MASS TIMBER'S MAINSTREAM FUTURE: TRAINING, KNOWLEDGE, AND SKILLS DEVELOPMENT

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Cross-Laminated Timber (CLT) debuted in North America in early 2009, but it had been in Europe since the early 1990s. Although the first projects on this side of the Atlantic used materials imported from Europe, manufacturing began in 2010 when Nordic Structures in Quebec started providing structural mass timber panels.

Since then, the interest in and demand for mass timber products, especially CLT, has surged among designers, engineers, developers, and contractors. A structural material that could simultaneously serve as a finished surface and reduce environmental impact was well received.

But even the most attractive and well-designed building needs know-how throughout the value chain. The construction sector is, obviously, a crucial component. But mass timber construction was new, and at the start, the expertise came from craft sectors like log and timber frame crews.

Heavy timber buildings have historically been one-off structures constructed on the building site using logs, sawn timber, and, for the last century or so, engineered wood like glulam and nail-laminated timber (NLT). Workers were skilled in processing and installing the wood elements. Whether it was a temple in Asia, a log home in Maine, or a warehouse in Toronto, crews hand-built the structure, often hewing the material on-site.

Timber construction expertise came from working on-site and learning from trial and error. Over time, more formalized apprenticeship programs led to the accreditation of journeymen carpenters and master builders. This system remains in place today throughout much of North America, but mass timber construction skills are not a big part of it.

Scores of carpentry training programs are housed in colleges, trade schools, and technical institutions across North America. Most, however, are focused on the light-frame construction methods typical in residential home construction, low-rise commercial and institutional buildings, and increasingly in mid-rise projects up to 6 stories.

Very few programs in North America provide even a foundation in mass timber construction. There are some, but more are needed.

THE EUROPEAN EXPERIENCE

In Europe, training specific to mass timber has been incorporated into apprenticeship programs, mostly through on-the-job experience. Students at schools like the Bern University of Applied Sciences at Biel, for example, can get hands-on experience and a master of science degree in wood technology.

The university prepares wood industry professionals for a wide range of specialist and managerial functions through a mix of theory and practice,

THE TRAINING OFFERED BY THE MID-AMERICA CARPENTERS REGIONAL COUNCIL PROVIDES A SOLID FOUNDATION IN MASS TIMBER SYSTEMS, PRACTICES AND SAFETY AT THEIR FACILITY IN ROCKFORD, ILLINOIS.

Photo Courtesy of Craig Triplett, Mid-America Carpenters Regional Council

with experienced lecturers in an attractive educational environment. These new specialist skills, interdisciplinary teamwork, and a broad network throughout Switzerland lay the foundation for careers in fabrication, construction, and design.

Through apprenticeships at Höhere Fachschule Holz Biel, carpenters, timber construction specialists, sawyers, forest wardens, and other professionals in the timber trade expand their specialized knowledge in an application- and practice-oriented manner. As a result, they become sought-after specialists. The courses are continuously developed in cooperation with professional associations, commissions, and business partners, and are recognized nationally and internationally.

Another long-standing wood education program is in Rosenheim, Germany. Established in 1925, Fachschule Rosenheim has a long tradition of training wood technicians and merchants. Over time, what started as a technical school developed into a globally recognized training center. It is now a state school.

Both Bern University and Fachschule Rosenheim are key European participants in the International Wood Building Forum held annually in Innsbruck. The program has become a must-do for serious designers and builders of mass timber structures.

In addition to a long-standing tradition of institutional education, the professional carpentry trade in Europe has a strong and consistent apprenticeship program that includes mass and heavy timber construction skills. Most crews working in the mass timber construction sector are well versed in

mass timber manufacturers' software. Crews can work directly with panel design teams and manufacturers to provide detailed shop drawings, reducing time between design and manufacturing, and increasing the productivity of construction teams and manufacturers. Manufacturers can thus handle larger numbers of smaller jobs while still supplying large projects. One manufacturer in Europe produces mass timber panels for 1,100 projects every year.

