New research will lead to better design of sustainable wooden buildings

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The annual rings of a tree not just tell us how old it is, they are also vital to the strength and stiffness of wood. A new project from Linnaeus University has received SEK 3 million from Formas to study the mechanical properties of wood using both computer models and advanced experiments. The results will provide important scientific bases for the use of cross-laminated wood in buildings.

Plywood is a well-known board material, composed of several layers of thin wood veneers (lamellae) laid up with rotating the grain direction 90 degrees to each other, glued and pressed together. This makes the board strong and stable, thus useful in everything from furniture to boats and buildings.

Cross-laminated timber (CLT) is like plywood in a larger scale, with at least three layers of solid wood boards with a thickness between 12 and 45 mm each. CLT is used to manufacture entire construction elements such as floors and walls of buildings, and is becoming more and more popular. At the same time, it has only been used for twenty years and the need for research in this area is therefore large. Dimensional calculations are mainly based on experiments, but advanced, computerized calculation models are missing. Therefore, the new project "Compression perpendicular to the grain in cross-laminated engineered wood-based products" is of great importance to the construction industry.

"We want to contribute to the development of design criteria for cross-laminated timber through research that increases the scientific knowledge base. Specifically, we will examine how the material properties affect the performance of the products when used in timber structures," says Thomas Bader, Senior Lecturer at the Department of Building Technology and Project Manager.

Wood is a building material with exceptional mechanical properties. The wood material itself consists to 70 % of cavities, located in the middle of the wood grains (cells), while the cell walls have high strength. Another important factor in how wood behaves when compressed is the annual ring structure.

The goal of the project is to develop a computerized calculation model that describes the relationship between the properties and the behavior of wood as a material, and what happens to cross-laminated timber subjected to compression perpendicular to the grain. Laboratory experiments with an advanced system for measuring deformations under mechanical loading will provide confirmation, validation and calibration of the model.

"Using the model, we can examine how cross-laminated wood products are affected by the lamellae, such as the number, thickness and orientation, by the material's properties, such as the pattern of annual rings, and loading and support conditions. Our research on the relationship between CLT products' structure and function creates valuable knowledge that will lead to improved dimensioning and design rules for sustainable wooden structures in the future," concludes Thomas Bader.

Provided by Linnéuniversitetet

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