Designing and Building with Mass Timber: Design, Planning and Performance

November 4, 2026

Presented by:

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Image: Amy Gutmann Hall, Data Science & AI Building, Lake Flato Architects, KSS Architects, Buro Happold, Photo Jeffrey Totaro

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

AIA Approved Continuing Education

Course Description

How can architects, engineers and contractors collaborate to meet the growing demand for mass timber buildings? While developers across the country are pursuing mass timber projects, knowledge among AEC professionals is not yet widespread. Firms have varying degrees of familiarity with both the products and practicalities of designing, sourcing, and building a modern mass timber structure, and early adopters continue to play a significant role in educating the rest of the community. This presentation seeks to build on this openness and environment of shared learning, providing an overview of mass timber products, planning, design and implementation to maximize the benefits these buildings can deliver. We'll also discuss why some mass timber projects face resistance, and how to overcome misconceptions to achieve success. Topics will also include preconstruction coordination and interactions between the manufacturer and design/construction teams, case-based approaches to costing and scheduling, project delivery methods, how to achieve the highest level of efficiency for costs, schedule, and performance, and additional education and training opportunities.

Learning Objectives

1. Identify project planning, coordination and design topics that translate into successful buildings for both the design and construction team.
2. Explore best practices for interaction between manufacturer, design team and preconstruction manager that can lead to cost efficiency and safety on site.
3. Discuss potential construction schedule savings and construction fire safety practices realized through the use of prefabricated mass timber elements.
4. Discuss benefits of using mass timber products, including structural versatility, prefabrication, lighter carbon footprint, and reduced labor costs.

Outline

- Mass Timber Overview
  - Products
  - Structural Solutions and Connections
  - Projects and Code Considerations
- Mass Timber Construction
  - Planning for Construction
  - Performing Construction
  - Workforce Development

Outline

- Mass Timber Overview
  - Products
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Overview

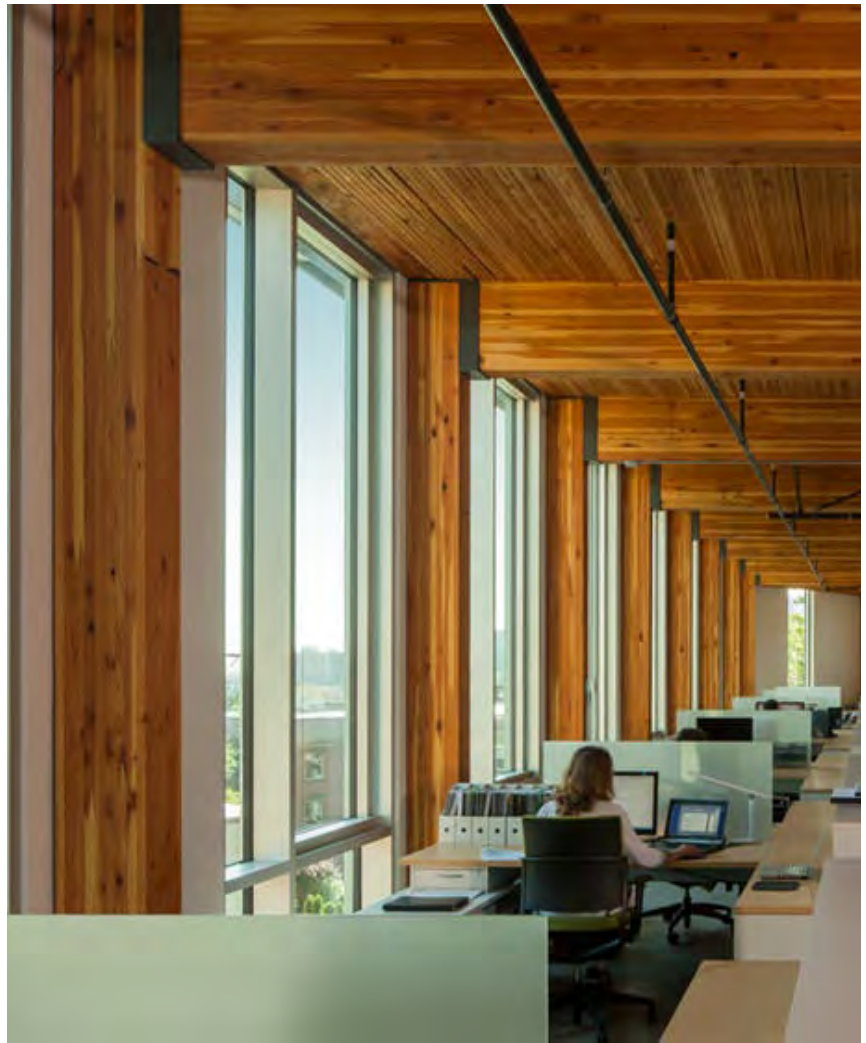
Light Wood-Frame
Photo: WoodWorks



Heavy Timber
Photo: Benjamin Benschneider



Mass Timber
Photo: John Stamets



Glue Laminated Timber (Glulam)
Beams & columns



Photo: StructureCraft



Cross-Laminated Timber (CLT)
Solid sawn laminations



Photo: LendLease



Cross-Laminated Timber (CLT)
SCL laminations



Photo: Freres Lumber

Photo: LEVER Architecture



Dowel-Laminated Timber (DLT)



Photo: StructureCraft



Photo: StructureCraft

Nail-Laminated Timber (NLT)



Photo: Think Wood

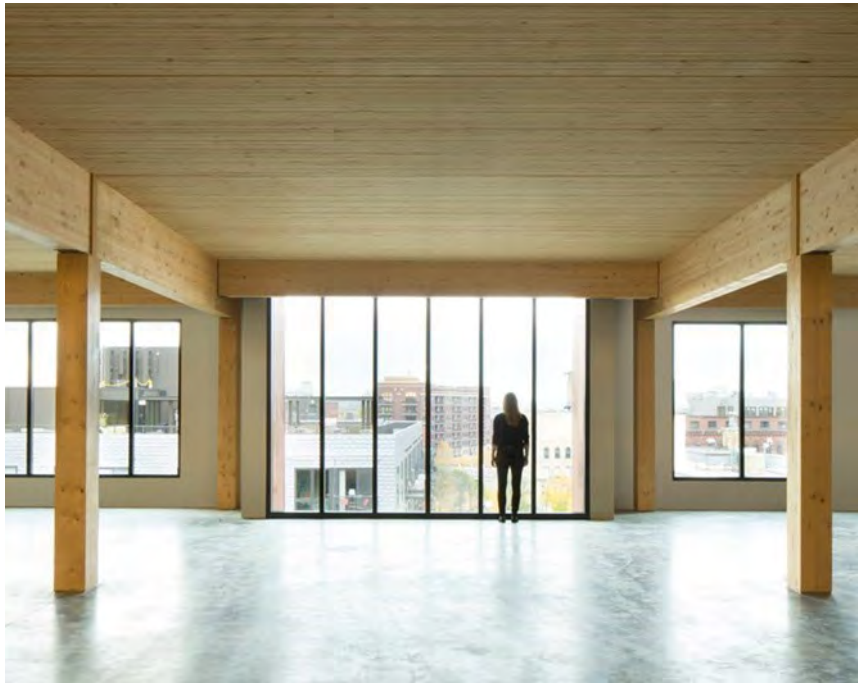


Photo: Ema Peter

Glue-Laminated Timber (GLT)

Plank orientation



Photo: StructureCraft



Photo: Manasc Isaac Architects/Fast + Epp

Glue Laminated Timber

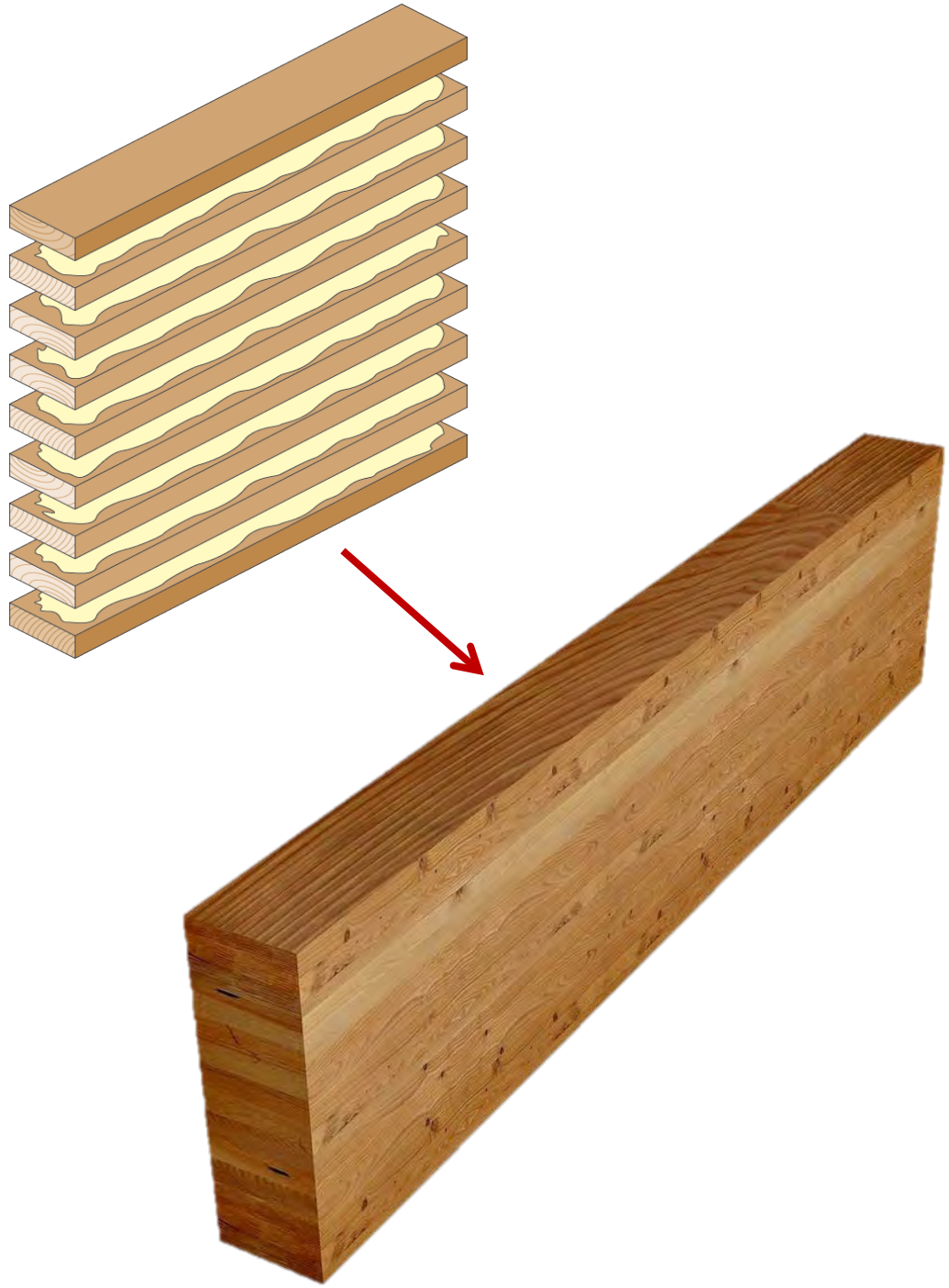


Photo: Alex Schreyer

Glue Laminated Timber



Photo: Manasc Isaac Architects/Fast + Epp

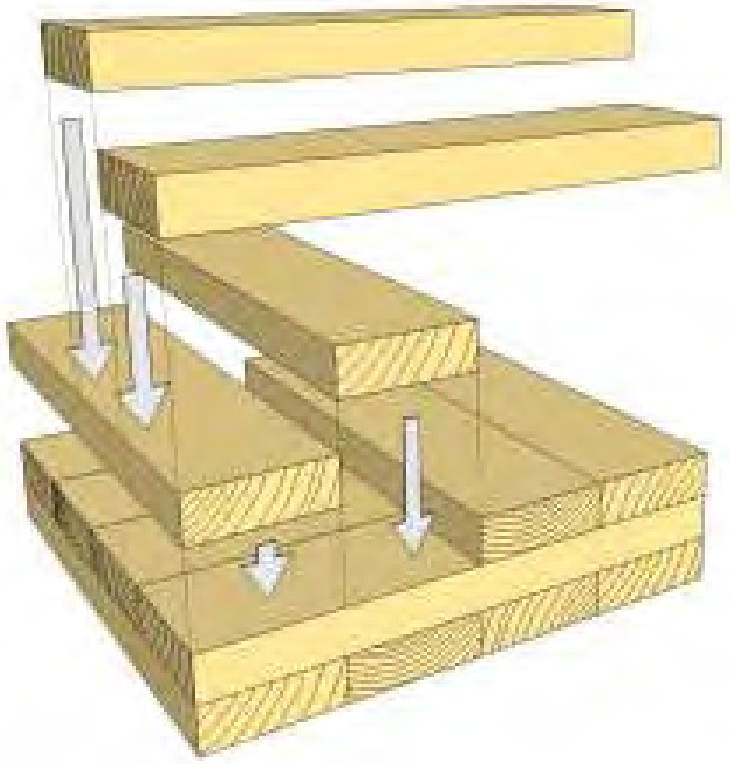


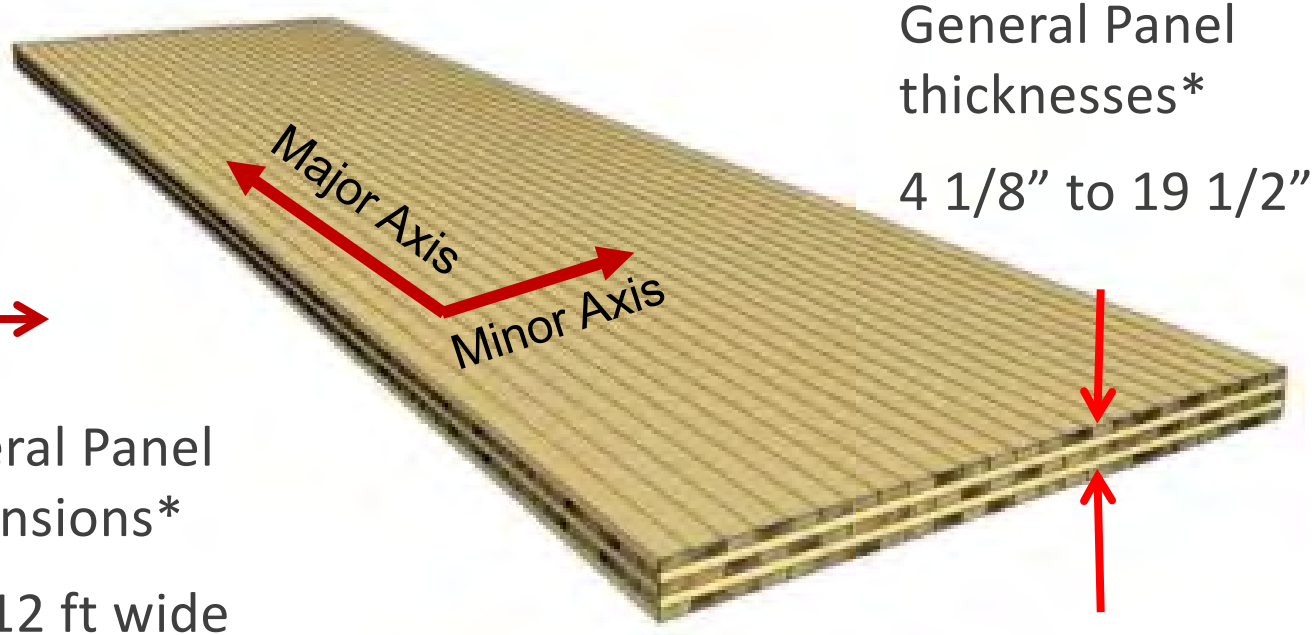
Cross-Laminated Timber (CLT)



Cross-Laminated Timber (CLT)

With solid sawn laminations





General Panel thicknesses*

4 1/8” to 19 1/2”

General Panel dimensions*

4 to 12 ft wide

24 to 64 ft long

*Consult with manufacturers for available panel sizes

Nail-Laminated Timber (NLT)



Photo: StructureCraft

Nail-Laminated Timber (NLT)



Photo: StructureCraft

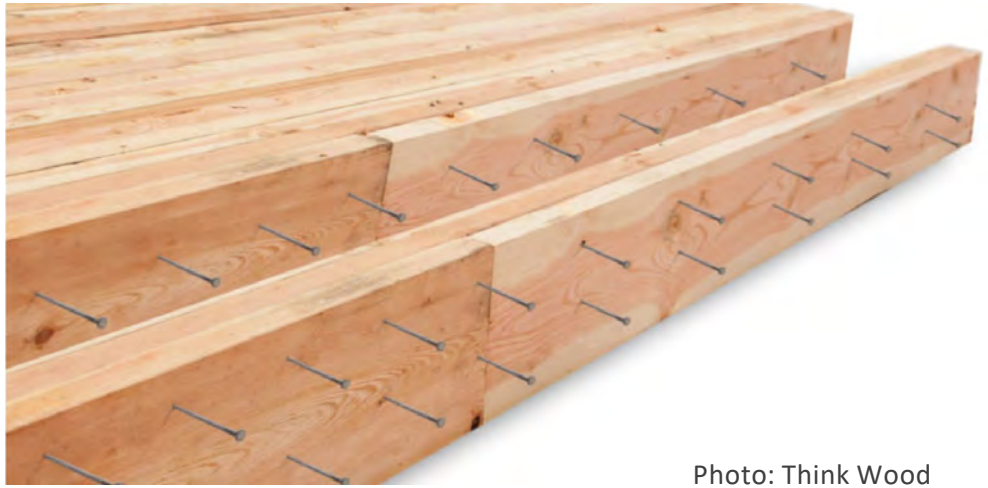


Photo: Think Wood



Dowel-Laminated Timber (DLT)



Photo: StructureCraft

Dowel-Laminated Timber (DLT)

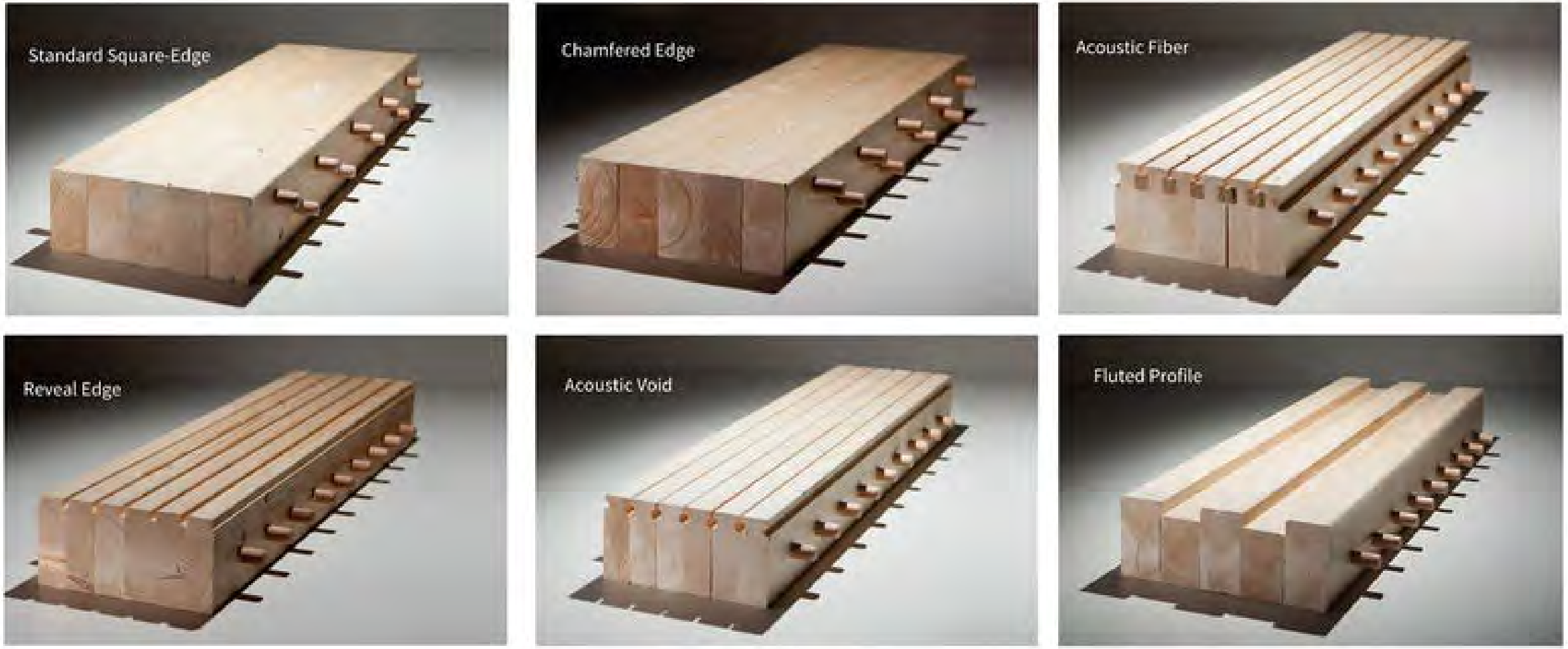


Photo credit: StructureCraft

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

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  - Performing Construction
  - Workforce Development

