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Mass Timber Overview: Systems, Products & Codes

Mass Timber Construction Management Design through Project Close Out



Photo: Structurlam

Learning Objectives

1. Understand the preconstruction manager's role in material procurement and coordination of trades for code-compliant mass timber projects.
2. Highlight effective methods of early design-phase cost estimation and building official interaction on code compliance topics that keep mass timber options on the table.
3. Discuss potential construction schedule savings and construction fire safety practices 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 OVERVIEW



OVERVIEW | TIMBER METHODOLOGIES



Heavy Timber
Photo: Benjamin Benschneider



Mass Timber
Photo: John Stamets

Glue Laminated Timber (GLT)



Cross-Laminated Timber (CLT)



Nail-Laminated Timber (NLT)



Photo: Think Wood



Photo: StructureCraft



Photo: LendLease



Photo: Ema Peter

Dowel-Laminated Timber (DLT)



Photo: StructureCraft

Mass plywood panels (MPP)



Photo: Freres Lumber

Decking



Photo: StructureCraft



Photo: LEVER Architecture

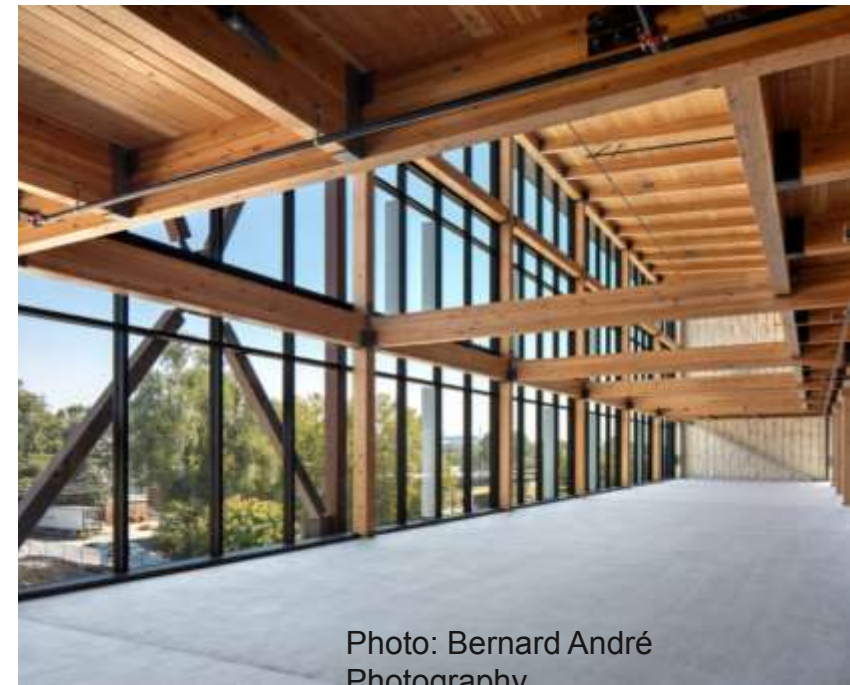


Photo: Bernard André
Photography

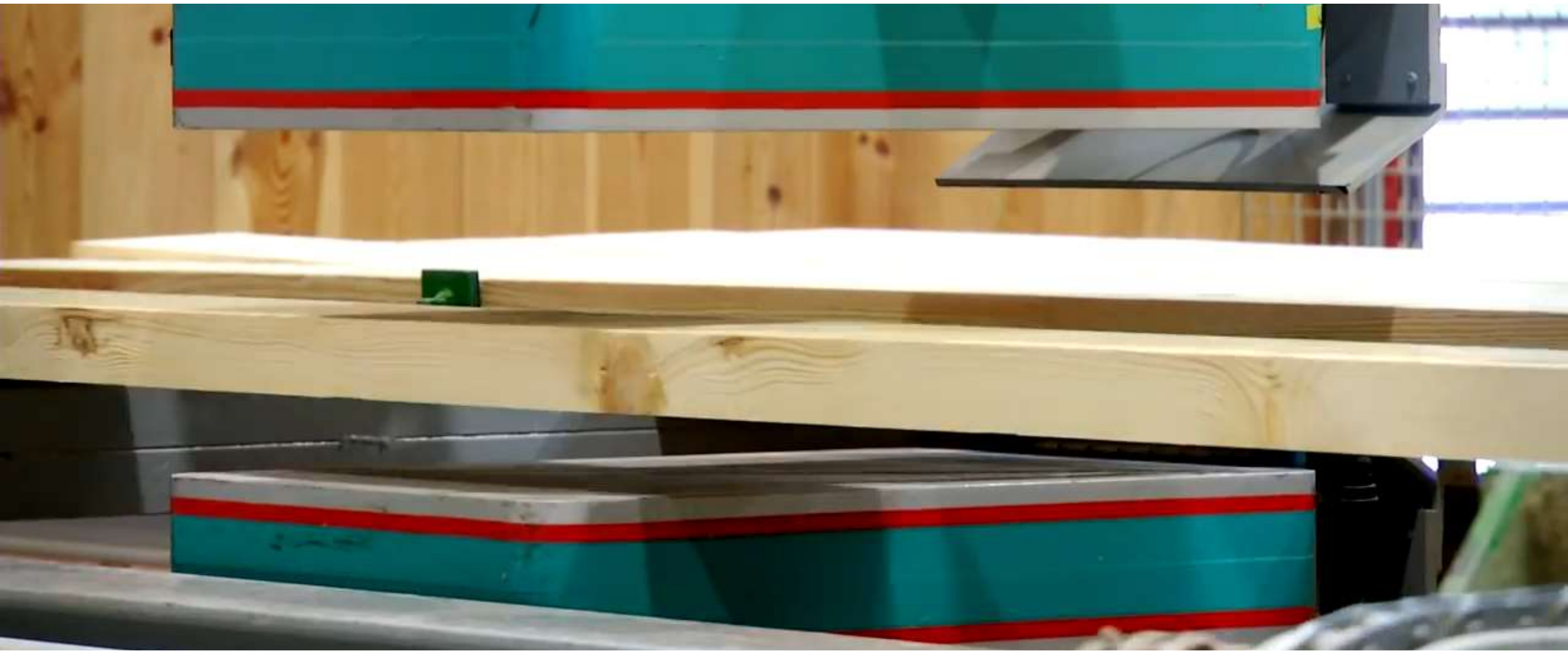




Photo: Ema Peter

STRUCTURAL SOLUTIONS | POST, BEAM + PLATE



Photo: Seagate Structures

STRUCTURAL SOLUTIONS | POST + PLATE



Photo: Lendlease



Photo: John Klein

STRUCTURAL SOLUTIONS | HYBRID LIGHT-FRAME + MASS TIMBER



Photo: SOM

STRUCTURAL SOLUTIONS | HYBRID STEEL + MASS TIMBER



Photo: Structurlam

STRUCTURAL SOLUTIONS | HYBRID CONCRETE + MASS TIMBER

OVERVIEW | CONNECTIONS



Concealed Connectors



Self Tapping Screws

Photos: Rothoblaas

OVERVIEW | CONNECTIONS



Beam to Column

Photo: StructureCraft



Photo: Structurlam



Column to Foundation

Photo: Alex Schreyer

OVERVIEW | CONNECTIONS



Panel to Panel & Supports

Photo: Charles Judd



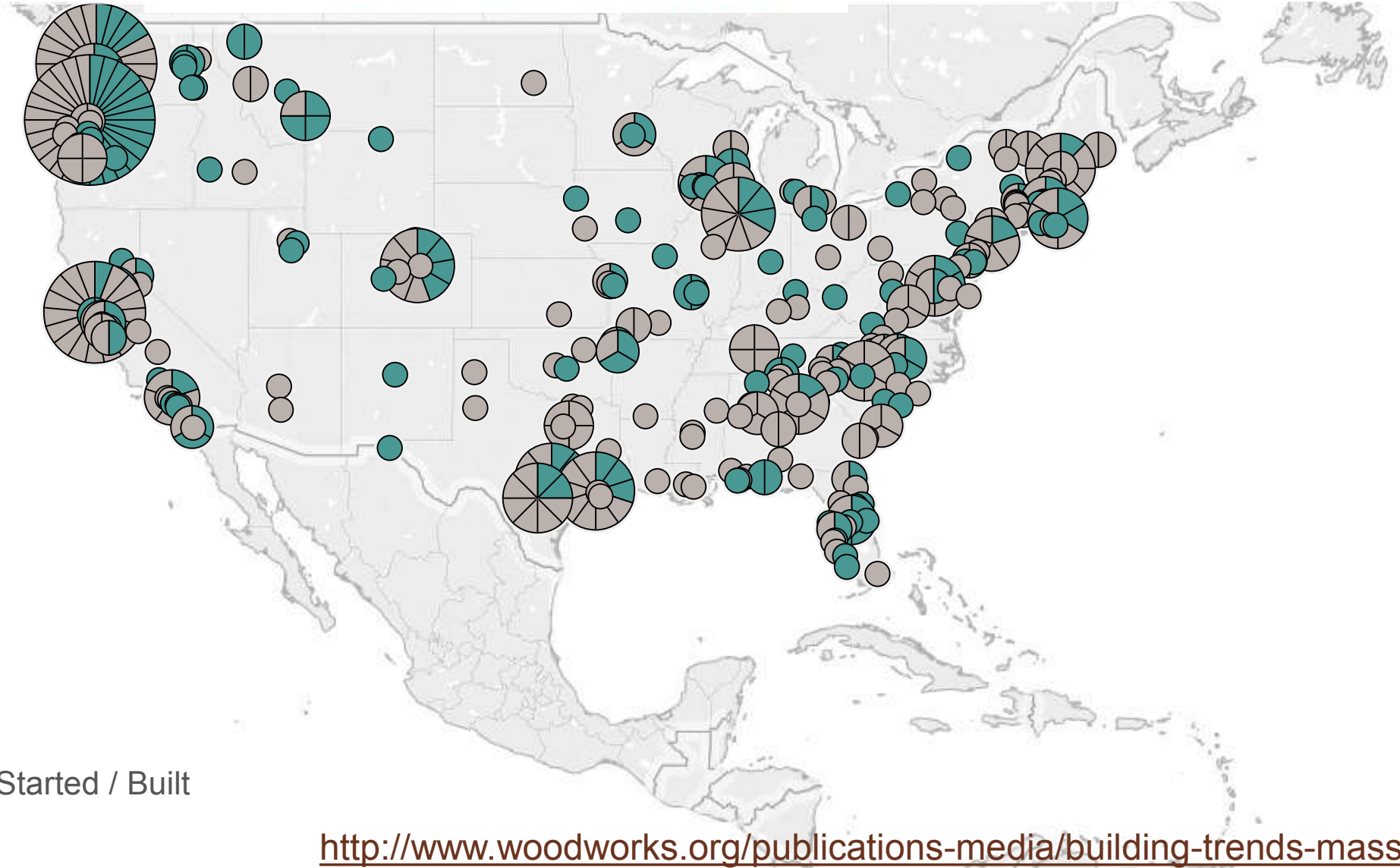
Photo: Alex Schreyer

CURRENT STATE OF MASS TIMBER PROJECTS

As of July 2019, **599** multi-family, commercial, or institutional projects have been constructed out of mass timber across the U.S., or they're currently in design.



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Stage

- Construction Started / Built
- In Design

<http://www.woodworks.org/publications-media/building-trends-mass-timber/>



Photo: Nordic Structures



Photo: ©Albert Vecerka/Esto



Photos: Baumberger Studio/PATH Architecture



Photo: Hines



Photo: Corey Gaffer courtesy Perkins + W



Photos: StructureCraft



Photo: Hartshorne Plunkard Architecture



Photos: Flank



Photos: Swinerton | DJC Oregon

PRECEDENT PROJECTS | FIRST TECH CREDIT UNION HILLSBORO, OR



Photos: Michael Elkan | Naturally Wood | UB



Photos: Daniel Shearin | Waugh Thistleton Architects



Photos: Bygg Mesteren | Voll Arkitekter

MASS TIMBER PRODUCTS



Glue Laminated Timber (GLT)



Photo: Alex Schreyer

Glue Laminated Timber (GLT)

