2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
Host Sponsor UNC Charlotte
Paper ID #50951

Developing and Implementing a New Course on Mass Timber Design and Construction

Prof. John J Phillips P.E., Oklahoma State University

JOHN PHILLIPS, a registered engineer and Professor of Architectural Engineering, practiced as a structural engineer for nine years before returning to his alma mater to teach at Oklahoma State University in 2000. He teaches undergraduate and graduate level courses in building structures, and is a faculty member in the Integrative Design Studio capstone course for architecture and architectural engineering students.

Morgan Price Eubanks, Oklahoma State University

Morgan Eubanks, Senior undergraduate student studying Architectural engineering (Concentration of Structures) at Oklahoma State University. Interned at B+T Group in Tulsa, OK. Currently interning with Cyntergy, in Tulsa, OK. Co-Author on Developing and Implementing a New Course on Mass Timber Design and Construction with Professor John Phillips, PE at Oklahoma State University School of Architecture.

Developing and Implementing a New Course on Mass Timber Design and Construction

INTRODUCTION

The topic of Mass Timber is of growing interest to the AEC (Architecture, Engineering, and Construction) professions, and it is increasingly important that higher education addresses this building type as we prepare students for the future. In the past five years alone, there has been more than a 400% increase in the number of mass timber building projects under development and/or completed in the United States [1], and the number will continue to increase for the foreseeable future. Based on the growing popularity of this building system, a decision was made to offer a course on mass timber design and construction to undergraduate students within the Oklahoma State University (OSU) School of Architecture.

Developing a new course is a time-consuming effort, but one that is rewarding in being able to address the needs of the students, program, and professions. This course was developed as an elective for undergraduate Architecture and Architectural Engineering majors and explores how a mass timber building project should be approached from the standpoint of architectural design, engineering, and construction. This paper will give an overview of the origins of the course, provide a literary and program search for similar courses offered in higher education, outline the development process and interactions with AEC professions as the course was developed, and assess students enrolled on their knowledge before and after taking the course.

DEVELOPMENT OF THE COURSE

In the fall semester of 2024, it became apparent that with the increasing enrollment within the School of Architecture at OSU, providing additional elective courses to the program was needed to allow students to have choices as they worked through their educational career. The program serves both architecture and architectural engineering students, and elective courses in our program have greater success when they provide content that is of interest to students of both degree paths. With the advance of mass timber in the United States over the past decade, it is a topic that has made its way into several classes taught in the program, but that coverage is limited and by no means gives the students an overview of the systems and how they can be utilized in building design and construction. Additionally, mass timber is a topic that has been of interest to the author for some time, and the development of a class on the subject would allow for exploration and research into the system more fully while at the same time providing a valuable course for our students - But how to get this effort going, with the demands and responsibilities faculty are under, became the question.

Once discussions started within our program on the need for a course on this topic, three separate encounters helped jump start the development of this course. The first two were a pair of interactions with professional organizations promoting mass timber, occurring at the Architectural Engineering Institute Conference held in April of 2024 in Kansas City, and at the American Institute of Architects National Convention held in June of 2024 in Boston. It was at these events that the author interacted with representatives from WoodWorks and was encouraged to move forward with developing the course. WoodWorks is a non-profit organization that promotes wood use for building projects and provides free technical support and resources to those interested in wood construction. The resources and contacts to the mass timber industry that are accessible through interactions with the organization are impressive, and very helpful and informative. At both of the events the author was able to have long conversations pertaining to development of the course and was able to gain important contacts who helped during the development of the course.

Between those two events, an invitation was received to attend a Mass Timber Educators Workshop to be held at Auburn University in May of 2024. The author submitted for and was accepted to attend the workshop, whose sponsors included Leers Weinzapfel Associates Architects, Auburn University's Mass Timber Collaborative and Rural Studio, and the Softwood Lumber Board along with numerous others. This three-day event introduced attendees to the use of mass timber in building design and construction and how it could be taught in a college course setting. The event included lectures by educators and practicing professionals, tours of a timber mill and a glulam / CLT panel manufacturing facility, interactions with forestry experts, and visitations to several projects under construction or completed that utilize mass timber in the states of Alabama and Georgia. The information and resources gained by attending the workshop

Figures 1 - 3: Mass Timber Educators Workshop

were invaluable in the development of the course. Many questions were answered, and other topics that I had no knowledge of were discussed, all enhancing the development of the course. Both the author and students in our program are indebted to those responsible for putting on the important workshop.

It was the interactions with numerous people met and contacts made at these events that accelerated the development and implementation of the course. With the resources obtained, and with a summer to put together the course, the author jumped into the deep end of mass timber, signed up to teach a course on the topic in the fall 2025 semester, and began developing the course.

MASS TIMBER EDUCATION IN UNIVERSITIES

As development of the course began, a literature and program study was performed to better understand the existence of higher education courses that focus on the topic of mass timber design and construction. Mass timber construction is a significant shift in sustainable building practices, and Universities have become critical catalysts, as construction gains momentum across North America. Both the education and application of mass timber systems are advancing each year. This section of the paper analyses mass timber education programs at universities across the United States. Breaking down the successful approaches implemented by leading institutions and the challenges faced by programs in various stages of development.

