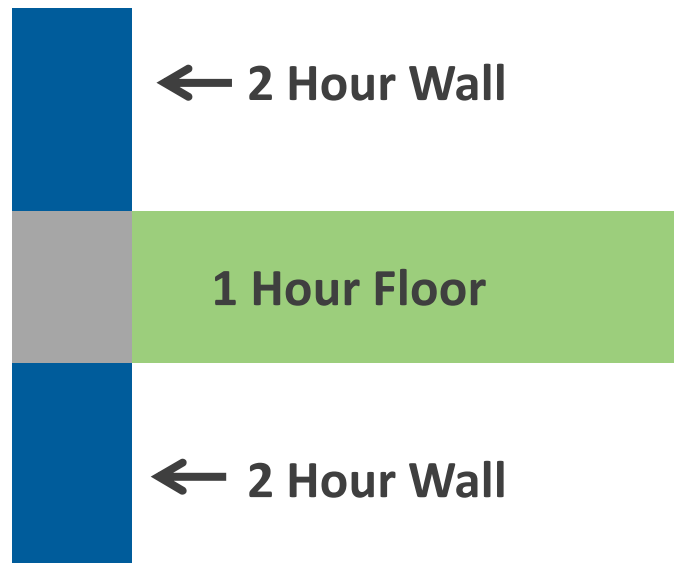
Key Differences in Fire Ratings for Construction Types			
	IIIA	IIIB	VA
Exterior wall framing	FRT	FRT	non-FRT
Exterior bearing wall fire rating	2 hr	2 hr	1 hr
Interior bearing wall fire rating	1 hr	0 hr	1 hr
Interior non-bearing wall fire rating	0 hr	0 hr	0 hr
Floor assembly fire rating	1 hr	0 hr	1 hr
Fire wall rating	3 hr	3 hr	2 hr

IBC Tables 601 & 705.5

Note: FRT = Fire Retardant Treated

Intersection of Tested Assemblies

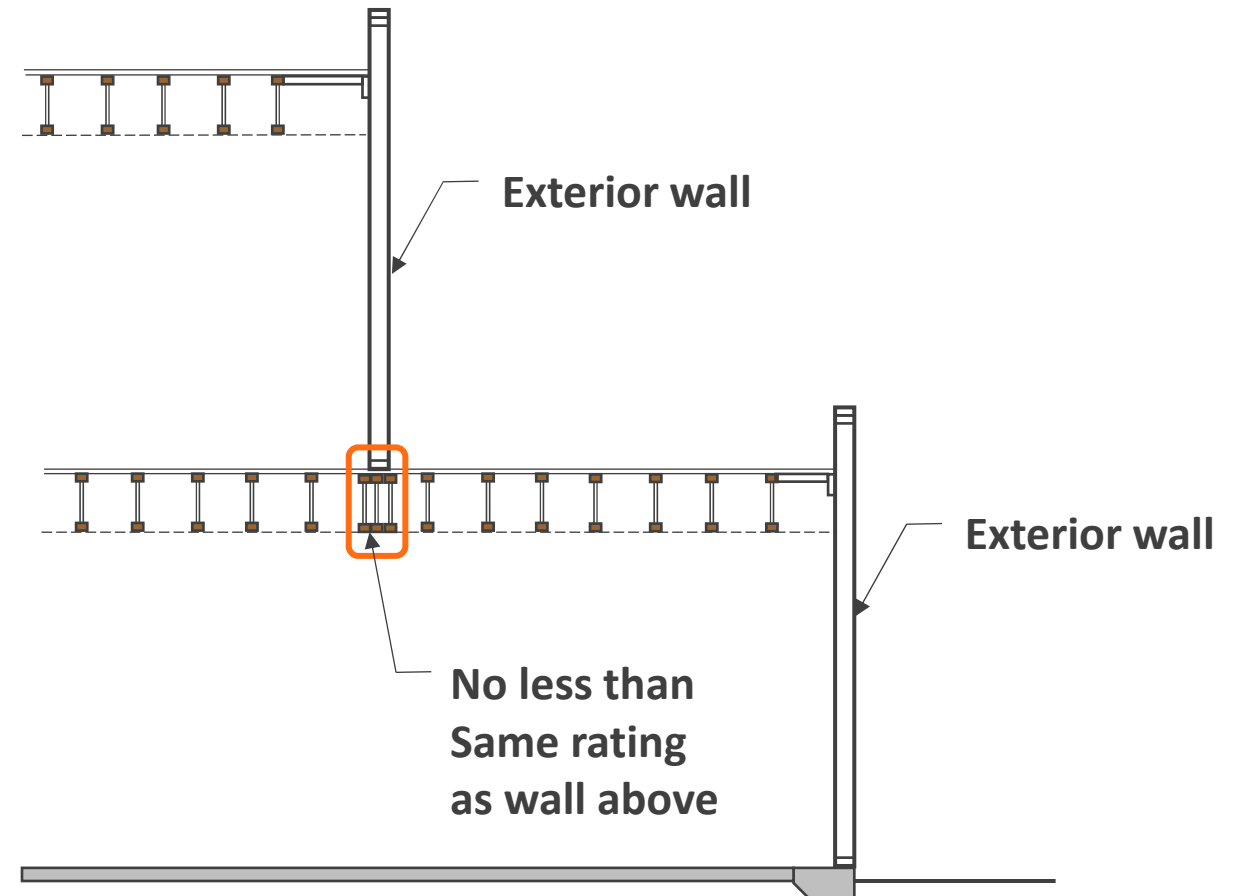
- » Many options are available for fire resistance tested floor assemblies and wall assemblies
- » No tested intersection details exist
- » We must understand the intent of the code, provide a rationale that meets the code's intent, and utilize available information and testing results



Supporting Structure – IBC 704.1

Structural members, that support a rated assembly must be fire-resistance rated to not less than the rating of the supported assembly.

