WOOD STANDS TALL

Architects, engineers, contractors and developers value wood for its structural capability, natural beauty and superior environmental performance. It provides a sustainable, cost-effective alternative to traditional steel and concrete construction – with a significantly lower carbon footprint.

Photo: Andrew Pogue

Oregon Forest Resources Institute

As a building material, wood has many advantages.

Tall wood buildings meet or exceed rigorous safety standards for fire and earthquakes. Mass timber products, which include glue-laminated timber (glulam), cross-laminated timber (CLT) and mass plywood panels (MPP), create new jobs and a positive economic impact, reinvigorating Oregon's timber and wood products industries.

At the same time, new mass timber commercial buildings rise tall with features tenants want, such as open floor plans, exposed structural elements and beautiful natural finishes.

CARBON STORAGE

Half the dry weight of wood is carbon. As trees grow, they pull in carbon dioxide from the atmosphere during photosynthesis and sequester the carbon in their trunks and branches, releasing oxygen in the process. That carbon stays in the wood after the trees are harvested, and remains there for the life of the product. This essentially makes wood buildings massive carbon-storage units. The cycle continues when new trees are planted to replace those harvested.

Research looking at wood construction's environmental impact highlights its clear superiority over other materials. Multiple tests and computations show that wood has a significantly smaller carbon footprint than either concrete or steel.

Photo: Jeremy Bittermann

ENVIRONMENTALLY RESPONSIBLE

Wood distinguishes itself as the only building material that is both renewable and sustainable.

Wood products require significantly less energy and less water to produce than either steel or concrete, and almost none of it goes to waste during the manufacturing process. More than 99 percent of every log is put to use. Even wood shavings and sawdust are captured for use in other products, or as biomass to generate electricity that helps power the mill. The products themselves are also both reusable and recyclable.

For example, the new eight-story Carbon12 condominium building in Portland was built with 24,400 cubic feet of wood. The 577 metric tons of carbon dioxide equivalent stored in the wood, combined with 223 metric tons of CO_2-equivalent emissions avoided by using wood instead of more carbon-intensive materials such as steel or concrete, make wood's total carbon benefit in this building approximately 800 metric tons. That's equivalent to pulling 1,609 cars off the road for a year.

Developers and others can calculate the carbon benefit of their projects using a carbon calculator found at cc.woodworks.org.

