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A Comparison of Mass Timber Perceptions Among Construction Professionals Over Time

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Mass timber, including products such as cross-laminated timber (CLT) and glue-laminated timber (glulam), is gaining attention as a sustainable alternative to traditional steel and concrete, offering benefits such as reduced carbon emissions and enhanced aesthetic appeal. However, despite its advantages, mass timber adoption faces significant challenges, including high costs, limited practitioner experience, and unique material protection requirements. This study investigates the evolving awareness, benefits, and challenges associated with mass timber construction among U.S. construction professionals. Through a survey of over 100 construction practitioners, primarily from Cal Poly's Construction Management Advisory Council (CMAC) in California, this study provides updated insights on industry perceptions, particularly in comparison to Ahmed's 2022 research on mass timber awareness. Findings reveal an increase in contractors' exposure and experience with mass timber, with 67% of respondents reporting involvement in mass timber projects—a notable 22% rise since 2022. Key challenges identified include the cost of materials, limited practitioner experience, and a new concern with material protection against environmental factors, which can impact both structural integrity and aesthetic quality. By examining these perceptions and comparing them with previous data, the study highlights critical trends, informs on evolving industry challenges, and underscores the importance of continued development in mass timber practices to enhance adoption and reduce barriers.

Key Words: Mass Timber, Construction Industry, Challenge, Industry Perception, Survey

Introduction

Mass timber as a building material refers to a variety of large-scale engineered wood products used in building construction. These mass timber products are typically used either in conjunctions, or as an alternative to traditional structural steel and reinforced concrete construction. There are several large-scale engineered wood products currently available including cross-laminated timber (CLT), structural-composite lumber (SCL), glue-laminated timber (GLT and/or glulam), nail laminated

timber (NLT), and dowel-laminated timber (DLT) (Gong, 2019; Woodworks, 2024). Common uses of mass timber construction are with CLT and glulam; being used as flooring, walls, beams, girders, trusses, and columns.

CLT consists of wood boards, stacked on top of each other, with each layer rotating the board 90 degrees. Commonly made with an odd number of layers (typically three, five, or seven). CLT provides a high degree of strength, the cross lamination allows protection in both sheer in-plane and tension perpendicular to the grain (Brander et al., 2016). Compared with Glulam/GLT, while the manufacturing process is similar, in glulam beams the grain is all ran parallel to the longitudinal direction (Figure 1). This difference makes glulam stronger in the longitudinal direction and weaker in the transverse direction, making the product appealing as an alternative to beams and girders. (Issa and Kmeid, 2004; Woodworks, 2024).



Figure 1: Comparison of Glulam (left) and CLT (right) construction (Woodworks, 2024)

Understanding the level of awareness among construction practitioners is critical for advancing the development and widespread adoption of mass timber construction. Greater awareness has the potential to address existing challenges associated with mass timber, including reducing costs, improving design efficiency, and enhancing constructability and installation processes (Ahmed, Dharmapalan, and Jin, 2024).

This study utilizes a survey distributed to over 100 construction practitioners to gather current data on their opinions and awareness of mass timber. By comparing the findings with data from previous research, the study aims to identify emerging trends and track the evolution of mass timber adoption within the construction industry.

Existing Benefits of Mass Timber

Mass timber is widely recognized as an environmentally friendly building material for several key reasons:

- **Carbon Sequestration:** Mass timber products store carbon dioxide absorbed during the trees' growth, effectively reducing greenhouse gas emissions over the structure's lifecycle.
- **Reduced Embodied Energy:** The production of mass timber requires significantly less energy compared to traditional materials such as steel and concrete, further lowering its carbon footprint.
- **Sustainability:** When sourced from responsibly managed forests, mass timber offers a renewable alternative to nonrenewable materials, contributing to long-term environmental conservation (Ahmed, et al., 2024).

