

Mass Timber Construction Management

Introduction and Overview

This paper provides an overview of best practices from the WoodWorks Mass Timber Construction Management Program, including key resources such as construction management education, installer training opportunities, the WoodWorks Innovation Network and the forthcoming Mass Timber Construction Manual.

- [Construction Management Training](#)
- [Mass Timber Construction Manual](#)
- [Installer Training](#)
- [Find Your Team – WoodWorks Innovation Network](#)

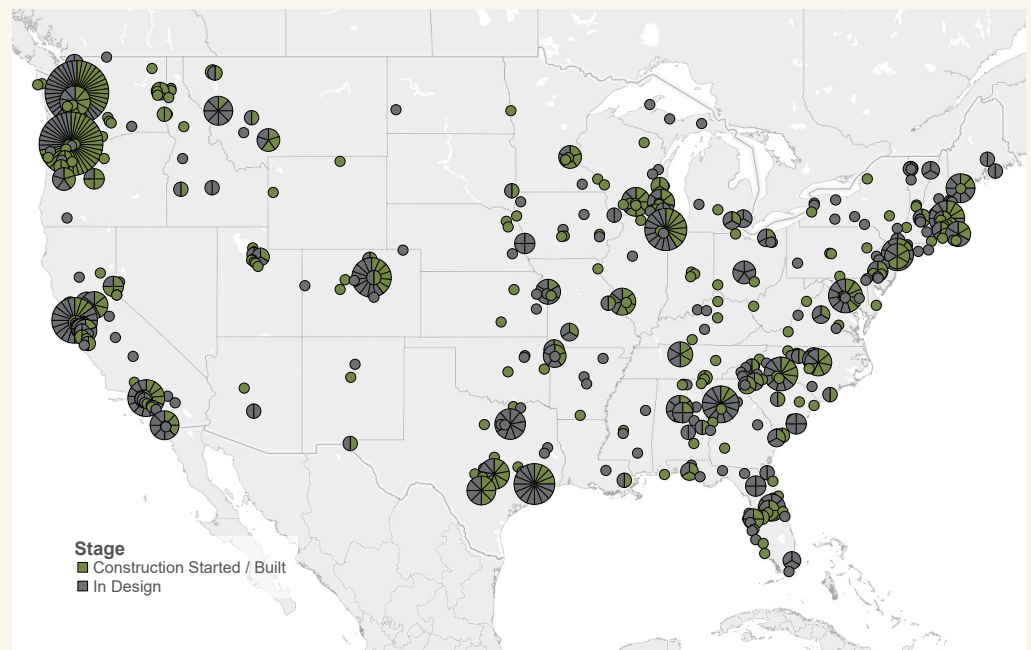
WoodWorks held the first CLT symposium in the U.S. in 2013 and, over the last eight years, has been on the front lines with project teams as they have considered mass timber for their building structures. As of December 2020, there have been 462 mass timber projects built in the U.S., and another 598 are in design. Considering that each year 17,000 buildings built in the U.S. could be constructed in wood but instead use alternate, more fossil fuel-intensive materials, there is significant opportunity to use mass timber to improve the sustainability of the built environment.

WoodWorks supports developers and design teams with education and free project assistance related to U.S.

commercial and multi-family wood buildings. The traditional WoodWorks audience has been primarily architects and structural engineers. However, during our work with these groups, we identified a gap, specific to mass timber, between design firms and the contractors who would ultimately build these projects. In short, contractors experienced with concrete and steel had virtually no experience with mass timber. This resulted in skewed pricing of mass timber to cover the unknowns, including risk and perceived liabilities. As a result, projects that could have been built in mass timber were constructed in other materials.

To address critical gaps in knowledge and skills among contractors and installers, WoodWorks created the Mass Timber Construction Management Program as a pilot in 2019, and has since expanded it significantly.

Mass Timber Projects in Design and Constructed in the U.S.



Above: WoodWorks tracks mass timber projects across the U.S. and publishes an updated map quarterly.
<https://www.woodworks.org/publications-media/building-trends-mass-timber/>

The program includes two distinct elements. Project management curriculum provides education for individuals who estimate, procure and manage new construction projects. A separate mass timber installer training program, offered in partnership with various entities, targets the crew leaders and installers who physically build structures on site.

