



WHY NOT MASS TIMBER

**PERCEIVED RISKS OF
USING MASS TIMBER BY
INDUSTRY PROFESSIONALS**

John Spanier, AIA, NCARB, LEED AP

March 8, 2021

SMITHGROUP

INTRODUCTION & PROBLEM STATEMENT

Why do developers, owners, and construction industry professionals choose not to use mass timber for new projects? This is the question at the core of this study. The premise is that knowing this information will allow industry professionals to better support the development of new mass timber projects. To effectively promote the use of mass timber, we need to know the potential roadblocks and how to address them with our clients.

This research is focused on the reasons for real clients not to pursue mass timber on past projects, and how the design and construction industry can either dispel misunderstandings about mass timber or develop the information needed to answer these questions. And it is not important that these

risks be completely accurate or defensible. Rather, the most important aspect of this research is to understand the perception of mass timber in the marketplace, as they are these ideas about mass timber that are the initial obstacles to its mainstream use.

To develop this information, seven representative industry leaders were surveyed to provide their thoughts and experience about recent projects that considered using mass timber at the early stages of development, and then did not utilize it. They have provided insight into why they initially considered mass timber, why they did not use it, and what they perceive to be the obstacles to using mass timber on future projects.

BACKGROUND

Mass timber construction is an evolving structural system that uses solid and laminated wood structural components for building projects. It is based upon existing Heavy Timber construction knowledge and continues to add more options for structurally resilient system components, such as glue laminated timber (Glulam), nail laminated timber (NLT), dowel laminated timber (DLT), cross laminated timber (CLT), and mass plywood panels (MPP), for example. Each of these have their own advantages in terms of cost, manufacturing, and structural performance. Advantages in terms of lower project costs, shortened construction schedules, and healthy building interior environments have already seen considerable documentation worldwide.

Mass timber is also based upon the assumption that wood is a rapidly renewable resource, when paired with sustainable forestry practices. This industry is pushing the practice of forestry as an agricultural crop, like corn or soybeans. Timber is also seen as a major carbon sequestration opportunity, and expanding the world's forests is necessary for reducing atmospheric carbon to manageable levels before the atmosphere is overloaded. The fabrication of the mass timber components also produces significantly less carbon than similarly scaled steel or concrete components. Mass timber construction has the advantage of being able to provide these environmental benefits while also providing value for developers and users.

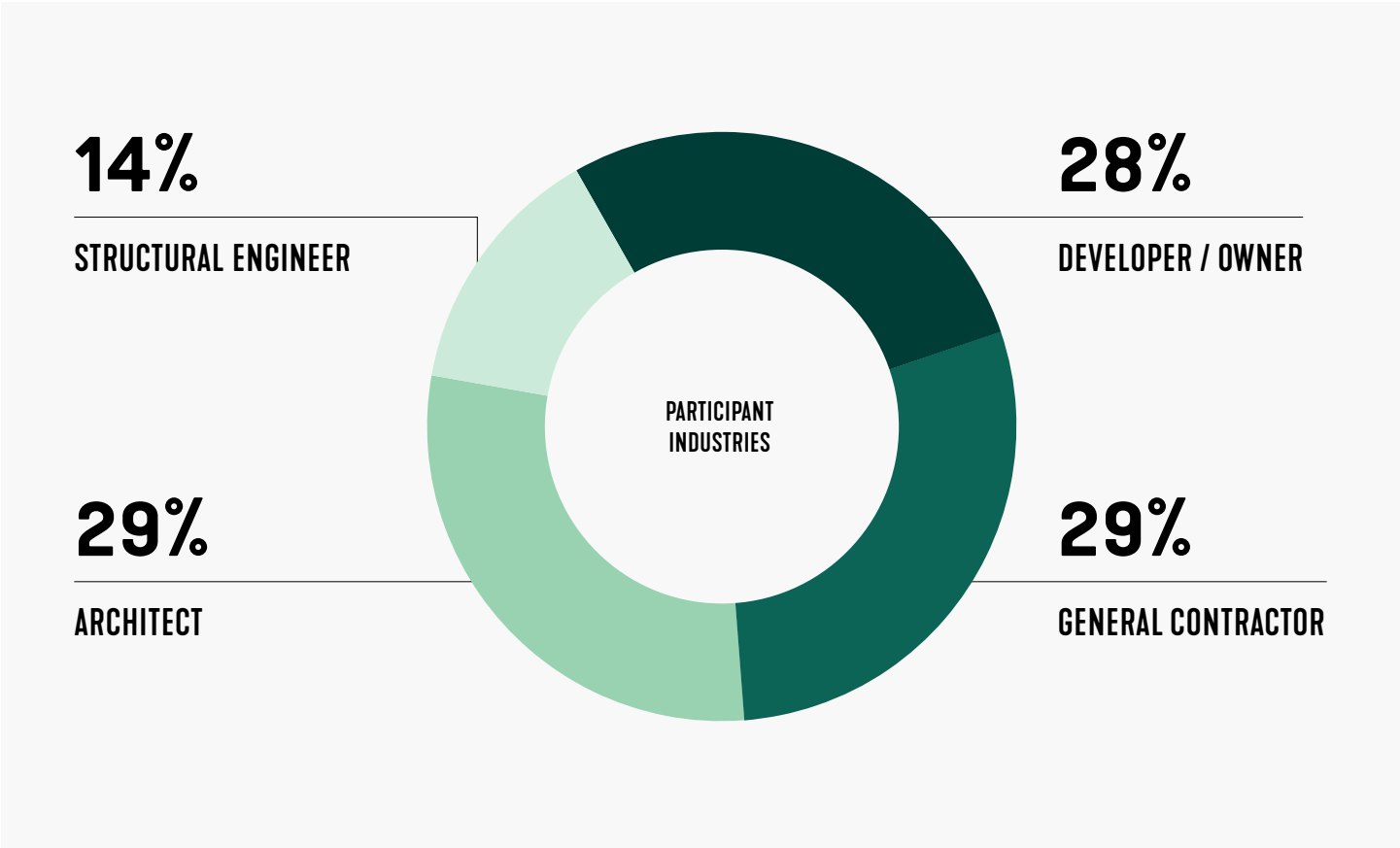
Recently in North America, we are also seeing the recognition and approval of these systems in the building and fire codes, making it much easier for these projects to be realized. The

2021 edition of the International Building Code has included new sections under Type IV construction that allows the use of these newer system components and for use in larger buildings.