LEADING UNIVERSITIES WITH MASS TIMBER PROGRAMS

The University of Oregon and Oregon State University both collaborate through the TallWood Design Institute. This is one of the most comprehensive mass timber education programs in North America. In fall 2021, the partnership launched a Master of Science in Architecture with a Mass Timber Design focus. In addition, an online graduate certificate in Mass Timber is offered consisting of 20-21 quarter credits through Oregon State University [2]. This joint program allows students to cross-enroll in courses at both institutions and is supported by a $1 million NSF Regional Innovation Engines grant and a $41.4 million Build Back Better Regional Challenge award. The program features state of the art facilities that include Oregon State's Emmerson Advanced Products Laboratory and Oregon Acoustics Research Laboratory [3]. Oregon's position as the nation's leader in lumber and plywood production provides geographic advantages as well [4].

Michigan State University launched one of the first mass timber construction management courses in the U.S. in Spring 2025, uniquely teaching from a construction management perspective rather than purely design [5]. The program's credibility stems from Michigan's first mass timber building, the STEM Teaching & Learning Facility, built in 2021 [6]. A National Science Foundation grant supports development of the facility as part of a national curriculum model. This curriculum is led by Professor George Berghorn who brings 20 years of construction industry experience [7]. The program emphasizes learning through field trips, guest lectures from industry leaders, while also understanding chain analysis.

Auburn University’s program spans from the College of Architecture Design & Construction, College of Forestry Wildlife & Environment, and Samuel Ginn College of Engineering [8]. The program has received over $12 million in extramural funding, supporting facilities including an Advanced Structural Engineering Lab, Forest Products Development Center, CADC Research Shop with CLT press, and Rural Studio for full-scale prototyping [8]. Research focuses on blast resistant structures for the Department of Defense, hybrid steel-timber floor assemblies, and passive ventilation systems [8]. In an attempt to advance mass timber education, Auburn hosted the Timber Design Faculty Development Workshop in May 2025 [9], attended by the author.

UNIVERSITIES EXPERIMENTING WITH MASS TIMBER PROGRAMS

Several universities are developing their own mass timber programs, with each taking unique approaches to further education and research. Rice University has offered a graduate "tall timber" seminar since 2015 and received a $100,000 USDA grant to plan a five-story mass timber residential building [10]. The University of Arkansas has made efforts into mass timber education, dedicating the Anthony Timberlands Center for Design and Materials Innovation in August 2025. This $43 million, primarily mass timber building designed by Grafton Architects was named 2025 Project of the Year by The Architect's Newspaper [11] and consists of an 11,000-square-foot fabrication shop that serves as both an educational facility and research laboratory for construction methods. The University of Maine operates a Mass Timber Commercialization Center focused on reducing technical barriers for manufacturers, leveraging Maine's position as the nation's most heavily forested state [12]. Clemson features two campus mass timber buildings and has installed sensors for long-term performance monitoring [12]. These examples of universities exploring mass timber gives validity to the course at OSU.

SUCCESS PATTERNS IN MASS TIMBER EDUCATION

Analysis of leading programs reveals consistent patterns contributing to their success. Successful programs unite architecture, engineering, and construction disciplines within their courses. This implies that mass timber requires integrated knowledge across all of these fields. Direct connections with manufacturers, contractors, and developers ensure that educational content remains relevant to industry needs, while allowing students to gain exposure to professional practice. The vin diagram, shown in *Figure 4*, breaks down successful patterns that leading universities, and the program at OSU are experiencing to form successful mass timbers program.