WoodWorks Construction Management Training

General contractors have decades of project experience and historical cost data with concrete and steel structures. They know these structural systems inside and out. They have substantial subcontractor coverage for competitive and quality bids for both supply and installation. They know their business. However, when it comes to mass timber, they may have zero project experience, so everything is new. They have questions about constructability, available subcontractors and supply chain. When these questions go unanswered, it often results in contingency to cover unknowns and perceived liabilities.

Recorded presentations on the topics below are available online at <https://youtube.com/playlist?list=PLal7sjhZuOfYg99c3dlukdHa0GwiDzD3S>, providing asynchronous educational offerings to increase your knowledge base. WoodWorks has identified the following focus areas and corresponding best practices to increase construction industry proficiency in the estimation, procurement and management of mass timber projects.

These in-depth segments explore mass timber from design through preconstruction, fabrication, erection and project close-out. They offer an overview of mass timber products and sustainability attributes, as well as construction topics such as risk analysis, design team interaction, cost optimization, scheduling, site planning and other logistics. Intended for construction industry professionals looking to gain a deep understanding of the unique attributes of mass timber construction, they are intended to provide information needed to successfully bid and construct a mass timber project.

Risk Analysis & Scheduling Approaches

Mass timber construction has gone from quaint to cutting-edge and is exciting architects, forest/wood economy boosters, and sustainable forestry advocates. However, as with any new technology, it takes time and education for workers to become familiar and comfortable with new construction materials. Choosing the right contractor for a mass timber job could not be more important, but it is challenging when the building material is new to the marketplace. This segment answers questions such as: How do you navigate the risk? Design-bid-build vs. design-build—what is the best approach for the project? Who can install the product? In many regions of the U.S., contractors and

subcontractors have little or no experience with mass timber. Should you use outside resources or your own internal forces? If using outside resources, which trades will you turn to for bids?

In union spaces, wood construction of any type means carpenters do the work. If the project also contains a lot of glue-laminated timber (glulam), that may mean a timber framer. Large framing contractors and timber framers could be a logical choice for mass timber installation. Mass timber manufacturers may also have resources for consideration. Because subcontractors have less (or no) experience with the product, you will have limited ability to vet them based on similar projects as would typically be the norm. In this situation, the prequalification process becomes even more important and more challenging. Pay attention to everything the process tells you, and act on it with appropriate risk mitigation to address operational and financial risks.

Many builders approach installation of cross-laminated timber (CLT) and other mass timber products using their own forces first. Internal performance may be desirable for several reasons. It advances the builder's knowledge and experience for future projects — i.e., it's an opportunity to really learn the product. It also leads to increased schedule control and provides the ability to adjust course as needed.

Watch the course video: <https://youtu.be/traVe7zx1CY>

Design Engagement: Building the Team and Managing the Design

The planning phase is key. The advanced use of modern planning and design technology tools is itself a potential risk mitigation strategy. With all that goes into producing prefabricated components like CLT, the need is much greater to “build it once.” There is little opportunity for value engineering or late modifications. Because of this, builders and their subcontractors are required to be more intensely involved in the planning phase, which requires more sophistication than the traditional workflow.

Early engagement of key subcontractors such as the mass timber manufacturer and MEP subcontractors are critical. If they are not up to the task, the burden of making the project buildable falls on the engineers and architects, and this is not optimal. A better result will be realized when all of the parties who will build the structure are involved in the earliest possible details.

Watch the course video: <https://youtu.be/wK5xhdMpTQI>

Site Planning: Logistics, Coordination, Safety and Site Management

Staging, crane use/safety, lift plans, installation-sequenced deliveries, temporary bracing, protection of materials and finishing/aesthetic repairs must be incorporated into the general contractor's Site Logistics Plan. Transportation issues can be more than just an inconvenience; they can also have large physical impacts. CLT transportation considerations

are like those of structural precast concrete. Different manufacturers can make different size panels and designers may be dazzled by the possibilities, but state or international permits and limitations on transport by Authorities Having Jurisdiction (AHJs) require serious consideration before the design is finalized.

Use of CLT should mean more manageable QA/QC. However, while site-based activities are simplified, the means and methods may be completely new to crews. Although ANSI/APA PRG 320: Standard for Performance-Rated Cross-Laminated Timber covers the manufacture of CLT panels, it must be understood and followed. Any manufacturing issue has the potential to be a large structural or repetitive defect. Jobsite safety is dramatically increased due to the prefabrication of CLT panels and the fact that pneumatic drills are usually the only power tools needed. Due to the prefabrication and seamless installation, site noise is also greatly reduced allowing construction in urban areas with minimal public disturbances. Additionally, construction using CLT can proceed year-round and is much less inhibited by winter conditions and precipitation than other systems.

