CASE STUDY
Oregon State University – Cascades
Edward J. Ray Hall

New campus building makes meaningful use of mass timber
When Corvallis-based Oregon State University (OSU) established a new campus 130 miles away in Bend, they demonstrated their commitment to becoming a model for innovation and sustainability by locating the new 128-acre campus on the site of a reclaimed pumice mine and former landfill. OSU furthered that commitment to sustainability by setting goals that new facilities meet net zero energy design standards, and by having Edward J. Ray Hall, a new building for science, technology, engineering, arts and math (STEAM), contain a meaningful use of mass timber. 
OSU will realize numerous long-term benefits from these requirements. The net zero energy target sets a standard for all future campus development, reducing energy use for decades to come. Mass timber building elements were used to minimize embodied energy and enable increased building depth to improve the health of the forest. Using wood allowed for an exciting and unique project when compared with other materials, and prefabricated mass timber presented unique opportunities for fast, cost-effective construction.

The design team also applied innovative principal concepts to optimize the structure, adding to its cost-effectiveness. Edward J. Ray Hall will serve as the prototype for OSU's future campus expansion, combining pioneering design with flexible academic spaces that can be adapted to accommodate future growth.

With seven classrooms, 12 laboratories and a mix of collaborative and quiet spaces, Edward J. Ray Hall was built to house classes for the university's rapidly growing STEM programs. The four-story structure in front of the open air plaza, cascading plazas that will eventually lead to other campus buildings.

In 2019, OSU sponsored a design competition for the project as part of the architect selection process. Understanding that the use of mass timber was an important requirement, SRG Partnership proposed a hybrid structure—steel beams and columns with cross-laminated timber (CLT) decking—assuming it would be the least expensive. But when Swinerton joined the project team, they demonstrated that an all-mass timber structure would cost less. "Our company has done nearly 30 mass timber buildings, so we understand that its advantages come through smart design and knowing how to take advantage of prefabrication and construction efficiencies relative to other trades," said William Silva, Swinerton's Director of Preconstruction.

The design evolved to a glulam post-and-beam frame with CLT floor and roof panels, based on a modular grid to allow future modifications. "OSU had three specific requirements: they wanted a flexible and adaptable structure, a meaningful use of mass timber, and a net zero energy-ready building," said Lisa Petterson, a Principal with SRG. "We initially wondered how we could afford to do it all, but were surprised and pleased to learn that a full mass timber frame would be less expensive. In the future, our first go-to design option will be an all-mass timber system."
vibration, we found we could step down from a 5-ply stress-rated CLT panel, which provided a significant cost-savings—between $5 and $10 a square foot. This reduced the overall building weight as well, which cut the amount of concrete the building needed for shear walls and foundations."

The layout also eliminated the need for perimeter girders, which allowed windows to extend to the underside of the CLT floor above, bringing daylight farther into the rooms. Classrooms have no drop ceilings; the major mechanical systems run through the corridors. Air ducts feed from the corridors into the rooms but do not extend through the ceilings, existing visual impact and leaving the CLT ceilings fully exposed to the spaces below. Plumbing and electrical conduits for lab requirements such as fume hoods and lighting were run through the concrete topping sides of the floors above and routed through the CLT panels, built for a clean aesthetic and future flexibility.

“For us, it's just about being flexible and adaptable today,” said Dave Peterson, Director of Buildings and Operations for OSU Cascades. “It's about having buildings that we can reconfigure in 15 or 20 years as our educational requirements change. This structural system gives us the ability to do that.”

E-Rated CLT Panels
One of the keys to cost savings with the Edward J. Ray Hall project was the design team’s use of E-rated CLT panels. Panels with a grade of E1 through E5 are manufactured using machine stress-rated (MSR) lumber for longitudinal layers (layers parallel to the major axis) and visually-graded lumber for transverse layers. This differs from CLT grades V1 through V5, which use visually graded lumber for both longitudinal and transverse layers.

"Because the strength properties have been mechanically measured and verified, we know the minimum engineered properties of each piece of MSR lumber," explained Russ Vaagen, CEO of Vaagen Timbers. "This means that all E-rated CLT panels have more predictable strength and stiffness properties, which means better vibration performance. Even though they were thinner, the E-rated panels for Edward J. Ray Hall could span further.”
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Silva added, “Our ability to go with a 3-ply CLT panel was driven in part by our decision to run four inches of structural concrete topping on top of the slab. When we played with the bay spacings, we learned that the 10-foot span worked with a 3-ply panel if the panel was E-rated. This optimized the fiber within the structural frame while still meeting the layout needs of the classrooms, labs and other spaces within the building.”