Post & Beam



Photo: Ema Peter

Post & Plate



Photo: Seagate Structures

Honeycomb



Photo: Lendlease

Hybrid Light-Frame and Mass Timber



Hybrid Steel and Mass Timber



Photo: Timberlab

Hybrid Concrete and Mass Timber



Photo: Jeremy Bitterman

Connections

Concealed Connectors

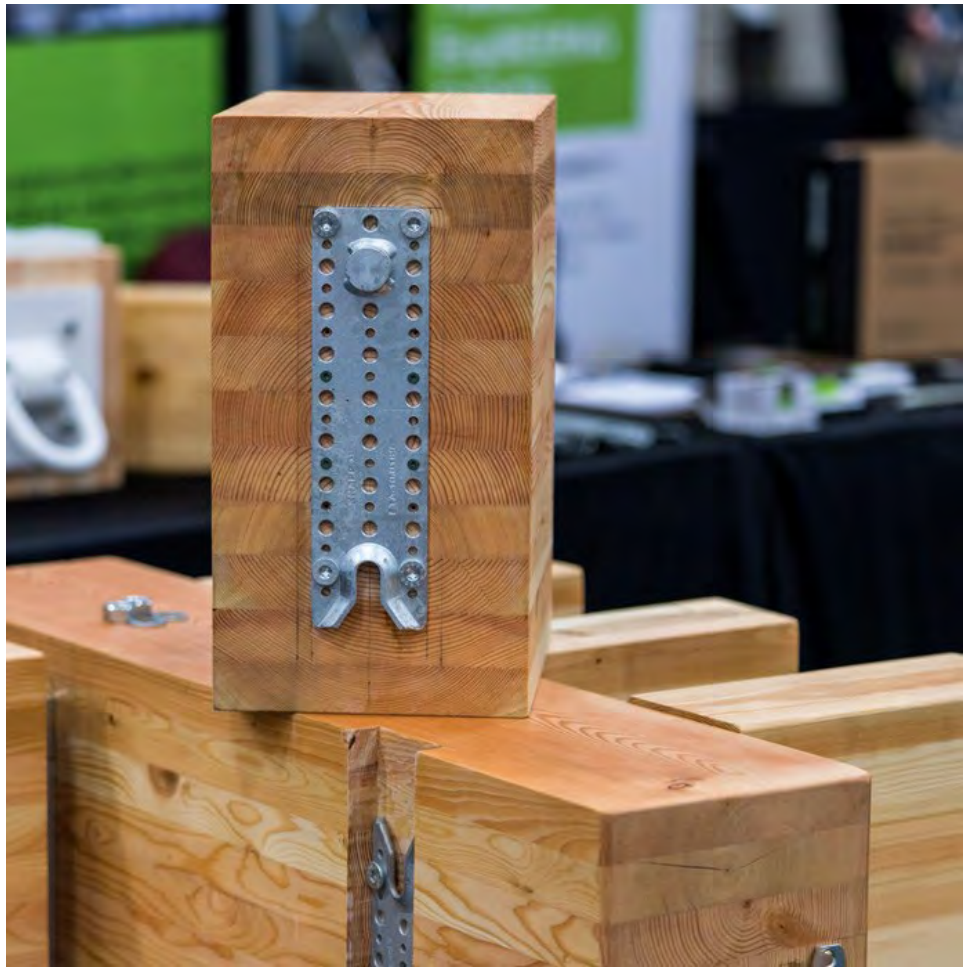


Photo Marcus Kauffman

Self Tapping Screws





Photo Simpson Strong Tie

Connections

Beam to Column



Photo: StructureCraft



Photo: Structurlam

Connections

Column to Foundation



Photo: Alex Schreyer

Connections

Panel to Panel & Supports



Photo: Charles Judd



Photo: Alex Schreyer

Outline

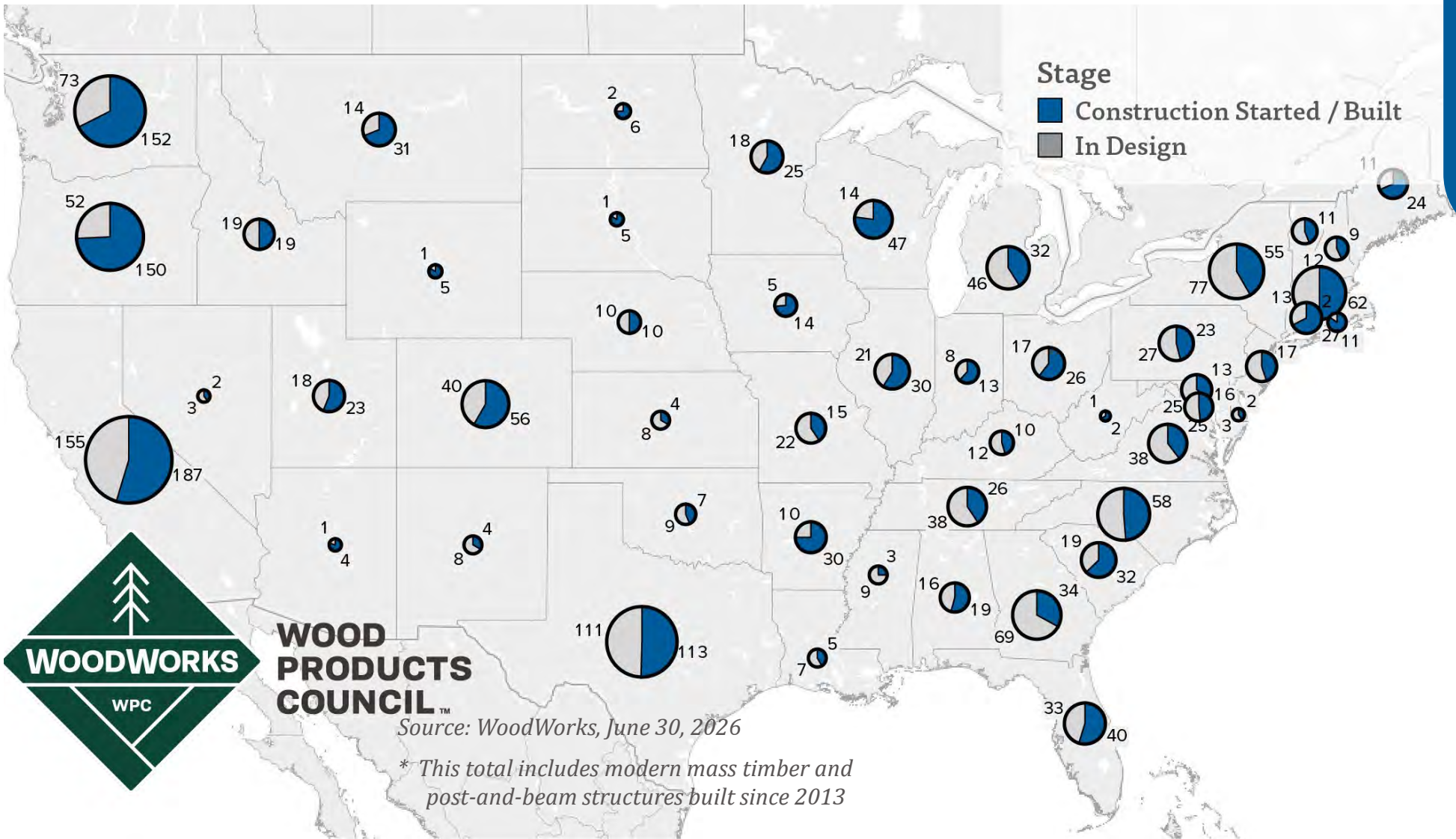
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Current State of Mass Timber Projects

As of Q2 2026, in the US, **2,833** multi-family, commercial, or institutional projects have been constructed with, or are in design with, mass timber.

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

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



WOODWORKS WPC

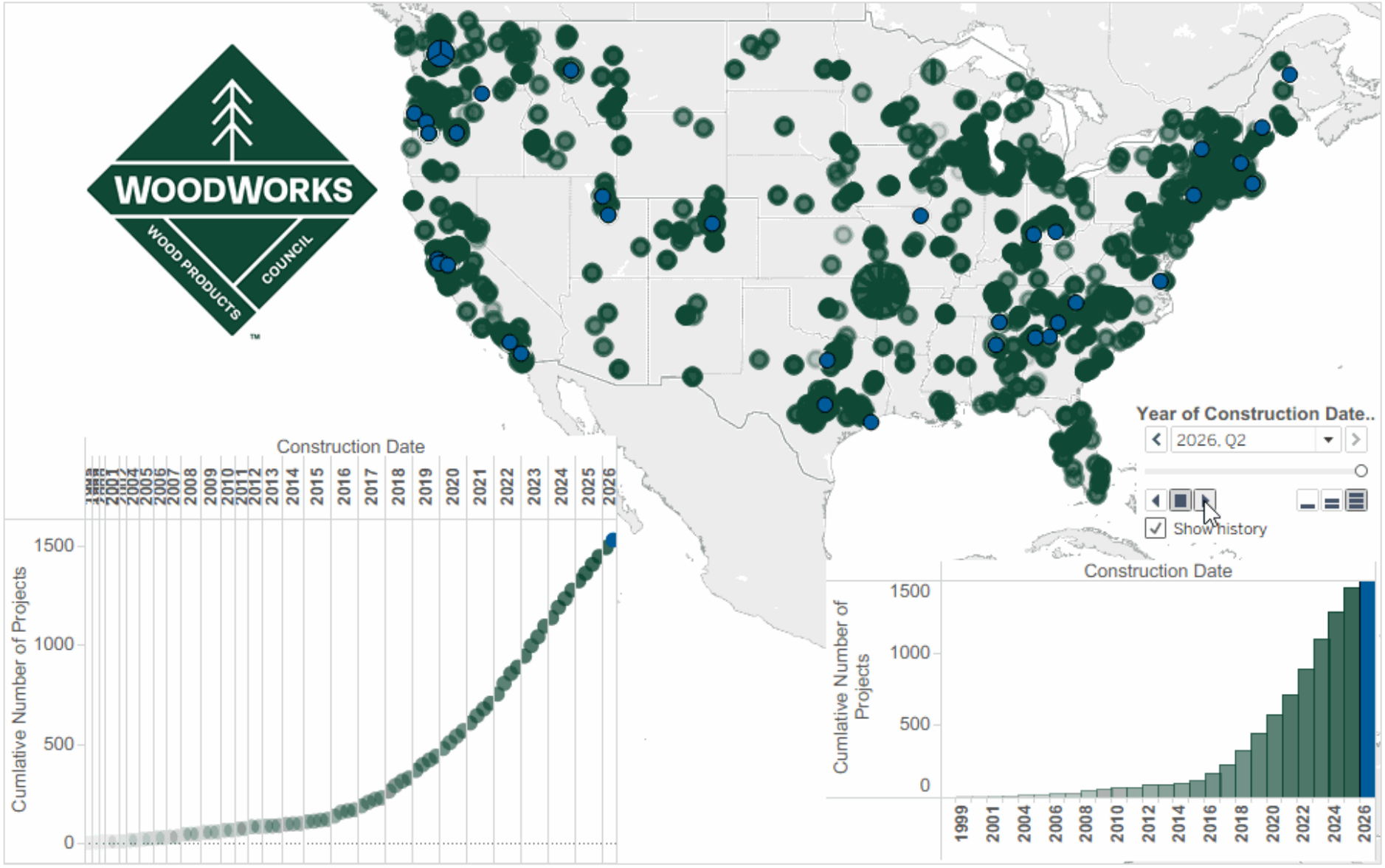
WOOD PRODUCTS COUNCIL™

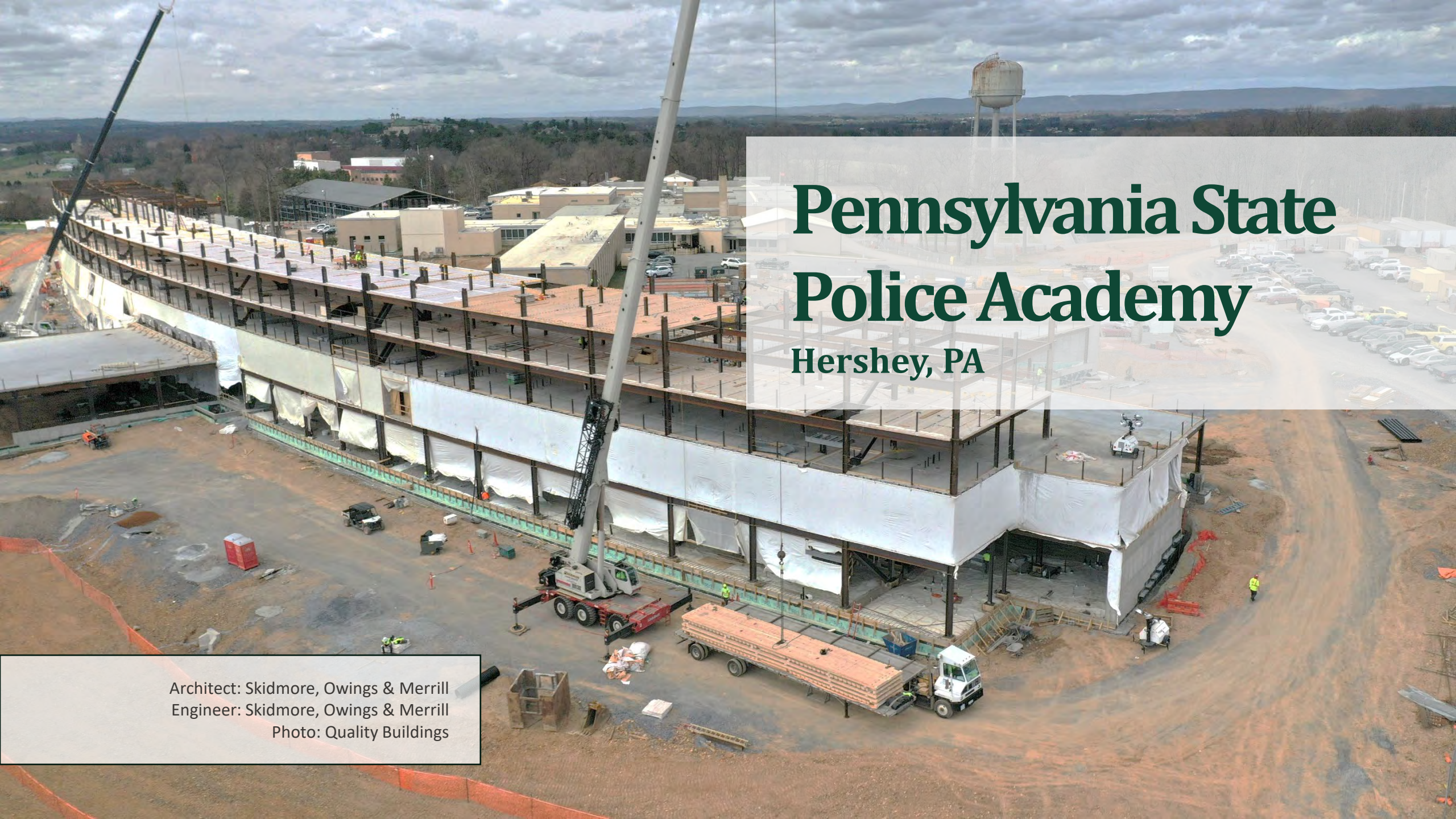
Source: WoodWorks, June 30, 2026

** This total includes modern mass timber and post-and-beam structures built since 2013*

Current State of Mass Timber Projects Over Time

US Market Q2 2026





Pennsylvania State Police Academy

Hershey, PA

Architect: Skidmore, Owings & Merrill
Engineer: Skidmore, Owings & Merrill
Photo: Quality Buildings



Pennsylvania State Police Academy

Hershey, PA

102,905 sf, 4 stories

Type III-A

Institutional

Estimated Completion Fall 2026

WN PROFILE

Architect: Skidmore, Owings & Merrill
Engineer: Skidmore, Owings & Merrill
Photo: Quality Buildings

Pennsylvania State Police Academy

Hershey, PA

- CLT Panels were coordinated and holes were pre-drilled for seamless integration and installation
- 30 days lay all 300+ panels
- 10 panels or 3400 sf CLT a day in CLT





Photos: Quality Buildings

Architect: Skidmore, Owings & Merrill
Engineer: Skidmore, Owings & Merrill

Edelman Fossil Park Museum of Rowan University

Mantua Township, NJ

Ennead Architects and KSS Architects
Engineer: Buro Happold
Photo: Courtesy of Edelman Fossil Park & Museum



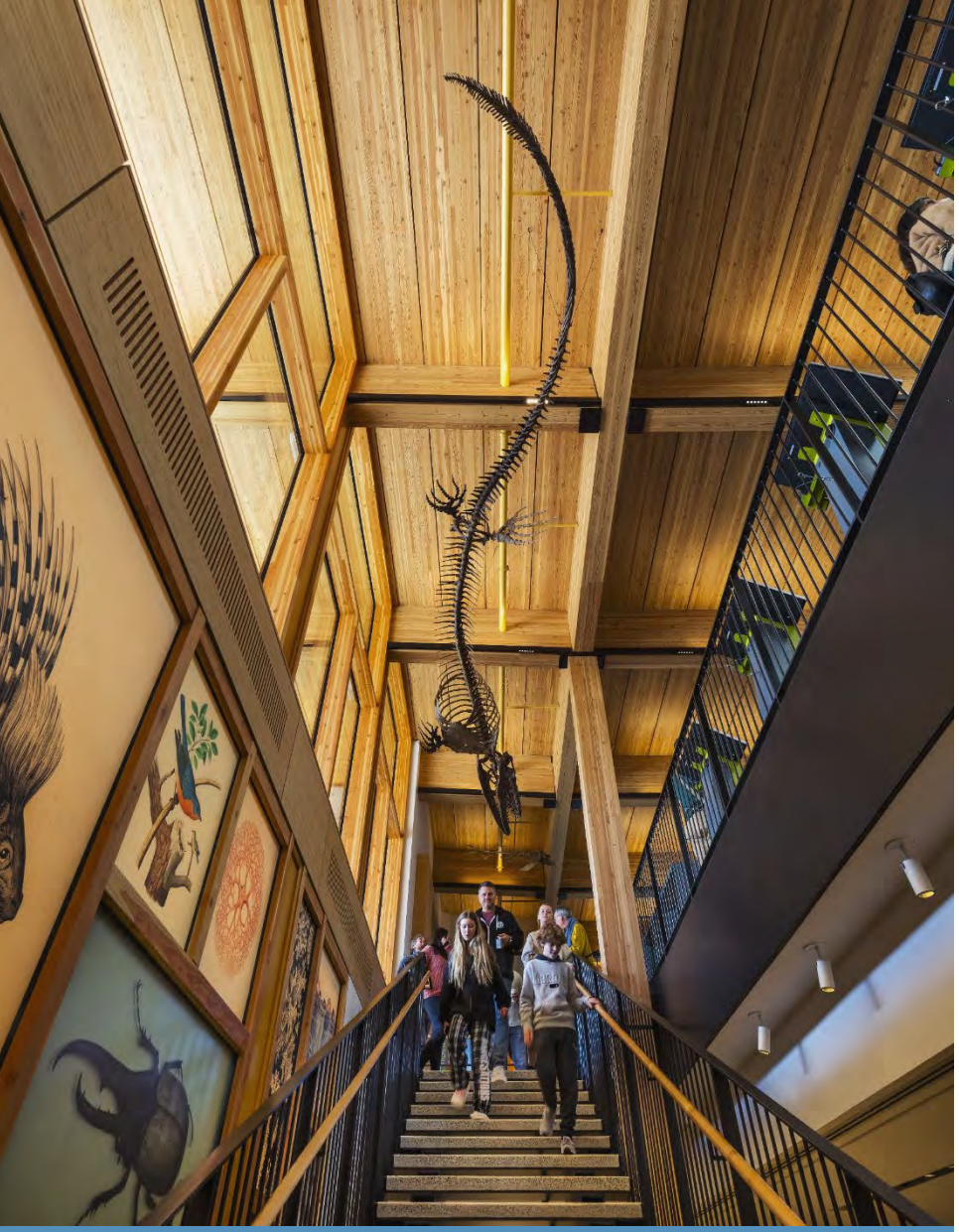


Photo: Courtesy of Edelman Fossil Park & Museum

Edelman Fossil Park Museum of Rowan University

Mantua Township, NJ



Building Facts	44,000 sf, 2 stories
	Type V-A
	Assembly
	Completed 2025

Developer	Edelman Fossil Park & Museum
Architect	Ennead Architects and KSS Architects
Engineer	Buro Happold Engineering
General Contractor	Dobco Group



Edelman Fossil Park Museum of Rowan University

Mantua Township, NJ

- Designed with Energy Petal Certification requirements and is carbon net zero
- Received the 2025 Green GOOD DESIGN Award

WN PROFILE

WoodWorks CASE STUDY

Ennead Architects and KSS Architects
Engineer: Buro Happold
Photo: Courtesy of Edelman Fossil Park & Museum