Watch the course video: <https://youtu.be/dj41mmD-F2E>

Economics: Taking on Financial Responsibility

Wood products sold in North America typically offer advantages in terms of material and construction costs. In addition to ease and speed of construction, wood's relative light weight can reduce the need for foundation capacity, and most communities have a large pool of skilled tradespeople with wood framing experience, which minimizes delays and keeps labor costs competitive.

Mass timber's cost for materials and labor may be lower than traditional building materials. Why? This segment explains it. CLT is lighter, so it requires a smaller foundation. Labor demands for mass timber projects are also less. In a tight labor market, this can be significant. Prefabricated panels require fewer workers to place them on site, allowing for a shift of labor to the safer working environments of factories.

Watch the course video: <https://youtu.be/SURUKcrEs9Y>

The Designer's Role in Anticipating and Addressing Construction Hurdles

As wood design and construction continue to advance, how are designers taking ownership in creating new tools and strategies that anticipate and ultimately address construction hurdles that arise on a project? From design development to construction documentation, the designer has an opportunity to proactively mitigate common issues early on and play an integral role in addressing challenges that arise once construction begins. Identifying potential problems before they occur is vital and can be achieved in a myriad of ways.

Foundational tools that can ensure a project's success from the beginning range from creating a shared foundation of knowledge to evaluating code issues early on and leveraging

prefabrication potential. Once construction begins, the design team can implement new strategies to overcome hurdles as they present themselves. Ensuring the proper protections are in place and being on hand to address necessary field accommodations are just a couple ways the design team can help to minimize the impact of construction issues. In short, with an innovative, proactive and dynamic approach, designers play an ever-essential role in helping to realize a wood project's potential.

Watch the course video: <https://youtu.be/MTEf8kH8Z54>

Making the Case and Keeping Costs in Check

When embarking on an innovative construction technology, one of the biggest questions is how to estimate the cost. This is certainly true of mass timber, which requires a vastly different approach—from design through construction—than buildings made from other materials. With an emphasis on maximizing design and cost efficiency, this workshop provides an overview of key factors that influence cost during the different design phases of a mass timber project. Discussion includes how to achieve faster construction schedules and labor savings, which design decisions impact cost, and where coordination between designers (architects and engineers) and builders (general contractors, construction managers, estimators, fabricators, installers, etc.) is crucial to cost optimization.

Through a holistic approach to cost comparison, this segment discusses how to achieve value from mass timber projects far beyond a simple comparison of structural systems. It emphasizes project schedule as critical to the conversation about cost savings and economic viability.

Watch the course video: <https://youtu.be/rf5BB3prQz8>

Sustainable Forestry: Renewable Materials Storing Carbon

Contractors may not be aware of sustainable forestry practices and the benefits of using wood products from properly managed forests. This overview provides historical context for forest volume, forest growth, and perspective on North American forest product use. A major factor favoring the use of mass timber is its relatively light carbon footprint, as well other environmental attributes. This presentation helps connect what happens in our forests to the use of responsible wood products and carbon storage in the built environment.

Watch the course video: https://youtu.be/bdAoi_jita8

WoodWorks also offers ongoing live education. Registration and details are available at <https://www.woodworks.org/events-calendar/list/>. For live sessions, content is regionalized for the audience and generally includes the above sections and areas of instruction. Education is delivered by experienced professionals in design and construction who are engaged in this work throughout the U.S.

Mass Timber Construction Manual

The forthcoming *Mass Timber Construction Manual* will give construction professionals the information needed to plan, organize, manage and construct mass timber buildings safely and efficiently. It is intended to provide best practices related to bidding, planning, erection/assembly and finish considerations for contractors, tradespeople, installers and sub-contractors involved in mass timber projects. Its content will be useful to a wide range of construction professionals, to bridge gaps in knowledge between their own experience and the needs of mass timber projects.