Because of these advantages, using a Mass Timber construction system will hopefully be considered a viable option for more and more projects, and it can be argued that it is become more of a necessity for managing our changing climate. However, it is still a niche system, not well understood by many clients, architects, contractors, or agencies. This research is part of a larger, growing body of information being developed to help professionals to understand how to determine when Mass Timber is appropriate and how to measure and weigh its costs and advantages.

This is a survey of a broad spectrum of industry professionals who have considered using mass timber on one or more projects. The group of participants is representative of a larger market, with the hope of more information to be included as this research project gains more momentum. The strategy has been to include multiple perspectives: a private for-profit developer, a non-profit university, two large-scale general contractors, a smaller scale and a larger scale architecture firms, and a global structural engineering firm. The hope is to understand the obstacles to utilizing mass timber construction and to identify either information to address those risks or spotlight areas where more study needs to be done.

RESEARCH



PARTICIPANTS IN THE STUDY

Since the scale of this study is limited, the approach was to include a variety of perspectives across the development and construction spectrum. With this breadth of disciplines, the hope is that this study will capture concerns regarding mass timber from multiple viewpoints and provide a balanced picture of mass timber in the current market. The intent is to then continue this investigation to include more participants and provide a growing body of information about mass timber in the marketplace, with a priority on concerns from owners and developers. Developers are the parties who take the biggest risk when considering using new technologies, and in the case of private developers, they have significant responsibilities to their investors. For this initial study, thoughts have been included from developers, general contractors, architects, and structural engineers, all of whom represent the various roles played in the development and execution of any construction project.

PARTICIPANTS INCLUDE:

Participant Name	Participant Role
Harvest Properties	Private Developer
Stanford University	Institutional Developer
Truebeck	General Contractor
Build Group	General Contractor
Lever Architecture	Architect
SmithGroup	Architect
Arup	Structural Engineer

QUESTIONS ASKED

The strategy for gathering this information was to capture each participant's thoughts and concerns about mass timber without leading them toward any particular response. The value of the responses is discovering what people in the construction industry honestly think about mass timber, regardless of any drive for technical accuracy. The whole point of this study is to understand how people perceive mass timber in the market now, because that will provide insight into what questions and concerns need to be addressed for mass timber to be successful. Questions were designed to be open-ended and were somewhat broad. This has meant some challenges to categorizing the responses; however, it will be demonstrated later how consistent some of the main issues are.

The structure of the questions took form in three categories:

1. Information about the specific industry and organization of the participant.
2. Information about the decision-making process for recent projects where mass timber was considered.
3. Information about the viability of mass timber for future projects and any perceived benefits or obstacles.

The first category establishes basic context for the information gathered. The primary interest is in the latter two categories about mass timber projects, with a focus on why mass timber would not be considered as successful option. It has been considered that separate questions about past projects and questions about future projects might provide an opportunity to reveal some lessons learned or questions that should have been asked in hindsight on past projects. The list of questions asked of the participants is included in the Appendix at the end of this paper.

INTERVIEWS/PROCESS

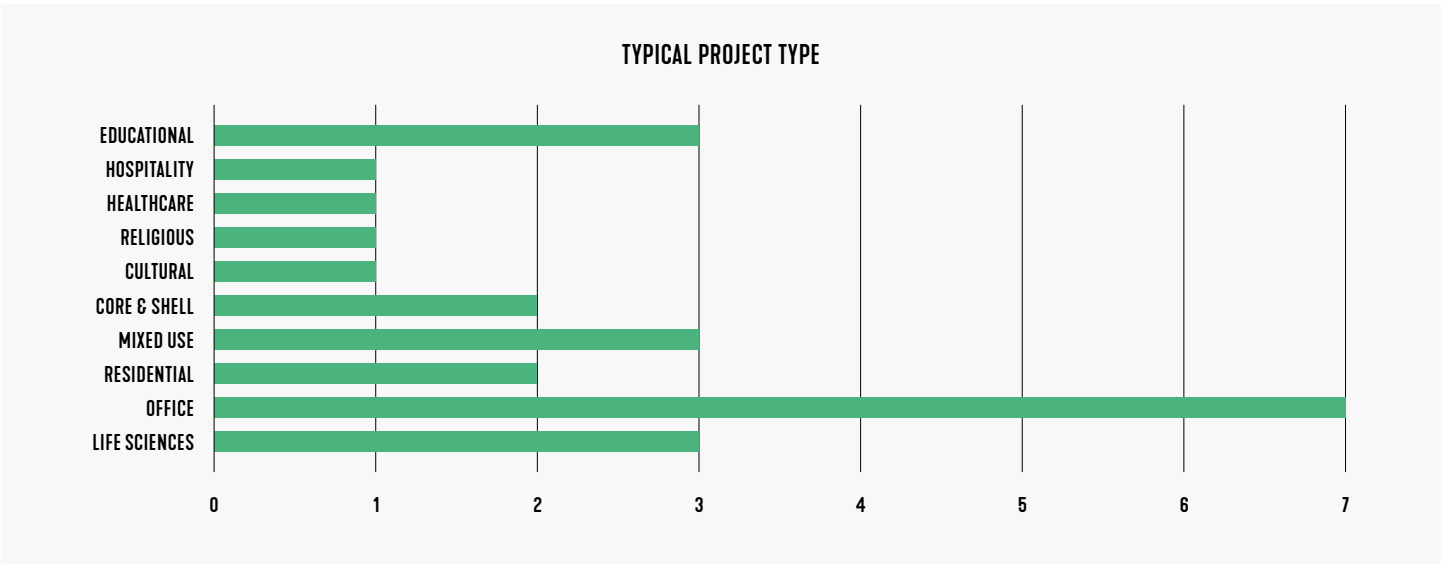
Interviews with the participants were conducted individually during October/November 2020 via video conference. Participants had received in advance the list of questions to be asked during the interviews, and those questions were discussed at the time of the interview. The responses to the questions have been logged following a review of the recording

transcripts to keep the responses as accurate as possible. Due to the nature of a conversation, not all answers were as concise or direct as might have been achieved through written responses. However, the hope is that the direct conversation may have helped to clarify some of the responses by allowing the opportunity to elaborate on certain points.

