Buildings, and many of the methods of their construction, are the single greatest collective source of CO₂ emissions in the US. The steel and concrete we use to make the mixed-use, high-density buildings we see all around us account for about eight percent of annual anthropogenic global greenhouse gas emissions and are the first and second largest sources of industrial carbon emissions in the country.

But as it turns out, a green alternative to building with steel and concrete is being produced right here in Oregon. Cross-laminated timber, or CLT, is an engineered wood product that has gained popularity among architects and engineers as a building material. It’s made of layers of wood that have been glued together and pressed. Its strength, durability, and versatility are comparable to steel-reinforced concrete. CLT is sustainably manufactured, and unlike steel and concrete it sequesters carbon.

In Portland, several architecture and engineering firms are already designing and building with CLT, the most notable of which is Lever Architecture, the firm behind the twelve-story Framework building (pictured left), which will be the country’s first wooden skyscraper when completed in 2017.

“CLT has elevated structural timber to new heights,” said School of Architecture professor Corey Griffin. “With CLT we have a plainer, two-dimensional product that is as strong as concrete, fire-resistant, and can be used in floor diaphragms and lateral load-bearing walls like those in the center of high-rise buildings. CLT can open the door to taller, mixed-use wooden buildings that weren’t possible before.”

Griffin’s research focuses on structural systems and green buildings. His colleague, Civil and Environmental Engineering professor Dr. Peter Dusicka, is an earthquake engineer whose research focuses on developing and testing components and materials that improve building stability and promote return to occupancy during and after seismic events. Working together, Dusicka and Griffin are positioning PSU as a major partner in Oregon’s expanding CLT ecosystem.

Griffin has previously studied barriers to the adoption of CLT as a building material and mentored...
graduate students whose research focused on building with engineered wood products. Dusicka, who directs PSU’s Infrastructure Testing and Applied Research (iSTAR) lab, works with consultants designing wood components for use in the Framework building, validating the “earthquake-readiness” of their designs. The two recently received a $400,000 NSF grant to address critical system-level technical and non-technical barriers to designing and erecting seismically resilient high-rise buildings with CLT panel structural cores.

The project’s three major components include developing, modeling, and testing system-level designs and components for seismically resilient buildings with CLT structural cores; assessing the current state of nontechnical barriers to widespread adoption of CLT as a building material; and creating educational materials to disseminate the results of their work to industry professionals and students, and to promote building with wood. According to Dr. Dusicka the project includes students from the Green Building Scholars program, an NSF-funded scholarship program at PSU that connects engineering and architecture students with interdisciplinary educational opportunities focused on reducing the environmental impact of buildings.

“The project is representative of PSU’s position as a regional leader for green building research and education,” Dr. Dusicka said. “I think Oregon—and Portland, in particular—is set to become a leader in green building design, construction, and the manufacturing of sustainable building materials, and PSU has a central role to play in that.”

For cities trying, like Portland, to meet the housing needs of a growing population while reducing their carbon footprint, CLT is a promising building material, but there are questions that need to be answered before cities begin approving plans for high-rise wooden buildings. Chief among those questions in regions like the Pacific Northwest are: can a building made with CLT withstand seismic forces during an earthquake, and will that building be safe to reoccupy when the shaking stops?

“There are currently limits on how tall you can build structures made of wood because there are a number of questions that have yet to be answered,” Griffin said. “We want to answer those questions and provide evidence showing you can safely build seismically resilient wooden skyscrapers in places like the Pacific Northwest.”

Testing CLT components in the iSTAR lab, image courtesy Tyler Williams