SOCIETY OF AMERICAN FORESTERS

Western Forester

October/November/December 2018 Oregon • Washington State • Inland Empire • Alaska Societies Volume 63 • Number 4

Wood Innovations are Creating Important Forestry Opportunities

BY BRIAN BRASHAW

Mass timber, wood energy, torrefied fuels, cellulose nanomaterials, advanced biofuels, and biochar are new product and market opportunities that augment traditional forest markets for lumber, pulp and paper, wood pellets, and structural panels.

This issue of the *Western Forester* highlights these emerging products and their markets, identifying the key investments, research, and partnerships that are working to expand and create new markets for forest products. A healthy forest products industry is one tool for supporting forest management, and healthy markets for the full range of forest products is essential for having a healthy industry. Simply, strong markets for forest products improve forest health and resilience, and support key benefits like clean water, clean air, wildlife habitat, and recreation opportunities.

Mass timber includes new innovation products like cross-laminated lumber (CLT), mass plywood, and nail and dowel-laminated lumber. When combined with traditional glue-laminated (glulam) and laminated veneer lumber, new options exist for building mid and tall timber buildings. The USDA Forest Service, in partnership with others, has supported key research, education, technical assistance, and special initiatives to support this expanding opportunity. Technical experts from Woodworks have supported over 440

(CONTINUED ON PAGE 2)

CREDIT: LEERS WEINZAPFEL ASSOCIATES, PHOTO: ALEXANDER SCHREYER

The John W. Olver Design Building at UMass Amherst is one of the most advanced mass timber buildings in the US, a four-story, 87,500-square-foot structure that exemplifies the university's commitment to sustainability.

PHOTO COURTESY OF LEVER ARCHITECTURE

Located in Portland, the four-story Albina Yard office building includes a glulam frame and CLT panels, all locally manufactured.

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Wood Innovations are Creating Opportunities

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mass timber projects that are in design, or where construction has been started or completed. This cohesive work has created opportunities for western US mass timber companies like D.R. Johnson, Freres Lumber, Smartlam, Euclid Timber, Vaagen Timber, and Katerra to build new manufacturing plants, creating expanded markets for lumber while supporting rural economic development. Building code changes have been adopted in Oregon, and a pending vote by the International Code Committee will add three more classes of tall wood buildings from 7-18 stories, creating an exciting new demand.

Wood energy is still an important use for sawmill residues, thinning, and other harvest woody biomass that have limited or no markets. Modern, clean and efficient thermal energy and combined heat and power plants use significant volumes of wood in the Northwest, but face market challenges from low-cost fossil fuels. To create new opportunities, Oregon Torrefaction is building a plant in John Day, Oregon, to process low-grade forest materials into a coal replacement using a torrefaction roasting technology. This durable and weather-resistant briquette can be used to offset or replace coal in power plants with minimal modification since it grinds and burn like coal.

The U.S. Endowment for Forests and Communities, USDA Forest Service Forest Products Laboratory, and other public and private partners have joined to form P3Nano, a partnership focused on research and implementation of cellulosic nanomaterials, materials that have unique benefits when added at a nano scale to other products. Key research and demonstration projects are being completed to assess options for their use in concrete, plastic films, automotive panels, coatings and lubricants, and electronics.

Advanced liquid biofuels and biochar are also emerging products, with new investments driven by sustainability goals by customers. Red Rock Biofuels broke ground in July

Western Forester

Society of American Foresters
4033 S.W. Canyon Rd. • Portland, OR 97221 • 503-224-8046
www.nwoffice.forestry.org/northwest-office/western-forester-archive

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Western Forester is published four times a year by the Oregon, Washington State, Inland Empire, and Alaska Societies' SAF Northwest Office

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2018 on a renewable fuels production facility in Oregon, focused on using woody biomass waste products. Organizations like the US Biochar Initiative are providing important support to uses and product options for biochar. While the current market for biochar is small and regional, it is growing and creating new interest.

Innovations are not limited to producers. The North American Forest Partnership (NAFP) #forestproud communication platform represents a diverse partnership of over 110 members. NAFP is the most diverse forest sector coalition that has been established and is aligned to share an essential story, proactively positioning the sector as relevant, responsible, and innovative. By managing, conserving and sustainably harvesting forests, the forest sector can provide large-scale solutions to pressing societal challenges. High quality shareable content is being produced by #forestproud, allowing partners to inform and subscribe to this content to: 1) build pride in their employees, making them more effective and vocal ambassadors; 2) attract new and diverse talent to the workforce; and 3) communicate the relevance of the sector to policymakers. For more information, search #forestproud on your favorite social platform or at www.forestproud.org.

To support new markets, the USDA Forest Service Wood Innovations Program has released their 2019 funding program. Up to $8 million of funds are available to stimulate, expand, and support wood products markets and wood energy markets to support forest management needs on National Forest System and other forestlands. More information can be found at https://bit.ly/2ANB48I.

While our forests face challenges from fire, insect and disease, and overstocking, this issue provides key updates on partnership-driven efforts to support and expand wood innovations. ◆

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Mass Timber Rises

Building codes and federal legislation could be a winning combination

BY ROBERT GLOWINSKI AND DAVE TENNY

Robert Glowinski

Dave Tenny

Modern timber structural systems developed for high-rise building design provide the first significant alternative to building with concrete and steel in more than a century. Achieving this milestone is no small feat, given the flurry of activity from competing industries that have aligned to prevent additional market entrants.

Fortunately, the introduction of these new systems is not only a priority for the wood products and forestry industries, but is also being driven by innovative building designers, engineers, and researchers who are seeing successful implementation of tall wood buildings across Canada, Europe, and other parts of the world. They are recognizing the growing pressure to find renewable, low-carbon alternatives to incumbent structural materials for use in development of the urban world, and are naturally turning to wood for a solution.

As detailed below, the US is making substantial progress in achieving broader acceptance for mass timber building systems, but there is still work to be done. An immediate challenge is gaining recognition of tall mass timber buildings in the 2021 edition of the *International Building Code* (IBC), the model code adopted in almost all US jurisdictions. Additionally, the US Congress is considering language to encourage additional cooperative research and development into mass timber construction that could further help change the way we build. Progress in both the building code and legislative arenas will be a significant leap in making mass timber construction more widely possible in the United States.

Building codes

While heavy timber (Type IV construction in the current IBC) is one of the oldest wood construction methods recognized in building codes to date, innovative mass timber products have now expanded what is possible within this category. And, as these innovations gain broader acceptance, construction standards are evolving to keep up.

Notably, the International Code Council (ICC) reviews and updates its family of building codes on a three-year cycle. The 2015 *International Building Code* was the first edition to recognize and provide specifications for cross-laminated timber (CLT), one type of mass timber that has most recently garnered much of the design community's imagination. However, other mass timber products such as structural composite lumber, laminated strand lumber, laminated veneer lumber, oriented strand lumber, parallel strand lumber and glued laminated timber (glulam) have all been long-recognized in past versions of the building codes.

ICC is currently undergoing the process of developing its 2021 edition of the building and fire code. Recognizing the emergence of mass timber globally, in 2015, ICC established an Ad Hoc Committee on Tall Wood Buildings to research the building science of tall wood buildings and make recommendations on how to extend its recognition in the code. The committee was comprised of 17 member-experts, including building and fire officials, fire protection engineers, architects, structural engineers, and representatives from all major materials groups. After two years of study that included full-scale compartment fire testing, the committee developed a package of 14 tall mass timber code change proposals (https://bit.ly/2qw8Aug) that would allow for construction of mass timber buildings up to 18 stories. These code change proposals are in process and will be finalized by ICC's Governmental Voting Members later this month. Approval will result in their incorporation into ICC's 2021 building codes.

However, with mass timber construction already underway in several US locations, some states are eager to provide guidance and incorporate construction provisions for tall mass timber building into their current state codes. For example, the state of Oregon began allowing tall mass timber construction under their unique code system as of August 2018. Similarly, the state of Washington has passed a bill supporting the use of mass timber for building construction "in a manner that ensures resilient, safe, and durable structures." The Washington State bill requires the state to adopt rules for

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Brock Commons dormitory is an 18-story mass timber hybrid building on the campus of the University of British Columbia.

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Mass timber samples shown during the "Timber City" exhibit at the National Building Museum in Washington, DC.

mass timber construction following such adoption by ICC.

Timber Innovation Act

Within the US Congress, the bipartisan Timber Innovation Act (TIA) represents another opportunity to expand the understanding and markets for mass timber construction. The bill directs the U.S. Forest Service to act on its existing mandate, "To sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations," and provide research and development support for exploring, expanding, and accelerating mass timber use.