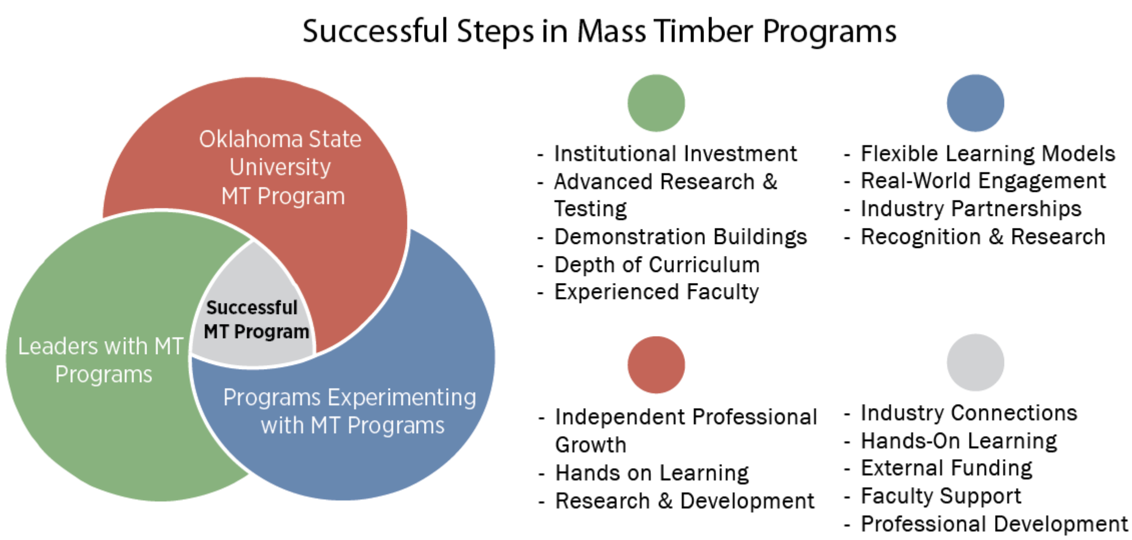

Figure 4: Success Vin Diagram

Infrastructure on campus plays a crucial role in program success. Testing labs, fabrication equipment, and demonstration buildings provide hands-on learning that cannot be replicated in normal classroom settings. Michigan State's STEM facility, Auburn's Rural Studio, and Arkansas's Anthony Timberlands Center serve as teaching tools. These lead to attracting industry attention and validating academic programs. Financial support through NSF grants, USDA funding, and state economic development funds have been essential for launching and sustaining programs. This funding enables acquisition of specialized equipment, construction of projects, and support for faculty research. Programs also benefit from experiential learning opportunities including site visits, design projects, and guest lectures from industry leaders. Successful programs take advantage of local forest resources and industry locations. Oregon's lumber industry, Alabama's manufacturing plants, and Arkansas's timber facilities provide natural foundations for educational programs, with geographic location allowing programs to reap benefits and develop industry connections.

CHALLENGES FACING MASS TIMBER EDUCATION PROGRAMS

Although there are numerous successes, there are also significant challenges that are faced when implementing a mass timber program. Figure 5 shows a vin diagram analyzing challenges that leading universities, upcoming universities, and OSU have encountered and are trying to resolve and work around for success on this topic.

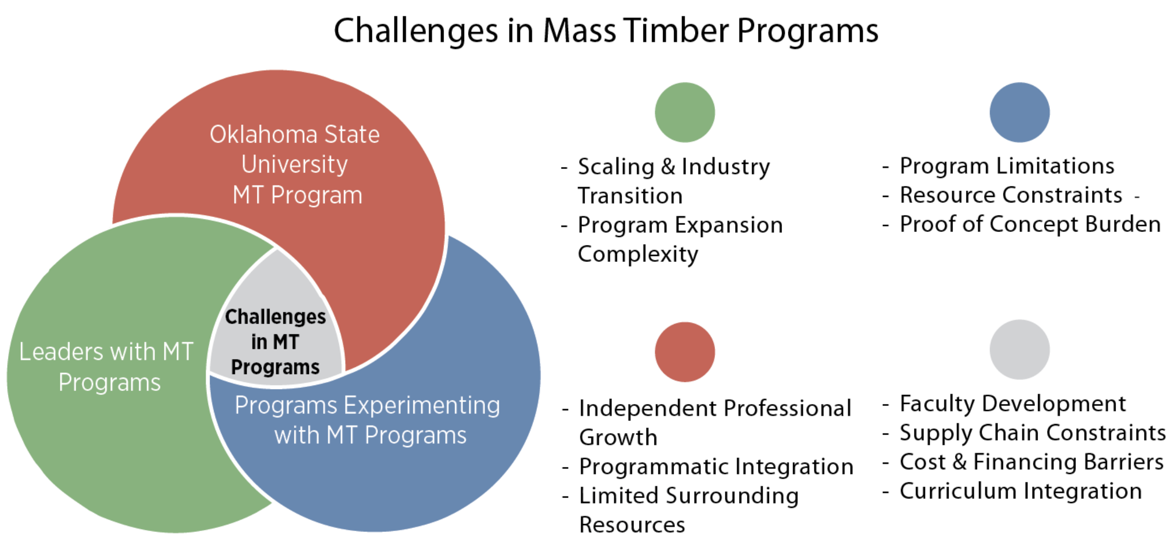

Figure 5: Challenges Vin Diagram

As mass timber becomes a more popular choice of material, the required education and training has increased. A survey conducted at Auburn University found that 80% of faculty need professional development before teaching mass timber courses [13]. Programs are heavily invested in the limited number of educators experienced on mass timber, with faculty development before launching courses being a solution to this issue. However, this lack of knowledge on the topic of mass timber can create delays and resource demands that some programs do not have the time or money to support.

The same survey conducted by Auburn found that 38% of institutions claim they have insufficient room in their existing curriculum, and this is a barrier to adding mass timber content in current curriculums [13]. Most existing courses are design focused, with virtually no programs offering a construction management perspective until Michigan State's recent initiative [5]. This disciplinary focus limits the comprehensive education needed to support mass timber adoption across the building industry. Designers and builders often show reluctance to adopt mass timber due to uncertainty about how to use it in practice [14]. Creating a problem where lack of expertise prevents adoption, thus limiting the demand for expertise development. Educational programs must address knowledge gaps through courses such as this course.

FORMAT OF THE MASS TIMBER COURSE

For the initial offering of the Mass Timber Design and Construction course, the format included a 16-week semester, meeting twice a week for 75 minutes each session. It was formatted to explore multiple topics associated with mass timber design and construction. Table 1 presents the topics that were covered in the course along with the number of class periods devoted to each.

