Mass Timber Insurance Strategy

SCIUS Advisory

This research was completed for the Climate Smart Buildings Alliance in cooperation with the Canadian Wood Council.

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Cover photo: University of British Columbia Forest Sciences Centre, photo by Don Erhardt, courtesy naturallywood.com

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Glossary

ANSI	American National Standards Institute
APA	Engineered Wood Association (formerly American Plywood Association)
BIM	Building Information Modeling
CLT	Cross Laminated Timber
CSBA	Climate Smart Buildings Alliance
CWC	Canadian Wood Council
DLT	Dowel Laminated Timber
EML	Estimated Maximum Loss
Glulam	Glue Laminated Timber
ISO	International Standardization Organization
ISO	Insurance Services Office
LSL	Laminated Strand Lumber
LVL	Laminated Veneer Lumber
MFL	Maximum Foreseeable Loss
NBC	National Building Code of Canada
NLT	Nail Laminated Timber
OSB	Oriented Strand Board
PML	Probable Maximum Loss
PSL	Parallel Strand Lumber
WIDC	Wood Innovation and Design Centre

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Executive Summary

The Mass Timber Insurance Strategy seeks to identify gaps and opportunities in existing public research to provide insurers with the data they require to accurately and reliably assess the risks of mass timber construction.

This project aims to centralize existing research, set a national and international research pathway that could impact insurance rates, and establish systems to ensure emerging research gets incorporated into insurers processes. It is part of the Mass Timber Insurance Action Plan, which is a collaborative project between the Climate Smart Buildings Alliance (CSBA), the Canadian Wood Council (CWC) and a range of building and insurance industry collaborators. The ultimate objective of the initiative is to reduce high construction and occupancy insurance costs which are currently a serious barrier to the growth of more mass timber construction in Canada. The Action Plan consists of four feasibility-stage projects aimed at addressing identified challenges related to data, contractor expertise and insurance capacity.

Through a series of interviews and a review of existing research, priority areas for future research have been identified in this Strategy. Insurance companies want to work with owners and developers to reduce risks by identifying best practices for mitigation, and to better understand the methods and costs to repair mass timber and other building components when necessary.

Insurance costs are based on historical claim data. Research and testing data will have a limited effect on reducing those costs. However, claim data is isolated and not visible to all companies. Additionally, data exists for repairs that are made but not expensive enough to result in insurance claims. Aggregating this data into a source that is accessible to the insurance industry can better define the range of issues, best practices to repair, and costs to repair.

New research and testing will add to insurance companies' comfort with mass timber as it demonstrates behaviour in different conditions. Data informing the methodology and cost of repairs can increase the capacity of available insurance as more companies become increasingly comfortable with mass timber and include these projects in their portfolios. With time, this growing capacity will drive down rates, assuming the conditions are favourable. Research and testing that simulates "real" conditions will accelerate the process.

Interviewees identified some areas for research and testing that would inform their processes. There was a strong interest in tests where buildings under construction or completed are exposed to fire, smoke and water damage and then repaired in a similar manner to a real situation. Research was suggested into the strength of joints and connections under normal building loads following a fire, and how those would be detected and repaired. Differences in behaviour and repairability of 3 storey buildings vs. 18 storey buildings is also of interest.

"There is a real concern that repair and rectification costs covered by the insurance policy could far exceed original construction costs and may require detailed engineering assessments and detailed or complicated repair procedures"

Introduction

Demand for more sustainable construction materials and methods, as well as more sophisticated design and production systems, is stimulating investment in mass timber in many countries. Construction with heavy timbers (large sawn logs, beams and columns) has been used for over a century.

Figure 1.The Kelly Douglas building at 375 Water Street, Vancouver (now known as The Landing) is a nine-storey heavy timber structure that was built in 1905 (source Wikimedia Commons).

Mass timber represents a modern interpretation of these traditional systems. It comprises a range of highly engineered wood products, primarily columns, beams, and panels, that are designed for high strength and used as structural elements in buildings. These products are typically manufactured off-site by bonding multiple layers of wood together using adhesives or fasteners, creating large, solid components. Early examples of mass timber buildings in Canada include:

- The Wood Innovation and Design Centre (WIDC) in Prince George, BC – a six-storey research and demonstration centre built with Cross Laminated Timber (CLT), completed in 2014
- University of British Columbia's Brock Commons Tallwood House in Vancouver, BC – an 18-storey student residence with a structure of CLT and glulam (glue laminated timber), completed in 2017

- The T3 Building in Toronto, Ontario – a nine-storey office building constructed with CLT and glulam beams, completed in 2017.

There are several advantages to building with mass timber. It is a highly engineered, homogenous factory-produced product offering predictability in performance and speed of construction that lends itself to modern methods of construction. The strength to weight ratio of large mass timber beams, columns and panels make them attractive to those building tall buildings, especially in poor soil conditions. Its lighter weight also reduces the requirements for foundations, reducing use of concrete and lowering costs.

From the environmental and health perspectives, mass timber also offers advantages. Wood is a renewable resource that sequesters carbon and can help mitigate climate change. Mass timber also has an aesthetic appeal, with visual and aromatic cues providing a biophilic experience that can reduce stress, improve cognitive function, and enhance overall well-being for occupants.[1]

Acquiring affordable insurance to construct mass timber buildings can be challenging. They can also be expensive to insure once occupied. Since risk assessment and rates are largely based on previous claim data, the lack of data for mass timber leads insurers to rate the projects on a par with light wood frame buildings.

There are currently over 690 completed buildings and bridges in Canada that use mass timber.[2] Most of those are less than ten years old, resulting in only a few claims in permanent property insurance. These projects also comprise just a small fraction of total buildings constructed every year so the number of builder's risk claims is also low. In the face of insufficient previous claim information, research and testing may aid owners, contractors and insurers in evaluating risks and inform them with best practices for risk mitigation and incident repair.

This report identifies possible research and testing that may be undertaken to aid insurers in evaluating risks, both for builders' risk and permanent property insurance. It identifies research that has already been completed and gaps where there is little information. It identifies research and testing that is of most interest to insurers, and has

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[1] https://www.naturallywood.com/resources/biophilic-design-with-wood-in-british-columbia/
[2] https://natural-resources.canada.ca/forest-forestry/mass-timber-construction-canada

the potential to impact their risk assessment, with the aim of facilitating more affordable insurance for mass timber buildings.

Methodology

Two main activities comprised the bulk of the research for this project, a literature scan and a series of interviews. The literature scan of existing reports, tests, guides and articles was compiled through an internet search and data sources recommended by insurers and other researchers. The literature collected is organized into a spreadsheet with keywords, dates, authors, and links to online publications. Also listed are existing literature, online articles and university research that is currently underway.

The interviews were conducted with underwriters, engineers and brokers who are participating in the Mass Timber Insurance Action Plan project and were recommended by the Climate Smart Buildings Alliance (CSBA) or the Canadian Wood Council (CWC). Ten interviews were completed. The information gathered during this process informed this report. No quotes are attributed to the person or company who provided them.

Existing Research

Various universities and research organizations have investigated the properties of mass timber, its performance under different conditions, behaviour with use of adhesives, and its behaviour when exposed to fire, water and seismic activity. These studies have informed best practices for manufacturing and construction. They have aided fire officials and informed building codes and insurance companies. The results of the tests and guides have also enlightened those who design, manufacture, construct and insure mass timber about the qualities that make it a unique building material and what to expect from it in different situations.

Notable resources include:

- WoodWorks - Mass Timber Insurance Strategy Roadmap:2025-2030 (2025)
- WoodWorks – The Mass Timber Insurance Playbook, US Edition (2024)
- WoodWorks – Insurance for Mass Timber Construction: Assessing Risk and Providing Answers (2021)
- CWC – A Guideline for Insuring Timber in Canada (2022)

- CWC - Large-Scale Fire Tests of a Mass Timber Building Structure for MTDFTP (2023)
- RDH Building Science – Moisture Risk Management Strategies for Mass Timber Buildings (2022)
- Arup – Fire Safe Design of Mass Timber Buildings (2024)
- WoodWorks – Repair of Fire-Damaged Mass Timber (2023)
- RI.SE – Post-Fire Rehabilitation of CLT (2021)
- Journal of Structural Engineering - Shake-Table Testing of a Full-Scale 10-Story Resilient Mass Timber Building (2024)

Figure 2. Large-scale fire test photo courtesy FPInnovations

Figure 3. Glulam column before and after 2-hour fire test. Photo: David Barber, Arup

Reports from WoodWorks, FPInnovations, the National Fire Protection Association (NFPA) Property Insurance Research Group (PIRG), the Research Institutes of Sweden (RI.SE), and Oregon State University are among those commonly referenced. Insurers keep track of research through professional organizations, communications with clients, and online research. There is not currently a single source for information about research and testing.

