

Benefits and Barriers in the Implementation of Mass Timber for Multistory Building Projects: Case Study Insights

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ABSTRACT: The growing focus on sustainable construction practices has brought mass timber to the forefront as a promising material for multistory buildings. Previous studies have highlighted its advantages, including reduced carbon emissions, faster construction times, and improved aesthetics. However, they have also identified barriers such as fire safety concerns, high upfront costs, and limited awareness among industry professionals. Despite these insights, few empirical studies have explored the real-world application of mass timber in large-scale projects, leaving a gap in understanding its practical challenges. Specifically, challenges encountered during the construction phase of a project often remain unaddressed due to the excessive complexity and difficulty of the data collection process. This study investigates the real-world challenges of mass timber adoption by conducting semi-structured interviews with industry professionals, including architects, engineers, and contractors. Using Inductive Thematic Analysis, this research identifies key obstacles, including regulatory inconsistencies, supply chain limitations, structural integration issues, and workforce knowledge gaps. The results indicate that complex approval processes, uncertainties in fire safety regulations, and material sourcing difficulties are among the primary hindrances to mass timber adoption. Additionally, the findings highlight the role of regulatory reforms, improved training, and investment in local manufacturing of mass timber to foster greater industry acceptance. By documenting the perspectives of practitioners, this study provides actionable insights and recommendations to support broader adoption of mass timber, contributing to the ongoing discourse on sustainable construction materials.

1. INTRODUCTION

The construction industry is facing increasing pressure to adopt sustainable and innovative materials to reduce its environmental impact while maintaining cost efficiency and structural performance. Mass timber has emerged as a promising alternative to conventional steel and concrete due to its renewable nature, carbon sequestration capabilities, and prefabrication advantages (Espinoza et al., 2016; Wong et al., 2024). Several studies have explored the economic, environmental, and aesthetic benefits of mass timber, highlighting its ability to improve construction speed, seismic performance, and occupant well-being (Svatoš-Ražnjević et al., 2022; Karjalainen et al., 2021). However, despite its growing appeal and benefits, the widespread implementation of mass timber remains constrained. These challenges span technical, regulatory, and financial barriers, all of which impact the feasibility and scalability of mass timber construction.

The 2021 International Building Code (IBC) introduced new mass timber construction types (IV-A, IV-B, and IV-C), expanding opportunities for taller timber buildings (Stegner & Fotheringham, 2022). This milestone followed extensive research, testing, and code proposal efforts led by organizations such as the American Wood Council and the Ad Hoc Committee on Tall Wood Buildings. While code updates like the 2021 IBC have broadened opportunities for mass timber applications in tall buildings, these changes have also exposed inconsistencies in code interpretation and implementation across jurisdictions. This regulatory shift highlights the need to have a more nuanced understanding of the use of mass timber in multistory building construction. Previous research on mass timber has predominantly focused on architectural design feasibility, material performance, and industry perceptions to name a few. While these studies provide valuable insights, they are limited in capturing the real-world challenges encountered during project execution (Ahmed & Arocho, 2021).

Prior work has primarily addressed barriers such as regulatory compliance, structural performance, economic feasibility, supply chain limitations, and industry knowledge gaps. However, there remains a need for practical industry-based examination of how these challenges manifest during actual multi-story projects and during the construction phase. Over the past few years, the industry has implemented several such projects, leading to increased knowledge and awareness among industry professionals regarding on-the-ground construction challenges. This study aims to document and critically analyze these real-world challenges of mass timber implementation and explore their implications for the broader construction industry.

2. LITERATURE REVIEW

This review synthesizes existing research on the regulatory, structural, economic, supply chain, and industry-related challenges highlighted in prior studies.