TABLE 1: Mass Timber Design and Construction - Course Topics

Topics	# Class Periods		Topics	# Class Periods
Acoustics Performance	1.5		Impact Performance	0.5
Carbon Aspects	1.0		Manufacturing Process	1.5
Case Studies	2.5		Mass Timber Construction	2.0
Components & Systems	1.5		Moisture	2.0
Detailing	2.0		Guest Speakers/Seminars	3.0
Fire Performance	1.5		Structural Connections	1.5
Forestry	1.5		Structural Sizing	1.5
IBC Code Requirements	1.0		Thermal Performance	1.5

A point to note is that for some topics included in the course, it became apparent during development that they needed to be expanded and given more time and importance. For example, when the author originally thought the topic of moisture in mass timber would need no more than a few slides, it was quickly determined that the need to regulate moisture both during construction and throughout the life of a building is an extremely important aspect of the system. Another example of topic expansion is for two related aspects of building construction, acoustic and impact performance. What originally was to be an approximately 20-minute discussion within one class period grew to two days of the class - This was due to an initial lack of knowledge pertaining to these topics by the author along with the importance of the topics as they relate to mass timber design and construction. Information provided in the class included code requirements for multi-family construction along with expectations and methods of construction that can be utilized to enhance the performance of a building design. To some it may be obvious that these topics needed more prominence in the course, and upon hindsight the author tends to agree, but initial knowledge of the subjects did not place much priority on these aspects - In other words, I didn't know what I didn't know.

One aspect of the course format that was both new and encouraging was the various levels of students taking the course, and the fact that it was an elective course. Students allowed to take the course were third year and above Architecture (ARCH) and Architectural Engineering (AE) majors, with course content heavy on discussion, and less calculation based than the author was used to, which at times led to asking '*what is this class about*'? Keep in mind that the author teaches primarily structural engineering courses, which are calculation and design code heavy, so switching to an elective course with minimal calculations was a big change. The AE program includes a course on structural timber that the author has taught, but with opening the mass timber course to younger students and to ARCH majors, it was necessary and prudent to limit the calculations in the course. Additionally, the course was offered as a comprehensive look at mass timber design and construction, and many of the topics included did not lend themselves well to calculations. The overall concept for the course was to introduce students to the system of mass timber and what to consider in the design and construction process when utilizing this exciting and aesthetically beautiful system.

In the class, it was also thought important to include those from the architecture, engineering, and construction (AEC) professions to interact with the class. Originally formatted to include four guest lectures from the AEC professions, this first offering of the course was able to include three. Two of the presentations, from WoodWorks and from SmartLam, introduced students to an overview of the mass timber industry, and to the specific products available from

Figures 6 & 7: Guest Lectures for the Mass Timber course

manufacturers, respectively. A third presentation was by a group of architects and engineers discussing a project currently under construction that will be the new headquarters for their firm. The lecture went through decisions made by the firm to arrive at the mass timber design. Including presentations from professionals in the AEC industry was a benefit for the course, and their involvement continues to date with interactions that continue with the program.

STUDENT RESEARCH DURING THE COURSE

In the first weeks of the mass timbers course, the curriculum included introduction to terminology and types of engineered wood products. During lectures, images were used to represent the variety of mass timber products, and it was thought that having physical models would be advantageous to explaining the products. At about the same time, an AE student taking the course approached the professor inquiring if there were opportunities to be part of undergraduate research pertaining to mass timber. Funding was available to explore topics, and the student was hired to perform research centered on teaching examples for the course. The program has a material library open to students and professors for reference, and in many classes, professors are able to show exact materials being discussed to students. This method of learning allows students to hold a physical member in their hands, giving a better understanding of details, connections, and material characteristics, which cannot be accomplished successfully with just images. The material library only had sawn lumber and few other types of special wood products available but did not offer any types of mass timber products for reference.

Once hired on, the student worked with the professor by providing simple sketches and material lists with the idea of constructing models of various mass timber panel types. The program has a dedicated workshop for in-house research projects. Upon discussions, the idea of constructing multiple sized models was developed. Initially, scaled down versions of mass timber panels were to be built, for ease of handling in the classroom, and later on, full scale models would be constructed. The full-scale models are being planned and prepped to be built in the near future, and the scaled models were developed and constructed during the initial offering of the course. Five mass timber models were constructed, including a 3-ply cross laminated timber (CLT) panel, a nail laminated timber (NLT) panel, a dowel laminated timber (DLT) panel, a glue laminated beam (glulam), and an experimented doweled 3-ply CLT panel.

The initial phase of research involved determining an appropriate scale for the models. Considerations included portability and weight, while maintaining adherence to building code. After conducting preliminary studies and evaluating various scaling options, a 1:4 scale was selected as optimal. Instead of scaling down an entire panel size, it was decided to scale down the single planks of wood used to construct the panels. This was chosen due to panel sizes varying in the manufacturing process and allowed for a more appropriate model size. The scaled plank dimensions were compared to a standard 2×4. Multiple planks were cut to a size of 0.375" x 0.875" x 12" for the CLT, NLT, and DLT panels, with resulting panel sizes that are approximately 4.5” x 12” in dimension.

Selection of the proper material for the panels was considered, with factors such as durability, weight, ease with which to work, and finish quality. Craft wood like balsa, plywood, and basswood were taken into consideration. Basswood was the primary choice of material, consisting of smaller sheets already sized at the desired thickness of 0.375”, and with lengths of 24” that could be easily obtained. From this size, the planks were cut to the desired size, enabling consistency when producing individual pieces for the panels. These planks would be the starting point for each type of model panel.