Encouragement from the federal government to further develop this emerging construction technology, as it has with other market innovations, will help drive the use of a renewable resource as a viable alternative to more energy and carbon intensive materials, as well as support infrastructure development and job creation in America's rural communities that have yet to recover from the Great Recession.

Mass timber construction is also a win for the environment. As an emerging market, it helps increase demand for wood products. Research shows that strong markets for wood products is the economic engine that drives investment in working forests, protecting them from conversion to other land uses, like development. Though it may seem counterintuitive, the more demand that exists for forest products, the more likely forests will remain intact. Keeping forests as forests means cleaner air and water, more wildlife habitat and a variety of other environmental benefits that improve overall quality of life for millions of Americans.

Much of the TIA's language is now included in House and Senate Farm Bills.

Adoption of the updated building codes and passage of a Farm Bill containing the TIA will help bring mass timber to a tipping point that will help us build the low carbon, energy efficient and environmentally superior communities of tomorrow.

To learn more about the building code process and tall mass timber code change proposals, visit www.awc.org/tallmasstimber. Visit www.timberinnovation.org for more information about TIA and the Farm Bill. ◆

Robert Glowinski is the president and CEO of the American Wood Council, which represents 86 percent of the structural wood products industry. Dave Tenny is the president and CEO of the National Alliance of Forest Owners, which represents more than 46 million acres of private working forests across the United States.

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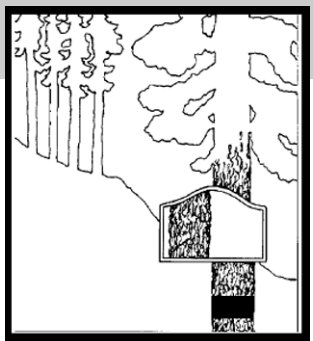

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Mass Timber: Part of an Effective Wildfire Reduction Strategy

BY JENNIFER COVER

Mass timber is newsworthy for a lot of reasons. Its strength and dimensional stability make it a renewable, sustainable and carbon-friendly alternative for building applications—such as offices, hotels and high-rises—where wood isn't typically considered. Because of the unique structural and fire-resistance characteristics of large, solid wood members, the International Building Code also allows the use of mass timber in exposed applications, creating exciting opportunities for a modern wood aesthetic. However, beyond their innovative uses and visual appeal, products such as cross-laminated timber (CLT) are part of a needed strategy for improving forest health and reducing the frequency and severity of wildfires.

There's no need to give a forestry lesson to a readership of foresters, but wildfires are getting worse, and overly dense forests are part of the problem. In the west, for example, a paper published by the USDA Forest Service says that severe wildfires "have led to concerns about heavy surface fuel loading and the potential for high-intensity reburning. Ponderosa pine (*Pinus ponderosa*) forests, often overly dense from a century of fire suppression, are increasingly susceptible to large and severe wildfires especially given warmer and drier climate projections for the future."

Mass timber products create an opportunity for large, solid structural elements to be manufactured from relatively small-diameter trees as well as other traditionally low-value resources (such as forests affected by insects). This creates a market incentive for forest thinning and other landscape restoration efforts, which in turn helps to reduce the risk of fire. This, along with the need to reinvigorate rural economies, is part of the reason states like Washington, Oregon, and California have developed policies or initiatives to accelerate markets for mass timber.

Growing the market

In the meantime, there are signs that mass timber is already becoming entrenched as a viable option for North American building designers.

Product Innovation and Supply. In 2011, when the first commercial CLT building was constructed in the US, the product came from Europe. That made sense; at the time, Europe had more than 20 years of mass timber history and North America's was just beginning. Since then, a casual reader of architectural news might have assumed that CLT is synonymous with mass timber. CLT is often included in taller wood buildings, here and internationally, so it garners a lot of press. However, there are many types of mass timber products—all now readily available in the US and Canada.

In addition to CLT, products in the mass timber family include nail-laminated timber (NLT or nail-lam), glued-laminated timber (glulam, or GLT when referring to panel products), and dowel-laminated timber (DLT). Product innovation is continuous, and a relative newcomer to this group is the mass plywood panel (MPP).

For CLT, an important nuance is whether a manufacturing plant has been certified to the *ANSI/APA PRG-320 Standard for Performance-Rated Cross-Laminated Timber*, which provides a basis for standardization of CLT quality, manufacturing, and structural properties for structural building applications in North America. Plants that are operational and certified to the standard for building applications include DR Johnson (Oregon), Nordic Engineered Wood (Quebec), SmartLAM (Montana), Structurlam (British Columbia), and KLH USA (Austria). Additional plants that have been announced and are in the process of being certified include International Beams (Alabama), Katerra (Washington), Vaagen Timbers (Washington), and Smartlam (northeast and southeast). There are also CLT plants such as Sterling Lumber that produce panels for rural roads and rigging mats, which don't require certification for building use.

Mass Timber Projects. The program I lead, WoodWorks, provides education and free project assistance related to the design, engineering, and construction of commercial and multi-family wood buildings. As such, we've had a unique opportunity not only to witness the evolution of the mass timber trend, but to help guide successful projects to fruition. In 2015, our technical staff provided assistance on a handful of buildings where the developer, architect, or engineer had an interest in using mass or heavy timber.

CREDIT: MICHAEL GREEN ARCHITECTURE & DLR GROUP, PHOTO COREY GAFFER

At seven stories and 220,000 square feet, T3 Minneapolis demonstrated the feasibility of large timber projects in the US. There are now at least two 12-story wood buildings in design in the Pacific Northwest.

In 2017, the number of projects had grown to 158, and we expect to support close to 200 projects this year.

As part of our project support efforts, we also have been tracking mass timber projects; as of October 2018, our database included more than 400 mass timber buildings that are either completed, under construction, or in design. This includes 23 projects completed in California, 15 in Washington, and 14 in Oregon.

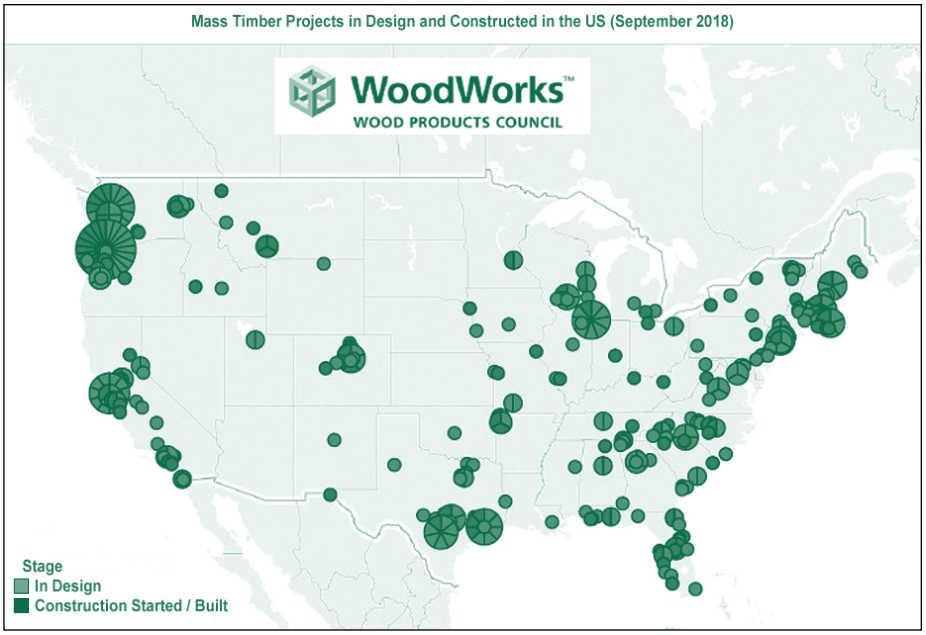
Availability of Experts. There is a symbiotic relationship between the design and building community's interest in developing mass timber expertise and the availability of education and resources to do so. Each drives the other, and the result is an ever-growing pool of professionals who understand the nuances of mass timber building design.

Since 2013, for example, WoodWorks has offered more than 460 mass timber education events. This has included national CLT and tall wood symposiums, Wood Solutions Fairs, the International Mass Timber Conference (co-produced with the Forest Business Network), webinars, workshops, lunch seminars, and lunch and learns presented in-house to design teams. WoodWorks has provided more than 50,000 tall wood and mass timber education hours to over 30,000 design and building professionals.

Governing influences

A discussion of the growing market for mass timber wouldn't be complete without recognizing the many factors that have made it possible—including an unprecedented amount of research.

