Insurance for Mass Timber Construction: Assessing Risk and Providing Answers

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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. Mass timber products have inherent fire resistance and can be left exposed in many applicaions and building sizes, achieving the triple function of structure, finish and fire resistance. Because of their strength and dimensional stability, these products offer an alternative to steel, concrete and masonry for many applications, but have a much lighter carbon footprint. 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.

As mass timber construction has proliferated across the U.S., a number of project teams have run into the same issue: insurance companies unfamiliar with these types of buildings can be reluctant to provide insurance.

The challenge has presented itself in two forms: builder's risk insurance (or course of construction) and property insurance (after the building is complete and occupied). Relative risks are assessed differently for each, and each requires a unique approach. For example:

- Construction-phase risks associated with fire are different in mass timber buildings than with most other framing systems. Since the timber elements have inherent fire-resistance capabilities, a building can have a certain level of passive fire resistance after the frame is erected. Protection doesn't rely on (and wait for installation of) materials such as spray-applied fire proofing. The potential for faster construction can also mitigate several risks. Less time under construction means less time for potential hazards such as theft, arson, etc.
- In addition to safety, property insurance for mass timber buildings requires an understanding of performance related to things like moisture, durability and building enclosure detailing. Much of the property insurance discussion is also site-specific—e.g., Is the area prone to flooding, earthquakes or high winds? Mass timber has been tested against potential natural disasters, and numerous test and research reports are available.

This paper is intended for developers and owners seeking to purchase insurance for mass timber buildings, for design/construction teams looking to make their designs and installation processes more insurable, and for insurance industry professionals looking to alleviate their concerns about safety and performance.

For developers, owners and design/construction teams, it provides an overview of the insurance industry, including its history, what affects premiums, how risks are analyzed, and how project teams can navigate coverage for mass timber buildings. Insurance in general can seem like a mystery—what determines premium fluctuations, impacts of a

Oregon Conservation Center, Portland, OR
Source: LEVER Architecture, photo Lara Swimmer

strong vs. weak economy, and the varying roles of brokers, agents and underwriters. This paper will explain all of those aspects, focusing on the unique considerations of mass timber projects and steps that can be taken to make these buildings more insurable.

For insurance brokers, underwriters and others in the industry, this paper provides an introduction to mass timber, including its growing use, code recognition and common project typologies. It also covers available information on fire performance and post-fire remediation, moisture impacts on building longevity, and items to watch for when reviewing specific projects.

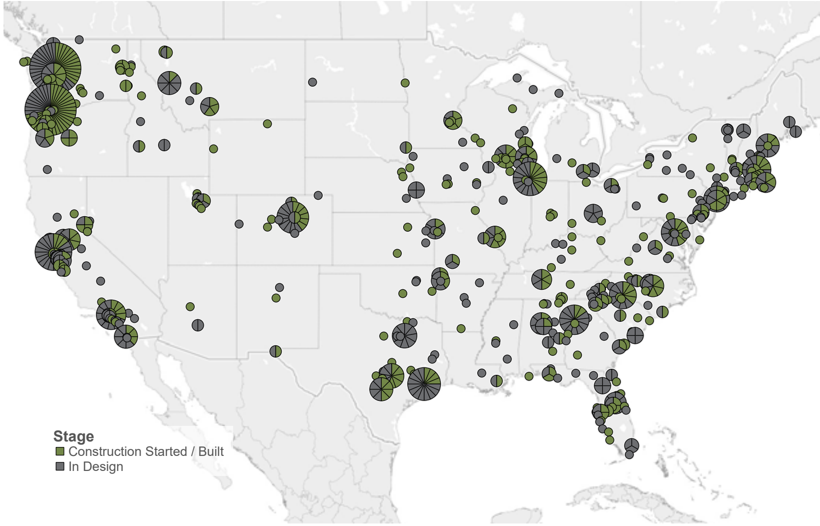


Figure 1: As of December 2020, there were 1,060 mass timber projects built, under construction or in design across the U.S.

Source: WoodWorks

What is Mass Timber?

As used in this paper, the term mass timber refers to a category of framing styles typically characterized by the use of large, solid wood panels. These panels are most frequently used in horizontal applications for floors and roofs, but can also be used vertically for bearing walls and shaft walls. They are often paired with engineered wood beams and columns to create an all-timber structural framework. The term heavy timber is typically associated with large cross sections of solid sawn members (beams, purlins and columns), often using tongue-and-groove decking for floors and roofs. That style of construction is not the focus of this paper.

Cross-Laminated Timber (CLT)

CLT consists of layers of solid sawn lumber or structural composite lumber (typically three, five or seven plies) oriented at right angles to one another and glued to form structural panels. Panels are typically between 4 and 12 feet wide, and between 20 and 60 feet long. The International Building Code (IBC) requires that CLT used in U.S. commercial and multi-family construction be manufactured and identified in accordance with the American National Standard, ANSI/APA PRG 320.[1]

CLT panel
Image: Katerra

Nail-Laminated Timber (NLT)

NLT has been used for more than a century but is undergoing a resurgence as part of the modern mass timber movement. It is created from solid sawn dimension lumber members (2-by-4, 2-by-6, etc.), stacked on edge and fastened with nails or screws to create larger structural panels. NLT is typically fabricated off-site in panels that range from 4 to 8 feet wide and 16 to 40 feet long. NLT is recognized prescriptively as mechanically-laminated decking in Chapter 23 of the IBC.

NLT panel
Image: Think Wood

Dowel-Laminated Timber (DLT)

DLT panels are made from solid sawn lumber (2-by-4, 2-by-6, etc.) stacked like the boards of NLT but friction-fit with hardwood dowels. The dowels hold each board side-by-side, while the friction fit adds dimensional stability. Rather than the butt-jointed laminations found in NLT, laminations in DLT are typically finger-jointed, resulting in full utilization of the panel's structural properties. DLT panels are commonly used in mass timber structures with accompanying third-party evaluation reports that address code compliance.

DLT panel
Image: StructureCraft

Structural Composite Lumber (SCL)

SCL is a category of engineered wood products that includes laminated veneer lumber (LVL) and laminated strand lumber (LSL). These products are relevant to the mass timber discussion because they can be manufactured as panels in sizes up to 8 feet wide with varying thicknesses and lengths depending on the manufacturer. Parallel strand lumber (PSL) columns can also be used in combination with mass timber panel products. SCL is prescriptively recognized in the IBC when it conforms with the requirements of ASTM D5456.[2]

PSL, LVL and LSL lumber
Image: Weyerhaeuser

Glue-Laminated Timber (Glulam)

Glulam has long been recognized in U.S. building codes, and is often used for beams, arches, columns and planks. It is created by combining solid sawn lumber members (typically 2-by material), layered parallel on their wide faces, with adhesive between layers. Jigs are used to form curves, bends and a variety of radii. In mass timber projects, glulam is commonly used as beams and columns. It is permitted under the IBC when manufactured and identified as required in ANSI 190.1[3] and ASTM D3737.[4] When used in plank applications, glue-laminated timber is referred to as GLT.