While insurance companies use the reports and testing data to inform their personnel and processes, claim data is much more heavily relied upon to set rates. The technical reports help them to understand the material and be more comfortable with mass timber construction, but the claim data provides what is needed to evaluate risks and costs to repair and replace. Repairs done on mass timber elements in existing research were primarily completed in a laboratory environment, however insurance companies are interested in how repairs would be completed in an existing building. The additional logistics and environmental conditions can introduce issues that impact methodology and cost.

New research and testing will increase familiarity and should add to their comfort level as it demonstrates the behaviour of mass timber in different conditions and the cost implications of those conditions. This is likely to increase the capacity of available insurance as more companies include these projects in their portfolios. With time, this increased capacity will drive down rates, assuming the conditions are favourable and insurance companies are more comfortable with the material. Research and testing that simulates "real" conditions, and identifies methods and costs to repair will accelerate the process.

Standards

Several International Standardization Organization (ISO) and American National Standards Institute (ANSI) / Engineered Wood Association (APA) standards were identified:

- ISO 12578:2016. Timber structures -- Glued laminated timber -- Component performance requirements
- ISO 16696-1:2019 -- Cross laminated timber -- Part 1: Component performance, production requirements and certification scheme
- ISO 22390:2020 Timber structures — Laminated veneer lumber — Structural properties
- CSA S478:19 Durability in buildings
- ANSI/APA PRG 320-2025: Standard for Performance-Rated Cross-Laminated Timber
- ANSI A190.1-2022 Product Standard for Structural Glued Laminated Timber
- ANSI 405-2023: Standard for Adhesives for Use in Structural Glued Laminated Timber
- ANSI 117: Standard Specification for Structural Glued Laminated Timber of Softwood Species

Insurance Services Office Classifications

The ISO standards specify manufacturing requirements and properties of mass timber. A separate entity, the Insurance Services Office (also ISO), run by Verisk, is collecting loss data and plans to provide subscription-based access to the large pool of claim data to insurance carriers.

Verisk is also adding mass timber construction to the 2025 Standard Classification of Property Exposer (SCOPES) revision, categorizing Types IVA, B and C as mass timber construction to align with the 2021 International Building Code (IBC). The preliminary definition places it between non-combustible and ordinary types (Types I,II and III) and wood frame (Type V) construction and expands the heavy timber classification of Type

IV.[3, 4] The three types of mass timber construction (IVA,IVB,IVC) define different levels of encapsulation, fire resistance rating requirements and building height.

Research of Interest

Existing claim data is required to set rates because data about the costs to repair underlies the risk evaluation for any project. Buildings are unique, as are accidents. Data about one type of incident does not directly apply for other buildings. Larger data sets can speak to general conditions and costs. For example, a better estimate can be made for how a fire or pipe leak in a six-storey apartment building is repaired and how much it might cost if data is available from dozens of similar incidents. The methodology and average costs would be understood and risk could be evaluated. In the absence of data, the risk is unknown and therefore assigned to a high level.

If the cost to repair is estimated to be greater than the value of the building, it may be evaluated as a total loss. Data on repair of damage will inform an estimated probable loss that an insurance company might reasonably incur. Research that demonstrates the methodology of damage repair to mass timber and provides costs to repair is a priority for making mass timber insurance available and affordable. While research cannot replace a larger data set from existing claims, it is a first step in understanding what is required. It can be used to estimate costs to repair and to educate restoration contractors who will be completing the repairs. There are currently few contractors with any experience in mass timber repairs.

Suggested Research and Testing

The behaviour of mass timber in fire has been well researched, and while there is more that can be investigated, insurers have a better understanding of its performance, especially in buildings where sprinkler systems have been installed. Concerns about water damage have risen to the forefront, including water damage associated with extinguishing of fire, leaks and weather events.

[3] https://www.verisk.com/resources/campaigns/mass-timber-new-technology-drives-a-new-construction-class/

[4] https://codes.iccsafe.org/content/IBC2021P1/chapter-6-types-of-construction

"Water damage is, for many insurers, the number one cost of loss. We need to include that in a very real-life way so that we can see the true costs for repairability."

The National Fire Protection Association (NFPA) Property Insurance Research Group (PIRG) is currently testing moisture repair in tall wood buildings, with the results due out in 2025. Results of that testing might inform future moisture testing.

Many of the research papers reference CLT and glulam, which is appropriate because those are the most popular types of mass timber building materials. However, as mass timber becomes more popular, other types of mass timber that are frequently used, such as NLT, should be included to identify any differences in behaviour.

Despite the reliance on claim data, insurers are interested in research. They are interested in tests that are designed to specifically answer the questions relevant to methodology and cost to repair. Through the interviews, the following design principles were identified for future tests.

"If somebody can build a large structure and burn it, put it out, repair it. That would be amazing."

Key Design Principles for Future Tests

Interviewees stressed that any research or testing shared on a CWC platform should be verified or validated.

Tests that involve demonstration through a large-scale experiment and other types of research should **involve insurance professionals** whenever possible to ensure that the data that is being gathered is as complete as possible to address insurance concerns. This may be as simple as a review of a scope of work or proposal, or they may be more hands-on in the design process, depending on the research being done.

Experiments should **resemble "real" situations**, whether the focus is course of construction or post-occupancy. Work that is done to repair mass timber inside a laboratory, for example, will not carry as much weight as repairs completed on-site with all the complexities of an actual building.

Fire, smoke and water damage can be introduced by simulation of accidents or natural causes. The insurance companies stressed that it is important that the **methodology,**

logistics and cost to repair the damage in place is the data that they are most interested in. This data is what will most closely resemble what is required on an insurance claim and will provide information about the financial responsibility should these types of damage occur.

The largest knowledge gaps currently involve moisture damage, what the potential issues are, how they can be prevented, mitigated and repaired, and the costs for these. What may seem to be an expensive prevention plan may be worthwhile when compared to the cost of repairs. Costs for prevention, mitigation and repair can be evaluated with risk of damage on a project-by-project basis, but there is currently little existing data to do this comparison, especially for the repairs. Cost and methodology to repair fire and smoke damage is also needed.

Suggested areas of research for repair of damage include:

Course of construction:

- Extinguishing of fire – repair of fire, smoke, water damage
- Weather events – rehabilitation or repair of water damage

During occupancy:

- Extinguishing of fire – repair of fire, smoke, water damage
- Leaks from plumbing or the roof – rehabilitation or repair of water damage

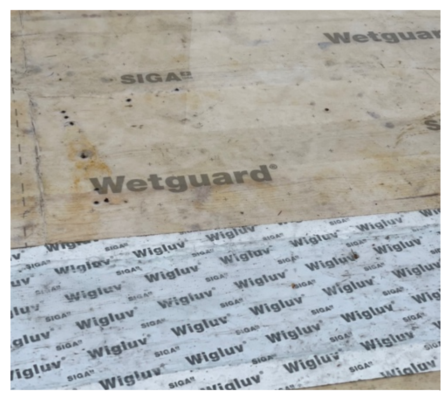

Figure 4. A protective moisture barrier applied to CLT panels

These tests can each be done on multiple types of mass timber, adhesives, and connections. Tests can be done with and without protective moisture barriers. Performance and repair of hybrid construction with mass timber mixed with steel or concrete and the connections between them can also be analyzed with each of these configurations.

The key data will be the methodology, logistics and cost to return the building to its condition before the event occurred. It will be valuable to compare variations in performance between the different types of mass timber, adhesives, connections, and hybrid construction.

Challenges that may occur with replacement of mass timber to match undamaged pieces should be noted. If charring can be removed from damaged yet structurally sound glulam and new wood is attached, will the new wood have a sufficiently similar appearance? If repairing structural components, will it be brought back to its original condition, or to a reduced performance level? If there is a minimum acceptable performance level, it should be identified along with methodology to demonstrate that performance.

Salvageable pieces should be identified. For example, if a kitchen fire is extinguished and only a single wall panel is charred, but water and smoke damage on other panels is more easily rehabilitated, that should be noted.

A threshold should be defined for when materials can be repaired vs. replaced. Costs to repair or replace, including labour, should be included with aesthetic and structural considerations. Potential challenges to different approaches should be identified.