For example, seismic testing of various mass timber diaphragms and connections has been performed at several US universities. Fire testing has been performed at a component level and an assembly level as required by code, and at the full-building scale—which is well beyond code requirements. This abundance of research, along with significant product testing, is the foundation of building code changes and government policies that are helping to facilitate the use of mass timber for a broader range of projects. Recent and pending changes to US building codes are discussed in the article, *Mass Timber Rises*, on page 4.



More than 400 mass timber projects have either been built or are in design across the US. California has the most completed projects (23), followed by Massachusetts (16), Washington (15), and Oregon (14).

CLT was prescriptively recognized in the *2015 International Building Code* (IBC). In 2016, the International Code Council (ICC) appointed a committee of building officials, fire officials, architects, fire protection engineers, and industry experts to examine and propose appropriate code requirements for tall wood buildings. While ICC members voted on the proposals of the Ad Hoc Committee on Tall Wood Buildings in October and November, Oregon became the first state to approve them under its Statewide Alternate Method (SAM), allowing design professionals to prescriptively design mass timber buildings up to 18-stories in height. Washington is poised to adopt the proposals in July 2019.

For more information, the Think Wood Research Library (http://research.thinkwood.com) is a central resource for mass timber and other wood building-related research from around the world.

How you can help?

For some building types, it isn't common to consider wood—large university buildings, for example, or big box stores. If you hear about a major non-residential project being considered in your community, let us know. Connect us with the developer or design team if you know them. WoodWorks has a team of wood design experts, including architects and engineers. As a non-profit US Forest Service partner, we can provide information on wood's performance capabilities based on the needs of the project, offer details on a code path, and respond to issues that arise throughout design and construction—all at no cost to the design and construction team. Email us at help@woodworks.org. ◆

Jennifer Cover is a California-licensed professional engineer and President/CEO of WoodWorks. Her background is in structural design, project management, and strategic planning. Prior to WoodWorks, she was an adjunct professor teaching timber design at the University of California, San Diego. She can be reached at jennifer@woodworks.org.

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U.S. Endowment Brings Innovation to the Forest Sector

BY MICHAEL GOERGEN

At the U.S. Endowment for Forestry and Communities (Endowment) we are focused on keeping forests as forests and creating family waged jobs in communities that depend upon forests. We believe vibrant and diverse markets are essential to achieve our mission. Most landowners need markets to keep their forests healthy and financially viable.

But markets don't last forever. Buggy whips evaporated with the Model T's emergence on America's roads. Plenty of forest products markets have gone away or are on the decline. Newsprint anyone? At the Endowment we are working to bring innovation to the forest sector and develop new markets, whether traditional or non-traditional, such as finding ways for landowners to get paid for things like water, which they largely provide for free.

When specifically looking at forest products, we see opportunities in areas where there is modest investment and where our resources can make a difference in accelerating market development. A good example is mass timber construction.

In most parts of the US, building codes do not allow wood construction above six stories—a serious limitation. The Endowment and its partners are working to make taller wood buildings reality. We are working with the U.S. Forest Service's Forest Products Laboratory to demonstrate the safety of tall wood construction. From fire testing to earthquake simulations, it has been demonstrated that wood performs as good or better than traditional building materials. We are working to create the opportunity to build up to 18 stories out of wood. Several partners have joined together to showcase this research to the International Code Council, opening new markets for wood and opportunities for foresters to continue managing forests to produce high-quality saw logs. Most cross-laminated timber consists of 2x6 or 2x8 boards of spruce and fir.

While saw logs are important, we know that low-value markets are just as important. The Endowment is making investments in torrefied wood made from low-value wood and residuals (see companion piece by Joe Koerner on page 20).

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U.S. Endowment for Forestry Facts

The U.S. Endowment for Forestry and Communities, Inc. (Endowment) is a not-for-profit corporation established as part of the 2006 Softwood Lumber Agreement (SLA). The Endowment is one of three entities designated to share in a one-time infusion of funds to support "meritorious initiatives" in the US. It has been endowed with $200 million under the terms of the SLA.

The SLA designated three purposes for use of the funds, and the Endowment was charged to advance two of those: (1) Educational and charitable causes in timber-reliant communities; and (2) Educational and public interest projects that address forest management issues that affect timber-reliant communities, or the sustainability of forests as sources of building materials, wildlife habitat, bio-energy, recreation, and other values.

As a perpetual endowment, the $200 million corpus is invested in broad financial markets. If depending only on funds generated from the corpus on an annual basis, $8-10 million/year is available to advance Endowment purposes.

The Endowment targets it funds using filters of seeking systemic, transformative, and sustainable change; moving the needle on seemingly intractable problems where few others will engage; bringing together coalitions of interested parties to address areas of concern; and taking risks to use creative solutions to advance their mission.

Areas of investment concentrate in seven focal initiatives using a market-based approach: retaining and growing traditional markets such as lumber and paper; advancing non-traditional markets like water; innovation and new markets; wood-to-energy; forest retention; forest health; and asset creation (working with disadvantaged populations to broaden the forestry tent).

For more information on the endowment, visit www.usendowment.org.

We are also exploring cellulosic nanomaterials (CN), which can also be made from lower value wood. CN are the basic building blocks of trees and have unique and desirable properties at the nanoscale. A nanometer is very small, about 1/20th the width of a human hair. Strange things happen at the nano scale: gold is actually a pink or red color as a nanoparticle; silver can eliminate odors; and in the case of cellulose, the material has the strength of steel at 1/5th the weight. CN have very promising applications.

PHOTO COURTESY OF MICHAEL GOERGEN

Students at Oregon State University preparing concrete samples from the first full-scale commercial test of cellulose nanomaterial-enhanced concrete.

For example, coating fiberglass with CN can yield a car bumper that is 20% lighter with the same strength. Lighter car parts equal better gas mileage, which is good for consumers and the environment. Packaging can be made stronger and lighter. The viscosity of paints and coatings can be improved. Production of oil and gas wells can be enhanced. The most immediate market appears to be concrete. By adding a small amount of CN to concrete, a stronger product can be developed that reduces CO2 emissions by about 15%.

New, disruptive markets are difficult to open. While adding tiny bits of wood to concrete may seem like it won't make much of a difference, it's important to understand that worldwide 4 trillion tons of concrete are used. We are not trying to replace existing additives in a concrete mix. In fact, by adding CN, manufacturers will be able to use less cement in the concrete mix, saving them money. Even with the many environmental wins from using CN in concrete, it's the cost savings that will accelerate adoption. Disruption that reduces costs is the kind of disruption industry likes.

One of the biggest long-term challenges our industry faces is its lack of investment in innovation. Innovation is expensive, and our sector is not making the investments necessary to keep up. The average investment in research and development in the US manufacturing sector is 3.4% of sales. In the forest sector it is 0.5% of sales. The Endowment's investments cannot make up for this lack of investment. However, we can showcase what is possible and draw attention to assets like the Forest Products Laboratory (FPL) that are in desperate need of reinvestment and reimagination. During World War II, the lab had 725 employees; today, it has just 141, only 50 of whom are researchers. FPL successes and innovations from the 1950s to 1980s are still yielding benefits sustaining today's lifestyles. Without investments made today, what will our future look like? And what are our competitors investing in to replace forest products?

The Endowment is not looking at innovation through the lens of what's possible for the future of the forest products industry. We are thinking about the forest. We believe that markets help keep forests as forests. We invest in the markets of today and tomorrow to ensure that landowners continue to find the value in their forest that encourages management and investment that is so vital to our forestlands. Our efforts today are developing products that ensure that consumers will continue to make forest products their first choice. And those forest products will help us manage and sustain what we have on the land today. ◆

Michael Goergen is vice president Innovation, and director, P3Nano, located in Bethesda, Maryland. He can be reached at 240-475-5741 or michael@usendowment.org.

