Mid-Rise Design & Detailing: Optimizing Size, Maximizing Value

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Regional Director
New England

WoodWorks
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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 2018 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

» Context for Mid-Rise Construction
» Mid-rise Building Types/Configurations
» Maximizing Height & Area
Outline

» Context for Mid-Rise Construction
  » Mid-rise Building Types/Configurations
  » Maximizing Height & Area
Global Population Boom

**Global Population**
- 7.9 billion now
- 9.7 billion by 2050
- 33% increase

**Urban Population**
- 6.4 billion by 2050
- 62% increase

Source: United Nations Department of Economic and Social Affairs
Sustainable Multi-Family & Mixed-Use Structures

Economically Meet Urban Housing Needs

Increase Environmental Responsibility

These 2 items don’t need to be in opposition—Wood-framing helps them work together!
Sustainable Multi-Family & Mixed-Use Structures

Mid-rise wood-frame construction provides a common ground for both

How?
Mid-Rise Construction

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

Where wood is a viable option, it’s likely the most appropriate choice.
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
Urban Infill Development
AvalonBay Stadium
Location: Anaheim, CA
251 Apts., 13K sf retail/restaurant
Type III modified
50% of their projects are podium
Semi-balloon framed with 16" Open web trusses at exterior walls
Carbon Case Study | High Density

Climate Change Advantage

- **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

- **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:**
- 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
Note: CO₂ on this chart refers to CO₂ equivalent.
Outline

» Context for Mid-Rise Construction

» Mid-rise Building Types/Configurations

» Maximizing Height & Area
Wood Mid-Rise Construction

How many stories can be wood framed in the IBC?

Photo credit: Matt Todd & PB Architects
Wood Mid-Rise Construction

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

Photo credit: Matt Todd & PB Architects
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.
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 (20-30 unites/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
Podium

4 stories of residential over podium (parking or retail)

» 60–80 units/acre

Inman Park Condos, Atlanta, GA
Davis & Church
Podium

5 stories over retail

» 100–120 units/acre

AvalonBay Stadium, Anaheim, CA
VanDorpe Chou Associates

Inman Park Condos, Atlanta, GA
Davis & Church
Podium

5 stories over residential podium

» 120–140 units/acre

16 Powerhouse, Sacramento, CA
D&S Development
LPA Sacramento
Mezzanine & Podium

5 stories with mezzanine + residential podium

» 125–145 units/acre
Outline

» Context for Mid-Rise Construction

» Mid-rise Building Types/Configurations

» Maximizing Height & Area

  1. Construction Types
  2. Tabulate Areas & Stories
  3. Allowable increases

1430 Q, The HR Group Architects, Buehler Engineering, Greg Folkins Photography
Typical Mid-rise Occupancy

- Hotels (R-1)
- Apartments (R-2)
- Condominiums (R-2)
- Student housing (R-2)
- Live/work units (R-2)
- Assisted living (R-4)

- (A-2) Restaurants/cafeterias
- (A-3) Workout facilities
- (A-3) Meeting rooms
- (B) Offices
- Nursing homes (I-2)
- (M) Shops
- (S-2/U) Parking
- (S-1) Storage
Mid-Rise Construction Types

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

**Type V**
- All building elements are any allowed by code

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

**Type IV (Heavy Timber)**
- Exterior walls non-combustible (may be FRTW)
- Interior elements qualify as Heavy Timber
Increased Height & Story Area

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>IIA (ft²)*</th>
<th>IIIA (ft²)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-1</td>
<td>72,000 +18,000 (max frontage)</td>
<td>72,000 +18,000 (max frontage)</td>
</tr>
<tr>
<td>R-2</td>
<td>72,000 +18,000 (max frontage)</td>
<td>72,000 +18,000 (max frontage)</td>
</tr>
</tbody>
</table>

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

** ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F
Opportunity for Residential Occupancy (R)

Type VA

- Height: 70'**
- ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F

Type VB

- Height: 60' (3)

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>VA (ft²)*</th>
<th>VB (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-1</td>
<td>36,000 +9,000(max frontage)</td>
<td>21,000 +5,250(max frontage)</td>
</tr>
<tr>
<td>R-2</td>
<td>36,000 +9,000(max frontage)</td>
<td>21,000 +5,250(max frontage)</td>
</tr>
</tbody>
</table>

* Areas reflect PER STORY max. Total building max may limit area further.
** ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F
Opportunity for Office Occupancy (B)

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>IIIA (ft²)*</th>
<th>IV (ft²)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>85,500 +21,375(max frontage)</td>
<td>108,000 +27,000(max frontage)</td>
</tr>
</tbody>
</table>

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

** ASCE7 12.2-1 limits wood shear wall seismic systems to 65' in height in SDC D,E,F
### Height – 2018 IBC Table 504.3

**IBC 2018:** Table 504.3 provides base & increased heights

<table>
<thead>
<tr>
<th>OCCUPANCY CLASSIFICATION</th>
<th>OCCUPANCY CHARACTERISTIC</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SEE FOOTNOTES</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>HT</td>
</tr>
<tr>
<td>A, B, E, F, M, S, U</td>
<td>NS&lt;sup&gt;b&lt;/sup&gt;</td>
<td>UL</td>
<td>160</td>
<td>65</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL</td>
<td>180</td>
<td>85</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>R</td>
<td>NS&lt;sup&gt;d, h&lt;/sup&gt;</td>
<td>UL</td>
<td>160</td>
<td>65</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>S13R</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL</td>
<td>180</td>
<td>85</td>
<td>75</td>
<td>85</td>
</tr>
</tbody>
</table>

**Footnotes:**
- **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** (not shown): Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.3 (NFPA 13D)
### Stories – 2018 IBC Table 504.4