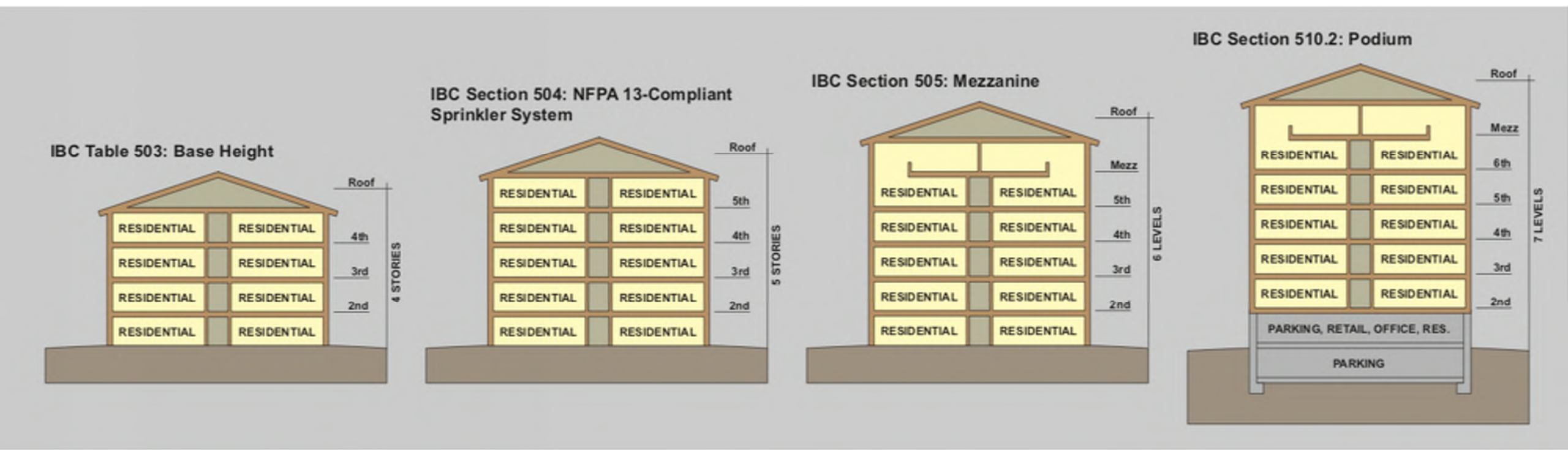
(Exceptions: 707.5, 707.8, 709.4, 711.2)



BEFORE IBC 2021 Code Limit for wood - 6 stories (business) 5 stories (residential) and 85 feet

Over 6 Stories:

Alternate Means and Methods Request (AMMR) through performance based design



Source: WoodWorks



U.S. BUILDING CODES

Tall Wood Ad Hoc Committee

Balanced Committee: 2016-2018

Development of code change proposals for prescriptive code allowances of tall wood buildings.



Mass Timber Fire Testing at ATF Lab (2017)

Three Main Categories:

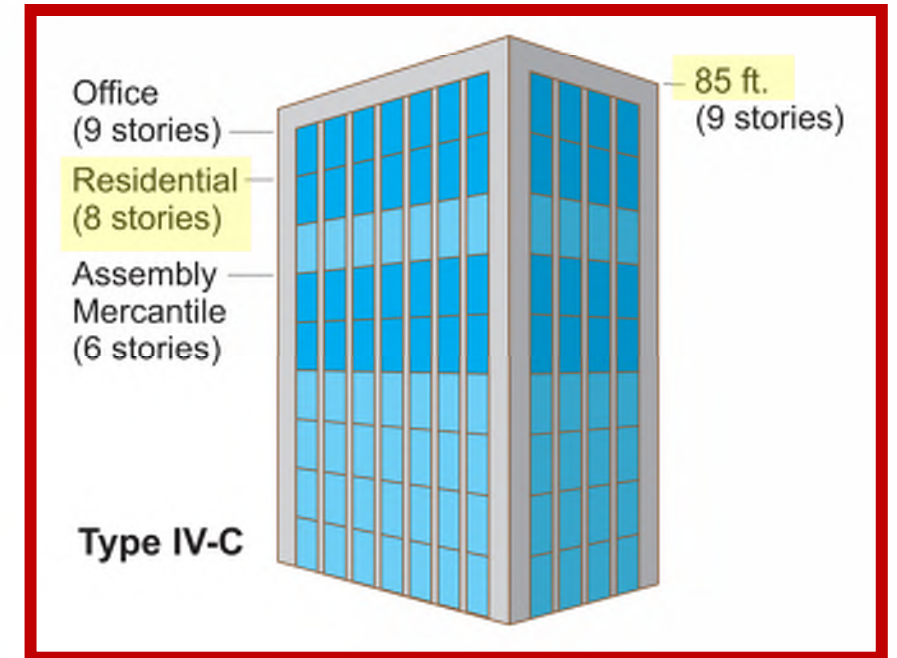
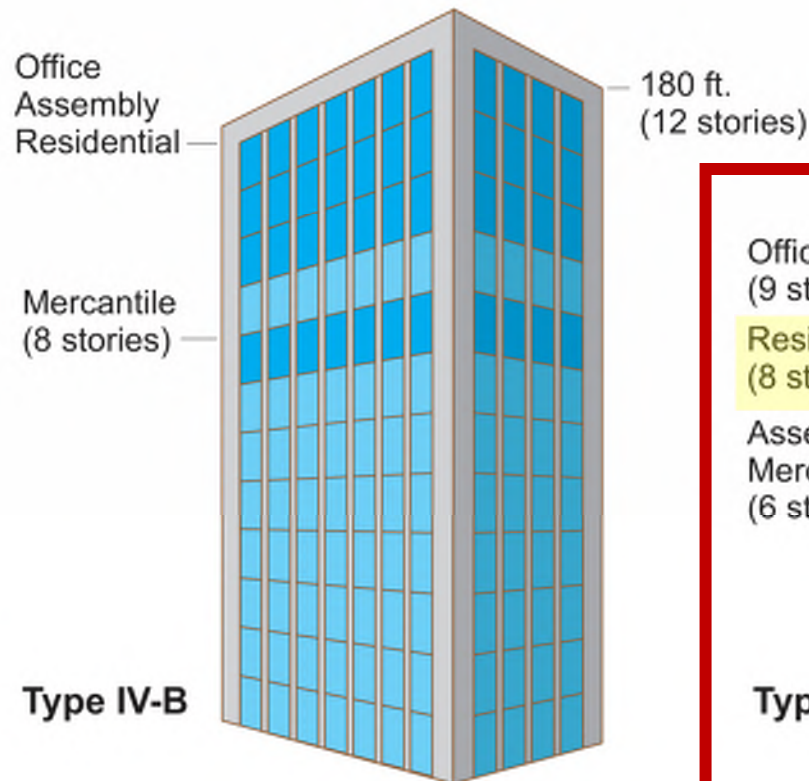
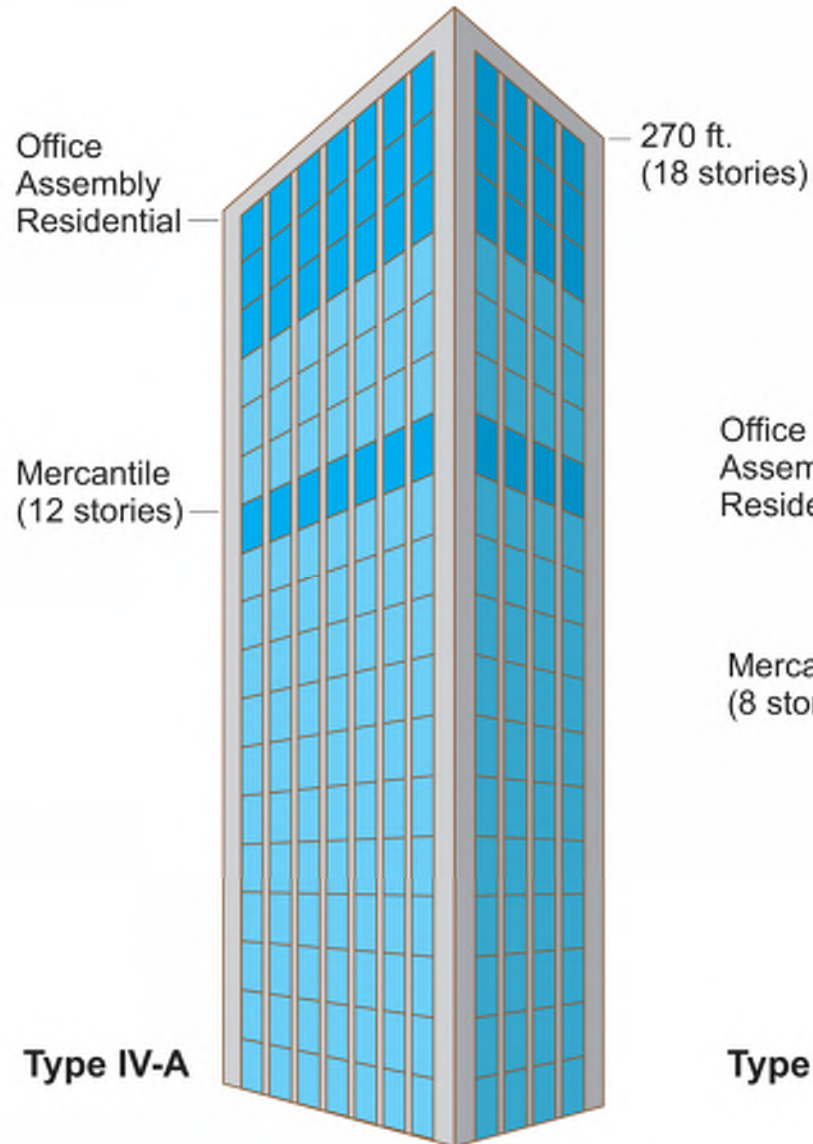
- 1. Noncombustible (Types I and II)
- 2. Light-Frame (Types III and V)
- 3. Mass Timber (Type IV)