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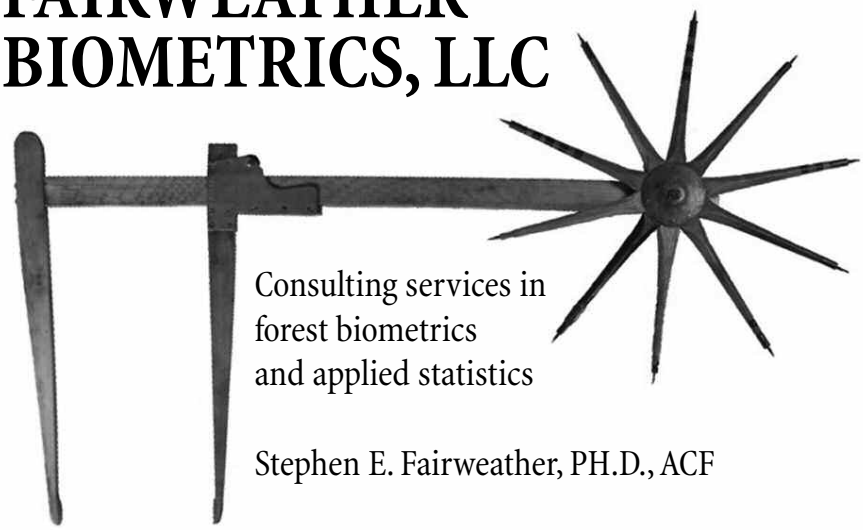

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Research for Resilience at the USDA Forest Products Laboratory

REBECCA WALLACE

As the only national laboratory of the USDA Forest Service, research at the Forest Products Laboratory (FPL) promotes healthy forests and forest-based economies through the efficient, sustainable use of wood. The long-term health of our nation's forests depends on sound conservation practices, including wise use. Efficient use of forest resources is a forest management tool that can improve resilience to natural disturbances such as wildfires, invasive species, and a changing climate.

For more than 100 years, FPL has been developing innovative ways to use one of the world's oldest building products. Today, one of those innovations is in mass timber, as researchers study the performance of materials like cross-laminated timber (CLT), which make building taller structures out of wood possible.

CLT is made from layers of dried lumber boards stacked in alternating direction at 90-degree angles, glued, and pressed to form solid panels. These panels have exceptional strength and stability and can be used as walls, roofs, and floors. Researchers at the lab have been studying CLT from many angles, including strength properties; fire, seismic, and moisture performance; and even their ability to withstand explosions.

FPL researchers recently recreated five fire scenarios in a two-story, full-scale test building constructed using CLT. The tests demonstrated that it is possible to build a CLT structure that's fire resistant, even with exposed CLT. Results from these tests will not only help inform building codes, but also provide useful information for property insurance groups, contribute to more accurate fire behavior modeling, and lead to safer firefighting in CLT buildings.

Researchers also conducted a series of blast tests on two-story structures made of CLT. The objective of these studies was to demonstrate the capability of CLT structures to resist airblast loads, thereby allowing the military to incorporate mass timber materials into their construction projects. The structures survived blasts with charges large enough to potentially cause lethal injuries.

Another critical part of the mission of FPL is to develop wood products that help pay for forest management. "On many forests where small diameter trees need to be removed to improve forest health, there must be product opportunities for that material that pay all costs, including logging and transportation," says Alan Rudie, FPL assistant director.

Thinning overgrown forests can reduce fire intensity and reduce the risk of beetle infestations, but the process is costly. Rudie explains how FPL researchers are looking to offset those costs by focusing on deriving chemicals with higher value than fuels from wood, and cellulose nanomaterials with high value as reinforcement materials in composites and as rheology modifiers.

Cellulose nanomaterials—wood broken down to the miniscule nanoscale—have incredible properties with strength greater than steel at one-fifth the weight, and are produced from a renewable resource, no less. Examples of potential uses for these materials include automotive and aircraft parts, food packaging, biomedical applications, and even "green" computer and cell phone components.

Cellulose nanomaterials are already solving problems in a variety of industries, as they are being used to keep things flowing for oil drilling in Canada and ink pens in Japan, keep diaper odors in check, and keep swim-

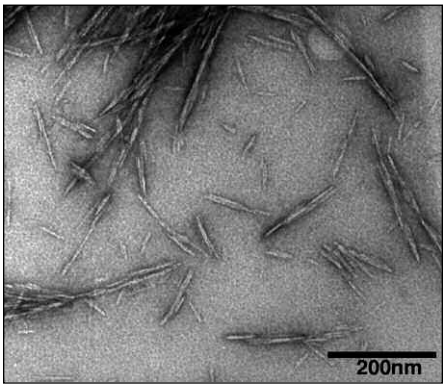

PHOTO COURTESY OF PURDUE LIFE SCIENCES MICROSCOPY CENTER

Cellulose nanocrystals as seen through a transmission electron microscope. Adding cellulose nanomaterials to concrete can improve its tensile strength by 30 percent.

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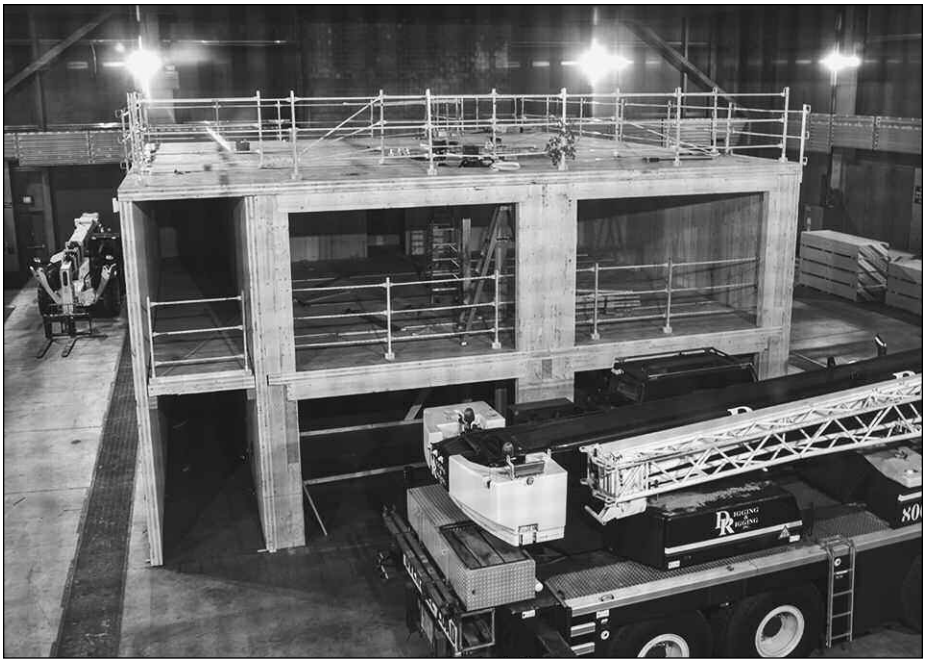

PHOTO COURTESY OF FOREST PRODUCTS LABORATORY

FPL researchers conducted a series of fire tests on a full-sized two-story CLT structure that showed it is possible to build a fire-resistant building using CLT.

ming goggles from fogging.

Long-time FPL partners at Purdue University found that adding cellulose nanomaterials to concrete can improve its tensile strength by 30 percent. Engineers and scientists at Oregon State University then helped bring the research to reality by conducting practical tests with a concrete truck and pours into various sized vessels to observe the material's properties. This research paved the way for the next step: a bridge recently built in California to test and demonstrate the capabilities of the material in a real-world application.

One aspect of research in FPL's Center for Wood Anatomy Research relates to the forensic identification of wood, which can also be important for forest products markets. According to FPL botanist Alex Wiedenhoeft, forest products derived from illegal logging are estimated to depress prices in the American forest products market by more than $1 billion per year. "The use of forensic wood anatomical techniques can be an integral part of forest product supply chain management and can help ensure the validity of certified forest products, as well as helping protect the global market from influxes of illegally logged material," says Wiedenhoeft.

FPL is working to capitalize on the wide range of research to support markets and implementation. Through the Forest Products Marketing Unit (FPMU) and the Forest Service Wood Innovations network, market development efforts include applied research, outreach, technical assistance, and various special initiatives. Beyond the research work in CLT and cellulose nanomaterials, FPMU is working to expand existing and emerging technologies and markets for torrefaction, biochar, wood energy for heat and power, thermal modified lumber, biofuels, and biochemicals.

These and a host of other research projects are conducted with the goals of healthy forests and healthy economies in mind. FPL research stimulates economic resilience in many sectors, including bioenergy, housing, tourism, and packaging and paper, all while helping remove barriers for innovative ideas to reach the marketplace. By producing high-quality, science-based innovation, FPL research quite literally improves the safety, comfort, and well-being of every American, every day. ◆

Rebecca Wallace is a public affairs specialist at the USDA Forest Service's Forest Products Laboratory in Madison, Wisconsin. She can be reached at 608-231-9275 or rwallace@fs.fed.us.

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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 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.

PHOTO COURTESY OF ERIC JEPSEN

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

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

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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-

PHOTO COURTESY OF TALLWOOD DESIGN INSTITUTE

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. ◆

Evan Schmidt is the outreach coordinator for TallWood Design Institute at Oregon State University in Corvallis. General inquiries about the TallWood Design Institute can be directed to tdi@oregonstate.edu.