CLT PANEL

Cross laminated timber (CLT) panels are a type of mass timber product made by stacking multiple layers of dimensional lumber perpendicular to each other and bonding them together with structural adhesive. Each layer is arranged in alternating directions with each layer rotated 90 degrees, ultimately creating a cross layered panel. This cross layering provides structural strength and dimensional stability in both directions. Twelve planks were cut for the strong direction, representing the primary load-bearing orientation, and thirteen shorter planks were cut for the weak direction, which would form the perpendicular cross-layer. Common wood glue was selected as the adhesive for this scaled model, providing plenty of bonding strength for demonstration purposes.

Assembly started with positioning of the six longer planks edge-to-edge, with adhesive applied uniformly to the narrow edges to form a unified panel section. This process was repeated to create two identical sections. These were used as the exterior strong axis faces of the panel. One strong-axis face was then positioned as the base layer, upon which the shorter weak-axis planks were placed perpendicularly [15]. Following the placement and adhesion of the transverse layer, the second strong-axis panel was applied parallel to the first base layer, creating the completed three-ply panel.

To ensure uniform pressure distribution across the entire panel surface, the CLT assembly was sandwiched between pieces of lumber with clamps. The panel remained secure for 24 hours to allow adhesive curing. The face panels were then sanded to achieve an architectural-grade finish. A completed model is shown in *Figure 8* below.

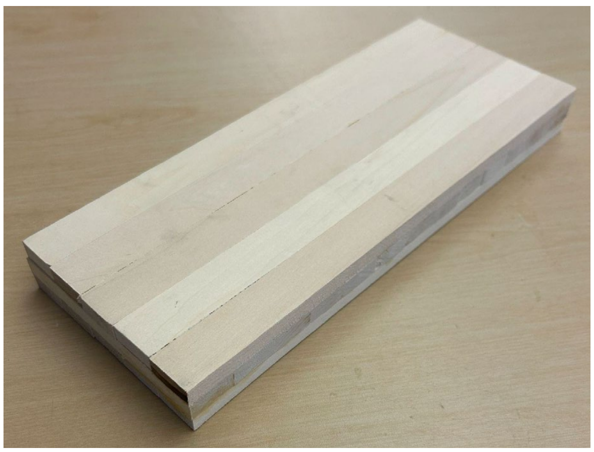

Figure 8: CLT Panel

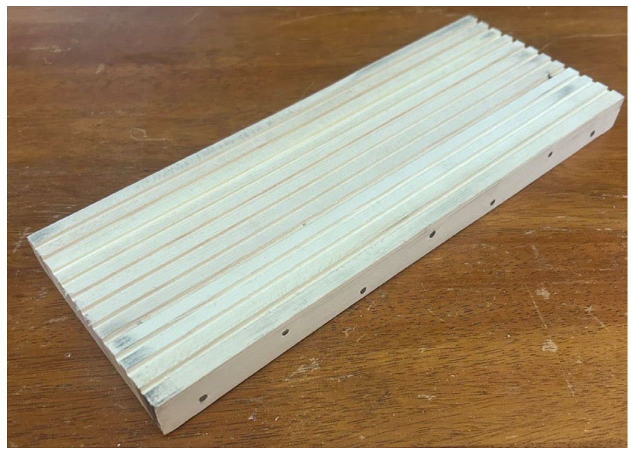

Figure 9: NLT Panel

NLT PANEL

Nail laminated timber (NLT) is a type of mass timber panel made by stacking dimensional lumber on edge and fastening them together with nails. They are arranged vertically and nailed in a staggered pattern to create a solid panel.

The model began with stacking two planks on their wide faces and securing them with clamps at both ends to maintain alignment. This provided clearance for nail installation on the wide faces, while preventing movement during hammering. The nail sizes for the NLT panels were derived from standard design specifications. Typically, 4-inch nails are used in full-scale NLT panels [16]. Applying the 1:4 scale factor to these sizes, equals 1-inch nails, and finish nails were chosen so the plank would not split when installing the connectors. While also maintaining the penetration depth for each lamination that is required in the NLT specification.

A single nail was driven at the midpoint of each two-plank interface. According to building code requirements for full-scale NLT applications, minimum longitudinal nail spacing ranges from 5 to 14 inches depending on connection type and load conditions [17]. Two standard nailing patterns exist: a single row configuration with alternating nail placement between laminations, and a double row configuration featuring two nails per interface with staggered positioning across laminations [17]. For this model, the single row alternating pattern was selected. Applying the scale factor, the minimum spacing for the model was calculated as 1.75 inches. Following panel assembly, the groves were processed using a table saw to create kerf profiles on one side. A 1/16-inch kerf edge detail was machined into the panel replicating decorative edge profiling. A completed model is shown in *Figure 9* above.

DLT PANEL

Dowel laminated timber (DLT) is a type of mass timber assembly that is also made by stacking dimensional lumber on their edge. However, instead of nails they are joined together on their sides with hardwood dowels. They are arranged vertically and friction fit hardwood dowels are inserted through predrilled holes. The dowels hold the lumber together forming a panel.
The first step started with stacking the planks on their wide faces and securing them with clamps. This provided clearance for the drill bit while maintaining the planks to stay in place. The use of an extended drill bit was used to completely drill through the wide face of the panel.