Glulam beam
Image: Boise Cascade

GLT plank
Image: StructureCraft

Commercial Construction and Property Insurance

A Brief History

Insurance policies have existed since 3000 BCE. Originally called bottomry contracts, they offered protection to merchants shipping goods overseas. Bottomry contracts were interest-bearing loans to merchants for the value of a particular shipment. The loans included a forgivable provision if the shipment was lost during transit at sea. If the goods survived the voyage, the merchant would repay the bottomry contract from the proceeds of their sale. These contracts served as investment vehicles for the lenders and risk transfer contracts for the merchants. As society has evolved, so have the causes of loss covered by insurance, but the principles of contractual risk transfer for a fee remain the same.

Insurance is purchased to protect the policy holder from losses, and insurance company investors receive premiums in return for accepting risk. Insurance policies are mutually beneficial contracts that add certainty to business transactions for both parties. Insurance companies employ underwriters to evaluate businesses and individuals to determine the risk of doing business with them, and to evaluate the risk associated with the type of insurance requested. Insurance underwriters apply both their individual knowledge and established company guidelines. These individuals are tasked with discerning which potential policyholders are least likely to have claims just as financial industry underwriters determine which potential borrowers are most likely to repay loans.

Factors That Influence Premiums

Numerous factors are considered when determining insurance premium costs for buildings. One, which has little to do with the actual project being insured, is the state of the insurance market. Premium costs flow like a sine curve, pushing the market back and forth between "hard" and "soft." In a hard market, insurance companies have little appetite for risk, which results in fewer coverage options and higher premiums. As rates climb, surplus premiums increase. This provides increased capacity for carriers to provide coverage. As loss ratio to premium decreases, capacity is increased and this pushes the industry toward a soft market where premiums decrease. Insurance companies purchase insurance against policy losses, which is called reinsurance. The reinsurance pricing and coverage fluctuations are a large part of the hard/soft market cycle.

Societal events can also have a big impact on the industry and market. For example, 2020 saw the COVID-19 pandemic and resulting economic upheaval, social justice movements, riots and tragic wildfires. In their attempt to anticipate increased losses and reinsurance costs, insurance companies increased premiums across the building sector, regardless of structural materials used. Underwriters also reacted by being more risk-averse than usual, and some have chosen to minimize their exposure by rejecting policies for projects with combustible framing. Examples have shown that many underwriters are unfamiliar with mass timber's tested fire performance, durability, etc.

The U.S. insurance industry is heavily regulated at the state level to protect policyholders. A multi-state policyholder will have different rates and coverage for each state either within the same policy or via separate policies.

Roles of the Policyholder, Broker, Agent and Underwriter

Insurance brokers are hired by policyholders to negotiate on their behalf with insurance company underwriters. An agent is the representative of an insurance company, often an employee. Personal lines insurance (e.g., a homeowner policy) is typically sold by agents. Commercial insurance, especially for larger businesses, tends to be the purview of brokers. At issue is where the duty of care lies for the specific representative. A broker is legally obligated to his or her client, who will be the policyholder. An agent is obligated to the insurance company.

When pursuing commercial building insurance, it is important that policyholder and broker agree on expectations, roles and responsibilities. A broker needs to fully understand the policyholder's company and insurance needs, including any requirements from lenders, regulators and other parties. Brokers will investigate a policyholder's risk tolerance. The insurance contract is one method of risk funding within a comprehensive risk management and mitigation strategy.

Once information is gathered from the policyholder, the broker packages it according to industry standards and sends it to several underwriters. Each broker submission is unique, and negotiations with underwriters vary widely.

Insurance companies will only review the first submission received for a policyholder. When submissions for the same project are received from multiple brokers, most underwriters will choose not to proceed with the underwriting process. The scope of work required without assurance of a deal is a poor resource allocation. These submissions are either declined or set aside. If the underwriter proceeds, they will review the submission, look for historical policies and submissions from the policyholder, research the submitted data to gain additional insight, and consult reference material about potential losses from similar operations. They will also ask a great deal of clarifying questions. The broker and underwriter will typically have several conversations examining the qualities of the policyholder, addressing their risk mitigation efforts, and exploring options to best meet the risk management needs of both the insurance company and policyholder. The underwriter will either decline or request management approval to release terms. Depending on premium size and authority of the underwriter, this can mean approval from several layers of management, including home office underwriters and the Chief Underwriting Officer. Each individual reviewing the submission will have additional concerns that need to be addressed. It is a time consuming process for the underwriter and the broker as all communication is conducted between those two parties, even though many individuals are involved in underwriting the risk.

When underwriters evaluate potential policyholders, they heavily weight past claims experience and financial health. This includes claims for the industry as a whole, similar businesses, the geographical area and the policyholder specifically. Frequency of losses is particularly negative and lack of historical data is viewed as a red flag. More information on underwriters and their perspectives on mass timber is included in the section, *Insurance Underwriters and Mass Timber* below.

Material and Building Classifications

Code-Specific Material and Building Classifications

In the IBC, each building must be assigned a construction type. Centering on the premise of designing for life safety, the code takes into account a number of factors that could affect the safety of occupants—factors that vary from one occupancy to another. Examples include the amount of combustible and/or hazardous materials stored in a building, the ability of occupants to evacuate the building (either with or without assistance) in the event of an emergency, and the presence of active fire safety and notification systems such as sprinklers and fire alarm systems. Along these lines, allowable building size (area, height and number of stories), allowable use of certain structural building materials, and amount and extent of fire-resistant measures are all aspects of design that are stipulated by the code based on each occupancy group present.

All three factors—allowable building size, allowable use of structural materials and required fire resistance levels—are interconnected. Allowable building size is based somewhat on the hazard level associated with the stated purpose of the building. Much of the consideration deals with the inherent difference in fire hazard levels of a building's contents. For example, a building that is used to store a large volume of combustible materials or a building where indoor welding is taking place has a different fire hazard level than an office building. Construction type, which is a direct function of the materials used (and vice versa) looks at limiting the size of the building based on the fuel load. In other words, how much of the building and its contents are combustible. Fire-resistant measures required for a building's structure dictate how long (e.g., 1 hour, 2 hours) the structural systems must remain intact and structurally sound in the event of a fire to provide opportunity for tenants to safely exit the building and fire service personnel to address the fire.

IBC Section 602 defines five construction types (Type I through V), all with subcategories. Construction types dictate, among other things, where and when mass timber can be used. As shown in Figure 2, Types III, IV and V permit the use of mass timber throughout the structure, and are used for modern mass timber buildings of all heights.

While not the focus of this paper, it is worth noting that heavy timber buildings (i.e., comprised of large cross sections of solid sawn members) are typically Type IV construction (Type IV-HT under the 2021 IBC). While exposed mass timber is permitted in Type IV construction, it is also allowed under other types. 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.