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Right-Sizing the Future Forest Industry

BY RUSS VAAGEN

It's time to build a right-sized industry that adds value to the by-products of forest restoration. We need to discover what kinds of materials and how much will be generated over time with a new forest restoration program on federal, state, and other forestlands. We need to take this data and align it with existing and new mill infrastructure. These mills are the physical and financial tools needed to manage our forests. Many mills already exist, but more will be needed.

Much of this can be done by removing some of the self-imposed Forest Service policy constraints. My desire is to see the private sector, collaborative groups, and the Forest Service come together to build upon our successes. We need to make projects scalable and adapt them to each unique landscape. As we do this, we will be building a sustainable supply for the infrastructure of the future. State, tribal, and private forests will also benefit.

What does this future infrastructure look like? Mills will need to focus on efficiently using small- and medium-sized logs, which will be the most abundant core supply. Many of the companies successfully engaging in collaboration and Forest Service contracts have already invested in necessary technologies for the future. The mills that are in place need to be provided with enough supply to invest and expand. Stability and quality of log supply will provide the confidence to invest in areas currently devoid of milling infrastructure. This is the only way to finance wide-scale forest restoration. This work should more than pay for itself and current focus needs to be directed to areas that generate the most retained receipts.

The importance of mass timber

Mass timber is a very important development for all forests and related industries. It occurs to me that not everyone in the forest industry understands the benefits that mass timber presents. The most obvious is the amount of wood used per square foot of structure. We have the opportunity to go from studs at every 16" in walls and joists in the floor to solid wood, three to five layers thick. Think about how much wood that is. This will provide more consistent markets and value over time that should increase and stabilize the market for logs and lumber.

If we see product adoption like what has been witnessed in Europe and other parts of the world, this could have a dramatic effect on lumber consumption as a whole. If we start to see wood being used in buildings from 7 to 18 stories in place of steel and concrete structures, the effect could be profound. In October of 2018, new preliminary additions to the International Building Codes were approved for buildings up to 18 stories. Once this becomes permanent and more widely accepted, this will drive a serious expansion for the use of wood.

Forest Service and collaboration

The Forest Service has also taken notice of mass timber and sees this as an opportunity to restore more acres. If the Forest Service can put together a new program that allows them to execute on larger contracts over a longer duration, investors may look to put money into facilities in places like north central Washington, southern Idaho, eastern Oregon, Montana, Wyoming, Colorado, Arizona, New Mexico, Utah, California, Nevada, and even Alaska.

In my experience, the collaborative groups are eager and ready to go further and faster than the Forest Service. The reasons for this include: not enough budget, not enough staff, waiting to hear back from the regional office, and leadership changes. How many of these could be solved or improved with policy changes? Policy is part of it, but attitude is another.

We need to inspire confidence in people to make decisions to try new things. Collaborative groups have done much of this heavy lifting. We have seen solutions develop that are creating real log volume to mills. Now we need the Forest Service, at the highest levels, to help these collaboratives do more. The volunteer groups have been providing an incredible service to our public lands. It's time for the Forest Service to recognize the value of collaboration by putting money, resources, and projects to support it.

If we can combine the efforts of collaboratives with new changes to policy, we might have a fighting chance to save our forests from wildfires, insects,

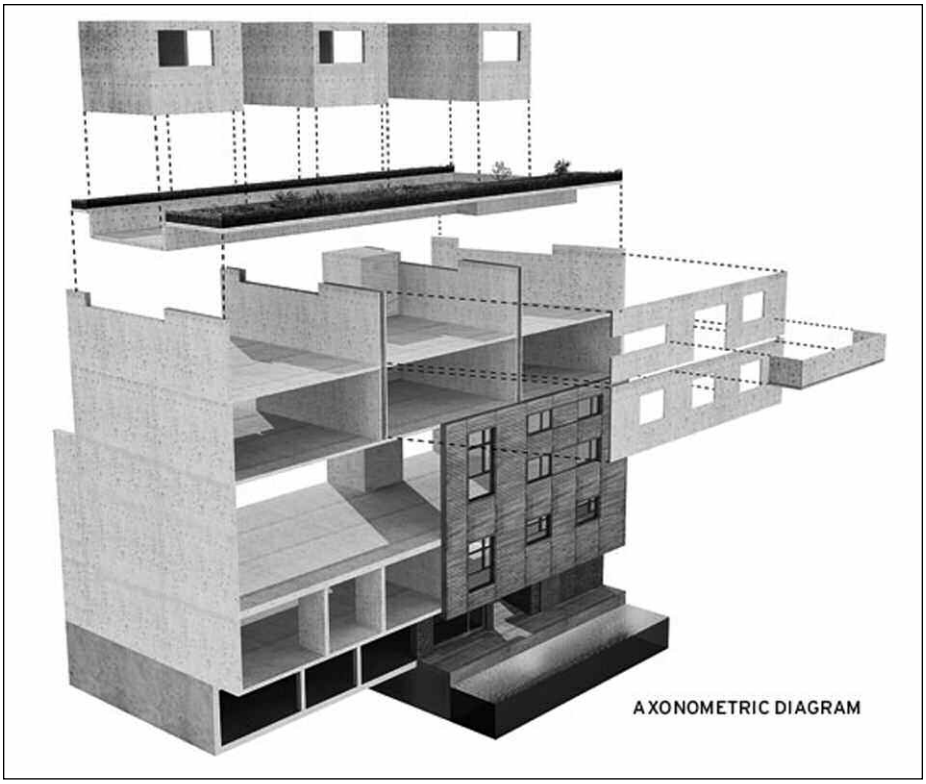

IMAGE COURTESY OF WAUGHTHISTLETON ARCHITECTS, LONDON, ENGLAND

This is a diagram of an apartment building in London. It shows how the massive elements of wood are used to construct the building.

and disease. The Forest Service is starting to realize this. Forest Service Chief Vicki Christiansen needs to continue to apply pressure and focus on changes to make the agency better and more confident. Doing this immediately will show Congress what changes need to be made to effectively restore our forests.

Environmental support

Environmental groups love the idea of CLT transforming the urban density from primarily steel and concrete to the natural elements of wood. Many environmental groups in the Northwest have been very proactive in the development of the mass timber market. Forterra, a Seattle-based environmental organization, has held several conferences on the subject. They have been working to bring leaders together to figure out how products like CLT benefit the environment and the community. Forterra isn't the exception. The Washington Environmental Council held the first ever "Carbon Friendly Forestry Conference" last year. I was asked to speak and I'm glad I did. The questions asked were good ones and I think participants walked away from that event believing that forestry and the products that go into mass timber products are better than they thought. There is tremendous support for collaboratively based forest restoration projects on our federal lands.

Added value

Mass timber allows forest products to add more value to the forest than ever before. This means that areas that used to have mills may again build a sawmill industry with newer technology that is aligned with the needs of the forest. This will add value to the government lands, but it will also allow the private landowners the opportunity to manage their forests as well. This added value in the form of mass timber production will add jobs in small communities, bringing high-paying professional jobs. Positions in engineering, architecture, electrical programming, production management, sales, and many others will infuse communities with the type of people that are assets to our communities.

Opportunity for forests

Forest collaboration along with the development of mass timber represents the biggest opportunity we've seen in a long, long time. We think this could make managing forests socially acceptable once again, showing our careers for what they are: valuable, honorable work to make our world a better place. It's been that way for a long time, but the story has been told in a way that did not accurately depict the benefits we provide as forest professionals. With the various types of people that are inspired by mass timber, this may be the opportunity we need to stand up, dust ourselves off, and be proud of the eco-friendly work that we do. ◆

Russ Vaagen is the founder and CEO of Vaagen Timbers in Colville, Wash. He also serves as the president of the Board of the Northeast Washington Forest Coalition and is the founder of www.theforestblog.com. He can be followed on LinkedIn, Facebook, YouTube, Instagram, and Twitter as Russ Vaagen. He can be contacted at 509-684-3678 or rvaagen@vaagentimbers.com.

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Innovative Wood Utilization

BY DAN SEMSAK

What changes are occurring in wood construction that could change the way timber is utilized? Let's look at characteristics of engineered wood products and how the characteristics of timber might affect them. Engineered wood products for structural use must meet minimum strength and stiffness criteria.

Engineered wood covers a broad range of products. The latest buzz centers around mass timber. Mass timber usually refers to CLT (cross-laminated timber) and glue-laminated timber beams and columns (glulam). Other mass timber products of limited production include DLT (dowel laminated timber), NLT (nail laminated timber), and MPP (mass plywood panels).