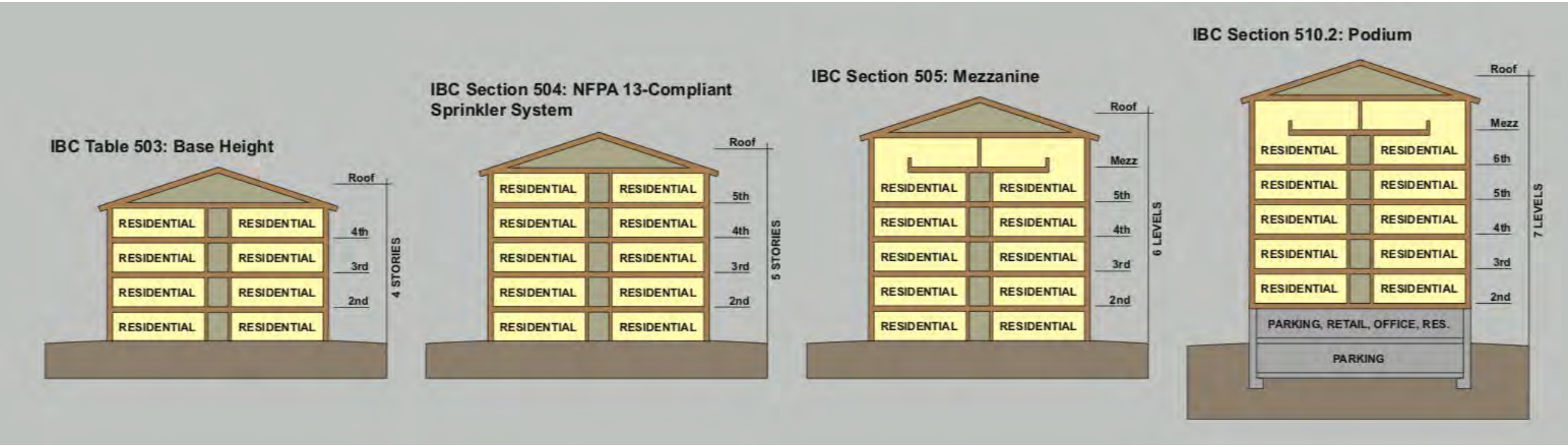
Mass Timber in the Code



Photo: Freres Lumber

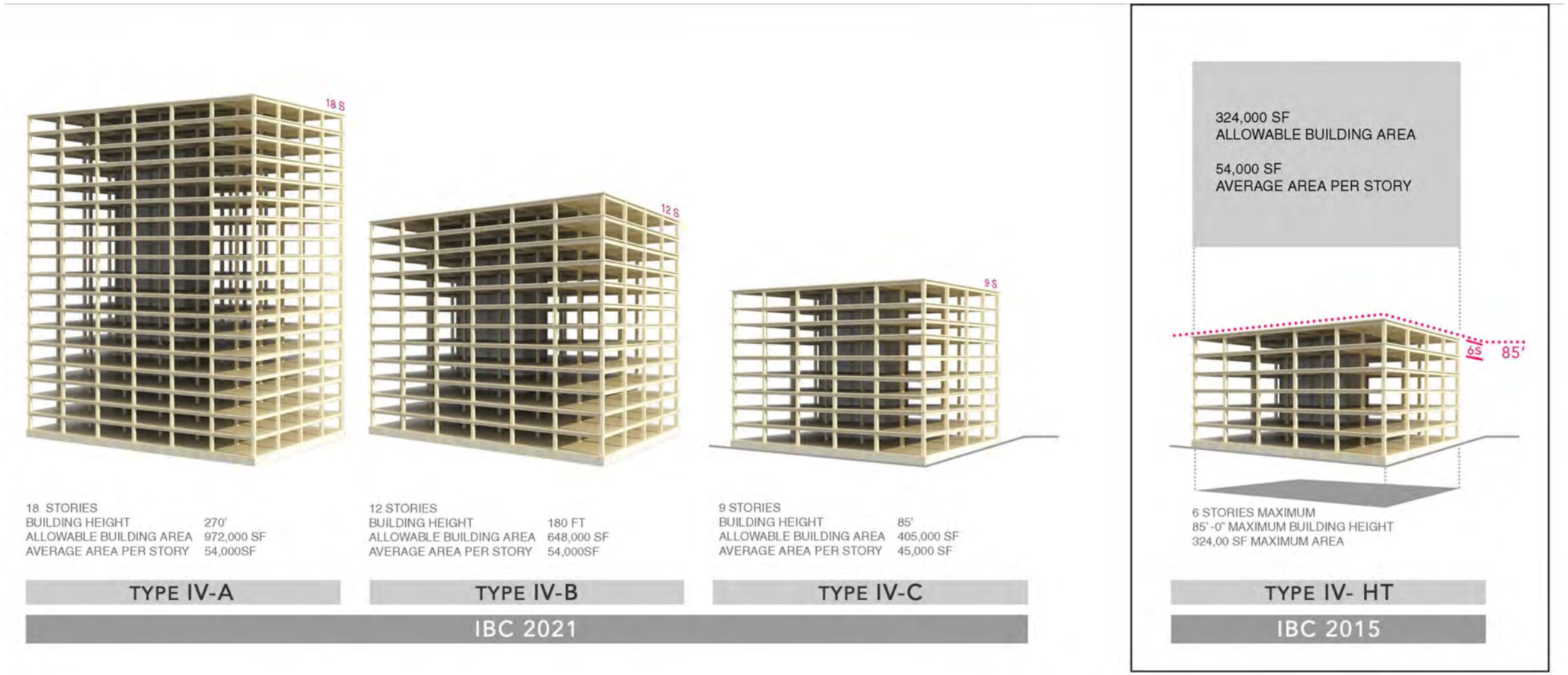
Construction Type

Mass Timber in Low- to Mid-Rise: 1-6 Stories in Construction Types III, IV or V



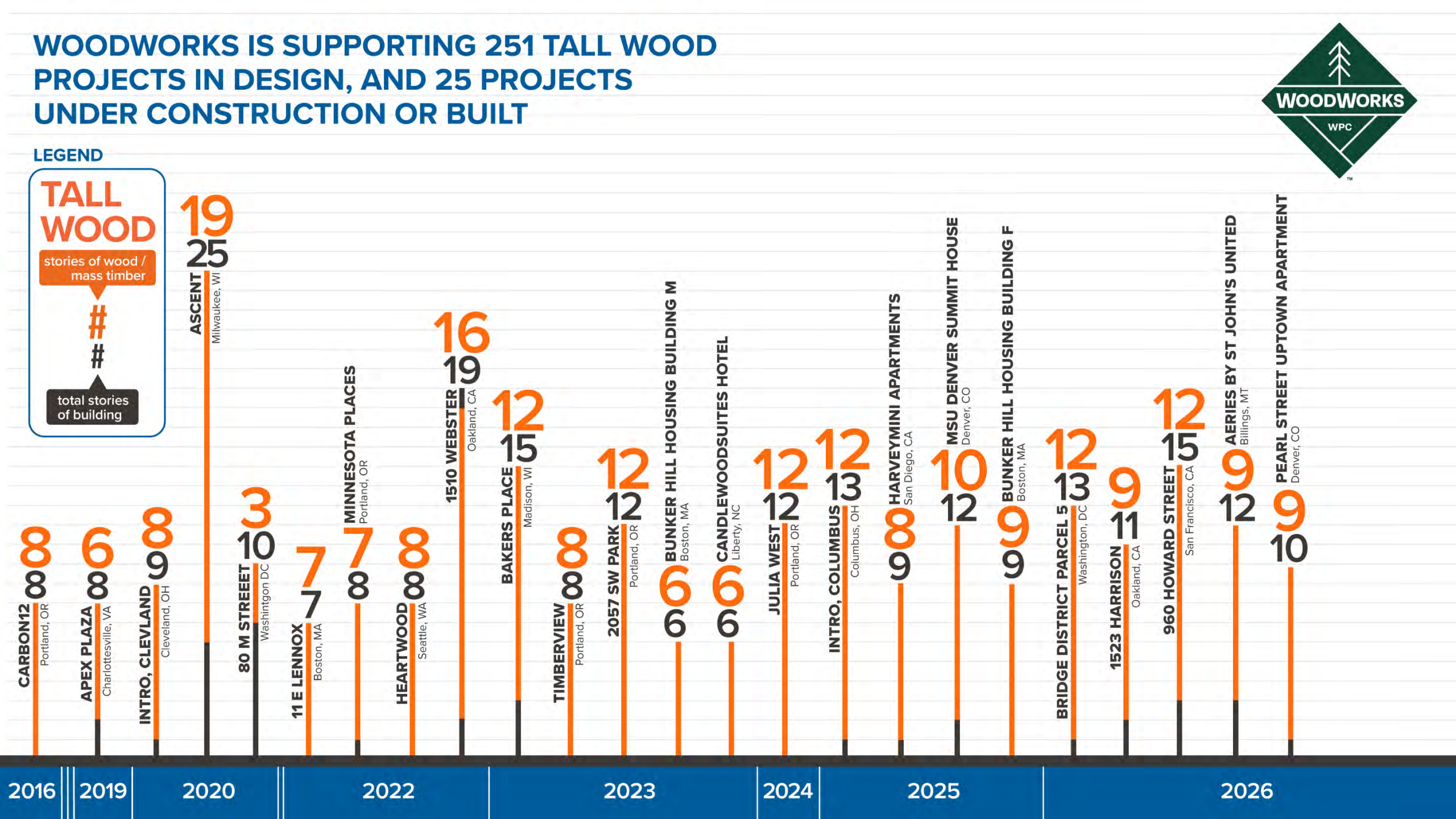
Construction Type

Tall Mass Timber: Up to 18 Stories in Construction Types IV-A, IV-B or IV-C



Credit: Susan Jones, atelierjones

WOODWORKS IS SUPPORTING 251 TALL WOOD PROJECTS IN DESIGN, AND 25 PROJECTS UNDER CONSTRUCTION OR BUILT



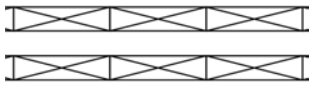
Cost: Construction Type

TABLE 601

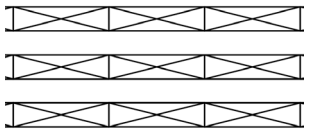
Fire Resistance Rating Requirements for Building Elements (Hours)

Building Element	I-A	I-B	III-A	III-B	IV-A	IV-B	IV-C	IV-HT	V-A	V-B
Primary Structural Frame	3*	2*	1	0	3*	2	2	HT	1	0
Ext. Bearing Walls	3*	2*	2	2	3*	2	2	2	1	0
Int. Bearing Walls	3*	2*	1	0	3*	2	2	1/HT	1	0
Floor Construction	2	2*	1	0	2	2	2	HT	1	0
Roof Construction	1.5*	1*	1	0	1.5	1	1	HT	1	0
Exposed Mass Timber Elements					None	20-40%	Most	All		

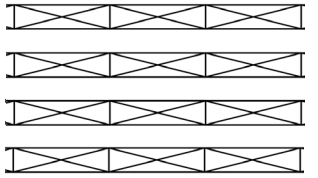
Baseline
0hr & HT



+$10/SF
1hr & maybe 2hr



+$12-15/SF
2hr FRR



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.

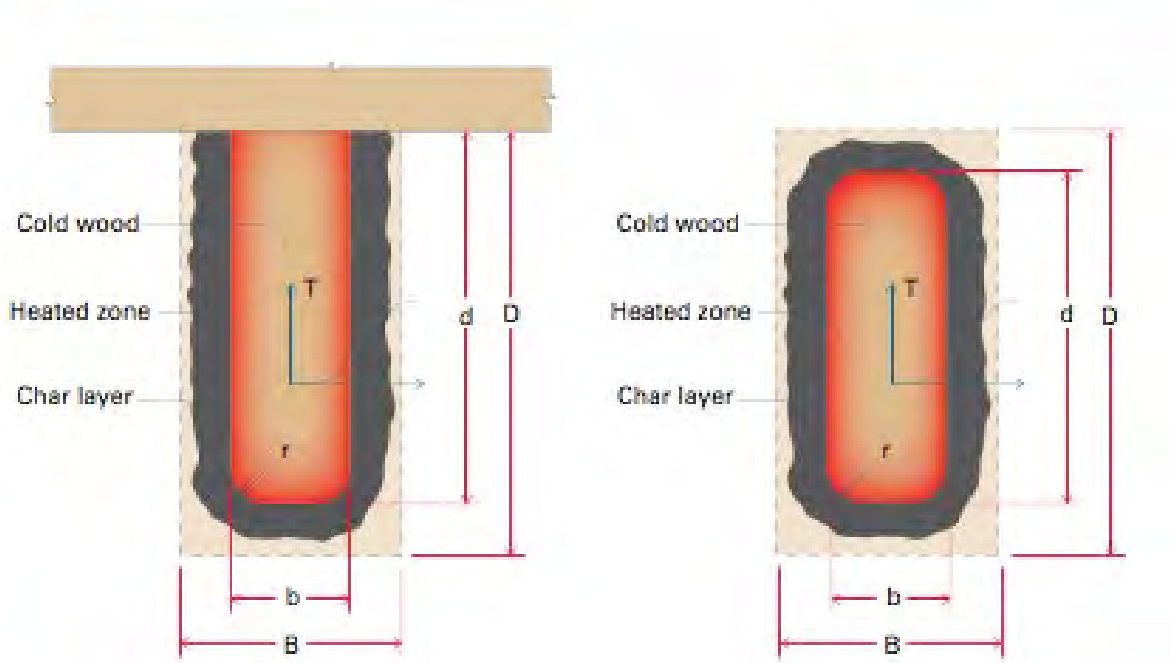
Fire Resistance

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 β_n = 1.5 in./hr.)

Required Fire Resistance (hr.)	Char Depth, a_{char} (in.)	Effective Char Depth, a_{eff} (in.)
1-Hour	1.5	1.8
1½-Hour	2.1	2.5
2-Hour	2.6	3.2

Source: AWC's NDS



Source: AWC's TR 10



Credit: David Barber, ARUP

Fire Resistance

NDS Chapter 16 includes calculation of fire resistance of NLT, CLT, Glulam, Solid Sawn and SCL wood products

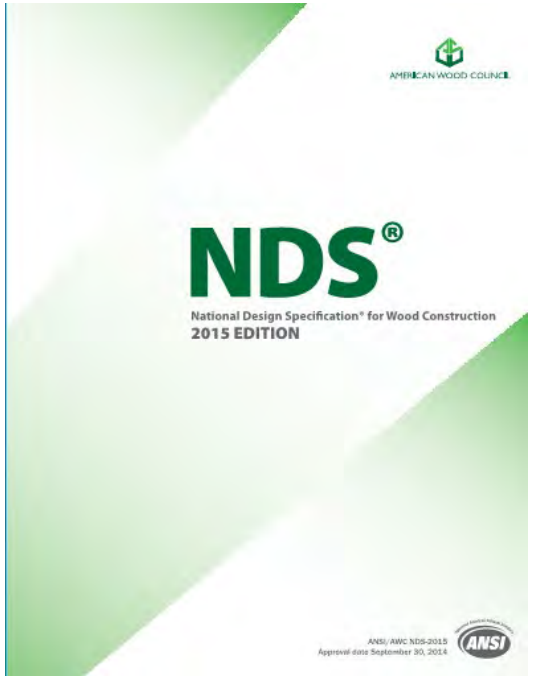




Table 16.2.1B Effective Char Depths (for CLT with β_n=1.5in./hr.)

Required Fire Endurance (hr.)	Effective Char Depths, a_{char} (in.) lamination thicknesses, h_{lam} (in.)								
	5/8	3/4	7/8	1	1-1/4	1-3/8	1-1/2	1-3/4	2
1-Hour	2.2	2.2	2.1	2.0	2.0	1.9	1.8	1.8	1.8
1½-Hour	3.4	3.2	3.1	3.0	2.9	2.8	2.8	2.8	2.6
2-Hour	4.4	4.3	4.1	4.0	3.9	3.8	3.6	3.6	3.6

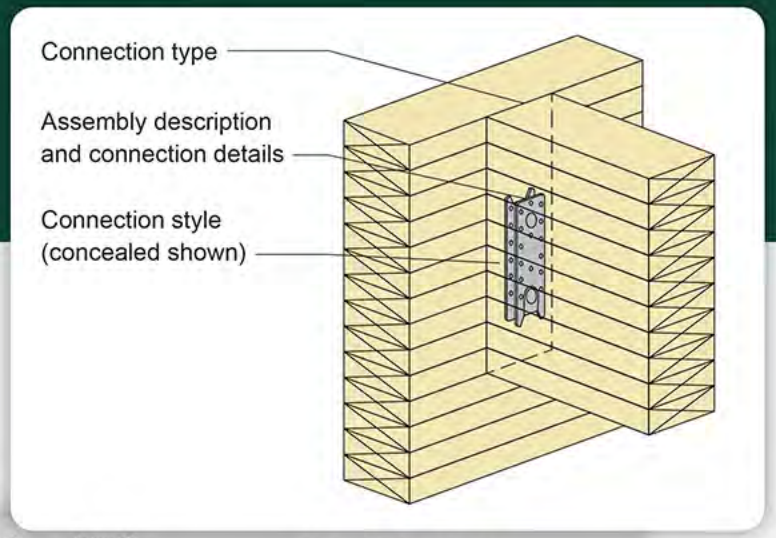


NEW ONLINE TOOL

Mass Timber Fire & Acoustic Database

Search tested and approved assemblies

https://www.woodworks.org/mass-timber-fire-acoustic-database/



< Back to Mass Timber Fire & Acoustic Database

Assembly Type

- Floor/Roof 532
- Wall 147

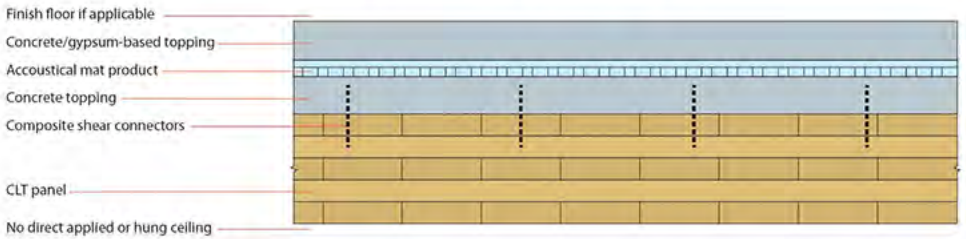
Application Type

- CLT/Concrete Composite 7
- Concealed Ceiling 201
- Concrete/Gypsum Topping 138
- Other 108
- Raised Access Floor or Wood Sleepers 78

Mass Timber Panel

- CLT 507
- CLT (SCL) 56
- NLT 72
- DLT 22

CLT-Concrete Composite Floor Assemblies, Ceiling Side Exposed



This illustration s
for specific const

Mass Timber Panel	Topping	Acoustical Mat Products Between Concrete Composite and Upper Topping	Upper Topping	Finish Floor	Sound Rating	Impact Rating	Method of Compliance
5-layer 5.40" CLT	2.25" Concrete	Maxxon Acousti-Mat® 3/8	1" Gyp-Crete®	52	STC	50 IIC	Maxxon / Intertek Report # K3094.97-113-11-R0 Contact Product Manufacturer for More Information
5-layer 5.40" CLT	2.25" Concrete	Maxxon Acousti-Mat® 3/8	1" Gyp-Crete®	53	STC	52 IIC	Maxxon / Intertek Report # K3094.69-113-11-R0 Contact Product Manufacturer for More Information
5-layer 5.40" CLT	2.25" Concrete	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4 Premium	1.5" Gyp-Crete®	56	STC	57 IIC	Maxxon / Intertek Report # K3094.98-113-11-R0 Contact Product Manufacturer for More Information
5-layer 5.40" CLT	2.25" Concrete	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4 Premium	1.5" Gyp-Crete®	57	STC	61 IIC	Maxxon / Intertek Report # K4507.06-113-11-R0 Contact Product Manufacturer for More Information
5-layer 5.40" CLT	2.25" Concrete	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4 Premium	2" Gyp-Crete®	60	STC	61 IIC	Maxxon / Intertek Report # K3094.86-113-11-R0 Contact Product Manufacturer for More Information
5-layer 5.40" CLT	2.25" Concrete	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4 Premium	2" Gyp-Crete®	58	STC	63 IIC	Maxxon / Intertek Report # K3094.86-113-11-R0 Contact Product Manufacturer for More Information
5-layer 5.40" CLT	2.25" Concrete	5/8" OSB on 5/8" Georgia Pacific Dens Deck® on Kinetics® Ultra Quiet SR	None	60	STC	62 IIC	Veneklasen Associates / Intertek Report # K3094.19-113-11-R0 Contact Product Manufacturer for More Information

https://www.woodworks.org/resources/fire-design-of-mass-timber-structural-members/

Scott Breneman, PhD, PE, SE
WoodWorks – Wood Products Council

Fire Design of Mass Timber Structural Members

Demonstrating Fire-Resistance Ratings of Mass Timber Products

Traditionally, the role of the structural engineer on building projects has focused on structure-related tasks—member sizing, connection detailing, general notes, and specifications for structural components. Design criteria such as fire-resistance ratings (FRRs), acoustics, and aesthetics have primarily been the architect's domain. However, when it comes to mass timber, the structure often contributes to the building's passive fire resistance. This can happen when the structure is functioning as an exposed finish or when partial fire resistance is provided by a covering over the timber and the rest is provided by the timber itself. This combination of structure, finish, and fire resistance makes the mass timber design process a necessarily collaborative effort between architect and engineer.



Trinity University Dicke Hall + Business and Humanities District
Lake Flato Architects / Datum Engineers

Robert Benson Photography

This paper presents several methods for demonstrating the FRR of a mass timber element, particularly when the mass timber structural members are required to be fire-resistance-rated. These elements include horizontal assemblies (floors, roofs) and walls, which serve both structural and fire containment purposes, and structural members such as beams and columns where the purpose is mainly structural. While much of the information is introductory, it covers how to evaluate the suitability of tested horizontal cross-laminated timber (CLT) assemblies with reduced load ratings for different spans and loading conditions and the different models for calculating structural FRRs of nail-laminated timber (NLT).

Sources of FRR Requirements

For buildings designed under the International Building Code (IBC), construction type is one of the major determinants of which timber products can be used, whether the timber products can be left exposed to view, and the FRR requirements for building elements, including those constructed with mass timber products. For information on selecting construction type and determining the FRR of building elements, see the IBC and the WoodWorks publication, *Fire Requirements for Mass Timber Elements – Code Applications, Construction Types, and Fire Ratings*. The latter provides a detailed review of the sources and types of fire requirements applicable to mass timber buildings.