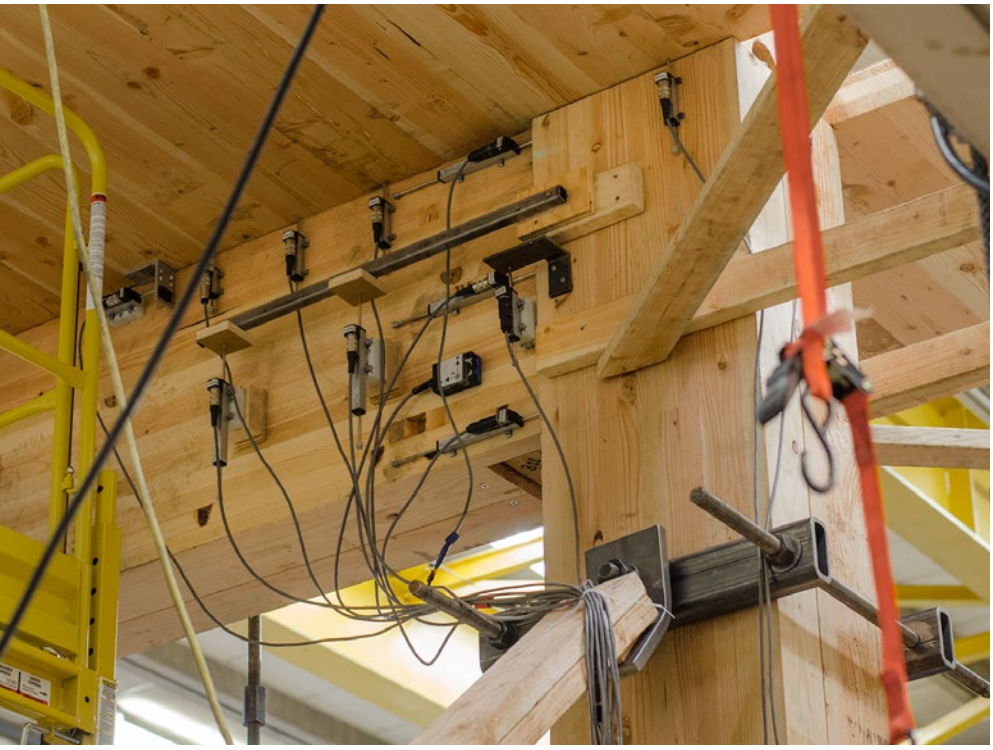
SUSTAINABLY SOURCED

Thanks to strong land-use and forest-protection laws that help keep forests as forests and require landowners to replant after timber harvests, Oregon's total forest land base remains steady at about 30 million acres. That's more than 90 percent of what it was in 1850. In fact, the Oregon Department of Forestry estimates the forest acreage in Oregon has remained around 30 million acres since as far back as 1630, when European settlers first arrived. Nationally, the forest land base in the U.S. is the same today as it was in 1900.

For forest land-base statistics, see https://www.fs.fed.us/sites/default/files/media/types/publication/field_pdf/GTR-WO-91.pdf.

It takes just minutes

for Oregon timberlands to regrow enough wood to replace that used to construct some of our largest wood buildings.



SEISMIC RESILIENCE

Extensive, rigorous testing demonstrates that by combining wood with other materials in structural systems, there are multiple paths to meeting seismic and heavy-wind-load code requirements. Ongoing research, including simulated earthquake studies conducted in November 2016 by Portland State University and in July 2017 by the Oregon-based Tallwood Design Institute, show that all-wood systems can provide seismic safety and resilience, allowing the structures to be reoccupied almost immediately after an earthquake.

FIRE SAFETY

Odd as it might seem, wood is fire-resistant. For decades fire engineers have understood the predictable rate at which wood burns, and have used wood in structural systems to protect steel connectors and other metal components.

Unlike light-frame building materials, the outermost layer of mass timber products chars, insulating the inside of the wood from fire and providing time for other fire-suppression efforts, such as sprinkler systems, to engage. The charred mass timber elements retain their structural integrity during a fire, allowing first responders to enter the building safely.

Mass timber buildings are as safe as any others

in a fire, because mass timber products char and fire suppression systems are commonly used.

Extensive fire tests conducted since 2015 in multiple laboratories throughout the U.S. have proved CLT buildings are just as fire-safe as concrete and steel construction.

Douglas-fir CLT assemblies with both malimide and polyurethane adhesives met fire-endurance requirements for two-hour tests, which helped form the basis for the tall wood building amendments to the 2021 International Building Code that passed in late 2018.

BUILDING CODES

Positive results from fire and seismic testing are leading to building-code changes that allow for taller wood buildings.

In December 2018, the International Code Council voted to approve 14 amendments to the International Building Code (IBC) to allow for tall wood buildings up to 18 stories in height. Oregon's Code Review Committee adopted those changes as part of its 2019 code amendment process. In August 2018, Oregon became the first state to codify tall wood buildings with adoption of a Statewide Alternative Method, creating a prescriptive path for wood high-rises that became effective immediately. Other states, including Washington and California, are taking similar steps.

Additionally, CLT withstood a series of live blast tests demonstrating its endurance in bomb explosions, prompting the U.S. Department of Defense to expand the use of wood for blast-resistant construction on military bases.

As building codes rapidly catch up with mass timber technology, tall wood buildings will become easier to permit and the overall costs for delivering these projects likely will decrease.

Indoor air quality

is not affected by adhesives used to make CLT.