The environmental benefits of mass timber are supported by numerous studies. Hemmati et al. (2024) found that replacing structural steel and concrete flooring with mass timber can result in a 19% reduction in carbon emissions. This finding underscores the material's potential to significantly decrease the environmental impact of construction. Additional research highlighted in WoodWorks' presentation, *Reducing Embodied Carbon with Wood: Why and How*, demonstrates that substituting conventional building materials with mass timber can lead to even greater reductions up to 75% in embodied carbon (WoodWorks). These studies collectively position mass timber as a highly sustainable and environmentally friendly alternative, capable of reducing the carbon footprint of the construction industry while maintaining economic feasibility.

One of the unique attributes of mass timber is its aesthetic appeal, which significantly contributes to its growing popularity in the construction industry. In addition to its aesthetic qualities, mass timber offers substantial psychological and physiological benefits. Exposed wood surfaces in buildings have been found to promote occupant well-being by reducing stress, enhancing comfort, and improving overall satisfaction with the indoor environment (Kremer et al., 2024). These benefits align with the principles of biophilic design, which emphasize the inclusion of natural elements in built spaces to foster a connection to nature.

Research by Burnard and Kutnar (2015) indicates that exposure to wood interiors can lower heart rates and reduce stress, demonstrating the material's ability to support mental and physical health. Similarly, Kellert et al. (2011) found that incorporating natural materials like wood into building design enhances cognitive performance and emotional well-being. These outcomes are attributed to the tactile and visual qualities of natural materials, which evoke a sense of calm and comfort. While mass timber buildings currently represent a small fraction of the total number of buildings in the United States—1,753 out of 5.9 million—there are several notable examples of large-scale, successful mass timber projects (Riddle, 2023). These projects demonstrate the material's potential for widespread adoption and its ability to meet both structural and aesthetic demands.

One prominent example is Google's 1265 Borregas Ave, Sunnyvale, CA, the company's first mass timber building. The structure is fully electric, and features exposed timber beams, wood ceilings, and concrete flooring, showcasing the versatility and appeal of mass timber in contemporary design (Mendez, 2023). The involvement of a major corporation like Google in mass timber construction is a significant step toward increasing its mainstream acceptance. As more high-profile companies adopt

this sustainable material, it is likely that others will follow suit, further driving the adoption of mass timber in the U.S. construction industry.

Existing challenges & awareness with MT

Despite the benefits of mass timber has over traditional steel and concrete construction, there are associated challenges that come with using it as well. Based on previous studies, one of the main existing challenges is the lack of awareness and experience among all the major players in a construction project: clients, architects, and contractors (Ahmed and Arocho 2021). According to Ahmed and Arocho's 2022 study, among contractors, a significant portion cite the lack of experience as a challenge on mass timber projects (Ahmed and Arocho 2022). Within the same study, architects cite that lack of awareness among stakeholders, high cost, and design difficulties are the largest challenges on mass timber projects (Ahmed and Arocho 2022).

It is also just as important that carpenters and installers are aware of the unique difficulties of mass timber as well (Ahmed et al., 2024). According to Ryan Richmond, who's case study provided the perspective of installers on multiple mass timber projects, "there was somewhat of a learning curve at the beginning of the job. The lack of prior training was overcome relatively quickly once installation began." (Richmond 2020). Having prior experience or training could mitigate this learning curve, even if it was quickly resolved after beginning (Ahmed and Arocho 2022).

Though the US mass timber market isn't as well vetted as the other regions such as Europe, Australia, and Asia; the US continues to see growth in the market, reflected in the continual code changes in recent years. Within the 2024 International Building Codes, mass timber is officially recognized as Type IV construction and given specific design requirements as a function of building height and allowable exposed mass timber (Heymfield et al. 2024). These new codes could assist in the design of mass timber buildings, an issue taken with architects and designers.

Additional cost is also cited as one of the challenges regarding mass timber construction projects. When comparing a mass timber project to a similar steel and concrete building in terms of size and scope, it has been found that there is a 2-6 percent increase in cost. (Ahmed and Arocho 2021). These costs are representative of the total cost of life of a building. With the cost of mass timber products and installation of said products being the main factor for cost increases.