CLT is made of alternating, perpendicular layers of lumber glued together in massive panels, hence the name "cross-laminated." It is similar to the production of plywood in that sense. The layers are typically 2" x 6" that have been finger-jointed together into long lengths and then laid up side-by-side. The top and bottom layers are parallel. In a 3-ply panel, the alternating layer is perpendicular to those. This could continue into thicker panels of 5-ply or 7-ply. The current ANSI standard allows for #2 grade lumber for the parallel chords, including any parallel layers in the core of 5- or 7-ply CLT. Number 3 grade is allowed in the cross plies. Note that these are visual lumber grades. MSR (machine-stress rated) lumber allows CLT manufacturers to develop new recipes or lay-ups, which could provide more flexibility in the future.

Glulam beams and columns utilize MSR lumber for the lam stock. The highest strength grade of lam stock is tension lam, which is used for the bottom layer or "chord." The top chord is in compression, which also requires a high grade. As you move toward the center, lower grades are used where tension and compression factors are minimized.

CLT and glulam require straight lumber, small knots, square edges, and straight grain. The moisture content must be 12% or lower for proper adhesion. The drier the lumber, timber characteristics like compression wood that can cause warp and twist become more of a factor. Home center customers also want square-edge lumber—they just will not buy lumber with wane. Between mass timber and home centers, wane-free lumber demand will continue to increase.

Knots are a defect. Lumber produced in the Inland US and Interior Canada typically have smaller knots and knot holes than lumber produced on the coast.

LVL (laminated veneer lumber) is another engineered wood product with special needs. LVL is similar to plywood in that thin, typically 4' x 8' veneers are laminated in layers into various thicknesses. However, plywood is made up of alternating 90-degree layers—or cross plies. Veneer used in LVL is laid up unidirectionally with the veneer laid out like a fan of cards. Each veneer sheet is offset from the one below it, longitudinally. The veneers are lapped over the sheet in front. This allows for LVL to be laid up into virtually any length, typically 40' to 80' long, called billets. The billets are sawn into structural beams or high-strength dimension lumber and studs. The strongest veneer comes from the sapwood portion of the logs. Smaller logs have a higher percentage of sapwood. LVL producers, therefore, get most of their veneer from smaller logs.

The suitability of wood fiber for structural purposes is determined by its bending stiffness, bending strength, and density. LVL utilizes veneer that has been tested for strength using

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sound waves. Veneer testing machines can measure the ultrasonic propagation time (UPT) of veneer. The denser the material, the faster sound waves will travel through the wood fiber. The veneer for LVL is separated into different strength classes by UPT. On average, the veneer laid up into LVL with fastest sound waves of UPT graded veneer is stronger than the slower UPT graded veneer. Newer veneer testing machines can also determine modulus of elasticity (E), specific gravity, and density, helping to more efficiently utilize veneer. One challenge for LVL manufacturers is that very gradually over time, those strength values have been declining, forcing them to occasionally increase the ratio of the higher strength veneers into the recipe.

In recent years, some mills that produce lam stock for glulam beam manufacturers or veneer for LVL mills have been separating logs using stress wave timing/testing or bonking with stress wave tools. This allows for higher density logs to be targeted toward engineered wood products, resulting in higher yields of stronger lam stock or veneer.

Acoustic tools are a non-destructive method of predicting the stiffness of materials. They work by measuring the propagation of stress waves through wood, either by time-of-flight (over a fixed distance) or via resonance (vibration at the wood's natural frequency).

While veneer producers are happy with round logs, the lumber mills would love square logs. The goal of timber producers is to provide logs with straight grain, small to no knots, with no compression wood. Unrealistic? Yes, so what defects can be minimized by forest management?

What if, at the time of thinning a managed forest, the criteria for selecting trees to cut were not based on size? Knot sizes and number, straight grain, and sapwood percentage are more useful criteria. Stress wave tools can determine the soundness of the tree, particularly decay. Is it possible to quickly determine the density of each tree and leave those to gain mass until final harvest? Marketing of higher-value logs toward engineered wood products producers would be the goal. ◆

Dan Semsak is vice president, Sales and Marketing, for Pacific Woodtech Corp, in Burlington, Wash., where he oversees sales, transportation, and marketing programs. He can be reached at 360-707-2200 or dan.semsak@pacific-woodtech.com.

LVL beams used in floor framing. PHOTO COURTESY OF PACIFIC WOODTECH

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2019 PNW SAF Forestry Leadership Conference

February 1-2, 2019 – Pacific Northwest Leadership: Building Common Ground!

Forestry, natural resource managers and students from the Northwest are invited to participate in the 2019 Leadership Conference on February 1-2, at the McMenamins Edgefield in Troutdale, Ore. Participants will gain insights from the conference with the theme "Building Common Ground."

DRAFT SCHEDULE

DAY 1—FRIDAY, FEBRUARY 1

9:00 am Registration and Networking (Coffee and pastries provided)
9:15 Introductions and opening remarks—**Meghan Tuttle**, OSAF Chair
9:30 Keynote Address "Building Each Other Up in Leadership"—**Jessica Homyack**, Weyerhaeuser Company
10:15 Next Generation Leadership Panel: Hearing from emerging natural resource leaders
11:00 Collaborative Strategies: Breakout Session on building teams and leadership capabilities
Noon Lunch (provided)
1:00 pm Leadership Lessons from the SAF President—**John McNulty**, SAF President
1:30 Developing Leaders: Local Leadership Breakout Session
2:30 Networking Break

Case Studies: Natural Resources Leadership in Action

3:00 Deputy Chief Forester, **Nancy Hirsch**, Oregon Department of Forestry
3:30 Washington State Forester, **George Geissler**, Washington State DNR
4:00 Willamette Forest Supervisor, **Tracy Beck**, U.S. Forest Service
4:30 Leadership Icebreaker—Edgefield Scavenger Hunt led by students
6:00 Dinner (provided)

DAY 2—SATURDAY, FEBRUARY 2

8:30 am Coffee and Pastries (breakfast on own)
9:00-11:30 **Skills for Forestry Leaders**

Communications

- Top 5 communication skills required for any leadership role
- Breakout Session: How to have difficult conversations—**Sara Duncan**, OFIC

Advocacy in SAF

- Advocating for forestry through SAF
- Policy Panel—**Mark Buckbee** and **Ed Shepard**, OSAF Policy Co-Chairs, **John Bailey**, SAF National Policy Committee/OSU, and **Seth Barnes** OSAF Capitol Chapter Chair/OFIC

Mentoring

- Essential strategies for effective mentoring
- Mentoring across generational differences

11:30 Closing Comments: Leadership Action Items for 2019 and 2019 SAF calendar
Noon Lunch (provided) and closing icebreaker
1:00 Concurrent State Executive Committee Meetings

LODGING

McMenamins Edgefield, 2126 SW Halsey St., Troutdale, Ore., is a unique facility featuring 114 overnight rooms. Some rooms are equipped with private baths; the majority are European style lodging with bathrooms located in the hall. Group rates are discounted, but prices vary greatly based on room selection. Call 503-669-8610 by Nov. 30 and mention "OSAF-Leadership Conference" to receive the group rate for Jan. 31 and Feb. 1, 2019. Their online registration does not recognize group rates.

Best Western Plus-Cascades Inn and Suites, 23525 NE Halsey St., Troutdale, Ore., located .7 miles from McMenamins. Call 503-491-9700 for rates and availability. Includes complimentary breakfast.

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QUESTIONS?

Program: Meghan Tuttle, meghan.tuttle@weyerhaeuser.com
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Register online at https://bit.ly/2T5JW0D or complete registration form and mail to: PNW SAF Leadership Conference, SAF Northwest Office, 4033 SW Canyon Rd., Portland, OR 97221. Visa and MasterCard accepted. Checks payable to Oregon SAF. Contact Melinda Olson, SAF Northwest Office, 503-224-8046, melinda@forestry.org, with questions. Full agenda at www.forestry.org.

Calendar of Events

CESCL: Erosion and Sediment Control Lead Training 2-Day in Oregon, Jan. 9-10, 2019, Corvallis, OR. Contact: NWETC.

2019 Western Region COFE Seminar, Jan. 17, Eugene, OR. Contact: WFCA.

Growth Rings: Professional Development and Communication Skills, Jan. 23, Heathman Lodge, Vancouver, WA. Contact: WFCA.

Mapping the Course, Jan. 24, Heathman Lodge, Vancouver, WA. Contact: WFCA.

Basic Road Design Workshop, Jan. 29-Feb. 1, Corvallis, OR. Contact: FEI.