2.1 Challenges of Mass Timber Implementation

2.1.1 Regulatory and Code Compliance Barriers

Despite growing interest in mass timber, regulatory constraints remain a significant barrier to its widespread adoption. Various studies indicate that building codes and fire safety regulations present hurdles to approval processes, delaying projects and increasing costs (Espinoza et al., 2016). The availability of technical information and standardized testing data for mass timber structures is another challenge, particularly in regions where mass timber construction is still developing (Ahmed & Arocho, 2021). The interpretation of fire codes varies by jurisdiction, making approvals unpredictable and requiring additional negotiations with local authorities (Zaman et al., 2022). While updates to building codes, such as those in the 2021 International Building Code (IBC), now permit taller mass timber buildings, inconsistent enforcement and lingering skepticism among regulatory bodies continue to pose obstacles (Laguarda Mallo & Espinoza, 2015).

2.1.2 Structural and Material Performance Concerns

Industry professionals often cite uncertainties regarding the structural behavior of mass timber in hybrid construction as a key barrier. In multi-story applications, challenges such as seismic performance, material shrinkage, and connection strength need to be addressed (Karjalainen et al., 2021). Studies suggest that bracing solutions, load-bearing capacities, and panel integration methods require further refinement to enhance mass timber's competitiveness against steel and concrete (Marfella & Winson-Geideman, 2021). Additionally, concerns about long-term durability and maintenance, particularly regarding moisture susceptibility, pose additional constraints (Bhandari et al., 2023). Research also highlights that public perceptions of structural safety and fire resistance, despite documented fire resilience properties of mass timber, remain a significant adoption barrier (Larasatie et al., 2018).

2.1.3 Economic and Cost-Related Barriers

Despite its potential cost-saving benefits in terms of speed and prefabrication, mass timber remains more expensive upfront compared to traditional materials due to higher material costs, specialized labor requirements, and added fireproofing measures (Espinoza et al., 2016). The economic feasibility of mass timber is further constrained by limited financial incentives, market hesitancy, and risk-averse investment strategies (Ahmed & Arocho, 2021). In Australia, an analysis identified cost perceptions, material imports, and an undeveloped domestic market as major economic hurdles preventing widespread adoption (Kremer & Symmons, 2015). However, case studies indicate that as supply chains mature and regulatory frameworks become more streamlined, mass timber could become more financially viable (Svatoš-Ražnjević et al., 2022).

2.1.4 Supply Chain and Market Limitations

One of the most persistent barriers to mass timber adoption is the limited supply chain infrastructure, particularly in regions where timber manufacturing capacity is underdeveloped (Svatoš-Ražnjević et al., 2022). A lack of local manufacturing facilities increases reliance on imports, leading to supply chain vulnerabilities and higher costs (Espinoza et al., 2016). In Australia and North America, studies highlight the need for investment in local CLT and glulam production facilities to enhance cost-effectiveness and material accessibility (Zaman et al., 2022). The absence of well-established timber certification programs in some regions further complicates procurement, limiting accessibility and acceptance in mainstream markets (Low et al., 2021).

2.1.5 Knowledge Gaps and Industry Hesitancy

The lack of familiarity with mass timber construction methods among contractors, developers, and regulatory authorities hinders its adoption (Ahmed & Arocho, 2021). Studies suggest that knowledge gaps in engineering curricula contribute to hesitancy, as many professionals lack the technical expertise required to design and construct mass timber buildings effectively (Daneshvar et al., 2021). Moreover, insurance and financing challenges persist, with insurers often viewing mass timber as a high-risk material due to perceived fire hazards and structural performance uncertainties (Marfella & Winson-Geideman, 2021). A survey of architects in the U.S. found that while interest in mass timber was high, limited technical guidance and lack of practical experience discouraged adoption (Mallo & Espinoza, 2015).

3. METHODOLOGY

3.1 Research Approach

This study adopted qualitative research approach using semi-structured interviews to investigate the real-world challenges to the implementation of mass timber construction in multistory construction projects. This method was selected for its ability to capture rich, nuanced insights from experienced professionals working directly with mass timber materials. The interviews were designed to explore participants' perceptions, challenges faced, and lessons learned throughout the planning and construction process.