Additional Ideas for Potential Tests

Interviewees identified some specific tests that they are interested in. They are listed here in no defined order.

1. Research into incidents involving mass timber that do not rise to the level of claims would enhance claim datasets. Issues either during construction or occupancy that can be resolved without filing an insurance claim are important data points when evaluating risk. These data points identify repairs that are not expensive or mitigation measures that limit damage. Data could include the type of issue, prevention, mitigation or repair measures, challenges of implementing those, and the costs associated with them. Including this information in insurer's data sets will provide more statistically significant data and inform their risk profiles for mass timber projects. If data is not currently accessible, owners and contractors who are interested in reducing insurance premiums in the future could be encouraged to start collecting and sharing the data.
2. A large test representative of a multi-storey building under construction that has been damaged by fire and smoke, with water damage from extinguishing the fire. Different sections could use different types of mass timber, coatings, encapsulation and connections. The test should also be done on a hybrid building to test connections between steel and mass timber. Identify the methodology, equipment and cost to repair in place, similar to what would need to be done on an actual building. A few insurers and FPInnovations have expressed interest in pursuing this research.

3. A test on a “post-occupancy building” with a mass timber structure that has been encapsulated. Drip water onto the mass timber where it is not seen for several months (as if it were a leaky pipe) or purposely damage the roof and let water seep in during wetter months. Use moisture monitoring sensors to measure the water exposure. Identify the damage to the mass timber, connections, and other materials. Repair the damage in place and record the methodology and costs. Include materials that need to be replaced other than mass timber in the evaluation of costs.
4. A loaded fire test on joints or connections. With screws holding a wooden beam into a CLT wall, we would expect some heat transfer and those screws to be affected. Will there be char around the screws? How does the heat affect deeper layers of adhesives? Is everything as strong as before the fire? There has been some testing but not under the load of a building.
5. Research into the costs, functionality and impacts of weather protection solutions during construction. At what point does the value proposition of weather protection during construction (roof tents, building wraps, etc.) make sense from a risk management or claims perspective?
6. Research what the most common types of mass timber buildings are now, and what they are projected to be in five or ten years. Are there projected changes in the building code that will affect what buildings are more commonly built? How are the technologies changing and what typologies should be the focus for further testing, so that we are doing research that will affect as many projects as possible?
7. Research and testing to identify the most common types of hybrid buildings and how they would perform in a fire or water incident. Does heat affect the materials differently, compromise connections, or cause other issues? Can water damage in mass timber be repaired without removing steel components? As with the other tests, methodology and cost to repair should be identified in the results.
8. Research into the differences in performance and repair between a 3-storey building and an 18-storey building. How would the two buildings behave differently in fire or with moisture? What is the difference in repairability? Noting the recent code change in British Columbia and Ontario to allow increased mass timber building heights from 12 storeys to 18 storeys, are there interim storey heights at which risk factors change?

9. Research identifying new technologies and best practices for how to prevent and mitigate damage from flood and water ingress and damage from fire, along with expected costs to repair damage if it occurs.
10. Research investigating how Design for Disassembly (DfD) can be used to design mass timber buildings, especially residential buildings, in a way that allows them to be repaired more easily. This could be a study on Design for Insurability. Can walls or floor panels be replaced in one unit without disrupting the entire building, displacing tenants or hiring a large crane? Develop guidelines for best practices to make buildings more repairable and therefore more insurable. For example, is there an alternative to using concrete topping on floors that would make them easier to replace?
11. Research identifying differences in performance for adhesives used in mass timber produced in Europe vs. North America. Current information is largely funded by mass timber manufacturers and may be designed to promote specific products. An independent analysis is needed to confirm the data.
12. Market research can also aid insurance companies to identify the appetite for mass timber buildings and projections of the size of the market. A growing market offers them opportunities if they can offer products that meet their risk profile while addressing clients' needs affordably. Market growth is closely tied to insurance, with availability, capacity and terms improving as more projects are in the pipeline.

"Give them a carrot of premium opportunity"

Knowledge Dissemination

Existing research, tests, and guidelines are accessed by insurance companies in a variety of ways, including the CWC and WoodWorks websites, LinkedIn posts from colleagues or organizations, direct email, other collaboration from colleagues, or from clients who wish to implement a new technology or approach and share the studies describing it. They also gather information from organizations such as Verisk or The National Fire Protection Association (NFPA) Property Insurance Research Group (PIRG).

To facilitate ease of access to future research and testing, a website hub hosted by CWC or a university is recommended to provide a central location to find relevant information. A list that can be filtered or sorted for dates and topics will enable interested parties to quickly determine what relevant information is available.

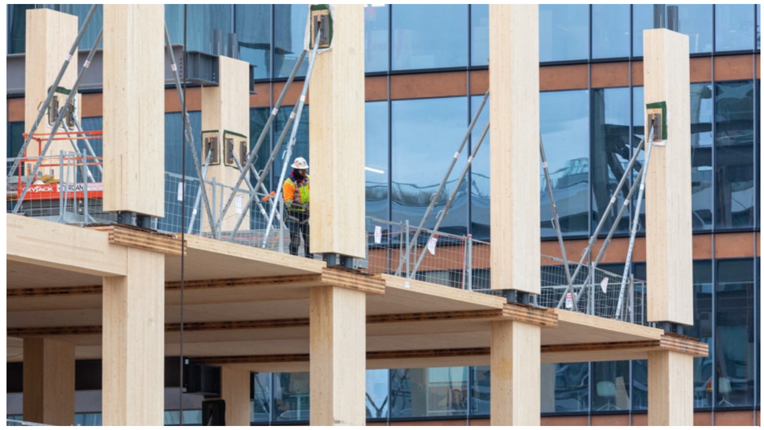

Figure 5. An innovative solution for long-span mass timber using slab-band technology at Limberlost Place on the George Brown College campus in Toronto. (photo courtesy Moriyama Teshima Architects)

In addition to the website, a monthly or quarterly newsletter that identified recent research, current tests, or interesting new projects and technologies can draw traffic to the website and alert insurers to the latest information. An opt-in option for the newsletter on the website will provide access for new subscribers. Initial notification of these resources can be sent through LinkedIn or national organizations, as well as direct contact with those who are already participating in mass timber insurance.

Role of Insurers

Insurance plays a pivotal role in both construction of buildings and asset maintenance. As buildings incorporate more technology and create better environments for their occupants, they also become more complicated. Building and maintaining them properly is crucial for longevity. Buildings have also faced increased environmental threats in recent years, with more frequent fires, floods and other natural disasters. Constructing them to be resilient to these occurrences increases their complexity. Insurance can be key to the success of these projects as it can provide financial and other assistance when things do not happen as expected.

Insurance brokers act as intermediaries between clients and underwriters. They evaluate projects to identify the relevant details, risks, challenges and concerns including those related to workers' safety, property damage, equipment, liabilities, and environmental impacts. They inform underwriters about the mitigation activities that owners and contractors have taken to reduce risks and can advocate on behalf of the clients to try to reduce premiums. They negotiate to find the best balance between protection and price.

Insurance underwriters generally offer many different types of insurance. Expanding their offerings can reduce their exposure to any one event or type of damage. The amount of insurance they are willing to provide for a specific risk (such as the use of mass timber materials and systems) is referred to as capacity. It describes the portion of their portfolio they are willing to risk. Assessing that risk requires evaluation of the people, companies, materials and history of the projects involved. As mentioned earlier, risk assessment is heavily reliant on previous claims, what kind of damage has occurred before, if that threat is reduced in the current project, and what the costs were for the previous claims.

Insurers use different terminology to describe how they evaluate risk, including Estimated Maximum Loss (EML), Maximum Foreseeable Loss (MFL) and Probable Maximum Loss (PML). Understanding the differences in how each one evaluates risk according to loss assumptions can help with understanding variability in coverage and rates. While devastating, maximum loss can be easier to understand: the complete loss of a building. Partial losses are more challenging to evaluate.

"How did you fix it and what are the long-term implications?"

Different underwriters will be willing to take on different amounts of risk for different types of projects. Often, for large projects, the policy will be split between multiple companies, each taking a fraction of the risk rather than one assuming all of it. They may also purchase reinsurance which, in essence, is insurance purchased by an insurance company, to further reduce their losses in the event of claims, or to increase their capacity.

Insurance companies frequently work with clients to reduce their risk. They can suggest measures to prevent incidents, require monitoring or recommend training. Their business relies on the ability to evaluate threats and mitigate them.

