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JEREMY BITTERMANN/COURTESY LEVER ARCHITECTURE

The State of the Art of Timber

CROSS-LAMINATED TIMBER SHIFTS FROM SPOTLIGHT TO STANDARD.

Engineers specializing in cross-laminated timber (CLT) see its future less in boutique prototype towers, requiring case-by-case demonstrations for approval, than in a meat-and-potatoes midrise market. While, according to Colorado State University's John van de Lindt, "some of those pioneering early CLT buildings are really almost like a partial R&D project in disguise," he and colleagues predict that the field's maturation **continued on page 11**



TONY HISGETT/Flickr

A Growing Industry

THE LUMBER INDUSTRY LOOKS TO THE FUTURE OF CONSTRUCTION WHILE MAINTAINING THE WORLD'S FORESTS.

North America's lumber industry helped define what it means to build in the modern era. With the invention of the light balloon-frame, lumber became an indispensable resource to the quickly expanding United States **continued on page 9**

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COURTESY STUDIO MA

Zeroing In

ARIZONA STATE REVEALS PLANS FOR A STUDIO MA-DESIGNED TIMBER NET-ZERO BUILDING.

Los Angeles-based Studio Ma has unveiled a radically sustainable master plan and conceptual design for Arizona State University's Interdisciplinary Science & Technology Building—a science and research complex that will be centered around a vast atrium filled with plants and water. **continued on page 12**

Carbon, Copied

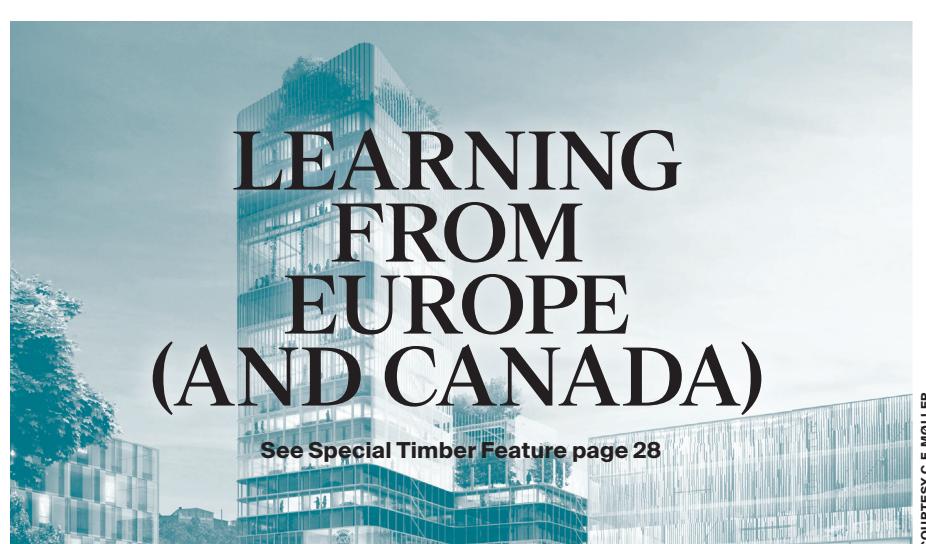
IS MASS TIMBER THE SUSTAINABLE SOLUTION ENVIRONMENTALISTS CLAIM IT IS?

We like to blame a lot of things for climate change—namely coal and cow farts—but if we were to search for a worthy scapegoat, architects might end up looking in the mirror. The building sector is responsible for 44.6 percent of U.S. carbon dioxide (CO₂) emissions. And, with an estimated 1.9 trillion billion square feet to be built in the next 33 years, those emissions will not subside without significant intervention. On the flip side, for architects anyway, **continued on page 5**

What Wood You Do?

A FIGHT IS BREWING OVER FEDERAL LEGISLATION THAT COULD GIVE THE TIMBER INDUSTRY A JOLT.

The battle over the 2017 Timber Innovation Act is gaining momentum in Washington, D.C., where two new Senate sponsors and four new Congress members have signed on to it since this past May. The pending legislation would provide funding for research into innovative wood materials and mass timber structures above 85 feet. The bill's proponents are hoping that it will be an impetus for transforming cities and towns across the country with a **continued on page 5**



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this means the power to reduce carbon emissions is quite literally in your hands. "No designer—I think—wakes up and says, 'I want to make the world worse today,'" William McDonough, architect, designer, and sustainable development leader said. "To make the world better, that's our job."

Identifying successful ways to build sustainably can be difficult in a haze of green washing and checklist-style certifications, but many environmental experts, architects, and scientists are looking to mass-built timber as a reliable way to reduce carbon and fossil fuel output. A recent study, "Carbon, Fossil Fuel, and Biodiversity Mitigation with Wood and Forests," stated that using wood as a building-material substitute could save "14 to 31 percent of global CO₂ emissions and 12 to 19 percent of global FF [fossil fuel] consumption by using 34 to 100 percent of the world's sustainable wood growth."