Types I & II — Noncombustible Structure

Allowances for Mass Timber Roof

Portland International Jetport
Portland, ME, Type I-B

- Larger buildings (Type I)
- Roof construction conforming to heavy timber element sizes permitted where a 1-hour or less fire-resistance rating is required

Credit: Gensler, Oest Associates
Images: StructureCraft, Robert Benson Photography

Type III — Interior Mass Timber Structure

Noncombustible or FRTW Exterior Walls

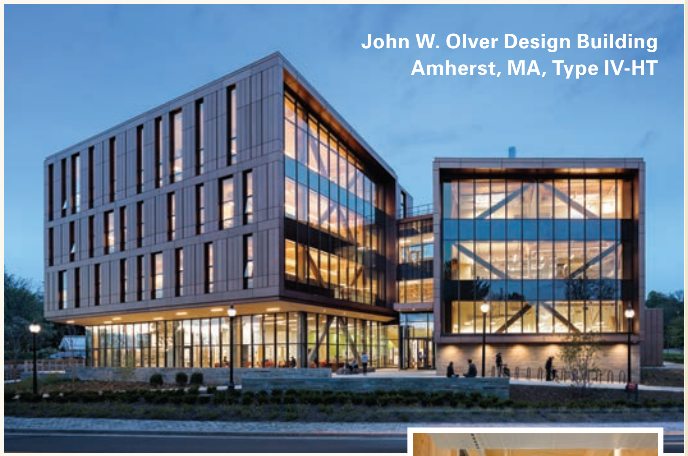
ICE Block I
Sacramento, CA, Type III-B

- Maximum height: Six stories; 85 feet
- Maximum area: 256,000 SF total building; 85,000 SF per floor
- Fire-rating requirements: 2-hour noncombustible exterior walls (FRTW permitted); 1-hour interior structure (III-A) or unrated (III-B)

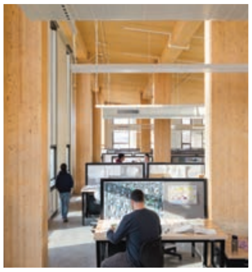
Credit: RMW Architecture & Interiors, Buehler Engineering
Images: Bernard André Photography

Type IV-HT — Entire Mass Timber Structure

Mass Timber or Noncombustible Exterior Walls



John W. Olver Design Building
Amherst, MA, Type IV-HT



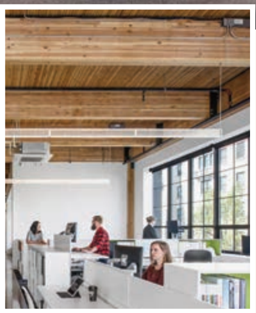
- Maximum height: Six stories; 85 feet
- Maximum area: 324,000 SF total building; 108,000 SF per floor
- Fire-resistance rating requirements: 2-hour heavy timber or non-combustible exterior walls (FRTW permitted); minimum heavy timber sizes for the interior structure

Credit: Leers Weinzapfel Associates, Equilibrium Consulting, Simpson Gumpertz & Heger
Images: © Albert Vecerka/Esto

Type V — Entire Mass Timber Structure

Mass Timber or Light-Frame Exterior Walls

The Hudson
Vancouver, WA, Type V-B



- Maximum height: Four stories; 70 feet
- Maximum area: 162,000 SF total building; 54,000 SF per floor
- Fire-rating requirements: 1-hour exterior walls and interior structure (V-A) or unrated (V-B)

Credit: Mackenzie
Images: Christian Columbres

Figure 2: Construction Types III, IV and V permit the use of exposed mass timber throughout the structure, while Types I and II allow mass timber for the roof structure.

Going Taller with Mass Timber: Full-Scale Fire Testing Supports New Construction Types

Over the past 10 years, there has been a growing interest in tall buildings constructed from mass timber materials. Around the world there are now dozens of timber buildings more than eight stories tall. However, mass timber projects designed under the 2018 or earlier versions of the IBC were constrained by prescriptive building height limits of generally five to six stories.

In 2019, the International Code Council (ICC) announced final approval of a set of proposals to allow tall mass timber buildings as part of the 2021 IBC. This version of the code includes three new construction types—Type IV-A, IV-B and IV-C—allowing the use of mass timber or noncombustible materials. These new types are based on the previous Heavy Timber construction type (Type IV, changed to IV-HT in the 2021 IBC) but with additional requirements regarding fire-resistance ratings and use of noncombustible protection. The 2021 IBC includes provisions for up to 18 stories of mass timber in Type IV-A construction.[5]

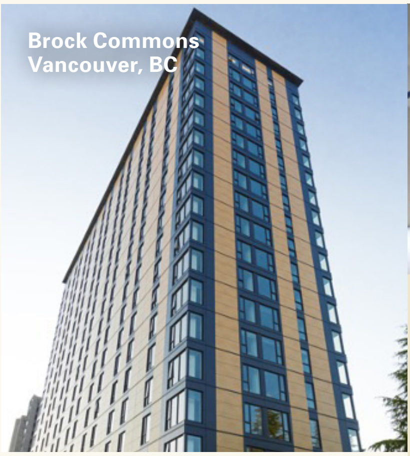
Numerous fire tests have been performed for mass timber floor, wall and roof assemblies,[6] both exposed and covered with noncombustible materials. However, to assess the fire safety of mass timber high-rise construction and validate the code change proposals, a series of full-scale compartment fire tests was performed in 2017. The ICC Ad Hoc Committee on Tall Wood Buildings designed, and the American Wood Council and U.S. Forest Products Laboratory managed, a series of five compartment fire tests on a structure at the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) Fire Research Laboratory.[7,8] The two-story structure was built and repaired between tests in conformance with the new construction types. CLT was used for construction of the floors, perimeter walls of the dwelling units and walls of the corridor and stair enclosure. Interior to the dwelling unit were glulam beams and columns supporting the levels above. The interior partition walls were built of non-rated light-gauge steel framing. Five design fires were performed, all with an identical fuel package representative of a high residential fuel load. (See Figure 3.)

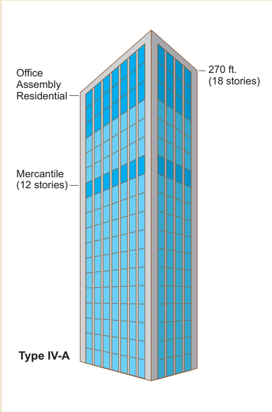
The five tests used varying configurations of full, partial and no timber exposure. For the tests with partial and no timber exposure, no sprinklers were activated after the fire was initiated and the fires were left to burn naturally for at least three hours. These test scenarios mimic an extreme combination of fire sprinklers not functioning and no fire service intervention. In each case, the fire was contained within the unit of origin, the contents were consumed, there were no structural failures and, where CLT was exposed, it self-extinguished. In tests where the timber was fully exposed, sprinkler activation was permitted; in one test activation was automatic, while in the other it was delayed and done manually. These tests were performed to demonstrate the impact of active fire sprinkler suppression. The sprinkler design density was half the minimum density required by the National Fire Protection Association's (NFPA's) NFPA 13 sprinkler standard. In both tests, the fire was extinguished quickly once sprinklers were activated. Summary videos of the tests can be found at http://bit.ly/ATF-firetestvideos.