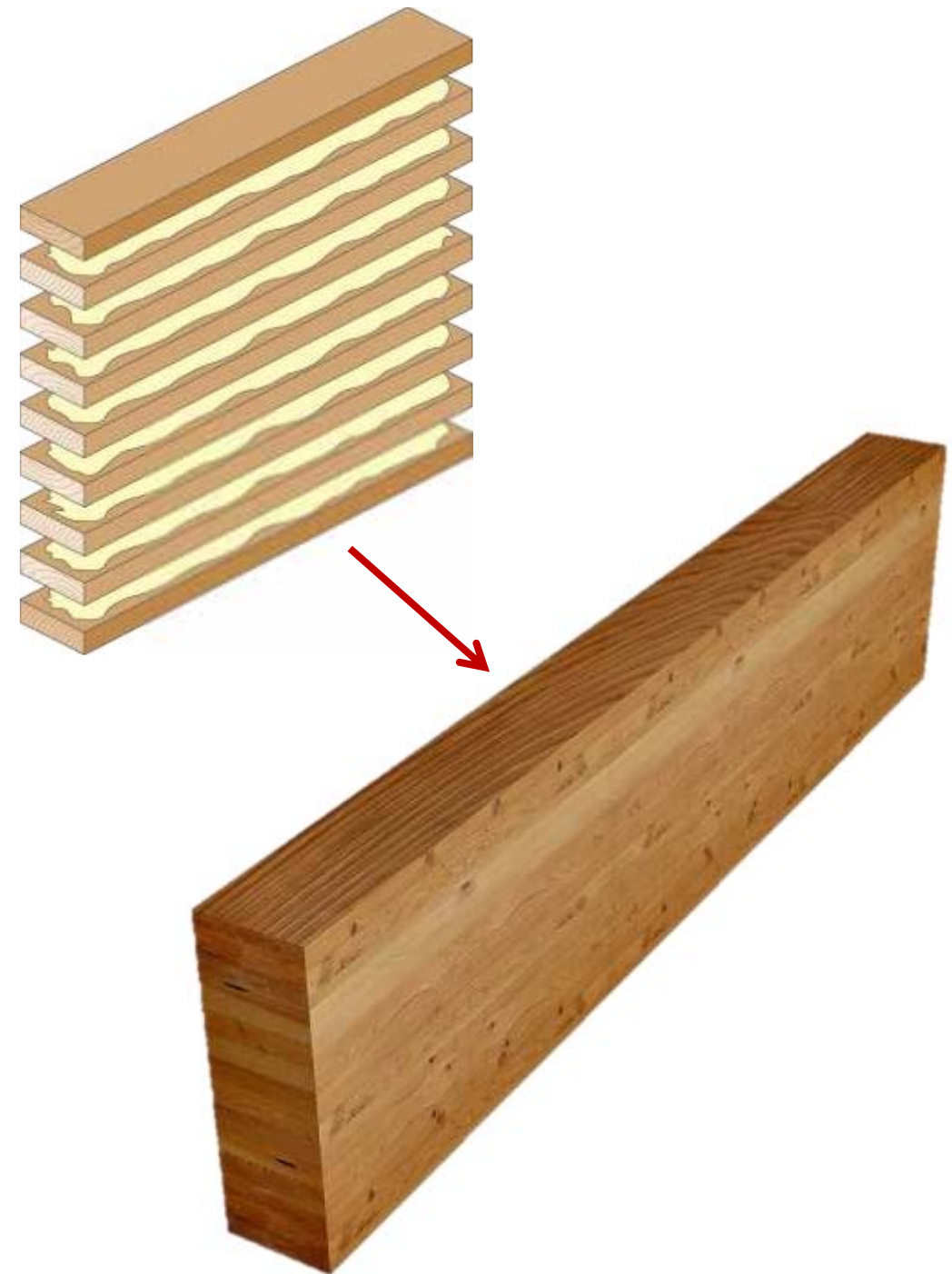