Building with timber reduces the overall carbon footprint in several ways. First, wood is a renewable resource, and growing a tree is a low-impact method of production (i.e. it uses photosynthesis rather than a plethora of machines). Second, trees are grown in abundance all over the United States and don't need to be imported from abroad, reducing the amount of energy expended on shipping. "Right now we harvest less than half of what we could and still be well within the threshold of sustainability," Kathryn Fernholz, the executive director at Dovetail Partners, an environmental non-profit, explained. "That's not the same in every single scenario, but in general in the U.S., we have an abundance of wood."

Third, and perhaps counterintuitive—many environmentalists believe that harvesting trees allows forests to become barren, an associate professor of architecture at the University of Washington and director of the Carbon Leadership Forum. "So sometimes it ends up negative and sometimes it ends up positive. It can be confusing." She is optimistic, however, that planting, grown, and harvested. "There is a research is close to resolving the difference between the plot of land's carbon sequestration infinitely malleable as trees are planted, grown, and harvested. "There is a

The United States has an abundance of wood in our forests, which can be sustainably harvested to build timber structures, saving 14 to 31 percent of carbon dioxide emissions.

widely held belief that cutting down trees is bad and causes loss of forest, but a strong market for wood products would cause us to grow more forests," Fernholz said. "The vast majority of deforestation is land conversion, using the land for something else like development or agriculture. We know what resources we have and we monitor them and adjust. Forestry is not in the same place it was a hundred or even fifty years ago when deforestation was an issue."

While that stance of de- and reforestation is under debate among environmental experts, across the board, timber is generally a more sustainable building material because it is a renewable resource (provided that responsible forest practices are used). This includes the energy consumed to produce cross-laminated timber (CLT) in factories, which have a carbon emissions advantage over steel because the wood does not need to be heated over 2,700 degrees Fahrenheit like steel or concrete—in fact, unless the wood is kiln dried, heat isn't needed at all. Although embodied carbon is typically measured per building, because different amounts of each material are used in different scenarios, Wood for Good, a campaign by the timber industry to promote the material, claims that a ton of bricks requires four times the amount of energy to produce as a ton of sawn softwood (wood used for CLT); concrete requires five times, steel 24 times, and aluminum 126 times.

"Reporting carbon emissions for wood includes a range of different assumptions and methods," explained Katrina Sim, an associate professor of architecture at the University of Washington and director of the Carbon Leadership Forum. "So sometimes it ends up negative and sometimes it ends up positive. It can be confusing." She is optimistic, however, that By insulating its interior, an exposed wood beam can actually be structurally stronger



COURTESY LEVER ARCHITECTURE

What Wood You Do? continued from front page

bevy of midrise and high-rise mass timber buildings.

"I am very impressed with the large cross-aisle support," Chadwick Oliver, director of Yale University's Global Institute of Sustainable Forestry, said. "You have Bruce Westerman, a Republican congressman from Arkansas and Peter DeFazio, a Democrat from Oregon who has been on the side of environmental groups. This looks like a bill that is quite serious about moving forward."

However, the concrete and steel industries are vigorously lobbying to derail the legislation, and have established a website called Build with Strength that contains a detailed critique of the new generation of wood buildings. "It is a piece of legislation that props up one industry over another and we think that it is misguided and dangerous," Kevin Lawlor, a spokesperson from Build with Strength, said. "We don't think that it is safe in three-to-five story buildings, and we don't think that it is safer in taller buildings."

The wood products industry, the U.S. Forest Service, and other advocates claim that technological advances make the new generation of tall timber buildings more fire resistant. In fact, According to Dr. Patricia A. Layton, director of the Wood Utilization + Design Institute at Clemson University, that is because of the way it chars in a fire: By insulating its interior, an exposed wood beam can actually be structurally stronger

Framework by LEVER Architecture was funded in part by a \$1.5 million U.S. Tall Wood Building award sponsored by the United States Department of Agriculture.

than a steel one. "Steel loses its strength at a lower temperature than does wood," she explained. "If you expose concrete or steel it is combustible, and it does feel the effects of fire."

Many of the act's supporters say that allowing buildings to be built from wood technologies such as cross-laminated timber (CLT) will result in a host of economic and environmental benefits. Most of the Timber Innovation Act's sponsors hail from states where the wood industry is struggling to recoup from the recent housing downturn and also suffering from the decrease in demand for paper that is a result of the increasing digitalization of the economy.