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

TALL MASS TIMBER CONSTRUCTION TYPES

2021 IBC: 3 New Tall Mass Timber Construction Types



Tall Mass Timber Requirements

602.4 Type IV. Type IV construction is that type of construction in which the building elements are mass timber or noncombustible materials and have fire resistance ratings in accordance with Table 601. Mass timber elements shall meet the fire resistance rating requirements of this section based on either the fire resistance rating of the noncombustible protection, the mass timber, or a combination of both and shall be determined in accordance with Section 703.2 or 703.3. The minimum dimensions and permitted materials for building elements shall comply with the provisions of this section and Section 2304.11. Mass timber

Exception: Type IV-HT Construction in accordance with Section 602.4.4.

Sprinkler Systems: 2021 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

Commercial Sprinkler Systems – IBC 903.3.1

- » NFPA 13
Standard for Commercial Construction 903.3.1.1
- » NFPA 13R
Residential Occupancies (One- and Two-Family or Low-Rise Multi-Family and Commercial, 4 stories max above grade) 903.3.1.2
- » NFPA 13D
Standard for One- and Two-Family Residences (but allowed in a few commercial occupancies) 903.3.1.3



NFPA 13 vs. NFPA 13R



NFPA 13



NFPA 13R

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

Height –2021 IBC Table 504.3

» 2021 IBC: Table 504.3 provides base & increased heights

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			HT	Type V		
		A	B	A	B	A	B	A	B	C		A	B	
R ^h	NS ^d	UL	160	65	55	65	55	65	65	65	65	65	50	40
	S13D	60	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	60
	S	UL	180	85	75	85	75	270	180	85	85	85	70	60

NS = Buildings not equipped throughout with an automatic sprinkler system

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 (NFPA 13)

S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (NFPA 13R)

S13D = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3 (NFPA 13D)

Stories–2021 IBC 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
R-2 ^h	NS ^d	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4		4	4	4	4	4	4	4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3

NS = Buildings not equipped throughout with an automatic sprinkler system

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 (NFPA 13)

S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (NFPA 13R)

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

Basements – 2021 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:

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



Fashion Valley, CA
AvalonBay Communities

Mezzanines – 2021 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

Area Factor – 2021 IBC 506.2

TABLE 506.2^{a, b}
ALLOWABLE AREA FACTOR (A_f = 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	A	B	C	HT	A	B
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												
	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

**Can increase these areas by the Frontage Factor of Section 506.3

NS = Buildings not equipped throughout with an automatic sprinkler system

S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 (NFPA 13)