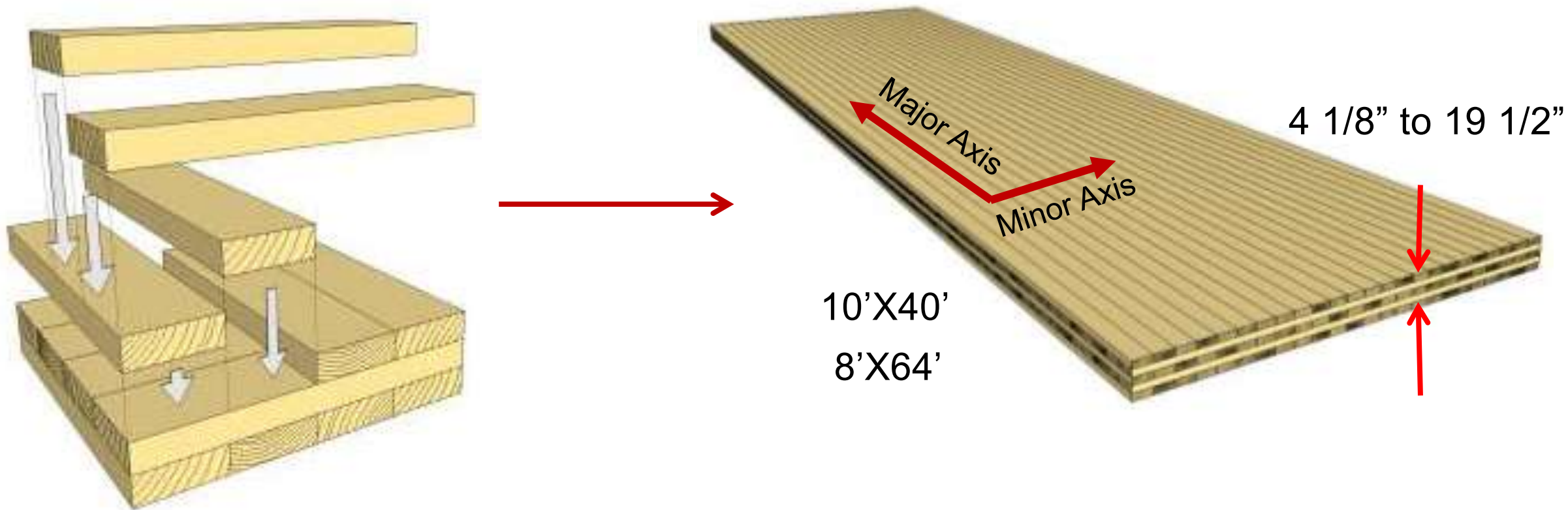


