RESEARCH in Progress

Forest Products Laboratory

Control of Solar-Driven Moisture Diffusion in Cross-Laminated Timber Walls with Absorptive Claddings

Cross-laminated timber (CLT) is a massive prefabricated panel used for construction of walls, roofs, and floors. CLT panels are made with at least three layers of lumber bonded together, with each layer oriented perpendicular to the adjacent layers. CLT is made from an abundant renewable resource, sequesters carbon, has low embodied energy, and has excellent aesthetic, structural, and thermal properties. Use of CLT in buildings is growing in North America, but a critical knowledge gap that hinders wider adoption of CLT is lack of data on long-term moisture performance and durability.

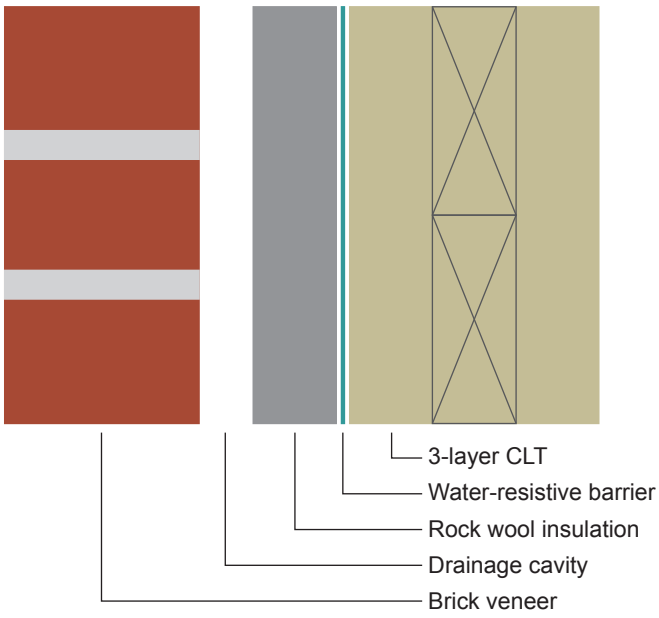

Figure 1—Illustration of the material layers in an example CLT exterior wall.

Background

Prior research showed that inward moisture diffusion from absorptive claddings such as brick veneer, stucco, or manufactured stone veneer can be significant in wood-frame walls. The inward migration of moisture is greatest when the cladding is heated by the sun after being wetted by rain. The same phenomenon is likely to occur in CLT walls with these types of claddings (Fig. 1). General guidance on CLT building envelope design was published in chapter 10 of the *U.S. CLT Handbook*, which cautions that inward diffusion of moisture from absorptive claddings could lead to moisture accumulation in CLT based on initial computer modeling predictions. Experimental measurements are needed to provide a stronger basis for design of CLT exterior walls.

Objective

The objectives of the project are to measure moisture conditions in CLT walls with absorptive claddings under exposure to simulated rain and sun and to identify design and construction practices that minimize the risk of moisture accumulation in different U.S. climates.

Approach

The study involves laboratory testing with a unique state-of-the-art facility, known as the CARWASh (Fig. 2). CLT walls will be constructed with different combinations of cladding (brick veneer, stucco, fiber cement), types of exterior insulation (rock wool,

Figure 2—Chamber for Analytic Research on Wall Assemblies exposed to Simulated weather (CARWASh) facility [credit: Steve Schmieding].

rigid foam), and types of water-resistive barrier, with products differing in their vapor permeance. Tests will involve exposure of walls to simulated weather conditions representing several different climates. Each test will run for at least one month. Moisture and temperature conditions within CLT walls will be monitored to understand wetting and drying behavior. In addition, a small-scale wall drying apparatus will be developed, and moisture-related properties of wood species used in construction of CLT walls will be measured in the laboratory.

Expected Outcomes

The laboratory research will be documented in a report that will provide insight into performance of CLT wall assemblies in regard to minimizing moisture accumulation from absorptive claddings. The report will assist building designers in specifying robust CLT exterior wall assemblies.

Timeline

Project planning and experimental design began June 2016. Laboratory measurements are expected to start September 2016 and end September 2017. The project report should be available by early 2018.

Contact Information

Samuel V. Glass
USDA Forest Products Laboratory
Madison, Wisconsin
(608) 231-9401; svglass@fs.fed.us