RESEARCH in Progress

Coalition for Advanced Wood Structures
a university, industry, government partnership

Evaluating Hygrothermal Performance of Interlocking Cross-Laminated Timber Walls

Cross-laminated timber (CLT) is a multilayer panel made of lumber, with each layer aligned perpendicular and joined to adjacent layers for rigidity and dimensional stability. Over the past two decades, CLT has become established in Europe for use as prefabricated structural members in floor, wall, and roof assemblies. This construction method is gaining interest in North America, but widespread adoption would require development of production capacity, design standards, and code acceptance. One essential aspect of building design is the durability of the building envelope. This study will investigate the thermal and moisture performance of interlocking cross-laminated timber (ICLT) wall assemblies in various U.S. climates.

Background

Unlike other solid wood panel systems, ICLT panels are manufactured without the use of adhesives or fasteners. Wood members are connected with tongue-and-groove joints within a given layer and with dovetail joints across layers. This reduces cost and allows ICLT panels to be disassembled at end of life to be repurposed in the building material supply chain. In addition, ICLT panels provide a means to utilize lumber from trees killed by mountain pine beetle.

Durability is critical for sustainable construction, and avoidance of moisture accumulation in wood structural members is essential for long-term performance. Little work has been done specifically on hygrothermal performance of massive timber construction.

Objective

The objective of this research is to identify building envelope design and construction practices for robust hygrothermal performance of ICLT walls in multiple U.S. climates.

Figure 1. Cross section of an ICLT panel showing tongue-and-groove joinery and dovetail joinery. ***Photo by Ryan Smith***

Approach

The study will involve computer modeling and laboratory testing with a unique state-of-the-art facility. An initial one-dimensional hygrothermal analysis using a computer simulation model will evaluate multiple design options in various climates and will aid in the design of laboratory experiments. The main parameters of interest in the simulations include climate, ICLT panel thickness, placement of thermal insulation (exterior or interior), thickness of insulation, vapor permeance of the wall assembly, level of air leakage, and level of wind-driven rain intrusion.

Laboratory testing will investigate ICLT wall assembly air tightness and moisture performance under exposure to simulated weather conditions. Tests in the FPL durability chamber will represent several different climates and will compare various wall constructions. Each test will run for at least a month. Moisture and temperature conditions within ICLT walls will be monitored to understand wetting and drying behavior. In addition,

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Figure 2. Building being constructed using ICLT panels. *Photo by Ryan Smith*

Figure 3. FPL's Chamber for Analytic Research on Wall Assemblies exposed to Simulated weather (CARWASh). *Photo by Steve Schmieding*

hygrothermal properties of wood species used in construction of ICLT walls will be measured in the laboratory.

Expected Outcomes

The modeling and laboratory research will provide insight to the performance of various ICLT wall designs in regard to their ability to avoid moisture accumulation and to dry out if wetting does occur. These results will guide designers on principles for specifying robust, moisture-tolerant ICLT wall assemblies.

Timeline

Modeling will begin in December 2011 and laboratory testing in January 2012. Project completion is expected by early 2013, with published reports available by late 2013.

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