Photo: Manasc Isaac Architects/Fast + Epp

Cross-Laminated Timber (CLT)



Cross-Laminated Timber (CLT)



Nail-Laminated Timber (NLT)



Photo: StructureCraft

Nail-Laminated Timber (NLT)



Photo: Think Wood

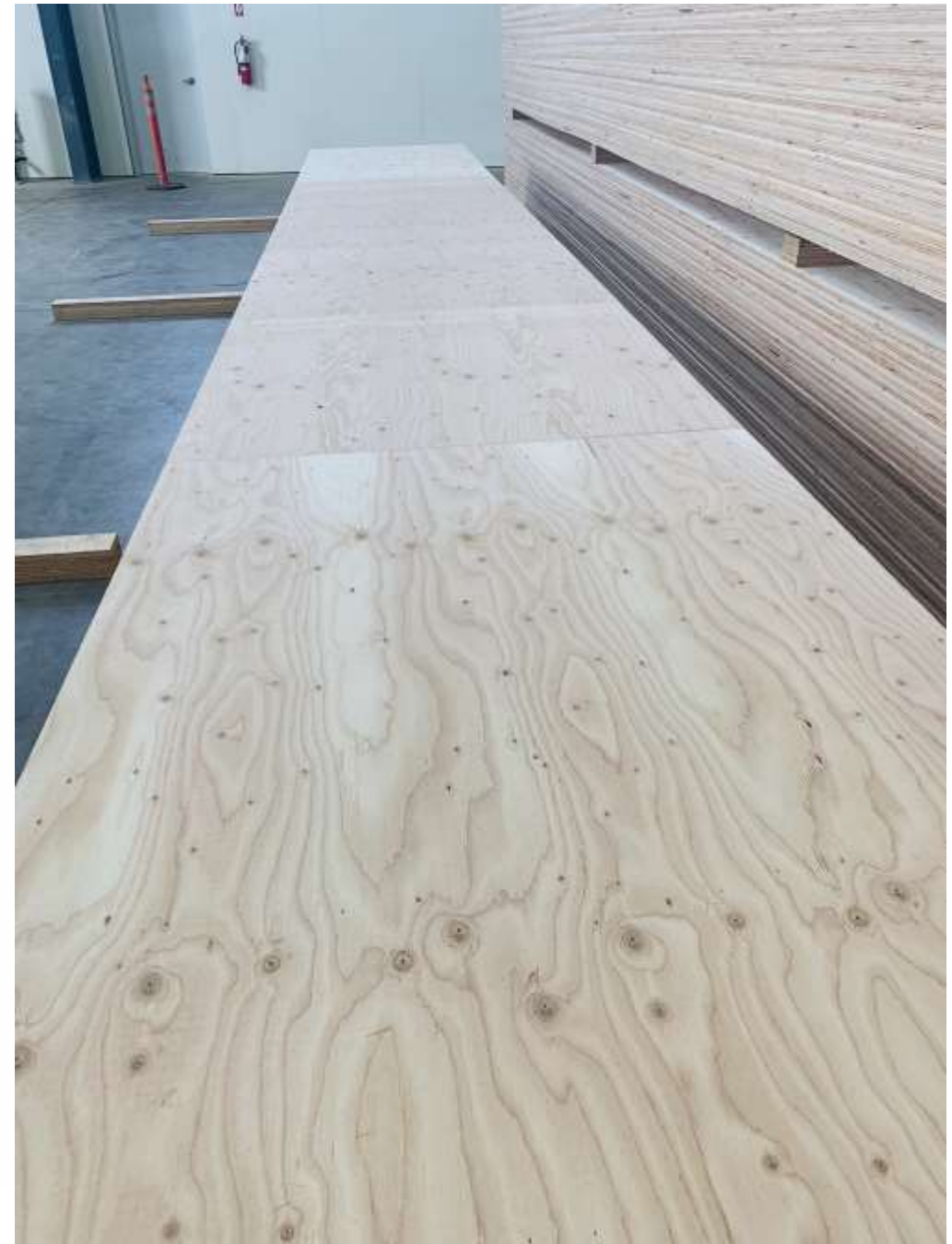


Dowel-Laminated Timber (NLT)



Photo: StructureCraft

Mass Plywood Panels (MPP)