UNITED KINGDOM

The Structural Timber Association (STA) represents the collective interest of its members by providing confidence in the use of structural timber across the construction industry. It works to influence legislation and regulation, supporting the collective objectives of its sector.

The association's principal objective "is to promote the use of structural timber in construction as timber presents our best opportunity for meeting the UK's net-zero commitments by 2050."

With this objective in mind, the association recognizes that the quality and standards of timber construction must be the highest. To achieve that, the association has developed both a training regimen and an accreditation system to show contractors, financial institutions, and insurance companies that its companies are held to high standards.

Training and accreditation taken under the quality assurance plan reassure the construction community that the association's members meet or surpass legislative and regulatory requirements. This accreditation is recognized by warranty providers, insurers, and other key stakeholders.

The 3-tiered accreditation program requires that 66 percent of the workforce of a contractor or installer of mass timber be certified as competent under the STA timber frame competency criteria.

The training program improves timber frame erectors' skill levels and acknowledges the competencies of existing timber frame erectors. The program sets industry wide standards for erectors and installers of structural timber frames. As part of the STA Assure quality initiative, members are required to complete three workbooks and an online test to examine practical and theory-based knowledge, which takes up to 1 year to complete.

CANADA

Carpentry is a voluntary trade in Canada, except in the province of Québec. Nonetheless, it consistently appears among the top 10 of more than 120 Red Seal trades in annual certificate completions. There are now over 53,000 carpentry completions in the 60-year history of the Red Seal program. (Officially known as the Interprovincial Standards Red Seal Program, it is a common standard for tradespeople and a partnership between the federal government, provinces, and territories). None of the programs requires expertise in mass timber. Only a few of the training institutions provide, or plan to provide, mass timber construction training.

BRITISH COLUMBIA

All apprentice and training programs in British Columbia (BC) are under the direction of the Industry Training Authority (ITA), a provincial crown corporation established in 2004 that is responsible for occupational training, recognition

of credentials, and funding. Thirteen postsecondary institutions have an estimated total of 2,000 "seats" in carpentry programs.

Of special interest is the introduction of a microcredential online course called "Introductory Studies in Mass Timber Construction" at British Columbia Institute of Technology (BCIT). The fee was fully funded by government, and the course was advertised to carpenters, ironworkers, quantity surveyors, construction managers, 3D modelers, developers, manufacturers, and designers. The fully online 5-credit course is open for continuous entry and takes 8 weeks to complete.

The course provides foundational training and covers introduction to mass timber construction, including cost estimating, digital project delivery, construction management, erection, installation of building envelope and services, performance, and visualization

In addition, in August 2022, BCIT launched a mass timber installer course. It grants an associate certificate in construction of mass timber structures. This program comprises 4 online courses and an in–person course at a new erection center at BCIT. Courses cover construction planning and rigging for mass timber; installation of mass timber structures; installation of building enclosures; installation of interior components and services; and a practicum on construction of mass timber buildings.

The BCIT course, like many mass timber training programs, is optional and not a requirement for a Red Seal (journeyman) accreditation. In BC, apprentice training decisions are dominated by the ITA. Mass timber is not yet part of the criteria, but BCIT's new mass timber introductory program may attract the ITA's attention and ensure mass timber becomes a future requirement.