ADHESIVES

There are two main concerns about adhesives used in mass timber products: their ability to hold the wood together over the long term, and the degree to which they might emit Volatile Organic Compounds (VOCs) such as formaldehyde.

Adhesives are chosen based on the manufacturing process. Glulam typically uses melamine formaldehyde (MF) and phenol-resorcinol-formaldehyde (PRF) adhesives, while CLT typically uses polyurethane (PUR) and MF adhesives. The current CLT manufacturing standard, PRG 320-2018, sets stringent adhesive requirements for performance under extremely adverse end-use and fire conditions.

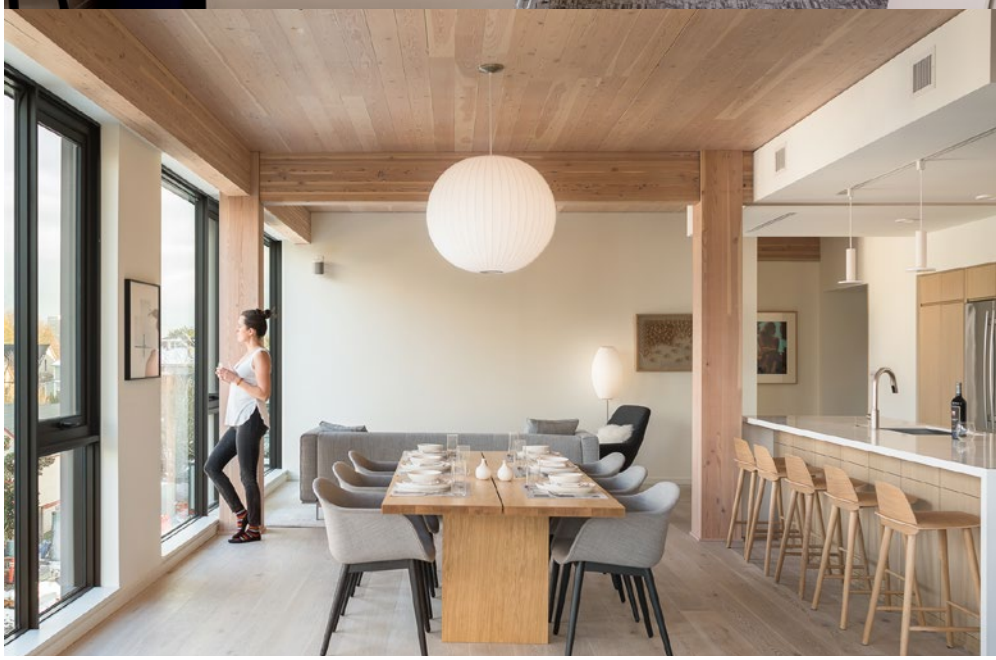
All current PRG 320-2018 adhesives are certified by Underwriters Laboratories' Greenguard® program at the Gold level. Once the adhesives set, any VOCs in them are fixed and will not be released. Any emissions detected in indoor wood-built environments come from the naturally occurring levels in wood itself, not from the adhesive.

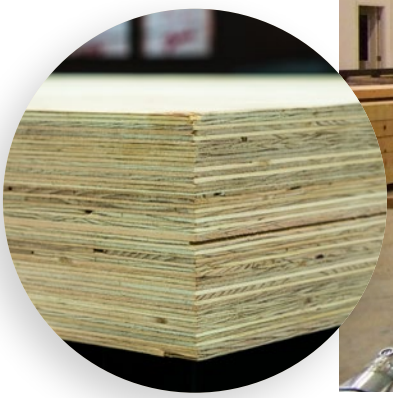
HEALTH AND HAPPINESS

Nature makes people happy. Yet, as people spend an estimated 90 percent of their time indoors, they lose that connection. Studies suggest that using natural elements in architectural design increases productivity in workspaces, promotes faster healing in healthcare settings, and lowers stress levels and blood pressure. Wood has even been connected to increases in serotonin, which science suggests decreases depression, aids digestion, and improves sleep and memory.