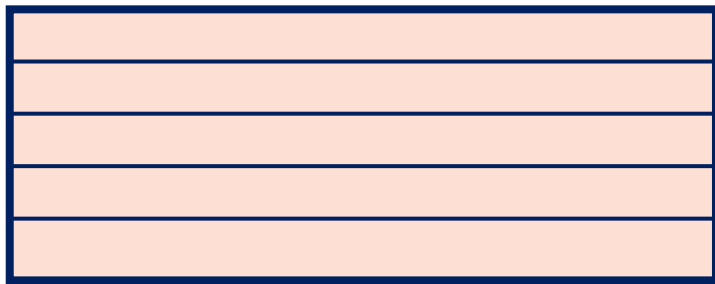
S13R = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (NFPA 13R)

SM = Buildings two or more stories above grade plane equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 (NFPA 13)

CALIFORNIA SPECIFIC: CBC Size Limits

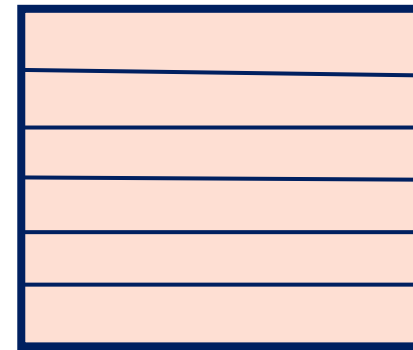
CBC has historically not allowed “double-dipping” for sprinkler increases of building area and height for occupancies A, E, H-4, H-5, I, R-1 and R-2

Also, for multi-story buildings that are occupancy group A, E, H, I, L or R, the total building area is equal to the allowable floor area multiplied by the number of stories not to exceed 2. In IBC, this value is not to exceed 3.



Larger Area

VS.



Taller

CALIFORNIA SPECIFIC: CBC Size Limits

For example, if using sprinkler **area increases**, allowable height is **20 ft and 1 story less than IBC max limits** for occupancies A, E, H-4, H-5, I, R-1 and R-2

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

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
R-2 ^h	NS ^d	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4		4	4	4	4	4	4	4	3
	S (with height increase)	UL	12	5	5	5	5	18	12	8	5	4	3
	S (with area increase)	UL	11	4	4	4	4	17	11	7	4	4 ^o	2

Special V-A allowance

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

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												
	S1	UL	UL	96,000	64,000	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM (with area increase)	UL	UL	72,000	48,000	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
	SM (with height increase)	UL	UL	24,000	16,000	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000

Single Occupancy, 1 Story – 506.2.3

$$A_a = A_t + [NS \times I_f]$$

(Equation 5-1)

A_a = Allowable area per story (sq. ft.)

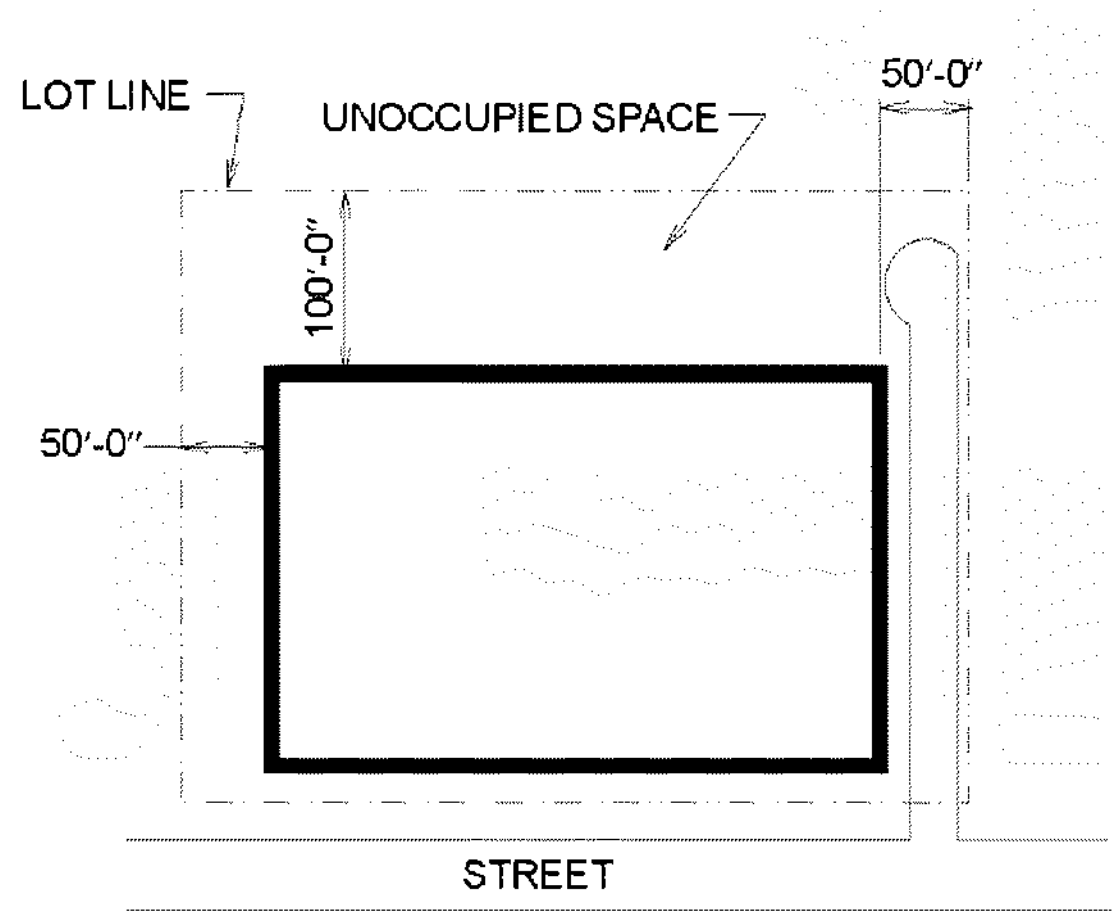
A_t = Tabular allowable area per story per Table 506.2
for **NS, S1 or S13R** (sq. ft.)

NS = Tabular allowable area per story per Table 506.2
for non-sprinklered building (sprinklered or not)

I_f = Area increase factor due to frontage per 506.3
 $I_{f, \max} = 0.75$

Area Modification – Frontage IBC 506.3

The allowable area of a building is permitted to be increased when it has a certain amount of frontage on streets (public ways) or open spaces, since this provides access to the structure by fire service personnel, a temporary refuge area for occupants as they leave the building in a fire emergency and a reduced exposure to and from adjacent structures.