In late 2020, a second series of compartment fire tests was conducted on a mass timber structure at the Research Institute of Sweden (RISE). The research project, funded by the USDA Forest Service and undertaken by the American Wood Council, aimed "to assess possibilities for safe increases to U.S. code-prescribed limits of exposed mass timber surface areas, for mass timber products that comply with current U.S. product standards."[9] A summary report is available which discusses the compartment fire test series and provides a summary of basic results. A final project report, to be issued at a later date, will have a full overview of all results, including a case study to repair a portion of a fire-damaged structure.

Figure 3: Mass timber compartment fire testing at ATF lab
Image: U.S. Forest Products Laboratory

Type IV-A
Entire Mass Timber Structure
Except Shafts; No Exposed Timber

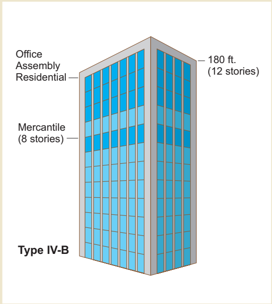




- Maximum height: 18 stories; 270 feet
- Maximum area: 972,000 SF total building; 54,000 SF average per floor
- Fire-rating requirements: 3-hour primary frame; 2-hour floors

Credit: Urban One, Fast + Epp
Images: Structurlam, naturally:wood

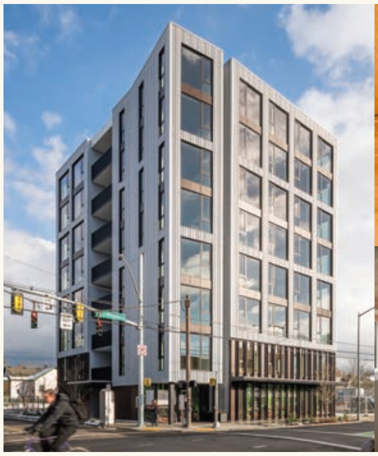
Type IV-B
Entire Mass Timber Structure
Partial Exposed Timber

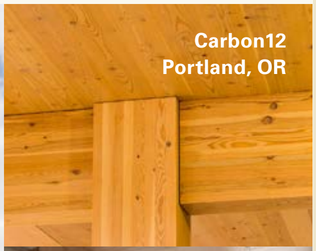


- Maximum height: 12 stories; 180 feet
- Maximum area: 648,000 SF total building; 54,000 SF average per floor
- Fire-rating requirements: 2-hour primary frame; 2-hour floors

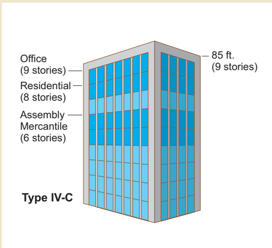
Credit: LEVER Architecture

Type IV-C
Entire Mass Timber Structure
Fully Exposed Timber





- Maximum height: 9 stories; 85 feet
- Maximum area: 405,000 SF total building; 45,000 SF average per floor
- Fire-rating requirements: 2-hour primary frame; 2-hour floors



Credit: Kaiser+Path
Images: Andrew Pogue, Marcus Kauffman

Preliminary Tall Wood Buildings
(December 2020)

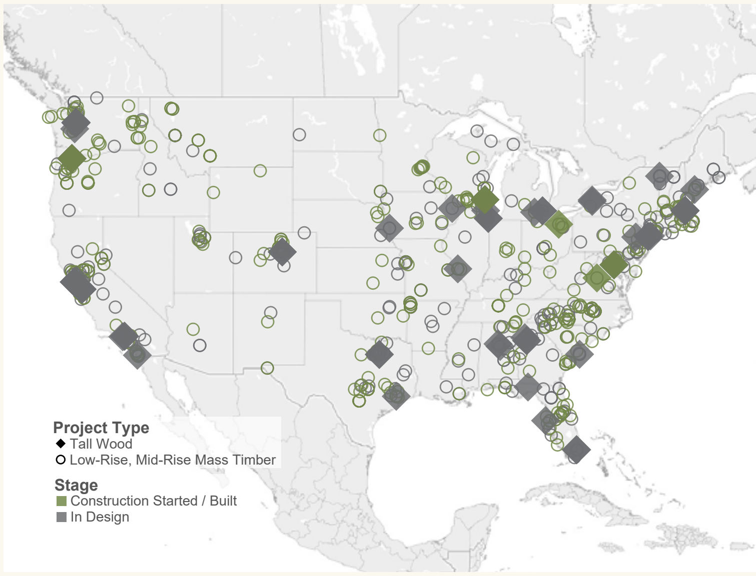


Figure 4: Construction Types IV-A, IV-B and IV-C allow mass timber buildings up to 18 stories. The map shows projects built and under construction, by height, across the U.S.

CLT Heat-Induced Delamination

Concurrent with the work and testing directed by the ICC Ad Hoc Committee on Tall Wood Buildings, the NFPA Fire Protection Research Foundation (FPRF) began working on a project titled, *Fire Safety Challenges of Tall Wood Buildings*. Under this program, a series of compartment tests of design fires evaluated the performance of protected and unprotected CLT compartments independent of the ICC Ad Hoc Committee code proposals.[10] In the FPRF series, compartment tests were performed with CLT fully protected with noncombustible protection (i.e., Type IV-A). These tests resulted in compartment fires that essentially self-extinguished without contribution from the protected mass timber. Compartment tests were also performed with significant exposed CLT (i.e., Type IV-C) in which no sprinklers were used to control the fire. In certain configurations, the compartment fires did not decay and self-extinguish after burn-out of the contents. In these configurations, heat-induced delamination of CLT manufactured with adhesives not permitted in the new 2021 IBC construction types resulted in failure of the glue line as the char front approached. Thin pieces of the laminations fell to the floor, exposing the surface of uncharred wood on a new lamination, which contributed to fire regrowth.

As containment of the fire within the compartment of origin is an important performance goal for high-rise fire protection, further studies were led by the NFPA FPRF[11] and American Wood Council to define testing methods to discern when heat-induced delamination can occur. The code-referenced CLT product standard, ANSI/APA PRG 320, was then revised to incorporate a new mandatory test for adhesives used in CLT production. This test evaluates the elevated temperature performance of adhesives, and is intended to exclude use of adhesives that permit CLT heat-induced delamination, as noted in PRG 320 Section 6.3.3:

> *6.3.3 Elevated temperature performance requirements in the U.S. and Canada*
>
> *Adhesives shall be evaluated and comply with the requirements for elevated temperature performance in accordance with Annex B.*
>
> *Note 7. The intent of the elevated temperature performance evaluation is to identify and exclude use of adhesives that permit CLT char layer fall-off resulting in fire regrowth during the cooling phase of a fully developed fire.*

Passing this test is required for adhesives used in all CLT certified to the 2018 and 2019 editions of PRG 320. This valuable change helps provide assurance that CLT manufactured to the standard meets the performance requirements of high-rise buildings. However, while the test was initially focused on CLT used in tall mass timber construction types, all North American and European CLT manufacurers with PRG 320 certification have been certified to the 2018 version, meaning that heat-induced delamination leading to fire regrowth is a non-issue for PRG 320-compliant CLT used in any construction type and building size.