Generally, the IBC requires lower FRRs for smaller buildings and higher FRRs for larger buildings. Using business occupancies (B) as an example, unrated construction is allowed in some buildings up to four stories (Type III-B), and 1-hour-rated construction is permitted in some buildings up to six stories (Type III-A). For the newer Type IV-C and IV-B construction types, which can be a

Trinity University Dicke Hall + Business and Humanities District
Lake Flato Architects / Datum Engineers
Robert Benson Photography

https://www.woodworks.org/resources/fire-design-of-mass-timber-connections/

David Barber, ME, PEng
CHM Fire
Scott Breneman, PhD, PE, SE
WoodWorks – Wood Products Council

Fire Design of Mass Timber Connections

Requirements and Compliance Strategies

Introduction

This paper introduces the design of mass timber connections for fire resistance. It is intended for architects and engineers with limited experience in this type of connection design and describes pathways for compliance under the International Building Code (IBC), connection types, and methods for determining a fire-resistance rating (FRR). References are to the 2024 IBC and may be applicable to other editions.

For a more comprehensive look at the fire design of mass timber buildings, see the WoodWorks publications, *Fire Requirements for Mass Timber Elements: Code Applications, Construction Types, and Fire Ratings* and *Fire Design of Mass Timber Structural Members: Demonstrating Fire-Resistance Ratings of Mass Timber Products*.

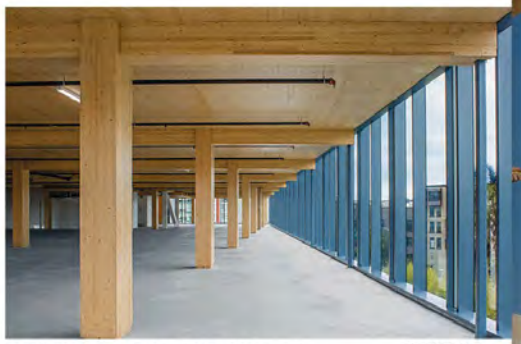
Fire-Resistance Ratings and Connections

A fire-resistance rating is a quantified measure of how long a building component or assembly—such as a wall, floor, beam, or column—can continue to function when subjected to a controlled fire exposure. Established through laboratory tests following standards like ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials and UL 263 Standard for Fire Tests of Building Construction and Material, FRRs reflect the component or assembly's ability to resist heat, prevent flame and hot gas passage, and, when applicable, support applied loads for a defined period, typically expressed in hours. The tests simulate fire conditions using a standard time-temperature curve, and tested assemblies are required to meet performance thresholds for structural stability and thermal protection. These ratings are essential standardized benchmarks in building codes, guiding design decisions to improve occupant safety and limit fire damage.

IBC Section 704 provides FRR requirements specific to structural members. This section does not explicitly mention connections; however, it states that the FRR of a structural member "shall not be less than the ratings required for the fire-resistance-rated assemblies supported by the structural members." For connections between fire-resistance-rated structural members, the connection needs fire protection that achieves at least the same FRR as the supported member(s).

Other sections of the IBC have FRR requirements that apply to structural members based on aspects of the project such as construction type (Table 601), occupancy separations (Section 508), dwelling unit separations (Section 420.1), and support of horizontal assemblies (Section 711).

If a connection has a fire protection requirement, the two main paths for demonstrating fire resistance of the connection assembly are the same as for structural members: testing and approved analytical methods.



1 De Haro / SKS Partners / Perkins&Will / DCI Engineers

Photo: David Wakely

Perkins&Will
Photo: Kyle Jeffers

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  - Workforce Development

Value Analysis

$$\text{Value} = \frac{\uparrow \text{Function} + \uparrow \text{Aesthetics}}{\downarrow \text{Cost}}$$



Cost Impacts of Construction Type

Construction Type Early Decision Example



4-story building on college campus

- Mostly Group B occupancy, some assembly (events) space
- NFPA 13 sprinklers throughout
- Floor plate = 7,700 SF
- Total Building Area = 23,100 SF

Impact of Assembly Occupancy Placement:

- Owner originally desires events space on top (4th) floor
  - Requires Construction Type IIIA
- If owner permits moving events space to 1st, 2nd or 3rd floor
  - Could use Type IIIB

Cost Impacts of Construction Type

Construction Type Early Decision Example



4-story building on college campus

Cost Impact of Assembly Occupancy Placement:

Location of Event Space	4th Floor	1st Floor
Construction Type	III-A	III-B
Assembly Group	A-3	A-3
Fire Resistive Rating	1-Hr	0-Hr
Connections	Concealed	Exposed
CLT Panel Thickness	5-Ply	3-Ply
Superstructure Cost/SF	**$65/SF**	**$53/SF**



Source: PCL Construction

Cost Impacts of Design Choices

Panel volume usually 65-80% of MT package volume

Type IIIA option 1

1-hr FRR

Purlin: 5.5”x28.5”

Girder: 8.75”x33”

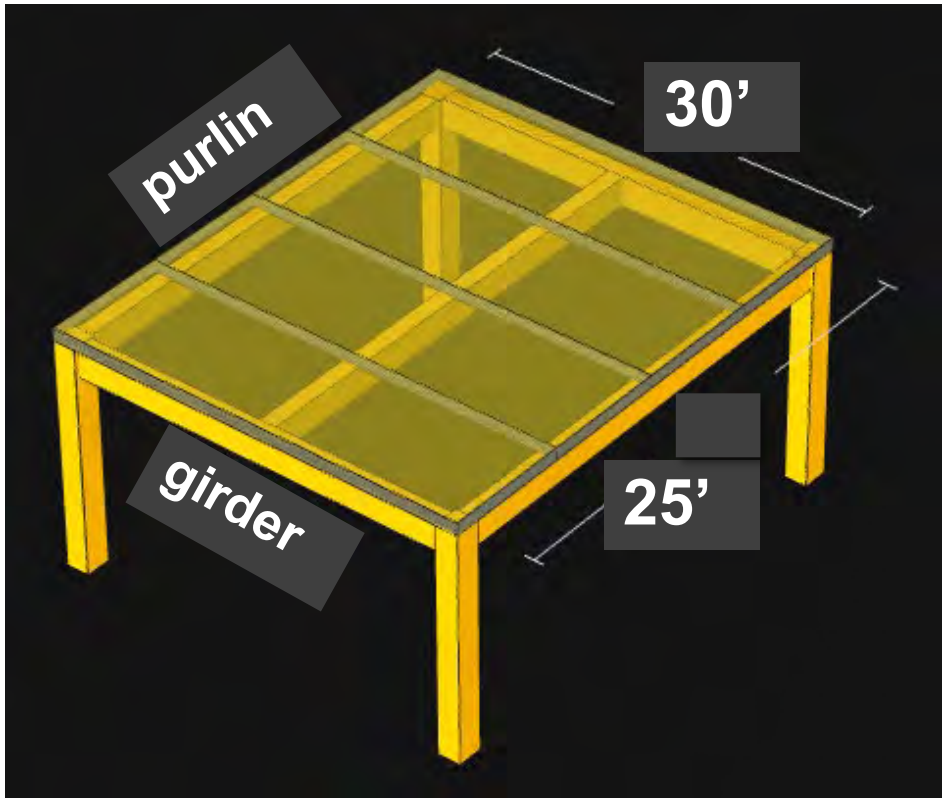
Column: 10.5”x10.75”

Floor panel: 5-ply

Glulam volume = 118 CF (22% of MT)

CLT volume = 430 CF (78% of MT)

Total volume = 0.73 CF / SF



Source: Fast + Epp, Timber Bay Design Tool

Cost Impacts of Design Choices

Panel volume usually 65-80% of MT package volume

Type IIIA option 2

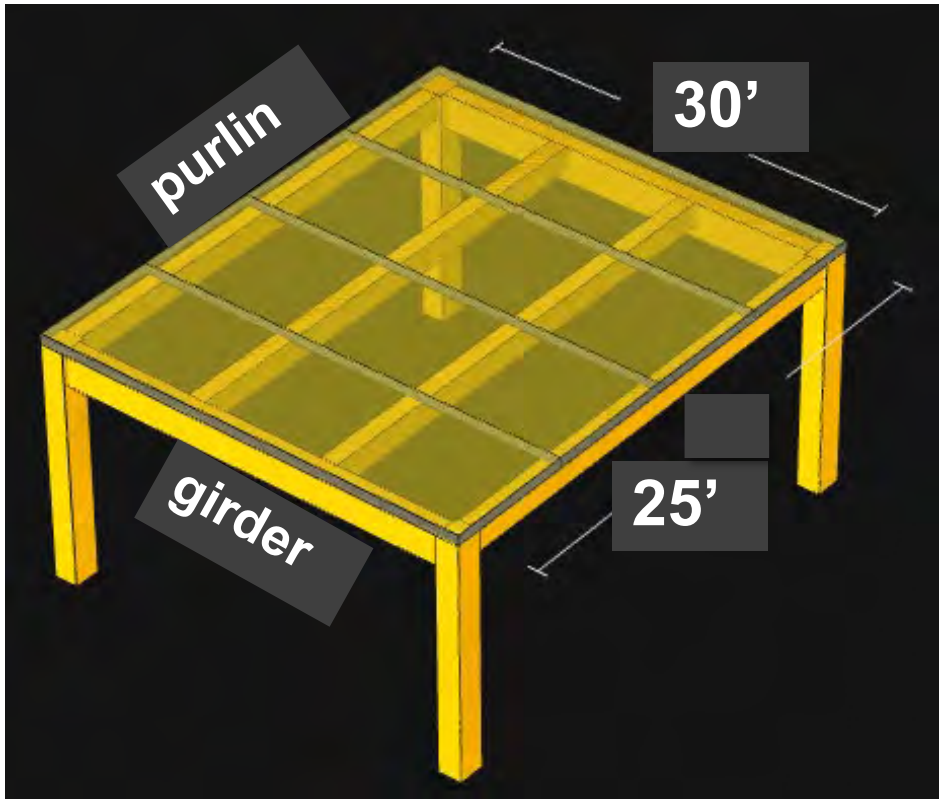
1-hr FRR

Purlin: 5.5”x24”

Girder: 8.75”x33”

Column: 10.5”x10.75”

Floor panel: 5-ply



Source: Fast + Epp, Timber Bay Design Tool

Glulam volume = 123 CF (22% of MT)

CLT volume = 430 CF (78% of MT)

Total volume = 0.74 CF / SF

Cost considerations: One additional beam (one additional erection pick), 2 more connections

Cost Impacts of Design Choices

Panel volume usually 65-80% of MT package volume

Type IV-HT

0-hr FRR (min sizes per IBC)

Purlin: 5.5”x24” (IBC min = 5”x10.5”)

Girder: 8.75”x33” (IBC min = 5”x10.5”)

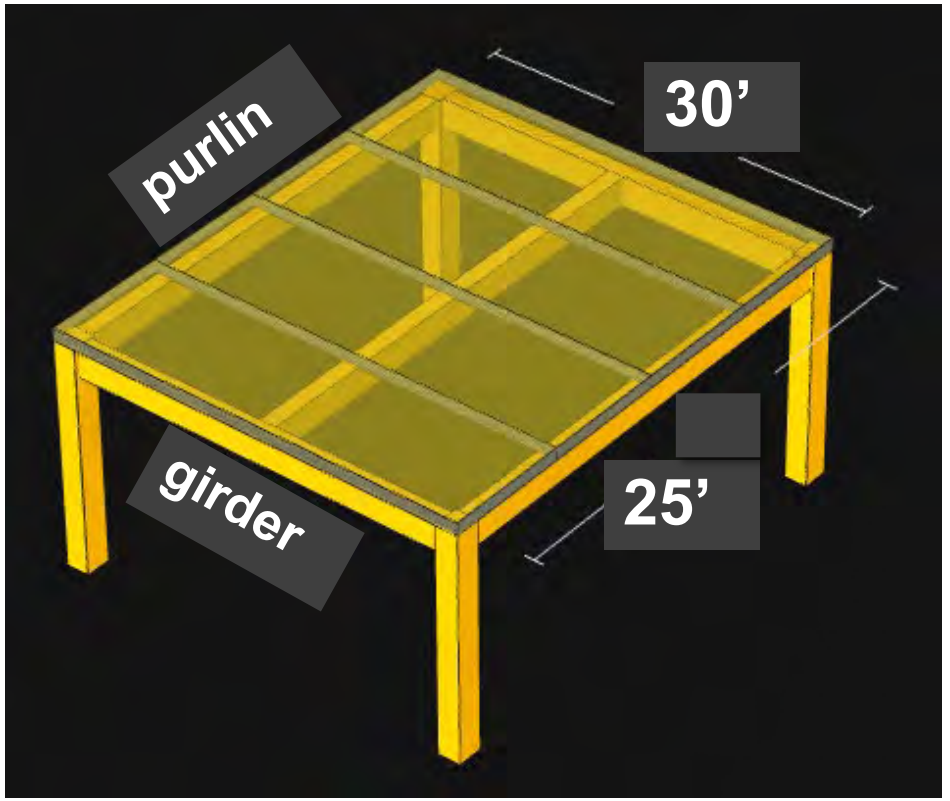
Column: 10.5”x10.75” (IBC min = 6.75”x8.25”)

Floor panel: 3-ply (IBC min = 4” CLT)

Glulam volume = 120 CF (32% of MT)

CLT volume = 258 CF (68% of MT)

Total volume = 0.51 CF / SF



Source: Fast + Epp, Timber Bay Design Tool

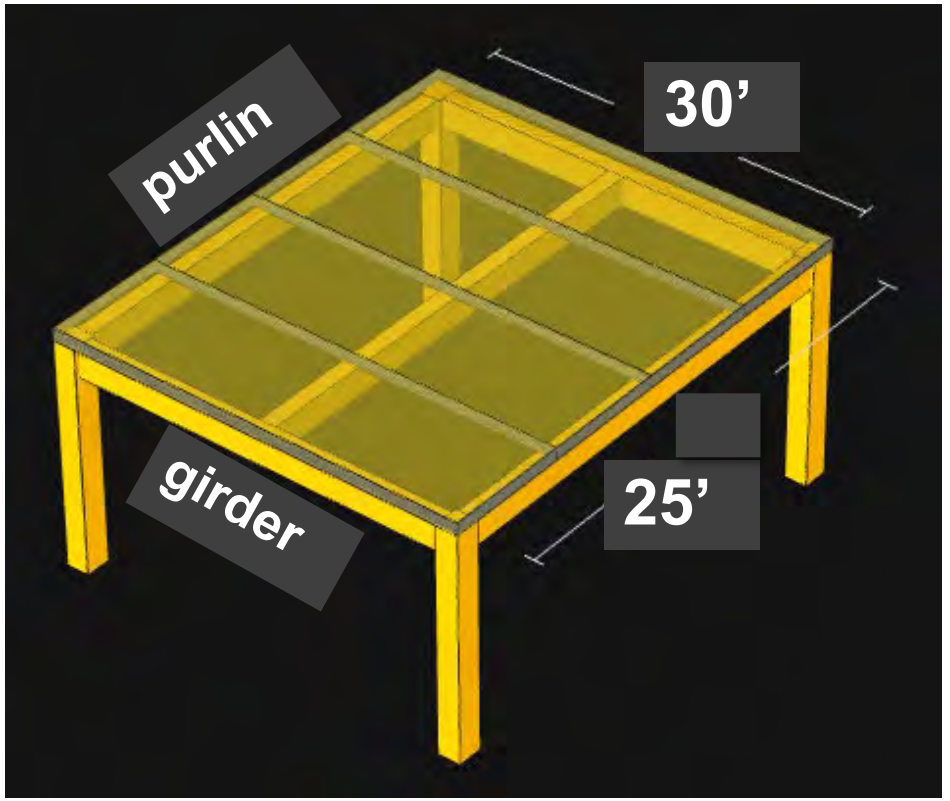
Cost Impacts of Design Choices

Panel volume usually 65-80% of MT package volume

Which is the most efficient option?

	Timber Volume Ratio
III-A – Option 1	0.73 CF / SF
III-A – Option 2	0.74 CF / SF
IV-HT	0.51 CF / SF

A general rule of thumb for efficient mass timber fiber volume is no higher than 0.75 CF per SF for up to a 1 hour rated structure (higher if 2-hour exposed timber in tall mass timber). Ratios in the 0.85 to 1.0 CF / SF range tend to become cost prohibitive



Source: Fast + Epp, Timber Bay Design Tool

Expert Tips

Key Design Considerations for Mass Timber Projects

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

Share

Selecting a Construction Type

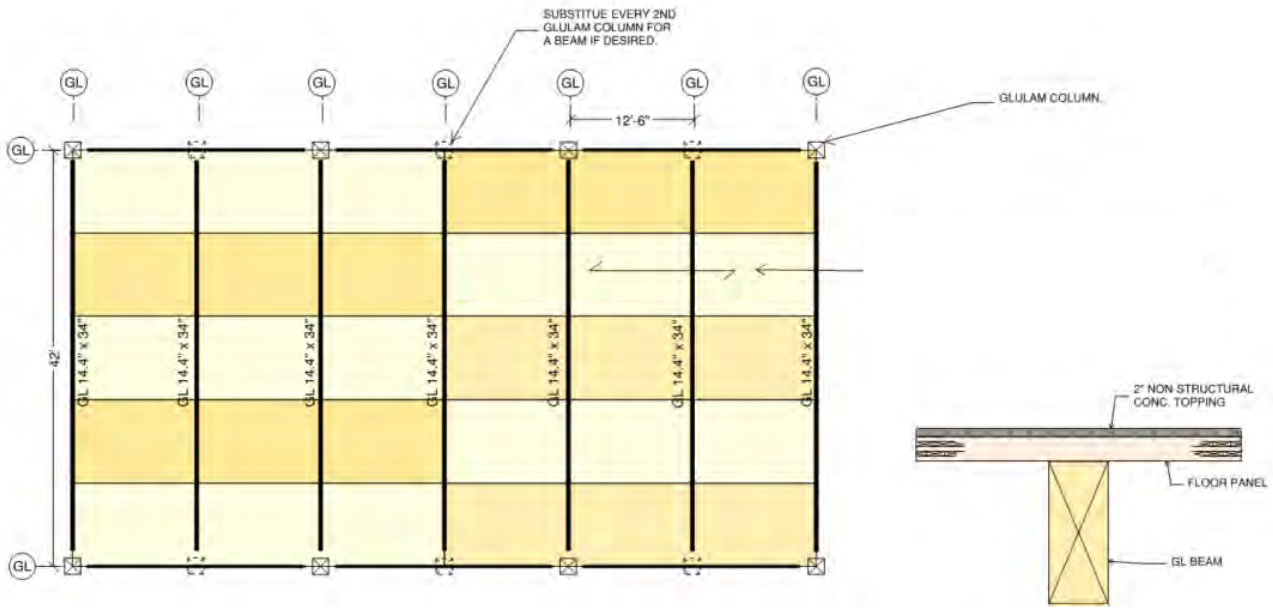
For mass timber projects, selection of construction type is one of the more significant design decisions. While it's common to choose construction type based on structural material—i.e., to assume that steel and concrete structures should be Type II, light-frame wood should be Type V, and exposed heavy/mass timber should be Type IV—this approach can lead to additional costs. While Type IV construction can be used for exposed

Cost Proposition



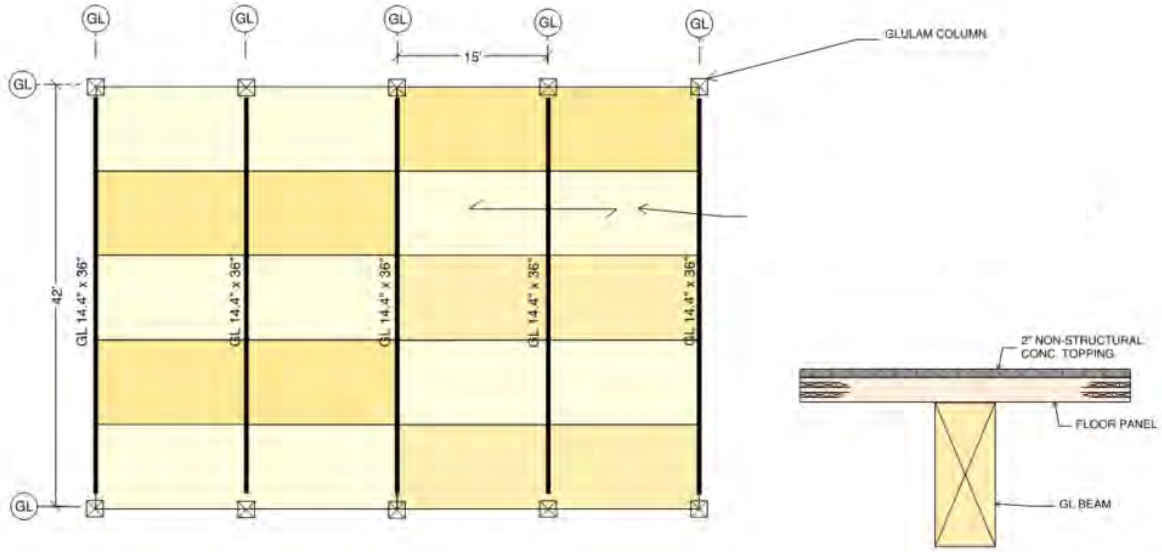
Photo: Swinerton

Cost: Structural System & Grid



Baseline

12’-6” Glulam Spacing



$ +5%

15’ Glulam Spacing

Source: Seattle Mass Timber Tower Book

Expert Tips

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.