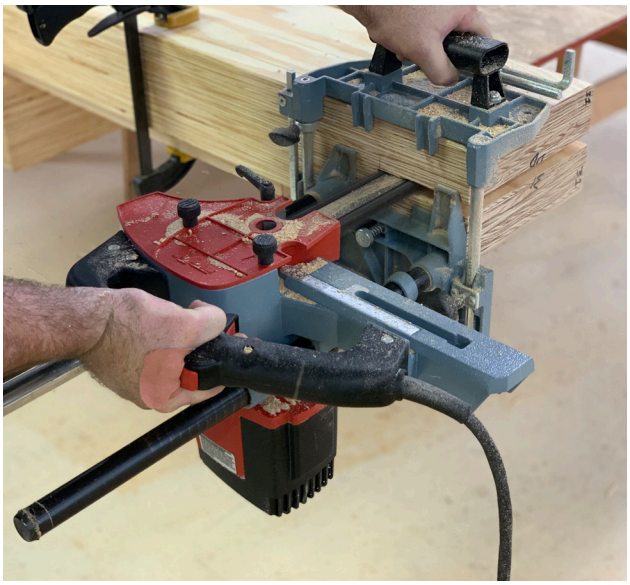
ONTARIO

In Ontario, the College of Carpenters and Allied Trades delivers construction skills courses under full-scale, site-simulated conditions in its state-of-the-art facilities in Woodbridge. The mass timber program had its first cohort in fall 2019. COVID-19 put the program on hiatus, but it is now back in operation.

This full-time, 4-week (20 days) mass timber course is an in-depth training program focusing on building with mass timber. The course includes an in-class component focusing on the characteristics of wood, and the forces applied, such as shear, compression, and tension. The course explores the advantages of using wood with a focus on sustainable building materials, carbon sequestering, fire resistance because of charring, and its other unusual characteristics. CLT, glulam, NLT, and other building options are introduced and discussed. Students study screws and fasteners, including the understanding of ductility, and determining fastener selection and placement from the drawings of the CLT modules. The rigging/signaling component takes 5 days and is also hands-on, working with a mobile crane and operator.

Tony Currie, director at Carpenters Union, has been involved from the beginning. Demand for mass timber is growing rapidly, but the number of skilled installers cannot keep pace.

"We need at least at least 100 trained journeymen. These are people that can lead the crew, not necessarily run the whole job, but oversee an installation crew," said Currie. "To do that, a



LEFT — MASS TIMBER CONSTRUCTION CONNECTIONS SYSTEMS ARE INCREASINGLY MORE COMMON — AND DIVERSE. HANDS-ON TRAINING FOR BEAMS, COLUMNS AND PANELS IS CRITICAL FOR ACCURATE AND EFFICIENT CONSTRUCTION.

RIGHT — SPECIALIZED EQUIPMENT IS OFTEN PART OF THE MASS TIMBER INSTALLERS TOOLBOX, BUT IS NOT ALWAYS INCLUDED IN TRADITIONAL CARPENTER TRAINING PROGRAMS — YET..

Photos Courtesy of Craig Triplett, Mid-America Carpenters Regional Council

worker needs to understand wood, the mass timber, the assembly system, the connections, safety, water, etc. And that's what we provide."

The 50,000-square-foot training facility can handle hundreds of students over the course of a year, but not enough people are taking advantage of this program. "Every trade is facing labor shortages," said Currie, "but if mass timber is going to grow, we have to invest in these programs and in our tradespeople to give them the necessary skills. And for that, we need to work together to get more students to go into the construction trades."

ALBERTA

The Southern Alberta Institute of Technology (SAIT) in Calgary has developed a certificate of competencies in mass timber construction management and sustainability. The program, which is under development, will provide 120 hours of training and include an option for hands-on lab practice, including assembly of mini-mass timber structures.

SAIT is also developing a program for existing practitioners, including these 3 microcredentials (MC):

MC 1: Mass timber products and building systems

- Module 1 – Mass timber as a building material
- Module 2 – Mass timber building systems

MC 2: Sustainable mass timber construction project management

- Module 3 – Sustainability and mass timber construction
- Module 4 – Construction management of mass timber projects

MC 3: VDC and AR in mass timber construction projects

- Module 5 – Mass timber construction in Virtual Design and Construction (VDC)
- Module 6 – Mass timber system assembly Virtual Reality (VR) or lab

UNITED STATES

TallWood Design Institute

The TallWood Design Institute (TDI) is a collaboration of educational, industry, and labor organizations that seek to expand the understanding, knowledge, and construction skills necessary to increase the use of wood in construction.

