RESEARCH in Progress

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

Solid Timber from Blue Stain Beetle Killed Ponderosa Pine: Phase 1

The past decade's beetle epidemic is unprecedented in its environmental and social impacts. The underutilized affected timber can be used for fuel, directly as chips or ground material, or as pellets for stoves and boilers (releasing CO_2 into the atmosphere). However, use for energy is the lowest value application and will not cover costs of removal and transportation. The preferred use is for higher value products, such as housing and commercial construction (storing CO_2 in built works) and then applying the residual to energy use.

Interlocking cross laminated timber (ICLT) was developed in Utah by Euclid Timber, LLC. This system of solid wood floor, roof, and wall panels utilizing beetle-killed pine has been implemented in several buildings with three- and five-layer interlocking dovetail-joined prototypes designed by Acute Engineering and manufactured and installed by Euclid Timber. The documentation of two building prototypes and preliminary moisture movement testing has demonstrated a proof of concept that needs further refinement and optimization for further market penetration of beetle-killed pine panel product. This project is phase 1 of ICLT optimization efforts to evaluate methods of drying timber to 14% and the associated cost/scale/supply chain and to identify barriers to interoperability between design and fabrication software applications.

Background

CLT is an innovative solid timber system that is held together without adhesives. The need for optimized no-glue systems is evidenced by the relatively high cost of investment for startup of CLT solid timber production, making a market case of lower entry cost solid timber production. This provides an opportunity to support small to medium enterprises in the intermountain west and diversify and integrate the timber supply chain for innovative product research and development through university-led study.

ICLT panel optimization to three-layer assembly.

Objective

This project supports research on optimizing no-glue solid timber panel assemblies utilizing beetle-killed pine to prove the viability of this assembly for the market. The project is focused on optimizing dimensional stability and software interoperability from design to fabrication of ICLT panel construction.

Approach

Digital Optimization—CADWorks, a manufacturing software for timber fabrication, is unable to communicate effectively for lean delivery of wood products with design software (such as Revit, SketchUp, and Rhino). This has not been a problem in turn-key contracts for which Euclid Timber delivers both design and construction; however, it presents an obstacle on

Advanced Housing Research Center
Forest Products Laboratory
Madison, Wisconsin

USDA Forest Service

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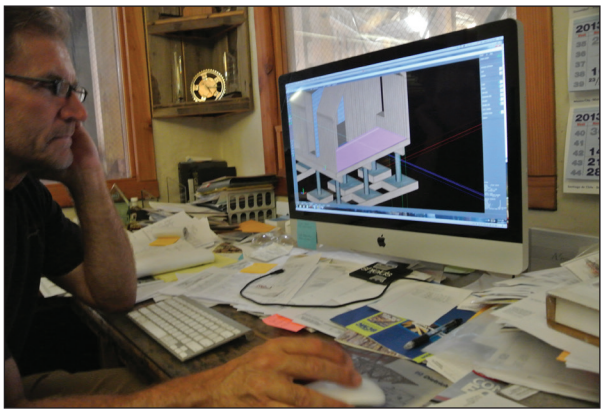

Kip Apostol of Euclid Timber modeling in CADWorks.

larger projects for which Euclid Timber provides fabrication and/or construction or licenses ICLT to other fabricators for production. This project identifies the barriers to interoperability between design and fabrication software through intrinsic and extrinsic qualitative research. Intrinsic research evaluates the software communication via field tests, with Euclid Timber translating solids modeling information across platforms and documenting the information lost. Extrinsic research involves targeted interviews with key industry stakeholders in digital information, including software vendors, designers, fabricators, and BIM consultants to identify potential barriers and solutions discovered in similar precedents, including the precast and steel fabrication sectors.

Dimensional Optimization—Timber for ICLT is air dried to 18%. Solid timber products (including CLT, diagonal laminated timber, and nail laminated timber precedent systems) require a moisture content of 12% to 14%. The instability of the timber presents difficulties with setting and fitting panels on site, adhering finishes, and long-term durability. Optimizing the thickness of the ICLT panel will make drying easier and the product will be dimensionally stable in use. This research evaluates the cost/benefit of reduced dimensional thickness of individual lamellas, kiln drying, and handling. Investigators are working closely with Euclid Timber and local saw mills to determine tactical approaches to air and kiln drying to 12% to 14%, performing distortion optimization tests for yield in drying batches, and evaluating costs associated with drying to this level.

Expected Outcomes

In this phase 1 project, the barriers to interoperability between design and fabrication software, specifically between Revit, SketchUp, and Rhino and CADWorks, will be qualified and potential solutions to overcome these barriers identified. In addition, this study will determine the drying techniques with their accompanying economic impact on the product to get beetle-killed pine to 14% MC.

Timeline

The project was initiated in July 2013. The digital and dimensional optimizations are occurring concurrently as distinct scopes of work. Phase 1.1 digital optimization is to be completed by July 2014. Phase 1.2 dimensional optimization is to be completed by August 2014. A summary report and recommendations for phase 2 will be completed by September 2014.

Cooperators

University of Utah
USDA Forest Service, Forest Products Laboratory

Contact Information

Ryan Smith
Integrated Technology in Architecture Center
University of Utah
Salt Lake City, Utah
(801)-585-8948; rsmith@arch.utah.edu

David E. Kretschmann
USDA Forest Service, Forest Products Laboratory
Madison Wisconsin
(608) 231-9307; dkretschmann@fs.fed.us