Data Needed to Acquire Insurance

The risks buildings pose during construction are different to when they are completed and occupied. During construction, an owner or general contractor will often seek a builder's risk policy to insure against damage during construction from environmental threats such as fire, floods or earthquakes, or human threats such as accidents, poor craftsmanship, inadequate safety practices or deliberate sabotage. An incomplete building can be more exposed to weather, where moisture can damage wood or adhesives, or fire from activities like roofing application. Once a building is completed, a different type of insurance is required to cover the permanent property. This insurance covers operational risks such as pipe leakage and tenant damage but also includes environmental threats such as fires and extreme weather events.

CSA Standard S478:19 (R2024) Durability in Buildings sets out all the agents and mechanisms of potential destruction related to durability in buildings and provides advice for incorporating requirements for durability into the design, operation, and maintenance provisions for buildings and their components[5]. Although it does not specifically address mass timber, it does emphasise the need for early engagement ideally at the design stage and certainly prior to occupancy. Following guidelines in this standard will help to inform insurers about details of projects and inform contractors or owners about risk mitigation measures that they can consider in order to offer better terms.

Evaluating the risk for a property is based on information about that specific project as well as the claims history of similar projects. Lengthy questionnaires are usually required to gain insights about the people and products involved. Insurers may inquire about training, processes, certifications, financial stability of contractors, previous projects, experience with mass timber, quality control practices, fire and water mitigation and prevention schemes, storage of materials, and use of dimensional lumber, wood trusses, plywood or oriented strand board (OSB). They also ask about availability of replacement materials. If the replacement materials are difficult to acquire quickly, either because of species, manufacturer capacity, or shipping issues, that can cause lengthy repair delays. US WoodWorks has an example questionnaire to aid project teams with collecting the necessary information.[6]

[5] https://www.csagroup.org/store/product/CSA%20S478%3A19/

[6] https://www.woodworks.org/resources/mass-timber-project-questionnaire-for-builders-risk-insurance/

Fire

Wood burns. Traditional light wood frame construction is not covered by some insurers due to its combustibility. However, testing by a consortium led by the Canadian Wood Council demonstrates that mass timber performs differently in a fire than light wood frame[7]. The tests showed that the fire performance of a mass timber structure is similar to that of non-combustible construction and confirms that mass timber can perform well – even under the very rare fire scenario in which the sprinkler system fails, and the fire department is unable to respond. This performance is due to the mass timber charring. The char forms a fire-protective layer to the underlying structure. Engineers account for the charring layer in their designs, so the structural integrity of the building is maintained through the fire event.

Combining light wood frame with mass timber is an efficient form of construction – particularly for residential projects. However, hybrid mass timber and light wood frame structures are generally classified as wood frame construction due to the combustibility factor and, as such, struggle to secure affordable insurance.

Figure 6. The combination of CLT floors with wood frame walls is an efficient form of construction for multifamily residential buildings (photo credit: Pollux Chung, Seagate Structures, courtesy naturallywood).

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[7] https://firetests.cwc.ca/

Moisture

Traditional wood construction is exposed to all weather. When allowed to get wet for extended periods, wood can be susceptible to microbial growth (mould). It is not generally common practice to install weather protection for timber projects, despite the benefits not only in terms of improved hygrothermal conditions and reduced risk of mould growth but also improved work environment and productivity.[8]

If not properly dried, moisture can degrade the quality of the wood, weaken connections, or create unsightly stains on surfaces. Mould is hazardous to human health. If the moist area is covered by encapsulation, floor toppings or other areas where it cannot dry easily, long term moisture can compromise the quality of the structure. Moisture mitigation plans are currently encouraged or required for mass timber buildings for both builders' risk and permanent property insurance. Insurance companies may require customers to have a plan to prevent mass timber from getting wet and a plan to dry it out quickly.

Hybrid Buildings

Many mass timber projects use some form of hybrid construction with elements of mass timber combined with other materials – such as steel and concrete. For these buildings, it is important to inform the insurer where the different materials are used in the building and the total cost of installation (labour and materials) for each material. This information is

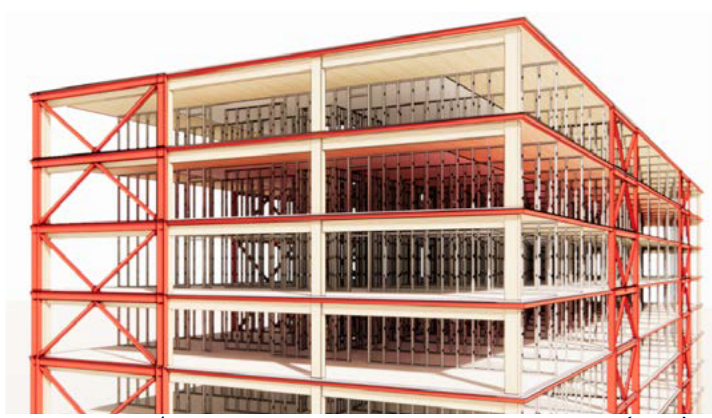

Figure 7. CLT/CFS with lateral load resisting system (LLRS) steel braced frame (image courtesy Timber Engineering, Inc)

[8] Kalbe, Kristo & Pärn, Roland & Ruus, Aime & Kalamees, Targo. (2024). Enhancing CLT Construction – Hygrothermal Modelling, Novel Performance Criterion, and Strategies for End-Grain Moisture Safety. Journal of Building Engineering. 98. 111411. 10.1016/j.jobe.2024.111411.

used to understand the cost and effort to replace parts of the building should damage occur, and how damage to one material might affect another. For example, mass timber used decoratively in the lobby of an office building would be evaluated differently from mass timber that comprised the structure of the building. What if the structure is CLT floors with cold formed steel (CFS) walls? If mass timber is structural and damaged on a lower floor, how difficult is it to repair or replace without taking apart the whole building? Hybrid buildings built with mass timber and steel or concrete are generally classified as mass timber projects and not as a type of non-combustible or fire-resistive project. Implementation varies between insurers.

Hybrid buildings pose a challenge for insurers because each one is unique. While they have historical evidence to understand how a wood, steel or concrete building will behave, they have little evidence that demonstrates how mass timber would interact with other materials, especially with the large number of variations in how it may be used in a building. Innovative techniques to build taller buildings or larger spans are revolutionizing the types of buildings that can be built with mass timber. Sharing the information about these innovations and how they are improving the performance of mass timber buildings will aid insurers to understand why the hybrid approaches are being used and how they affect risk of damage from fire, moisture, wind or seismic activity. Including information about innovative projects in knowledge dissemination activities will normalize innovation in mass timber and improve comfort levels overall.

If there are hybrid building types that are more common approaches, comparisons can start to be made that will help to standardize risk evaluation of hybrid buildings. Tests that can be conducted on those types of hybrid buildings will further inform the evaluation.

Other risks

Risk mitigation for other situations is also encouraged. For example, there are many rules and regulations regarding worker safety. Fire safety is important when using hot works for roofing applications. Some insurers may require extended watches for smouldering or thermal imaging to confirm cooling. Depending on the situation for a given building, the preparation of risk management plans provides important information when applying for insurance and may influence perceived risk and therefore rates or availability.

Insurance companies are most concerned about the cost to repair or replace components of a building if they are damaged. If planning for ease of repair or replacement can be done at the design stage, that information would be important data to share with them. This may become more feasible as more buildings are designed using prefabrication, design for disassembly and Building Information Modeling (BIM).

Existing Claim Data

Different types of buildings pose different risks and there are many ways that mass timber is used in buildings. For example, glulam is a very versatile material and can be found in bridges and other long-span applications such as arena roofs. CLT, DLT and NLT can be used in floors, walls, stairs and elevator shafts. Currently, insurers have little claim data to differentiate one type of mass timber from another. However, they do have claim data about different types of buildings. This claim data is often derived from incident case studies. Sharing these more widely between insurers will expand the total data available for each company.

International claim data can be referenced, however the standards and building codes that may have had a bearing on this data vary. In some cases, regulations in the National Building Code of Canada (NBC) would prevent incidents in Canada that have occurred in other countries. If mass timber is purchased outside of Canada, it is important to confirm that the imported products meet what is defined in the NBC.

Existing claim data reveals that for permanent property insurance, multi-family residential buildings are a higher risk than office buildings for moisture damage because there is significantly more plumbing, with kitchens and bathrooms in every unit. Kitchens also pose a higher fire risk. Sprinkler systems may get triggered, causing fire and water damage. Maintenance may be the responsibility of individual tenants and not consistent throughout the building. These issues affect non mass timber buildings as well, but may pose a higher risk for mass timber than those classified as non-combustible. The risks can be difficult to quantify due the variability of existing claims and lack of data for mass timber. To err on the side of caution, a higher risk level might be assumed.

"We do not have a wealth of claims where things have gone wrong and the mass timber itself has been repaired or sections of it replaced, following a fire or following a water damage incident or following some other sort of loss."

The Insurance Services Office run by Verisk is collecting claim data and providing subscription-based access to the large pool of data to insurance carriers. A forthcoming risk classification for mass timber is anticipated in 2025[9].

Designing with Repairability in Mind

Insurers are aware that mass timber poses less of a fire risk than light wood frame. However, they are not willing to classify it as non-combustible, because charring will still need to be repaired to satisfy requirements to return damaged areas to "like-new" condition. Lacking sufficient data about availability, cost and feasibility to repair damage, it can be assumed to be the same or more expensive (and complicated) than the original installation. Some insurers use a calculation of estimated maximum loss (EML) because of this uncertainty.

> *"What happens if they're eight floors up and doing the interior finishing and there's a massive water escape from a pipe or sprinkler main? If the mass timber is encapsulated and gets wet, does everything need to be taken apart for the repair? What does that cost? Will it be more than the original installation cost?"*

Projects that provide more information, have more experienced owners, architects, manufacturers and contractors, and are not in flood plains or remote wooded areas will be more attractive to insurers. Providing them with the confidence that the team is aware of the issues and has planned to limit losses can lead to better terms and conditions or improved rates.

While it is not a common practice, a repair or rehabilitation plan from the design team is viewed favourably. A preplanned methodology to be able to repair or replace walls or beams, for example, without displacing other tenants of an office or residential building, would place boundaries on expected costs for certain types of claims. A repair plan could also identify what is acceptable as a repair, if char removal and a new veneer can be installed rather than replacing the component if it is structurally sound. It could also identify what variations in the appearance compared to components that were not

[9] https://www.woodworks.org/wp-content/uploads/FieldEdge_MT_Insurance_Strategy_Roadmap_03.2025.pdf

damaged are acceptable. CSA S478 offers a methodology for preparing a durability plan that could be adapted to mass timber buildings.

Monitoring Instrumentation

Moisture monitoring instrumentation has become an important tool for risk mitigation, especially in residential buildings. Sensors installed during construction can identify conditions where mass timber is exposed to moisture and not able to dry out quickly. Measurements are often taken on roofs before final roofing materials may be installed, and of walls and floors before they are closed up. Researchers have identified the acceptable moisture content for different types of materials and different uses. During occupancy, sensors can alert building management to leaks if moisture is suddenly present where it is not expected, or increases over time.

Some insurers require regular (every few years) thermographic imaging of roofs and walls to detect water leaks for permanent property insurance. This increases the likelihood of finding leaks early to avoid major issues.

Training and Certification

Opinions varied in the interviews about how additional training for insurers would affect pricing or availability of mass timber insurance. Some would like to see training discussing recent innovations or test results. Options are already available for online introductions to mass timber for insurers. Engineers might benefit more from a course exploring the details of a complicated test similar to a shake table test[10] or a large-scale fire test[11]. Some are also interested in training on technologies that are available to detect, prevent and mitigate issues, particularly water ingress and leak detection.

Training for mass timber installers and other trades also had a mixed reaction. Experience on an actual project is seen as the most valuable, whereas a short course may not have the same impact and be enough to make a difference for rates or

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[10] https://ascelibrary.org/doi/10.1061/JSENDH.STENG-13752

[11] https://firetests.cwc.ca/wp-content/uploads/2023/06/38e02b27-e352-4189-bcfc-3e38fe1be12d.pdf

availability. They typically assess the experience of the owner, general contractor, architect of record, structural engineer, manufacturer and installers.

Certifications also were questioned because there is a cost to acquire those certifications, with no clear advantage at this point to impact insurance. They look instead to overall team experience and a well-developed plan for risk mitigation. Being a newer building method means there are fewer professionals who have a great deal of experience. Other interviewees see value in establishing a certification system because it would provide a standardized way of evaluating teams if training, experience and financial stability were all evaluated.

One area where very few contractors or trades have experience is in repairing damage to mass timber resulting from fire or water incidents. If a test is conducted to cause the damage and the methodology is documented, this information would be valuable to include for training for anyone completing future repairs.

Conclusions

Research and testing that will be useful to accessibility and affordability for both builders' risk and property insurance for mass timber buildings centers around the methodology and cost of repairs. Insurers want to characterize the nature of potential damage, if adhesives or connections that are not visible can be compromised, and what it will take to repair it.

The lack of data on water damage is most concerning, as previous tests have done a good job of characterizing the behaviour of mass timber in fire and under seismic conditions. Behaviour of adhesives and connections in fire and water are next on the list.

All the interviewees stressed that claim data and case studies are most relevant, but indicated that testing does provide useful information. It may have a greater impact on capacity and availability than on reducing premiums. They suggested that data that is available on repairs and mitigation measures for existing projects that does not rise to the level to justify a claim is valuable to their processes. The costs associated with, and the methods that were taken to prevent or repair issues, provide information about less costly losses that can inform the limited actuarial data on mass timber.

Costs of mass timber insurance are an issue worldwide, not only in Canada. The lack of claim data may lead one to intuitively believe that costs should be low because there are few claims. However, insurance companies view lack of data as an unknown and assign a higher risk because the range of circumstances that could affect mass timber buildings is broad, and the costs to repair could be large. The threshold is unknown for when a building is a complete loss and more expensive to repair than to replace.

Research studies will be most useful if they can provide information about how repairs can be made, the costs to repair different issues, and what kind of repairs are acceptable from structural and aesthetic points of view. Research into guidelines for best practices to prevent damage and design buildings with repairability in mind will aid owners and developers. Insurance companies want to work with them to reduce risks and complete and maintain successful projects.

While there is no guaranteed rate reduction, providing this information will improve insurers' confidence in this new method of construction. As mass timber becomes more popular, the increased opportunity to capture market share may incentivize them to move the needle on insurance premiums or terms if the research results indicate that lower repair costs are achievable.

At the end of the day, I think trying to get to a non-combustible rate is an unrealistic approach. Moving from light wood frame to a better rate is feasible.

Appendix – Identified research

Mass Timber Insurance Literature

organization	Year	Title	author	Link	pgs	keywords
Allianz	2024	Mass timber reduces construction's carbon footprint, but introduces new risk scenarios	Allianz Commercial	https://commercial.allianz.com/content/dam/onemarketing/commercial/commercial/pdfs-risk-advisory/emerging-risk-mass-timber.pdf	16	Embodied Carbon, Design, Fire, Fire Safety, Water, Seismic, Flood, Repair
American Society of Civil Engineers	2023	Design and Cyclic Experiments of a Mass Timber Frame with a Timber Buckling Restrained Brace	Emily Williamson, Chris P. Pantelides, Hans-Erik Blomgren Douglas Rammer	https://ascelibrary.org/doi/10.1061/JSENDH.STENG-12363		Seismic, Lateral, Wind, Timber Buckling Restrained Brace
American Society of Civil Engineers	2023	Guiding Mass Timber Design and Research: A Parametric Modeling Approach to Understanding Impacts	Samantha J. Leonard, Ryan Solnosky	https://ascelibrary.org/doi/10.1061/9780784484777.021		Design, Modeling, Sustainability
APA - The Engineered Wood Association	2025	ANSI/APA PRG 320: Standard for Performance-Rated Cross-Laminated Timber	APA	https://www.apawood.org/SearchResults.aspx?q=PRG%20320&tid=1	78	CLT, Quality Assurance, Lamination, Adhesives, Moisture, Testing
Arup	2024	Fire Safe Design of Mass Timber Buildings	Arup	https://www.arup.com/insights/fire-safe-design-of-mass-timber-buildings/	158	Fire, Site Safety, Design, Fire Safety, Structural, Char, Char Depth, Fire Test
Canadian Wood Council	2023	Large-Scale Fire Tests of A Mass Timber Building Structure for MTDFTP	Joseph Su, Eric Gibbs, Mark Weinfurter, Pier-Simon Lafrance, Karl Gratton, Andrew Frade, Patrice Leroux	https://firetests.cwc.ca/wp-content/uploads/2023/06/38e02b27-e352-4189-bcfc-3e38fe1be12d.pdf	121	Fire, Fire Test, glulam, DLT, CLT, Temperature, Char, Char Depth, Structural

Canadian Wood Council	2022	A Guideline for Insuring Timber in Canada	Tim Buhler	https://cwc.ca/wp-content/uploads/2022/05/20220104_InsuranceBestPracticesGuideLowRez.pdf	22	Fire, Moisture, Repair, Rehabilitation, Structural, Insurance
Canadian Wood Council	2021	Insuring Timber: Breaking Down Barriers to the Advancement of Timber Construction	Canadian Wood Council	https://cwc.ca/wp-content/uploads/2021/04/Insuring-TimberFinal.pdf	12	Fire, Moisture, Fire Test, Insurance
Conference: 12th Asia-Oceania Symposium on Fire Science and Technology	2021	Influence of Adhesive on Decay Phase Temperature Profiles in CLT in Fire	Felix Wiesner, Rory Hadden, Luke A. Bisby	https://www.researchgate.net/publication/356838157_Influence_of_Adhesive_on_Decay_Phase_Temperature_Profiles_in_CLT_in_Fire		Fire, CLT, Adhesives, Char, Thermal Profiles
Conference: 12th Asia-Oceania Symposium on Fire Science and Technology	2021	Delamination and char fall-off in fire exposed cross-laminated timber loaded in shear	Čolić, Antonela Wiesner, Felix Bisby, Luke Hidalgo, Juan	https://www.researchgate.net/publication/356838044_Delamination_and_char_fall-off_in_fire_exposed_cross-laminated_timber_loaded_in_shear		Char, Delamination, Fire, CLT, Adhesives
Construction and Building Materials	2022	Structural fire engineering considerations for cross-laminated timber walls	Felix Wiesner, Rory Hadden, Susan Deeny, Luke Bisby	https://www.sciencedirect.com/science/article/abs/pii/S0950061822002963		Fire, CLT, Adhesives, Fire Test
Construction and Building Materials	2024	Moisture and mould growth risk of cross-laminated timber basement walls: Laboratory and field investigation	Fernanda Bezerra Tomaduci Imamura, Yuxiang Chen, Lijun Deng, Ying Hei Chui	https://www.sciencedirect.com/science/article/pii/S095006182401291l		Moisture, Mould, CLT, Basement, Flood, Water
Construction and Building Materials	2020	The effect of adhesive type and ply number on the compressive strength retention of CLT at elevated temperatures	Felix Wiesner, Daniel Thomson, Luke Bisby	https://www.sciencedirect.com/science/article/abs/pii/S0950061820331603		CLT, Fire, Adhesives, Performance, Thermal Analysis
Factory Mutual Insurance Company	2023	FM Property Loss Prevention Data Sheets 1-36 Mass Engineered Timber	FM Global	https://www.fm.com/FMAApi/data/ApprovalStandardsDownload?itemId={FDEC1FFE-F6A8-4469-B154-579B20DB3D9B}	11	Moisture, Vegetative Roofs, Solar PV Panels, Roof Membrane, Adhesives, Fire

Fire	2022	Large-Scale Enclosure Fire Experiments Adopting CLT Slabs with Different Types of Polyurethane Adhesives: Genesis and Preliminary Findings	Danny Hopkin, Wojciech Węgrzyński, Michael Spearpoint, Ian Fu, Harald Krenn, Tim Sleik , Carmen Gorska, Gordian Stapf	https://www.mdpi.com/2571-6255/5/2/39		Adhesives, CLT, Fire, Fire Test, Char, Char Depth, Structural
Fire Safety Journal	2023	Fully-developed compartment fire dynamics in large-scale mass timber compartments	Ian Pope, Vinny Gupta, Hangyu Xu, Felix Wiesner, David Lange, José L. Torero, Juan P. Hidalgo	https://www.sciencedirect.com/science/article/pii/S0379711223002904		Compartment Fire, Fire Dynamics, Heat Transfer, CLT
Fire Safety Journal	2022	Large-scale compartment fires to develop a self-extinction design framework for mass timber—Part 1: Literature review and methodology	Hangyu Xu, Ian Pope, Vinny Gupta, Jaime Cadena, Jeronimo Carrascal, David Lange, Martyn S. McLaggan, Julian Mendez, Andrés Osorio, Angela Solarte, Diana Soriguer, Jose L. Torero, Felix Wiesner, Abdulrahman Zaben, Juan P. Hidalgo	https://www.sciencedirect.com/science/article/pii/S0379711222000017		CLT, Fire, Self-extinction, Fire Test, Compartment Fire
Fire Safety Journal	2021	Fire dynamics in mass timber compartments	Carmen Gorska, Juan P. Hidalgo, Jose L. Torero	https://www.sciencedirect.com/science/article/abs/pii/S0379711220301338		Compartment Fire, Fire Safety, Fire Dynamics
Fire Safety Journal	2021	Fire resistance and burnout resistance of timber columns	Thomas Gernay	https://www.sciencedirect.com/science/article/abs/pii/S0379711221000916		Fire, Fire Test, Fire Dynamics, CLT, glulam
Fire Technology	2013	Performance of Timber Connections Exposed to Fire: A Review	Maraveas, C., Miamis, K. & Matthaiou	https://link.springer.com/article/10.1007/s10694-013-0369-y	31	Fire, Fire Safety, Connections, Temperature

FPInnovations	2024	Fire Performance of Modern Mass Timber Connections: Part 1 Thermal Assessment	Aram, Monireh Dagenais, Christian	https://library.fpinnovations.ca/link/fpipub11016	83	Fire Test, Connections, Thermal Analysis, Char Depth, Charring Rate
FPInnovations	2019	Solutions for Upper Mid-Rise and High-Rise Mass Timber Construction Rehabilitation of Mass Timber Following Fire and Sprinkler Activation	Lindsay Ranger	https://library.fpinnovations.ca/media/WP/19785.pdf	39	Fire, Moisture, Salvage, Remediation, Sprinkler, Rehabilitation
FPInnovations	2019	Taller and Larger Wood Buildings: Potential Impacts of Wetting on Performance of Mass Timber Buildings	Wang, Jieying	https://library.fpinnovations.ca/link/fpipub40151	43	Moisture, Lamination, Performance
FPInnovations	2021	Fire Performance of Mass Timber	Dagenais, Christian Ranger, Lindsay	https://library.fpinnovations.ca/link/fpipub8295	5	Fire, Codes, Modeling, Performance, Standards, Sustainability
FPInnovations	2019	Evaluating fire performance of nail-laminated timber	Lindsay Ranger, Christian Dagenais, Noureddine Bénichou	https://library.fpinnovations.ca/viewer?file=%2Fmedia%2FWP%2F19780.pdf#page=1	44	NLT, Fire, Char, Fire Test
FPInnovations	2020	Wetting and drying performance of cross-laminated timber related to on-site moisture protection. Field measurement and hygrothermal simulations	Lin Wang, Jieying Wang, Hua Ge	https://library.fpinnovations.ca/media/WP/TR2020N27.pdf	46	Water, Moisture, CLT, Hygrothermal
FPInnovations	2018	Advanced Wood-Based Solutions for Mid-Rise and High-Rise Construction: Modelling of Timber Connections under Force and Fire	Zhiyong Chen, Chun Ni, Christian Dagenais	https://library.fpinnovations.ca/media/WP/16794.pdf	85	Fire, Temperature, Connections, LVL, glulam, Modeling
International Organization for Standardization	2020	ISO 22390:2020 Timber structures — Laminated veneer lumber — Structural properties	ISO	https://www.csagroup.org/store/product/iso_072425	9	LVL, Performance, Requirements, Structural
International Organization for Standardization	2019	ISO 16696-1:2019 -- Cross laminated timber -- Part 1: Component performance, production requirements and certification scheme	ISO	https://www.csagroup.org/store/product/iso_062883/	25	CLT, Performance, Requirements, Tolerances, Moisture

International Organization for Standardization	2016	ISO 12578:2016. Timber structures -- Glued laminated timber -- Component performance requirements	ISO	https://www.csagroup.org/store/product/iso_061598/	14	GLT, Structural, Species, Adhesives
Journal of Architectural Engineering	2024	State-of-the-Art Review of Mass Timber Design Standards and Specifications	Ernest Heymsfield Talbot Rueppel Peter Stynoski	https://ascelibrary.com/doi/abs/10.1061/JAEIED.AEENG-1802		Standards, Adhesives, Guidelines
Journal of Architectural Engineering	2024	State-of-the-Art Review of Moisture Content Sensor Deployment in Mass Timber Construction	Dorothy Johns, Yash Vyas, Russell Richman	https://ascelibrary.org/doi/10.1061/JAEIED.AEENG-1638		Moisture, Monitoring
Journal of Architectural Engineering	2022	Effect of Short-Term Simulated Rain Exposure on the Performance of Cross-Laminated Timber Angle Bracket Connections	Shrenik Bora, Arijit Sinha, Andre R. Barbosa	https://ascelibrary.org/doi/10.1061/%28ASCE%29AE.1943-5568.0000560		CLT, Connections, Moisture, Water
Journal of Architectural Engineering	2021	Mechanical Properties of Dowel Laminated Timber Beams with Connectors Made of Salvaged Wooden Materials	Mohammad Derikvand, Serveh Hosseinzadeh, Gerhard Fink	https://ascelibrary.org/doi/10.1061/%28ASCE%29AE.1943-5568.0000513		DLT, Connections
Journal of Architectural Engineering	2021	Structural Repair of Fire-Damaged Glulam Timber	Bronwyn Chorlton, John Gales	https://ascelibrary.org/doi/abs/10.1061/%28ASCE%29AE.1943-5568.0000445		Fire, Repair, Structural
Journal of Architectural Engineering	2019	Structure Moisture Monitoring of an 8-Story Mass Timber Building in the Pacific Northwest	Steven Kordziel, Shiling Pei, Samuel V. Glass, Samuel Zelinka, Paulo Cesar Tabares-Velasco	https://ascelibrary.org/doi/10.1061/%28ASCE%29AE.1943-5568.0000367		Moisture, glulam, CLT, Monitoring, Performance, Water
Journal of Building Engineering	2024	Enhancing CLT construction – Hygrothermal modelling, novel performance criterion, and strategies for end-grain moisture safety	Kristo Kalbe, Roland Pärn, Aime Ruus, Targo Kalamees	https://www.sciencedirect.com/science/article/abs/pii/S2352710224029796		Moisture, CLT, Hygrothermal, Modelling, Safety, Water
Journal of Building Engineering	2023	Effects of Re-drying on properties of cross laminated timber (CLT) connections	Kenneth Emamoke Udele, Arijit Sinha, Jeffrey J. Morrell	https://www.sciencedirect.com/science/article/abs/pii/S235271022301478X		Moisture, CLT, Lateral, Connections, Water, Performance

Journal of Building Engineering	2022	Experimental and numerical investigation into the fire performance of glulam bolted beam-to-column connections under coupled moment and shear force	Jing Luo, Minjuan He, Zheng Li, Zhaozhuo Gan, Xijun Wang, Feng Liang	https://www.sciencedirect.com/science/article/abs/pii/S2352710221016624		Fire, glulam, CLT, Shear, Fire Test, Connections, Fire Safety
Journal of Structural Engineering	2024	Shake-Table Testing of a Full-Scale 10-Story Resilient Mass Timber Building	Shiling Pei, Keri L. Ryan, Jeffrey W. Berman, John W. van de Lindt, Steve Pryor, Da Huang, Sarah Wichman, Aleesha Busch, William Roser, Sir Lathan Wynn, Yi-en Ji, Tara Hutchinson, Shokrullah Sorosh, Reid B. Zimmerman, James Dolan	https://ascelibrary.org/doi/10.1061/JSENDH.STENG-13752		Seismic, Lateral, Structural, Design, Repair, CLT, DLT, GLT, NLT, LVL
National Fire Protection Association	2024	Mass timber structures post-fire: A gap analysis	Daniel Brandon Joseph Su	https://www.nfpa.org/education-and-research/research/fire-protection-research-foundation/projects-and-reports/fire-safety-challenges-of-tall-wood-buildings/mass-timber-structures-postfire-a-gap-analysis		CLT, Fire Safety, Repair, Smoke, Water, glulam, Temperature, GLT, Thermal Analysis
NRC	2023	Large-scale fire tests of a mass timber building structure for MTDFTP	Su, Joseph, Gibbs, Eric, Weinfurter, Mark, Lafrance, Pier-Simon, Gratton, Karl, Frade, Andrew, Leroux, Patrice	https://nrc-publications.canada.ca/eng/view/object/?id=38e02b27-e352-4189-bcfc-3e38fe1be12d	121	Fire, Sprinkler, Fire Test, Structural, Performance
NRC	2020	Numerical Modelling of Water Mist Systems in Protection of Mass Timber Residential Buildings	Elsagan, Nour Ko, Yoon	https://publications.gc.ca/site/eng/9.890599/publication.html	19	Fire, Fire Test, Water, Fire Suppression, Moisture

NRC	2020	Water mist systems for protection of mass timber structures - phase 2 residential fire suppression tests	Yoon J. Ko, Nour Elsagan, Eric Gibbs	https://publications.gc.ca/site/eng/9.889965/publication.html	43	Fire, Water, Fire Suppression, Fire Test, Moisture, CLT
NRCan	2021	Fire testing of rooms with exposed wood surfaces in encapsulated mass timber construction	Su, Joseph, Leroux, Patrice, Lafrance, Pier-Simon, Berzins, Rob, Gratton, Karl, Gibbs, Eric1, Weinfurter, Mark	https://nrc-publications.canada.ca/eng/view/object/?id=f444b1ba-c6f5-49fd-8bd1-d8269c3717cf	75	Fire, CLT, Char, Fire Test, glulam, Temperature
Oregon State University	2021	Structural health monitoring data collected during construction of a mass-timber building with a data platform for analysis	Esther J. Baas, Mariapaola Riggio, André R. Barbosa	https://www.sciencedirect.com/science/article/pii/S2352340921001293?via%3Dihub		CLT, Monitoring, Structural, Moisture, Temperature
Oregon State University	2020	A Methodological Approach for Structural Health Monitoring of Mass-Timber Buildings Under Construction	Baas, Esther J.	https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/vt150q97r		Monitoring, Hygrothermal, Water, Moisture, Structural, Sensors, CLT, glulam, Shear
Oregon State University	2018	Environmental response of a CLT floor panel: Lessons for moisture management and monitoring of mass timber buildings	Evan L. Schmidt, Mariapaola Riggio, Andre R. Barbosa, Ignace Mugabo	https://www.sciencedirect.com/science/article/abs/pii/S0360132318307339		CLT, Moisture, Hygrothermal, Shear
RDH	2022	Moisture Risk Management Strategies for Mass Timber Buildings	RDH Building Science	https://www.rdh.com/resource/moisture-risk-management-strategies-for-mass-timber-buildings-v2/	76	Moisture, Design, Water
RDH + Mass Timber Institute	2021	Mass Timber Building Science Primer	Dr. Ted Kesik, Rosemary Martin	https://academic.daniels.utoronto.ca/masstimberinstitute/building-science-primer/	70	Moisture, Performance, Water, Fire, Fire Safety, Connections, Codes, Structural
RI.SE	2021	Fire Safe Implementation of Mass Timber In Tall Buildings	Daniel Brandon, Johan Sjöström, Alastair Temple, Emil Hallberg and Fredrik Kahl	https://www.ri.se/en/expertise-areas/projects/fire-safe-implementation-of-mass-timber-in-tall-buildings	223	Fire, CLT, Delamination, Repair, Fire Safety
RI.SE	2021	Glue Line Integrity in FIRE	Daniel Brandon Michael Klippel Andrea Frangi	https://www.ri.se/en/expertise-areas/projects/glue-line-integrity-in-fire	86	Adhesives, Delamination, Fire, CLT