Share

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

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



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



Photo Credit: StructureCraft



Photo Credit: GLI Partners

Insurance vs. Building Codes

- It is important to note the distinct difference between the primary concerns of insurers vs. primary concerns of building codes
- Insurance primarily concerned with property loss
- Building codes primarily concerned with occupant safety

- As such, code acceptance and associated testing may be helpful to insurers in evaluating a new product like mass timber, but it will not address all concerns





https://www.woodworks.org/resources/mass-timber-insurance-playbook/

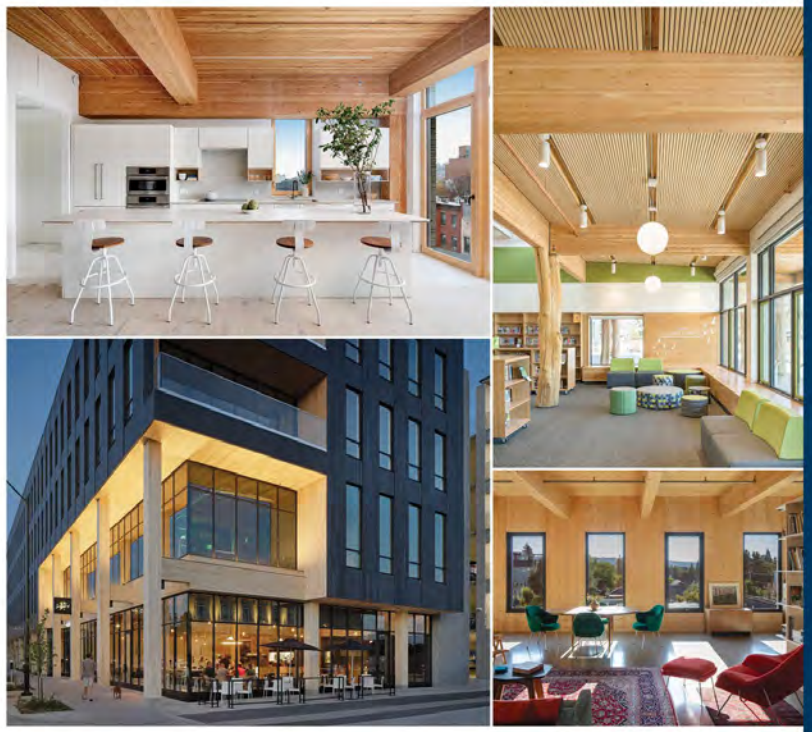
11 E Lenox / Monte French Design Studio / H+O Structural Engineering
Photo H+O Structural Engineering

The Mass Timber Insurance Playbook

U.S. Edition

A guide to insuring mass timber buildings

Co-authored by Philip Callow and Jim Glockling
Adapted for the United States by Mike Hastings in collaboration with WoodWorks – Wood Products Council
U.S. Edition published by WoodWorks



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

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



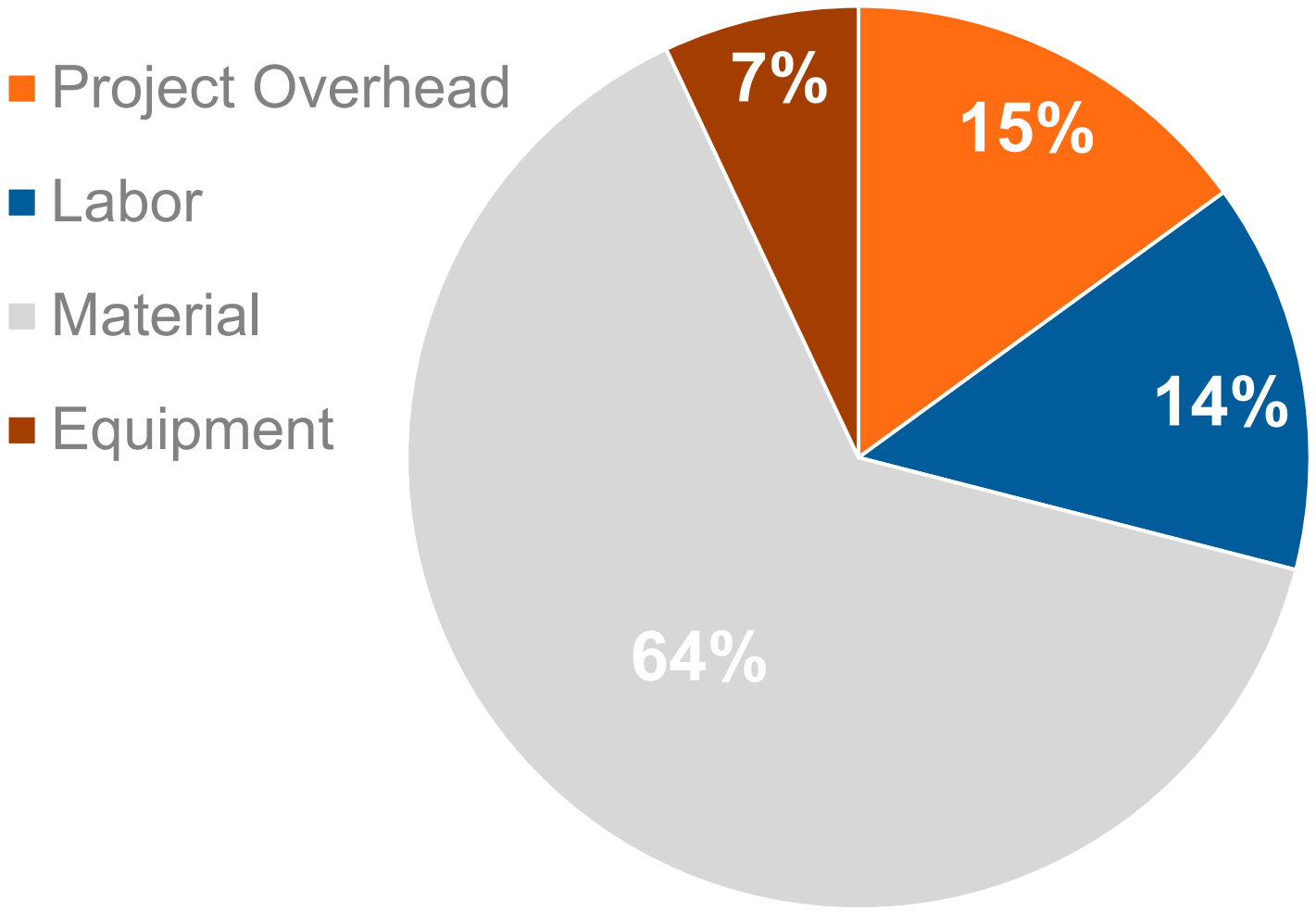
$/SF



$/SF

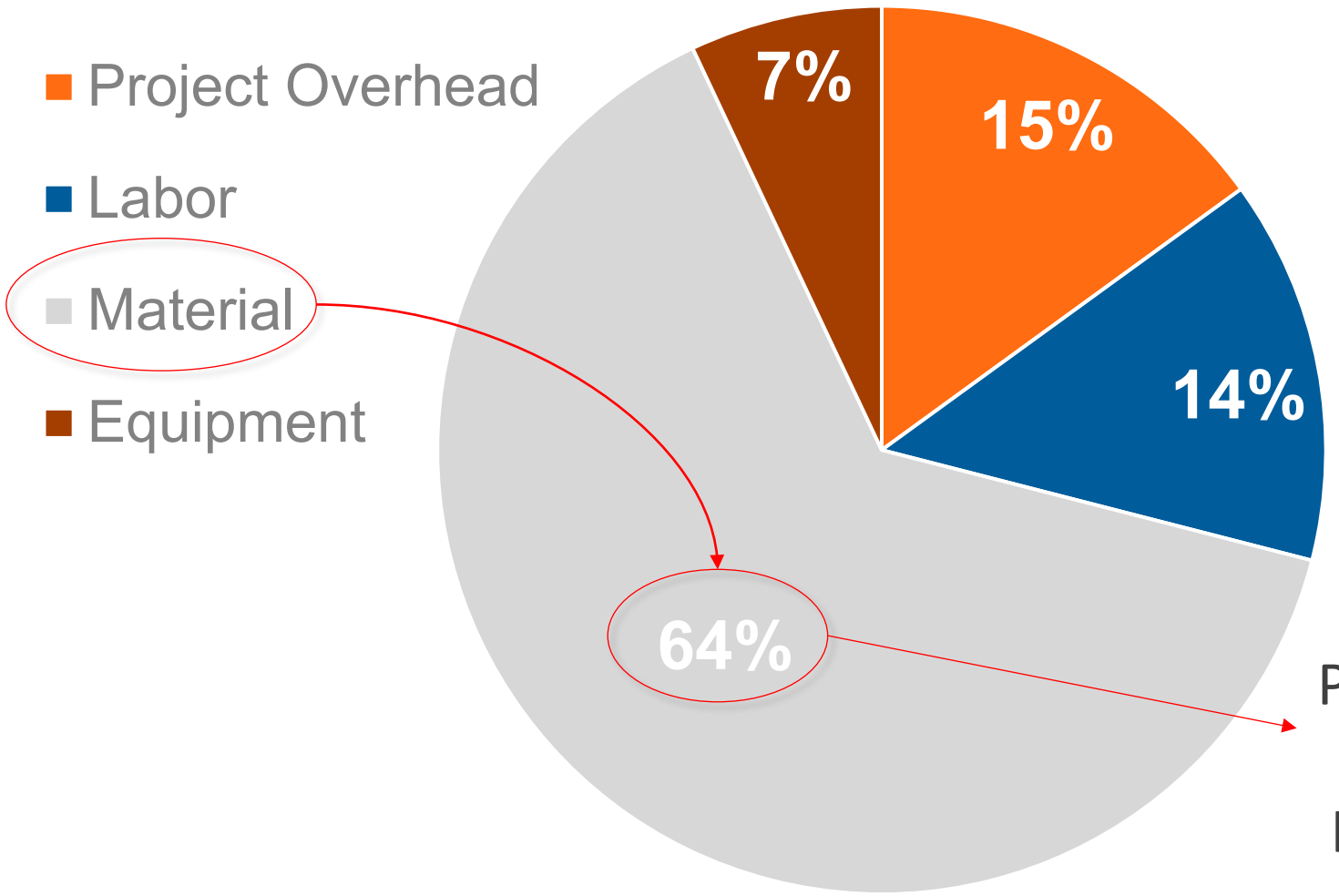
Image: GBD Architects

Anatomy of a Turnkey Mass Timber Package



Source: Swinerton

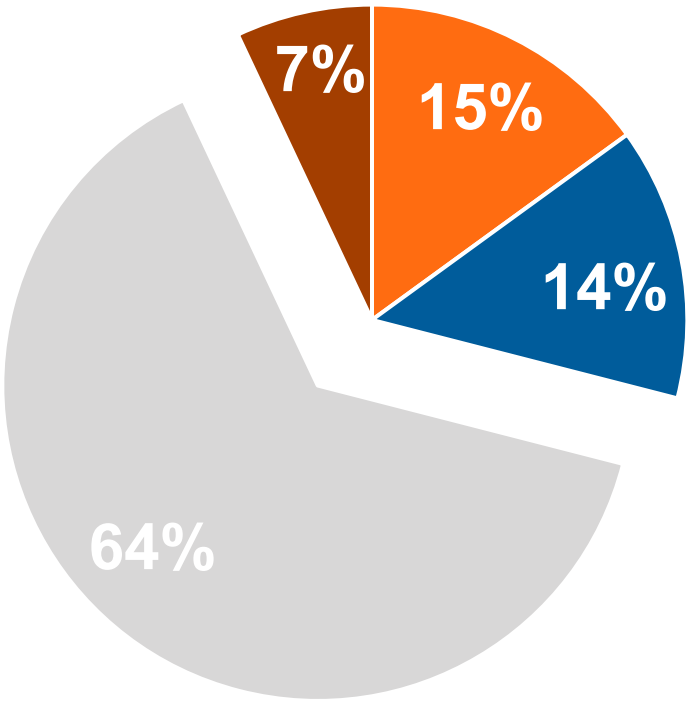
Mass Timber Package Costs



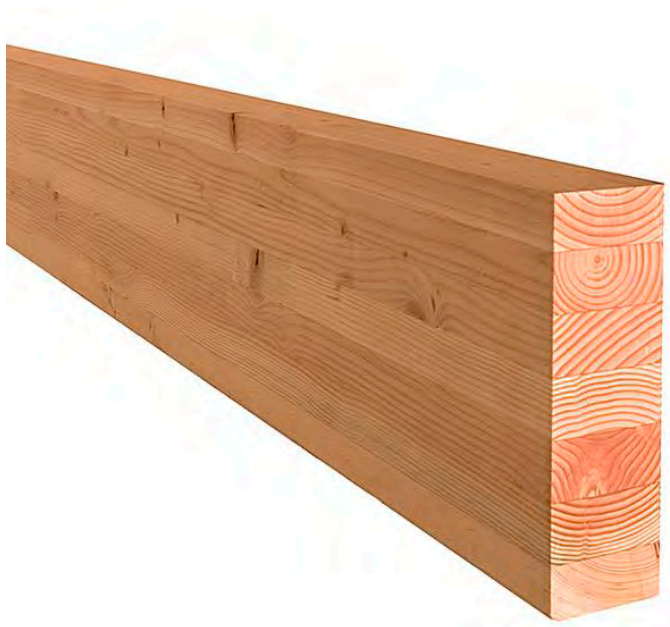
Panels are the biggest part of the biggest piece of the cost pie.

Source: Swinerton

Material (Direct Cost)



Turnkey Mass Timber Package



or



Source: Swinerton

Total Project Cost Analysis

CONSIDERATIONS:

- Ceiling Treatment
- Floor Topping
- HVAC System & Route
- Foundation Size
- Soil Improvements
- Exterior Skin Coordination
- Value of Time



Credit: Hacker Architects

Sample Procurement Strategies

GC/CM Hires Turnkey Mass Timber Subcontractor	GC/CM Buys Material, Self-Performs Installation and Coordinates	GC/CM Buys Material, Subcontracts Labor and Coordinates
RISK SPECTRUM		
+ Hiring experience + Single point of responsibility	+ Hiring experience + Single point of responsibility + Financial security of strong GC/CM	+ Potential added mark-up
– Prequalify capacity of subs – Potential added mark-up	– Lack of familiarity with supply chain – Steep learning curve for coordination	– Multiple layers of coordination – Prequalify capacity of sub