Purpose

This study aims to provide updated insights into perceptions of mass timber within the construction industry by building on the work of Ahmed's (2022) study, "Identifying the Level of Awareness and Challenges to Adopt Mass Timber by the Construction Practitioners in the United States." By utilizing the same survey questions from the 2022 study, this research seeks to understand how construction professionals' opinions about mass timber have evolved in the past few years. These findings can help forecast future market trends and the adoption potential of mass timber.

Methodology

This study was developed by adapting the questions from Ahmed's (2022) study, "Identifying the Level of Awareness and Challenges to Adopt Mass Timber by Construction Practitioners in the United States." While the original questions were retained, slight modifications were made to align with the objectives of the current research. The current research focused exclusively on California's construction market targeting contractors, an area that has not been thoroughly explored in existing literature. While prior studies have typically assessed mass timber perceptions across the U.S. as a whole, this research emphasizes the importance of regional insights to better understand industry awareness and market-specific challenges and opportunities. Furthermore, since 2021, numerous companies have gained exposure to mass timber projects. This study reevaluates the industry's perception after three years, which is an adequate timeframe given the rapidly growing mass timber market.

An online-based survey was employed, comprising a combination of multiple-choice, Likert scale, and open-ended free-response questions. This mixed-method approach allowed for the collection of both quantitative and qualitative data. The survey was structured to target construction managers and contractors. The survey was designed to provide a comprehensive understanding of the current state of awareness, adoption, and challenges related to mass timber across the California's construction industry. The survey's quantitative questions provide informed data on participants' demographics, work experience, and perceptions of mass timber. The survey's qualitative data allows for open-ended responses from the participants. Open-ended responses provide the option for participants to clarify, go more in depth, and provide their own opinions on mass timber perceptions, current issues, and potential solutions; without being limited to quantitative type questions.

The survey was distributed to members of the Construction Management Advisory Council (CMAC) at California Polytechnic State University, which comprises over 100 construction companies focused on alumni involvement and student engagement with industry professionals. CMAC members include professionals such as project managers, construction company owners, CEOs, principals, and other key decision-makers. This diverse group provides an excellent representation of the construction industry. No heavy civil contractors were included in this survey due to mass timber not being used in the heavy civil industry. Additionally, CMAC members were encouraged to share the survey with their colleagues in California, expanding their reach to professionals in related fields. This approach ensures a more comprehensive dataset, encompassing perspectives from various disciplines integral to mass timber adoption.

The survey is based on Microsoft Office Forms. This is one of the standard tools that the Construction Management department uses to send out surveys. It is an anonymous, online based platform for making forms and surveys. By analyzing this data, the study aims to identify evolving trends in mass timber awareness, perceptions and adoption, providing a foundation for industry stakeholders to develop targeted strategies for promoting mass timber as a sustainable construction material.

Results

The survey was distributed once, and participants were given a four-week period to respond. The survey received a relatively low response rate, with 12 responses out of the 100 contractors it was sent to. However, a 12% return rate is not uncommon for studies employing similar methodologies. As a result, it was determined that the responses would still be significant considering the nature of the topic and suitable for comparison with Ahmed's 2022 study.

Demographics

The survey received 12 responses from constructors and project managers. Despite being only constructors, the size of the companies varied evenly: 17% of participants work at a company with 50-250 employees, 25% with 250-500 employees, 25% with 500-1000 employees, and 33% with more than 1000 employees. While the company size had a relatively even spread, the annual budget shows that 66% of participants work at companies with budgets greater than 400 million per year. These results are proportional with those received in Ahmed's 2022 study. In regard to constructors, their study similarly had an even distribution of employee size and the majority working with a budget of more than 400 million annually.

The survey return rate was low for this study, roughly 12%. Although the return rate percentage was higher than the survey sent out in "Identifying the Level of Awareness and Challenges to Adopt Mass Timber by the Construction Practitioners in the United States", it was still lower than the average online survey response rate of 41% (Wu et al. 2022). In addition, this survey was sent out to considerably fewer participants initially and as a result received considerably fewer responses. Despite having a higher return rate, the overall number of responses was significantly lower. The low response rate can be attributed to the constraints of the methodology: due to this study being created as a part of a bachelor's degree thesis, it needed to be completed within a 10-week period. This constraint reduced the amount of time participants would have to take, the number of times the survey could be redistributed, and who the survey was distributed to.