The Oregon-based institute has developed a certificate program in mass timber manufacturing and construction, a modular training program in mass timber manufacturing intended to help workplace and professional learners acquire the skills to understand and succeed in the sector. The program was spearheaded in large part by regional trade organizations with support from WoodWorks.

Although most of the course modules are designed for manufacturers, a few are relevant to both the design and construction of mass timber buildings. Like many programs, it includes an online and an in-person component, enabling greater outreach to practitioners and students remote from the training center and reducing time away from work.

TallWood has built relationships with some community colleges, again to reduce travel demands on students. Participants can take 1 or more modules based on their individual interests or learning needs, or they can complete the entire program to earn the certificate.

The courses offer introductory elements, such as the technical characteristics of different mass timber products and the ways they are best used; and more advanced components, including examining software used in manufacturing, design, and construction, and how mass timber construction processes differ from traditional. The program also includes key elements of efficiency, safety, and success.

Iain MacDonald, director at TDI, is cautiously optimistic about mass timber. "Looking 5 years down the road, I see a lot of opportunities for mass timber construction. However, the degree and speed of adoption of mass timber from its current niche status to mainstream is yet to be determined," he said.

MacDonald thinks the sector will need to have a diversity of project types that can serve as reference points for developers and contractors. "The sector will grow much faster if we can address the 2 big issues—fiber supply and workforce skills and numbers," he said. "The easier we can make it for the industry to find and retain interested workforces, the better off it will be."

MID-AMERICA CARPENTERS REGIONAL COUNCIL APPRENTICE AND TRAINING PROGRAM

As interest in mass timber construction grew in the Midwest, the Mid-America Carpenters Regional Council Apprentice and Training Program partnered with WoodWorks to provide mass timber installer training to construction professionals in Greater Chicago. Intended to serve as a model for training across the US, the program is helping ensure the availability of experienced construction professionals to meet increasing demand for buildings made from CLT and other mass timber products.

The program includes an introduction to mass timber concepts, with an emphasis on CLT. Topics include materials introductions, project planning, equipment safety and signaling, total station/e-drawings integration, site layout, rigging and handling, fall protection and safety, bracing and shoring, and making connections. The intent was to establish a knowledge base that equipped installers to work with CLT, Mass Plywood Panels (MPP), and glulam. Mock-up assemblies include 3 common joint types (lap, butt, spline), and training aligned with industry practices in rigging, connection hardware, and screw fastener installation. Virtual training for union contractors is available upon request.

Craig Triplett oversees the program out of the council's office and training center in Rockford, Illinois. He's also been involved in setting up more than 20 "train the trainers" programs—each 4 days long—across the country.

But even then, key barriers to mass timber installer training exist. "It is still a niche market, but as buildings come into the market, the contractor in that market will contact training centers. But if a training center is not close to where their project is, they can't afford to send people to take the course. It seems only the large national contractor companies can undertake the training otherwise," Triplett said.

"A lot of contractors don't yet know how to do things with mass timber. And if they don't know what they are doing, they cannot bid properly. Getting trained up and knowledgeable allows them to be more competitive in bidding," he said.

INDUSTRY PROGRAMS

In the absence of a comprehensive and available training network, many companies have undertaken their own internal training.

In 2010, when CLT first sparked interest in the construction sector, there weren't a lot of experts. Aside from educational institutions, most contractors had to learn from their mistakes and the experiences of others. But those first days of head scratching are paying off now for some of the early adopters in the construction sector.

Brendan Kelly, now field operations manager with Timberlab in Oregon, said he hit the mass timber experience wall early. "I didn't know what mass timber was 5 years ago when we got our first project," he said, "and there wasn't a training program anywhere.