3.1.1 Data Collection

The study collected data through eight semi-structured interviews with professionals directly involved in mass timber construction projects, including contractors, designers, and engineers. Participants were recruited via a combination of convenience and snowball sampling (Noy, 2008). The interview questions were designed to capture practical experiences, challenges, and lessons learned of mass timber, covering topics such as decision-making process, observed impacts, implementation challenges, comparative analysis, and future outlook for mass timber construction. The full interview guide is included in the Appendix. Interviews were conducted remotely, depending on participant's availability, and lasted between 45 and 90 minutes. Each session was audio-recorded and transcribed verbatim, meaning the participants'

words were recorded exactly as spoken, to ensure data accuracy for qualitative analysis. Table 1 provides the demographic information of the interviewees.

Table 1: Anonymized demographic information about interviewees

#	Project Type	Company Type	Title	Years of Experience (years)	Years of Experience in Mass Timber (years)
Interviewee 1	Commercial Office Building	General Contractor	Principal in charge	35	6
Interviewee 2	Mid-rise and High-rise Residential Building	Structural Engineering firm	CEO and President	28	15
Interviewee 3	Commercial Office Building	Architecture and Interior Design firm	Senior Associate	18	5
Interviewee 4	Commercial Building	General Contractor	Senior Structural Engineer	10	5
Interviewee 5	High-rise Residential Building	Structural Engineering firm	Associate Principal	12	7
Interviewee 6	Multi-story educational facility	Manufacturing and installation firm	Co-founder	22	7
Interviewee 7	Commercial Education facility	General Contractor	Senior Project Manager	10	2
Interviewee 8	Commercial Office Building	Architecture and Design firm	Principal	18	13

3.1.2 Data Analysis

An Inductive Thematic Analysis (Braun & Clarke, 2006) approach was applied to the transcribed interview data, utilizing Nvivo software for qualitative coding. First, transcripts were read repeatedly for familiarization. Initial codes were then generated based on relevant segments of text. These codes were reviewed, grouped, and refined into broader thematic categories through iterative discussion among the research team. Axial coding was used to cluster related codes into second-order categories. The final themes represent both convergence and divergence in participant experiences and reflect common barriers to mass timber implementation.

3.2 Validity

To enhance the validity and reliability of the findings, two strategies were employed. First, member checking was conducted by sharing the synthesized themes with a subset of participants for feedback. Second, investigator triangulation was used, where multiple researchers reviewed the coded data independently before consensus on final themes was reached.

4. RESULTS

The interview findings are presented across four key recurring themes that emerged from the thematic analysis. Each theme is described below with illustrative interviewee statements in the context of implementation challenges.

4.1 Higher Initial Cost and Market Uncertainty

Despite its long-term environmental and operational benefits, mass timber continues to face higher upfront costs than traditional materials, often requiring developers to justify its economic viability. Participants frequently discussed the higher upfront costs of mass timber compared to conventional materials, often attributing these costs to market immaturity, specialty subcontractors, and risk pricing. The perception of elevated cost was compounded by supply chain instability and insurance requirements. . One structural engineering firm's CEO and President explained, "We had to justify mass timber against concrete based on lifecycle costs, not just initial expenses" (Interviewee 2). Interviewee 8 noted the impact of price fluctuations, stating, "Material costs and supply chain uncertainties make budgeting for mass timber tricky" (Principal, Architecture and Design firm). Furthermore, insurance and financing for mass timber remain difficult to secure due to their unfamiliarity with timber systems, with some financial institutions perceiving it as a higher-risk material. "Many insurance companies still see mass timber as a higher risk, making financing more complicated." (Interviewee 1, Principal in-charge, General Contractor). This highlights the economic challenge of mass timber adoption, requiring policy incentives and supply chain investments to improve affordability.

4.2 Regulatory and Approval Barriers

Interviewees consistently reported challenges with jurisdictional approval processes, particularly related to fire safety and code interpretation. Compliance with fire safety regulations was frequently cited as a major challenge for mass timber projects. Variability in local fire codes and long approval times were highlighted as key concerns. One interviewee from a structural engineering firm who had a regulatory background noted, "Local fire codes delayed our approval process by several months due to mass timber-specific concerns" (Interviewee 5, Associate Principal). Several participants noted extended review timelines and modifications to building envelopes and interior finishes to meet prescriptive requirements. A contractor explained the impact of fireproofing requirements, stating, "We had to encapsulate certain areas with gypsum board, reducing the desired exposed wood aesthetic" (Senior Project Manager, General Contractor). These findings highlight the regulatory challenges that mass timber continues to face and the need for clearer guidance, particularly in jurisdictions where fire safety guidelines are still evolving.