These health and wellness benefits cap off the sustainability and economic impacts that already make a strong case for building with wood.

Photo: Jeremy Bittermann





Increased use of mass timber in commercial buildings is generating **greater economic opportunity** in rural communities.

NEW ECONOMIC OPPORTUNITIES

Innovative mass timber technologies can boost Oregon's timber and wood products economy, as well as foster rural economic development.

Rural communities in Oregon are already realizing the benefits of manufacturing mass timber products. In the small town of Riddle in Douglas County, D.R. Johnson Wood Innovations makes CLT. In Marion County, Freres Lumber Co. built its new MPP plant in the rural community of Lyons.

An analysis by VentureLab (formerly Oregon BEST) and others shows that CLT and related manufacturing could directly create up to 6,100 Oregon jobs, and more than 17,000 total jobs through indirect and induced impact. Wages for directly related jobs alone could total as much as $371 million annually.

Oregon showcases mass timber technology in at least 40 new or in-progress structures around the state. Notable examples include the Oregon Forest Science Complex at Oregon State University in Corvallis, due to be completed in 2020; First Tech Federal Credit Union in Hillsboro, the nation's largest CLT building at the time of its completion; Albina Yard in Portland, the first building in the U.S. to use domestically produced CLT in a structural application; and Carbon12, also in Portland, which at 85 feet is currently the tallest CLT building in the United States.

CONSTRUCTION COSTS

Precisely pre-fabricated, CLT goes up fast, allowing buildings to be completed in less time than using traditional methods and materials. Because wood is much lighter than both steel and concrete, in many cases less robust foundations are needed. Fewer skilled tradespeople are required on the job. Shorter build times also reduce interest expenses for construction loans, and shorten the time for the completed building to lease up with tenants.

Builders at the First Tech Federal Credit Union project estimate that using wood saved 4 percent in construction costs and four months in construction time. On a small CLT building project in Brooklyn, NY, builders realized more than $1 million in overall savings.

In the United Kingdom, more than 500 timber structures have been built in recent years. Builders and developers there have said the majority of new buildings can be delivered faster and more cost-effectively using wood rather than reinforced concrete and steel.

Realizing the full economic benefits of mass timber construction requires taking a holistic approach to projects, including involving more members of the design and build team much earlier in the planning process. For example, pre-planning layouts for electrical, data, plumbing and mechanical systems prior to fabricating the structural components for a building allows the wood manufacturer to prefabricate mass timber components with these designs in mind. This significantly reduces or even eliminates the need for construction alterations at the construction site.

As the mass timber industry grows, competition and other factors should put downward pressure on prices for the products, as well as for design and engineering.

WOOD SUPPLY

Managed forests in Oregon are among the most productive in the world. In fact, it takes Oregon timberland just 6.1 minutes to grow the amount of wood used to build the Carbon12 condominiums. The wood that was needed to construct the much larger, 156,000-square-foot First Tech Federal Credit Union office building grows on Oregon timberland in just 46 minutes.

Mass timber products can serve as an outlet for the small-diameter, low-value wood that needs to be removed from millions of acres of Western federal forests to restore forest health and mitigate fire risk. Oregon State University is conducting research to develop manufacturing capabilities and establish engineering values for CLT panels made from small-diameter ponderosa pine, which represents more than half the wood fiber expected to be produced by these restoration efforts.

ACKNOWLEDGEMENTS

This publication is made possible through a grant from the USDA Forest Service.

ABOUT OFRI

The Oregon Legislature created the Oregon Forest Resources Institute in 1991 to advance public understanding of forests, forest management and forest products, and to encourage sound forestry through landowner education. A 13-member board of directors governs OFRI. It is funded by a portion of the forest products harvest tax.

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For more information on mass timber in Oregon, contact Timm Locke, OFRI Director of Forest Products, at locke@ofri.org or 971-673-3191.

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