Mass timber construction has similarities to other systems, but it also has unique attributes—and a complete understanding of the differences is crucial to establishing efficient construction methodologies. This manual is envisioned as a how-to for mass timber, from preconstruction through fabrication, erection and project close-out. After setting the stage with an overview of mass timber products and sustainability attributes, it addresses preconstruction topics, including a brief discussion on risk analysis and cost optimization, design team interaction, scheduling, site planning and other logistics.

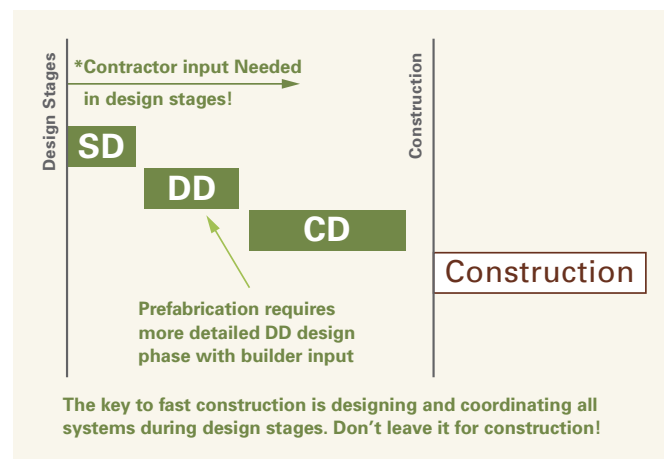
The installation section provides significant detail for on-site installation of mass timber elements including equipment, rigging, material handling connectors, types of connections, staging deliveries, installation techniques, and potential inspection requirements. Every contractor has their preferred means and methods, which are frequently modified based on project constraints. The manual is intended as an overview and guide with examples for insight and not as the only way to construct a building. There is no “one size fits all” solution, but there are techniques and methods that have been found to work better than others. All applicable jurisdictional and safety agency guidelines and practices should be incorporated as part of the overall project execution plan.

The manual is a first step in creating a set of understood informal guidelines that further mass timber’s acceptance and demonstrate “what right looks like.”

Focus Area: Early Engagement and Prefabrication Coordination

WoodWorks has published design and cost optimization checklists that were originally intended for building designers (architects and structural engineers), but many of the topics should also be discussed with the fabricators and builders. Outside of major market areas, AHJs may be unfamiliar with mass timber systems, and early pre-application meetings are also useful for aligning expectations and mitigating concerns far in advance of permit application. Stakeholders might include jurisdictional code, fire and planning staff along with the developer, contractor, architect and engineer. WoodWorks regional staff can offer support during this process and participate in these discussions.

Thoughtful consideration is needed when determining what prefabrication work should be conducted in the manufacturing plant vs. on site. This maximizes efficiency gains with mass timber but requires a higher level of preparation and attention to detail. It is a different process and requires a different approach to realize the full value. A best practice for mass timber projects is engagement of mass timber supplier(s), the general contractor and key subcontractors throughout the design process and even in the conceptual phase. This ensures that constructability and prefabrication coordination are considered as part of the design process.