"A big part of the innovation act is having the U.S. Forest Service work to expand markets and attract business to heavily forested states, particularly those that have a major timber industry," said Andrew Dodson, vice president of the American Wood Council, who notes that the U.S. Timber Innovation Act is a way to help jump-start a sagging wood-products industry. "Mills are running at much lower capacity," he said, "two shifts versus three or four—we want to put more mill jobs back in place."

However, some in the mass timber industry say that the Timber Innovation Act will be of limited

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Carbon, Copied continued from page 5 square footage in the midrise sector could be made with mass timber. These statistics harvest occurring on long rotations so that the forest has time to regenerate itself and care can be taken to avoid removing other plants, roots, and branches in the process.

Lastly, "Wood can be a durable good, as we've seen in ancient wooden buildings like the Temple at Nara, Japan [originally built in 745 AD and rebuilt in 1709]," McDonough said. "In [wood's] history, it is often put into a cycle of use and reuse that can take it from large numbers to smaller and smaller [components]."

Its ability to withstand centuries and to be disassembled and then reassembled into other buildings and furnishings keeps it out of the landfill and in a perpetual cycle of use until it can ultimately be returned to the environment in some form.

Although well over 90 percent of one-to-three-story residential buildings are already wood-built, there are only a handful of midrise and tall timber buildings across the United States, a result of building codes that often prohibit timber-built structures larger than four to six stories. However, thanks in part to innovative wood products, including CLT, nail laminated timber (NLT), and glue laminated timber (glulam), wood construction can be used in buildings as tall as 40 stories. A study by consulting and engineering company Pöyry and the New England Forestry Foundation shows that the greatest potential for timber-built is in midrise (six to 14 story) buildings, as it also tends to be more economical to build with timber at that scale. According to the Softwood Lumber Board, over two-thirds of the

square footage in the midrise sector could be made with mass timber. These statistics combined, in addition to the taller structures that mass timber can create, have the potential to make a sizable dent in our CO₂ and fossil fuel emissions.

Like virtually everything in architecture, though, it is all in the details; for timber to be sustainable it has to be done correctly, from responsible forestry practices to environmentally safe glues and binders to craftsmanship and the design itself. "It is tremendously exciting. Building with wood creates diverse opportunities—there are different species and materials that all can work," Fernholz said. "However, it is important to recognize that some things can come from wood, but nothing replaces good design and planning."

Olivia Martin

What Wood You Do? continued from page 5

utility until building codes are changed to allow for the use of CLT. "The code issue is more critical than the Timber Innovation Act," Jean-Marc Dubois, director of business development for the Montreal-based Nordic Structures, said. He believes that New York City's restrictive building codes have helped stall progress on tall timber, pointing to the wooden skyscraper designed by SHoP architects (page 7) that was killed earlier this year as an example.

Even though the 2015 International Building Code (IBC), which New York City has not adopted, allows for the use of CLT, Dubois said that building departments throughout the country haven't updated their codes to allow for the use of CLT. Having the SHoP project, which received a lot of publicity, fail to get built was a major setback for the industry, according to Dubois. "New York City had the ability to be a real-world leader with timber innovation," he said. "It was disappointing."

A \$250,000 grant from the U.S. Forest Service's Wood Innovations Grant program helped Yugon Kim of Boston-based IKD develop what he believes is the first hardwood CLT structure in the U.S.: An outdoor sculpture in Columbus, Indiana, which consists of a series of ascending arcing forms (page 15).

Congress is not the only place in Washington where the merits of tall mass timber are being explored. Steve Marshall, assistant director at the U.S. Forest Service, has been working with the International Code Council to develop standards for the use of

CLT. In addition, the U.S. Department of Defense has been conducting blast tests with CLT to determine whether it is an appropriate material to use on its bases.

Marshall said there are other potential sources for government support for CLT projects aside from direct funding from the Timber Innovation Act. In the third week of October, his agency will be releasing a new round of grants of up to \$250,000 under its Wood Innovations Grants program. Next year, the Forest Service is planning on making \$8 million available under the same program, and applications will be due by mid-January.

One of the most notable examples of how government funding can play a difference is with LEVER Architecture's innovative design of the 12-story (148-foot-tall) Framework building (page 5) under construction in Portland, Oregon, which will be the first wood high-rise in the U.S. A \$1.5 million U.S. Tall Building Award sponsored by the U.S. Department of Agriculture helped fund the seismic and fire-safety tests that enabled it to pass muster with Portland building department officials.

Thomas Robinson, principal of LEVER Architecture said that the concrete and steel industries shouldn't be worried about losing market share because in the future most tall timber structures will be hybrids that include concrete and steel as well as wood. "We need to look at each material for its appropriate purpose," he said.

Alex Ulam

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