<table>
<thead>
<tr>
<th>OCCUPANCY CLASSIFICATION</th>
<th>TYPE OF CONSTRUCTION</th>
<th>SEE FOOTNOTES</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>HT</td>
</tr>
<tr>
<td>A-2</td>
<td>NS</td>
<td>UL 11</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
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<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>A-3</td>
<td>NS</td>
<td>UL 11</td>
<td>3</td>
<td>2</td>
<td>3</td>
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<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>NS</td>
<td>UL 11</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>R-1</td>
<td>NS&lt;sup&gt;d&lt;/sup&gt;</td>
<td>UL 11</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>S13R</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>R-2</td>
<td>NS&lt;sup&gt;d&lt;/sup&gt;</td>
<td>UL 11</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>S13R</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>S-1</td>
<td>NS</td>
<td>UL 11</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
Sloped Sites

Fashion Valley, CA
AvalonBay Communities

Seattle, WA
PB Architects
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.
Basements – 2018 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.
# Summary of Building Heights

## Building Heights and Stories by Building Type

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>IIIA</th>
<th>IIIB</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 ft</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>75 ft</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>70 ft</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>60 ft</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>R-1/R-2/R-4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>A-2/A-3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>M</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>S-2</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>S-1</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**ASCE7 12.2-1 limits wood shear wall seismic systems to 65’ in height in SDC D,E,F**
### Area Increases – IBC 2018

**TABLE 506.2**, **ALLOWABLE AREA FACTOR (A_I = NS, S1, S13R, or SM, as applicable) IN SQUARE FEET**

<table>
<thead>
<tr>
<th>OCCUPANCY CLASSIFICATION</th>
<th>SEE FOOTNOTES</th>
<th>TYPE OF CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TYPE I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>R-1</td>
<td>NS&lt;sup&gt;d,b&lt;/sup&gt;</td>
<td>UL</td>
</tr>
<tr>
<td></td>
<td>S13R</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1</td>
<td>UL</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>UL</td>
</tr>
</tbody>
</table>

**Can still 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)  
**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)  
**S13R** = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.2 (NFPA 13R)
Sprinkler Systems: 2018 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
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) 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

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

$I_{f,\text{max}} = 0.75$
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

\[ I_f = \left[ \frac{F}{P} - 0.25 \right] \frac{W}{30} \]

(IBC Equation 5-5)

WHERE:

» \( I_f \) = Area increase due to frontage

» \( F \) = Building perimeter that fronts on a public way or open space having 20 feet open minimum width

» \( P \) = Perimeter of entire building

» \( W \) = Width of public way or open space (feet) in accordance with section 506.3.2
MINIMUM QUALIFICATIONS

25% min of building perimeter is on a public way or open space 20' min distance from building face to:

» Closest interior lot line

» Entire width of public way

» Exterior face of adjacent building
Frontage Increases – IBC 506.3.2

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

Bldg. 1 → W ≠ FSD → Bldg. 2
Frontage Increases – IBC 506.3.2

For two buildings on DIFFERENT lots

Bldg. 1

Bldg. 2

lot line

W

FSD
Frontage Increases – IBC 506.3.2

For two buildings on the SAME lots

Bldg. 1

imaginary lot line

W

FSD

Bldg. 2
Frontage Increases – IBC 506.3.2

Buildings near public right of ways:

Bldg. 1

Bldg. 2

lot line

FSD

centerline of public way

W

FSD

W
Frontage Increases – IBC 506.3.3

\[ W = \left[ (L_1 \times w_1) + (L_2 \times w_2) + (L_3 \times w_3) \ldots \right] / F \]

(IBC Equation 5-4)

**WHERE:**

\( W \) = Calculated Width (weighted average) of public way or open space (feet)

\( L_n \) = Length of a portion of the exterior perimeter wall

\( w_n \) = Width (≥ 20 ft) of public way or open space associated with that portion of the exterior perimeter wall

\( F \) = Building perimeter that fronts on a public way or open space having 20 feet open minimum width
Total Building Area – 2018 IBC 506.2.3

\[ A_a = [A_t + (NS \times I_f)] \times S_a \]  
(Equation 5-2)

- \( A_a \): 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
  \( I_{f, \max} = 0.75 \)
- \( S_a \): Actual number of building stories above grade
- \( S_{a, \max} = 3 \) for non-sprinklered buildings and those w/ NFPA13
- \( S_{a, \max} = 4 \) for buildings w/ NFPA 13R
Total Building Area – 2018 IBC 506.2.3

1 story building

» Total Area is $1 \times A_a$

R-2
S13R

R-2
SM

24K
96K
Total Building Area – 2018 IBC 506.2.3

2 story building

» Total Area is $2x A_a$
Total Building Area – 2018 IBC 506.2.3

3 story building

» Total Area is $3 \times A_a$

» Frontage Increase is included in $A_a$

<table>
<thead>
<tr>
<th>R-2</th>
<th>S13R + $I_f$ (NS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$24K$ +</td>
<td>$.75(24K)$</td>
</tr>
<tr>
<td>$24K$ +</td>
<td>$.75(24K)$</td>
</tr>
<tr>
<td>$24K$ +</td>
<td>$.75(24K)$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R-2</th>
<th>SM + $I_f$ (NS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$72K$ +</td>
<td>$.75(24K)$</td>
</tr>
<tr>
<td>$72K$ +</td>
<td>$.75(24K)$</td>
</tr>
<tr>
<td>$72K$ +</td>
<td>$.75(24K)$</td>
</tr>
</tbody>
</table>
Total Building Area – 2018 IBC 506.2.3

4 story IIIA building

» Total Area is 3x $A_a$ for NFPA 13

» Total area is 4x $A_a$ for NFPA 13R

<table>
<thead>
<tr>
<th>R-2S13R</th>
<th>R-2SM</th>
</tr>
</thead>
<tbody>
<tr>
<td>24K</td>
<td>72K</td>
</tr>
<tr>
<td>24K</td>
<td>54K (no frontage)</td>
</tr>
<tr>
<td>24K</td>
<td>67.5K (full frontage)</td>
</tr>
<tr>
<td>24K</td>
<td>72K</td>
</tr>
<tr>
<td>24K</td>
<td>54K (no frontage)</td>
</tr>
<tr>
<td>24K</td>
<td>67.5K (full frontage)</td>
</tr>
<tr>
<td>24K</td>
<td>72K</td>
</tr>
<tr>
<td>24K</td>
<td>54K (no frontage)</td>
</tr>
<tr>
<td>24K</td>
<td>67.5K (full frontage)</td>
</tr>
</tbody>
</table>
Mixed Occupancy, Multi-story

Story Area: \( \sum \left[ A_t + (NS \times I_f) \right] / A_a \leq 1 \)
(Described in 508.4.2)

Total Building Area: \( \sum \left[ A_t + (NS \times I_f) \right] / A_a \leq S_a \)
(Described in 506.2.4)

\( A_a \) = 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
\( I_f, \ max = 0.75 \)
\( S_a \) = Actual number of building stories above grade
\( S_{a, \ max} = 3 \) for non-sprinklered buildings and those w/ NFPA13
\( S_{a, \ max} = 4 \) for buildings w/ NFPA 13R
Mixed Use Occupancy – Design Aid

WoodWorks/AWC Heights & Areas Calculator App
Based on 2015 IBC
Available for FREE at woodworks.org
Frontage Calculation – Design Aid
Case Study Innovations in Wood

**Emory Point**  Atlanta, GA

- 3 buildings complete – Luxury Apt., retail, restaurants
- (1) 5 story Type III wood frame over slab on grade
- (2) 4 stories of wood over 1 story concrete podium

**35% Structure Savings**

- $14/sf (wood concept)
- $22/sf (PT conc. Slab and frame)

**Architect:** Cooper Carry, The Preston Partnership

**Engineer:** Ellinwood + Machado, Pruitt Eberly Stone

**Contractor:** Fortune-John

**Photo credit:** Gables Residential
Mezzanines – 2018 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 ≤ 42” allowed)
    » Several exceptions

» Slightly different for equipment platforms

*Does count toward fire area with regard to fire protection in Chapter 9
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 min of either building
» 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
Starting in 2015, IBC allows multiple podium stories above grade.
Case Study Maximizing View and Value With Wood

Marselle Condominiums
Seattle, WA
» Type IIIA condo complex
» 5 1/2 stories of wood over 2 stories of concrete
» Mezzanine added $250K cost but $1M in value
» 30% cost saving over concrete
» Time savings over steel

Architect: PB Architects
Engineer: Yu & Trochalakis
Contractor: Norcon, NW
Completed: 2009
Photo Credit: Matt Todd Photography
Parking Beneath Group R – 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/
Horizontal Separation

Horizontal Wood Assemblies are effectively used to transition from Residential units above to Retail/Parking below.
Case Study: Horizontal Separation

Galt Place Apartments
Location: Galt, CA
Mixed Use Residential over Retail and Parking
Architect: Applied Architecture
2018 Code Conforming Wood

Available for Free Download: www.awc.org
Outline

» Fire Rating Requirements for Exterior Walls
  » Assembly Asymmetry
  » Addition of Wood Structural Panel
  » Bearing vs. Non-bearing
  » Vertical offsets

» Exterior Wall to Floor Intersection
  » Fire Resistant Continuity
  » Fire Retardant Continuity

» Parapets & Balconies
Outline

» Fire Rating Requirements for Exterior Walls
  » Assembly Asymmetry
  » Addition of Wood Structural Panel
  » Bearing vs. Non-bearing
  » Vertical offsets
» Exterior Wall to Floor Intersection
  » Fire Resistant Continuity
  » Fire Retardant Continuity
» Parapets & Balconies
Fire Performance

Combustibility

Fire Resistance

Flame Spread Classification

Fire Protection Systems
## Fire Resistance Ratings

### Key Differences in Fire Ratings for Construction Types

<table>
<thead>
<tr>
<th></th>
<th>IIIA</th>
<th>IIIB</th>
<th>VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior wall framing</td>
<td>FRT</td>
<td>FRT</td>
<td>non-FRT</td>
</tr>
<tr>
<td>Exterior bearing wall fire rating</td>
<td>2 hr</td>
<td>2 hr</td>
<td>1 hr</td>
</tr>
<tr>
<td>Interior bearing wall fire rating</td>
<td>1 hr</td>
<td>0 hr</td>
<td>1 hr</td>
</tr>
<tr>
<td>Interior non-bearing wall fire rating</td>
<td>0 hr</td>
<td>0 hr</td>
<td>0 hr</td>
</tr>
<tr>
<td>Floor assembly fire rating</td>
<td>1 hr</td>
<td>0 hr</td>
<td>1 hr</td>
</tr>
<tr>
<td>Fire wall rating</td>
<td>3 hr</td>
<td>3 hr</td>
<td>2 hr</td>
</tr>
</tbody>
</table>

**IBC Tables 601 & 706.4**

Note: FRT = Fire Retardant Treated
Fire-Resistance Rated Wall Assemblies

• **Fire-Resistance Rating:** The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.

• **Tested under a standardized test fire exposure for a given duration to:**
  1. Prevent the passage of flame and temperature rise from one side to the other
  2. Continue to provide vertical structural support when exposed to fire and elevated temperatures
Choosing Fire Rated Assemblies

Common tested assemblies (ASTM E119) per IBC 703.2:
» UL Listings
» Gypsum Catalog
» Proprietary Manufacturer Tests
» Industry Documents: such as AWC’s DCA3

Alternate Methods per IBC 703.3
» Prescriptive designs per IBC 721.1
» Calculated Fire Resistance per IBC 722
» Fire-resistance designs documented in sources
» Engineering analysis based on a comparison
» Fire-resistance designs certified by an approved agency
Fire-Resistance Rated Wall Assemblies

- There are four basic types of fire-resistance rated wall assemblies:
  - Exterior Walls (IBC 705)
  - Fire Wall (IBC 706)
  - Fire Barrier (IBC 707)
  - Fire Partition (IBC 708)
Unique to Exterior Walls

- Exterior walls differ from other light frame fire assemblies in three basic ways:
  - Hourly rating requirements per Tables 601 vs 602
  - Structural stability requirements
  - Non-combustible exception
Basic assumption is that fires begin at the interior and rated wall assemblies are not required *from* the exterior unless close to another structure.
Exterior Walls – Fire Separation Distance

- **705.5 Fire Resistance Ratings**: Exterior walls shall be fire-resistance rated in accordance with Tables 601 and 602 and this section. The required fire-resistance rating of exterior walls with a fire separation distance of greater than 10 feet shall be rated for exposure to fire from the inside. The required fire-resistance rating of exterior walls with a fire separation distance of less than or equal to 10 feet shall be rated for exposure to fire from both sides.
# Exterior Wall Fire Resistance

## Table 601

<table>
<thead>
<tr>
<th>BUILDING ELEMENT</th>
<th>TYPE I</th>
<th>TYPE II</th>
<th>TYPE III</th>
<th>TYPE IV</th>
<th>TYPE V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>HT</td>
</tr>
<tr>
<td>Primary structural frame (see Section 202)</td>
<td>3(^{a,b})</td>
<td>2(^{b})</td>
<td>1(^{b})</td>
<td>0</td>
<td>1(^{b})</td>
</tr>
<tr>
<td>Bearing walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior(^{c,f})</td>
<td>3(^{a})</td>
<td>2(^{a})</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Interior</td>
<td>3(^{a})</td>
<td>2(^{a})</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nonbearing walls and partitions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonbearing walls and partitions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior(^{d})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor construction and associated secondary members</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(see Section 202)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof construction and associated secondary members</td>
<td>1(^{1/2}) ,</td>
<td>1(^{b,c})</td>
<td>1(^{b,c})</td>
<td>0(^{c})</td>
<td>1(^{b,c})</td>
</tr>
<tr>
<td>(see Section 202)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Table 602

<table>
<thead>
<tr>
<th>FIRE SEPARATION DISTANCE = X (foot)</th>
<th>TYPE OF CONSTRUCTION</th>
<th>OCCUPANCY GROUP H(^{*})</th>
<th>OCCUPANCY GROUP F-1, M, S-1(^{a})</th>
</tr>
</thead>
<tbody>
<tr>
<td>X &lt; 5(^{b})</td>
<td>All</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5 ≤ X &lt; 10</td>
<td>IA</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>10 ≤ X &lt; 30</td>
<td>IA, IB</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>IIB, VB</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>X ≥ 30</td>
<td>All</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**OCCUPANCY GROUPS:**

- A, B, E, F-2, I, R, S-2, U

\(^{a}\) See Section 2304.11.2

\(^{b}\) See Section 202

\(^{c}\) See Section 2304.15.6
Type III Exterior Walls: Fire Rating Requirements

<table>
<thead>
<tr>
<th>Fire Rating of Structural Elements</th>
<th>IIIA</th>
<th>IIIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>For occupancy groups A, B, E, F-2, I, R, S-2, U</td>
<td>Int. face of wall</td>
<td>Ext. face of wall</td>
</tr>
<tr>
<td><strong>FSD ≥ 30 ft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior bearing walls (hrs)</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Exterior Nonbearing walls (hrs)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>10 ft &lt; FSD &lt; 30 ft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior bearing walls (hrs)</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Exterior Nonbearing walls (hrs)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>FSD ≤ 10 ft</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior bearing walls (hrs)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Exterior Nonbearing walls (hrs)</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Exterior Wall Fire Ratings

- Using the provisions of section 705.5 and Tables 601 and 602 could result in requiring a 1-hour or 2-hour rating on the inside face of exterior walls, while no rating is required on the exterior face of exterior walls.

- How do we specify such an asymmetric assembly?

- This is where prescriptive code methodology begins to break down; procedural data does not align with requirements. Most building jurisdictions understand that this is a deficiency of the system and will recognize one tested assembly for the outside and a second for the inside.
Exterior Walls - Asymmetry

- Common issues with tested assemblies:
- Assembly asymmetry: separate assemblies for each side
Exterior Walls – 1-hr Int; 0-hr Ext

Design No. U348
April 01, 2013

Bearing Wall Rating — 1 Hr
(EXPOSED TO FIRE ON INTERIOR FACE ONLY)

Finish Rating — 23 min
## Exterior Walls – 1-hr Int; 0-hr Ext

**IBC Table 721.1(2)**

<table>
<thead>
<tr>
<th>16-1.1³</th>
<th>2” × 4” wood studs at 16” centers with double top plates, single bottom plate; interior side covered with ⅜” Type X gypsum wallboard, 4” wide, applied horizontally unblocked, and fastened with 2⅝” Type S drywall screws, spaced 12” on center. Wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound. Exterior covered with ⅜” wood structural panels, applied vertically, horizontal joints blocked and fastened with 6d common nails (bright) 12” on center in the field, and 6” on center panel edges. Cavity to be filled with 5⅜” mineral wool insulation. Rating established for exposure from interior side only.</th>
<th>4 ½</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-1.2³</td>
<td>2” × 6” wood studs at 16” centers with double top plates, single bottom plate; interior side covered with ⅜” Type X gypsum wallboard, 4” wide, applied horizontally or vertically with vertical joints over studs and fastened with 2½” Type S drywall screws, spaced 12” on center, wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound. Exterior side covered with ⅜” wood structural panels fastened with 6d common nails (bright) spaced 12” on center in the field and 6” on center along the panel edges. Cavity to be filled with 5⅜” mineral wool insulation. Rating established from the gypsum-covered side only.</td>
<td>6⅜₁₆</td>
</tr>
<tr>
<td>16-1.3³</td>
<td>2” × 6” wood studs at 16” centers with double top plates, single bottom plates; interior side covered with ⅜” Type X gypsum wallboard, 4” wide, applied vertically with all joints over framing or blocking and fastened with 2½” Type S drywall screws spaced 7” on center. Joints to be covered with tape and joint compound. Exterior covered with ⅜” wood structural panels, applied vertically with edges over framing or blocking and fastened with 6d common nails (bright) at 12” on center in the field and 6” on center on panel edges. R-19 mineral fiber insulation installed in stud cavity. Rating established from the gypsum-covered side only.</td>
<td>6⅜₂</td>
</tr>
</tbody>
</table>

---

16. Exterior walls rated for fire resistance from the inside only in accordance with Section 703.5.
Exterior Walls – 2-hr Int; 0-hr Ext

Design No. U349
August 21, 2013
Bearing Wall Rating — 2 Hr
(EXPOSED TO FIRE ON INTERIOR FACE ONLY)
For Wood Studs, Finish Rating — 55 min
Exterior Walls – 2-hr Int; 0-hr Ext

**Design No. W408**

April 01, 2013

**Bearing Wall Rating** — 2 Hr when EXPOSED TO FIRE ON INTERIOR FACE ONLY

**Bearing Wall Rating** — 1 Hr when EXPOSED TO FIRE ON EXTERIOR FACE ONLY, see Item 4 and 6

For Wood Studs, Finish Rating — 50 min when EXPOSED TO FIRE ON INTERIOR FACE.

For Wood Studs, Finish Rating — 17 min when EXPOSED TO FIRE ON EXTERIOR FACE.
“Wood stud walls may contain fire-retardant-treated studs as well as untreated wood studs. The use of fire-retardant-treated plywood (wood structural panels) may be used in Designs that contain use of untreated plywood when all other specified attributes are equivalent to the wood structural panel used in the Design.”
Exterior Walls – Addition of Wood Structural Panel

- Can include WSP in assemblies which were tested without them:
  - ESR 2586
  - AWC’s DCA4
  - Gypsum Association Manual

GA Fire Resistance Design Manual Item 23, Section 1 of the General Explanatory Notes:

“When not specified as a component of a fire-resistance rated wall or partition system, wood structural panels shall be permitted to be added to one or both sides.”
Exterior Wall – Bearing vs. Nonbearing

- Non loading-bearing exterior walls may have lower fire resistance rating requirements than bearing walls in certain situations. IBC Chapter 2 defines load bearing walls as:

[BS] WALL, LOAD-BEARING. Any wall meeting either of the following classifications:

1. Any metal or wood stud wall that supports more than 100 pounds per linear foot (1459 N/m) of vertical load in addition to its own weight.

[BS] WALL, NONLOAD-BEARING. Any wall that is not a load-bearing wall.
Exterior Walls – Bearing vs. Non-Bearing

- If framing parallel to long exterior walls is possible, minimizes area of load bearing exterior walls
Exterior Walls – Vertical Offsets

- There is no requirement for an exterior wall to extend to the foundation in a stepped building.

Posts, beams or walls, that support a rated exterior wall must be fire-resistance rated not less than the rating of the supported wall (IBC 704.1)
Outline

» Context for Type III Construction
» Fire Rating Requirements for Exterior Walls
  » Assembly Asymmetry
  » Addition of Wood Structural Panel
  » Bearing vs. Non-bearing
  » Vertical offsets
» Exterior Wall to Floor Intersection
  » Fire Resistant Continuity
  » Fire Retardant Continuity
» Parapets & Balconies
Platform Framing

- **Structural**
  - Direct bearing/no add’l hardware
  - May require load transfer blocking for concentrated loads from above
  - Wall sole plate and floor sheathing crushing may need to be considered

- **Constructability**
  - Framing can be completed before drywall and insulation are installed
  - Common length studs
Semi-balloon Framing

**Structural**
- Additional hardware/no direct bearing
- No load transfer blocking req’d

**Rated Assemblies**
- May accommodate continuity in exterior walls in type III construction

**Constructability**
- Framing can be completed before drywall and insulation are installed
- Custom length studs
- Can help minimize building shrinkage
# Intersection of Assemblies - Ratings

<table>
<thead>
<tr>
<th>Key Differences in Fire Ratings for Construction Types</th>
<th>IIIA</th>
<th>IIIB</th>
<th>VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior wall framing</td>
<td>FRT</td>
<td>FRT</td>
<td>non-FRT</td>
</tr>
<tr>
<td>Exterior bearing wall fire rating</td>
<td>2 hr</td>
<td>2 hr</td>
<td>1 hr</td>
</tr>
<tr>
<td>Floor assembly fire rating</td>
<td>1 hr</td>
<td>0 hr</td>
<td>1 hr</td>
</tr>
</tbody>
</table>

**IBC Tables 601 & 706.4**

Note: FRT = Fire Retardant Treated
Intersection of Tested Assemblies

Design No. U301
May 20, 2015
Bearing Wall Rating — 2 HR.
Finish Rating — 66 Min.

GA FILE NO. WP 4135
GENERIC

GYPSUM WALLBOARD, WOOD STUDS
Base layer 5/8" type X gypsum wallboard or gypsum veneer base applied at right angles to each side of 2 x 4 wood studs 24" o.c. with 6d coated nails, 1 7/8" long, 0.085" shank, 1/4" heads, 24" o.c. Face layer 5/8" type X gypsum wallboard or gypsum veneer base applied at right angles to each side with 8d coated nails, 2 9/16" long, 0.100" shank, 1/4" heads, 8" o.c.
Joints staggered 24" each layer and side. Sound tested with studs 16" o.c. and with nails for base layer spaced 6" o.c. (LOAD-BEARING)

2 Hour Wall

2 x 4’s firestopped
Intersection of Tested Assemblies

1 Hour Floor
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
Type III Exterior Walls – FRT

- **Type III and IV Construction - IBC Section 602.3:**
- Fire-retardant-treated wood framing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less
- **What does this FRTW requirement include?**
  - Wall Framing (Studs & Plates) – **Yes**
  - Wall Sheathing – **Yes**
  - Floor sheathing - ?
  - Rim Joist- ?
  - Floor Joists- ?
Some have interpreted the allowance of FRT framing in exterior walls of type III construction as not including FRT wall sheathing. The inclusion of wall sheathing is intended in the allowance of FRT framing.