PNW Leadership Conference, hosted by Oregon SAF, Feb. 1-2, Troutdale, OR. *See registration info on opposite page.*

18th Annual Foresters Forum, Feb. 6-8, Coeur d'Alene, ID. Contact: info@forestersforum.com, www.forestersforum.com.

Cable Logging Workshop, Feb. 11-14, Corvallis, OR. Contact: FEI.

Alaska Legislative Breakfast, hosted by Alaska SAF Juneau Chapter, Feb. 14, Juneau. Contact: Ed Morgan, edmorgan4@msn.com.

SkylineXL Workshop, Feb. 15, Corvallis, OR. Contact: FEI

CESCL: Certified Erosion and Sediment Control Lead Training, Feb. 20-21, Lynnwood, WA. Contact: NWETC.

81st Annual Oregon Logging Conference, Feb. 21-23, Lane County Convention Center and Fairgrounds, Eugene, OR. Contact: oregonloggingconference.com.

2019 Oregon Chapter of The Wildlife Society annual meeting, Feb. 27-Mar.1, Bend, OR. Contact: ortws.org/2019-annual-meeting.

International Mass Timber Conference, March 19-21, Oregon Convention Center, Portland, OR. Contact: www.masstimberconference.com.

Variable Probability Sampling, March 25-29, Oregon State University, Corvallis, OR. Contact: blogs.oregonstate.edu/variableprobability.

NWSA 90th Annual Meeting, March 26-29, Lewiston, ID. Contact: www.northwestscience.org.

Washington State SAF annual meeting, April 3-5, Port Angeles, WA. Contact: Joe Murray, abies@olypen.com.

Oregon SAF annual meeting, April 17-19, Boulder Falls Inn, Lebanon, OR. Contact: Jeremy Felty, jeremy.felty@oregonstate.edu.

Alaska SAF annual meeting, April 24-26, Anchorage. Contact: Trevor Dobell-Carlsson, trevor.dobell@alaska.gov.

The Hagenstein Lectures Special Event: A Conversation with John Maclean, May 2, Miller Hall, World Forestry Center, Portland, OR. Contact: www.hagensteinlectures.org/special-events.

Contact Information

FEI: Forest Engineering Incorporated, 541-754-7558, office@forestengineer.com, www.forestengineer.com.

NWETC: Northwest Environmental Training Center, 425-270-3274, nwetc.org.

WFCA: Western Forestry and Conservation Association, 503-226-4562, richard@westernforestry.org, www.westernforestry.org.

Send calendar items to the editor at rasorl@safnet.org.

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Steven Louis Klein, 65, originally of Chevy Chase, Md., died at his home in Corvallis, Ore., on July 6, 2018. He is survived by his son Jonathan Aaron Klein; siblings Linda Klein McAuliffe, Gary A. Klein, and Michael I. Klein; and many nieces and nephews. He is preceded in death by his parents, Beverly C. Klein and Joseph S. Klein.

Steven had a love for the outdoors and a deep passion for the environment and natural resource preservation. He recently retired after a 42-year career in environmental science and research. He worked for the U.S. Forest Service from 1979 to 1986 on the Umpqua and Winema National Forests in Oregon. Steven then worked for the Environmental Protection Agency in various technical and management positions. At the EPA, Steven's research focus was on climate adaptation, water, forests, and natural resource planning. Most recently, he led a collaborative study, coordinating with state agencies, other federal agencies, and non-governmental organizations involved in the arena of climate change science and policy to consider how projected climate change impacts could be incorporated into the Clean Water Act and salmon recovery in the Pacific Northwest. The final 3-volume product of his research represented the culmination of a 4+ year effort that provides a basis for forest and salmon management in the Pacific Northwest.

Steven earned a B.A. in Forest Management from Mississippi State University (1978), completed post-graduate studies at the Silvicultural Institute; Oregon State University—University of Washington (1984) and held a certificate in Strategic Planning; American Management Association (1990). He was an active member of the Society of American Foresters and the American Society of Adaptation Professionals.

Sharp-witted, funny and thoughtful, Steven loved his family and his work and will be deeply missed. In lieu of flowers, donations can be made to the ALS Association, PO Box 37022 Boone, IA 50037 (www.alsa.org/donate). ◆

Using Torrefaction Process, Low-Grade Materials Turn into a Coal Substitute

BY JOE KOERNER

Oregon Torrefaction, LLC (OTL) is an Oregon benefit company formed to develop and serve a market for biomass to support forest restoration activities. With a mission to advance forest health and rural, forest-rich community vitality, the company is developing the first commercial-scale torrefaction facility to demonstrate production that achieves the cost, quality, and product volumes needed to allow the torrefied biomass market to fully develop. OTL also focuses on the use of forest restoration residuals, which further achieves the mission and that of partners U.S. Endowment for Forestry and Communities (Endowment) and the USDA Forest Service.

Efforts are focused on forest restoration-based projects, recognizing that for a reliable, large volume market to emerge, forest-based fuel sources and multiple facilities will be necessary. The Endowment is the principal funder and has formed Restoration Fuels, LLC (RFL) to operate the facility.

Torrefaction is the roasting of renewable wood or biomass in the absence of air to make it crispy enough to be crushed to a fine powder. It serves as fuel to replace fossil coal at power generation stations. A medium-sized coal power plant can consume 8,000 tons of fuel per day, which equates to substantial market pull.

Our experience

In 2016, Oregon Torrefaction signed a purchase order with Portland General Electric (PGE) to be the sole supplier of torrefied biomass for testing at PGE's 600 MW Boardman Coal-fired Power Plant. Five thousand tons of torrefied biomass fuel was provided in a four-month period to support PGE's five test burns, including a 100% test. These successful tests demonstrated that torrefied biomass fuel can be substituted 100% for coal in an existing power plant with few plant modifications. This in-depth experience puts Oregon Torrefaction at the forefront of this emerging industry.

PHOTOS COURTESY OF WAYNE LEI

Five thousand tons of torrefied biomass was processed at the Boardman Power Plant and used as a coal replacement in late 2016 and into 2017. Torrefied fuel is received either as densified pellets or briquettes—in the case of Boardman, they received pellets. The crushing to a fine powder is performed by the pulverizers at the power plant, an action that emulates how coal is processed at a coal-fired power plant.

Restoration Fuels, LLC—Grant County Project

The torrefaction facility is co-located at the Malheur Lumber mill in John Day, Ore. The site is owned by OTL's operational partner, Ochoco Lumber, which brings decades of local fiber sourcing, lumber mill, and white pelleting experience. The facility will sustainably source biomass from national forest restoration activities on the Malheur, Ochoco, and Deschutes national forests, as well as biomass from private land management and mill residuals. Biomass from national forests will have been vetted for environmental impact through the National Environmental Policy Act (NEPA) requirements and termed "shelf ready."

The torrefied fuel will be sold to domestic and off-shore utilities under long-term contracts and in smaller quantities to facilitate expanded power plant testing and market development. The location in John Day with nearby rail trans-shipment in Prineville, Ore., facilitates local, regional, and international deliveries. The facility in Grant County will have a 100,000 ton per year production capacity, but will undertake a phased ramp up with initial production beginning in the second quarter of 2019 at 40,000-50,000 tons. ◆

Joe Koerner is the restoration fuels plant manager for Restoration Fuels, LLC. He can be reached at jakwsu@yahoo.com.

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Mass Timber Project Hopes to Create Home Court Advantage

ARCHITECT RENDERING OF THE IDAHO CENTRAL CREDIT UNION ARENA AT THE UNIVERSITY OF IDAHO IN MOSCOW, IDAHO. (COURTESY OF IDAHO ATHLETICS)

This wood engineered facility will be a game-changer for University of Idaho student-athletes, students, alumni, and the greater Moscow community as a modern and comfortable gathering space. The ICCU Arena will demonstrate how Northwest wood can be a lower-cost, green option. The Sustainable Forestry Initiative is partnering with UI to document the chain of custody and feature the ICCU Arena as a sustainable showcase facility to a global audience.

In the future, the University of Idaho's (UI) planned Idaho Central Credit Union (ICCU) Arena will not simply be a building, but a well-appointed, tasteful home to men's and women's basketball games, concerts, and convocations.

Now, though, it is a vision of what architecture and wood can create. Most important, it is a bold statement of what UI can and should be, according to Michael Perry, UI special projects fundraiser who is responsible for getting ICCU Arena paid for.

The $51 million project—$48 million for the building and the remainder for associated infrastructure improvements, such as new electrical service to the arena and to the Kibbie Dome and UI law school—will fulfill a facilities wish at Idaho for a new basketball venue that has been unrequited since 1969.