RESULTS & DISCUSSION

TYPICAL PROJECT DATA

To put the information about mass timber into some context, the participants provided some background on the projects that they typically develop. This information included project type/use, project locations, project size, typical construction system other than mass timber, the perceived advantages of these construction systems, and some supplementary details.



TYPICAL PROJECT INFORMATION

Leading the project type category were commercial offices, with all participants involved with the development with this kind of project. Nearly half of participants were involved with mixed use, educational, life sciences projects. One third of participants were involved with residential, or core & shell projects, and one participant focused more on cultural and religious projects. Of the participants, only 30% were involved with speculative projects, meaning that most of the projects developed were for the end user.

The locations of these projects were primarily in California. Projects located in Oregon followed second, and then equally in the US Midwest and East Coast regions, and continental Europe. This is due to the location of the participant group, and not reflective of the interest in mass timber in other parts of the US. However, it is important to highlight as regional and local considerations are mentioned frequently in the responses, so developers in other areas may provide other information than will be shown here.

Steel was heavily favored as the most common structural system used. Precast concrete followed second, and then cast-in-place concrete and light wood framing. These types of concrete were kept separate as they have different attributes

and benefits. It is worth noting that regional availability and regional costs were the main reasons why these systems were selected. For example, Portland, Oregon was described as having a very competitive concrete market that made its use more common in that location.

Advantages to these construction systems were described primarily in terms of material properties or construction considerations. Favorable material properties included flexibility and plasticity in building different shapes, the construction quality of the material or product, and structural efficiencies due to the material or its fabrication. Construction advantages included ease of use, familiarity of the material by construction teams, options for off-site fabrication, local availability, and relative cost.

Surprisingly, the subject of project sustainability was not aligned with any specific program. When asked about any specific green building metrics, such as LEED, WELL Building, Zero Net Energy, etc., none of these were a primary issue. The program mentioned most was WELL, with thoughts about being WELL-ready or using some of the program strategies, though none of the projects were pursuing certification.

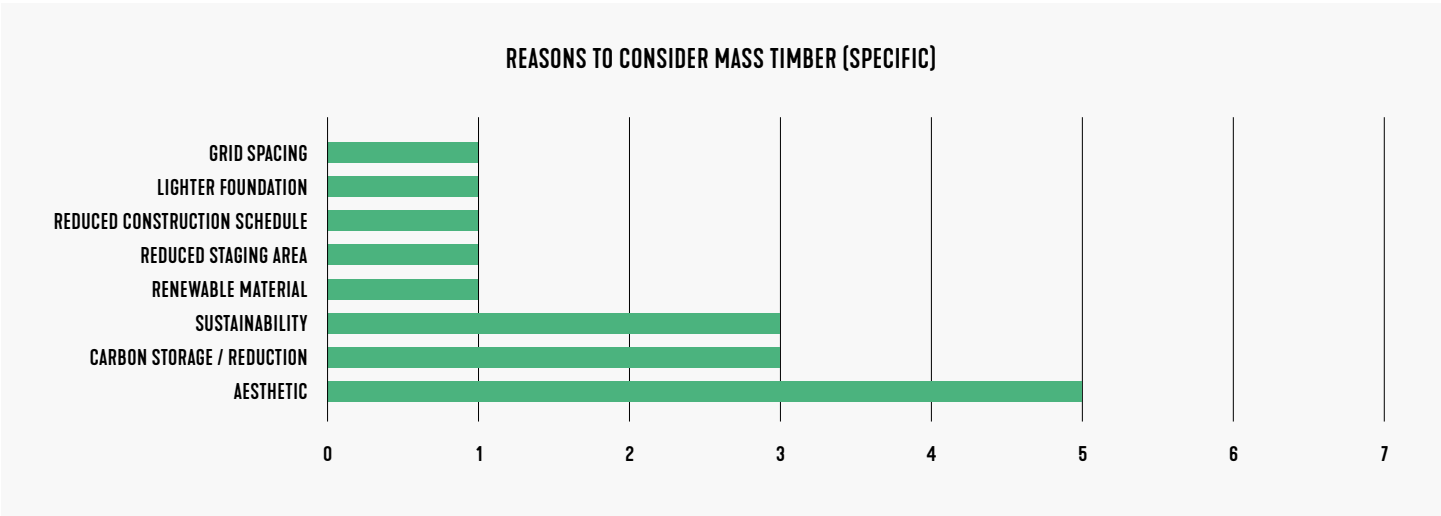
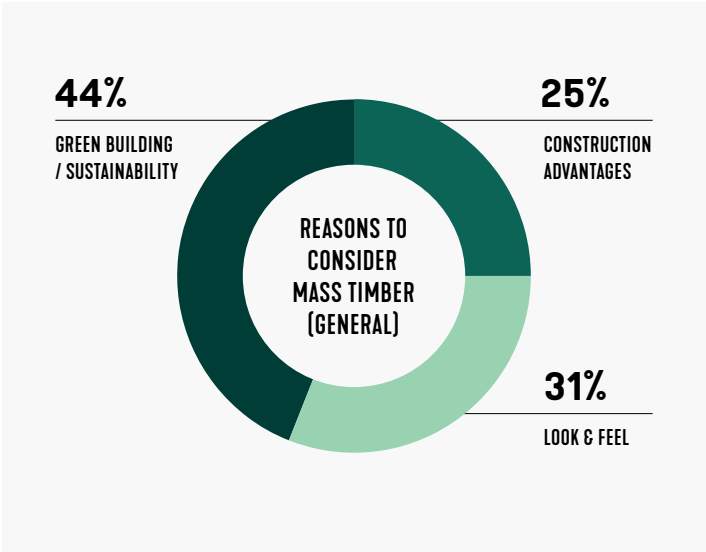
MASS TIMBER SURVEY RESPONSES

RECENT PROJECT INFORMATION:

The recent project information provides responses on projects recently considered for use of a mass timber system. The questions asked from the study can be separated into three categories:

- 1. Perceived advantages, or the reasons to use mass timber.
- 2. Perceived disadvantages, or the risks to using mass timber.
- 3. The primary reasons that mass timber was not pursued on the recent projects.