Source: Timberlab

Risk Mitigation: Trade Partner/Master Builder Approach

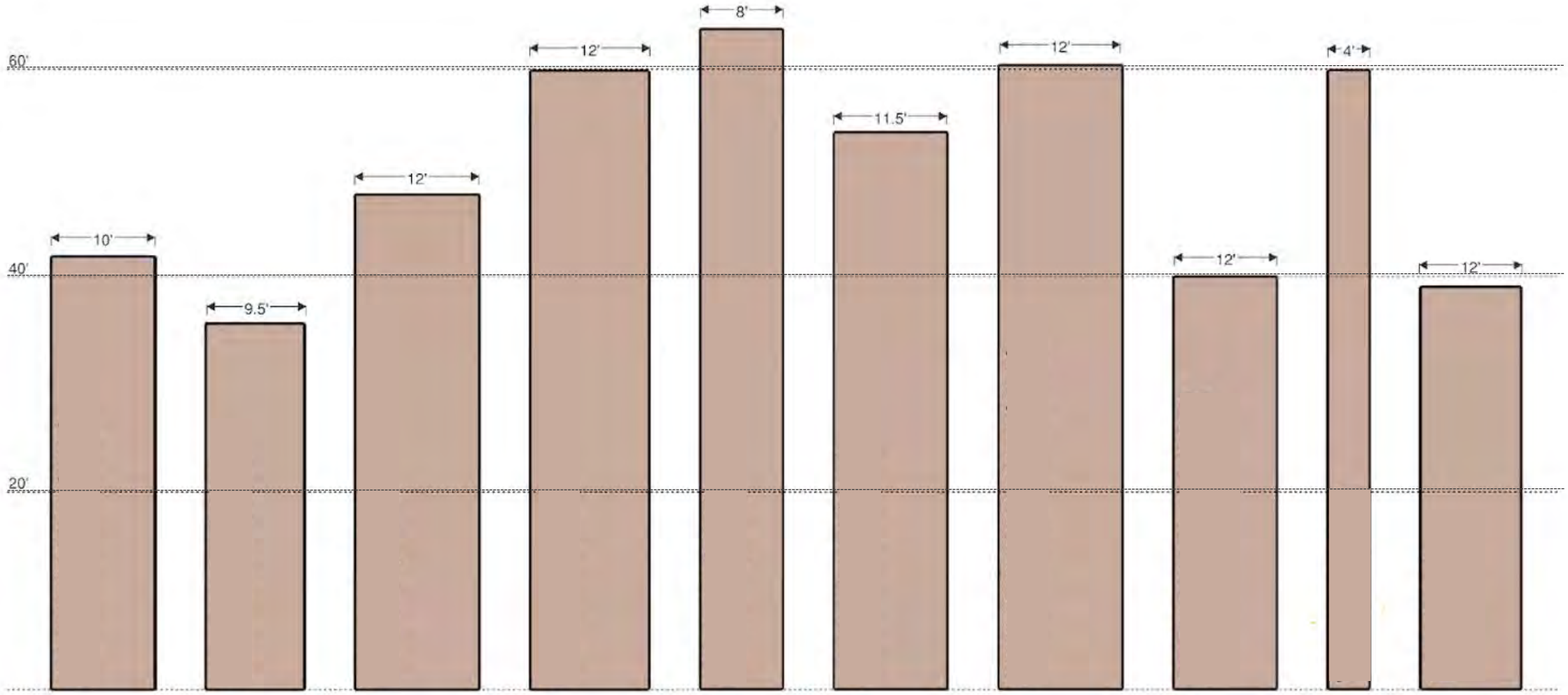


Risk: Lack of Supply Chain Understanding



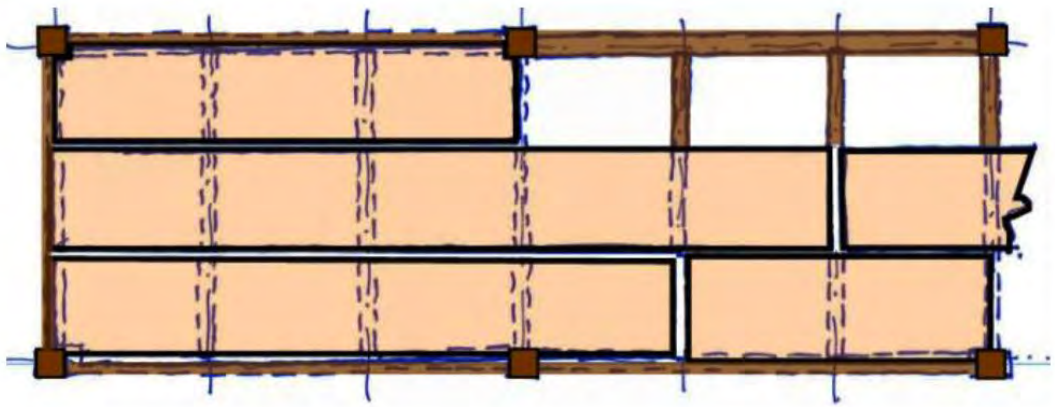
Photo: Swinerton

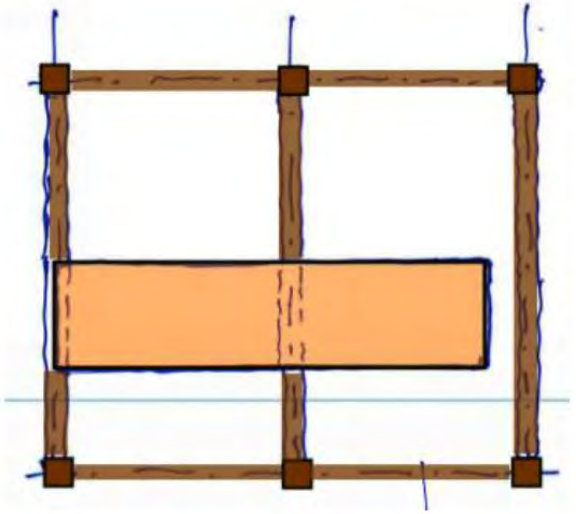
Understand Manufacturer's Capabilities

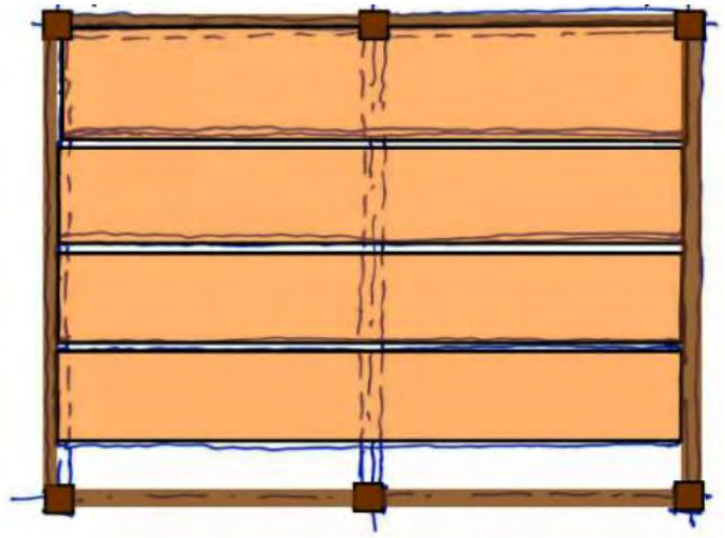


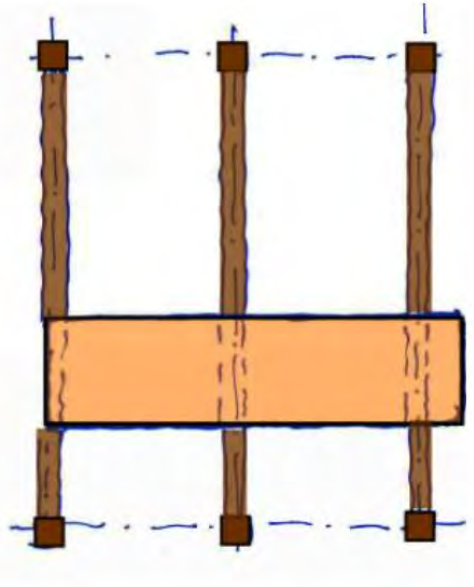
Credit: TimberLab

Understand Manufacturer's Capabilities









Credit: Tanya Luthi, Entuitive

Embrace the Prefab Advantage



Photo: Swinerton

Schedule



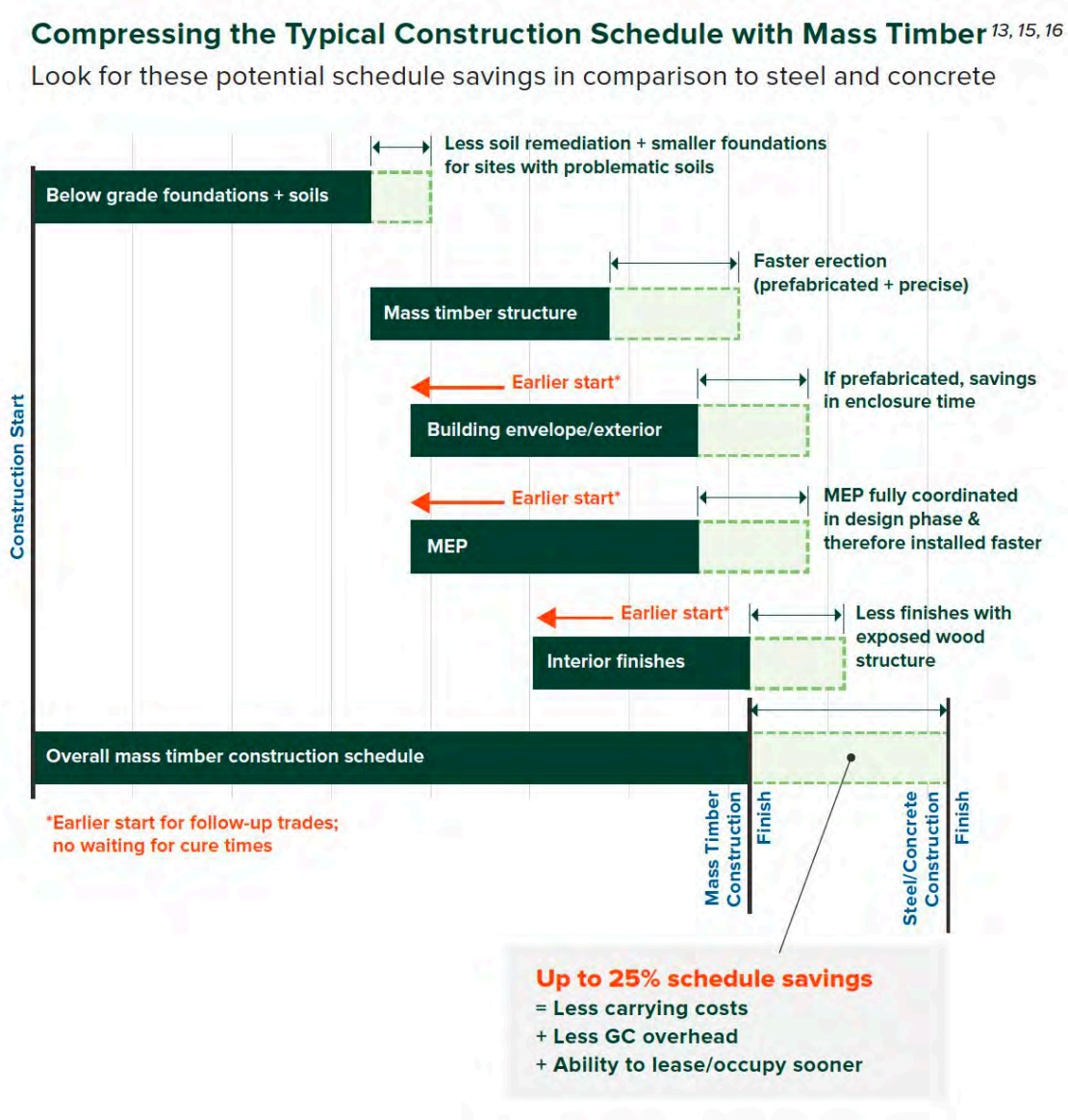
Photo: Swinerton

Procurement Approach Determines Schedule



Photo: Alex Schreyer

Procurement Approach Determines Schedule

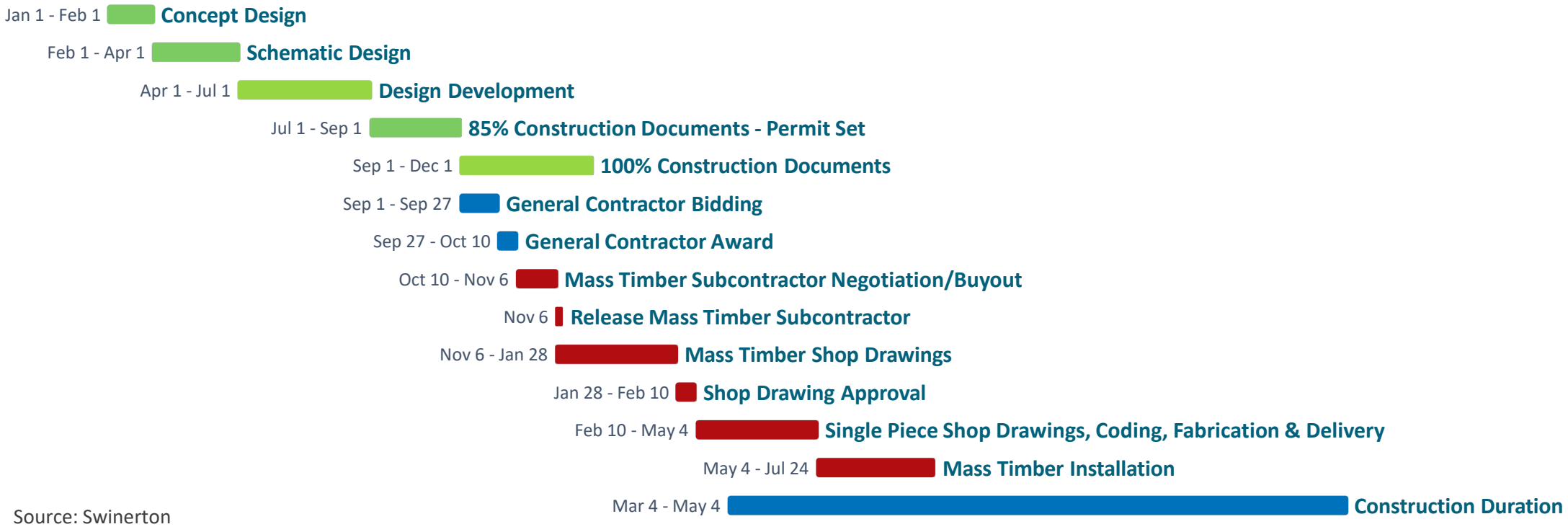


Source: WoodWorks

Procurement Approach Determines Schedule

Example 6-Story Type III-A Project

Design-Bid-Build Procurement

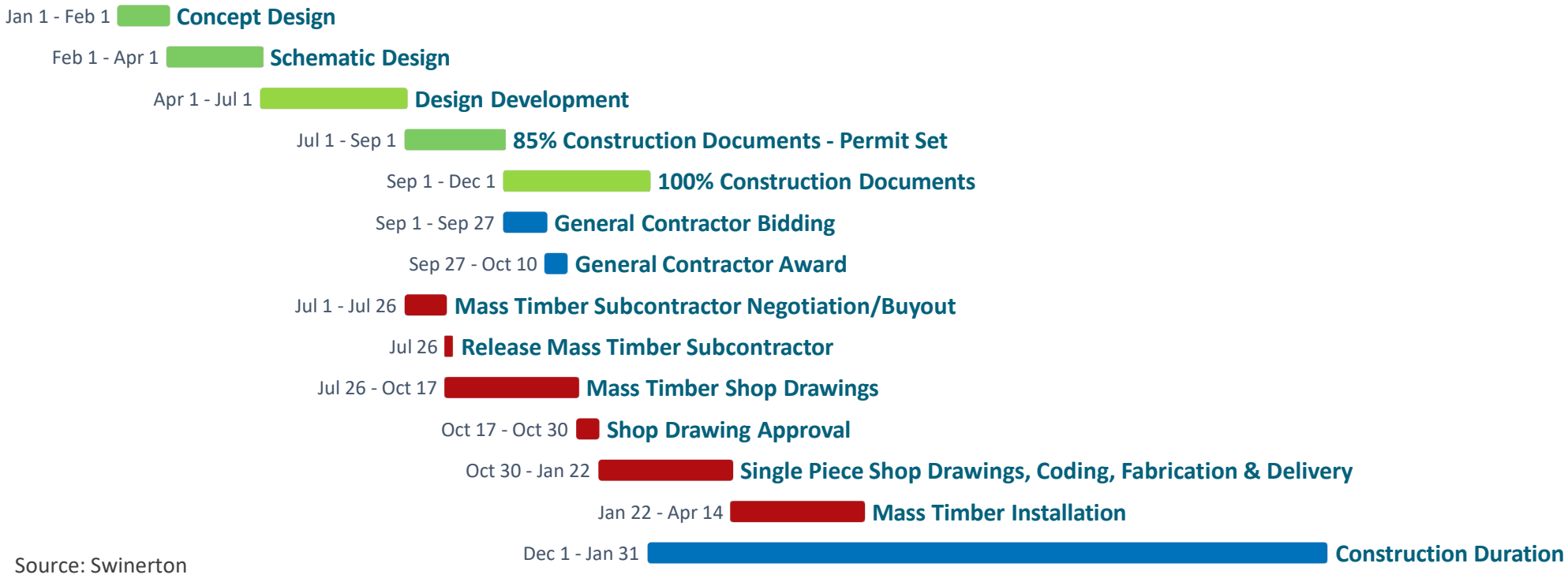


Source: Swinerton

Procurement Approach Determines Schedule

Example 6-Story Type III-A Project

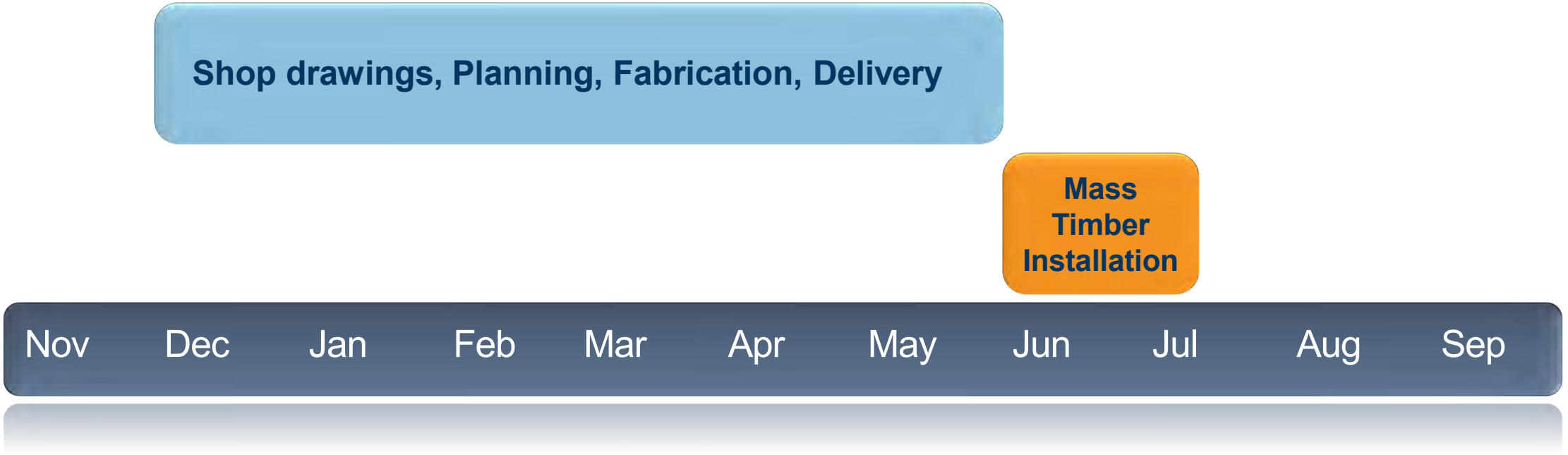
Design-Build/Design-Assist Procurement



Source: Swinerton

Procurement Logic for Scheduling

Example 6-Story Type III-A Project



Source: Swinerton

Schedule Savings for Rough-In Trades

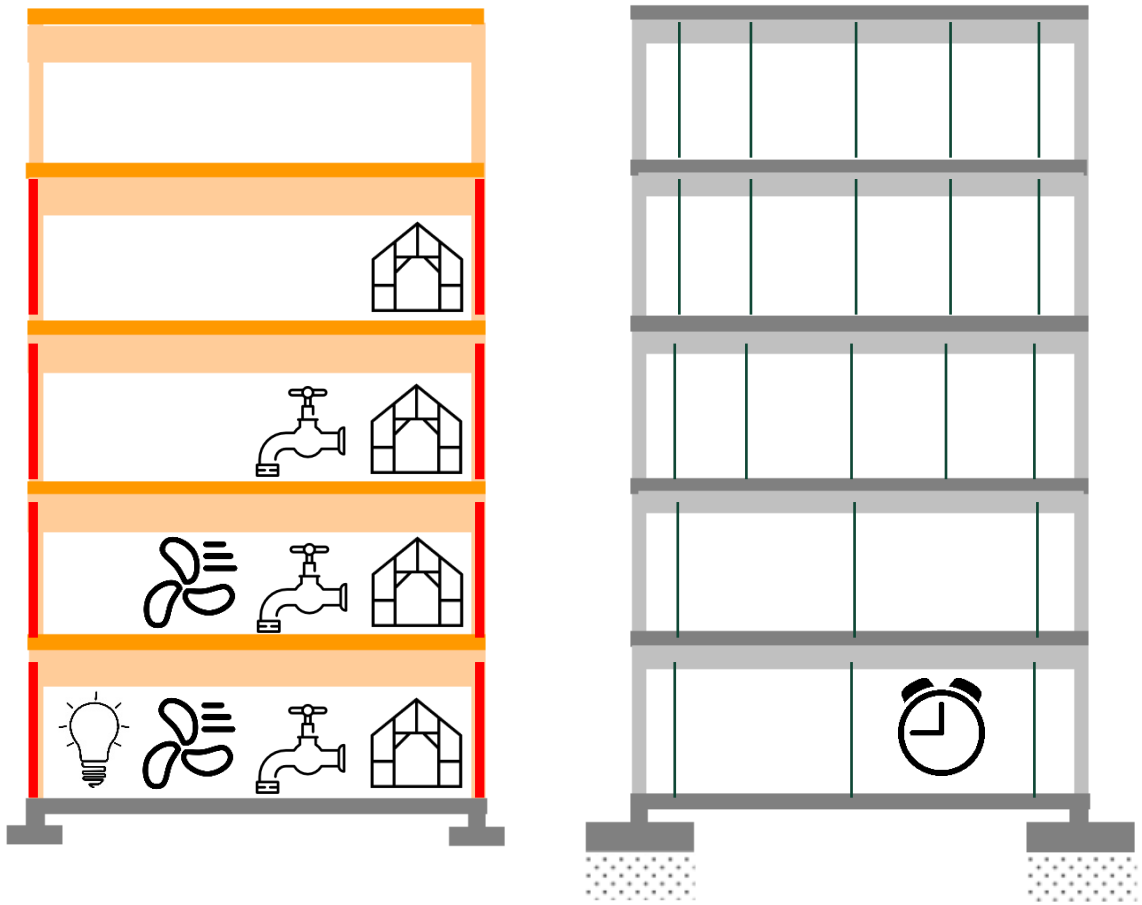


Image: Swinerton



Photo: WoodWorks

Early Move-In for Rough-In Trades

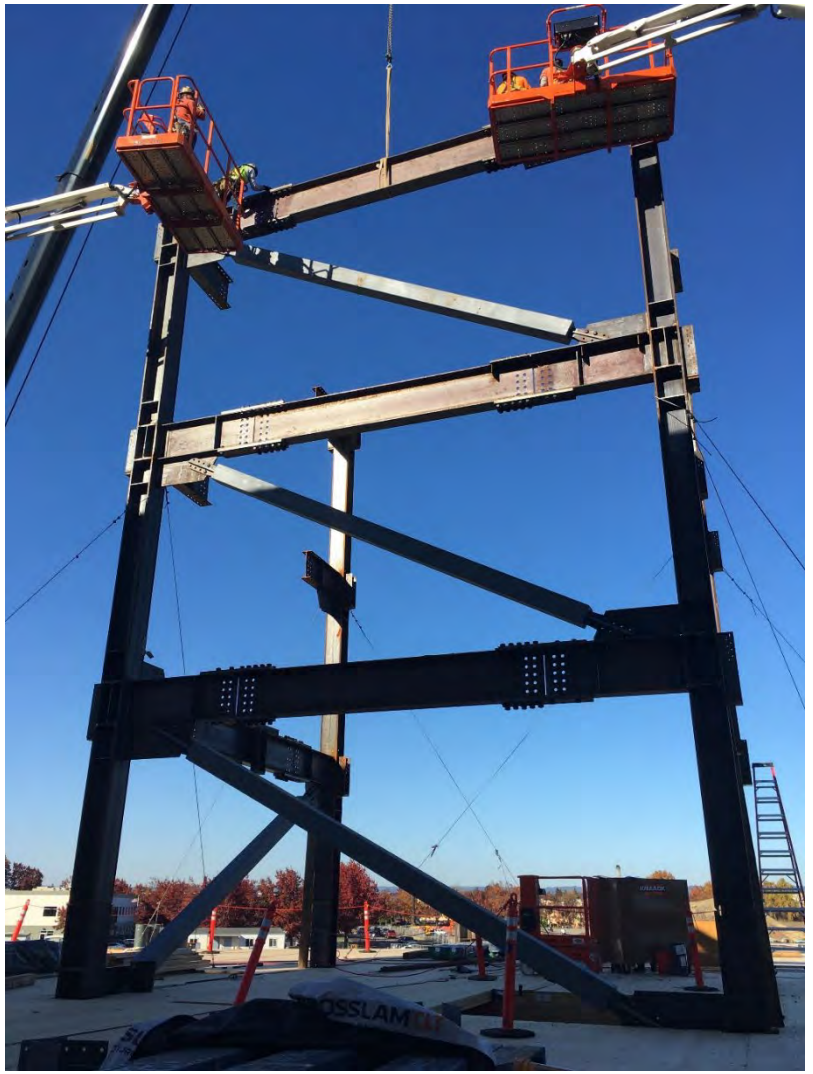


Photos: Swinerton



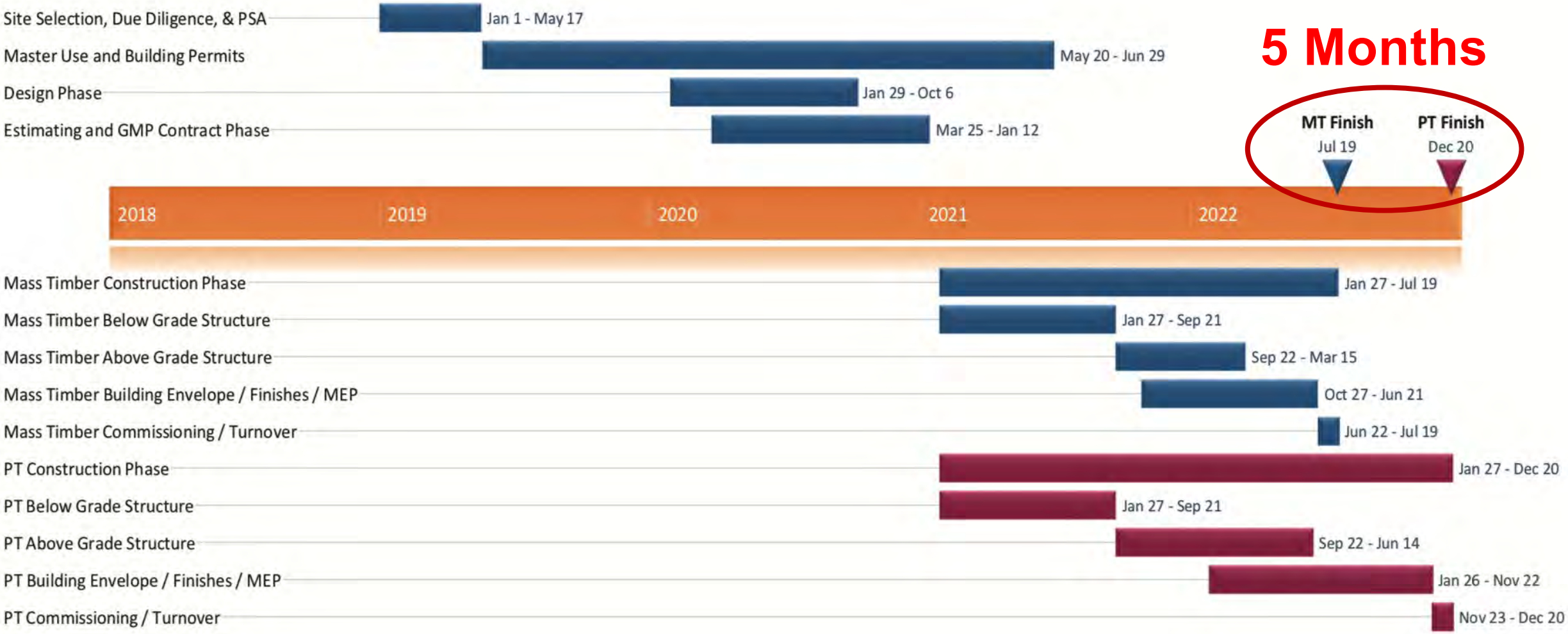
Schedule Impacts: Hybrid Structures





Photos: Swinerton

Overall Project Cost Analysis: 12 Story Type IV-B



Source: Swinerton

Schedule Impact on Cost | Value of Time

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.