Building Classifications for Insurance

The insurance industry does not classify buildings in the same manner as the IBC. Much of the difference is rooted in the primary concern of each—the insurance industry with property loss and the building code with occupant safety. For insurance purposes, buildings are usually categorized according to one of six classifications developed by the Insurance Services Office (ISO), Inc. in its Commercial Lines Manual. These classifications are based on susceptibility to damage by fire.

- ***Frame*** – Exterior walls of wood, brick veneer, stone veneer, wood ironclad or stucco on wood (Construction Code 1)
- ***Joisted Masonry*** – Exterior walls of masonry material (adobe, brick, concrete, gypsum block, hollow concrete block, stone, tile or similar materials) with combustible floor and roof (Construction Code 2)
- ***Noncombustible*** – Exterior walls, floor and supports made of metal, asbestos, gypsum or other noncombustible materials (Construction Code 3)
- ***Masonry Noncombustible*** – Same as joisted masonry except floors and roof are of metal or other noncombustible materials (Construction Code 4)
- ***Modified Fire Resistive*** – Exterior walls, floors and roof are of masonry or fire-resistive material with a fire-resistance rating of at least 1 hour but less than 2 hours (Construction Code 5)
- ***Fire Resistive*** – Exterior walls, floors and roof are of masonry or fire-resistive materials with a fire-resistance rating of at least 2 hours (Construction Code 6)

Structures that include more than one building classification are rated based on the most vulnerable classification. Upon completion, it is important to have the building inspected by the ISO or licensed state inspection agency to realize the benefits of correct classification.

Insurance for Mass Timber Construction

Contractors and developers have routinely seen high insurance premiums for their mass timber projects, matching or nearly matching rates for projects that are light wood-frame. In many cases, this is because the ISO Frame classification has been used, driven by a "wood is wood" mentality. The ISO Frame classification is mainly intended for projects that consist of solid sawn or engineered wood studs for vertical systems, and floor/roof systems comprised of trusses, I-joists or solid sawn/engineered wood joists. One of the keys to understanding the insurance aspects of mass timber is to understand how, as a family of products, it performs differently than light wood-frame construction—and, in fact, any other existing building system. This is discussed further in the section below, *How Does Mass Timber Compare to Other Building Materials?*

Some mass timber projects have been classified as Modified Fire Resistive, but there is often pressure for underwriters to use more expensive classification codes. There is also interest in exploring a seventh classification specific to mass timber. Working with a broker experienced with mass timber is very helpful in terms of negotiating an appropriate classification. The broker can speak to its performance capabilities, advantages for the project at hand, and historical use in similar buildings.

While there are many types of insurance coverage for buildings, this paper is focused on general liability and property coverage for a building owner.

General liability coverage insures your legal liability to third parties for bodily injury and/or property damage. It covers both defense costs and any indemnity payments. There are exclusions for intentional acts, coverage that can be purchased under another policy, illegal acts and acts of government. General liability policy premiums are calculated based on employee payroll, revenue and the cost of subcontracted work, including materials. Rates vary based on specific tasks performed, location of the work, past claims history of the entity, breadth of coverage, the insurer providing the policy and negotiation skills of the insurance broker. Typical general liability limits are $1,000,000 for each occurrence, $2,000,000 general aggregate and $2,000,000 products/completed operations aggregate. This is considered a one million limit policy, as the occurrence limits are referenced in conversations about coverage. Aggregate refers to the maximum the policy will pay regardless of the number of claims. The general liability policy is a dual aggregate contract. Which aggregate applies depends on whether a product or construction work product caused the claim or it was caused by something else (e.g., a visitor who slipped and fell). Excess liability limits are purchased in one million dollar increments above the primary general liability limits.

The liability insurance policy contract is modified to include specific coverages and exclusions tailored to the unique nature and exposures of each industry as well as insurance company preferences. For example, workmanship is excluded from construction general liability policies under the "your work" exclusion. As a prudent business owner, you are expected to oversee the quality of the work performed by your employees, so it is not covered. This is considered uninsurable as there would be no way to pay for the amount of losses if quality was the responsibility of a third party. However, resulting damage is insured (e.g., a roof mistakenly installed with a gap that allows moisture into the building). Insurance will pay for the cost to repair the damage inside the building, but not the cost of materials and labor to close the gap in the roof. The exclusion of "your work" carries a substantial amount of risk to the contractor performing the work; however, work performed by subcontractors is typically not excluded.

General Liability Insurance Structure Options

For a developer of a mass timber project, there are two types of general liability insurance available.

The first covers just the developer's operations. This can be an annual renewable policy that is part of a larger program covering all of the firm's projects or a standalone policy covering a single project for its duration. In this scenario, the general contractor and each of the trade subcontractors purchase their own annual renewable policies. Annual renewable policies are called "practice" policies. A typical construction project has over forty applicable general liability practice policies, most of which include at least $5,000,000 in excess liability policies. Contractors and subcontractors are usually contractually obligated to name the developer as an additional insured on their policies.

The second option is a Controlled Insurance Program, which is called either an Owner Controlled Insurance Policy (OCIP) or Contractor Controlled Insurance Policy (CCIP), depending on whether the owner or general contractor is named first. These types of policies are issued for a specific project for all parties working at the site. They cover the term of construction through the statute of ultimate repose for the state where the project is located. Due to the depth and breadth of coverage, OCIPs and CCIPs are more expensive than practice policies. They're typically used when the owner wants to assign the liability coverage for a project to the insurance company, in order to end their liability when the project is sold. Sometimes a lender will require this type of insurance to provide clear liability pathways away from the borrower. This policy is advantageous to contractors as their liability is removed from the balance sheet while the income from operations is retained. In this scenario, the general contractor and subcontractors often contribute to the insurance premium payment. However, it is rare that OCIP and CCIP limits are as large as the sum of all limits purchased by all contractors working on a project.

Figure 5: Mass timber construction site

Image: Alex Schreyer, John W. Olver Design Building, University of Massachusetts – Amherst

Property Insurance

Unlike liability policies, property policies are generally standardized. They specify the unit and value to be insured for a detailed covered cause of loss (e.g., earthquake coverage with a $20,000,000 building limit subject to a deductible of 2% of the unit insured; 2% of the $20,000,000 limit offered would be a $400,000 deductible for earthquake coverage).

Property coverage includes permanent building coverage and course of construction builder's risk coverage. Property coverage is a first-party policy, which means the policyholder is both purchaser and claimant. All liability policies are third-party policies as the claimant is not a party to the contract.

Property premiums are based on rates multiplied by the values to be insured over the duration of the policy. Rates are negotiated using type of construction, location, square footage, protection class, building security, sprinkler system, insurer appetite for risk and broker expertise. Protection classes are national ratings by zip code, which reference the location of the closest fire department, whether it is volunteer or paid, fire hydrant proximity and quality of the water system supporting the fire suppression. Security includes cameras, alarms, fences, lighting and security guards. Water pressure within the sprinkler system is evaluated on a floor-by-floor basis. Whether there are sprinklers and fire walls in the attic is important, and the developer of a newly constructed building will often provide detailed plans for the underwriter. Building beyond code requirements for fire suppression can reduce property premiums.

Insurance Underwriters and Mass Timber

Nearly all insurance company home office underwriters and Chief Underwriting Officers have analyzed mass timber construction and made decisions regarding their company appetite for this construction type risk. These executive-level decisions are made using information provided during industry conferences, trade papers and evaluations by corporate counsel. The insurance company is an investor. This is the first and foremost concept to keep in mind. When claims occur, the amount paid to policyholders is many times the amount of the premium. By making careful underwriting choices, only a fraction of policyholders will have claims and the premiums collected will exceed the total of the claims plus operating overhead. Insurance companies that pay more in claims than they collect in premiums go out of business. Underwriters who have severe losses or frequent losses do not last long. However, the adequacy of premiums compared to losses is not known until well after the policy expires. The system of insurance relies on spreading the risk over multiple policies with only a handful experiencing losses.

The easiest way to understand the underwriting process is the following thought exercise. Ask yourself if you are willing to accept $800 a year from a family member in return for writing them a check for $400,000 if they have an auto accident. The answer is probably no. However, what if that were spread over 5,000 people; you would receive $4,000,000 in annual premiums guaranteed and write a check only when someone has an accident. The answer changes to "it depends." How much of the $4,000,000 would you have to pay out? Most certainly there will be accidents, but how many? What is the likelihood that you would pay out the full $4,000,000? How do you begin to evaluate the percentages? You ask yourself, what do I know about those 5,000 people?

Some insurers consider mass timber to be high risk because there is little historical loss data. While it has been used in Europe for decades, this is not typically viewed as applicable aggregate loss data in the U.S. The covered perils for property coverage and legal liability differ slightly by country within the European Union, and greatly between the U.S. and the rest of the world. The greatest difference lies within the U.S. court system. The volatility of judicial and jury decisions is a huge risk to insurance companies. The court can amend the coverage contract to provide coverage that was neither anticipated nor intended and for which premiums were not paid. Social inflation has increased jury awards exponentially, and the long liability tails due to statute of limitations adds another layer of unpredictability. Large verdicts against manufacturers and their insurance companies can exceed policy limits and cause the manufacturing company's bankruptcy. This could be happening to a key supplier without your knowledge during the construction of the building. In other parts of the world, businesses must carry a minimum asset base to protect consumers. Large suppliers' balance sheets plus product liability policies backstop the course of construction builder's risk policy.

When evaluating a mass timber project, underwriters have few reference points for comparison. Finding 50 similar projects in the same geographical area is not yet possible. Developers and design/construction teams don't have long lists of completed mass timber projects. However, the growing number of successfully completed mass timber buildings, shown in the map on page 2, is helping by illustrating collections of projects in various geographical areas. A number of design and construction firms are also now specializing in mass timber and have expanding portfolios that demonstrate both their own experience and contribution to the nationwide momentum. Information on many these projects, including their project teams, can be found on the WoodWorks Innovation Network (www.woodworksinnovationnetwork.org). To an insurer, experience helps mitigate risk.

Figure 6: Sideyard, Portland, OR
Image: Skylab Architecture, photo Stephen Miller

How Does Mass Timber Compare to Other Building Materials?

Mass timber is a unique building system. It is combustible, like all wood products, but consists of large cross sections of material forming columns and beams, and solid slabs similar to those used in concrete and steel construction. However, it performs differently than any other system.

Mass timber elements have inherent fire resistance, and in most applications and buildings sizes do not need applied fire protection materials such as gypsum wallboard. In a fire, mass timber members form a char layer on their surface while their interior remains undamaged and structurally sound, allowing them to retain their load-carrying capacity. The inherent fire-resistance capability of heavy timber has long been recognized in the IBC under Type IV construction. Comparing the allowable building size limits of a Type IV building to a Type II-A building in IBC Chapter 5, they are very similar.

- A Type II-A building must be framed with noncombustible materials and most structural elements (beams, columns, floors) are required to have a 1-hour fire-resistance rating. Type II-A buildings are commonly framed with structural steel, with spray-applied fireproofing added to the structural framework to achieve the 1-hour rating.
- In a Type IV building, which includes exposed heavy or mass timber elements, those elements must meet code-specified minimum sizes. However, they are not required to have a specific hourly fire-resistance rating or fire protection.

The insurance industry may generally understand that mass timber and light wood-frame construction perform diffrently, but the fact that they are both wood, combined with a lack of historic loss data associated with mass timber buildings, contributes to the use of light-frame insurance rates for all wood buildings. This follows the insurance industry's understandable practice of selecting the highest possible rate when the risk is undeterminable.

Often, when a project proforma is being created, the insurance cost estimate is from a broker who is unfamiliar with the nuances of mass timber. The broker will propose aggressive costs based on the corresponding IBC construction classification. It is rare for buyers to consider the broker's level of expertise as an area of potential concern. Rather, they tend to buy insurance based on the lowest bid or relationship. This is a pervasive problem within the insurance industry. There are many skilled brokers; however, discerning the depth and breadth of insurance expertise is something few buyers take the time to do. It is prudent for a developer to spend adequate time selecting a broker and evaluating their mass timber experience, much in the same way they select a general contractor.

Evaluating Mass Timber's Attributes

An insurer considering coverage for a mass timber project needs to understand all aspects of the building materials chosen, including the component pieces. This is an area where project-specific technical documentation can be instrumental. Examples of information that can lead to a mutually beneficial agreement include:

- Third-party certification and material test reports for manufacturing processes, adhesives, fire performance, structural properties and building code compliance
- Moisture management strategies for protecting the timber elements during construction
- Other water damage mitigation strategies (e.g., floor drains, emergency back up roof drains, etc.)
- Building enclosure details that protect the timber structure from long-term moisture intrusion
- Other impacts of building enclosure assembly choices
- Site security plan for protection against arson, vandalism and other intrusions
- Sprinkler protection plans for construction and final phases, including activation plans and coordination with the local fire department
- Complete construction schedule with key dates noted (highlight difference between mass timber and other materials and how a compressed schedule = less risk, less exposure)
- Risk management plans detailing response strategy for natural disasters, riots and other civil unrest

Third-Party Certification and Material Test Reports

One method for mitigating potential risk with mass timber construction is to verify that it has been evaluated and certified to meet specific requirements. As noted, the IBC requires mass timber products to comply with specific manufacturing standards, which have been rigorously vetted through testing. In order to verify compliance, it is recommended that the developer or design/construction team obtain third-party evaluation reports for the mass timber manufacturer(s) supplying the project. Examples include APA Product Reports, ICC-ES Reports, PFS TECO product reports, Intertek reports and more.