Both the perceived advantages and perceived disadvantages are considerations made while making the determination to use mass timber. The last set of responses provide the actual reasons for not using mass timber on these projects.



PERCEIVED ADVANTAGES OF MASS TIMBER, RECENT PROJECTS:

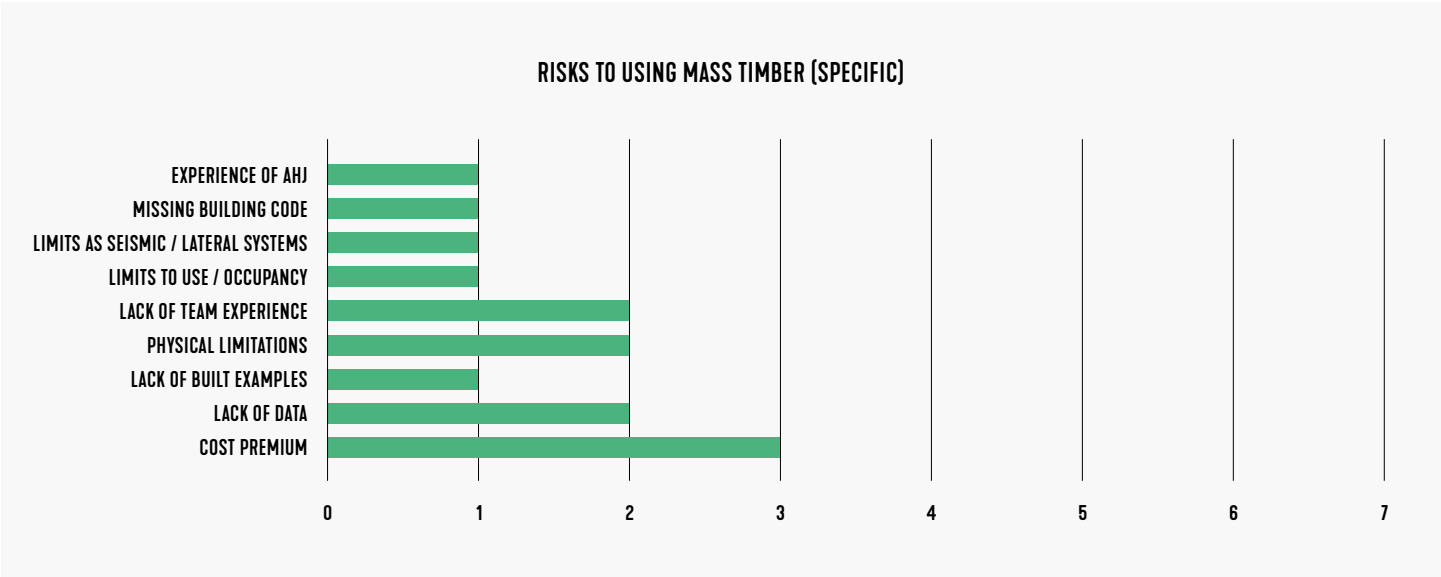
The reasons provided by the participants to why they were initially interested in mass timber as an option can be divided into three subcategories:

- 1. Aesthetics, or the look and feel of the product.
- 2. Green building characteristics, such as carbon sequestration or being a renewable material.
- 3. Construction advantages, such as reductions in schedule or lighter foundations because of system weight.

In terms of these categories, the greatest number of reasons for using mass timber were related to green building and sustainability, with the look and feel of mass timber, and construction advantages following in that order.

If these three global categories are looked at in more detail, they are divided into the following, specifically mentioned components. The aesthetics of mass timber takes the most prominent position, as a single defining quality. Green building is separated into three subcategories of carbon storage, general sustainability, and the renewability of the material. The ability of mass timber to sequester carbon is surprisingly pronounced as a specific characteristic. The subject of construction advantages is separated equally in the subcategories of reduced staging area requirements, reduction in construction schedule, the impact of the lighter weight of the timber to reduce the size of foundations, and the ability of mass timber systems to adapt to more efficient grid spacing.

MASS TIMBER SURVEY RESPONSES (CONTINUED)



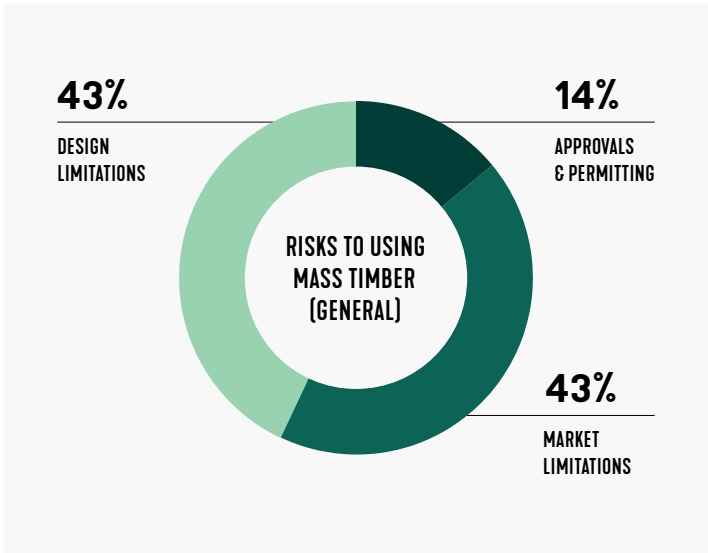
PERCEIVED DISADVANTAGES OF MASS TIMBER, TO RECENT PROJECTS:

The concerns expressed by the participants as reasons to not choose mass timber for their projects, the risks to using mass timber, can be understood in three global categories:

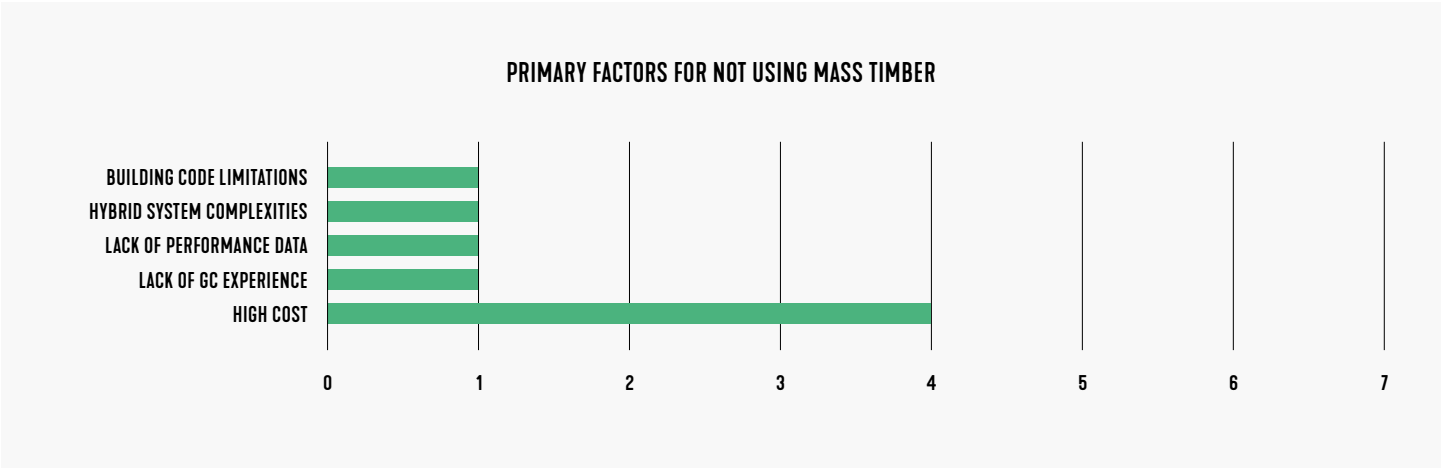
- 1. Market limitations, such as cost premiums or lack of market data.
- 2. Design limitations, such as perceived physical limitations to design solutions.
- 3. Risks to approvals and permits, such as building codes not including guidance for mass timber implementation.

Market and design limitations were identified as being the most concerning, with risks to permit approvals following.

Reviewing these categories in more detail, they can be divided into the following subcategories. Market limitations are led by cost premiums, followed by the lack of data to demonstrate market or performance values, and then by lack of built examples for market comparisons. Design limitations are matched in the subcategories of physical limitations, such as restrictions to floor-to-floor heights, and lack of team experience with mass timber. These limitations are followed by perceived limitations on occupancy types that can be housed in mass timber structures, with laboratories being highlighted as incompatible, and perceived limitations of the use of mass timber components as part of a seismic, lateral force resisting structure. The final category of approvals and permitting is equally divided between the lack of specific mass timber building codes and the lack of jurisdictional authorities having experience permitting mass timber projects.



MASS TIMBER SURVEY RESPONSES (CONTINUED)



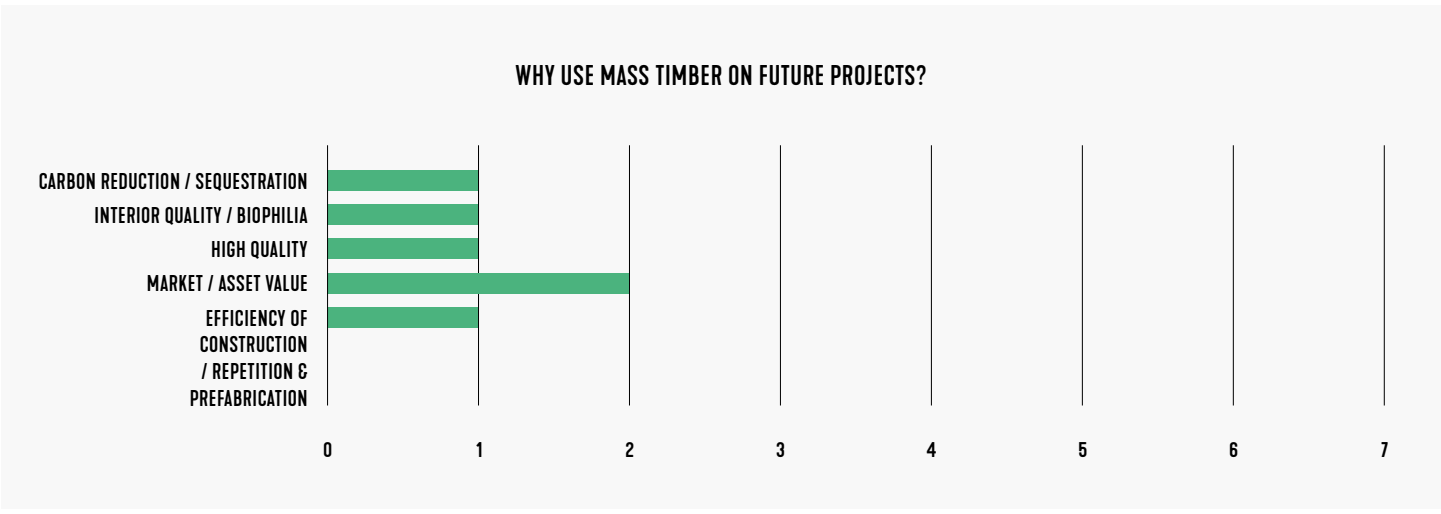
REASONS FOR NOT USING MASS TIMBER, RECENT PROJECTS:

When making the decision to use mass timber on a recent project, each participant performed some form of due diligence to make that determination. This included preliminary designs, review with jurisdictional authorities, and phase-appropriate cost estimates. This decision varied somewhat between participants in which phase of the project it was made. In some cases, this decision was made in the early conceptual design phase, others it was later during schematic design or design development. All participants stressed the need for making the decision as early as possible.

