Research in Progress

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

Characterization of Moisture Performance of Energy-Efficient Light-Frame Wood Wall Systems

Recent changes in the minimum energy codes (2012 IECC) resulted in increased wall insulation and reduced wall air leakage. The long-term moisture performance of these wall systems is not well understood with regard to (1) accumulation of condensed water and (2) drying potential for water accumulated from condensation or rain events. With moisture performance an increasingly important design consideration in selection of wall systems, home builders and designers need practical guidance for construction of walls that ensure durability of wood buildings. This type of design guidance is particularly needed as various industry groups are advocating specific wall design solutions based on incomplete information.

This project involves monitoring the moisture performance of six energy-efficient wall configurations (R-19 or higher), with the study variables including 2×6 framing, exterior rigid foam, weather resistive barrier, and interior vapor retarder. In addition, six 2×4 wood-frame wall systems with various cladding materials (including cedar siding, stucco, manufactured stone, vinyl siding, brick, and fiber cement siding) are being monitored.

Background

In two previous research studies using these test huts, winter relative humidity levels of 30% (a relatively normal level) and 40% (a relatively comfortable level) were analyzed. Although research findings showed a wide range of measured moisture levels in the test wall sections, none of the walls had enough moisture to promote decay or lead to reduced structural performance.

Figure 1—Test buildings No. 1 (right) and No. 2 (left).

Objective

The objective of this research is to identify robust design rules and construction practices for durable exterior wood-frame and wood-sheathed walls in a mixed-humid climate. In addition to continued monitoring of wood walls with various cladding systems, this study focuses on measuring the effect of energy-efficiency features and increased indoor relative humidity on performance of the wood-based materials within the wall assemblies.

Approach

This research involves intensive monitoring of wall assemblies installed in two test structures near suburban Washington, D.C., that are temperature- and humidity-controlled. The wall assemblies include a variety of claddings and approaches to insulation and vapor control. Six wall assemblies have a primer plus two coats of paint on the interior drywall and alternate between kraft-paper-faced batt insulation and unfaced batt insulation. Two wall pairs highlight the use of exterior foam insulation as the weather-resistive barrier (WRB) versus the use of a house wrap between the foam and the sheathing. Each configuration has a north- and south-facing exposure. Within each wall section, temperature, relative humidity, and moisture conditions are monitored, as are interior temperature and humidity and exterior conditions, such as temperature, humidity, wind, driving rain, and solar radiation. Throughout the monitoring period, quarterly simulated rainwater leakage events are performed by injecting a metered amount of moisture behind the WRB to monitor the ability of each wall to dry. The winter indoor relative humidity is controlled to follow ASHRAE Standard 160 "Simplified Method" approaching 50% levels to simulate the newer, tighter homes built in today's market.

Expected Outcomes

Project results will provide design guidance for builders and building scientists on design of more moisture-tolerant wall assemblies. Results will also provide insight to the influence of indoor relative humidity on the moisture performance of the wall assembly.

Timeline

Monitoring ran from November 2011 through December 2012. Moisture injections were performed seasonally. A final report is expected in the third quarter of 2013.

Cooperators

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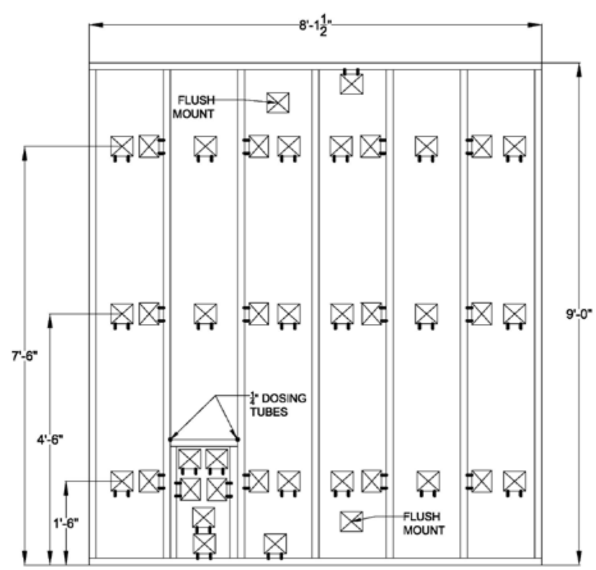

Figure 2—Diagram of typical wall cavity sensors.