RESEARCH in Progress

Forest Products Laboratory

Innovative Technologies for Affordable Housing

Energy efficiency, durability, and good indoor air quality are essential in affordable housing. Although widely recognized, these desirable attributes are frequently compromised or poorly executed, leaving future homeowners with high utility and maintenance costs and poor air quality that could affect health and productivity.

Background

Housing technology researchers at the University of Minnesota have developed a new and highly innovative approach to walls. The design mitigates many of the moisture concerns of light-frame construction while maintaining the use of renewable materials and a high level of energy efficiency.

Erection of the SEP wall system on Demonstration House 2. The floor system will be installed next.

Demonstration House 2 with SEP walls completed and waiting for the roof deck. To the right is the completed and occupied Demonstration House 1.

Objectives

The objective of this research is to investigate innovative building materials and systems that have the potential to enhance building performance while maintaining or reducing construction costs. The innovations will be tested for energy efficiency, durability, constructability, and health effects. In addition, these innovations will be evaluated and compared on the bases of economic models, lifecycle analysis, and policy issues. This project will help to optimize the system design and better characterize its structural and hygrothermal behavior, with the objective of continuing to move it toward code acceptance and commercialization.

Approach

First year research will include laboratory testing for volatile organic compound (VOC) off-gassing, moisture-resistance, and strength properties of oriented strandboard (OSB) when used as the primary structural element of a building envelope. On-site measurements at a demonstration house will include indoor air quality (VOC off-gassing), temperature, relative humidity, radon, and moisture migration. Future research will include advanced building envelope performance comparisons, life-cycle analysis, and economic and housing policy issues with regard to innovative materials and construction practices.

Much of the first year research will focus on a novel building system using 1-1/8-in.OSB panels to replace the traditional light-frame stud wall. In an earlier University of Minnesota study, 1-1/2-in. (actually two 3/4-in. panels laminated together) OSB panels were used. Although this approach was successful, there is a desire to further test and optimize the system using monolithic 1-1/8-in. panels that are readily available in the marketplace today. In this project, researchers will design, build, and test three wall systems that include the structural

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engineered panel (SEP), measure VOC off-gassing of the SEP system, and develop a plan for a future marketing study on the SEP system.

The research is structured in four tasks:

- Structural panel comparison—This task includes a literature review on the individual products of the SEP wall, two alternative walls, and a traditional 2 by 4 wall system as a base case. Each wall system will be tested for stiffness before and after three moisture cycles.
- Moisture source determination—A novel tracer is being investigated to determine moisture sources and transport mechanisms involved in building mold and decay. Although the fundamental technique has been proven in a laboratory setting, it must be redesigned and tested for use in residential building materials and assemblies. A goal of this research is the ability to modify this technique to determine moisture sources in the SEP wall system.
- Composites, VOCs, and indoor air quality—The impact of wood composite technology on indoor air quality will be investigated. As more engineered wood-based composite products are used in residential construction, it is important to understand the effect of these products on the indoor environment. VOC emissions from wood composites and finishes to be used in a pilot house will be measured and evaluated.
- Feasibility study design for marketing and economics of new composite products—A study will be designed to identify market barriers and opportunities for this innovative SEP building system.

Demonstration House 1 construction showing a novel "studless" wall system of 1-1/2-in. OSB panels that will be covered by an exterior thermal and moisture management system.

Expected Outcomes

The primary long-term outcome of this research will be increased market acceptance and adoption of cost-effective, energy-saving, and innovative technologies and wood-based products by the home-building industry.

There are several short-term outcomes: First, this project will improve our understanding of SEP technology and how it can be best applied to affordable housing. Second, the moisture tracer technique will be advanced for improved building system evaluation. Third, VOC off-gassing of OSB panels will be characterized so that indoor air quality will not be compromised.

Timeline

First-year activities will be completed by summer 2005. Future work will focus on SEP panel optimization and characterization and a market feasibility study.

Cooperators

University of Minnesota (College of Natural Resources, Department of Bio-based Products, Cold Climate Housing Program; College of Architecture and Landscape Architecture, Center for Sustainable Building Research and Metropolitan Design Center)

Amherst Wilder Foundation

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