Source: Swinerton
Photo: Alex Schreyer

Outline

- Mass Timber Overview
  - Products
  - Structural Solutions and Connections
  - Projects and Code Considerations
- Mass Timber Construction
  - Planning for Construction
  - Performing Construction
  - Workforce Development

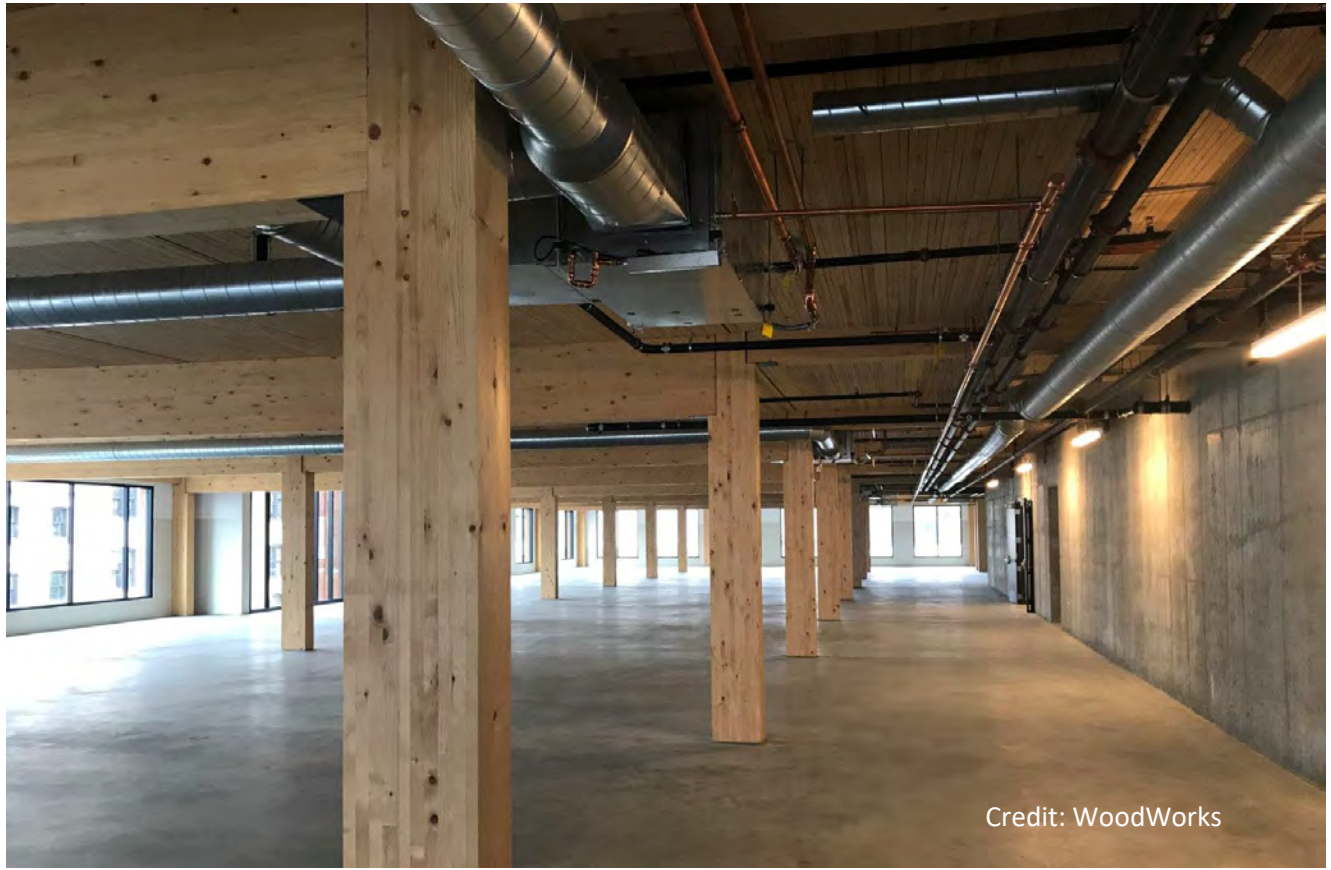
MEP Layout & Integration



MEP Smaller Grid Bays at Central Core

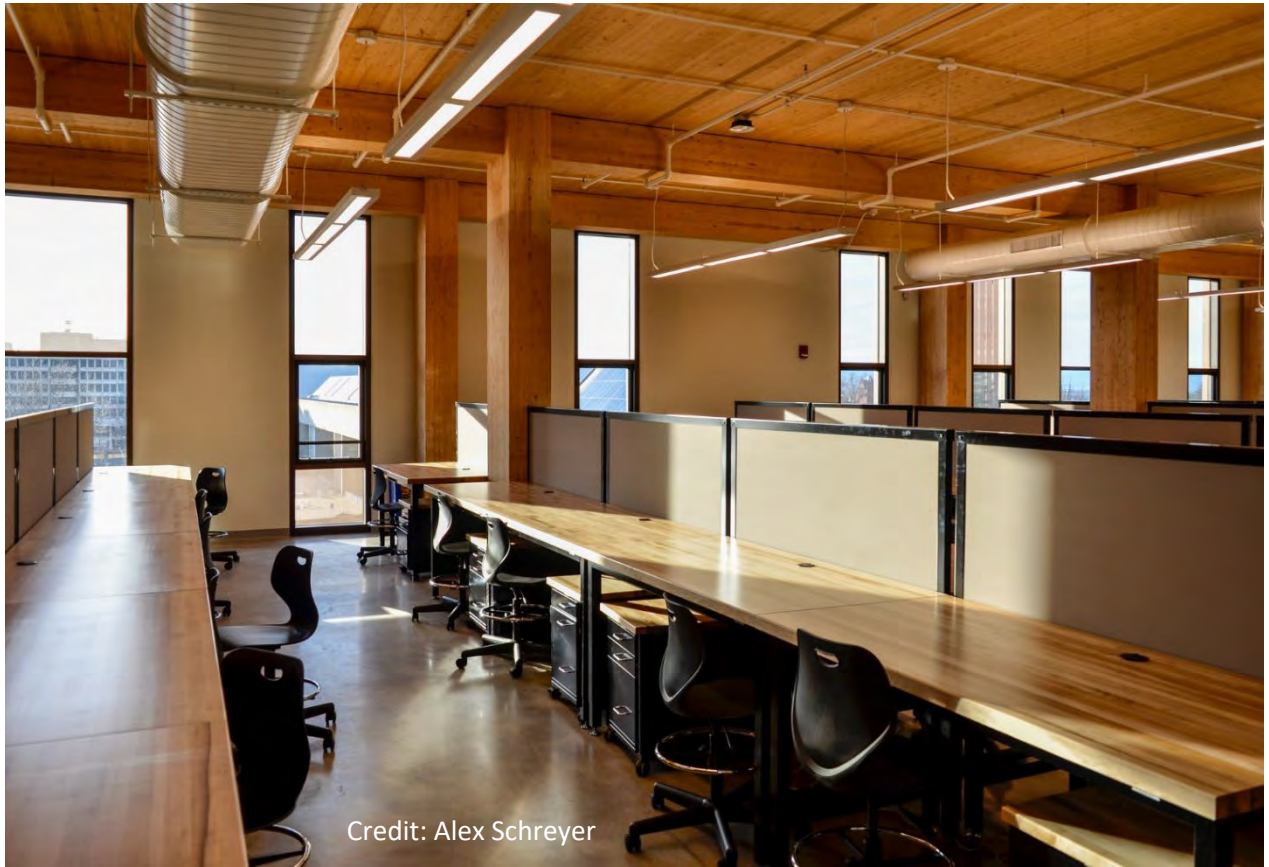
- More head height
- Main MEP trunk lines around core, smaller branches in exterior bays


Credit: Blaine Brownell


Credit: WoodWorks

MEP Dropped Below MT Framing

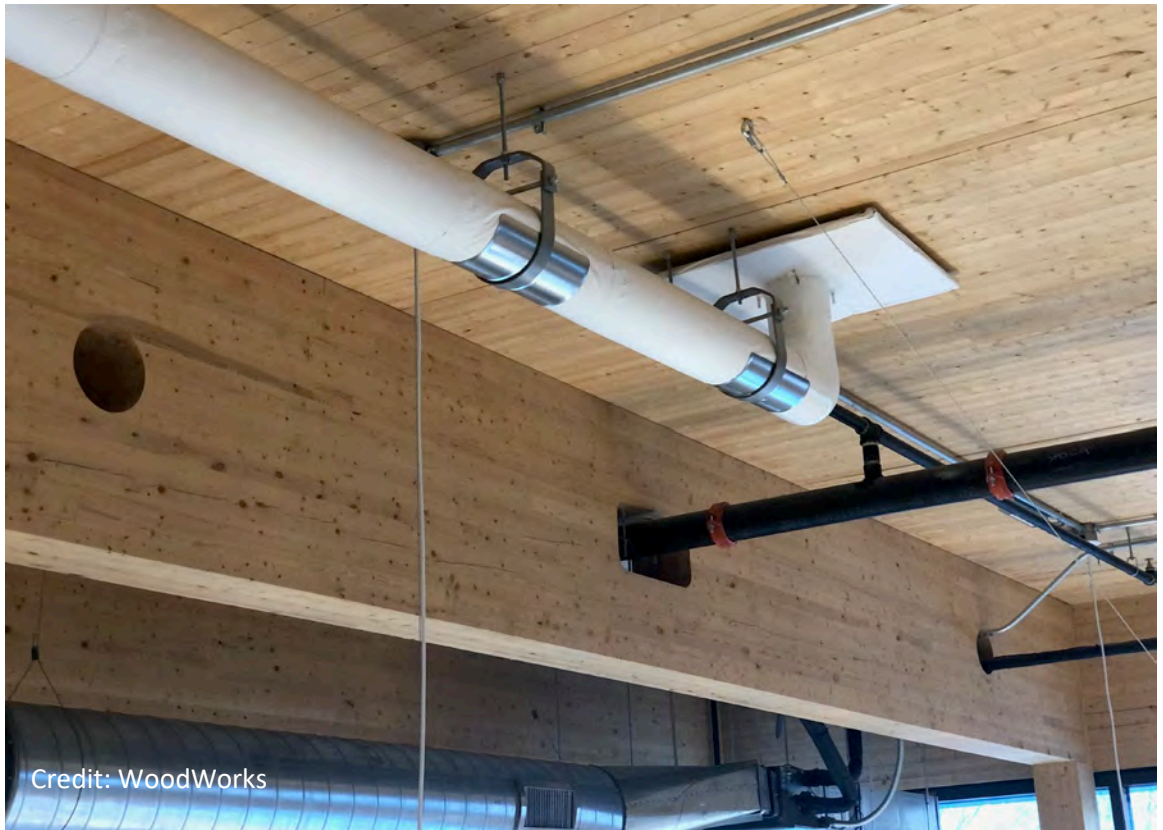
- Can simplify coordination (fewer penetrations)
- Bigger impact on head height


Credit: Alex Schreyer


Credit: WoodWorks

MEP In Penetrations Through MT Framing

- Requires more coordination (penetrations)
- Bigger impact on structural capacity of penetrated members
- Minimal impact on head height


Credit: WoodWorks


Credit: WoodWorks

MEP In Chases Above Beams And Below Panels

- Fewer penetrations
- Bigger impact on head height (overall structure depth is greater)
- FRR impacts: top of beam exposure


Credit: JC Buck


Credit: KL&A Engineers & Builders

MEP In Gaps Between MT Panels

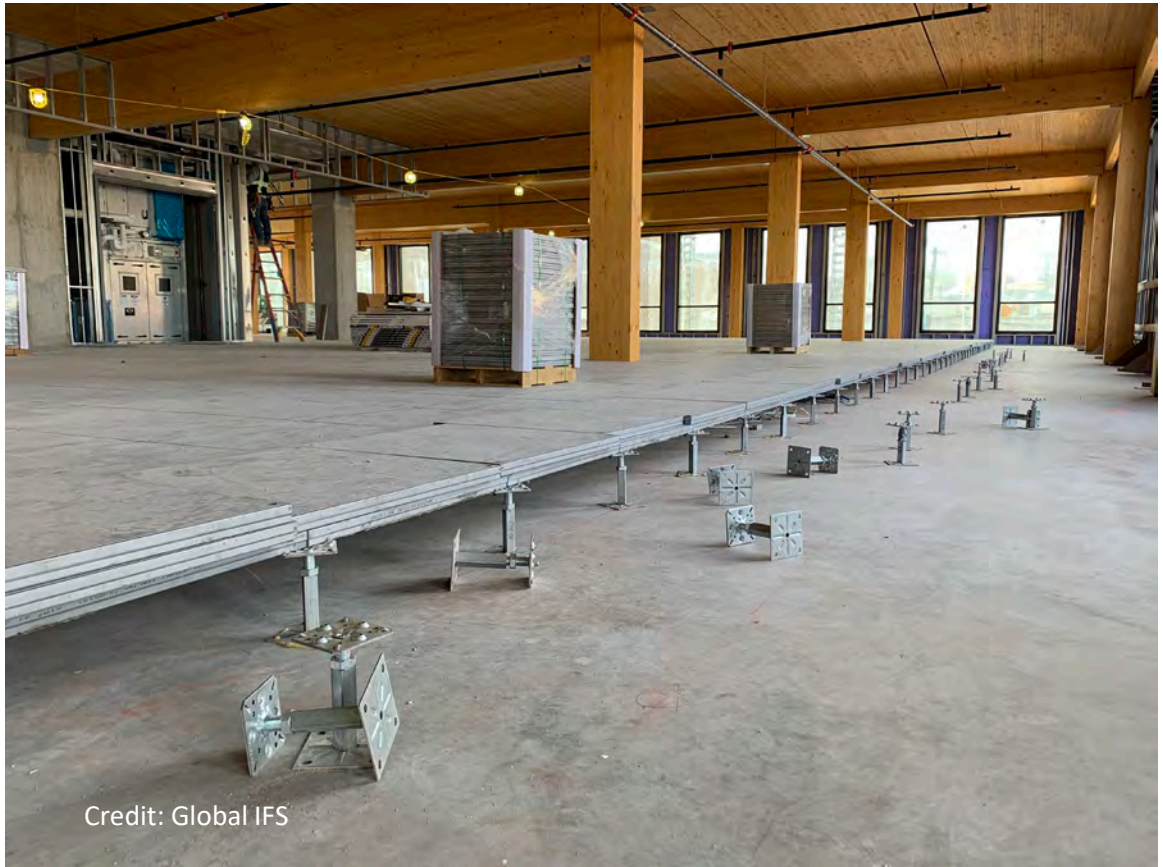
- Fewer penetrations, can allow for easier modifications later


Credit: Ema Peter/MGA


Credit: Hacker Architects

MEP In Raised Access Floor (RAF) Above MT

- Impact on head height
- Concealed space code provisions





MEP In Topping Slab Above MT

- Greater need for coordination prior to slab pour
- Limitations on what can be placed (thickness of topping slab)
- No opportunity for renovations later



https://www.woodworks.org/resources/integrating-mepf-in-mass-timber-buildings/

T3 Minneapolis
MGA | Michael Green Architecture / DLR Group
Magnusson Klemencic Associates / StructureCraft

Julie Gorham, PE, *Excel Engineering in collaboration with WoodWorks – Wood Products Council*

Integrating MEPF in Mass Timber Buildings

Techniques for Incorporating Building Infrastructure Systems in Exposed Wood Structures

The opportunity to leave structural elements exposed in a mass timber building offers tremendous design possibilities. It also brings creative challenges not seen with other building types, such as how to expose as much of a mass timber ceiling as possible and keep it relatively uncluttered to emphasize the beauty and biophilic properties of the natural wood panels. This requires careful attention to mechanical, electrical, plumbing, and fire suppression systems (MEPF), either to hide them in concealed areas or incorporate them in a way that suits the architectural design.

This paper explores strategies being used to incorporate MEPF in U.S. mass timber buildings. While there is no "best" approach, effective integration considers the impacts of services on all aspects of the project, including aesthetics, structural performance, fire protection requirements, grid utilization, reconfigurability, and cost. MEPF options should be considered early and often during the design of a mass timber building to avoid issues later.

Elements commonly left exposed:

- Ducting for forced air distribution and exhaust
- Sprinklers (piping and heads)
  - Easier to meet requirements for distribution, density, and coverage of sprinkler lines and heads
- Electrical conduit
  - Exposed more frequently in office and institutional buildings

Elements commonly concealed (e.g., with dropped ceilings, topping slabs, soffits, chases, and within walls):

- Plumbing supply and drain lines
  - Dropped ceilings common in bathrooms and kitchens, which are often stacked story-to-story
- Data and low-voltage cabling
- Hydronic piping
- Electrical conduit

Common Approaches to MEPF in Exposed Wood Structures

In a multi-family building, designers often expose mass timber ceilings in living rooms, bedrooms, dining areas, and hallways of dwelling units, and use dropped ceilings in kitchens, bathrooms, and corridors to conceal the heavier concentration of MEPF systems. In office, retail, assembly, and institutional buildings, it is common to expose mass timber ceilings in all areas except bathrooms, mechanical rooms, and other spaces with significant MEPF systems.