RISE Research Institutes of Sweden	2021	Post-Fire Rehabilitation of CLT	Daniel Brandon Johan Sjöström Fredrik Kahl	https://www.ri.se/sites/default/files/2021-08/Rehabilitation%20of%20fire%20exposed%20CLT%20-%20A%20case%20study%20FINAL.pdf	36	Rehabilitation, Fire, Fire Test, Replacement, Structural, Char, Repair, Char Depth
RISE Research Institutes of Sweden	2021	Fire Safe implementation of visible mass timber in tall buildings – compartment fire testing	Daniel Brandon, Johan Sjöström, Alastair Temple, Emil Hallberg, Fredrik Kahl	https://www.ri.se/sites/default/files/2021-07/Final%20report%2020210630.pdf	223	Fire, Fire Test, CLT, GLT, Char, Char Depth, Temperature, Thermal Analysis
Simon Fraser University	2024	Design Solutions to Prefab Mass Timber Construction v2.0	SFU Renewable Cities | Morris J. Wosk Centre for Dialogue, ZGF	https://www.sfu.ca/content/dam/sfu/renewable-cities/mass-timber/Design-Solutions-to-Prefab-Mass-Timber-Construction-V2-March-2024.pdf	29	Design, Structural, Codes
Structural Timber Association	2021	Insurance Industry Guide to Mass Timber in UK Construction	Structural Timber Association	https://www.structuraltimber.co.uk/wp-content/uploads/2023/12/stainsurersguidetomasstimberfinal.pdf	16	Safety, Fire, STA Assure, Structural, Fire Safety
The Alliance for Sustainable Building Products	2024	The Mass Timber Insurance Playbook: A guide to insuring mass timber buildings	Philip Callow, Jim Glockling.	https://asbp.org.uk/wp-content/uploads/2024/12/MTIP_A4_document_2024_final.pdf	53	Fire, Flood, Water, Design, Insurance
University of Alberta		Axial Performance of Self-tapping Screws in Mass Timber Products Under Moisture Content Variation	Khan, Mehsam T.	https://era.library.ualberta.ca/items/ab26746e-1d35-418e-88ec-18da374fbea2	216	Connections, CLT, glulam, Moisture, Structural, Modeling
University of British Columbia	2024	Fire safety for timber structures: the intersection of fire resistance and reaction to fire.	Dr Felix Wiesner	https://cwcrn.ca/wp-content/uploads/2024/12/FWiesner-CWCRN-webinar.pdf	33	Fire, Codes, Sprinkler, Safety, Fire Test
Verisk	2024	Mass Timber: New Technology Drives a New Construction Class	Xiaochuan (Lydia) Shi, Kevin Kuntz	https://www.verisk.com/resources/campaigns/mass-timber-new-technology-drives-a-new-construction-class/	16	Char, Fire, Design, Fire Test, Wind, Water
WoodWorks	2023	Repair of Fire-Damaged Mass Timber	WoodWorks	https://www.woodworks.org/resources/repair-of-fire-damaged-mass-timber/	16	Fire, Repair, Restoration, Char, Fire Test, Charring Rate, Char Depth, glulam, CLT

WoodWorks	2021	Insurance for Mass Timber Construction: Assessing Risk and Providing Answers	Richard McLain, Susan G. Brodahl	https://www.woodworks.org/wp-content/uploads/wood_solution_paper-MassTimber_INSURANCE.pdf	16	Insurance, Fire, Water, Schedule, Codes, Standards
WoodWorks	2022	Tall Wood Buildings in the 2021 IBC	WoodWorks	https://www.woodworks.org/wp-content/uploads/wood_solution_paper-tall-wood.pdf	12	IBC, Fire, Encapsulation, FRR, Fire safety
WoodWorks	2024	The Mass Timber Insurance Playbook; U.S. Edition	Philip Callow, Jim Glockling	https://www.woodworks.org/resources/mass-timber-insurance-playbook/	47	Fire, Water, Flood, Design, Insurance
World Conference on Timber Engineering Oslo	2023	Heat Delamination In Cross Laminated Timber: Intermediate Scale Test Based Upon The North American Standards	Samuel L. Zelinka, Keith J. Bourne, Laura E. Hasburgh, Kara Yedinak	https://www.fpl.fs.usda.gov/documnts/pdf2023/fpl_2023_zelinka001.pdf		CLT, Fire, Adhesives, PRG320

Online Articles						
source	year	Title		Link		keywords
American Society of Civil Engineers	2023	Lateral force bracing system strengthens mass timber building frame design	Leslie Connelly	https://www.asce.org/publications-and-news/civil-engineering-source/article/2023/11/01/lateral-force-bracing-system-strengthens-mass-timber-building-frame-design		Lateral, Seismic, Wind, Timber Buckling Restrained Brace
Construction Executive: The Business of Construction	2018	Fire Safety of CLT and Mass Timber Buildings		https://www.constructionexec.com/article/fire-safety-of-clt-and-mass-timber-buildings		Fire, Fire Safety, CLT
Construction News	2014	What Nottingham University fire means for timber-frame construction		https://www.constructionnews.co.uk/sections/long-reads/what-nottingham-university-fire-means-for-timber-frame-construction-17-09-2014/		Fire, Electrical, Insurance
Construction News	2022	Timber tensions: renewing the argument for wood		https://www.constructionnews.co.uk/sustainability/timber-tensions-renewing-the-argument-for-wood-17-05-2022/		Insurance, Embodied Carbon, Fire
Construction News	2024	Calls for more research into modular construction's fire safety		https://www.constructionnews.co.uk/buildings/building-safety/calls-for-more-research-into-modular-constructions-fire-safety-06-12-2024/		Fire
Construction News	2023	Risk register proposed to address insurers' timber fears		https://www.constructionnews.co.uk/government/risk-register-proposed-to-address-insurers-timber-fears-12-12-2023/		Fire, Water
Construction News	2023	Aviva commits to insuring engineered timber		https://www.constructionnews.co.uk/sustainability/aviva-commits-to-insuring-engineered-timber-16-08-2023/		Insurance, Embodied Carbon, Sustainability
Construction News	2021	How safe are modern methods of construction?		https://www.constructionnews.co.uk/sections/long-reads/how-safe-are-modern-methods-of-construction-10-03-2021/		Standards, Repair

Engineering News Record	2019	Cross-laminated-timber structures performed well in blast tests		https://www.youtube.com/watch?v=iMyom2pB4f8		CLT, Explosion
Insurance Thought Leadership	2024	Mass Timber: Challenges and Loss Prevention		https://www.insurancethoughtleadership.com/commercial-lines/mass-timber-challenges-and-loss-prevention		
NAIOP	2021	How Ascent Is Pushing Mass Timber to New Heights	Jim Villa	https://www.naiop.org/research-and-publications/magazine/2021/summer-2021/business-trends/how-ascent-is-pushing-mass-timber-to-new-heights/		
naturally:wood	2022	Latest testing further documents mass timber's fire safety		https://www.naturallywood.com/resources/mass-timber-fire-safety/		Fire, CLT, Fire Test
naturally:wood		Top tips for insuring your next mass timber building		https://www.naturallywood.com/resources/owners-insuring-mass-timber/		Insurance, Site Safety
naturally:wood		Essential insights for insurers on mass timber buildings		https://www.naturallywood.com/resources/insuring-mass-timber/		Insurance
Oregon State University	2025	Burning it all down to figure out safe mass timber construction		https://engineering.oregonstate.edu/all-stories/burning-it-all-down-figure-out-safe-mass-timber-construction		Fire, Fire Test, Char, Smoke, Structural
Society of Fire Protection Engineers (SFPE)	2021	Fire Protection Engineers and Cross-Laminated Timber		https://www.sfpe.org/publications/fpemagazine/fpeextra/fpeextra2021/fpeextraissue66		CLT, Fire
Timberlab		Earthquake Resilience at 10 Stories		https://timberlab.com/projects/nheri		Lateral, Seismic
WOOD Design & Building, CWC Volume 24, issue 95		Strength and Resilience A demonstration of the strength of wood in the face of an explosion		https://cwc.maglr.com/wood-design-building-2025-volume-24-issue-95/feature-study-in-resilience		Explosion, Fire, Flood, glulam, Sprinkler, Truss, Prefabrication
Wood Innovation Research Laboratory	2024	From disaster to discovery: WIRL's structural resilience		https://www.unbc.ca/our-stories/story/disaster-discovery-wirls-structural-resilience		Prefabrication, Fire, Repair
WoodWorks	2025	Market Trends Map Snapshot of Mass Timber Projects in the U.S.		https://www.woodworks.org/resources/mapping-mass-timber/		

Current Research						
source		Title		Link		
University of Alberta		Use of Mass Timber Panel in Basement Construction		https://sites.google.com/ualberta.ca/timber/our-research/projects#h.nv21105a3igx		Fernanda Imamura (PhD Candidate)
University of Alberta		Application of CLT Panels for Basement Walls		https://sites.google.com/ualberta.ca/timber/our-research/projects#h.l5c17vs6saw		Milan Marojevic (MSc Student)
University of Alberta		Resilient Hybrid Steel-Timber Structural Systems for Seismic Applications		https://sites.google.com/ualberta.ca/timber/our-research/projects#h.s5f1euf0zsg7		Ahmed Mowafy (Ph.D. Candidate)
University of Alberta		Performance of Self-tapping Screw due to Moisture Variation in Mass Timber Products		https://sites.google.com/ualberta.ca/timber/our-research/projects#h.mak2s2e59m8y		Mehsam Khan (MSc)