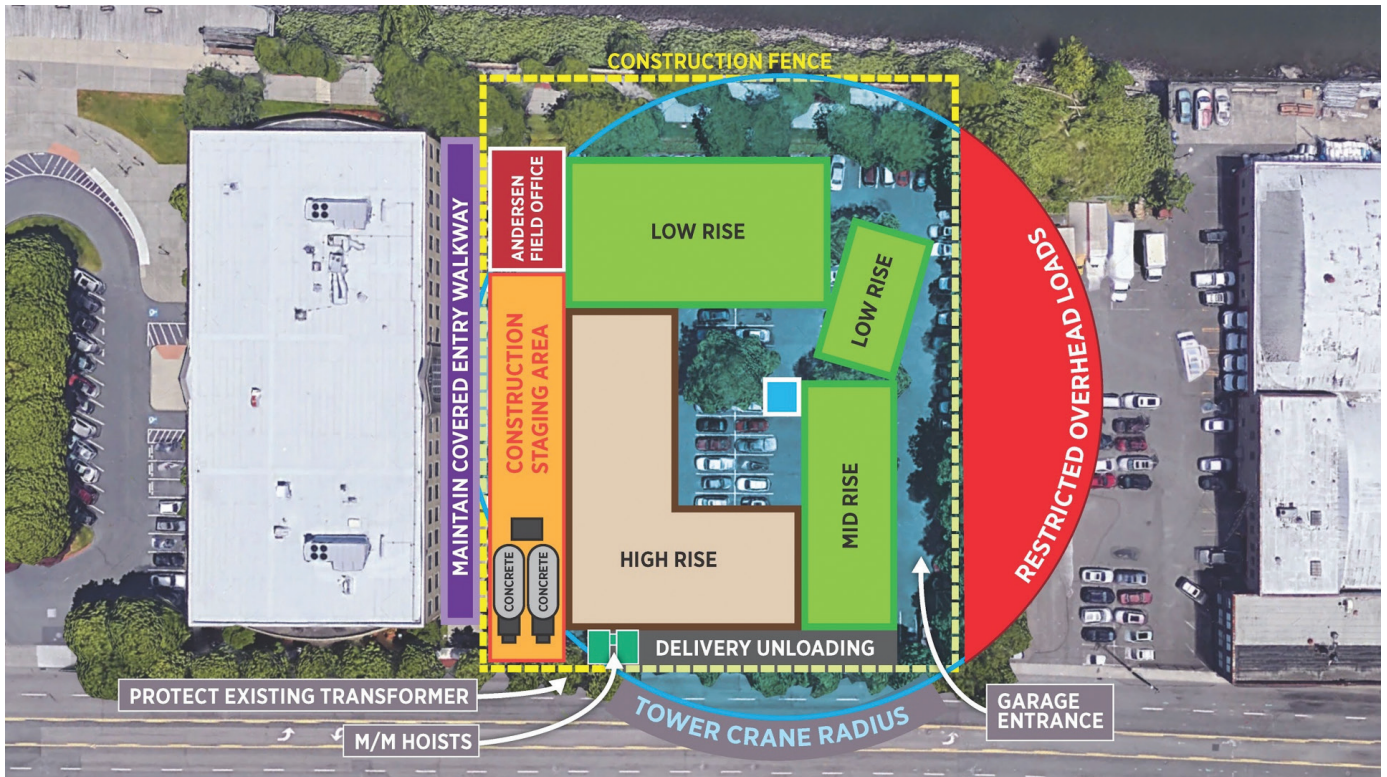


Above: Schedule compression and cost savings as a result of mass timber use and early engagement and coordination

Source: Adapted from WoodWorks' *Mass Timber Cost and Design Optimization Checklists*

The traditional design-bid-build approach without builder (and specialty subcontractor) input prior to the bid is not cost-effective and can reduce mass timber’s inherent benefits. Early coordination between designers and builders (general contractors, construction managers, estimators, fabricators, installers, etc.) is also beneficial as they are estimating and making cost-related decisions on a mass timber project toward the end of the Schematic Design and Design Development phases, and prior to the Construction Document phase.

Depending on the project location and contracts, field labor resources can be expensive and scarce and not as productive as an enclosed factory environment. It should be noted that all CNC router cuts require time to coordinate among the parties, input into the fabrication model and additional shop time on the CNC router. While there is time, cost and coordination necessary for efficient and effective prefabrication, these areas are orders of magnitude more complex when attempted in the field. Field activities also come with higher site labor costs, less precision, and increased risk of danger to installers and damage to materials. Early coordination and prefabrication mitigate many of these issues.



Above: Example site logistics plan for a mass timber project
 Courtesy of Andersen Construction

Pre-installation and post-installation material protection should be integrated into the construction plan and may impact design and fabrication. Often the mass timber material is both structure and finish, as the wood is left exposed. Moisture protection is often overlooked in traditional building but cannot be overemphasized for building with mass timber. It is critical that all parties understand potential effects of moisture and establish expectations as early as possible in the project, and have a clear understanding of the mitigation plans across the jobsite. Expectations and responsibilities should be determined during the procurement process and fully understood by all installers and sub-contractors who may have contact with installed mass timber. Water and rainfall are expected factors during construction, but one of the most important safeguards for a quality installation is preventing wet mass timber from becoming wet and dirty mass timber.

In addition to a robust and well understood moisture mitigation or protection plan, a similar plan must be put in place for installed material. Protection from damage from bumps, scrapes, gouges and other routine jobsite activities must be factored into the installation plan and shared across the jobsite. This is especially important if the mass timber is intended to remain exposed to showcase the natural beauty and biophilic effects of wood in buildings.