Moisture Management Strategies

Mass timber is a hygroscopic material, meaning it has the ability to absorb and release moisture. Its moisture content will move toward a climatic equilibrium, which is a function of temperature and relative humidity. However, it is also subject to moisture impacts when exposed to bulk water such as rain. Since mass timber elements often serve as both structural framework and exposed finish, it is important to have a comprehensive plan in place to protect the wood from moisture during construction. This is key not only for aesthetics but durability and resistence to fire and water damage—which are of particular concern to insurers.

Figure 7: Example of construction moisture management technique
Image: Andersen Construction

Construction-phase moisture protection has historically been a means and methods item under the purview of the contractor. However, with mass timber projects, it is common for a member of the design team and/or a building science consultant to have input into the moisture management plan and participate in construction site inspections of related practices. In addition to having a plan, mock-ups and preconstruction meetings are essential to ensure that all parties involved understand the expectations and installation strategies.

There are many methods for protecting timber elements from moisture during construction, and they vary widely in terms of effectiveness, cost and time. The following resources can help project teams evaluate the options and make decisions based on their specific needs:

- *Nail-Laminated Timber: U.S. Design and Construction Guide, Binational Softwood Lumber Council*[12]
- *Moisture Risk Management Strategies for Mass Timber Buildings, RDH Building Sciences Inc.*[13]

These publications offer both narrative on the topic of moisture protection and examples of techniques that can be applied to all mass timber products.

Building Enclosure Details

Underwriters need more than just satisfaction that the timber is being protected from moisture during construction. They need long-term assurance of specific geographical durability beyond the statute of ultimate repose. This is where building enclosure detailing is critical. Building enclosures, also referred to as building envelopes, are the assemblies (exterior walls and roofs) that surround a structure and protect it from external elements such as rain, heat and cold. Properly designed assemblies allow interior spaces to maintain desired temperature and humidity levels, and contribute to long-term building durability by diverting bulk water and vapor intrusion. Individual elements within a building enclosure serve specific purposes—such as water control, air control, thermal control and vapor control—and are referred to as control layers. Regardless of the structural framing material (e.g., steel, concrete, masonry, light wood-frame, mass timber or other), any system has the potential to be impacted by moisture-related problems. However, these potential issues can be avoided with well-thought-out and executed building enclosure details and assemblies. Wood has been successfully used for hundreds of years to construct durable building enclosures.

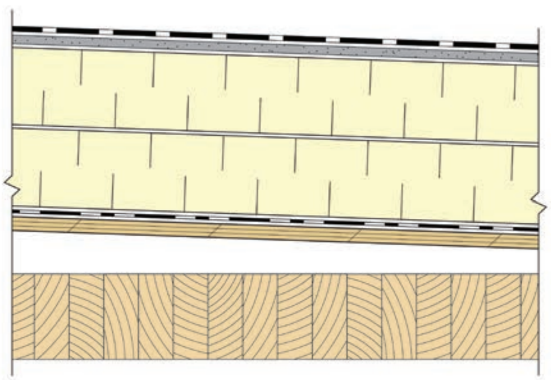


Figure 8: Example mass timber roof assembly
Source: RDH Building Science Inc.

Similar to the construction moisture protection strategies noted above, building enclosure details and assemblies should be designed for the specific project, based on its specific climatic conditions. The following resources provide further narrative on this topic as well as examples of implementation.

- *Nail-Laminated Timber: U.S. Design and Construction Guide*
- *Mass Timber Building Enclosure Best Practice Design Guide*, RDH Building Science Inc.[14]

An important note is that mass timber is not intended for use as exposed cladding or the exposed elements of a roofing system. For building envelope applications, mass timber can be used as the structural framing (e.g., roof panel) with continuous control layers installed outboard, protecting it from the elements.

Other Water Damage Mitigation Strategies

Aside from moisture management during construction and building enclosure detailing and installation, other techniques can be employed to prevent moisture-related issues. The key to avoiding decay and reducing maintenance is to keep the wood "dry by design"—i.e., implement strategies to prevent water from accessing timber elements within wall, floor and roof assemblies. For example, in areas such as bathrooms, labs and kitchens where floors are often wet, it is prudent to install floor drains and/or elevate the wall structure and finishes. One approach is to install a minimum 6-inch-tall concrete curb under the walls. In addition to protecting the structure, the objective is to avoid costly and time consuming repairs associated with finishes that are not resistant to moisture. Other options include leak detection systems and routinely scheduled inspections.

Site Security Plan for Protection Against Fire Risks

The ability to buy cost-effective insurance is one of many reasons that a detailed site security plan is essential. Fire is a danger for all buildings and construction sites regardless of building material. During the construction phase, some sites are especially susceptible until sprinkler systems and fire alarm systems are fully functional, and passive fire protection measures such as gypsum wallboard are installed. Fire risks and fire sources during construction include smoking, hot work, heaters and cooking equipment, presence of shavings and sawdust, and temporary electrical equipment.

An effective security plan is multi-faceted and includes reducing ignition sources, removing or controlling potential fuel sources (e.g., sawdust), training on-site workers on protocols for safe working conditions, and being prepared with on-site and other local emergency response teams. Provisions of the IBC and the International Fire Code should also be followed when putting together and executing site-specific fire safety protcols and procedures. A number of additional resources on this topic, including fire prevention checklists, a review of applicable code provisions and methods of implementation, example safety plans and much more, are available from the Construction Fire Safety Coalition.[15] The American Wood Council also provides a one-page document summarizing some of the information referred to above.[16]

Construction Schedule Impacts

Mass timber buildings are erected more quickly than buildings made from other materials. Not only can this result in financial benefits associated with a shorter construction schedule and earlier lease/occupancy, it can also mitigate some of the risks associated with construction. A compressed schedule results in less time that the site is susceptible to arson, theft, weather damage and other risks.

According to Lendlease, Candlewood Suites at Redstone Arsenal, a four-story mass timber hotel, was built 37% faster overall and with 40% fewer construction workers than a similar cold-formed steel military hotel. DLR Group also published a case study projecting that the 12-story Seattle Mass Timber Tower would be constructed 25% (five months) faster than a similar post-tensioned concrete building.[17]

The full construction schedule should be presented to the underwriter, noting key dates of significant completion. To highlight the reduced risk, it may be helpful to provide a side-by-side comparison of the mass timber construction schedule vs. an estimated schedule for the same building in steel or concrete.