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

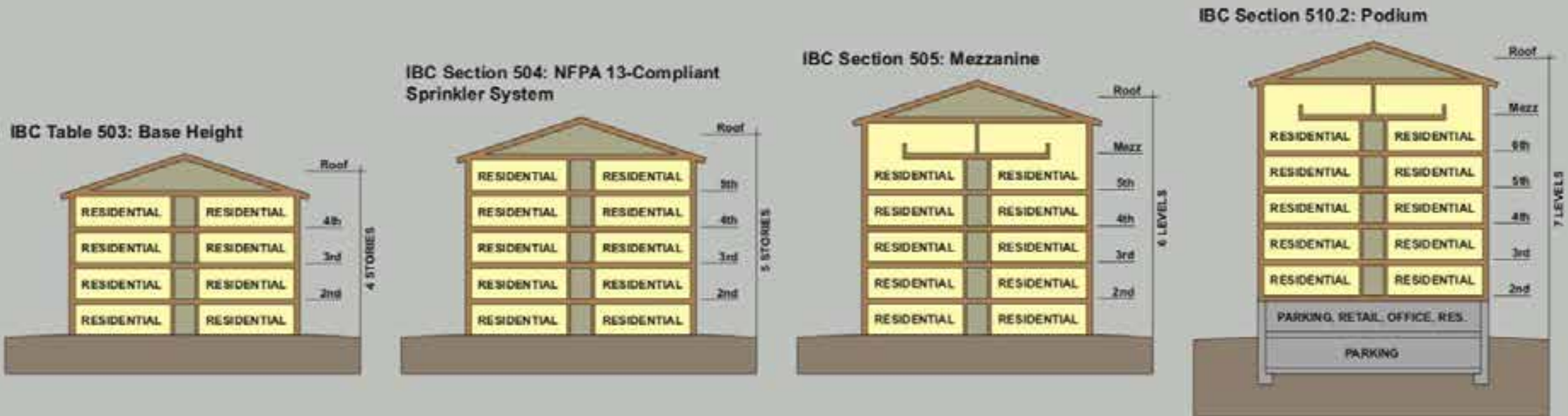


Decking

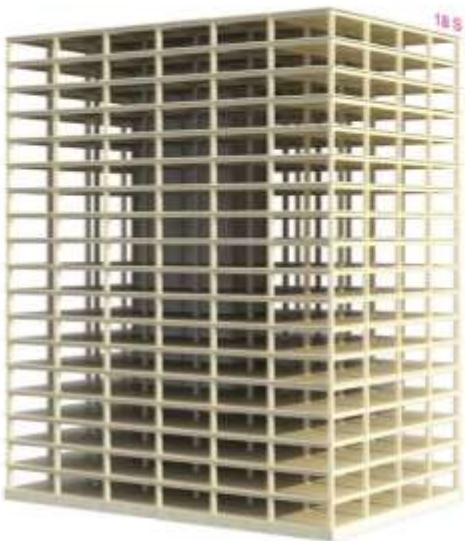
MASS TIMBER IN THE CODE



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



18 STORIES
BUILDING HEIGHT 270'
ALLOWABLE BUILDING AREA 972,000 SF
AVERAGE AREA PER STORY 54,000SF

TYPE IV-A



12 STORIES
BUILDING HEIGHT 180 FT
ALLOWABLE BUILDING AREA 648,000 SF
AVERAGE AREA PER STORY 54,000SF

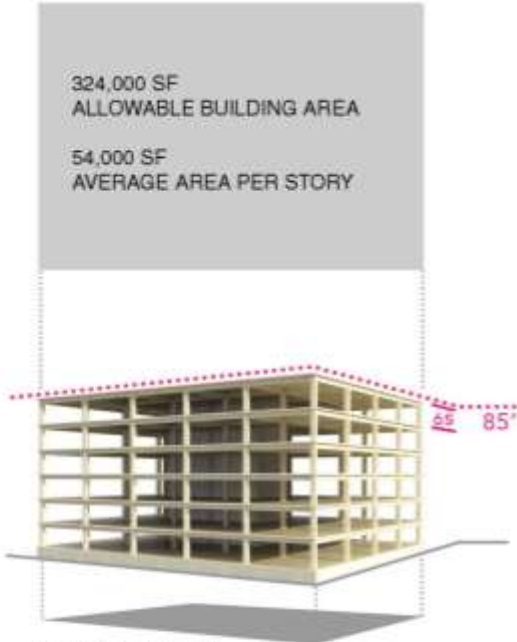
TYPE IV-B



9 STORIES
BUILDING HEIGHT 85'
ALLOWABLE BUILDING AREA 405,000 SF
AVERAGE AREA PER STORY 45,000 SF

TYPE IV-C

IBC 2021



6 STORIES MAXIMUM
85'-0" MAXIMUM BUILDING HEIGHT
324,00 SF MAXIMUM AREA

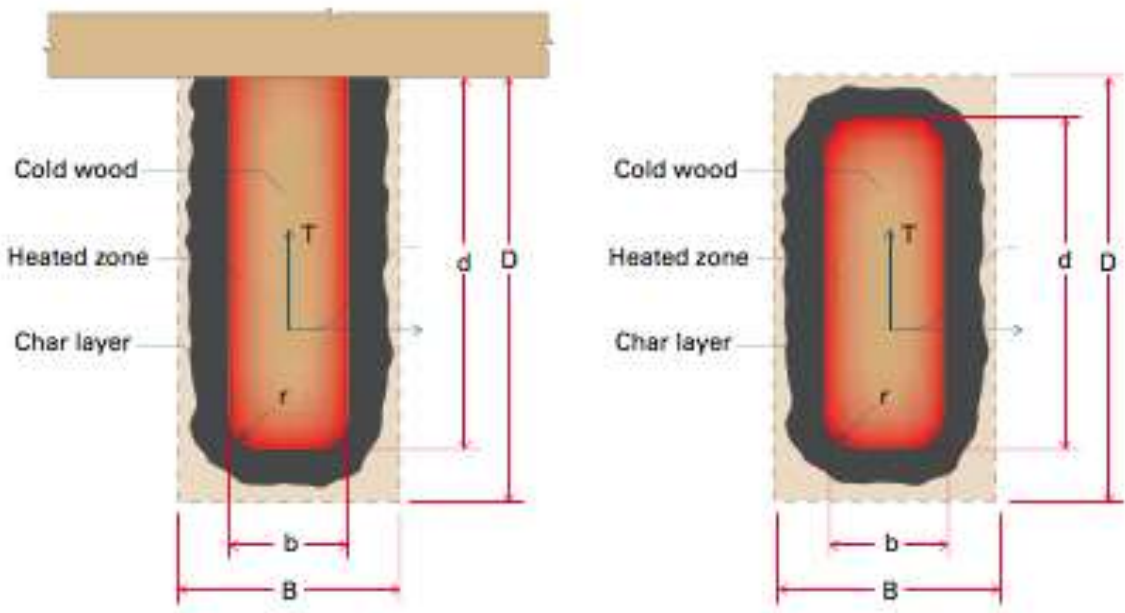
TYPE IV- HT

IBC 2015

BUSINESS OCCUPANCY [GROUP B]

*BUILDING FLOOR-TO-FLOOR HEIGHTS ARE SHOWN AT 12'-0" FOR ALL EXAMPLES FOR CLARITY IN COMPARISON BETWEEN 2015 TO 2021 IBC CODES.

Mass Timber’s Fire-Resistive Performance is Well-Tested, Documented and Recognized via Code Acceptance



Source: AWC’s TR 10

Table 16.2.1A Char Depth and Effective Char Depth (for $\beta_n = 1.5$ 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



Credit: David Barber, ARUP

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Fire-Resistive Design of Mass Timber Members

Code Applications, Construction Types and Fire Ratings

Richard McCam, P.E., SE • Senior Technical Director • WoodWorks
Scott Berman, Ph.D., P.E., SE • Senior Technical Director • WoodWorks

For many years, exposed heavy timber framing elements have been permitted in U.S. buildings due to their inherent fire-resistance properties. The predictability of wood's char rate has been well-established for decades and has long been recognized in building codes and standards.

Today, one of the exciting trends in building design is the growing use of mass timber—i.e., large solid wood panel products such as cross-laminated timber (CLT) and nail-laminated timber (NLT)—for floor, wall and roof construction. Like heavy timber, mass timber products have inherent fire resistance that allows them to be left exposed and still achieve a fire-resistance rating. Because of their strength and dimensional stability, these products also offer a low-carbon alternative to steel, concrete, and masonry for many applications. It is this combination of exposed structure and strength that developers and designers across the country

