Research in Progress

Forest Products Laboratory

Development of a Mold Risk Model for Wood Buildings

Hygrothermal analysis allows a designer to predict moisture and temperature conditions that might occur within a building envelope assembly over time. Such analysis can improve the understanding of how the building envelope responds to indoor and outdoor environments and can help identify potential moisture problems. ASHRAE Standard 160, *Criteria for Moisture-Control Design Analysis in Buildings*, provides a standardized set of criteria on how to conduct hygrothermal analyses and evaluate and report the results. In addition to setting input moisture loads and selection of design weather years, it also provides evaluation criteria. The evaluation criteria are used to interpret the results of the hygrothermal analysis to see whether the building may have problems with mold growth or corrosion. Although the standard claims to be a performance-based design criteria, the evaluation criteria for mold growth and corrosion are fixed criteria and are not a reliability, risk-based, approach. Because of this, the original mold criteria within the standard were overly conservative and many buildings that were already built and showed no visible mold growth actually failed the Standard 160 mold criteria (Glass and others 2015). Recently, Standard 160 incorporated improved mold evaluation criteria based on the work of Viitanen and colleagues (Ojanen and others 2010). This project plans to extend these new evaluation criteria to include a reliability-probabilistic approach so that the risk of mold can be evaluated for each construction.

Background

That mold growth is dependent on temperature and moisture conditions at the surface is well understood. Standard 160 incorporated the “mold growth index,” first proposed by Viitanen and Ritschkoff (1991), which was used to quantify the amount of mold growth that occurs in laboratory tests under controlled temperature and humidity conditions. The mold growth index assigns an ordinal number between 0 (no growth) and 6 (very heavy and tight growth). The Viitanen model can calculate the mold growth index from outputs of hygrothermal simulations and incorporates time, surface temperature, surface relative humidity, and the material sensitivity class. Standard 160 now requires that the mold growth index, calculated from hygrothermal simulations, be less than 3 (the threshold for visible mold growth). The current project will work on quantifying the probability that visible mold growth will occur for a given level of calculated mold index.

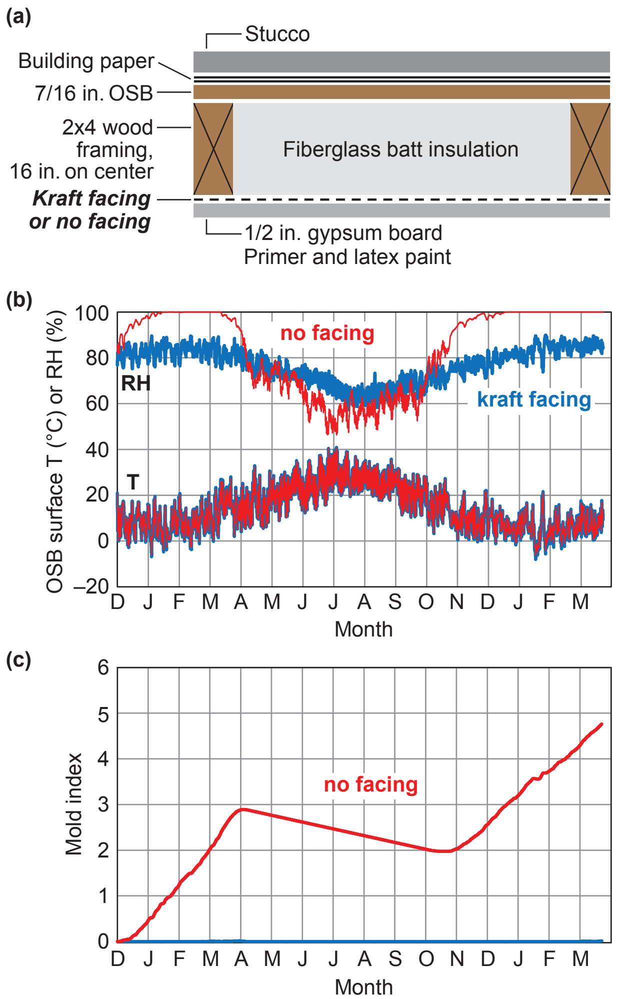
Mold growth on oriented strandboard sheathing.

Objective

The objective of this research is to develop a reliability-based approach for quantifying the likelihood of true mold growth in wood buildings given environmental conditions.

Approach

This study will utilize both experiments and modeling. In the experimental portion, wood will be exposed to



(a) Example wood-frame wall assembly with oriented strand-board (OSB) sheathing; (b) temperature (T) and relative humidity (RH) at OSB surface from hygrothermal simulation of walls with kraft facing on the insulation or no facing; and (c) modeled mold index at OSB surface for the corresponding walls.

temperature and humidity conditions that result in various mold indices, and the actual mold index from these experiments will be recorded. A performance-based evaluation framework will be utilized to develop fragilities for mold growth conditional on identified key conditions. Construction of the fragilities will be based on existing experimental research data, as well as new experimental data developed on an as-needed basis.

Expected Outcomes

This research is expected to result in a data set and calculation methodology that can show the probability of a given level of mold given certain temperature and humidity inputs—fragility curves. These fragility curves can be used in reliability-based assessment of mold hazard, and help inform the future changes in mold related design standards, such as ASHRAE 160. The research is also expected to result in one or more refereed publications.

Timeline

The project is expected to start September 2016. Experimental work will be conducted in 2017, and the project will be completed by August 2018.

Cooperators

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