Frontage Increases – IBC 506.3.3

- » 2021 IBC / 2022 CBC: Frontage increase calculation simplified
- » Frontage increase is based on the smallest public way or open space that is >20' and the percentage of the building perimeter having >20' frontage (506.3.1 & 506.3.2).
- » Area factor determined in accordance with table 506.3.3

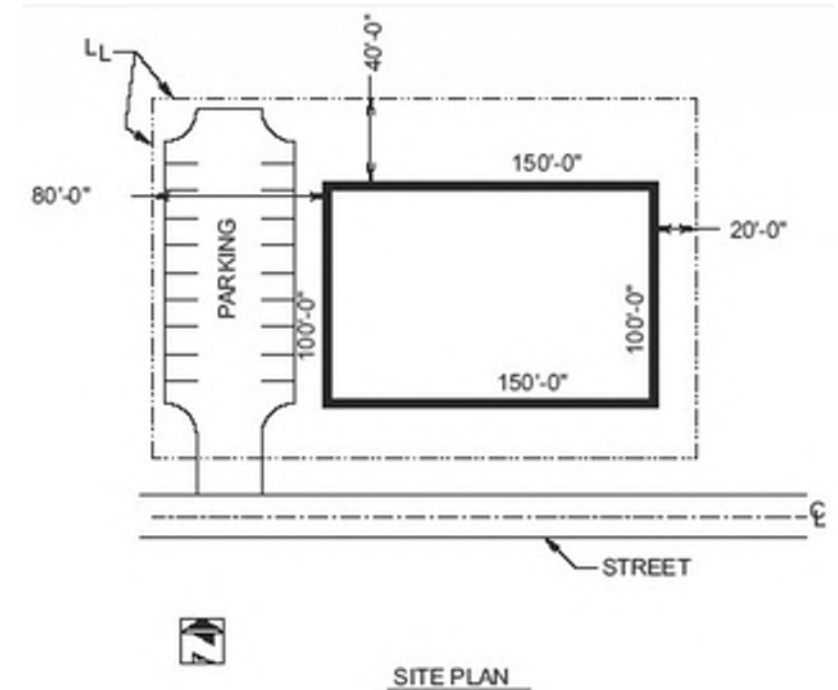


TABLE 506.3.3
FRONTAGE INCREASE FACTOR^a

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

a. Interpolation is permitted.

Total Building Area – 2021 IBC 506.2.3

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

(Equation 5-2)

A_a = Total allowable area more than 3 stories (sq. ft.)

A_t = Tabular allowable area per story per Table 506.2 for NS, SM or S13R (sq. ft.)

NS = Tabular allowable area per story per Table 506.2 for non-sprinklered building (sprinklered or not)

I_f = Area increase factor due to frontage per 506.3

$I_f, \text{max} = 0.75$

S_a = Actual number of building stories above grade

$S_{a, \text{max}}$ = 3 for non-sprinklered buildings and those w/ NFPA13

$S_{a, \text{max}}$ = 4 for buildings w/ NFPA 13R

$S_{a, \text{max}}$ = 2 *For Group A, E, H, I, L and R occupancies, high-rise buildings, regulated by the Office of the State Fire Marshal, actual number of building stories above grade plane, not to exceed two. (CALIFORNIA ONLY)*

Mixed Occupancy, Multi-story

<https://www.woodworks.org/resources/taking-the-guesswork-out-of-mixed-use-building-requirements/>

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.

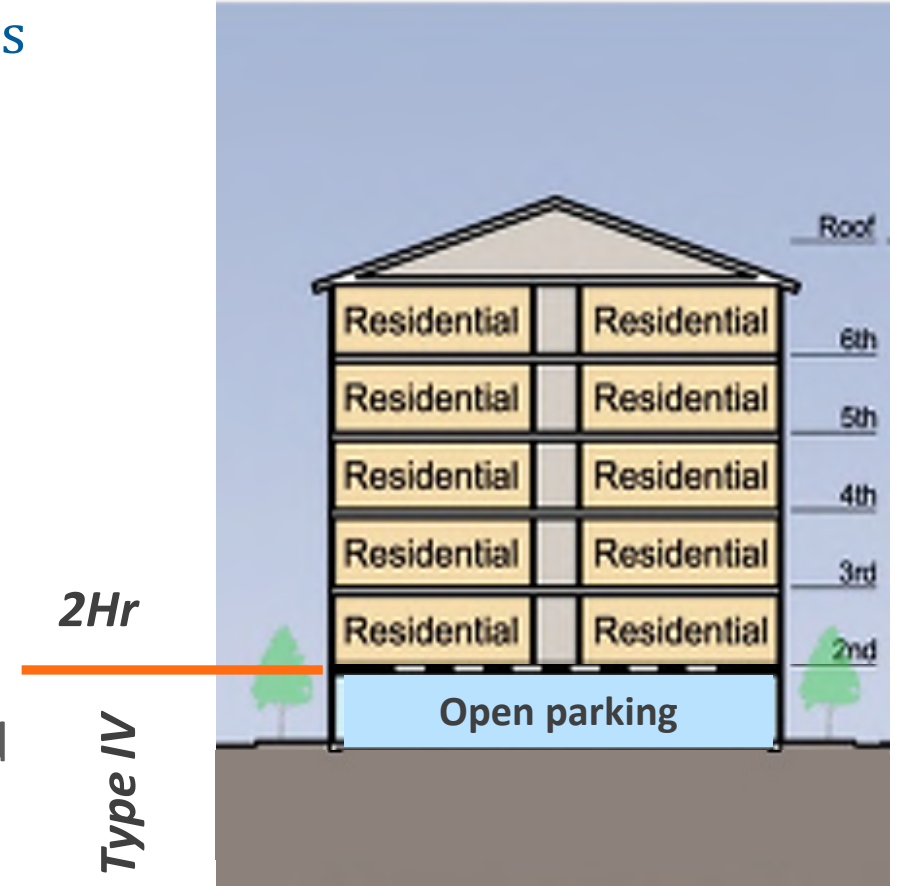


Special Provisions – IBC 510.4

Possibility of a **Type IV podium** where number of stories starts above parking when:

- » Occupancy above is R and below is S-2
- » Lower floor is open Type IV parking with grade entrance
- » Horizontal assembly between 1st and 2nd floor shall be:
 - » Type IV
 - » Have 1 hr fire resistance rating when sprinklered
 - » Have 2 hr fire resistance rating when not sprinklered
- » Overall height is still limited to occupancy

<http://www.woodworks.org/experttip/can-parking-incorporated-mixed-use-wood-frame-buildings-construction-type-perspective/>



**5 story Type III Building
On Top of a Type IV**

Special Provisions – IBC 510.5

Group R-1 & R-2, Type IIIA Buildings

- Height limitation increased to 6 stories & 95 ft
- First floor assembly above the basement has a fire-resistance rating of not less than 3 hours
- Floor area is subdivided by 2-hour fire-resistance-rated fire walls into areas of not more than 3,000 square feet

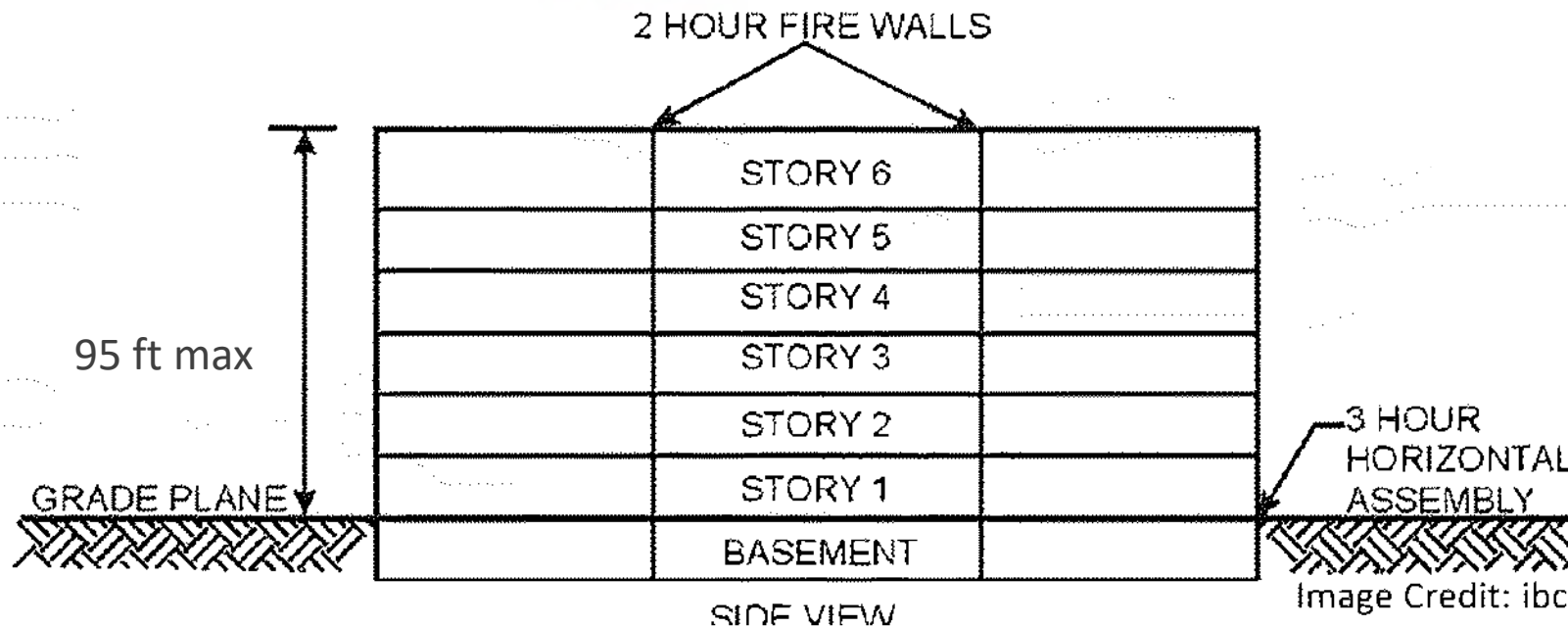


Image Credit: ibc code commentary

Arguably, one of the most important sections of the International Building Code (IBC) is not used for most construction projects. 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**.

<https://www.woodworks.org/resources/getting-to-yes-making-effective-use-of-the-alternate-means-process/>

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

Michael F. Malinowski, 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 intent may not actually be innovation newly developed



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

1430 Q

Sacramento, CA



III-A

- **6 stories of wood + mezzanine** over 2-story concrete podium (IIIA over IA)
- 63,000 square feet
- Needed 6 floors of residential units to make the project viable
- Concrete and steel were too expensive

Architect: HRGA, The HR Group Architects
Structural Engineer: Buehler

1430 Q

Sacramento, CA



Photo: Gary Folkins

1430 Q



Volume of wood products used:
1,708 cubic meters (60,334 cubic feet)



U.S. and Canadian forests grow this much wood in:
5 minutes



Carbon stored in the wood:
1,426 metric tons of CO₂



Avoided greenhouse gas emissions:
3,031 metric tons of CO₂



TOTAL POTENTIAL CARBON BENEFIT:
4,457 metric tons of CO₂

EQUIVALENT TO:

Source: US EPA



942 cars off the road for a year



Energy to operate 471 homes for a year

Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations. Note: CO₂ on this chart refers to CO₂ equivalent.

Tacoma Municipal Code

2.02.140 Amendment to IBC Section 504.4 – Number of Stories – by amending subsection 504.4.1 WA State amendment to the IBC and by addition of a new Section 504.4.1.1 – Type B occupancies within R-1 and R-2 occupancies.

The following section amends Section 504.4.1 of the State Building Code amendments to IBC Section 504.4 – Number of Stories, by replacing 504.4.1 in its entirety, and by addition of a new Section 5.4.4.1.1.