Focus Area: Site Planning and Coordination for Successful Installation Activities

Mass timber logistics should be discussed as early as possible when determining jobsite logistics plans. Planning for on-site delivery, road access, site conditions, overhead clearance and equipment requirements is typical for any construction project. Mass timber presents a few additional areas for the general contractor to address.

Depending on the supplier, mass timber components may be delivered on typical flatbed trailers, in shipping containers, or some combination of the two. In both cases, every attempt should be made to maximize efficient loading to reduce the number of times a piece is handled while also maximizing load content to reduce the overall number of loads required.

While the contractor will seek to maximize efficiency by requesting materials be loaded in reverse order (top panels install first while bottom panels install last) to accelerate field installation and minimize crane time, the supplier will seek to maximize shipping efficiency by filling the trailer or container to the maximum extent possible. If shipping cost is a risk (e.g., when using overseas sea-borne cargo) maximum trailer/container efficiency saves trips and therefore costs, but the trailers and containers are loaded for maximum freight utilization not erection efficiency. This will require shake-out of materials in the field and may require additional labor and/or additional heavy lifting equipment to maintain production on site.

Mass timber construction is unique as it requires installation and erection techniques commonly associated with traditional timber framing, structural steel and structural precast concrete. Where glulam beams and columns are installed much like structural steel framing, wall and floor panel installation often resembles structural precast concrete or tilt-up wall panel handling and installation. There are many similarities between structural precast concrete beams, columns, stairs and other components to both CLT and glulam products. Deliveries must consider the project schedule, sequencing and order of material installation. Other factors are site access, including the size and proximity of storage areas, and jurisdictional regulation of load delivery.

Individual mass timber components can be quite large so coordinating and understanding the potential constraints on the movement of finished pieces is important for proper planning and scheduling into and out of the construction site. For example, CLT wall panels may require pre-connection of temporary connectors or bracing based on the installed position and limited accessibility/stability when unhooking from slings. Flying panels from truck to installed position should be modeled, scheduled and understood by the general contractor or entity with formal control of the site. Efficiency of time saved during erection is lost if site cranes are monopolized during installation.

Continuous communication with the mass timber fabricators during fabrication and delivery phases will keep the project site well organized and the project moving along. Ensure that the fabricator is aware of the installation plan, desired delivery timelines, storage capacity on site, shake-out limitations, and any other hindrances to efficient delivery and offloading. Mass timber is a specialized product and requires care when handling to prevent damage. Unlike commodity products, mass timber that is damaged during transportation or erection is not likely to be available for immediate replacement; it was manufactured to fit a specific area and likely shipped to arrive just in time to keep the project moving.

Mass timber is a newer system in the U.S.; however, an experienced general contractor can quickly absorb requirements and execute successful projects.

Join the *WoodWorks Mass Timber Construction Manual* interest list by signing up on our website [here](#). The full manual is planned for release mid-2021.

Installer Training

“The need for a skilled workforce is crucial to delivering projects on time and under budget and the only way to create a skilled workforce is by training.” – Craig Triplett, Assistant Director of the Chicago Regional Council of Carpenters Apprentice and Training Program

Installer is used to define the individuals who complete the physical process of construction and assembly of structures on a construction site. It is also used to define those companies who are subcontracted, typically by the general contractor, to provide the labor and equipment to complete structure assembly.

WoodWorks-sponsored installer training is delivered by third-party training facilities. Union carpenter and signatory contractor training organizations have been the first to embrace the training of mass timber installers. The following training centers offer ongoing training to their membership, so whether you are seeking an educational opportunity to become a trained installer or looking to build a team of qualified installers, the following centers are a good place to start:

- Chicago Regional Council of Carpenters Apprentice and Training Program via <https://chicap.org/>
- Northwest Carpenters Institute of Washington via <https://www.nwci.org/>
- Pacific Northwest Carpenters Institute via <https://www.pnci.org/> (*Course in development*)
- Carpenters International Training Center <https://www.carpenters.org/itc/> (*Course in development*)