Changes to the 2018 IBC clarify this.

602.3 Type III.
Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. Fire-retardant-treated wood framing and sheathing complying with Section 2303.2 shall be permitted within exterior wall assemblies of a 2-hour rating or less.

602.4 Type IV.
Type IV construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated wood, heavy timber (HT) or structural composite lumber (SCL) without concealed spaces. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, structural composite lumber (SCL), and cross-laminated timber and details of Type IV construction shall comply with the provisions of this section and Section 2304.11. Exterior walls complying with Section 602.4.1 or 602.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rating or heavy timber complying with Section 2304.11.2.2 shall be permitted.

Relocated

602.4.1 Fire-retardant-treated wood in exterior walls.
Fire-retardant-treated wood framing and sheathing complying with Section 2303.2 shall be permitted within exterior wall assemblies not less than 6 inches (152 mm) in thickness with a 2-hour rating or less.
Exterior Walls – Structural Stability

• IBC 705.6 Structural Stability:

• Exterior walls shall extend to the height required by 705.11. Interior structural elements that brace the exterior wall but that are not located within the plane of the exterior wall shall have the minimum fire resistance rating required in Table 601 for that structural element. **Structural elements that brace the exterior wall but are located outside of the exterior wall or within the plane of the exterior wall shall have the minimum fire resistance rating required in Tables 601 or 602 for the exterior wall.**
Structural stability of fire-resistance-rated construction is an important concern. Section 705.6 requires elements providing bracing support to be fire-resistance rated for the same duration of time as the exterior wall. In light-frame platform construction, this will require that the band joist or beam supporting the floor and the wall above also be of fire-resistance construction. Although the floor construction may not be required to be of fire-resistance construction in Type IIB and VB construction, every effort must be made to ensure that the floors, at least at the exterior wall, are of fire-resistance construction. Although the floor framing acts as lateral support for the exterior wall, this section does not require that the entire floor system be of fire-resistance rated construction. To state otherwise would prohibit Type IIB and VB buildings with an FSD of less than 10 feet (3048 mm). Only the structural element within the floor system that supports the vertical load of the wall must be of fire-resistance-rated construction.

“In light-frame platform construction, this will require that the band joist or beam supporting the floor and the wall above to also be of fire-resistant construction.... Although the floor framing acts as a lateral support for the exterior wall, this section does not require that the entire floor system be of fire-resistance rated construction.”
Exterior Walls – Intersecting Floors

• Please note that the following details are examples of what we have seen used on projects and do not necessarily represent details that will be accepted and applicable in all jurisdictions and to all projects.

• These details are not intended as recommendations for universally accepted details. Local product availability and manufacturer specifications should also be considered for each project.

• The Architect of Record and Engineer of Record should verify acceptance of the details used on their project with all provisions of the building code, including local amendments, with the local Authority Having Jurisdiction.
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Typical Platform Framing

Considerations:
» Shrinkage of rim, plates, joists
» Protection of rim for fire

Rationale for detail approval:
» Intersection of rated assemblies (wall & floor) considered sufficient

Legend
- Untreated or FRT
- FRT Wood

Floor Joist Options:
• Solid Sawn
• Trusses
• I-Joists

FRT sheathing
Floor sheathing
Rim joist
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Typical Platform Framing

Considerations:
» Shrinkage of rim, plates, joists

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
» At floor cavity, ceiling provides 1 hour
» 1 layer of blocking provides 2nd hr through char calculations
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Typical Platform Framing

Floor Joist Options:
- Solid Sawn
- Trusses
- I-Joists

Considerations:
- Shrinkage of rim, plates, joists

Rationale for detail approval:
- Membranes on both side of wall provide fire resistance via their approved assembly
- At floor cavity, 2 layers of blocking provide 2-hr protection through char calculations
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Modified Platform Framing

Considerations:
» Shrinkage of rim, plates, joists

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
» At floor cavity, 4x rim provides 2-hr protection through char calculations
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Modified Platform Framing

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
» At floor cavity, 4x rim provides 2-hr protection through char calculations
Exterior Walls – Intersecting Floors

- AWC’s DCA3 provides floor to wall intersection detailing options
- Addresses both continuity provisions and requirements for FRT elements in exterior wall plane
Exterior Walls – Intersecting Floors

Figure 1A: Example detail for Type III-A exterior wall-floor intersection with rim board and blocking
Calculated Fire Resistance of Wood

- For Exposed Wood Members: IBC 722.1 References AWC’s NDS Chapter 16 (AWC’s TR 10 is a design aid to NDS Chapter 16)
Equations for Calculating Fire Endurance

- Assumptions:
  - Nominal assumed char rate = 1.5”/hr.
  - Uses ultimate strength for design check
- Structurally spanning members: reduced section checked for capacity vs. demand

Source: AWC’s TR 10
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Semi-Balloon Framing

Floor sheathing

FRT sheathing

Floor Joist Options:
• Solid Sawn
• Trusses
• I-Joists

Blocking

Joist hanger

Legend

- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:
» Intersection of rated assemblies (wall & floor) considered sufficient
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor

Semi-Balloon Framing

Floor Joist Options:
• Solid Sawn
• Trusses
• I-Joists

Legend

- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:
» Ceiling membrane provides 1-hr protection
» Blocking in wall provides 2nd hr through char calculations
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

Rationale for detail approval:
» Ceiling membrane provides 1-hr protection
» Blocking between joists provides 2nd hr through char calculations
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

Floor Joist Options:
• Solid Sawn
• Trusses
• I-Joists

Rationale for detail approval:
» Ceiling membrane provides 1-hr protection
» 1 layer of wall membrane provides 2nd hr
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

Floor Joist Options:
• Solid Sawn
• Trusses
• I-Joists

Rationale for detail approval:
» 1 layer of wall membrane provides 1-hr protection
» Blocking between joists provides 2nd hr through char calculations
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing

Floor Joist Options:
• Solid Sawn
• Trusses
• I-Joists

Top flange joist hanger approved to span 2 layers GWB

Legend
- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
Over Gypsum Hangers

- Commonly called Fire Wall or Drywall Hangers
Over Gypsum Hangers

- Top Flange Hangers & Face Mount Hangers Available
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing w/ Ledger

Floor Joist Options:
• Solid Sawn
• Trusses
• I-Joists

This detail is often used with a balcony; ledger is thru-bolted

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
» At floor, ceiling membrane provides 1 hr
» Blocking provides 2nd hr & maintains FRT continuity
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Top Chord Bearing

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
» At floor cavity ceiling membrane provides 1 hr
» 1 layer of wall membrane provides 2nd hr

Legend
- Untreated or FRT
- FRT Wood
- Untreated

FRT sheathing

(2) 2x flat blocking

Floor sheathing

Should specify truss web holdback (3/4” min) to allow gypsum installation

Blocking
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor Platform Framing w/ Top Chord Bearing

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
» At floor cavity, blocking in wall provides 1 hr
» 1 layer of wall membrane provides 2nd hr
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Semi-Balloon Framing w/ Hangers

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly
» At floor cavity, blocking in wall provides 1 hr
» 1 layer of wall membrane provides 2nd hr
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor Platform Framing w/ Top Chord Bearing

Legend

- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:
- Membranes on both side of wall provide fire resistance via their approved assembly

FRT sheathing

(2) 2x flat blocking

Floor sheathing

Should specify truss web holdback (1 1/2” min) to allow gypsum installation
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Top Chord Bearing

Legend
- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:
» Membranes on both side of wall provide fire resistance via their approved assembly

FRT sheathing

Floor sheathing

Note reduced truss bearing length

2x rim

Should specify truss web holdback (1 1/2” min) to allow gypsum installation
Exterior Walls – Intersecting Floors
Exterior Walls – Intersecting Floors

Gaps between end of truss members and wall to allow gypsum install after
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Top Chord Bearing & Ledger

Rationale for detail approval:
- Membranes on both side of wall provide fire resistance via their approved assembly
- At top chords, ledger & sheathing provide continuity
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Bottom Chord Bearing

Legend

- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:
» Intersection of rated assemblies (wall & floor) considered sufficient
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Bottom Chord Bearing

Rationale for detail approval:

» Membranes on both side of wall provide fire resistance via their approved assembly

» At floor cavity, blocking in wall provides 1 hr

» Ceiling provides 2nd hr
Exterior Walls – Intersecting Floors

Type III Construction: 2-hr Wall, 1-hr Floor
Platform Framing w/ Bottom Chord Bearing

Legend
- Untreated or FRT
- FRT Wood
- Untreated

Rationale for detail approval:
- Membranes on both side of wall provide fire resistance via their approved assembly
Exterior Walls – Intersecting Floors
IBC 2024 Changes: Floor to Wall Intersections

• Two key changes that have been approved for inclusion in the 2024 IBC clarify platform framed floor to wall details

• **Code change 1**: clarifies fire-resistance continuity requirements for exterior walls:

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**2021 International Building Code**

705.6 Continuity. The fire-resistance rating of exterior walls shall extend from the top of the foundation or floor/ceiling assembly below to one of the following:

1. The underside of the floor or roof sheathing, deck or slab above.

2. The underside of a one-hour fire-resistance rated-floor/ceiling or roof/ceiling assembly, assembly having a fire-resistance rating equal to or greater than the exterior wall and the fire separation distance is greater than 10 feet.
IBC 2024 Changes: Floor to Wall Intersections

2021 International Building Code

705.6 Continuity. The fire-resistance rating of exterior walls shall extend from the top of the foundation or floor/ceiling assembly below to one of the following:

1. The underside of the floor or roof sheathing, deck or slab above.
2. The underside of a one-hour fire-resistance rated floor/ceiling or roof/ceiling assembly having a fire-resistance rating equal to or greater than the exterior wall and the fire separation distance is greater than 10 feet.

• **Example 1:** Type VA Construction, Group R-2

• 1 hour exterior wall, 1 hour floor

• Fire-resistance rating extends from the top of the floor/ceiling assembly below to the underside of an assembly having a fire-resistance rating equal to the exterior wall
Example 2: Type IIIA Construction, Group R-2

2 hour exterior wall, 1 hour floor

Fire-resistance rating extends from the top of the floor/ceiling assembly below to the underside of the floor sheathing above.
IBC 2024 Changes: Floor to Wall Intersections

- **Example 2:** Type IIIA Construction, Group R-2

- 2 hour exterior wall, 1 hour floor

- Since FRR of exterior wall is greater than FRR of floor, the exterior wall’s FRR must extend to the underside of the floor sheathing. As noted previously, this doesn’t mean that the wall needs to fully bypass the floor, but we do need to demonstrate the wall’s 2 hour FRR through the depth of the floor.
IBC 2024 Changes: Floor to Wall Intersections

- Two key changes that have been approved for inclusion in the 2024 IBC clarify platform framed floor to wall details.