4.3 Construction and Durability Challenges

Interviewees described technical and material-related barriers encountered during construction, particularly around moisture protection and hybrid integration. Mass timber is highly sensitive to moisture, requiring special handling during transportation and installation. Contractors reported challenges in preventing swelling and discoloration, particularly in projects exposed to the elements before full enclosure. A construction manager explained, "Managing on-site moisture was our biggest issue, we had to ensure all timber elements were properly sealed" (Interviewee 7, Senior Project Manager). Another noted, "Even slight exposure to rain during construction led to discoloration and required rework" (Interviewee 6, Co-founder manufacturing and installation). Hybrid systems—integrating timber with steel and concrete—introduced coordination challenges that required design modifications and sequencing changes. "The hybrid approach, while promising, is still a challenge to perfect," remarked a structural engineer. These responses align with prior studies highlighting moisture management and structural performance as a key factor in mass timber durability. As such, the findings suggest that moisture management strategies—such as protective coatings, controlled site logistics, and rapid enclosure—are critical for successful implementation.

4.4 Workforce and Training Gaps

Many interviewees discussed workforce readiness as a challenge to mass timber adoption. General contractors unfamiliar with mass timber installation often introduced cost and time contingencies. As one participant summarized, "General contractors are unfamiliar with how to build a mass timber building is a barrier." A lack of contractor expertise in mass timber installation was highlighted as a barrier to wider adoption. Some interviewees described training initiatives required to prepare crews for mass timber projects. One contractor observed, "Most general contractors still price in unnecessary contingencies

because they are unfamiliar with mass timber" (Interviewee 7, Senior Project Manager). Another respondent noted, "We had to train our crew on proper installation techniques, adding unexpected time to the schedule" (Interviewee 1, Principal in-charge, General Contractor). These findings indicate the need for industry-wide training programs and workforce development to reduce learning curves and contractor uncertainty.

5. DISCUSSION

The findings of this study highlight the multifaceted barriers preventing mass timber's widespread adoption. While regulatory updates have made tall mass timber structures more feasible, industry professionals continue to struggle with interpretation inconsistencies and lengthy approval processes. Existing literature has consistently pointed to the potential of mass timber in carbon reduction, material efficiency, and prefabrication benefits. However, this study reinforces previous concerns raised by Mallo & Espinoza (2015) regarding contractor inexperience and regulatory uncertainty, while also providing new insights into structural performance concerns in hybrid construction (Larasatie et al., 2018).

A notable contribution of this study is its emphasis on structural integration challenges in hybrid buildings. Unlike previous studies that primarily focus on mass timber as a standalone material, this research identifies the complexities that arise when integrating timber with other materials such as steel and concrete. Additionally, this study sheds light on the impact of supply chain uncertainty, offering empirical insights into how logistical delays and regional supplier limitations affect project feasibility (Espinoza et al., 2016). Another key contribution is the identification of industry-wide training deficiencies, with findings demonstrating that gaps in formal education programs significantly contribute to mass timber's slow adoption (Kremer & Symmons, 2018).

The implications of these findings suggest several practical steps that can be taken to mitigate barriers to mass timber adoption. Regulatory reforms are needed to standardize building code interpretations across jurisdictions, reducing approval delays. Enhanced training initiatives should be developed to increase contractor familiarity with mass timber construction techniques. Investment in domestic CLT and glulam manufacturing can strengthen supply chain resilience and reduce procurement challenges.