Risk Management Plans for Response to Riots and Other Civil Unrest

Each project should have a risk management plan addressing potential building and property damage as a result of civil unrest. Since the impacts of civil unrest can be difficult to predict, it is important to identify the potential scenarios, hazard levels and resulting losses in property and schedule. An example of safety and property protocols can be found on the website of the Travelers insurance company.[18]

How Can Mass Timber be Repaired Post-Fire?

Two common questions when insurers are evaluating a mass timber project are, *How is it repaired after a fire?* and *How much will the repairs cost?*

Since mass timber's use in the U.S. is relatively recent, few projects have experienced losses resulting in repairs. However, as noted above, mass timber—including assemblies, full-scale compartments and multi-story structures—has undergone extensive fire testing, and much can be learned from the results.

In response to questions raised during the review of tall wood code provisions that were subsequently included in the 2021 IBC, SmartLam and the American Wood Council created example solutions for in-situ fire repair. The examples focused on mass timber structures that incurred fire damage as a result of the ATF lab compartment fire tests mentioned in the section above, *Going Taller with Mass Timber: Full-Scale Fire Testing Supports New Construction Types*. The solutions can be viewed on the ICC website.[19]

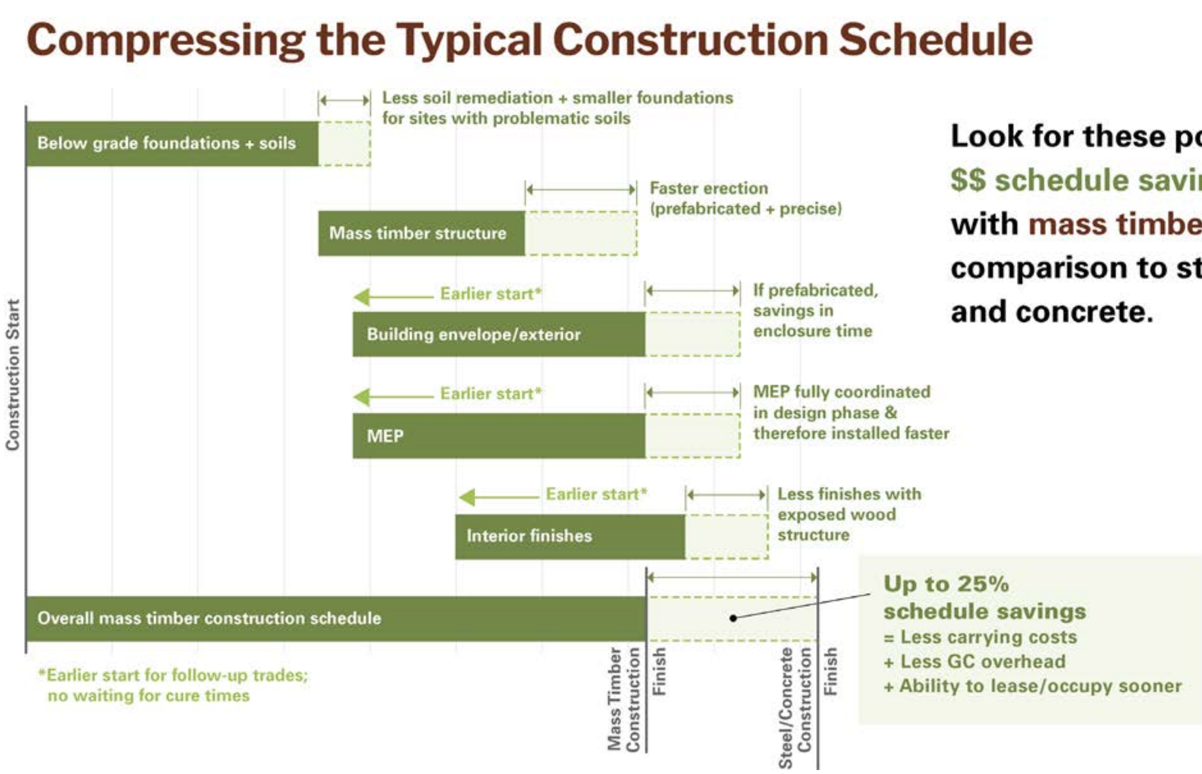


Figure 9: Schedule savings associated with a mass timber building

Source: Mass Timber Cost & Design Optimization Checklists, WoodWorks

Figure 10: Charred CLT post fire during the ATF lab tests
Image: SmartLam, American Wood Council

In addition to potential fire damage, water damage from sprinklers and/or the use of firefighting hoses is also a concern. To address this, FPInnovations published a report, *Solutions for Upper Mid-Rise and High-Rise Mass Timber Construction: Rehabilitation of Mass Timber Following Fire and Sprinkler Activation.*[20] The report provides methods of evaluating the structural integrity of fire-affected mass timber elements, guidelines for assessing which members can remain as-is and which require repair or replacement, and references to additonal research on the topic.

Examples of Mass Timber Buildings That Have Experienced a Fire

The FPInnovations report mentioned above includes information on four mass timber buildings that experienced fires and/or sprinkler activation. Of particular note is a fire that occurred in October 2018 at the Arbora complex in Montreal, QC. The multi-family building consists of eight stories of mass timber above a one-story podium, and the fire occurred near a balcony on the third floor. The fire was restricted to the balcony area and there was some limited damage just inside the balcony as a result of water spray through a broken window. During the clean-up, a section of the concrete topping was cut to assess damage to the mass timber floor panels. The mass timber was found to be at ambient temperature with typical moisture content, indicating that the fire and water did not reach the mass timber. The active fire suppression systems were effective at preventing fire spread and the concrete topping was effective at preventing water from fire fighting operations from reaching the mass timber. Additional information on the project, as well as other fires, can be found in the FPInnovations report.

Figure 11: Fire damage in the Arbora complex in Montreal, QC
Image: FPInnovations

Conclusion

While mass timber is relatively new in the U.S., the number of buildings has grown significantly over the last decade, in most regions of the country, and there is every reason to believe the market will continue to accelerate. As with any unfamiliar material or building type, insurance challenges are anticipated. There is a great deal of information available to help insurance brokers and underwriters evaluate the relative risks of mass timber construction today, and research and testing is ongoing. It is also important for developers, owners and contractors to work with experienced brokers as this is key to leveraging the unique attributes of mass timber and realizing insurance premiums that reflect the benefits of this innovative wood material.

WoodWorks – Wood Products Council provides education and free technical support related to the design, engineering and construction of commercial and multi-family wood buildings in the U.S. A non-profit organization staffed with architects, structural engineers and construction experts, WoodWorks has the expertise to assist with all aspects of wood building design. If you are experiencing challenges with insurance for mass timber buildings, or have any questions related to the design or construction of mass timber or wood-frame buildings, contact us at www.woodworks.org/project-assistance or email help@woodworks.org. Visit our website at www.woodworks.org.

End Notes

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