The dowel sizes for the DLT panels were derived from standard design specifications. Typically, ¾ inch dowels are commonly used in DLT panel construction [18]. Applying the 1:4 scale factor to these sizes, equals 3/16 inch dowels. Three holes were drilled with center-to-center spacing of 3.25 inches. According to building code requirements, the minimum spacing between dowel holes in full-scale applications is 8 inches [18] Applying the scale factor, the minimum spacing for the model was 2 inches. Similarly, the code mandated a minimum edge distance of 1.5 inches, scaled to 3/8 inch [18]. The achieved edge distance of 7/16 inch exceeded this minimum requirement.

Three 3/16-inch holes were drilled, and custom dowels with slightly larger diameters were fabricated to ensure a tight fit. Installation required gentle persuasion with a hammer to fully seat each dowel through the panel thickness. The panel then had structural integrity through friction forces transferring between the compressed planks and dowels. After assembling, the edges were cut using a table saw to create kerf profiles on one side. Similarly, a 1/16-inch kerf edge was machined into the panel, replicating edge profiling common in full-scale DLT panels. A completed model is shown in *Figure 10* below.

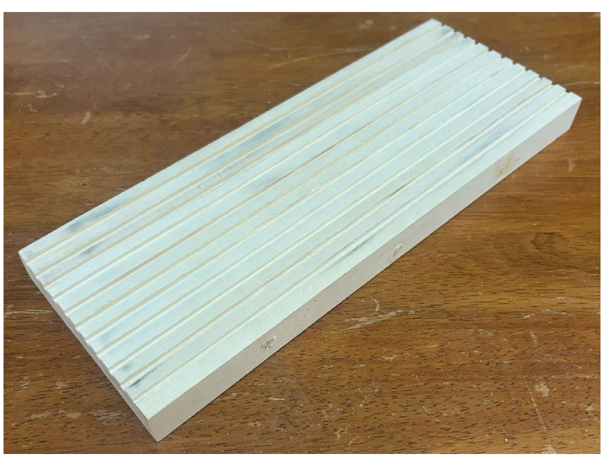

Figure 10: DLT Panel

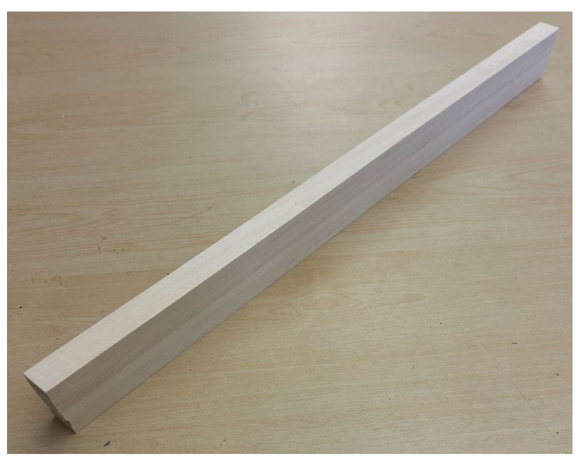

Figure 11: Glulam

GLULAM BEAM

Glue laminated beams (glulam) are a type of mass timber assembly made by adhering layers of dimensional lumber together with structural adhesive. These stacked layers form large structural supports like beams and columns. The boards are stacked horizontally with their grain running parallel in the same direction, then glued under pressure to create a single member. Glulam beams can be manufactured in a wide range of sizes, lengths, and shapes.

The first step included cutting the basswoods into longer planks. Instead of having the planks as 12” like the panel length, the length was doubled to 24”. This was done to emphasize that this member is designed to span long distances as if it were a beam or column. The width and height of each plank was still scaled down to an equivalent size of a 2x4.

Next, included gluing two planks together on their wide faces with wood glue. Multiple clamps and scrap wood were used to help allow the glue to bond evenly across the beams for 24 hours. Once the pairs were done curing, they were then all stacked together and glued once again forming a solid beam after curing for an additional 24 hours. Once the curing process was complete, the beam was sanded to an architectural grade finish for its final presentation. A completed model is shown in *Figure 11* on the previous page.

EXPERIMENTAL DOWELL CLT PANEL

The experimental dowel CLT panel has similar properties to the CLT panel already mentioned above. However, instead of using an adhesive for the panel to bond, multiple smaller dowels were used. Dowels would be pressed into the panel and the friction from the dowels would then hold the panel together without using glue adhesive. This type of panel does not have much supporting research or any design specifications to follow. A combination of CLT and DLT design standards were used to help follow as many specifications as possible.

Tape was used to temporarily hold the two sets of longer plank layers and the shorter plank layer in their respective places. They were then stacked on top of each other to start forming the panel. Clamps held the panel shape as a grid was drawn on the top layer. Each intersection point marked a drilling location for a dowel. This spot was at the middle point of all three layers. Sixty-five intersection locations were drilled to a 3/16” hole. Dowels were then inserted individually into each hole. For proper fitment a hammer was used to gently tap the slightly larger dowels into its respected hole. Once all dowels were seated into all sixty-five holes, the panel was structurally sound without the help of tape or clamps. Resulting in a layered panel held together with no adhesives.

Extra material of dowels was extended past the outer layer, not creating an appealing finish. With the use of a sander, the dowels were then flush with the outer layers leaving an architectural grade finish. A completed model is shown in *Figure 12* on the next page.