"I had 18 years' experience as a formwork carpenter and had to take my knowledge of vertical and concrete deck buildings. It was a hard job—little experience or knowledge. All in all, quite frustrating."

Kelly took his experience with many of the elements—cranes, braces, and practical knowledge

ON THE JOB EXPERIENCE IS A CRUCIAL SUCCESS FACTOR AND A NATURAL EXTENSION OF CLASS ROOM AND LAB TRAINING.

WoodWorks

of general construction—and applied it to mass timber. "Over the last 6 years, we've really refined our skills. It's quite possible I may not even be doing it the right way, but it works for us. There's a million ways to skin these cats, and we learn something on every job.

"On a mass timber project you are exposed to some of the most dangerous elements of construction—height, heavy equipment, and cranes. It's not just how the building goes together, but we have to make sure our crew is safe.

"We also have to figure out what questions to ask. Since mass timber projects can be so fast, a safety event causes a big productivity loss. Our crews have to be very aware. When you are building fast, you can also get into trouble really fast."

One of the problems Kelly faced was designers' lack of understanding of actual mass timber construction practices. While the WoodWorks programs in Canada and the US have elevated the awareness and skills of architects and engineers, much is still to be learned across the whole value chain.

"One of the big challenges early on with these buildings was working with designers who may be designing things that cannot be built or are difficult to put together. That's changing, but as more designers take an interest in mass timber, their learning curve is going to be steep—just like ours was.

"We all screw up in our career, and we get experience from that. You don't know what you don't know. If you don't have experience messing up, you're going to."

Swinerton/Timberlab have a crew of about 30 people.

Job safety training is the primary objective. The secondary objective is to develop experienced

people who can be project supervisors on future jobs. "I want every single person advancing their career—from apprentice to journeyman to supervisor to replacing me! Having consistency of crews is paramount. We need to share our knowledge and experiences from every job."

Scott Cameron, general superintendent and mass timber specialist at Turner Construction Company, one of the largest general contractors in North America, agrees, saying, "We have to invest today in the training of the people who will be building tomorrow's mass timber buildings.

"Mass timber is demonstrating it is the next big thing in construction, and we need to allocate resources to build the capacity. And that means all of us—carpenters, contractors manufacturers, educators, government. We are all in it."

Cameron believes mass timber has proven itself to be good for the construction sector and good for the communities in which these buildings are being built. "Construction is quieter, is faster, has a smaller footprint on communities, The noise is less; site time is less. Our teams would be 1/3 the size of a concrete crew. And all of that matters when you are a builder or developer."

He sees knowledge exchange as crucial to the success of the entire mass timber community. "The mass timber community includes designers and architects. It needs to include carpenters, other trades, installations, developers—all with their own skill sets. Sure, it may seem like a risk to share what you think are your secrets. But we all had to learn from someone. The end results will be good for everyone—more manufacturing, more financially viable projects, more acceptance in the market, and more jobs.

"I'm hopeful that, if I can set the tone and share information from my company, it will be reciprocated at some point and a valuable information exchange can happen.

"The bottom line, from a business point of view, is a positive financial outcome. If you are the only one who knows what to do, it is not going to solve the problems a project will face when you encounter someone who doesn't understand.

"At this point in the growth of mass timber construction, the community needs to support and collaborate with each other. We need to share best practices, so that the systems become mainstream. If there are more installers and [general contractors] who understand it, the pricing will be better, and there will be more buildings."

There are consistent messages about mass timber construction:

- Knowledge sharing is essential.
- A larger and more skilled labor force is paramount.
- A strong commitment to, and investment in, training by government, educators, designers, manufacturers, and builders will bring mass timber into the mainstream the planet needs.

"I have a lot of passion for this," said Timberlab's Kelly. "My work through construction has been really good for me and my family. When you have a really good team and a good plan, you can make this stuff easy and be successful. The worst thing is trying to wing it. Training—and lots of it—is essential."