are leveraging to create innovative designs with a warm yet modern aesthetic, often for projects that go beyond traditional norms of wood design.

This paper has been written to support architects and engineers exploring the use of mass timber for commercial and multi-family construction. It focuses on how to meet fire-resistance requirements in the International Building Code (IBC), including calculation and testing-based methods. Unless otherwise noted, references refer to the 2018 IBC.

Mass Timber & Construction Type

Before demonstrating fire-resistance ratings of exposed mass timber elements, it's important to understand under what circumstances the code currently allows the use of mass timber in commercial and multi-family construction.

A building's assigned construction type is the main indicator of where and when all wood systems can be used. IBC Section 602 defines five main options (Type I through V) with all but Type IV having subcategories A and B. Types III and V permit the use of wood framing throughout much of the structure and both are used extensively for modern mass timber buildings.

Type III (IBC 602.3) – Timber elements can be used in floors, roofs and interior walls. Fire-retardant-treated wood (FRTTW) framing is permitted in exterior walls with a fire-resistance rating of 2 hours or less.

Type V (IBC 602.5) – Timber elements can be used throughout the structure, including floors, roofs and both interior and exterior walls.

Type IV (IBC 602.4) – Commonly referred to as "Heavy Timber" construction, this option



Cathlamet | Portland, Oregon
Kaiser Group | Bell Architecture
Muring Structural Engineering

Mass Timber Fire Design Resource

- Code compliance options for demonstrating FRR
- Updated as new tests are completed
- Free download at woodworks.org



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