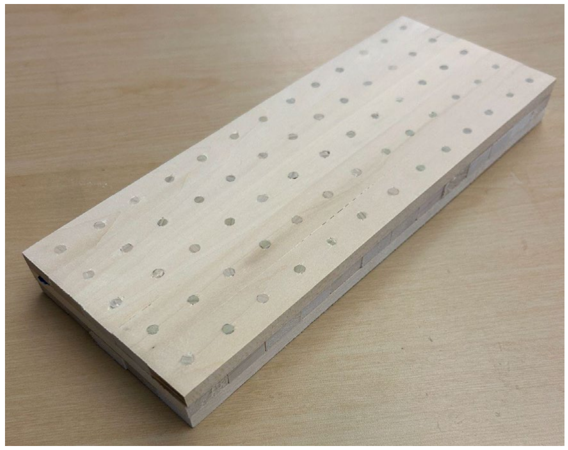

Figure 12: Dowel CLT Model

CHALLENGES

Challenges experienced in the creation of the models centered around how the automated manufacturing process has helped advance mass timber production. Automated manufacturing allows for faster production while also being more accurate and consistent, and this was a challenge for handmade scaled models.

The lamination process presented challenges in the CLT model. Particularly the alignment of perpendicular plank edges at layer interfaces. Slight variations in plank lengths resulted in uneven panel edges. A right-angle reference line was marked on the panel's perimeter, and a bench sander was used to achieve flush edges. The primary challenge when constructing the NLT and DLT models was the absence of a manufacturing jig. This would have enhanced accuracy and repeatability throughout panel fabrication when layering planks.

THE NEXT STEPS

As mentioned, the creation of full-scale models emphasizing common and special connections are the next step. However, detailing and development has not taken place at this point. A common request for the full-scale models involved connections to be interactive with each other, as if it were a mass timber Lego set. Much of the feedback for the scaled models came from an exit survey conducted at the end of the fall semester. Students enrolled in the mass timbers course gave their own thoughts and opinions on the class as a whole and specific moments they wanted to improve.

STUDENT ASSESSMENT OF THE COURSE

Student assessment for this course consisted of two surveys - One at the start of the semester and one at the end. The initial survey asked for basic information about student majors, year in the program, and why students enrolled in the course. 34 of the 35 students enrolled in the course responded, and Figure 13 gives results from the survey. The majority of students in the class were 4th year architecture majors, with a good distribution of 3rd through 5th year students. The vast majority took the course because they are interested and want to know more about mass timber, and because they needed an elective course. It was interesting to note that 12% of the class has plans to work in mass timber related fields, and 21% of students are interested in performing research on the topic of mass timber.

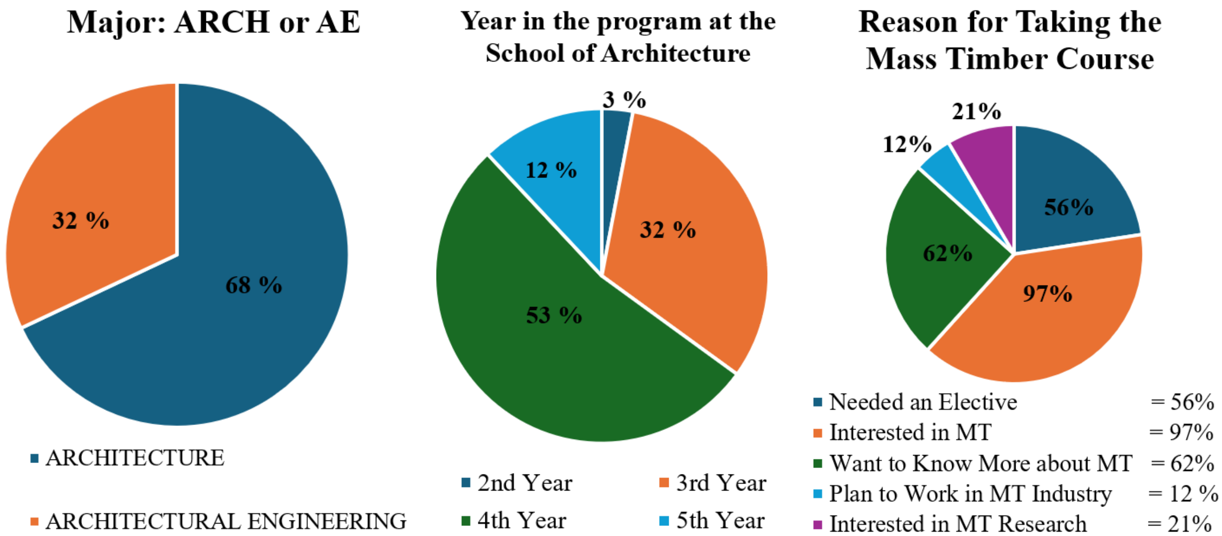

Figure 13: Start of Semester Student Survey Results

The second survey was more extensive and occurred at the end of the semester, delving into topics covered in the course, with students assessing which topics were important, the sufficiency with which each topic was covered, and what aspects of the course should be enhanced or added for future offerings of the course. In Table 2, topics that should be added to or enhanced in the course are covered - There is little surprise that site tours are at the top of the list, with the other five choices trailing significantly behind. Lack of support for projects in the course may stem from the large number of studio projects with which many of the students are already involved in their architectural design studio courses.