WoodWorks Installation Training Program Partners

Chicago Regional Council of Carpenters Apprentice and Training Program

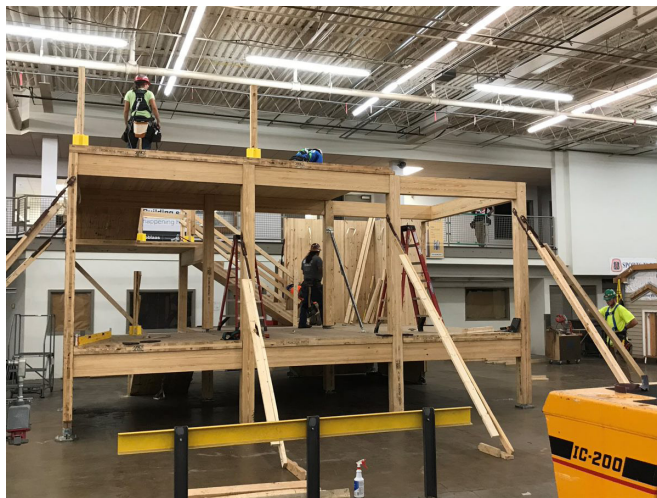
With growing interest in mass timber and tall wood buildings, WoodWorks partnered with the Chicago Regional Council of Carpenters Apprentice and Training Program to provide mass timber installer training to construction professionals in the Greater Chicago area. Intended to serve as a model for training across the U.S., the program is helping to ensure the availability of experienced construction professionals to meet increasing demand for buildings made from CLT and other mass timber products. Training is completed at the Chicago Regional Council of Carpenters (CRCC) Training Center in Elk Grove Village, IL.

The program provides classroom and hands-on training for pre-apprentice, apprentice, and journeymen carpenters. The CRCC represents 19 locals with over 35,000 working men and women in 72 counties in Illinois and Eastern Iowa. The CRCC invests in its members by providing programs and

classes so that the safest, best trained, and skilled workforce is at the forefront of technology to meet the employment needs of the industry, now and in the future.

The 32-hour training course provides an overview of the materials, means and methods used in mass timber construction. The classroom portion identifies the difference between a mass timber jobsite as compared to a concrete or steel structure including planning, virtual design and construction, prefabrication, delivery and installation. The course then transitions to the shop, where participants are issued iPads with the ProCore construction app to lay out the structure using the loaded structural and shop drawings, shoot elevation, rig, signal, hoist and erect a tri-level mass timber structure consisting of glulam posts and beams and CLT shear walls, decks and stair section all while maintaining a 100% fall protection protocol. WoodWorks procured a full-scale mock-up comprised of approximately 1,200 square feet of glulam and CLT to support this part of the program.

After completion of the timber installation, the participants install guardrails and stair rails at all leading edges. In addition to the glulam and CLT tri-level training structure, the participants gain hands-on experience working with smaller 4 x 4 SCL and mass plywood modules to install hardware from various manufacturers and receive instruction on the proper use of routers, various beam saws, and Mafell slot mortisers. In addition to an overview of fall protection, aerial lift and rigging as they pertain to mass timber construction, all participants receive the CCTC crane signal person training. (Source: Training program materials)



Above: Carpenters complete hands-on installation, connections and temporary shoring of mass timber components using the WoodWorks-provided mass timber mock-up at the Chicago Regional Council of Carpenters Apprentice and Training Center on 12/19/2020.

Photo credit CCTC Pat Sowers/Craig Triplett

The Chicago program awarded 2,656 training hours during its first 18+ months (as of 2/28/2021). The program will provide installer training to any journeyman-level union carpenter as well as companies signatory to the carpenters. Contact the training center at 847.640.7373 or via their website <https://chicap.org/>.

Northwest Carpenters Institute of Washington (Kent, WA)

The NWCI class is intended to develop the journeyman carpenter's ability to select and use the proper means and methods for assembling solid wood structures, specifically those using CLT. Fundamentals of solid wood, logistics plan development, rigging principles, handling and placement strategies, technical print reading applications, and site safety models are covered. Three major conceptual schemes comprise the focus of the course: planning for assembly, implementing the installation plan, and managing site variables. Although the major emphasis of the course is on effective installation, views on technique by class participants are also considered. (Source: NWCI)



Above: Carpenters use shop drawings and standard tools to prepare and assemble the WoodWorks-provided mass timber components at the 8/14/2020 installation training workshop in Kent, WA.

Photo credit: NWCI Steve Anderson

The NWCI awarded 136 training hours during the first 12 months of this training program (as of 2/28/21). COVID restrictions in 2020 dramatically impacted training programs in the Pacific Northwest and we look forward to an increased pace of training in the latter part of 2021 and beyond.

