TallWood Design Institute: Oregon State and University of Oregon Unite to Test Tall Timber

BY EVAN SCHMIDT

As the author of "Wood: Craft, Culture, History" points out, wood is often perceived as so common that the layperson tends to underestimate its complexity, range of uses, and potential for innovative applications. I think it may have taken an entire year of my graduate studies in Wood Science and Engineering for my family to grasp that not only was "Wood Science" a real thing, but that I was also studying it. I remember the Thanksgiving after I began at Oregon State University, when my aunt politely asked me what it was that I was researching (with a strategically full wine glass), and I remember the next Thanksgiving when she timidly asked, "Wait…what exactly is wood science again?"

I don't blame her, it's difficult for most people to get excited about cellulose, or to see wood beyond its typical applications. What really made it stick for her, though, was to hear a story about wood science and engineering that always stirs intrigue: the story of

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CLTs are structural panels comprised of alternating layers of dimension lumber, laminated together at right angles.

tall wooden buildings. Often, I have seen dubious curiosity turn to true amazement as someone is led to understand that not only *can* we build 8-, 12-, and even 18-story buildings from wood, but that across North America we are in fact already beginning to do so. These tall, wood buildings use large structural wooden elements commonly referred to as mass timber in conjunction with, or in lieu of, conventional materials such as steel and concrete.

These mass timber elements have good strength-to-weight ratios, are easy to manufacture and machine, and are characterized by rapid constructability, good seismic performance, and visual appeal. Cross-laminated timber (CLT)—large structural panels made of wood studs laminated together in alternating layers of 90 degrees—has become the iconic product for this new building movement.

These buildings are more than just impressive feats of engineering. Wood's relatively low processing energy, high capacity for carbon sequestration, and resource renewability makes it a sustainable material alternative for building construction, an industry that contributes more greenhouse gas emissions than any other sector globally. Mass timber is rejuvenating interest in wood products because it tells a story that people want and need to hear: that with proper management of our forests and with innovative design solutions, there is a healthy and sustainable path forward.

"What about fire?" and, "Is it strong enough?" are a few questions people ask regarding use of wood in large buildings. In answering such questions, I try to first point to history—namely that wood has served as an excellent material in large-scale applications for millennia, and that engineered wood products have been around for over 150 years. The assembly room at King Edward VI College in the UK, as an example, has a still-standing glulam roof structure dating all the way back to 1866. And while wood is technically a combustible material, mass timber components burn much more slowly and predictably than light-frame hollow-wall construction because of how wood chars. Engineers have traditionally met fire ratings for glulam beams by adding additional material, i.e., a "sacrificial layer" of wood that is allowed to slowly char, and which protects the core structural area of the timber in the case of a fire. Massive wooden members perform so well in fire, in fact, that they can be used instead of a fire-retardant foam to protect steel elements from exposure.

A new College of Forestry and the TallWood Design Institute

While there is a lot of current interest surrounding mass timber, and a great deal known about its general performance, there are still barriers to erecting these structures in the United States. Since there are many variables in how a building is assembled, and many parameters of performance (e.g., acoustics, durability, fire, connector performance), mass timber projects generally still require custom research, engineering, and design to assure they pass or exceed modern building code requirements. In addition, there is a need to develop both the material supply chain for these projects (i.e., CLT panels, from timber harvest, to manufacturing and fabrication) as well as a knowledgeable and skilled workforce at the manufacturing, design, and installation levels. To that end, the scientific research and design/manufacture/build communities, along with government entities, have collaborated over the last few years to investigate, validate, and improve the performance of mass timber products and building systems. One outcome of this collaborative push has been the creation of the TallWood Design Institute in 2015.

The TallWood Design Institute (TDI) is an industry-oriented mass timber research and design collaboration between Oregon State University (OSU) and University of Oregon (UO), created to help overcome knowledge and workforce barriers to mass timber adoption. More specifically, TDI is comprised of a network of associated researchers in the Colleges of Forestry (OSU), Engineering (OSU), and Design (UO) that collaborate together and with industry to build on knowledge of mass timber performance (such as fire and seismic behavior). The disciplines of wood science, civil engineering, and architecture form the backbone of TDI's work, which is based on three pillars: 1) applied mass timber research; 2) product testing and development; and 3) education, outreach, and workforce training.

TDI is housed at the College of Forestry at OSU and will occupy its new headquarters—the Emerson lab—after construction is completed in summer of 2019. The Emerson lab will be a 15,000 square foot, state-of-the-art advanced manufacturing and structural testing facility used to test, prototype, and teach. Emerson will have the capacity to produce panels and beams, as well as to cut intricate connections and test up to three-story structures. The lab—part of a series of TDI's available and slated testing facilities—is located adjacent to the new forestry building (Peavy Hall), which is also currently under construction.

Both facilities are utilizing innovative wood products made in Oregon, including CLT produced by DR Johnson and mass plywood panels produced by Freres Lumber.

Peavy Hall is a unique structure for multiple reasons, including the fact that it is a "living laboratory" (short-

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Peavy Hall—the College of Forestry's headquarters—was redesigned in mass timber. Here a CLT shear wall is assembled at the construction site. Peavy will be outfitted with hundreds of sensors, that will monitor structural and moisture performance over time, giving direct feedback to designers.

and long-term research is being conducted on the structure itself) and has the country's first seismically resistant timber rocking shear wall system. But really, the reason why Peavy is special is because it symbolizes—in a beautiful space and tangible way—the will to collaborate and push for innovative change toward a better future. Peavy Hall captures the fact that forestry, resource management, and the built environment are intimately connected, and I can think of no better material than wood to connect us in our homes and places of work to our natural forest resources. My aunt may never know what cellulose is, but she certainly knows how wood can warm up a room and has never forgotten about tall wood buildings. ◆

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