Photo Chad Davis



DPR Office / SmithGroup / Buehler Engineering

Site Planning



Photo: Swinerton

QA/QC



Photo: Swinerton

Site Inspections

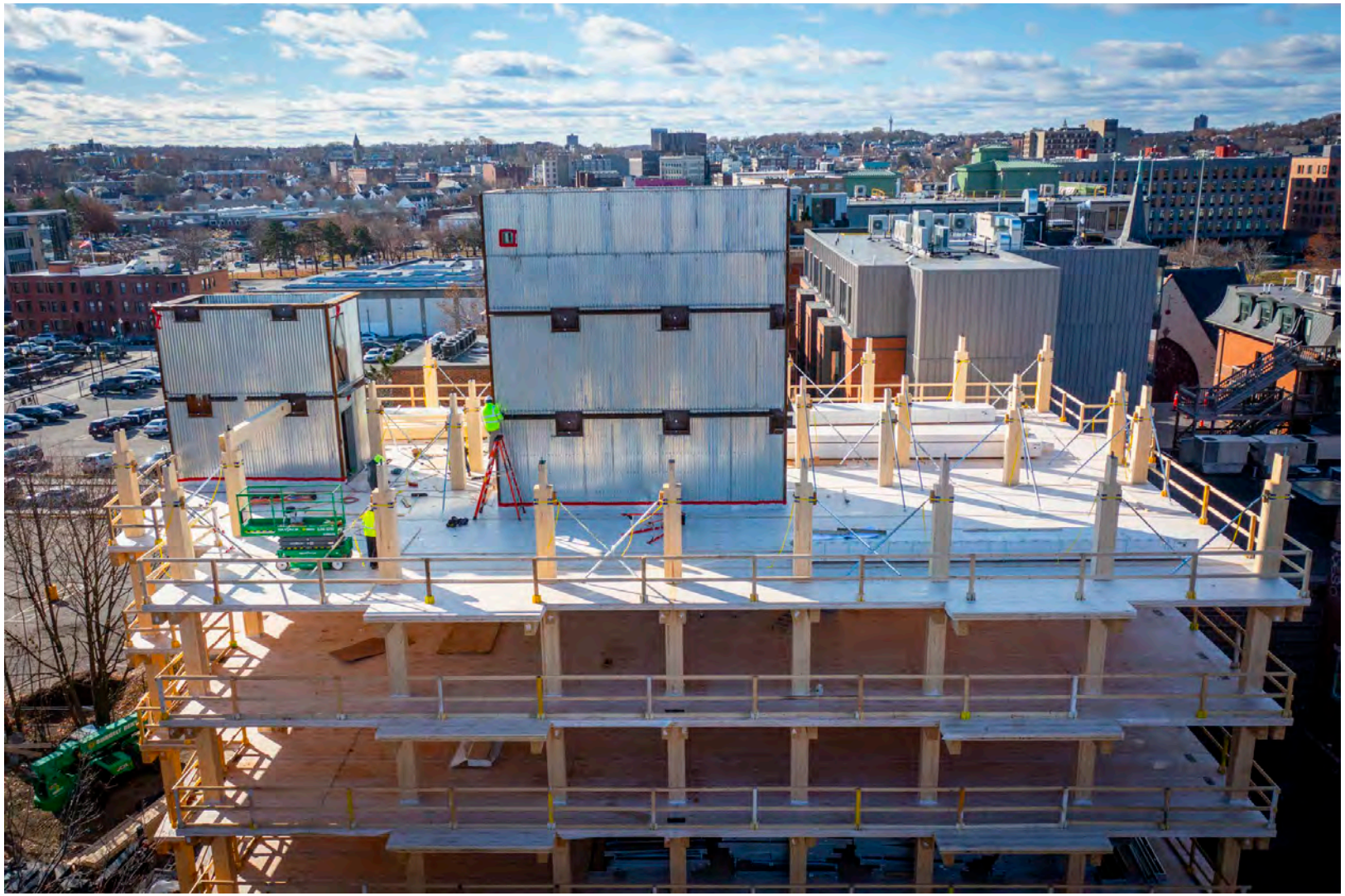


Photo: H+O Structural Engineering, Kure Creative

Tall Mass Timber Special Inspections

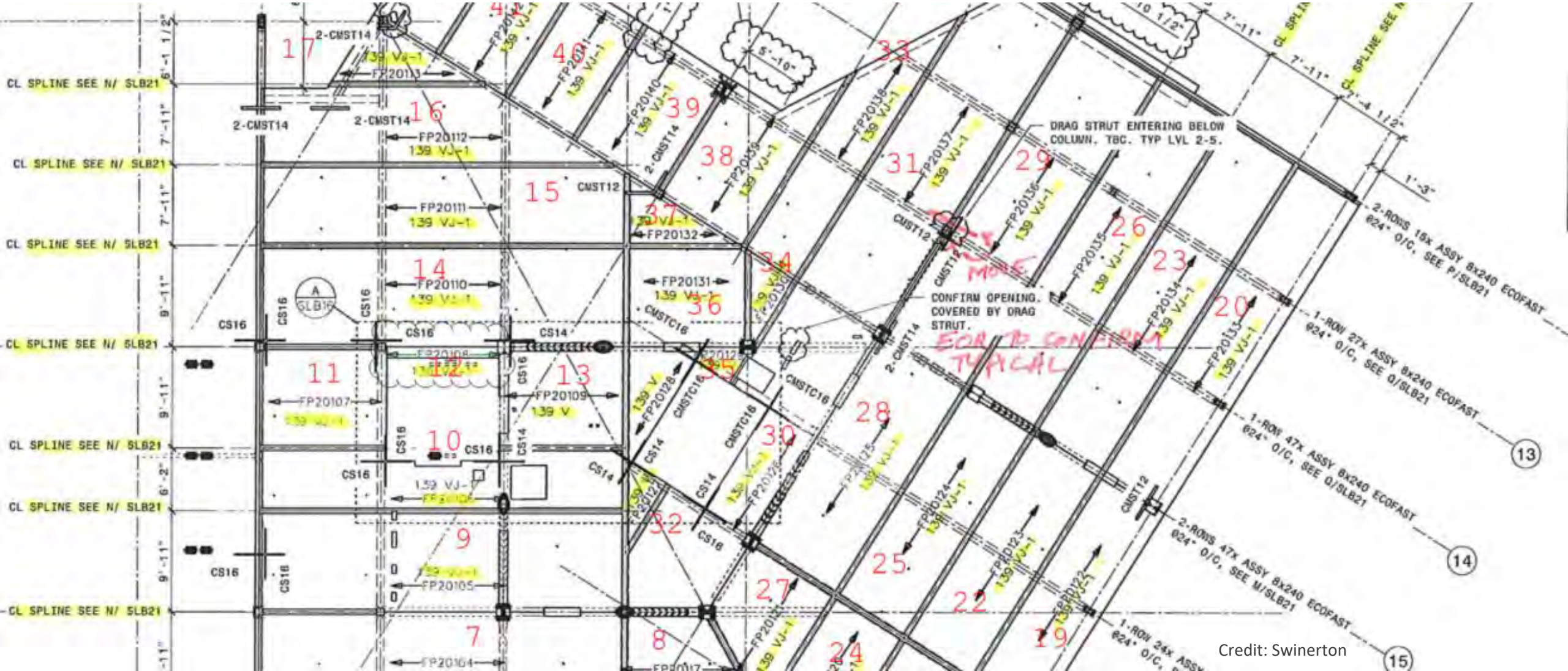
TABLE 1705.5.3
REQUIRED SPECIAL INSPECTIONS OF MASS TIMBER CONSTRUCTION

Type	Continuous Special Inspection	Periodic Special Inspection
1. Inspection of anchorage and connections of mass timber construction to timber deep foundation systems.		X
2. Inspect erection of mass timber construction		X
3. Inspection of connections where installation methods are required to meet design loads		
3.1. Threaded fasteners		
3.1.1. Verify use of proper installation equipment.		X
3.1.2. Verify use of pre-drilled holes where required.		X
3.1.3. Inspect screws, including diameter, length, head type, spacing, installation angle, and depth.		X
3.2. Adhesive anchors installed in horizontal or upwardly inclined orientation to resist sustained tension loads	X	
3.3. Adhesive anchors not defined in 3.2.		X
3.4. Bolted connections		X
3.5. Concealed connections		X

Source: International Building Code

Table is only required for Type IV-A, IV-B, and IV-C

Sequencing



Credit: Swinerton

Pick Plan



Photo: Swinerton

Material Delivery



Photo: Swinerton

Site Organization and Staging



Photo: Swinerton

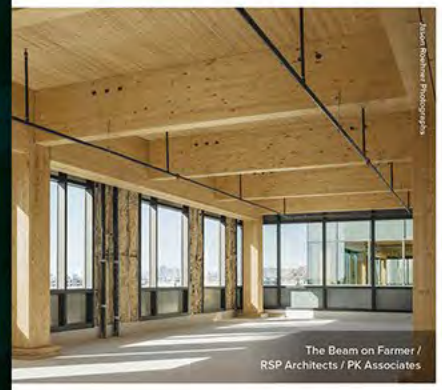
https://www.woodworks.org/resources/mass-timber-projects-inspection-and-observation/

Developed by WoodWorks
in collaboration with
Alex Lege, PE, SE
PCS Structural Solutions

Construction Quality Assurance on Mass Timber Projects: Inspection and Observation

Considerations for project teams developing inspection and observation plans

Quality assurance for mass timber projects involves many considerations, which can create a learning curve for teams new to these materials. For example, in addition to code-required inspections that apply to almost any project, mass timber projects benefit from other types of inspections—but it can be challenging to find information on what they entail. While inspection standards and methods have long been codified for other structural materials (including other types of wood construction), mass timber is relatively new to the United States. And although mass timber projects are subject to many of the existing inspection requirements, the 2021 International Building Code (IBC) was the first version to include requirements specific to these materials.



The Beam on Farmer / RSP Architects / PK Associates

This paper explores inspection considerations for mass timber projects, including special inspections and structural observations, and how to effectively communicate the requirements and review the results. It is intended to provide a basis for conversation that helps teams comply with the building code and develop Construction Documents (CDs) specific to the project by finetuning their approaches to construction quality assurance.

This publication references the 2024 IBC, but most references are identical in the 2021 code.

Inspections Performed by the Building Official

The building official, or Authority Having Jurisdiction (AHJ), performs a set of inspections focused on the administration and enforcement of the building code. These are not the same as special inspections and undertaking one type does not preclude the other. Provisions for building official inspections are included in IBC Section 110 and apply to most projects, regardless of structural material. Section 110.1 notes:

> *Construction or work for which a permit is required shall be subject to inspection by the building official and such construction or work shall remain visible and able to be accessed for inspection purposes until approved.*

This section also notes the importance of leaving the work in a condition that allows easy inspection until approved:

> *It shall be the duty of the owner or the owner's authorized agent to cause the work to remain visible and able to be accessed for inspection purposes. Neither the building official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material required to allow inspection.*

DPR Office / SmithGroup / Buehler Engineering

Material Environmental Exposure and Moisture Management

- Enroute
- Onsite
- Post-Install
- Other Material



Photo: Swinerton

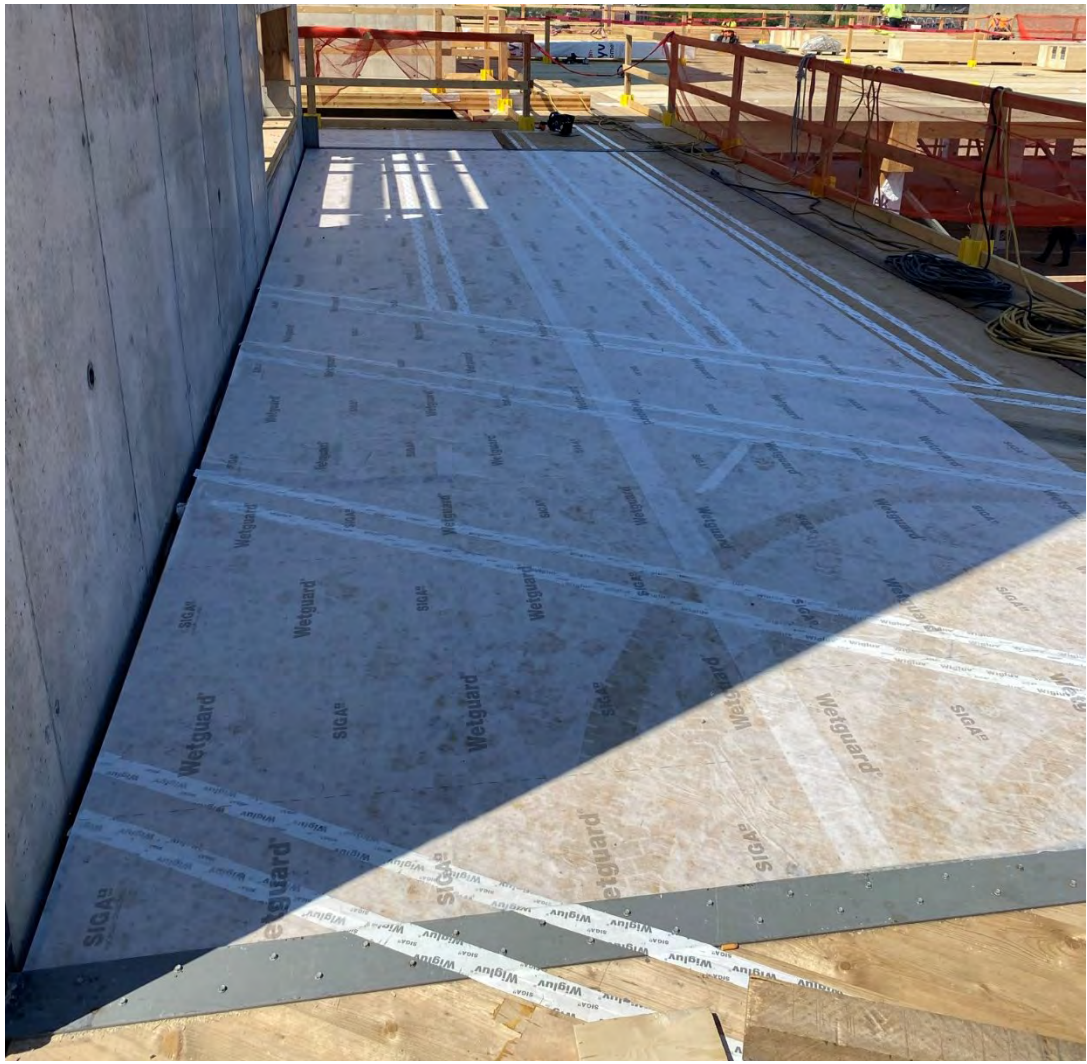


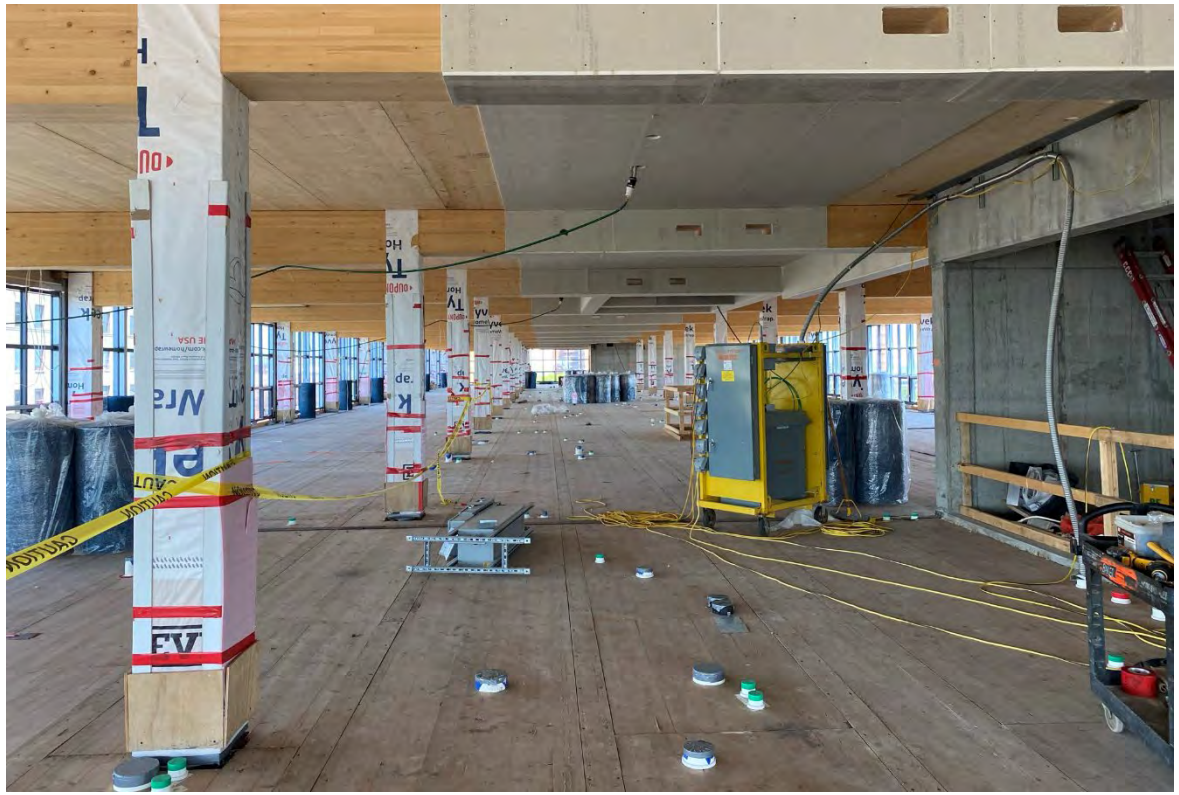
Photo: Alex Schreyer

Enroute Exposure





Onsite Considerations



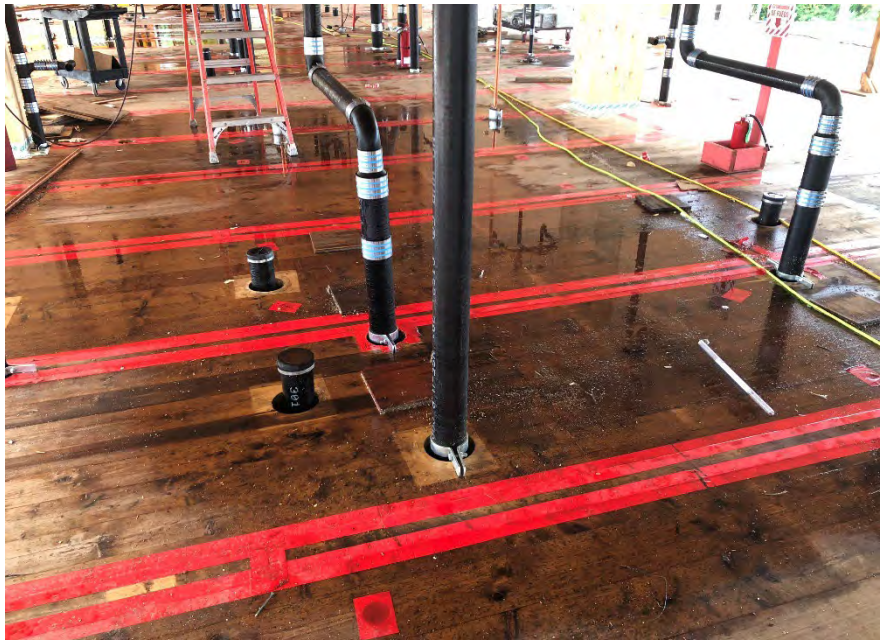


Onsite Considerations



Onsite Considerations







EXPERT TIP

Mass Timber Moisture Management for Construction



Strategies for managing the unique moisture risks of mass timber building projects

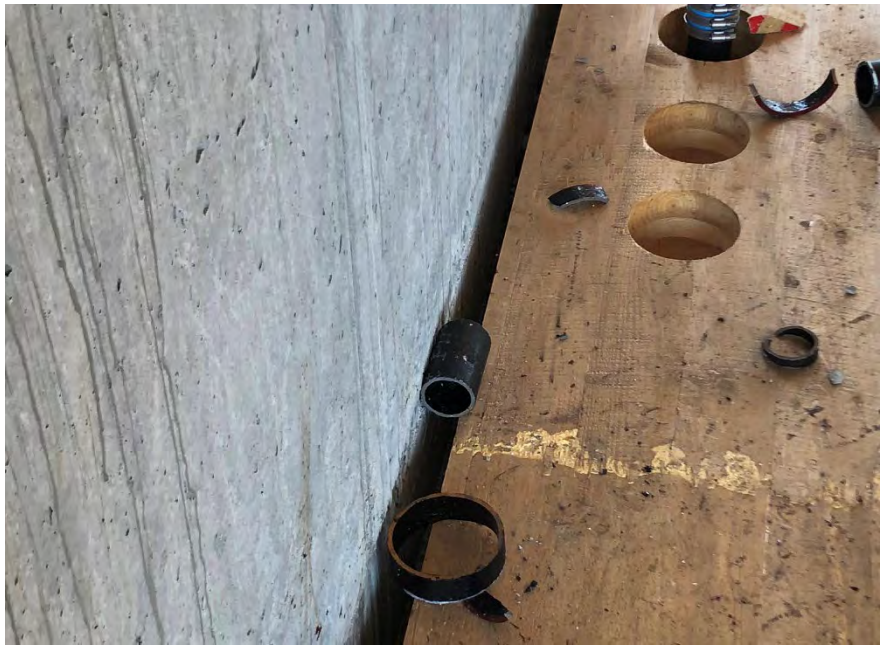
Photo RDH Building Science

https://www.woodworks.org/resources/mass-timber-moisture-management-for-construction/

Other Materials







Outline

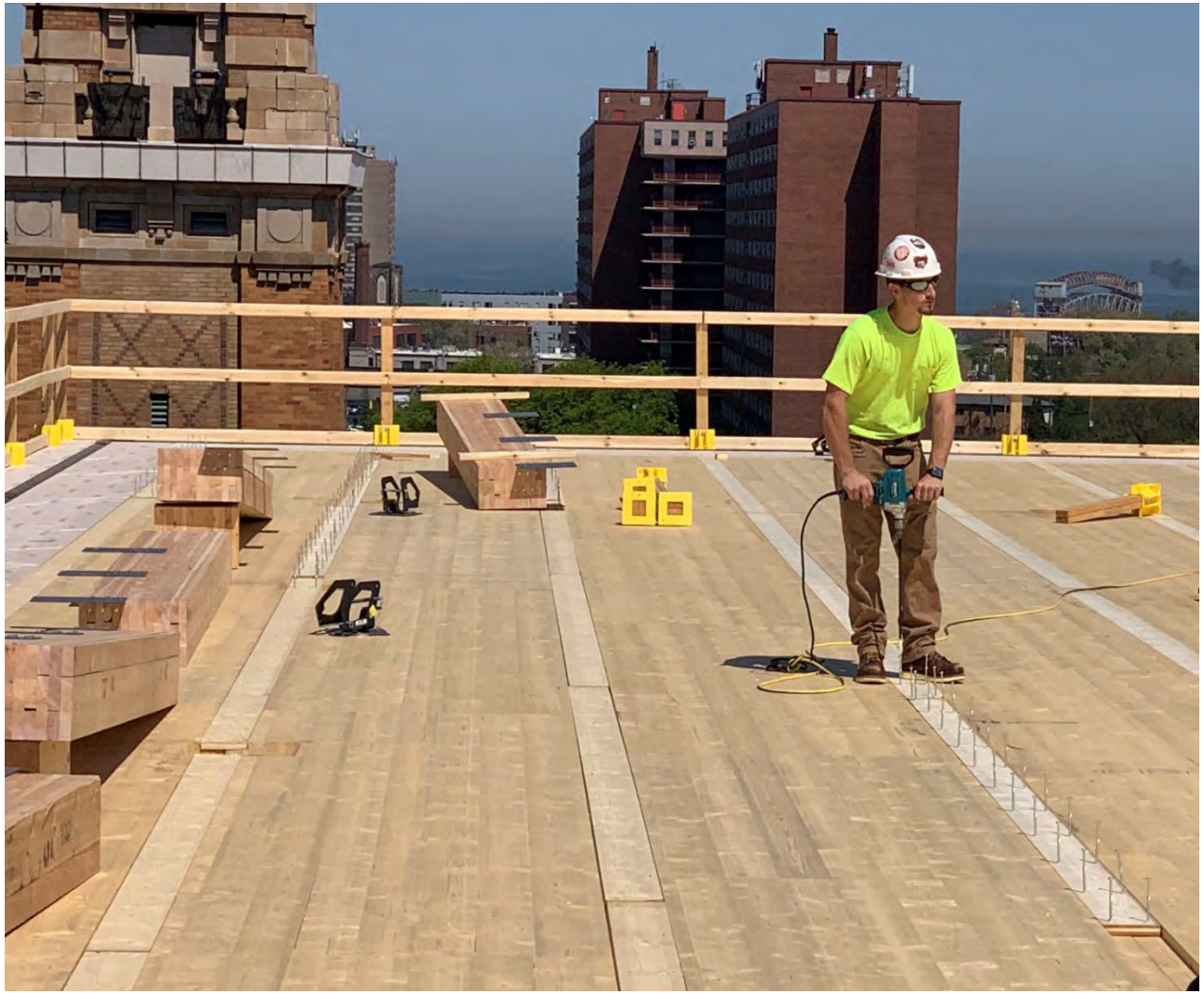
- Mass Timber Design
  - Products
  - Structural Solutions and Connections
  - Projects and Code Considerations
- Mass Timber Construction
  - Planning for Construction
  - Performing Construction
  - Workforce Development

Workforce Development

- Training is the key to efficiency
- Training takes time and money
- Training vs. 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

https://www.woodworks.org/resources/u-s-mass-timber-construction-manual/

U.S. Mass Timber Construction Manual



The Soto / Hixon Properties
BOKA Powell
Photo: StructureCraft

Questions? Ask us anything.



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

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