TABLE 2: Additional MT Topics	
Additional Topics to add to the Timber Course:	**Mass**
Construction Site Tours:	**1.68**
Additional Guest Lectures:	**3.29**
Product Presentations:	**3.41**
Additional Case Studies:	**3.71**
Class Individual Projects:	**3.71**
Class Team Projects:	**4.21**

Rank (1-6) of topics to be added to the course

Further survey questions involved the effectiveness and importance of topics covered in the course - All topics covered in the course were presented to the students to gauge their opinion on if the topic was covered sufficiently in the course, and also their opinion on the importance of the topic in a Mass Timber Design and Construction course. Results from this portion of the survey are presented in Table 3. For results to these questions, topic coverage and topic importance did

TABLE 3: Effectiveness and Importance of Topics		
Topics	Effectiveness of Topics Covered in the Course	Importance of Topics Covered in the Course
Acoustics Performance	2.26	2.85
Carbon Aspects	2.30	2.55
Case Studies	2.53	2.71
Components & Systems	2.48	2.00
Detailing	3.29	3.06
Fire Performance	2.35	2.27
Forestry	2.26	2.85
IBC Code Requirements	2.41	2.03
Impact Performance	2.41	2.65
Manufacturing Process	1.76	2.47
Mass Timber Construction	1.82	1.82
Moisture	1.88	2.39
Guest Speakers/Seminars	1.88	2.39
Structural Connections	2.82	2.75
Structural Sizing	2.56	2.40
Thermal Performance	2.44	2.66
	Complete Coverage 1 Enhanced Coverage 2 Adequate Coverage 3 Minimal Coverage 4 Lack of Coverage 5	Most Important 1 Moderately Important 2 Important 3 Minimally Important 4 Not Important 5

not always align. For example, the manufacturing process was evaluated as being the most sufficiently covered topic in the course but fell to but midpoint when considered for importance. The student surveys will be helpful as we look to enhance and improve the course for next year.

FUTURE ENHANCEMENT FOR THE COURSE

With the initial offering of the course now complete, reflection on how the class can be enhanced in the future included several ideas. Towards the end of the course, the authors decided to develop a survey to be sent to architecture, engineering, and construction firms. The survey asked the recipients to evaluate the perceived need for mass timber design and construction education in undergraduate architecture and architectural engineering programs, and the importance of topics to be included in a mass timber course. The survey was sent to 24 Architecture, 18 Engineering, and 21 Construction firms, with a total of 28 respondents. The survey asked if the firms feel that a course on Mass Timber Design and Construction is important for a School of Architecture to provide to students in the program. The results were very positive, with an average Likert value of 1.34 (1 being extremely important). A space for comments was provided, and it was encouraging on the number of firms that volunteered to be involved with the course in the future through lectures, workshops, and providing site visits to their projects. Additionally, the survey asked the firms to rank the importance of the 16 topics covered in the mass timber course - Results from that survey question are provided in Table 4.

TABLE 4: AEC Industry Survey	
Topics	**Importance of Topics Covered in the Course**
Acoustics Performance	3.32
Carbon Aspects	3.75
Case Studies	3.64
Components & Systems	3.43
Detailing	1.79
Fire Performance	2.25
Forestry	4.21
IBC Code Requirements	1.89
Impact Performance	3.32
Manufacturing Process	3.93
Mass Timber Construction	2.75
Moisture	1.96
Guest Speakers/Seminars	3.82
Structural Connections	2.86
Structural Sizing	2.50
Thermal Performance	2.39
	Most Important 1 Moderately Important 2 Important 3 Minimally Important 4 Not Important 5

Results from the AEC industry firms were a little different from the student survey pertaining to the importance of topics. Where students felt that construction and components & systems were of greatest importance, industry professionals felt that detailing, code requirements, and moisture were of greater importance. Also, the topics of Forestry and Manufacturing Process were those thought of as being of least importance - With the reputation of some of the firms that responded to the survey, it can be understood how these results could occur.

In looking at the survey results from students at the end of the semester, and from those in the AEC industry, several conclusions have been drawn for enhancing future offerings of the Mass Timber Design and Construction course, including:

- Increased focus on Case Studies: Though not thought of as greatly important by the AEC professionals, case studies do have educational aspects that allow a building design to cover multiple topics within a course. The idea will be to spread out case studies so that they occur throughout the semester and focus on specific topics that are currently being covered in the course.

- Inclusion of a Project: Though not one of the more popular topics from the student viewpoint, small individual or team projects can enhance the design knowledge of students. Projects would allow students to experience multiple design decisions that must be considered in mass timber building design.

- Detailing of Mass Timber Designs: For any course offered in the School of Architecture, any time detailing can be added to the topics covered, it will be of benefit to the students. Detailing involves many topics that fall into the course, from structures to fire to acoustic and impact performance, so including more attention to detailing in the course will help enhance most topics covered.

CONCLUSION

With the considerable growth in mass timber buildings over the past decade, and in the foreseeable future, it is important that graduates of architecture and architectural engineering programs understand how this system for buildings can be utilized and maximized in the design and construction process. With the development and implementation of this course, students are able to explore the material and understand the unique aspects of design and construction associated with this trending system. Through including a variety of topics, case studies, guest lectures, and hands-on examples of mass timber components, a comprehensive introduction to how this system can be successfully utilized in building design was presented to students in our program, with great success. By offering a course in Mass Timber Design and Construction, graduates of this program will be adept and ready to serve the needs and demands of the AEC industry.

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