504.4.1 Stair Enclosure Pressurization Increase.

For **Groups R-1 and R-2** in buildings of **Type VA or IIIA construction**, or I-1 Condition 2 Assisted living facilities licensed per chapter 388-78A WAC and residential treatment facilities as licensed by Washington state under chapter 246-337 WAC located in buildings of Type VA construction equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1, **the maximum number of stories permitted in Section 504.4 may be increased by one provided the interior exit stairways and ramps are pressurized** in accordance with Sections 909.11 and 909.20. Legally required standby power shall be provided for buildings constructed in compliance with this section and be connected to stairway shaft pressurization equipment, elevators and lifts used for accessible means of egress, hoistway pressurization equipment (if provided) and other life safety equipment as determined by the authority having jurisdiction. For the purposes of this section, legally required standby power shall comply with most currently adopted NEC Section 701.12, options (A), (B), (C), (D), (E), (F), or (G) or subsequent revised section number(s).

Seattle, WA



Photo: Matt Todd/PB Architects

College Park, MD



Photo: Matt Church

Normal, IL



Image: OKW Architects

Los Angeles, CA



Photo: Lawrence Anderson/Esto

Atlanta, GA



LORD · AECK · SARGENT Image: Lord Aeck Sargent

PROJECT ONE, OAKLAND, CA



Credit: Gurnet Point

CANYONS, PORTLAND, OR



Credit: Jeremy Bittermann & Kaiser + Path

11 E LENOX, BOSTON, MA

7 STORIES

70 FT, Passive House, Multi-Family



11 E LENOX, BOSTON, MA

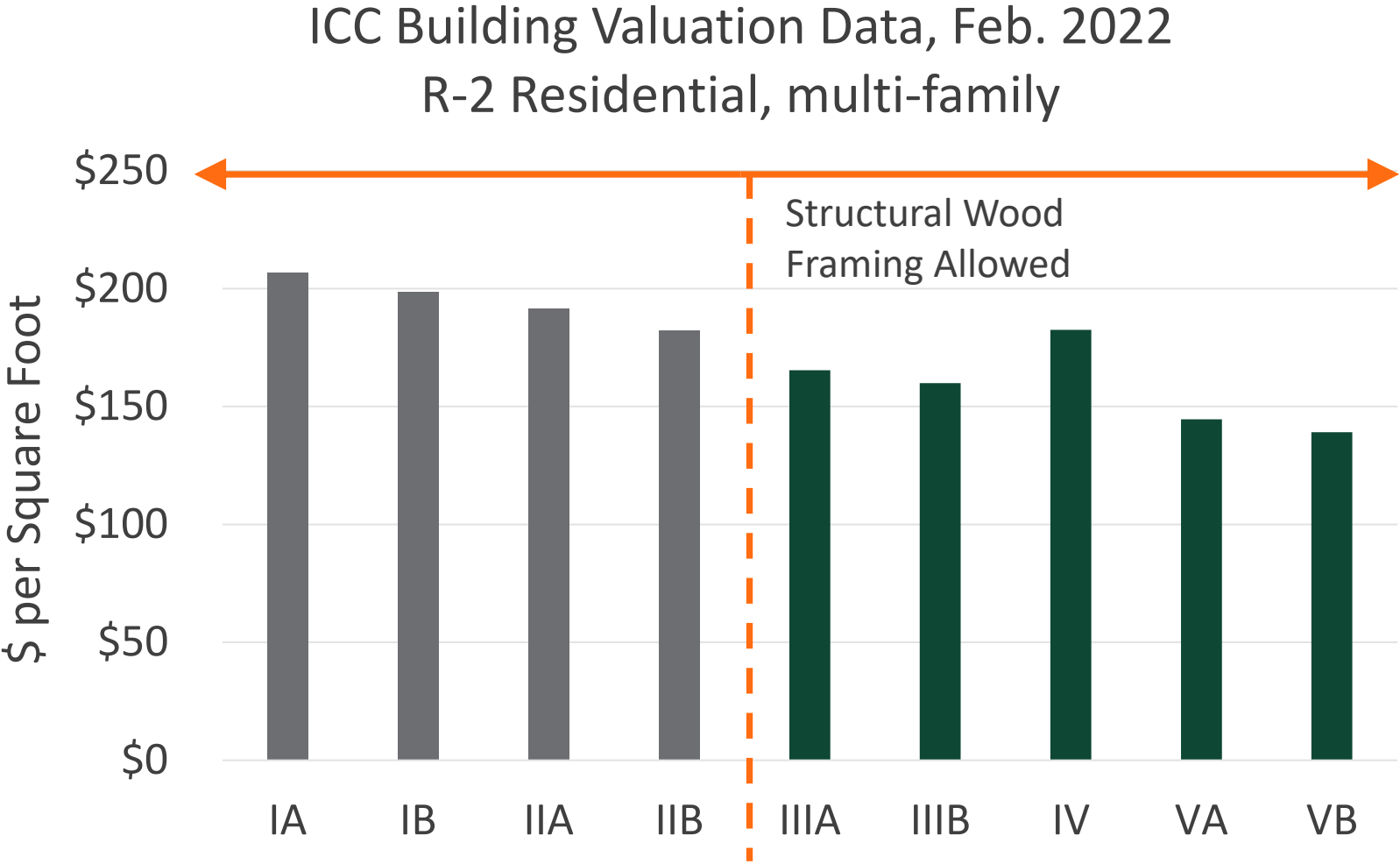


Credit: H + O Structural Engineering

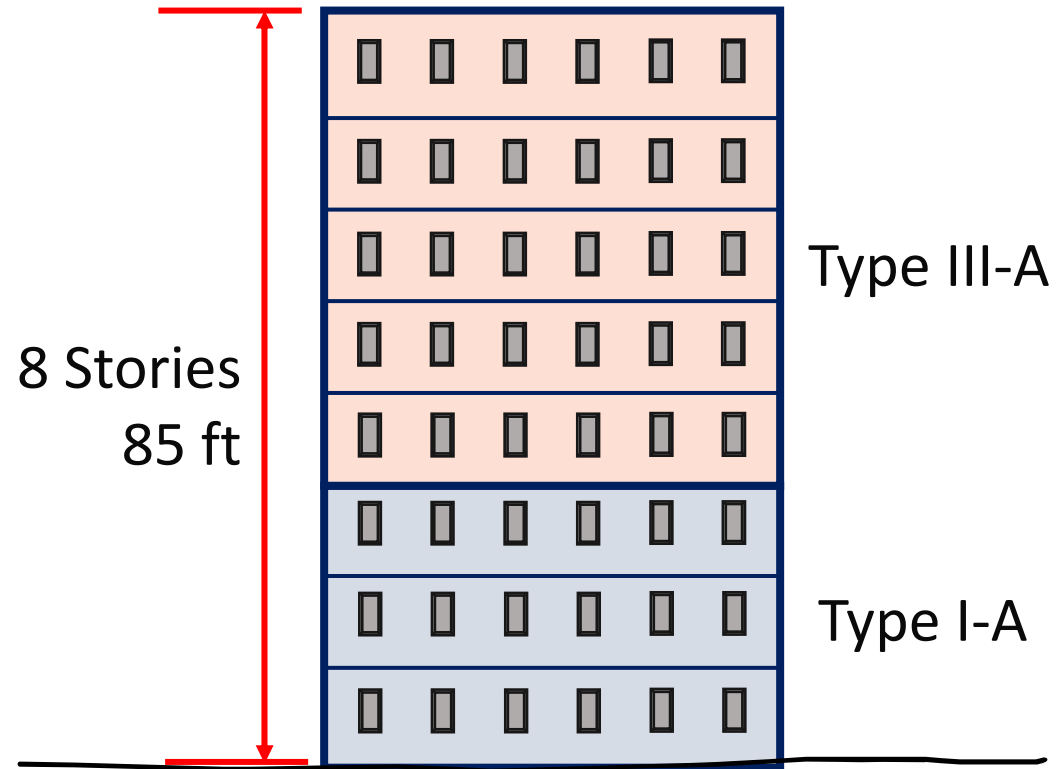