Current Awareness of Mass Timber

The results indicate that awareness among contractors has increased over the past two years. Specifically, 67% of respondents reported involvement in mass timber projects, reflecting a 22% increase compared to Ahmed's 2022 study. However, it is important to note that this study focused solely on California's construction industry and had a low response rate, which may limit the generalizability of the findings.

Regarding experience, 42% of respondents indicated less than one year of experience with mass timber, while another 42% reported having 1–5 years of experience. This suggests a shift, with fewer contractors having less than one year of experience and more gaining 1–5 years of experience. These findings imply an overall increase in the level of awareness and engagement with mass timber among

contractors compared to Ahmed’s 2022 study. Figure 2 illustrates the distribution of contractors' involvement with mass timber projects, while Figure 3 depicts their experience levels.

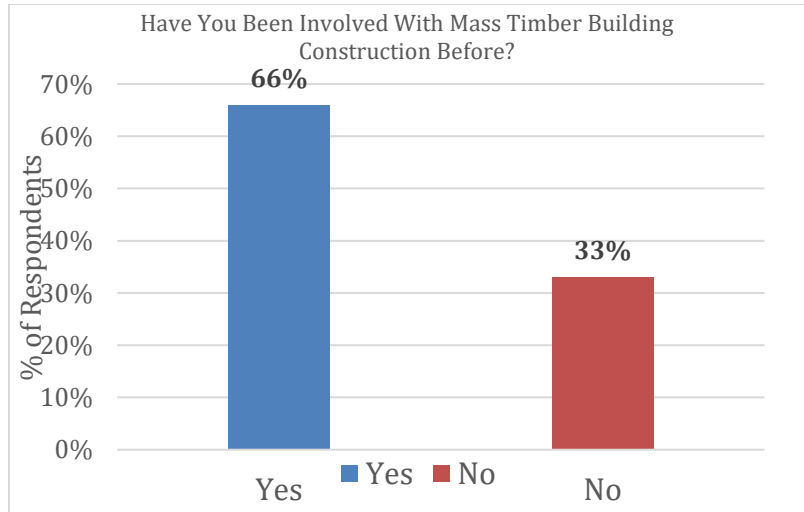


Figure 2: Contractor Involvement with Mass Timber

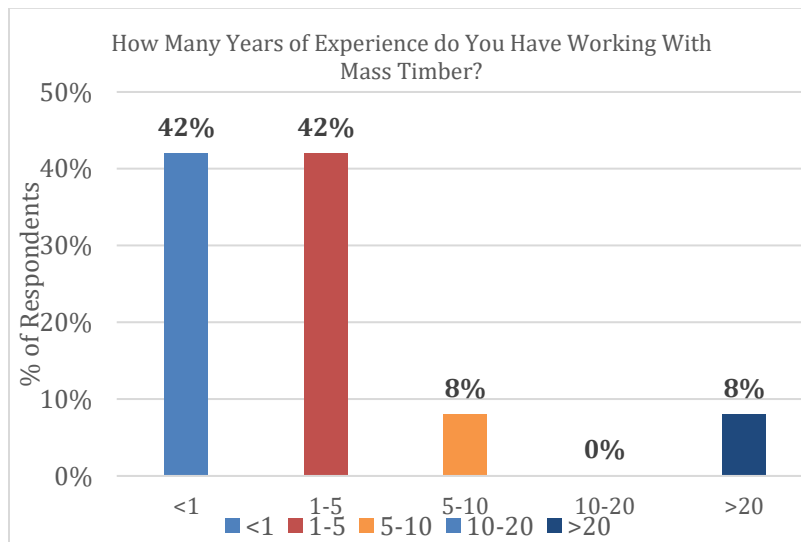


Figure 3: Contractor Experience with Mass Timber

Challenges of Mass Timber Materials

When identifying current challenges regarding mass timber materials, participants were asked to freely respond with their opinions. In order to utilize open-ended responses, this survey implemented the qualitative content analysis method. This method involves analyzing and interpreting the

participants' responses and categorizing them into a keyword that represents the original meaning and intent of the response. The respondents to this survey responded that mass timber had 3 main issues:

1. Material protection during construction,
2. Initial cost of the material and construction
3. Lack of experienced workers and professionals in this field.