The final reasons for not choosing mass timber differ somewhat from the list of disadvantages previously identified. Worth noting is that about 38% of the projects went on to use mass timber. However, for those who did not use mass timber,

the primary reason was the premium price of mass timber over the costs of other typical systems. Reports indicated that mass timber came in anywhere from 10% to 30% higher than steel or concrete. The reasons for this price difference were not discussed and is something that could be studied in more detail. Regardless, this is a major factor and one that deserves attention when considering any new mass timber project. Additional reasons provided are all related to the lack of experience in the industry with mass timber projects, and they include the lack of experience by project builders, lack of experience of different trades working together with mass timber, lack of experience of building and code officials, and lack of experience with the performance of mass timber buildings over time and in the market.

FUTURE PROJECT INFORMATION



MASS TIMBER SURVEY RESPONSES (CONTINUED)

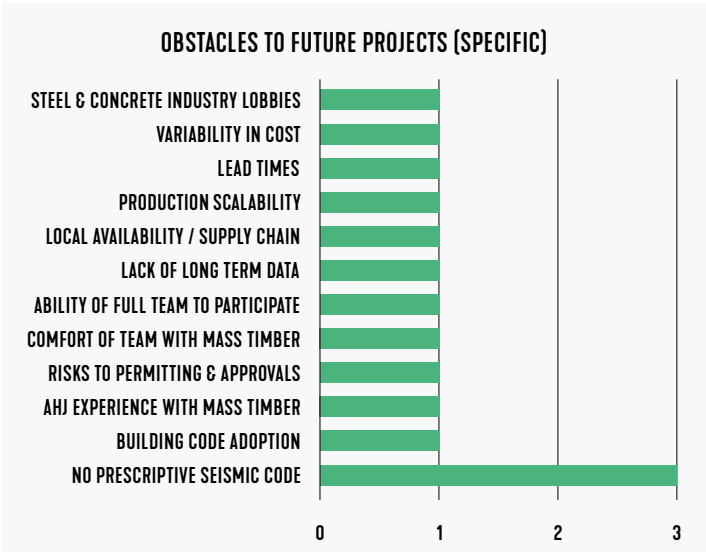
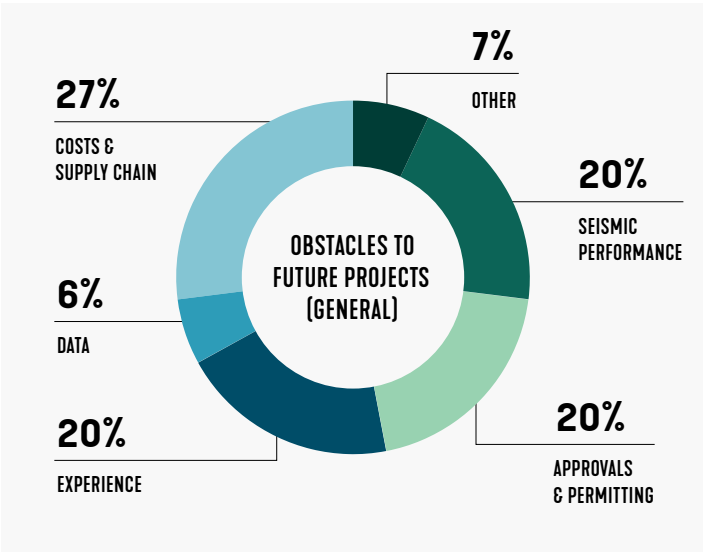
REASONS OF MASS TIMBER TO FUTURE PROJECTS:

When asked if any of the participants would consider using mass timber on a future project, 100% indicated that they would. When asked why they would explore this option the responses could be considered in five different categories:

- 1. The market value and asset value added by using mass timber.
- 2. The high quality of mass timber construction, or the perception that it is high quality.
- 3. The look and feel of mass timber and its contribution to project biophilia.

- 4. The efficiency of construction with repetitive, prefabricated elements.
- 5. Carbon sequestration inherent to mass timber and the lower carbon produced during fabrication.

All of these can be looked at through the lens of potential market advantages, targeting higher market desirability, higher asset value, and cost-effective construction methodologies.

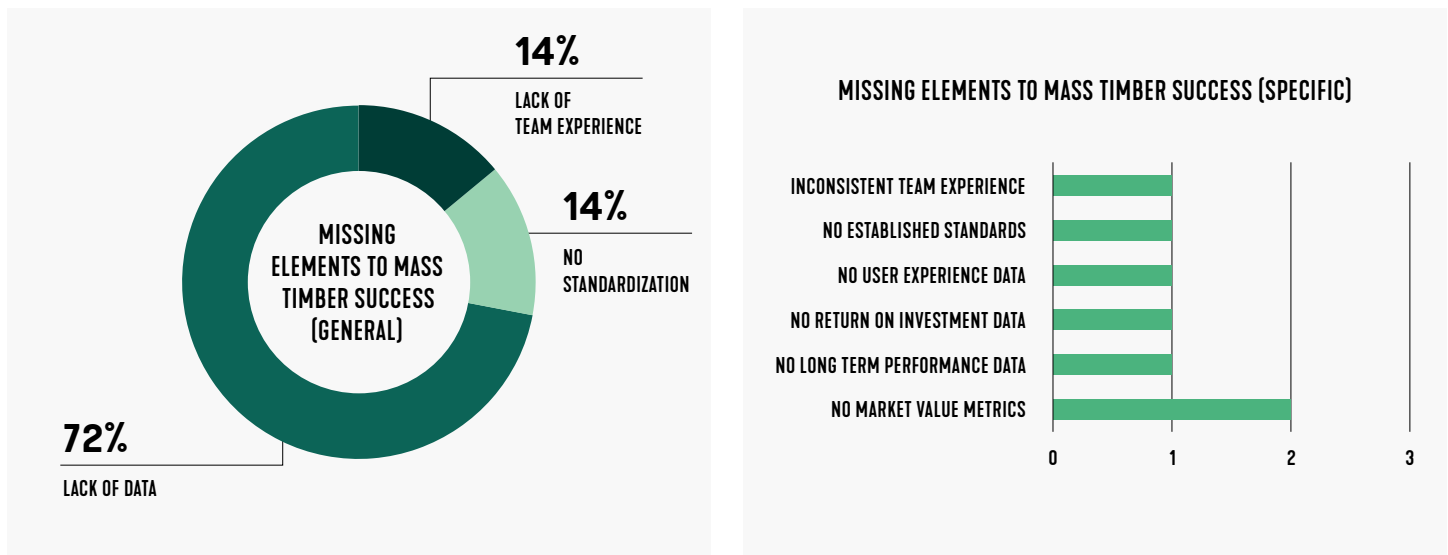


OBSTACLES TO FUTURE PROJECTS:

On the other side of this position are the potential obstacles to future mass timber projects. Participant responses were very similar to risks identified earlier, but with some clear differences. The lead concern raised was about seismic performance, with emphasis on the lack of a standardized, prescriptive code for seismic values as seen with steel and concrete. There is then a related category of general risks to project approvals and permitting, including lack of specific building codes, lack of experience of jurisdictions with regard to mass timber projects, and the associated risks to permit approvals and approval schedules that were unpredictable. The next category is regarding the experience of the project teams with mass timber, specifically in the ability of all team

members to fully participate, the general comfort of the team with the mass timber system, and lack of team experience and project data to support decisions around mass timber. Interestingly, the main difference in these responses from the previous responses are more specific concerns about cost and supply chain issues. These include questions about local availability, the ability of suppliers to scale production to meet demand, standard expectations for lead times, and the variability in the cost of mass timber and its effect on the predictability of the final cost. It was also expressed that there is some concern about the steel and concrete industries lobbying against mass timber as it potentially threatens their market share, which creates doubt around what information about mass timber is reliable.

MASS TIMBER SURVEY RESPONSES (CONTINUED)



MISSING ELEMENTS TO MASS TIMBER SUCCESS:

Finally, the participants were asked what they saw as gaps to the successful implementation of mass timber in their projects, where solutions could be provided. All the issues identified will be able to be solved if/when mass timber becomes more of a commonly used system or expertise is developed through hands-on experience. In general terms, these issues are:

1. Team experience.
2. Standardization.
3. The increase in available data.

The lack of data continued to be highlighted as a major concern. Data in this case can be understood in a variety of areas: data on user experience, data on system performance over time, data on ways to quantify the value of mass timber to a project other than construction costs, and data on the expected return on the investment in mass timber and any market premiums that could be expected. Team experience continued to be considered an important variable, with familiarity mass timber not common yet among all of the industry disciplines. Finally, standardized detailing and construction methods were seen as a missing component to predictability and ease of design for mass timber projects.

ACKNOWLEDGMENT OF LIMITATIONS

It is important to this study to acknowledge its limitations. The study is by no means comprehensive, since the pool of participants is still small. There are also only a small number of survey points, due to the limited nature of this initial study. Finally, the responses to the questions are subjective, and based upon the experience and opinions of the participants, with no request of reference material to substantiate any responses.

However, these issues are in accord with the premise of this study, which is to provide preliminary insight into the state of mass timber at this moment in the minds of the construction industry. The proposed next steps will hopefully bring the results of this study into clearer focus by adding to the number

of participants, offering the opportunity to refine the questions, and to shine some light on the critical questions about mass timber that need to be explored.

Having seen the responses to the survey questions, there are also a few structural questions that could be asked. For example, how important is it to focus on the recent vs future project advantages and risks? Is the way the responses have been categorized the only way to look at the information? Should the survey questions be revised and issued for written responses? This kind of self-critique will be necessary in the longer term. Any thoughts on these or other aspects of the study would be welcome if moves forward into another cycle.

ANALYSIS & CONCLUSIONS

If nothing else, there is a demonstrable consistency in advantages, risks, and obstacles to mass timber uncovered in this study, across the group of participants. While there are some slight differences in the way mass timber has been viewed between the past and future opportunities, there are some clear takeaways.

In the description of the advantages of mass timber, or what could be considered its most desirable qualities, the look and feel of the mass timber system is by far the most pronounced, single characteristic.

When looking at the risks to using mass timber, and this should be considered the global description of risks/obstacles/gaps to success, there are clear issues defined with costs and supply chain, experience and data, approvals and permitting, and seismic performance. If we consolidate and cross reference from the previous information, the list of primary issues to be understood are as follows:

- Costs & Supply Chain
 - Cost premium for mass timber
 - Variability in cost & predictability
 - Local availability
 - Scale of production
 - Lead times
- The lack of data
 - Market value and asset value
 - Return on investment

- Long term performance
- On user experience
- The lack of team experience
 - Design team experience
 - Construction team experience
 - Experience of disciplines working together
 - Industry experience and standardized construction
- Approvals and permitting
 - Specific building codes
 - AHJ experience / familiarity with mass timber
 - Risks to permitting due to unpredictability of review process and schedule
- Seismic performance
 - Can mass timber elements provide adequate lateral strength
 - Prescriptive building codes for mass timber seismic values, as with steel and concrete

The primary takeaway from this study, if anything, should be that in order successfully foster the use of Mass Timber we as design professionals must better support our clients to reduce their risks of adopting this construction system. Any ways that we can answer questions, educate, and create predictability in the use of Mass Timber for our clients will aid in this goal. If we can understand these issues and how to address them, we can support the successful realization of new mass timber projects.

PROPOSED ACTIONS

After review of the results of this analysis, it appears that there are some basic steps that can be taken to address each area of risk. These are just initial thoughts that can hopefully lead to the development of a more in-depth strategy. In a general, the strategy is to be prepared to address these risks head on and have as much information at hand to provide to your client. Suggestions for how to do this are as follows:

COST & SUPPLY CHAIN

If system costs and supply are a main concern, but are variable across regions, it stands to reason that the best course of action would be to develop and maintain local information about these issues in the region that you are working. Recent local projects can be identified and mined for any current data regarding cost, suppliers, etc. If no local projects are available the next option could be to expand your search to a wider area for other projects or contact some of the larger suppliers about what they know about your region. The point being, come prepared with as much information about your local market as possible.