Construction Type – Primarily based on building size & occupancy

	Construction Type (All Sprinklered Values)							
	IV-A	IV-B	IV-C	IV-HT	III-A	III-B	V-A	V-B
Occupancies	Allowable Building Height above Grade Plane, Feet (IBC Table 504.3)							
A, B, R	270	180	85	85	85	75	70	60
	Allowable Number of Stories above Grade Plane (IBC Table 505.4)							
R-2	18	12	8	5	5	5	4	3
	Allowable Area Factor (At) for SM, Feet ² (IBC Table 506.2)							
R-2	184,500	123,000	76,875	61,500	72,000	48,000	36,000	21,000

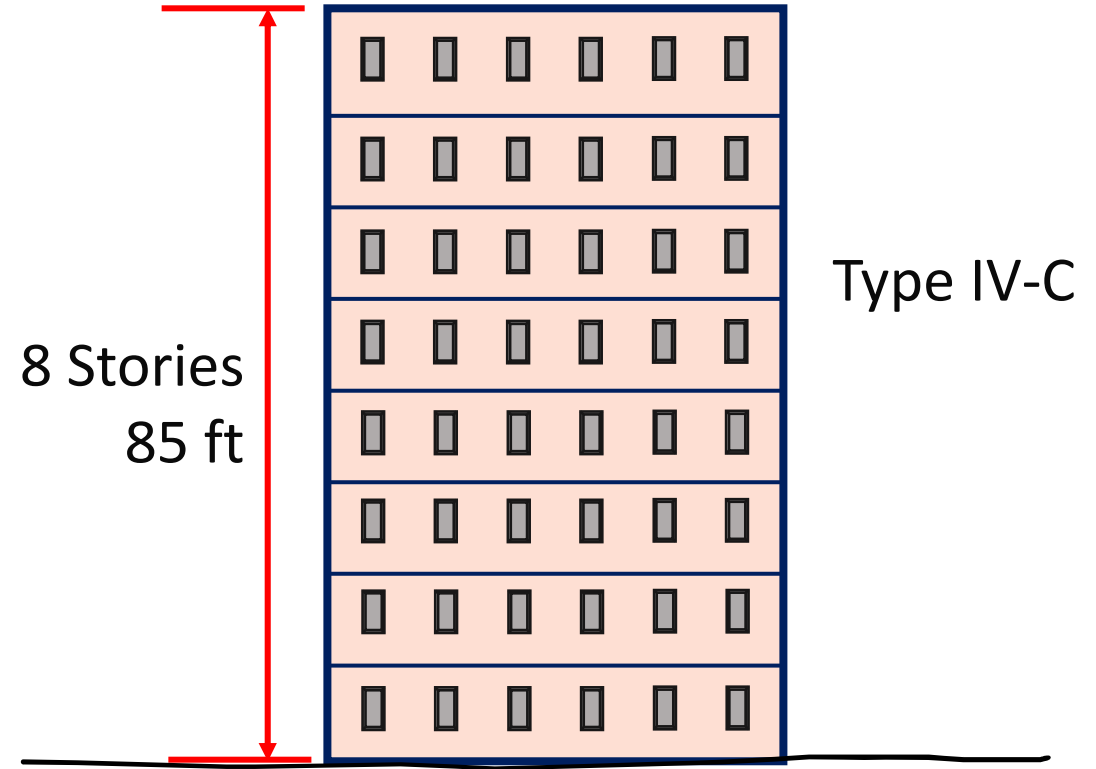
ICC Building Valuation Data



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



Type III-A



Type IV-C

Questions? Ask us anything.



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Fire Resistance Ratings

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

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV				TYPE V	
	A	B	A	B	A	B	A	B	C	HT	A	B
Primary structural frame ^f (see Section 202)	3 ^{a, b}	2 ^{a, b, c}	1 ^{b, c}	0 ^c	1 ^{b, c}	0	3 ^a	2 ^a	2 ^a	HT	1 ^{b, c}	0
Bearing walls												
Exterior ^{c, 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 ^h	1 ^{b, c}	1 ^{b, c}	0 ^c	1 ^{b, c}	0	1 1/2	1	1	HT	1 ^{b, c}	0

[A] **104.11 Alternative materials, design and methods of construction and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed alternative meets all of the following:

1. The alternative material, design or method of construction is satisfactory and complies with the intent of the provisions of this code.
2. The material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code as it pertains to the following:
 - 2.1. Quality.
 - 2.2. Strength.
 - 2.3. Effectiveness.
 - 2.4. Fire resistance.
 - 2.5. Durability.
 - 2.6. Safety.

Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved.