Mass Timber Construction: Making the Case

April 10, 2024

Presented by
Tino Kalayil, PE, WoodWorks
## Agenda

### Mass Timber Construction: Making the Case

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 am – 11:00 am</td>
<td>Mass Timber Construction Management: Economics, Logistics &amp; Risk Analysis</td>
</tr>
<tr>
<td>11:00 am - 11:15 am</td>
<td>Break</td>
</tr>
<tr>
<td>11:15 pm – 12:15 pm</td>
<td>Mass Timber: Making the Case to Developers and Owners</td>
</tr>
<tr>
<td>12:15 pm – 1:00 pm</td>
<td>Lunch</td>
</tr>
</tbody>
</table>
Regional Directors: One-on-One Project Support
Expert support for your commercial or multi-family wood project.

WoodWorks is your go-to resource for successful and multi-family wood building design, engineering, and construction. We're here to support you with free one-on-one project assistance, continuing education, design tools, and on-demand resources.

Get to know us ➔

Andy Goldkamp: Outdoor Education Center, Clemson University / Cooper Cromy Photo: Jonathan Wiggin

Need Project Support?
<table>
<thead>
<tr>
<th>Building Systems</th>
<th>Building Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light-Frame</td>
<td>Multi-Family / Mixed Use</td>
</tr>
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<td>Mass Timber / CLT</td>
<td>Education</td>
</tr>
<tr>
<td>Off-Site / Panelized Construction</td>
<td>Office</td>
</tr>
<tr>
<td>Hybrid</td>
<td>Commercial Low Rise</td>
</tr>
<tr>
<td></td>
<td>Industrial</td>
</tr>
<tr>
<td></td>
<td>Civic / Recreational</td>
</tr>
<tr>
<td></td>
<td>Institutional / Healthcare</td>
</tr>
<tr>
<td></td>
<td>View All</td>
</tr>
</tbody>
</table>

Our experts can help—ask us anything. Get Free Project Support

WoodWorks is your go-to resource for commercial and multi-family wood building design, engineering, and construction. We’re here to support you with free one-on-one consultations and dedicated project teams.

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Find over 140 continuing education courses on wood topics for architects, engineers, general contractors, and code officials.

WoodWorks Innovation Network
Discover mass timber projects across the US and connect with their teams.
Acoustics and Mass Timber: Room-to-Room Noise Control

This paper covers key aspects of mass timber acoustical design, including rules of thumb for optimal design, common assemblies, detailing strategies, and flanking paths. Companion to the Inventory of Mass Timber Acoustic Assemblies.

Solution Papers

Designing Mass Timber Floor Assemblies for Acoustics

The growing availability and code acceptance of mass timber for construction has given designers a low-carbon alternative.

Expert Tips

Impact of Wall Stud Size and Spacing on Fire and Acoustic Performance

Interior wall partitions in a wood-frame building—such as unit demising and corridor walls in a multi-family project—must meet several design objectives simultaneously. Two primary functions are fire resistance and acoustical separation. Having to cite two tested wall assemblies, one for fire-resistance endurance results and another for acoustic results, is common.

Export Tips

Firehouse 12

The continuous plywood shell that creates varying acoustic conditions within the performance space forms the exterior of the auditorium.

Award Winner

Acoustical Considerations for Mixed-Use Wood-Frame Buildings

This paper will help you understand the effects of acoustics in the context of other performance areas, enabling you to more easily navigate the decisions and trade-offs required when evaluating assembly options.

Solution Papers

Holes and Penetrations in Mass Timber Floor and Roof Panels

Guidance for the design of mass timber floor and roof panels with openings, including structural, fire resistance, and acoustic impacts, and tips for reinforcement.

Expert Tips
### Membership Type

- **Individuals**
  - Verified by Project Experience: 156
- **Community Members**
  - Manufacturers & Suppliers: 22
  - WoodWorks Partners: 22
- **Companies**
  - Verified by Project Experience: 109

### Industry
- Architect: 0
- Contractor: 0
- Developer: 0
- Engineer: 0
- Installer: 0
- Insurance Broker: 0
- Other: 1

### People & Companies

<table>
<thead>
<tr>
<th>Name</th>
<th>Industry Type</th>
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<th>Save</th>
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<tr>
<td>Sansin</td>
<td>Manufacturer Partner</td>
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</tr>
<tr>
<td>StructureCraft</td>
<td>Manufacturer Partner</td>
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<tr>
<td>SmartLam NA</td>
<td>Manufacturer Partner</td>
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<tr>
<td>Simpson Strong-Tie</td>
<td>Manufacturer Partner</td>
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<tr>
<td>Freres Engineered Wood</td>
<td>Manufacturer Partner</td>
<td><img src="#" alt="View" /></td>
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</tr>
<tr>
<td>HASSLACHER Group</td>
<td>Manufacturer Partner</td>
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<td><img src="#" alt="Save" /></td>
</tr>
<tr>
<td>Global Integrated Flooring Solutions (Global IFS)</td>
<td>Manufacturer Partner</td>
<td><img src="#" alt="View" /></td>
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Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
How do contractors answer the increasing demand for mass timber buildings from architects and ownership groups? Growing this budding industry requires an understanding from both designers and seasoned construction professionals of how to construct efficiently, navigate jurisdictions new to mass timber, and manage the procurement risks to deliver the dream of a new and optimized building system. This session will introduce mass timber products and building systems then consider why some mass timber projects never pass the concept stage, what can mitigate risk and improve financial feasibility, and how the development, architectural, engineering, and construction community can achieve success with mass timber projects of various scales and typologies. Particular emphasis will be given to preconstruction coordination, holistic approaches to costing and scheduling studies, project delivery methods, and how to achieve the highest level of cost efficiency.
Learning Objectives

Mass Timber Construction Management: Economics, Logistics & Risk Analysis

1. Understand the preconstruction manager’s role in material procurement and MEP coordination of code-compliant mass timber projects.

2. Highlight effective methods of early design-phase cost estimation that keeps mass timber options on the table.

3. Discuss potential construction schedule savings realized through the use of prefabricated mass timber elements.

4. Explore best practices for interaction between manufacturer, design team and preconstruction manager that can lead to cost efficiency and safety on site.
Mass Timber: Making the Case to Developers and Owners

Would you like to pitch sustainable mass timber to a client? Are you wondering how mass timber might pencil in a project pro forma? If so, this presentation will provide insight on completing the value proposition for developers and owners. The aesthetic differentiation and biophilic benefits of mass timber have broad appeal to a wide range of stakeholders, from end users to ESG-investors. Professionals hoping to influence decisions to use mass timber will learn how this appeal can translate to return on investment in an overview of initial findings from WoodWorks’ Mass Timber Business Case Study series, written for the developer/owner/investor audience. This presentation will provide an overview of the case study series highlighting key takeaways. Developers/owners, architects, engineers and builders will all learn how mass timber can create value.
Learning Objectives

Mass Timber: Making the Case to Developers and Owners

1. Discuss the environmental benefits of mass timber and how they resonate with a wide range of stakeholders from occupants to project teams, investors and communities.

2. Understand how the biophilic benefits of wood can contribute to occupant health, tenant appeal and the financial value of a real estate development.

3. Through case study examples, explore code-compliant design of mass timber structures.

4. Learn talking points to translate the biophilic and ESG-related benefits of mass timber into potential value creation for developers, owners, and investors; helping to convince these decision makers to invest in a more sustainable and healthier built environment.
Learning Objectives

Mass Timber: Making the Case to Developers and Owners

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Mass Timber Construction: Making the Case
Part 1: Mass Timber Construction Management: Economics, Logistics & Risk Analysis

April 10, 2024

Presented by
Tino Kalayil, PE, WoodWorks
Presentation Outline

1. Mass Timber Overview
   » Structural Solutions
   » Connections
   » Projects
   » Products

2. Construction Management
   » Risk Analysis (Risks & Solutions)
   » Economics (What does it cost?)
   » Logistics (Schedule & Coordination)
OVERVIEW | TIMBER METHODOLOGIES

Light Wood-Frame
Photo: WoodWorks

Heavy Timber
Photo: Benjamin Benschneider

Mass Timber
Photo: John Stamets
Glue Laminated Timber (Glulam)
Beams & columns

Cross-Laminated Timber (CLT)
Solid sawn laminations

Cross-Laminated Timber (CLT)
SCL laminations

Photo: StructureCraft

Photo: LendLease

Photo: LEVER Architecture
Dowel-Laminated Timber (DLT)

Nail-Laminated Timber (NLT)

Glue-Laminated Timber (GLT)

Plank orientation

Photo: StructureCraft

Photo: Think Wood

Photo: StructureCraft

Photo: Ema Peter

Photo: Manasc Isaac Architects/Fast + Epp
STRUCTURAL SOLUTIONS | POST, BEAM + PLATE

Photo: Ema Peter
STRUCTURAL SOLUTIONS | HYBRID LIGHT-FRAME + MASS TIMBER

Photo: John Klein
STRUCTURAL SOLUTIONS | HYBRID STEEL + MASS TIMBER
STRUCTURAL SOLUTIONS | HYBRID CONCRETE + MASS TIMBER
OVERVIEW | CONNECTIONS

Concealed Connectors

Self Tapping Screws

Photos: Rothoblaas
OVERVIEW | CONNECTIONS

Beam to Column

Photo: StructureCraft

Photo: Structurlam
OVERVIEW | CONNECTIONS

Column to Foundation

Photo: Alex Schreyer
Panel to Panel & Supports

Photo: Charles Judd

Photo: Alex Schreyer
MASS TIMBER PRODUCTS
Glue Laminated Timber (GLT)
Glue Laminated Timber (GLT)

Photo: Manasc Isaac Architects/Fast + Epp
Cross-Laminated Timber (CLT)
Cross-Laminated Timber (CLT)

With solid sawn laminations

General Panel dimensions*
4 to 12 ft wide
24 to 64 ft long

*Consult with manufacturers for available panel sizes

General Panel thicknesses*
4 1/8” to 19 1/2”
Cross-Laminated Timber (CLT)

With SCL laminations

Photos: Freres Lumber
Nail-Laminated Timber (NLT)
Nail-Laminated Timber (NLT)
Dowel-Laminated Timber (NLT)

Photo: StructureCraft
Other Mass Timber Product Options

- Glue Laminated Timber (GLT)
- Laminated Veneer Lumber (LVL)
- Parallel Strand Lumber (PSL)
- Laminated Strand Lumber (LSL)
- Timber-Concrete Composite (TCC)
- Decking

Photos: StructureCraft
MASS TIMBER IN THE CODE
Mass Timber in Low- to Mid-Rise: 1-6 Stories in Construction Types III, IV or V
Tall Mass Timber: Up to 18 Stories in Construction Types IV-A, IV-B or IV-C

Credit: Susan Jones, atelierjones
Mass Timber’s Fire-Resistive Performance is Well-Tested, Documented and Recognized via Code Acceptance

Table 16.2.1A  Char Depth and Effective Char Depth (for $\beta_n = 1.5$ in./hr.)

<table>
<thead>
<tr>
<th>Required Fire Resistance (hr.)</th>
<th>Char Depth, $a_{\text{char}}$ (in.)</th>
<th>Effective Char Depth, $a_{\text{eff}}$ (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Hour</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td>1½-Hour</td>
<td>2.1</td>
<td>2.5</td>
</tr>
<tr>
<td>2-Hour</td>
<td>2.6</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Source: AWC’s NDS

Source: AWC’s TR 10
Fire Design Resource

Discusses:
» Code compliance options
» Structural fire calculations
» Inventory of fire-tested assemblies

Free Resource: www.woodworks.org

https://www.woodworks.org/resources/wood-frame-schools-durability-techniques-for-interior-high-traffic-and-moisture-areas/
MASS TIMBER CONSTRUCTION MANAGEMENT

RISK ANALYSIS
Threats to mass timber projects
Strategic project delivery

ECONOMICS
Holistic project estimating
Anatomy of a mass timber package

LOGISTICS
Design Engagement
Schedule
Site Planning
Mass Timber Construction Management

THREE KEY POINTS:

1. Mass timber is a custom building system, not a commodity.
2. Select the right partners for your project.
3. Assess projects holistically when estimating costs.
Risk: Cost Analysis of Structure Only

$/SF

$/SF

Image: GBD Architects
CONSIDERATIONS:
• Ceiling Treatment
• Floor Topping
• HVAC System & Route
• Foundation Size
• Soil Improvements
• Exterior Skin Coordination
• Value of Time
Risk: Design-Bid-Build Procurement
Risk Mitigation: Trade Partner/Master Builder Approach
Procurement Strategy is Key to Success

5% Savings  Neutrality  10% Premium
Risk: Perception of a Commoditized Material
Risk Mitigation: Embrace the Prefab Advantage

Photo: Swinerton
I don’t have any historic cost data for this structural system.

Who makes this stuff? How do you procure it?

Risk: Lack of Supply Chain Understanding
Risk Mitigation: Complementary Procurement

**GC Hires**
Turnkey Mass Timber Subcontractor

**GC Buys Material**
GC Self-Performs Install
GC Coordinates

**GC Buys Material**
GC Subcontracts Labor
GC Coordinates

**RISK SPECTRUM**

- Hiring Experience
  - Single Point of Responsibility
- Prequal Capacity of Sub
  - Potential Added Mark-Up

- Hiring Experience
  - Single Point of Responsibility
  - Financial Security of strong GC
- Lack of familiarity with supply chain
  - Steep learning curve for coordination

- Potential Added Mark-Up
- Multiple layers of coordination
  - Prequal Capacity of Sub
Understand Manufacturer’s Capabilities
Understand Manufacturer’s Capabilities

Credit: Tanya Luthi, Entuitive
Schedule Savings for Rough-In Trades

Image: Swinerton

Photo: WoodWorks
Anatomy of a Turnkey Mass Timber Package

- Project Overhead: 7%
- Labor: 15%
- Material: 64%
- Equipment: 14%

Source: Swinerton
Material (Direct Cost)

Turnkey Mass Timber Package

Source: Swinerton
Labor (Direct Cost)

Turnkey Mass Timber Package

Source: Swinerton
Equipment (Direct Cost)

Turnkey Mass Timber Package

64%
14%
15%
7%

Source: Swinerton

Photo: Swinerton
Photo: Alex Schreyer
Project Overhead

- Turnkey Mass Timber Package: 64%
- Cost Analysis: 15%
- Design Refinement: 14%
- VD&C: 7%
- Detail Optimization: 7%
- System Integration: 15%
- Logistics Planning: 6%

Source: Swinerton

Photos: Swinerton
Value Analysis

\[ Value = \frac{Function + Aesthetics}{Cost} \]
## Cost: Construction Type

### TABLE 601
Fire Resistance Rating Requirements for Building Elements (Hours)

<table>
<thead>
<tr>
<th>Building Element</th>
<th>I-A</th>
<th>I-B</th>
<th>III-A</th>
<th>III-B</th>
<th>IV-A</th>
<th>IV-B</th>
<th>IV-C</th>
<th>IV-HT</th>
<th>V-A</th>
<th>V-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Structural Frame</td>
<td>3*</td>
<td>2*</td>
<td>1</td>
<td>0</td>
<td>3*</td>
<td>2</td>
<td>2</td>
<td>HT</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ext. Bearing Walls</td>
<td>3*</td>
<td>2*</td>
<td>2</td>
<td>2</td>
<td>3*</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Int. Bearing Walls</td>
<td>3*</td>
<td>2*</td>
<td>1</td>
<td>0</td>
<td>3*</td>
<td>2</td>
<td>2</td>
<td>1/HT</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Floor Construction</td>
<td>2</td>
<td>2*</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>HT</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Roof Construction</td>
<td>1.5*</td>
<td>1*</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
<td>1</td>
<td>1</td>
<td>HT</td>
<td>1</td>
<td>0</td>
</tr>
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</table>

Exposed Mass Timber Elements

<table>
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<tr>
<th>Rating Requirement</th>
<th>None</th>
<th>20-40%</th>
<th>Most</th>
<th>All</th>
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</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0hr &amp; HT</td>
<td>+$10/SF</td>
<td>1hr &amp; maybe 2hr</td>
<td>+$12-15/SF</td>
</tr>
</tbody>
</table>

Cost Source: Swinerton

*These values can be reduced based on certain conditions in IBC 403.2.1, which do not apply to Type IV buildings.
Key Design Considerations for Mass Timber Projects

Important considerations related to construction type, fire ratings, panel thickness, member size and occupancy.

Selecting a Construction Type

For mass timber projects, selection of construction type is one of the more significant design decisions. While it’s common to choose construction type based on structural material—i.e., to assume that steel and concrete structures should be Type II, light-frame wood should be Type V, and exposed heavy mass timber should be Type IV—this approach can lead to additional costs. While Type IV construction can be used for exposed mass timber projects, a full understanding of the allowable use of materials in all five construction types, as well as the unique allowances and limitations associated with each, will help to inform the most efficient design.

To optimize a building design from a construction type and level of fire resistance perspective, it is best to start from the lowest end of the spectrum, Type V-B construction, and work up. This avoids unnecessary defaults or assumptions—and unnecessary costs. The fact that certain materials are being used doesn’t mean there is only one option for construction type. Similarly, a mix of occupancy groups doesn’t dictate that certain materials, construction types or building configurations are required. For example, a mass timber building may have isolated steel, concrete or masonry structural elements, but this doesn’t mean that Type I or II construction is necessary, nor does it mean that some or all of the building can’t be framed with mass timber. Likewise, a building with mass timber elements has options other than Type IV construction. Note IBC Section 602.11.

602.11 Minimum requirements. A building or portion thereof shall not be required to conform to the details of a type of construction higher than that type which meets the minimum requirements based on occupancy even though certain features of such a building actually conform to a higher type of construction.

This section permits the use of elements commonly used in a higher construction type without requiring that the entire building meet all of the provisions of that construction type. For example, if a building’s size permitted the use of Type V-B construction, it could still be completely framed with noncombustible materials while being classified as V-B. Similarly, a Type III or V building could be framed with a combination of combustible and noncombustible materials.

As noted, from a fire safety perspective, there are many more considerations for mass timber buildings besides construction type.
Value: Open Floor Plan
Cost: Structural System & Grid

Baseline
12’-6” Glulam Spacing
5.5” CLT

$ +5%
15’ Glulam Spacing
7” CLT

Source: Seattle Mass Timber Tower Book
Creating Efficient Structural Grids in Mass Timber Buildings

Although a mass timber solution may work economically on grids created for other materials, a few modifications can increase efficiencies related to member sizing and manufacturer capabilities.

Mass timber products such as cross-laminated timber (CLT), nail-laminated timber (NLT) and glue-laminated timber (glulam) are at the core of a revolution that is shifting how designers think about construction. At no time has materials selection been such an integral aspect of the building designer’s daily responsibilities. In addition to its sustainability and light carbon footprint, mass timber has benefits that include enhanced aesthetics, speed of construction and light weight, all of which can positively impact costs. However, to convince building owners and developers that a mass timber solution is viable, the structural design must also be cost competitive. This requires a full understanding of both material properties and manufacturer capabilities.

Mass timber is commonly seen in projects such as offices, schools and tall mixed-use buildings, which often have assumed structural grids. Intended to meet the need for tenant flexibility, these “default” grids align with the capabilities of materials historically used—i.e., steel and concrete. When it comes to laying out a structural grid for mass timber, the square peg/round hole analogy is pertinent. Although a mass timber solution may work economically on many grids conducive to steel/concrete framing, some grid modification may be valuable. Trying to force a mass timber solution on a grid laid out for steel and concrete can result in member size inefficiencies while negating opportunities related to manufacturer capabilities. As such, it is critically important to design a mass timber building as a mass timber building from the start. This requires a thorough understanding of how to best lay out the structural grid, without sacrificing space functionality, to optimize member sizes—but there’s more to cost efficiency than column spacing.

The following considerations are based on a post-and-beam frame for occupancies such as offices; however, many also apply to bearing wall-supported systems in other occupancy types.

Grid Selection

Simplistically, there are two main grid options for mass timber buildings: square and rectangular. In deciding which to use, there are a number of factors to consider.

To determine efficient grid spacing, it is important to understand possible span ranges for mass timber floor panels. Due to their relative light weight, allowable spans for these panels are often governed by vibration and deflection rather than bending or shear capacity. In addition to code vibration

Value: Perimeter Glazing

Photos: Mark Bitterman
Cost Impacts of Finish/ Appearance Grade

Appearance vs. Industrial Grades

Aesthetic Expectations
• Appearance grade more $
• Industrial grade can save $
• Specification of appearance grade varies by product
• CLT, DLT, NLT: aesthetic expectations are agreed upon by building designer and manufacturer/ fabricator (ask for samples & outline in specs)
• Glulam: grades are standardized
Expert Tips

Specifying Appearance Grades for CLT, NLT and Glulam

Information for designers seeking to specify appearance grade for cross-laminated timber (CLT), nail-laminated timber (NLT), or glue-laminated timber (glulam).

Share

For mass timber, specification of appearance grade varies by product. Aesthetic expectations for cross-laminated timber (CLT) and nail-laminated timber (NLT) are agreed upon between the building designer and manufacturer/fabricator and described in the product specifications, whereas grades for glued-laminated timber (glulam) are standardized.

CLT Appearance Grades

Starting with the 2015 version of the International Building Code (IBC), CLT has been prescriptively
Procurement Approach Determines Schedule

When do we need to engage a trade partner for the mass timber work?
Procurement Approach Determines Schedule
Example 6 Story Type IIIA Project

Source: Swinerton

Design-Bid-Build Procurement
Procurement Approach Determines Schedule

Example 6 Story Type IIIA Project

Source: Swinerton

Design-Build/Design-Assist Procurement
Procurement Logic for Scheduling

Shop drawings, Planning, Fabrication, Delivery

Mass Timber Installation

Source: Swinerton

Example 6 Story Type IIIA Project
What are the schedule drivers on a mass timber project?
Schedule Impacts: Translating 2D to 3D

Photos: Swinerton
Schedule Impacts: Hybrid Structures
Is there a schedule savings with a mass timber structure compared to other structural systems?
Overall Project Cost Analysis: 12 Story Type IV-B

<table>
<thead>
<tr>
<th></th>
<th>MASS TIMBER</th>
<th>PT CONCRETE</th>
<th>MASS TIMBER SAVINGS VS. PT CONCRETE (%)</th>
</tr>
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<tbody>
<tr>
<td><strong>DIRECT COST OF WORK</strong></td>
<td>86,997,136</td>
<td>85,105,091</td>
<td>2.2%</td>
</tr>
<tr>
<td><strong>PROJECT OVERHEAD</strong></td>
<td>9,393,750</td>
<td>11,768,750</td>
<td>-20.2%</td>
</tr>
<tr>
<td><strong>ADD-ONS</strong></td>
<td>8,387,345</td>
<td>8,429,368</td>
<td>-0.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>104,778,231</strong></td>
<td><strong>105,303,209</strong></td>
<td><strong>-0.5%</strong></td>
</tr>
</tbody>
</table>

Source: Swinerton

*Includes 2 layers of gyp on 80% of interior surfaces*
Overall Project Schedule Analysis: 12 Story Type IV-B

Source: Swinerton
A large scale MT project can be up to 2% higher in direct costs, but a minimum of 20% lower in project overhead costs. The net result is cost-neutrality and higher value.
Early Move-In for Rough-In Trades.
Embracing BIM for Fabrication

Photos: Swinerton
Holistic Schedule Analysis

Shorter Schedule = Lower General Conditions Costs

Photo: Swinerton
SITE PLANNING

Photo: Swinerton
LOGISTICS PLANNING
SITE ORGANIZATION & STAGING
Sequencing
Material Protection

Painting steel
Taping joints
Protect end cuts of timber

Photo: Swinerton

Photo: Alex Schreyer
Workforce Development
Training is the key to efficiency
Training takes time and money

Training versus Education

Resources available to all
MT Construction Manual
Installer Curriculum
Other WW Resources
CM Workshops
Previous recorded versions
Learning Management System
Mass Timber Construction Management Program

- Mass Timber Construction Manual
- 8- & 16-Hour Installer Training Package and Training Centers
- Community College and University CM Programs
- Virtual and/or In-Person Workshops
- Partner with Construction Associations
- Project Tours
- Engage with General Contractors Across the US
# Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
</tr>
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<tbody>
<tr>
<td>10:00 am – 11:00 am</td>
<td>Mass Timber Construction Management: Economics, Logistics &amp; Risk Analysis</td>
</tr>
<tr>
<td>11:00 am - 11:15 am</td>
<td>Break</td>
</tr>
<tr>
<td>11:15 pm – 12:15 pm</td>
<td>Mass Timber: Making the Case to Developers and Owners</td>
</tr>
<tr>
<td>12:15 pm – 1:00 pm</td>
<td>Lunch</td>
</tr>
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</table>
Mass Timber Construction: Making the Case
Part 2: Mass Timber: Making the Case to Developers and Owners

April 10, 2024

Presented by
Tino Kalayil, PE, WoodWorks
Topics

» Resources for Developers/ Owners
» Forest to City, A Mass Timber Introduction
» Sustainability & Forestry
» Tall Wood
» Construction Management
» Insurance
» Mass Timber Buildings Sold
» Business Case Studies
Topics

» **Resources for Developers/ Owners**
  » Forest to City, A Mass Timber Introduction
  » Sustainability & Forestry
  » Tall Wood
  » Construction Management
  » Insurance
  » Mass Timber Buildings Sold
  » Business Case Studies
Resources for Developers/Owners

Mass Timber Business Case Studies

Mass Timber Cost and Design Optimization Checklists

Find projects & team members


Scan for website
Topics

» Resources for Developers/Owners

» Forest to City, A Mass Timber Introduction

» Sustainability & Forestry

» Tall Wood

» Construction Management

» Insurance

» Mass Timber Buildings Sold

» Business Case Studies
Forests – Timber – Building Materials
Processing Chain - Engineered Timber

Source: The Wood from the Trees: The Use of Timber in Construction
Small Diameter Trees
Mass Timber Products

Nail-Laminated Timber (NLT)

Cross-Laminated Timber (CLT)

Glue-Laminated Timber (GLT)

Structural Composite Lumber (SCL)

Image source: StructureCraft
Large Pre-fabricated Mass Timber Panels

Candlewood Suites, Redstone Arsenal, AL | Lendlease

Image: MyTiCon
Mass Timber Buildings
Forest-to-Cities Climate Challenge
A Systemic Solution in Action

www.ForesttoCities.org
Topics

» Resources for Developers/ Owners
» Forest to City, A Mass Timber Introduction

» Sustainability & Forestry
» Tall Wood
» Construction Management
» Insurance
» Mass Timber Buildings Sold
» Business Case Studies
Sustainability Brief

» High level overview of sustainability benefits of mass timber
» Carbon benefits
» Forest health & wildfire resilience
» Healthy buildings & biophilia
» Energy efficiency & insulation
» Circular economy

» Short read - great for developers, their capital partners, and anyone who just needs a brief intro to topic

https://www.woodworks.org/resources/meeting-sustainability-objectives-with-wood-buildings/
Healthy Buildings & Biophilia
The Built Environment & Carbon Dioxide Emissions

Built environment generates about 40% of annual carbon dioxide emissions

» Building Operations
» Embodied Carbon

Embodied carbon: 15%

» Cement
» Iron
» Steel
» Aluminum
Carbon Terms

» **Embodied Carbon**: Carbon emissions associated with the entire life cycle of the building including harvesting, mining, manufacturing, transporting, installing, maintaining, decommissioning, and disposing/reuse of a material or product

» **Operational Carbon**: Carbon emissions associated with operating a building including power, heat, and cooling
Embodied Carbon

- Primarily related to **manufacturing of materials**
- More significant than many people realize, has been **historically overlooked**
- Big upfront GHG “cost” - which makes it a **good near-term target** for climate change mitigation
Carbon Benefits of Wood

» Lower embodied carbon compared to other common building materials
» Less fossil fuel consumed during manufacture
» Avoid process emissions
» Extended carbon storage in products
» Carbon sequestration in forests
» Promotes forest health
Carbon Storage: Wood $\approx 50\%$ Carbon (dry weight)
Extractivism and its Impacts

Source: Timber City Research Initiative, Gray Organschi Architecture
WoodWorks Carbon Calculator

- Available at woodworks.org
- Estimates total wood mass in a building
- Provides estimated carbon impacts:
  - Amount of carbon stored in wood
  - Amount of greenhouse gas emissions avoided by choosing wood over a non-wood material

http://www.woodworks.org/carbon-calculator-download-form/
Platte Fifteen
Denver’s First CLT Commercial Office Building
Puts Sustainability to Work

PROJECT DETAILS
LOCATION:
Denver, Colorado
SIZE:
Five stories; 150,418 square feet

Source: Platte Fifteen Life Cycle Assessment
https://www.woodworks.org/resources/platte-fifteen-life-cycle-assessment/
Mass Timber Comparative Life Cycle Assessment Series
Comparing the embodied carbon impacts and cost of mass timber buildings to functionally equivalent buildings

Introduction

Author
KL&A Engineers & Builders / KL&A Team Carbon
Credits for Sustainable/ Well Certifications

**LEED v4.1 BD+C**
Indoor Environmental Air Quality
- Low-Emitting Materials
- Thermal Comfort

**Passive House 3rd Edition**
Core Principles
- Thermal Insulation
- Thermal Bridge Reduced Design
- Airtightness

**WELL v2**
Materials
- Materials Transparency

Mind
- Nature & Place
- Restorative Spaces

Thermal Comfort
- Thermal Performance
- Verified Thermal Comfort

**Living Building Challenge 4.0**

*Energy Petal*
- Energy + Carbon Reduction
- Net Positive Carbon

*Materials Petal*
- Responsible Materials
- Responsible Sourcing
- Living Economy Sourcing
- Red List
- Net Positive Waste

*Beauty Petal*
- Beauty + Biophilia

Source: Mercer Mass Timber and The Environment
U.S. Forest Land:
Forest Area in the United States 1630 – 2017

Forest Area has been stable for more than 100 years

State of our Forests: US Timber Volume on Timberland

Volume of Trees has been growing for 60+ years!

US Forest Lands

Forest Land Ownership

This map displays the basic vegetation (forest vs. non-forest) of the conterminous United States as well as ownership (private vs. public). The lands displayed as "public" include Federal and State lands but do not generally include lands owned by local governments and municipalities.

Data sources:
- Forest: NLCD (1992)
- Ownership: PAD (2001)
- States: ESRI Data & Maps 2002
- Urban areas: DCW (1998)

USDA Forest Service, State and Private Forestry, Cooperative Forestry Staff, Washington Office.

Public forest
Private forest
Non-forest
Urban areas
Regeneration vs. Deforestation

Deforestation is the permanent conversion of forest land to non-forest land uses. Worldwide, agricultural expansion is the main driver of deforestation, but in the U.S., the rate of deforestation has been virtually zero for decades.

World Growth in Consumption of Raw Materials 1961-2017

Demand Has Multiplied ‘x’ Times (1961-2017)

- Steel: 4.9
- Cement: 12.7
- Aluminum: 12.7
- Plastics: 25.8
- Wood: 1.6

Demand for wood has only increased 1.6 times!
That’s less than the population growth of 2.45 times.

Source: An Introduction To The Circular Economy
Dovetail Partners, Inc.
https://dovetailinc.org/porfoliodetail.php?id=5e6f6ff64cb3
## Wood Products
Increase Forest Value & Support Rural Economies

<table>
<thead>
<tr>
<th></th>
<th>Jobs</th>
<th>Annual Payroll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Products</td>
<td>434,900</td>
<td>$21 Billion</td>
</tr>
<tr>
<td>Forestry &amp; Logging</td>
<td>145,900</td>
<td>$3 Billion</td>
</tr>
<tr>
<td>Total Employment</td>
<td>580,800</td>
<td>$24 Billion</td>
</tr>
</tbody>
</table>

[Download State info:](https://www.awc.org/publicpolicy/statefactsheets)
Private Working Forests

Download State info: https://nafoalliance.org/
ULI Report: The Materials Movement

**Office Occupier Demand for Healthy Materials:**
- Powerful expression of tenant’s brand
- Helps recruit top talent
- Healthy air quality supports worker productivity, cognitive performance, mental & physical health

**Enhanced Building Value:**
- Office green premium on rents: from 2% to >15%
- Certified healthy buildings transact 4.4% to 7.7% higher rent per SF than noncertified buildings

“Building with mass timber provides a host of benefits to stakeholders across the real estate value chain.”

Featured Project – Prologis Evergreen Warehouse

ULI Report: The Materials Movement

- 246,000 SF speculative logistics warehouse
- Brampton, Ontario (Greater Toronto Area)
- CLT roof panels over glulam beams & columns
- 52’x50’ bay sizes w/ 60’ staging bay
- 36’ clear height

- Mass timber in lieu of steel deck & framing - *reduced embodied carbon footprint by 62%*
- Helps Prologis meet their net zero goals & responds to increasing customer interest in sustainable buildings that go beyond operational efficiency.
- Provides a differentiated asset in competitive market

- Developer: Prologis
- Completion: December 2024 (expected)

Mass Timber as a Sustainable Investment
Research Commentary by

Traditional Investment Considerations:
» Can mass timber outperform market? Achieve higher rents & faster lease up? Lower cap rates?
» If so, rating agencies & investors can modify net cash flow projections & cap rates.
» Expect this could happen over time, but not enough quantitative data available yet

Environmental & Social impact:
» E: Low carbon
» S: healthy/ well & labor benefits

As of year-end 2023, in the US, 935 multi-family, commercial, or institutional projects have been constructed with mass timber. Including those in design, the total is 2,035.

Source: WoodWorks, December 31, 2023

Scan this code or use the url to find the map and more details online.

www.woodworks.org/resources/mapping-mass-timber/
Topics

» Resources for Developers/ Owners
» Forest to City, A Mass Timber Introduction
» Sustainability & Forestry

» Tall Wood
» Construction Management
» Insurance
» Mass Timber Buildings Sold
» Business Case Studies
WoodWorks is supporting 217 tall wood projects in design 14 projects under construction or built.
Tall Mass Timber Code Adoptions

Tall Mass Timber Code Adoptions by State

- 2021 IBC in Whole
- 2024 IBC TMT Provisions
- 2021 IBC TMT Provisions
- 2024 IBC Pending

2021 IBC TMT Provisions adopted on a per-city basis in:
  - City of Nashville

2024 IBC TMT Provisions adopted on a per-city basis in:
  - City of Denver
  - City of Dallas
Type IV-A

18 Stories
Height = 270’
Wood covered/ not exposed

1510 Webster
Oakland, CA
Developer/Architect/Builder: oWOW
Images: Andrew Nelson
Type IV-B

12 Stories
Height = 180’
Wood partially exposed
Image: Susan Jones, atelierjones

Baker’s Place
Madison, WI
Developer: The Neutral Project
Images: Michael Green Architecture
Type IV-C

8 Stories
Height = 85’
Wood fully exposed

Image: Susan Jones, atelierjones

Heartwood
Seattle, WA
Community Roots Housing | Skipstone

Images: Susan Jones, atelierjones
Topics

» Resources for Developers/ Owners
» Forest to City, A Mass Timber Introduction
» Sustainability & Forestry
» Tall Wood

» Construction Management
» Insurance
» Mass Timber Buildings Sold
» Business Case Studies
Cost & Design Optimization Checklists

» Distribute to entire design & builder team
» Reduce risk/ cost surprises
» Developers/ owners - read Pre-design & SD sections
# Potential Benefits

<table>
<thead>
<tr>
<th>Fast construction</th>
<th>✓</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic Value (Potential leasing velocity/ premiums)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Healthy Building / Biophilia</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lightweight structure (multi-story, poor soils, tilt-walls, vertical additions)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Labor shortage solution</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• small crews</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>• entry level workers</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Just-in-time delivery (ideal for dense urban sites)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Environmentally friendly (low carbon footprint)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Healthy forests/ wildfire resiliency &amp; support rural economies</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Compressing the Typical Construction Schedule

Look for these potential \textit{$\$$ schedule savings} with \textit{mass timber} in comparison to steel and concrete.

- Faster erection (prefabricated + precise)
- If prefabricated, savings in enclosure time
- MEP fully coordinated in design phase & therefore installed faster
- Less finishes with exposed wood structure
- Earlier start for follow-up trades; no waiting for cure times

\textbf{Up to 25\% schedule savings}:
- Less carrying costs
- Less GC overhead
- Ability to lease/occupy sooner

Below grade foundations + soils

Mass timber structure

Building envelope/exterior

MEP

Interior finishes

Overall mass timber construction schedule

Construction Start

Mass Timber Finish

Steel/Concrete Finish
Builder input during pre-design is essential to optimizing costs.

- Assemble Design & Builder Team
- Contract model: consider CM at risk, design-assist, IPD, or design-build
- Establish project goals through discussions with owner, designer and builder.
- Cost estimating considerations
- 3D modeling & coordination of structural, MEPF & architectural systems
Anatomy of a Turnkey Mass Timber Package

- Project Overhead: 7%
- Material: 64%
- Labor: 15%
- Equipment: 14%

Source: Swinerton
Plan for early conversations with building & fire departments

» Acoustics – set expectations

» If it hasn’t already been done, decide whether the GC or subcontractor will install the framing.

» Ensure safety policies are in place to protect against construction fires.

» Determine “shop or field” for connectors and finishes.

» Decide how wood will be protected during transportation and construction.
Acoustic Performance

Typical mass timber floor assembly
Material Protection

- Moisture
- UV rays
- Damage
Moisture Management

Keep wood as dry as possible to avoid:

» Stains and dirt
» Shrinkage and swelling
» Damage from prolonged moisture exposure

Mass timber can get wet—and will get wet on most projects. That is not a problem, provided an effective moisture management plan is in place.
Factory-Applied Sealants & Coatings
Finish Quality: Exposed Structure
Mass Timber Appearance

Panel appearance (CLT, NLT, DLT, etc.)
» negotiated by owner/ manufacturer
» No industry standard
» Request large samples
» Industrial appearance, save $ 

Glulam beam & column appearance
» Industry standards

Expert Tip: Specifying Appearance for CLT, NLT and Glulam
https://www.woodworks.org/resources/specifying-appearance-grades-for-clt-nlt-and-glulam/
Looking to source mass timber products?

Connect with a WoodWorks Partner to scout products for your next mass timber project.

Education / Resources / Free Project Support
Working on a commercial or multifamily wood building in the U.S.? Get the information and support you need at woodworks.org.
Topics

» Resources for Developers/ Owners
» Forest to City, A Mass Timber Introduction
» Sustainability & Forestry
» Tall Wood
» Construction Management

» Insurance
» Mass Timber Buildings Sold
» Business Case Studies
Insurance Resources

WoodWorks resources for mass timber insurance:

» Video series on MT Builder’s Risk insurance challenges
» Mass Timber Project Questionnaire for Builder’s Risk Insurance – download & fill it out!
» Insurance for Mass Timber Construction: Assessing Risk and Providing Answers (white paper)
» Discuss with WoodWorks Regional Director:
  » Lists of experienced insurance brokers
  » Help answering questions from brokers & insurers

www.woodworks.org/learn/mass-timber-clt/mass-timber-building-insurance/
Insurance Challenges

What is causing the challenges with insurance for mass timber projects?

» Insurance industry volatility & hard market
» Lack of loss data
» ISO building classifications (none specific to mass timber)
» Variation of mass timber knowledge among insurance industry

ISO Types 1-6: Construction Code Descriptions

ISO 1 – Frame (combustible walls and/or roof)
Typically RMS Class 1
Wood frame walls, floors, and roof deck
Brick Veneer, wood/hardiplank siding, stucco cladding
Wood frame roof with wood decking and typical roof covers below:
  • Shingles
  • Clay/concrete tiles
  • BUR (built up roof with gravel or modified bitumen)
  • Single-ply membrane
  • Less Likely metal sheathing covering
  • May be gable, hip, flat or combination of geometries
Roof anchorage
  • Toe nailed
  • Clips
  • Single Wraps
  • Double Wraps
Examples: Primarily Habitational, max 3-4 stories

ISO 2 – Joisted Masonry (JM) (noncombustible masonry walls with wood frame roof)
Typically RMS Class 2
Concrete block, masonry, or reinforced masonry load bearing exterior walls
If reported as CB walls only, verify if wood frame (ISO 2) or steel/noncombustible frame roof (ISO 4)
Verify if wood frame walls (Frame ISO 1) or wood framing in roof only (JM ISO 2)
Stucco, brick veneer, painted CB, or EIFS exterior cladding
Floors in multi-story buildings are wood framed/wood deck or can be concrete on wood or steel deck.
Wood frame roof with wood decking and typical roof covers below:
  • Shingles
  • Clay/concrete tiles
  • BUR (built up roof with gravel or modified bitumen)
  • Single-ply membrane
  • Less Likely metal sheathing covering
  • May be gable, hip, flat or combination of geometries
Roof anchorage
  • Toe nailed
  • Clips
  • Single Wraps
  • Double Wraps
Examples: Primarily Habitational, small office/retail, max 3-4 stories

If "tunnel form" construction meaning there is a concrete deck above the top floor ceiling with wood frame roof over the top concrete deck, this will react to wind forces much the same way as typical JM construction. It is slightly better from a fire rating standpoint and from a wind standpoint in terms of potential damage if the wood frame is damaged. Please provide comments in the construction details of SOV for this type of construction.

Insurance Challenges

What is causing the challenges with insurance for mass timber projects?

» Insurance industry volatility & hard market
» Lack of loss data
» ISO building classifications (none specific to mass timber)
» Variation of mass timber knowledge among insurance industry
Insurance Perspective on Mass Timber

- Lack of historic loss data = Unknowns
- Unknowns = Risk
- Risk = Higher Premiums
- Some take a ‘wood is wood’ approach

- Important to understand the significant differences in how mass timber performs in the event of a fire, etc. when compared to light wood-frame and all other building materials
Insurance Perspective on Mass Timber
How do we address the perceived unknowns?

» Demonstrate extensive testing, research and use
» Provide clarification on commonly misunderstood topics
» Highlight building code recognition and approvals
» Reference product reports, evaluations and 3rd party verifications
» Generate project-specific mitigation strategies

Photo Credit: US Forest Products Laboratory
Mass Timber Testing and Research - Fire

Mass timber has undergone extensive fire testing & evaluation. Elements, assemblies, connections, penetrations, compartments & more
Mass Timber Testing and Research – Wind/Impact

Mass timber has been evaluated for wind loading, cyclic pressure, uplift, debris impact & more. Results used to justify uses in areas such as Miami’s High Velocity Hurricane Zone.
Mass Timber Project Risk Mitigation

Each project should evaluate its specific conditions and constraints and create a project-specific risk mitigation plan that addresses items such as:

» Construction phase moisture protection – have a plan
» Long term moisture protection – traditional building envelope
» Construction site fire safety & other safety measures – have a plan
» Construction schedule impacts – shorter schedules help reduce risk

Sample Safety Plan

Address & Location

Table of Contents

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<td>b) Safety &amp; Health Objective</td>
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<td>c) Project Employee Responsibilities</td>
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<table>
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<tr>
<th>2) OCC Project Site Safety</th>
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</thead>
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<td>a) Project Safety Orientation</td>
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<td>b) Jobsite Safety Inspections</td>
</tr>
<tr>
<td>c) Emergency Procedures, Investigation &amp; Reporting</td>
</tr>
<tr>
<td>d) Emergency Signals &amp; Procedures</td>
</tr>
<tr>
<td>e) Fire Prevention</td>
</tr>
</tbody>
</table>
Risk Mitigation – Construction Moisture

Construction phase moisture protection strategies
» Sealers: factory applied, site applied? Type, application strategies
» Stain control, remediation strategies
» What to do at joints, intersections, connections
» Plans for finishing, drying
Topics

» Resources for Developers/ Owners
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» Insurance

» Mass Timber Buildings Sold
» Business Case Studies
Framework: Portland, OR

» 5-story speculative office
» 25,000 sf
» Developer: Urban Development + Partners
» Completed: 2015
» Both Framework & American Brush totaling 35,200 SF, were sold in February 2020 for $502/SF at 100% occupancy.


Architect: Works Progress Architecture | Engineer: TM Rippey Consulting Engineers | Photo: UD+P
T3 Minneapolis, MN

» 7-story speculative office
» (6) floors Type IV over podium
» 220,000 sf
» Developer: Hines
» Completed: November 2016
» NLT panels & glulam frame
» In May 2018, sold to LaSalle Investment Management at a 3.75 cap rate, well below the market cap rate of ~6 for top of market product at the time

source: CBRE’s Weekly Take Podcast, Knock on Wood Why Timber is Safe | CBRE
901 East 6th Street: East Austin, TX

- 5-story speculative office
- 129,000 sf
- Developers: Endeavor Real Estate & Pegalo Partners
- Completed: 2019
- CLT & steel frame hybrid
- Sold in 2019 to Clarion Partners
- Local real estate experts believe it sold for record value in market

source: Austin Business Journal article
Platte Fifteen: Denver, CO

- 5-story speculative office
- 153,000 sf
- Developer: Crescent Real Estate
- Completed: 2019
- Lionstone Investments was Limited Partner & bought out Crescent

Architect: OZ Architecture  |  Engineer: KL&A Structural Engineers  |  Photo: OZ Architecture
Topics

» Resources for Developers/ Owners
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» Sustainability & Forestry
» Tall Wood
» Construction Management
» Insurance
» Mass Timber Buildings Sold

» Business Case Studies
Mass Timber
Business Case Studies
Mass Timber Value Creation Analysis

What’s in a Business Case Study?

**Development Overview**
- Property information
- Product strategy
- Investment highlights

**Qualitative Discussion**
- Challenges
- Lessons learned
- Successes

**Quantitative Overview**
- Development timeline
- Costs
- Rents
- Lease-up

### Comparative Return Analysis

<table>
<thead>
<tr>
<th></th>
<th>Market</th>
<th>Pro Forma</th>
<th>Realized</th>
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<tbody>
<tr>
<td>Yield on cost</td>
<td>6.25%</td>
<td>7.00%</td>
<td>7.35%</td>
</tr>
<tr>
<td>Cap rate</td>
<td>4.75%</td>
<td>4.50%</td>
<td>TBD</td>
</tr>
<tr>
<td>Value/rentable SF</td>
<td>$550/ RSF</td>
<td>$717/ RSF</td>
<td>TBD ($800+/ RSF)</td>
</tr>
<tr>
<td>Leverage</td>
<td>65%</td>
<td>65%</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Users:

- **Finance-side**
  (investors, developers/owners, appraisers, lenders)
  seeking to “make informed decisions”

- **Services-side**
  (architects, engineers, contractors)
  seeking to “influence decisions”

- **Government-side**
  (building code, policy or zoning)
  seeking to “regulate decisions”
Contributors

We are grateful to the developers, owners and investors who have publicly shared their stories and financial data in these case studies.
Mass Timber Business Case Studies: Value Creation Analysis

Scan to download
Adohi Hall: Project Team

Owner
University of Arkansas

Architects:
Leers Weinzapfel Associates
Modus Studio
Mackey Mitchell Architects
OLIN (Landscape)

Structural Engineer
Equilibrium Consulting, Inc.

Contractor
Nabholz Construction

Mass Timber Business Case Study
Adohi Hall, University of Arkansas

Development Overview

- Create a living-learning student community center competitive with off-campus housing
- Appeal to student identity/desires related to innovation and sustainability
- Demonstration project to help incentivize greater use of mass timber in state

<table>
<thead>
<tr>
<th>Property Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Property timing</td>
<td>Completed 2019</td>
</tr>
<tr>
<td>Submarket</td>
<td>Fayetteville, AR</td>
</tr>
<tr>
<td>Construction Type</td>
<td>3B</td>
</tr>
<tr>
<td>Gross building area</td>
<td>202,491 SF</td>
</tr>
<tr>
<td>Residential area</td>
<td>154,554 SF</td>
</tr>
<tr>
<td>Program: Dorm Rooms</td>
<td>708 beds</td>
</tr>
<tr>
<td>Educational/Studio/Communal</td>
<td>22,360 SF</td>
</tr>
<tr>
<td>Mech/Accessory/Storage</td>
<td>16,093 SF</td>
</tr>
</tbody>
</table>

Mass Timber Business Case Study
Fayetteville Market

- Located in the Ozark Plateau, with 600,000 person MSA, employment anchors include Walmart, JB Hunt, Tyson, and the University of Arkansas

- The university is a centerpiece to the city

- Northwest Arkansas is known as the mountain biking capital of the world with over 250 miles of trails
Questions? Ask us anything.

Tino Kalayil, PE
Regional Director | IL, IA, MN, WI
(224) 639-2164
Tino.kalayil@woodworks.org

Survey
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