Ascent Tower: The Evolution of Mass Timber Construction
- Pushing the Mass Timber Envelope

February 06, 2024

Jordan Komp
Associate Principal
and MKE Office Director

Thornton Tomasetti
1500 ENGINEERS, ARCHITECTS, SCIENTISTS AND OTHER PROFESSIONALS

PROJECTS IN 50 COUNTRIES

50+ OFFICES

5 CONTINENTS
Mass timber is a relatively new technology in the United States, with unique characteristics and design methods. However, the market is showing a significant demand for projects featuring this material. This presentation will cover the design and construction of Ascent Tower, currently the tallest mass timber building in the world. Ascent has broken the world record for mass timber construction (height), nearly doubling the next tallest timber building in the United States (…for now).
AGENDA

1. Introduction to Mass Timber
2. Introduction to Ascent
3. Mass Timber Design Considerations
4. Ascent Permitting Process
5. Ascent Construction
6. The Future of Mass Timber?
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"Mass timber is a category of framing styles typically characterized by the use of large solid wood panels for wall, floor, and roof construction."

American Wood Council (AWC)
MASS TIMBER SLABS

CLT (Cross Laminated Timber)

Pros:
- Timber Aesthetic
- Code Approved
- Two-Way System
- “Layup” Flexibility
- Multiple Manufacturers

Cons:
- Limited Manufacturers in N.A. (currently)
- Cost Driven by Market Availability
- Reliance on Glue
MASS TIMBER SLABS

CLT Alternate #1 (NLT)

Pros:
- Efficient Use of Material
- Timber Aesthetic
- Comparatively Cheap
- Any Carpenter Can Construct

Cons:
- On-Site Quality Control is Difficult
- Labor Intensive, Time Consuming
- Difficult to Mass Produce
- Panel Size Controlled by Lumber Length
MASS TIMBER SLABS

CLT Alternate #2 (DLT)

Pros:
- Efficient Use of Material
- Timber Aesthetic
- “100% Wood”
- High Quality Control
- Potential Additional Acoustical Benefits

Cons:
- Cost Driven by Market Availability
  - Single Manufacturer (Structurcraft)
- Panel Size Controlled by Lumber Length
MASS TIMBER BEAMS AND COLUMNS

Beams and Columns

GLUED-LAMINATED TIMBER
[GLULAM]

PARALLEL STRAND LUMBER
[PSL]

LAMINATED VENEER TIMBER
[LVL]

Glued-Laminated Timber
(Glulam)

Parallel Strand Lumber
(PSL)

Laminated Veneer Lumber
(LVL)
WHY MASS TIMBER?

Sustainability
- Renewable resource
- Low Fabrication Emissions

Aesthetics
- Connection to nature / biophilia
- Intrinsic Beauty and Appeal

Construction
- Increased Speed of Construction
  - Prefabrication
  - Fit-Out
- Reduced Weight
  - Lighter Foundations
Embodied Carbon: Trees Absorption of CO2
EMBODIED CARBON

GWP

Steel & Concrete
Total GWP (kg CO₂e/m²)

- Steel frame & Precast slab
  - 210 total GWP kg CO₂/m²
  - 187.9 recycled steel, 10.3 recycled concrete, 12.9 recycled aggregate

Steel & Composite
Total GWP (kg CO₂e/m²)

- Steel frame & Composite slab
  - 230 total GWP kg CO₂/m²
  - 213 recycled steel, 12.7 recycled concrete, 7.9 recycled aggregate

Hybrid (Steel + Timber)
Total GWP (kg CO₂e/m²)

- Steel frame & CLT floors
  - 170 total GWP kg CO₂/m²
  - 157.3 recycled steel, 10.7 recycled concrete, 5.5 recycled aggregate

Concrete
Total GWP (kg CO₂e/m²)

- RC frame & Precast slab
  - 260 total GWP kg CO₂/m²
  - 237.7 recycled steel, 19.6 recycled concrete, 4.8 recycled aggregate

- RC frame & Flat slab
  - 390 total GWP kg CO₂/m²
  - 337.3 recycled steel, 34.6 recycled concrete, 20.5 recycled aggregate

Timber
Total GWP (kg CO₂e/m²)

- Glulam frame & CLT floor
  - 130 total GWP kg CO₂/m²
  - 111.1 recycled timber beams and columns, 13.4 recycled concrete, 1.2 recycled aggregate

- Steel frame & Slimflor
  - 340 total GWP kg CO₂/m²
  - 308.3 recycled steel, 19.6 recycled concrete, 12.1 recycled aggregate

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Ready-mix concrete C30/37, 0% recycled aggregate
ASCENT:
The building will sequester approximately 7,200 metric tons of CO2.

It will take approximately 25 minutes to grow this volume of wood in North American forests.

This CO2 benefit is also equivalent to taking approximately 2400 cars off the road for a year or the energy to operate over 1100 homes for a year.
Tall Buildings in Numbers

Tall Timber: A Global Audit

This data study complements the 84-metre-tall buildings eight stories tall, tall timber buildings under construction, organized by structural type and by region, globally. Key projects of each type are highlighted, and the proportion of each structural type within each region is presented in the pie chart. The number of tall timber buildings per structural type are shown as segments with project data. The data in this study is accompanied by a research paper on pages 22-30, which examines the context and additional information on the current state of tall timber buildings as of February 2022.
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ASCENT:

Milwaukee, WI
ASCENT FACTS:

- **19 STORIES OF TIMBER OVER A 6 STORY CONCRETE PODIUM**
- **HEIGHT:** 284 FT
- **FLOOR AREA OF TIMBER:** ~324,400 SF (259 UNITS)
- **GROSS AREA:** ~456,000 SF
- **APPROVALS PURSUED UNDER WCBC SECTION 361, SIMILAR TO 2015 IBC’S “ALTERNATE MATERIALS, DESIGN AND METHODS” SECTION**
- **ACHIEVES CLASS FIRE RESISTANCE THROUGH BOTH ENCAPSULATION AND SACRIFICIAL/ CHAR METHOD – (50% OF MASS TIMBER EXPOSED)**
ASCENT:  
Typical Floor Plans:
ASCENT STRUCTURE

Foundation

- Light weight superstructure
- Static Load Test: 450 Tons (Geotechnical)
  - Limited by reaction frame!
ASCENT STRUCTURE

Podium Framing

Transfer Slab

Typical Parking Slab
ASCENT STRUCTURE

Typical Residential

TYPICAL GRID

20’  25’  16’8”
ASCENT CONNECTIONS

Exposed

- “Framework” Connector
ASCENT CONNECTIONS

Concealed

- Wood-Wood Bearing
ASCENT STRUCTURE

Systems

- SLABS (CLT)
- BEAMS + COLUMNS (GLULAM)
- PODIUM AND LATERAL SYSTEM (CONCRETE)
CONSTRUCTION SEQUENCE
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MASS TIMBER

Material Considerations

• Visual Appearance vs. Material Properties
• Design Methodology
• Code Compliance (NDS vs. Eurocode)
MASS TIMBER

Sound and Vibration Considerations

<table>
<thead>
<tr>
<th>Category</th>
<th>Range of Damping (%)</th>
<th>Discussion</th>
</tr>
</thead>
</table>
| Lightly damped          | 1-2%                 | The lower end includes bare floors without topping and with minimal
                           |                       | furnishings. The higher end includes floors with concrete topping and
                           |                       | furnishings.                                                            |
| Moderately damped       | 2-4%                 | Lower values include bare timber-concrete composite floors, or timber
                           |                       | floors with a floating concrete layer and full furnishings. The higher
                           |                       | values include floors with floating floor layers, resilient floors,
                           |                       | full furnishings and mechanical systems. Floors with both
                           |                       | furnishings and permanent partitions, not otherwise accounted for,
                           |                       | could also be represented at the higher end of this damping range.      |
| Heavily damped          | 4.5%                 | Floors in this range represent the upper limit of inherent damping. These
                           |                       | floors likely include floating toppings, resilient floors, suspended
                           |                       | ceilings, furnishings, lexanes and/or permanent partitions not
                           |                       | otherwise taken into account.                                            |
| Explicit damping control| 5%                   | Generally, mass timber floors do not have more than 5% damping unless
                           |                       | explicit damping control (e.g., a tuned mass damper) is added. These are
                           |                       | beyond the scope of this guide.                                          |
MASS TIMBER

Modeling
MASS TIMBER

Coordination

TYPICAL RESIDENTIAL LEVEL
MASS TIMBER

Fire Rating

- Char
  - Calculations (Char Method)
- Full Scale (Global) Testing
- Element (Member) Testing
- Connection Testing
- Product Certificates
- Concealment
- Intumescent Paint (connections only)

<table>
<thead>
<tr>
<th>Table 16.2.1A</th>
<th>Effective Char Rates and Char Depths (for $\beta_n = 1.5$ in./hr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Fire Endurance (hr.)</td>
<td>Effective Char Rate, $\beta_{ef}$ (in./hr.)</td>
</tr>
<tr>
<td>1-Hour</td>
<td>1.8</td>
</tr>
<tr>
<td>1½-Hour</td>
<td>1.67</td>
</tr>
<tr>
<td>2-Hour</td>
<td>1.58</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 16.2.2 Adjustment Factors for Fire Design$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bending Strength $F_b$ x 2.85 $C_F$ $C_V$ $C_{fu}$ $C_L$ -</td>
</tr>
<tr>
<td>Beam Buckling Strength $F_{beE}$ x 2.03 - - - -</td>
</tr>
<tr>
<td>Tensile Strength $F_t$ x 2.85 $C_F$ - - - -</td>
</tr>
<tr>
<td>Compressive Strength $F_c$ x 2.58 $C_F$ - - - $C_P$</td>
</tr>
<tr>
<td>Column Buckling Strength $F_{ceE}$ x 2.03 - - - -</td>
</tr>
</tbody>
</table>

1. See 4.3, 5.3, 8.3, and 10.3 for applicability of adjustment factors for specific products.
2. Factor shall be based on initial cross-section dimensions.
3. Factor shall be based on reduced cross-section dimensions.
MASS TIMBER

Fire Performance

BEAMS

COLUMNS

CLT
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PRECEDEENTS

- T3, Minneapolis, USA (7 stories)
- Brock Commons, Vancouver, Canada (18 stories)
- Mjøstårnet, Brumunddal, Norway (18 stories)
# PERMITTING

## IBC 2015-2018

### 602.2 Types I and II
Types I and II construction are those types of construction in which the building elements listed in Table 601 are of noncombustible materials, except as permitted in Section 603 and elsewhere in this code.

### 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 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 (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. The 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.

### 602.5 Type V
Type V construction is that type of construction in which the structural elements, exterior walls and interior walls are of any materials permitted by this code.

<table>
<thead>
<tr>
<th>Type</th>
<th>Interior Material</th>
<th>Exterior Material</th>
<th>Façade exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types I &amp; II</td>
<td>Non Combustible</td>
<td>Non Combustible</td>
<td>None</td>
</tr>
<tr>
<td>Type III</td>
<td>Any</td>
<td>Non Combustible</td>
<td>Fire-retardant-treated wood (FRTW)</td>
</tr>
<tr>
<td>Type IV</td>
<td>Solid or laminated wood</td>
<td>Non Combustible</td>
<td>FRTW CLT</td>
</tr>
<tr>
<td>Type V</td>
<td>Any</td>
<td>Any</td>
<td>N/A</td>
</tr>
</tbody>
</table>

IBC 2015

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# PERMITTING

## IBC 2015-2018

### TABLE 504.3^c

**ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE**

<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>
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<tr>
<td>A, B, E, F, M, S, U</td>
<td>NS^d</td>
<td>UL</td>
<td>160</td>
<td>65</td>
<td>55</td>
<td>65</td>
<td>55</td>
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<tr>
<td></td>
<td>S</td>
<td>UL</td>
<td>180</td>
<td>85</td>
<td>75</td>
<td>85</td>
<td>75</td>
</tr>
<tr>
<td>H-1, H-2, H-3, H-5</td>
<td>NS^d,c</td>
<td>UL</td>
<td>160</td>
<td>65</td>
<td>55</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL</td>
<td>180</td>
<td>85</td>
<td>75</td>
<td>85</td>
<td>75</td>
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<tr>
<td>H-4</td>
<td>NS^d,c</td>
<td>UL</td>
<td>160</td>
<td>65</td>
<td>55</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL</td>
<td>180</td>
<td>85</td>
<td>75</td>
<td>85</td>
<td>75</td>
</tr>
<tr>
<td>I-1 Condition 1, 1-3</td>
<td>NS^d,c,e</td>
<td>UL</td>
<td>160</td>
<td>65</td>
<td>55</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
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<td>UL</td>
<td>180</td>
<td>85</td>
<td>75</td>
<td>85</td>
<td>75</td>
</tr>
<tr>
<td>I-1 Condition 2, 1-2</td>
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<td>160</td>
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<td>75</td>
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<tr>
<td>I-4</td>
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<td>55</td>
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<td>S</td>
<td>UL</td>
<td>180</td>
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<td>180</td>
<td>85</td>
<td>75</td>
<td>85</td>
<td>75</td>
</tr>
</tbody>
</table>

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**Office Building Heights:**

- Height: 160 feet
- Number of Stories: 5

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**Residential Building Heights:**

- Height: 150 feet
- Number of Stories: 5
## PERMITTING

### IBC 2015-2018

### TABLE 504.4, continued

**ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE**

<table>
<thead>
<tr>
<th>OCCUPANCY CLASSIFICATION</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>
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<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
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<tr>
<td>B</td>
<td>NS</td>
<td>UL 11</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4</td>
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<tr>
<td>R-1</td>
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<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>S13R</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>S</td>
<td>UL 12</td>
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<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>R-2</td>
<td>NS&lt;sup&gt;d, h&lt;/sup&gt;</td>
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<td></td>
<td>S</td>
<td>UL 12</td>
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<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>R-3</td>
<td>NS&lt;sup&gt;d, h&lt;/sup&gt;</td>
<td>UL 11</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<td>S13R</td>
<td>4</td>
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<tr>
<td></td>
<td>S</td>
<td>UL 12</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>R-4</td>
<td>NS&lt;sup&gt;d, h&lt;/sup&gt;</td>
<td>UL 11</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<td>S</td>
<td>UL 12</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
PERMITTING

IBC 2015-2018

3-hour fire separation

GROUND

5-stories max
Type III or IV

Type IA

85'

Thornton Tomasetti
PERMITTING

IBC 2015-2018

STICK FRAMING WALLS + CLT SLABS
CONCRETE PODIUM CONCRETE BASEMENT
PERMITTING

UNITED STATES APPROVALS

Framework (2017)
Portland, OR

Ascent (2020)
Milwaukee, WI

12 stories
25 stories
CODE DEVELOPMENT

IBC (2021 and Beyond)

- TYPE IV-C
  - 9 Stories
  - Fully Exposed

- TYPE IV-B
  - 12 Stories
  - Limited exposure (20% ceilings, 40% walls)

- TYPE IV-A
  - 18 Stories
  - Fully Concealed

IBC 2024 currently approving 100% exposed ceilings

FUTURE CODES?

Images From American Wood Council (https://awc.org/tallmasstimber)
PERMITTING

Alternate Materials

[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 design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and 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.

[A] 104.11.1 Research reports. Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

[A] 104.11.2 Tests. Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the building official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the building official for the period required for retention of public records.
## PERMITTING

IBC and the Wisconsin Commercial Building Code

### FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

<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>A</td>
</tr>
<tr>
<td>Primary structural frame (see Section 202)</td>
<td>3¹</td>
<td>2²</td>
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<td>1</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HT</td>
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<tr>
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<tr>
<td>Bearing walls</td>
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<tr>
<td>Exterior¹⁰ ²⁶</td>
<td>3</td>
<td>2</td>
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<td>0</td>
<td>2</td>
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<tr>
<td>Interior²⁶</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Nonbearing walls and partitions</td>
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<td></td>
<td></td>
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<tr>
<td>Exterior²⁶</td>
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<td>See Table 602</td>
</tr>
<tr>
<td>Nonbearing walls and partitions</td>
<td></td>
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<td>See Section 602.4</td>
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<td>Floor construction and associated secondary members</td>
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<td>(see Section 202)</td>
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<td>(see Section 202)</td>
<td>1½ᵇ</td>
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<td>1ᵇ</td>
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</tbody>
</table>

For S1: 1 foot = 304.8 mm.

- a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour when supporting a roof only.
- b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant treated wood members shall be allowed to be used for such unprotected members.
- c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.
- d. Not less than the fire-resistance rating required by other sections of this code.
- e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).
- f. Not less than the fire-resistance rating as referenced in Section 704.10.

### Chapter SPS 361

**ADMINISTRATION AND ENFORCEMENT**

Subchapter I — Scope and Application

(6) Alternatives. Nothing in chs. SPS 361 to 366 is intended to prohibit or discourage the design and utilization of new building products, systems, components, or alternate practices, provided written approval from the department is obtained first.

**Note:** Chapter SPS 361, subch. VI contains requirements for approval of building products and alternate standards.

Subchapter VI — Product and Standard Review and Approval

SPS 361.50 Building product approvals.

1. Voluntary approval.
   - (a) Materials, equipment, and products regulated under chs. SPS 361 to 366 may receive a written approval from the department indicating code compliance.
   - (b) 1. Approval of materials, equipment, and products shall be based on sufficient data, tests, and other evidence that prove the material, equipment, or product is in compliance with the standards specified in chs. SPS 361 to 366.
   - 2. Tests, compilation of data, and calculations shall be conducted by a qualified independent third party.

2. Alternate approval.
   - (a) Materials, equipment, and products that meet the intent of chs. SPS 361 to 366 and which are not approved under sub. [1] shall be permitted if approved in writing by the department.
   - (b) 1. Approval of materials, equipment, and products shall be based on sufficient data, tests, and other evidence that prove the material, equipment, or product meets the intent of the standards specified in chs. SPS 361 to 366.
   - 2. Tests, compilation of data, and calculations shall be conducted by a qualified independent third party.
PERMITTING

Fire Rating

- Char
  - Calculations (Char Method)
  - Element (Member) Testing
    - 1st Ever 3 Hour Test!
  - Connection Testing

Figure 8: Data from the 300°C Isotherm combined with data from the residual cross sections compared with 3 models.
PERMITTING

Fire Rating (Members)
PERMITTING

Fire Rating (Connections)

- “Framework Connector”
- Encapsulation
PERMITTING

Ascent – AHJ Agreements

- SPECIAL INSPECTIONS
  - (not required in WI)
  - Concrete cores
  - Automatic sprinkler system
  - Dual Water Supply to Fire Pump
  - Standpipe in Each Stair
  - Smoke detection
  - FD Vehicle Access on Two Roads
  - Electronically Supervised Valves
  - Fire Command Center
  - Fire Dept Communications Support
  - Voice Communications
  - Stair Pressurization
AGENDA

1. Introduction to Mass Timber
2. Introduction to Ascent
3. Mass Timber Design Considerations
4. Ascent Permitting Process
5. Ascent Construction
6. The Future of Mass Timber?
ASCENT

Construction Progress

Start of Timber Construction (June 2021)
Level 17 Complete (September 2021)
Level 26 (Roof) Topped Out (December 2021)
ASCENT

Primary Mass Timber Structural Components

GLULAM COLUMNS  GLULAM BEAMS  CLT PANELS  TIMBER SCREWS
Primary Mass Timber Connections

- COL-COL (EPOXY)
- COL-COL (INTERIOR)
- BEAM-COL (HANGER)
- BEAM-COL (BEARING)
AGENDA

1. Introduction to Mass Timber
2. Introduction to Ascent
3. Mass Timber Design Considerations
4. Ascent Permitting Process
5. Ascent Construction
6. The Future of Mass Timber?
CODE DEVELOPMENT

IBC (2021 and Beyond)

- TYPE IV-C
  - 9 Stories
  - Fully Exposed

- TYPE IV-B
  - 12 Stories
  - Limited exposure (20% ceilings, 40% walls)

- TYPE IV-A
  - 18 Stories
  - Fully Concealed

IBC 2024 currently approving 100% exposed ceilings

Images From American Wood Council (https://awc.org/tallmasstimber)
FIRE TESTING

IBC 2021 - 2024
## Quantitative Overview

### Costs

<table>
<thead>
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<th>Total project cost</th>
<th>$150,000,000</th>
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<tbody>
<tr>
<td></td>
<td>$800/1,000 unit</td>
<td></td>
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<tr>
<td>Land</td>
<td>$6,250,000</td>
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<tr>
<td>Market</td>
<td>$6,250,000</td>
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<tr>
<td>Pro Forma**</td>
<td>$6,180,000</td>
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<tr>
<td>Realized***</td>
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### NOI

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<th>Market</th>
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<td>Rental rates</td>
<td>1.5%</td>
<td>$1.850</td>
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<td></td>
<td>2.5%</td>
<td>$1.550</td>
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<tr>
<td></td>
<td>3.5%</td>
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<td>Parking Revenue</td>
<td>96%</td>
<td>$1.025</td>
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<tr>
<td>Retail</td>
<td>$1.025</td>
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### Return Performance

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<th>Market</th>
<th>Pro Forma**</th>
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<tbody>
<tr>
<td>Yield on cost - unsold</td>
<td>6.00%</td>
<td>5.83%</td>
<td>TBD/On track</td>
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<tr>
<td>Cap rate (MIT vs. appraised subject conclusion)</td>
<td>5.00%</td>
<td>4.70%</td>
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<tr>
<td>Value per unit</td>
<td>$500,000</td>
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<tr>
<td>Leverage</td>
<td>60%</td>
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<td>30%</td>
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<tr>
<td>Mezzanine leverage</td>
<td>15%</td>
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### Timeline

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<th>Content/Comment</th>
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<tr>
<td>April 2018</td>
<td>Mid-cycle</td>
</tr>
<tr>
<td>May 2020</td>
<td>Mid-cycle</td>
</tr>
<tr>
<td>June 2020</td>
<td>Late-cycle</td>
</tr>
<tr>
<td>July 2021</td>
<td>Longer (started early &amp; non concurrent self-design)</td>
</tr>
<tr>
<td>Aug 2022</td>
<td>Two phases of completion July 15 &amp; Aug 11</td>
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<tr>
<td>TBD</td>
<td>Projected June 2023</td>
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### Project Context

**Economic case made by demand**
- Leasing quickly at $1,000 per square foot is better than the market's typical average of $1,400 per square foot and better than the pro forma expectations.
- Superior luxury product with minimal commute in Milwaukee market.

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**Disclaimer**: Information herein was provided by the developer and verified for reasonability by a third-party expert. Market data and figures have been reviewed by an independent third-party using industry standard resources. For additional sources and disclaimers, see the Basis of Information page for this case study and the Disclosures, Disclaimers and Confidentiality page at the end of this case study package.
CODE DEVELOPMENT

2100 N Southport

- Approved through Standards and Test
- 9-stories
- Approved using portions of IBC 2021 Type IV-B
- Based on previous testing
- Concrete cores
COMPOSITE MASS TIMBER

Panel Composite Action
CONNECTIONS

2-hour Fire Rating

**MTC**
Double Ricon/Megan: 16.6 kips
(1.5 hours)

**Simpson Strong-Tie**
CBH2.37x9.97: 36kips
(2 hours)
HYBRID STRUCTURES

Mass Timber - Steel
HYBRID STRUCTURES

Mass Timber - Concrete
THANK YOU

Contact info
jkomp@thorntontomasetti.com