DATA

Performance data and metrics for mass timber come more into focus with each new project. Groups like WoodWorks and ThinkWood, though sponsored by lumber associations still have some of the best and most current information. Regional suppliers are also one of the better options for having local data and should be able to refer to any local project examples and local project teams. Many construction professionals are interested in mass timber, so it may also be possible to identify peers and members of previous project teams who may have new information or have worked on mass timber projects already. The mass timber community is cooperative and open source minded. Everyone in it is interested in increasing the number of mass timber projects. Tap into this community for information and ideas.

TEAM EXPERIENCE

Team experience is one of the biggest issues raised regarding successful mass timber projects. Primary team members specifically identified as risks were General Contractors and Structural Engineers. Not everyone is interested in using mass timber, so if you are paired with either of these partners and they are not willing to take on the challenge they will most likely be a liability to the success of your project. Because of this, a good course of action would be to start forming your mass timber team now, even before an opportunity presents itself. That way you will be confident that your team will be interested and able to take on a project with the best possibility for success. And be comprehensive in your teams. Because of the prefabricated nature of the mass timber system, any accommodations or penetrations for elements such as pipes, conduits, or ducts require them to be thoroughly laid out and detailed prior to fabrication. That means that not only do your MEP teams need to have provided completed designs, but your fire sprinkler engineer, A/V, and any other discipline that would have any kind of penetration or other design impact on the structure will also need to have completed designs much earlier than would be required on a similar steel or concrete structure.

APPROVALS & PERMITTING

Because local jurisdictions all have their own approaches to permitting, by extrapolation they may also have their own approaches to mass timber. Depending on their familiarity with mass timber in the building and fire codes they may be more or less ready to review and approve a mass timber project. Again, a preparatory meeting with your local building and fire department is a recommended course of action, to discuss their familiarity with mass timber and if they have any specific concerns that need to be addressed. The more information that you can bring early to your client about the local approvals process, the better equipped they will be to set expectations.

PROPOSED ACTIONS (CONTINUED)

SEISMIC PERFORMANCE

The issue of seismic / lateral system performance of mass timber is important enough to separate out from project approvals. Mass timber is not yet included in the International Building Code as a prescriptive lateral system. If your intention to use mass timber elements in this way, the only path available for using it is through an Alternative Means and Methods Request (AMMR) process, which can be lengthy and expensive. More than likely a hybrid system will be required, which means introducing steel or concrete into the system to account for lateral forces. This will translate into needing to be prepared to factor in the added complexities of how this will work. Examples of this are the added cost of the steel or concrete, extra time for coordination, different construction tolerances for the different systems, and understanding the impact to construction sequencing and timelines. Some initial study into how these complexities have been handled on different build projects can provide insight into how this can be done effectively and give confidence to your client.

These are only a few ideas about how to address some of these issues. Again, the key strategy that is being proposed here is to be prepared in advance so that your team is ready to address these issues when they come up. The other piece of advice that was given by one of the study participants was to not push mass timber on an unprepared or unready client. Being prepared to reduce the risk exposure of your client if they use mass timber is only part of the equation for a successful mass timber project. There are still many unknowns. If we as architects push too hard on projects to use mass timber and they fail, we may see more lasting impact by pushing back the adoption of mass timber in mainstream construction projects. By listening and supporting our clients when mass timber makes sense is the way we will make mass timber succeed.

SOURCE MATERIAL

Pozner, Zach (Director of Architecture, Stanford University) in discussion with the author, October 21, 2020, 0:49:42.

Robinson, Thomas (Founding Principal, Lever Architecture) in discussion with the author, October 23, 2020, 0:25:52.

Albini, Jake (Construction and Development Director, Harvest Properties) in discussion with the author, October 30, 2020, 0:42:52.

Boyle, Patty (Vice President/Corporate Director of Architecture, SmithGroup) in discussion with the author, October 30, 2020, 0:26:20.

Edwards, Ross Jr. (Chief Executive Officer, Build Group) email message to author, October 30, 2020.

Bice, Betsy (Preconstruction Executive, Truebeck Construction) in discussion with the author, November 3, 2020, 0:34:44.

Koppitz, Jan-Peter (Associate/Structural Timber Specialist, Arup) in discussion with the author, November 4, 2020, 0:47:30.

APPENDIX

INTERVIEW QUESTIONS

I. BACKGROUND INFORMATION:

1. What does your company/organization do?
2. What kind of projects do you pursue?
3. Where are these projects located?
4. What are the typical sizes of your projects?
5. What are the development time frames for your projects and is construction duration a factor for the success of your projects?
6. What types of construction do you usually utilize for your projects and why: e.g. what advantages are there to the systems that you typically use?
7. Are these projects speculative? For sale or lease?
8. Are issues such as Zero Net Energy, Zero Carbon Footprint, sustainable building practices, healthy building practices, LEED or any other building metric important to your projects?
9. What role do you play at your company?

II. PREVIOUS MASS TIMBER EXPERIENCE:

10. What is your familiarity with mass timber construction?
11. Have you or your organization ever considered using mass timber construction for any of your projects? If so, what information can you provide about these projects?
12. If you have, what issues did you consider in determining if mass timber construction was appropriate?
13. What were the primary factors for using or not using mass timber?
14. At what phase in the project(s) did you decide to use or not use mass timber?
15. What were the primary factors that led to that decision?
16. What was the final decision?
17. Did you experience any issues with any jurisdictional authorities?
18. Did you experience any issues with the other project disciplines or parties: e.g.- architect, engineer, contractor, or client?

III. FUTURE MASS TIMBER CONSIDERATIONS:

19. Would you consider using mass timber on any future projects?
20. If yes, why would you consider mass timber? If no, why would you not consider mass timber?
21. Is there any information regarding mass timber that you feel would be important for clients or the construction industry to understand mass timber more successfully? What kind of information is lacking?
22. Are there any obstacles to using mass timber on your projects?
23. Do you know about the recent development of the Type IV building codes for the 2021 International Building Code for mass timber construction and its use for tall buildings? Will this make a difference in considering mass timber for your projects?
24. Are you aware of the early adoption of these new building codes in states such as Oregon, Washington, and California, and jurisdictions such as Denver, Colorado? Will this make a difference in considering mass timber for your projects?
25. Are there any other issues that you think would be useful to share about using mass timber?