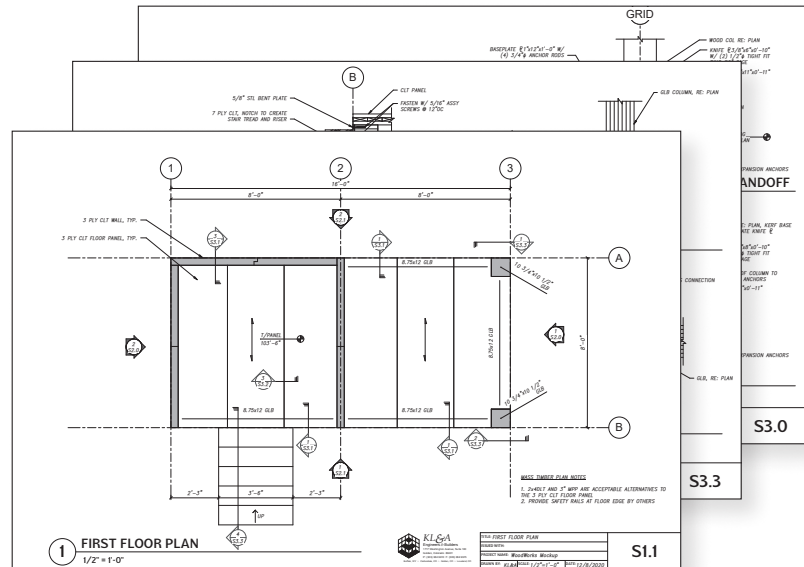
Pacific Northwest Carpenters Institute (Portland, OR)

This course is designed to introduce mass timber with an emphasis on CLT installation. Students will learn the benefits and limitations of mass timber and its application in new construction projects within the greater Pacific Northwest construction industry. Students will gain familiarity

with material types and components along with hardware, tools, and equipment associated with the safe installation of mass timber on active project sites. Participants will receive training in construction drawing reading/review and application of drawings with installation sequences, rigging, handling, placement and connections. Practical application of these techniques will be completed through hands-on use of the PNCI mass timber training mock-up. (Source: PNCI)

Program development has begun and agreement in principle has been reached between WoodWorks and PNCI for the procurement of a training mock-up. Training is expected to start in early 2022 or sooner.

Contact the PNCI at 503.287.3708 or via <https://www.pnci.org/>.



Above: Example of the WoodWorks standard mock-up drawings available for use in training programs

Carpenters International Training Center (Las Vegas, NV)

The United Brotherhood of Carpenters (UBC) and WoodWorks are in discussions to develop a train-the-trainer mass timber program for their Las Vegas, NV facility. The goal is to have an active training program in place by the Fall of 2022.

UBC’s world class training facility, the Carpenters International Training Center (CITC), is a state-of-the-art center used to train staff and instructors from the United States’ 250 carpenter training centers. UBC education and training advances leadership, skill, quality, productivity, safety and attitude with the goal of creating a constructive culture within the construction industry and providing a competitive workforce for our contractors and owners. (Source: UBC/CITC)

Contact the CITC at 702.938.1111 or via their website <https://www.carpenters.org/itc/>.

WoodWorks Mass Timber Installation Training Package

By year-end 2021, WoodWorks will develop a Mass Timber Installation Training Package for use by contractor training centers or construction companies. Using 8- and 16-hour formats, the curriculum will provide a training module framework for entities to use in the development of their own mass timber installation training programs.

WoodWorks will partner with and provide this information to any U.S. or Canadian party interested in developing an in-house training program. Potential training partners include construction associations, workforce training programs, and contractors seeking to train their in-house teams. With an “off-the-shelf” program available, WoodWorks will facilitate rapid expansion of mass timber installation training across the U.S.

In addition to education materials and building mock-ups provided for the training programs underway, WoodWorks has created standard mock-up drawings for use by others. These drawings will be an important part of the training package, contributing to robust and significant programs across the country.

Build Your Team with the WoodWorks Innovation Network

Having an experienced team can make all the difference to a building’s success. If you’re looking for a place to begin assembling your project team, the WoodWorks Innovation Network (WIN) is an online community that connects developers and design/construction professionals who share a mutual interest in and experience with mass timber. WIN is a place to meet mass timber professionals, including general contractors and installers who have both project and training experience. <https://www.woodworksinnovationnetwork.org/>

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