Sustainability Goals

OSU Cascades has ambitious sustainability targets for their long-range development plans, and they wanted the design of Edward J. Ray Hall to set the standard for future campus buildings. The project team approached the challenge by:

• Specifying a renewable, sustainable building material. Using mass timber reduced the embodied carbon of the structure when compared with other building materials like steel or concrete.

• Setting net zero energy, water and waste goals and using best design practices to reduce the operational energy needs of the building.

• Limiting solar heat gain by orienting the building in an east-west direction, adding large windows with vertical shading devices and broad overhangs to protect the interior from sun in this high-desert location.

• Powering the building using geothermal energy, with a groundwater-based exchange system that connects with an aquifer 500 feet below the surface. This system will provide year-round heating and cooling for the entire campus.

• Optimizing the building envelope for energy efficiency, taking advantage of CLT’s thermal mass and balancing the heating and cooling systems against the glazing percentage.

• Taking advantage of daylighting so that most classrooms can be used without electrical-powered lighting during the day. The structure was designed with no perimeter beams, which allowed windows to extend higher, bringing daylight further into each room.

“Improved daylighting was critically important in our ability to deliver a net zero energy building, and mass timber helped us manage the glazing area,” said Silva. “The mechanical distribution systems also fit well within the mass timber layout, and the fact that mass timber has thermal insulating properties helped improve our envelope rating.

There are so many strategies we can use when we take advantage of mass timber’s benefits.”

Making the Most of the Forest Resource

Forest management played an important role in the makeup of the CLT used for Edward J. Ray Hall and added to the environmental story so important to OSU Cascades.

Lumber used to produce the panels came from Vaagen Brothers Lumber, an independent mill that specializes in processing small-diameter logs. The logs are cut into dimensional lumber—2x4s and 2x6s—and turned into mass timber products like CLT.

“This means our CLT is really a byproduct of forest restoration efforts,” said Russ Vaagen, president of Vaagen Brothers Lumber. “Our selective harvest methods improve the forest; removing small trees and dense undergrowth leaves more room for larger trees to grow, creating a healthier forest that is better able to sustain forest fires and disease.”

Thousands of acres of coastal Northwest forests, including those on private, state, federal, tribal and city-owned lands, have been damaged by wildfires in recent years, making active forest management and thinning operations more important than ever.

How important? The project team worked with forest product experts to measure the impact on forest health and jobs created as a result of the wood products used for Edward J. Ray Hall. They found that more than 60 acres of improved forest health can be attributed to this one project, which created and supported jobs in seven Washington and Oregon counties.

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Creating Healthy Forests

Communicating a positive story about timber harvesting can be challenging. And while some designers turn to certified lumber for assurances of sustainable harvesting, there are other options.

“We think it’s a fair question when people ask how cutting trees can be good,” Vaagen said. “We lean into that by letting them know Edward J. Ray Hall is helping to create a healthy forest. It’s a better place long after the trees are gone.”

“As a mass timber project, we were able to store carbon in the school while it was being built,” Petterson added. “It was a multifaceted challenge but I’d do it again in a heartbeat.”

In addition to setting a standard of sustainability for the campus, OSU wanted a building where students felt comfortable to linger after class. “Mass timber helped us elegantly and efficiently create a warm and inviting space in a way that steel and concrete couldn’t,” Pitman said. “It was a multi-layered challenge to pull that off. And I look back on it now and I couldn’t be more pleased with how it turned out.”

OSU Cascades – Edward J. Ray Hall

Volume of wood products used:
- 71,645 cubic feet

U.S. & Canadian forests grow this much wood in:
- 6 minutes

Carbon stored in the wood:
- 1,803 metric tons of CO₂

Avoided greenhouse gas emissions:
- 697 metric tons of CO₂

TOTAL POTENTIAL CARBON BENEFIT:
- 2,500 metric tons of CO₂

529 cars off the road for a year

EQUIVALENT TO:
- Energy to operate 264 homes for a year


Note: CO₂ on this chart refers to CO₂ equivalent.

Photos: SRG Partnership, Inc.; Swinerton (construction images); Plum Creek (forest image)

Reducing Carbon Footprint

The use of wood lowers a building’s carbon footprint in two ways. Wood continues to store carbon absorbed by the trees while they were growing, keeping it out of the atmosphere for the lifetime of the building—longer if the wood is reclaimed at the end of the building’s service life and re-used. Meanwhile, the regenerating forest continues the cycle of carbon absorption. Wood products also capture energy to produce from sustainably harvested materials, and most of that comes from renewable biomass (e.g., bark and sawdust) instead of fossil fuels. Stabilizing forest for forest conservation makes a way to stem greenhouse gas emissions and reduce embodied carbon.

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