On a field just north of the dome, the 4,200-seat arena, practice court, coaches offices, locker rooms, team lounge, and alumni gathering room will rise from campus in flowing lines that mirror the rounded Palouse hills surrounding it.

Built of wood harvested from UI's Experimental Forest, some of it fashioned into massive laminated beams by Boise Cascade, and hauled by Jack Buell Trucking to a campus site prepared by Buell, the building will be unique in the US.

The partnership between a number of Idaho timber companies, industry associations, and the university to build a mass timber arena is unheralded. The closest similar athletic site is the 8,000-seat Richmond Olympic Oval that hosted speed skating at the 2010 Vancouver Winter Olympics. StructureCraft Builders, which developed the roof design for the Richmond Oval, is also involved in UI's project.

The dramatic building attracted proposals from 15 architectural firms, Perry said. "The industry is buzzing," he said.

UI settled on Opsis Architecture of Portland as principal architect. Hastings and Chivetta, a firm with experience building arenas, will oversee the interior design, and KPFF Consulting Engineers, with an office in Boise, is on board as a consultant.

Since seizing on a Seattle architect's proposal several years ago for a wood-engineered arena using mass timber construction, UI is fulfilling its mission as Idaho's land grant university and flagship higher education institution, Perry said.

The university has inspired the Idaho timber industry and the U.S. Forest Service with a $250,000 grant to get behind a mass timber arena that will be a demonstration project for similar construction that can boost the industry, Perry said.

The audacity to solicit seven-figure donations for a $51 million capital project signals UI has broken through to a new level of philanthropic expectation.

"Cost was important," Perry said. "But at the end of the day, we wanted an iconic structure, a showcase for North Idaho and the university, and that's exactly what we're getting."

So far, $38 million has been raised. The key gift is a $10 million donation from ICCU. It is the biggest donation in UI's history. "We had the courage to ask for it," Perry said.

UI is working with a handful of other significant donors. The ICCU gift sets a benchmark for what the university is willing to pursue for this and future projects.

"At every institution that received a million-dollar gift, people realize there is now a different level," Perry said. "ICCU rang the bell in spades for us. The UI is worthy of the highest levels of philanthropy to fulfill the mission of the institution."

The mass timber arena is coming

(CONTINUED ON PAGE 23)

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Policy Scoreboard

Editor's Note: To keep SAF members informed of state society policy activities, Policy Scoreboard is a regular feature in the Western Forester. *The intent is to provide a brief explanation of the policy activity—you are encouraged to follow up with the listed contact person for detailed information.*

OSAF Approves Updated Position Statement on Clearcutting. At the September 21 OSAF Executive Committee Meeting in Corvallis, an updated version of our Position Statement entitled "Clearcutting" was approved by the ExCom. Only minor changes were made to the existing position. The core position states that OSAF *"supports the careful use of clearcutting as a tool for meeting diverse management objectives, including desired conditions for the regeneration and health of important forest types. Many of the forests seen today in western Oregon were established after clearcutting, which demonstrates its effectiveness in regenerating native species such as Douglas-fir. Current laws include many measures that regulate the use of clearcutting on Oregon's private and public lands. Professional foresters and other specialists draw from a strong foundation of science and experience to further ensure that clearcutting is applied with prudent consideration of environmental, economic, and social concerns."* The updated statement can be found at www.oregon.forestry.org/oregon/policy/general. Contact: Mark Buckbee, OSAF Policy co-chair, buckbeefamily@msn.com.

New Watershed Study Articles Address Important Water Resource Concerns. Questions and concerns about water resource impacts of timber harvest and related practices continue to arise in public discussions of the efficacy of existing policies for forestry. Among the challenges in addressing such issues is that much of the research about the effects of forest management on water resources was done many years ago and thus does not reflect the likely benefits of newer practices and policies. To help close this knowledge gap, the Watershed Research Cooperative (WRC) conducted long-term watershed studies in three different areas of western Oregon where contemporary logging and other improved practices were used. After many years of data collection and analysis, WRC authors recently published some key findings of these important studies, which are very encouraging with regard to contemporary practices. Among the most recent reports are those that highlight effects on stream temperature (https://bit.ly/2mrI0QN), sediment (https://bit.ly/2LvOuc6), and fish (https://bit.ly/2muDUYh).

Two other recent publications should be especially useful to OSAF members who interact with interested citizens and public leaders as concerns are raised about regulations for private forest management. In February, the Oregon Department of Forestry updated its booklet that includes all the operational rules and statutory requirements under Oregon's Forest Practices Act (https://bit.ly/2LnYYNV). Similarly, this summer the Oregon Forest Resources Institute released its 3rd edition of "Oregon's Forest Protection Laws—An Illustrated Manual (Available at: https://oregonforests.org/publications). Together, these two publications span 350+ pages of detailed requirements that forest managers and operators must follow in Oregon. Contact: Mark Buckbee, OSAF Policy co-chair, buckbeefamily@msn.com.

Herbicide Spray Issue Could Reemerge Locally or in Salem. Although an initiative to ban aerial spraying in Lane County was kept off the May ballot by a local court ruling, it would not be surprising to see a modified version or other similar proposals directed at the state legislature next year. The recent update and revision of OSAF's position statement "Using Herbicides on Forestlands in Oregon" provides an important resource as questions and concerns arise from interested citizens and public leaders. For example, as the Lane County issue arose earlier this year, OSAF leaders used the new position to help draft responses to provide Lane County citizens with a professional perspective on herbicide use in forestry. All OSAF members are invited to review the expanded discussion and environmental references in the revised position (www.oregon.forestry.org/oregon/policy/general), and similarly use this material when communicating with policy makers and the interested public about this important issue. Contact: Mark Buckbee, OSAF Policy co-chair, buckbeefamily@msn.com. ◆

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Inland Empire Exits Northwest Office Partnership

BY STEVE PILKERTON, CF

Effective January 1, 2019, the Inland Empire SAF (IESAF) will no longer be affiliated with the SAF Northwest Office (SAFNWO). The decision is the result of a membership vote that concluded in August 2018 where 53.5% of the membership (26 responses) voted to withdraw and 46.5% (20 responses) voted to stay. This issue of the *Western Forester* is the last print edition Inland Empire members will receive.

The SAFNWO was established in 1965 by the Oregon and Washington State Societies to provide services and support to SAF units and members as directed by the Northwest Office Committee. Both Inland Empire and Alaska SAF joined the SAFNWO in 2012. In addition to providing internal SAF support, the SAFNWO also produces the *Western Forester* and manages our regional website at www.forestry.org.

I believe the strength of SAF is rooted in the local chapters and membership. SAF has multiple organizational levels, which depends on leadership development at the local and regional levels to support the national organization. The SAFNWO, both the paid staff and the volunteer committee structure (four members from each participating state society plus ad hoc members), provides continuity and institutional memory that results in a resource base of knowledge, experience, abilities, and skills for rotational leaders (experienced and developing) to help them achieve their objectives.

The Northwest Office Strategy Group and the Northwest Office Committee met in November and are transitioning to the new structure of a three-state partnership with Oregon, Washington State, and Alaska Societies. ◆

Steve Pilkerton, CF, is a past chair of the Oregon SAF and is chair of the SAF Northwest Office Committee. He can be reached at steve.pilkerton@oregonstate.edu. An article about the SAF Northwest Office partnership written by Alaska SAF member Brian Kleinhenz appeared in the September/October 2017 issue of the Western Forester *and is available at https://bit.ly/2OwHCvX.*

Mass Timber Project Hopes to Create Home Court Advantage

(CONTINUED FROM PAGE 21)

into being because two UI administrators—who will not be at the university when the ICCU Arena is opened in 2021—saw its possibilities and believed in it. Former athletic director Rob Spear was fired by the Idaho State Board of Education this year, and UI President Chuck Staben learned in May his contract will not be renewed at the end of the academic year.

"When Rob presented the idea to (Staben, he) saw what it could mean to this campus," Perry said. "He threw the weight of his presidency behind it."

The announcement of the ICCU gift in January sparked a burst of excitement about the arena project.

While that has quieted, behind-the-scenes momentum on the remaining fundraising continues unabated, Perry said. Idaho is committed to groundbreaking in April.

"We're all in," Perry said of the long-anticipated arena. "This is going to happen." ◆

—*Reprinted from* The Spokesman-Review, *Oct. 4, 2018*

ARCHITECT RENDERING OF THE IDAHO CENTRAL CREDIT UNION ARENA AT THE UNIVERSITY OF IDAHO IN MOSCOW, IDAHO. (COURTESY OF IDAHO ATHLETICS)

The practice court utilizes retractable seats that can be rolled back when needed.

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