Material protection pertains to the concept that wood is easy to damage, especially due to weather. Wood is susceptible to damage from environmental factors, particularly moisture. When exposed to rain, humidity, or extreme weather conditions, mass timber can experience swelling, warping, discoloration, and even decay, all of which compromise the material's structural integrity and visual quality. Studies indicate that moisture-related damage is especially problematic because mass timber is sometimes left exposed as a finished surface, making any visual imperfections highly noticeable and potentially costly to repair or replace (Gustafsson et al., 2018). The need for protective measures, such as temporary weather covers or coatings during construction, increases project complexity and adds both labor and material costs (Roberts et al., 2019). Moreover, even minor weather damage can lead to delays as contractors must wait for drier conditions or perform additional maintenance to restore timber to its intended state before continuing with installation.

The high cost of mass timber materials, coupled with additional expenses for skilled labor and protective measures, can make the overall cost prohibitively high for some projects. A participant mentioned that "It is often more expensive than more traditional methods. Engineers and constructors are less familiar with the materials". This premium cost is largely due to limited regional manufacturing capacity in certain areas, which drives up transportation costs. Additionally, mass timber products may require custom fabrication, further increasing costs. These financial barriers are a critical consideration for developers and contractors when assessing the practicality of mass timber, especially in regions without well-established supply chains (Schickhofer et al., 2020). However, considering that less than 5% of a building's total cost is typically associated with mass timber—and with its lower life cycle costs, this challenge appears to stem more from industry perception than from actual financial impact.

A lack of experience in mass timber installation is another significant barrier. Unlike traditional steel and concrete, mass timber requires specific knowledge and skill to handle, align, and secure correctly. Participants quoted that "Limited number of workers familiar with mass timber" and "lack of knowledge and familiarity of the product for engineers and constructors" make the construction more complicated. Studies show that construction teams often face a learning curve with mass timber, which can lead to errors, rework, and inefficiencies on the job site (Richmond, 2020). These issues can be further exacerbated by the lack of training programs focused on mass timber, leaving many workers unfamiliar with the unique characteristics of engineered wood products. Contractors must therefore invest in additional training or hire specialists, both of which can increase project timelines and costs. Additionally, inexperienced crews may underestimate the time required to protect, position, and connect mass timber components, which can result in delays and further cost overruns (Ahmed & Arocho, 2022).

In contrast to Ahmed's original study, this survey had both considerably fewer responses and categories. It can be seen that while work experience remains a large challenge of mass timber; cost increased as a challenge. In addition, material protection was a new category not recognized in Ahmed's study. It was identified that damage, discoloration, swelling, and the associated protections needed are a significant challenge when working with mass timber.

Conclusion

The findings of this study indicate that mass timber remains a relatively new construction material, with persistent challenges hindering its broader acceptance and utilization. Nevertheless, the study reveals that awareness among contractors has increased compared to two years ago, and the level of experience in handling mass timber is also rising. Identifying and addressing the challenges associated with mass timber construction is essential for fostering industry adoption. This study highlights that experience and expertise with mass timber installation remain significant obstacles. Additionally, a new challenge identified since 2022 is the protection of mass timber materials. This is crucial not only to prevent structural damage but also to preserve the aesthetic qualities of mass timber, given its common use as an exposed, finished element in buildings.

To effectively address these challenges, this study proposes implementing targeted training programs for construction professionals to develop expertise in mass timber handling and installation techniques. Such programs could help reduce the learning curve, improve efficiency, and minimize installation issues. Furthermore, developing best practices and protective measures for mass timber materials, particularly in adverse weather conditions, will help mitigate concerns about durability and finish. By disseminating these findings and recommendations throughout the industry, we can foster a greater understanding of mass timber's true costs and benefits, addressing misconceptions and promoting mass timber as a viable alternative to traditional materials in sustainable construction.

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