- **Code change 2:** clarifies material requirements for floor construction at exterior walls intersections (i.e. does floor sheathing, joists, rim board at exterior walls in Type III Construction need to be FRTW?):

  705.6.1 Supporting construction Floor Assemblies in Type III Construction. Construction that in Type III construction where a floor assembly supports gravity loads from fire-resistance-rated exterior walls shall have a fire-resistance rating that is equal to or greater than the required fire resistance rating of the supported wall. For achieving the required fire resistance rating for exposure from the interior of the building, ceiling materials shall be permitted to contribute to the required fire resistance of the supporting construction. — an exterior wall, the fire-resistance rating of the portion of the floor assembly that supports the exterior wall shall not be less than the fire-resistance rating required for the exterior wall in Table 601. The fire-resistance rating provided by the portion of the floor assembly supporting and within the plane of the exterior wall shall be permitted to include the contribution of the ceiling membrane when considering exposure to fire from the inside. Where a floor assembly supports gravity loads from an exterior wall, the building elements of the floor construction within the plane of the exterior wall, including but not limited to, rim joists, rim boards, and blocking, shall be in accordance with the requirements for interior building elements of Type III Construction.
IBC 2024 Changes: Floor to Wall Intersections

**705.6.1 Supporting construction Floor Assemblies in Type III Construction.** Construction that in Type III construction where a floor assembly supports gravity loads from fire-resistance-rated exterior walls shall have a fire-resistance rating that is equal to or greater than the required fire resistance rating of the supported wall. For achieving the required fire resistance rating for exposure from the interior of the building, ceiling materials shall be permitted to contribute to the required fire resistance of the supporting construction. An exterior wall, the fire-resistance rating of the portion of the floor assembly that supports the exterior wall shall not be less than the fire-resistance rating required for the exterior wall in Table 601. The fire-resistance rating provided by the portion of the floor assembly supporting and within the plane of the exterior wall shall be permitted to include the contribution of the ceiling membrane when considering exposure to fire from the inside. Where a floor assembly supports gravity loads from an exterior wall, the building elements of the floor construction within the plane of the exterior wall, including but not limited to, rim joists, rim boards, and blocking, shall be in accordance with the requirements for interior building elements of Type III Construction.

- Where a floor assembly supports gravity loads from an exterior wall, the building elements of the floor construction within the plane of the exterior wall, including but not limited to rim joists, rim boards, and blocking, shall be in accordance with the requirements for interior building elements of Type III Construction.

- Interior building elements (floor construction) in Type III is not required to be FRTW
Outline

» Context for Type III Construction
» Fire Rating Requirements for Exterior Walls
  » Assembly Asymmetry
  » Addition of Wood Structural Panel
  » Bearing vs. Non-bearing
  » Vertical offsets
» Exterior Wall to Floor Intersection
  » Fire Resistant Continuity
  » Fire Retardant Continuity

Parapets & Balconies
Exterior Wall – Roof Intersection

• The floor-wall intersection principles discussed previously apply here too - DCA 3 details could be applied to this condition

• Discussion with Building Official to determine their interpretation and requirements is often warranted
Parapets – IBC 705.11

- Parapets shall be provided on exterior walls of buildings.

- Exceptions:

1. The wall is not required to be fire rated per Table 602

2. Floor area is ≤ 1000 sf on each floor

3. Walls terminate at a roof that is rated for 2-hr or more OR Where roof and supporting construction are non-combustible
Parapets – IBC 705.11

• Parapets shall be provided on exterior walls of buildings.

• Exceptions:

4. 1hr rated exterior walls that terminate at the underside of the roof sheathing where:

   » Framing parallel to wall is not less than 1-hr rated for 4’ for Group R/U and 10’ for other occupancies
   » Framing perpendicular to wall is 1-hr rated for entire span
   » Openings are not located within 5’ of the exterior wall for Group R/U and 10’ for other occupancies.
   » Entire building has class B roofing

5. Groups R-2 and R-3 where roofing is Class C, 1-hr rated exterior walls that terminate at the underside of the roof sheathing where:

   » Sheathing is FRT for 4’ OR 5/8 Type X Gyp to underside of sheathing
Parapets – IBC 705.11.1

- Parapets, where required, shall have:
  - the same fire resistance as the supporting wall
  - minimum height of 30” above roof surface
If a building is type III construction and the exterior walls are framed with fire-retardant treated wood, do the parapets need to be framed with FRTW?

Parapet wall construction shall be of combustible or noncombustible material depending on the exterior wall requirements of the type of construction and shall be of fire-resistance-rated construction as required for the exterior wall. The interior facing the roof, including the flashing, shall be noncombustible to a height of 18 inches (457 mm) above the roof. The required height of the parapet shall be 30 inches (762 mm) above the roof unless the roof slopes upward away from the building at a pitch of 2 in 12 or greater. In some cases, a part of this section requires a higher parapet than is required on the FSD. When the slope of the roof is less than 2 in 12, the parapet shall extend to a height equal to the height of the roof at the point determined as follows:
What is the requirement for continuity?

For exterior walls, this section requires fire-resistance rated construction to extend to the roof construction or to the top of the parapet if a parapet is required (see Section 705.11). This begins with the assumption—in conventional light-frame platform construction, is the floor system supported by the exterior wall and supporting the exterior wall part of the exterior wall? And, if so, how far must you go to provide a fire-resistance rating? This is a valid concern in Type IIB and IIC construction with an FSD of less than 10 feet because the exterior wall is required to provide a fire-resistance rating while the floor system provides the continuity and the structural integrity illustrated in Commentary Figure 705.6.

When parapet walls are not required, the exterior wall for fire-resistant rating purposes stops at the roof/ceiling construction.
Balconies – IBC 705.2.3.1

• Balconies of combustible construction and not FRT shall be:
  » Rated in accordance w/ Table 601 for floors
  » Or be of Type IV
  » And shall not exceed 50% of bldg perimeter

• Exceptions
  » Balconies in Type III, IV and V can be of type V construction and shall not have fire resistance rating if sprinkler protection provided
  » Untreated wood is permitted for rails and guardrails
Balconies – IBC 705.2.3.1

- So...

- For Type III or V balcony options are:
  1. **Non-combustible**: no sprinklers, no fire rating
  2. **FRT**: no fire sprinklers, no fire rating
  3. **Type IV**: no fire sprinklers, no fire rating
  4. Non-treated: **with fire sprinkler**, no fire rating
  5. Non-treated: no sprinkler, **fire rated per 601 & 602**
Balconies – Exterior Wall Penetration

Exterior veneer as occurs
FRT decking

Floor sheathing

Caulking, sealants vapor barriers, and flashing not shown for clarity

Cantilever beam

Cantilever knife plate support

Top flange Joist hanger approved to span 2 layers GWB
Questions? Ask me anything.

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