6. CONCLUSIONS AND FUTURE WORK

This study provides empirical evidence on the challenges of mass timber adoption in multistory construction projects, filling a gap in previous research that focused primarily on its environmental benefits and theoretical feasibility. Through semi-structured interviews with contractors, engineers, architects, and developers involved in recent mass timber projects, key challenges were identified, including regulatory compliance barriers, structural performance uncertainties, supply chain limitations, and workforce training gaps. The findings reinforce prior research while introducing new, nuanced perspectives – particularly concerning the integration of mass timber with other materials in hybrid construction, logistical constraints, and unfamiliarity of contractors with the use of mass timber.

The study emphasizes the need for standardized building codes, increased investment in local manufacturing, and enhanced contractor training programs to support mass timber's viability in multistory construction. Moreover, several innovative strategies are recommended based on the findings. These include the development of digital permitting platforms to streamline jurisdictional approvals, adoption of prefabricated moisture-control systems (e.g., integrated wrap or panelized protection), and implementation of virtual and augmented reality tools for mass timber installation training. Additionally, investigating digital design tools and predictive modeling for hybrid mass timber structures may also optimize material integration and reduce design uncertainties.

The study was limited to specific geographic regions and project types, which may not fully represent the global diversity of mass timber applications. The findings are based on qualitative interviews, which, while rich in detail, may not capture all possible challenges that arise across different regulatory environments.

Future work should examine the perspectives of end users and occupants to understand the long-term performance and perceived value of mass timber buildings. Research should explore the end-of-life phase of mass timber buildings from a circular economy perspective, including disassembly potential, reuse of components, and recycling of engineered timber materials to better understand the sustainability profile across the full building lifecycle.

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APPENDIX: SEMI-STRUCTURED INTERVIEW GUIDE

Background Information

Objective: To collect information about the interviewee's role and professional experience

- Could you please describe your job title and primary responsibilities?
- How many years of experience do you have in the design or construction industry?
- How many years of experience do you have specifically with mass timber construction?
- How many projects involving mass timber have you been involved in?
- What type of company or organization do you represent (e.g., owner, contractor, designer, supplier)?
- Approximately how many employees work in your company or firm?

Project Context

Objective: To understand the type of project and contractual setting in which mass timber was used

- What is the primary type of project you worked on (e.g., residential, commercial)?
- What was the type of project site (e.g., greenfield, brownfield, renovation)?
- Was the building fully made of mass timber, or was it a hybrid structure (e.g., composite with steel/concrete)?
- What was the total baseline construction cost of the project?
- What type of project delivery method was used (e.g., general contracting, design-build, CM/GC)?
- Was the project phased using design-bid-build or was it fast-tracked?
- What type of construction contract was used (e.g., lump sum, cost-plus, unit price)?

Experiences with Mass Timber

Objective: To explore perceived benefits, performance, and environmental impacts

- What were the key factors that influenced the decision to use mass timber on this project?
- Who was the primary advocate or champion for implementing mass timber (e.g., owner, contractor, designer)?
- What significant outcomes did you observe during the construction phase?
- How did mass timber influence project performance (e.g., schedule, quality, cost)?
- Were any performance metrics or indicators used to track mass timber-related benefits?
- Were there any specific environmental considerations accounted for during project planning or construction?

Implementation Challenges

Objective: To identify difficulties during construction and how they were addressed

- What were the primary challenges encountered during the construction phase?
- Did you experience any issues with mass timber material availability or supply chain logistics?
- How did local building codes and regulations affect the construction process?
- Were there any challenges related to meeting fire resistance or safety requirements?
- Did you face difficulties in training personnel or sourcing skilled labor for mass timber construction?

Comparative Perspectives

Objective: To understand how mass timber compares to traditional materials like steel or concrete

- If applicable, how does constructing with mass timber compare to traditional materials like steel or concrete?
- What differences in project management or execution did you observe compared to non-timber projects?
- How did coordination among stakeholders (architects, engineers, contractors) differ in this project?

Future Outlook and Recommendations

Objective: To capture expert suggestions for improvement and future use of mass timber

- Based on your experience, what innovations or improvements would help overcome mass timber challenges?
- What lessons learned or recommendations would you share with others considering mass timber?

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