Put a Lid on It

Two test homes, one in Georgia and one in Michigan, demonstrate the positive effect Retrofit Insulated Panels (RIPs) can have on a home's energy performance.

Maryland-based, Home Innovation Research Labs is a research, testing, and consulting firm that was founded in 1964 as a subsidiary of the National Association of Home Builders (NAHB). Home Innovation works closely alongside product manufacturers, builders, remodelers, regulators, and government agencies to conduct market research, lab testing, product certification, green building certification, building science analysis, standards development, and field evaluation and testing.

In 2015, Home Innovation began its three-year study, *Attic Retrofits Using Nail-Base Insulated Panels*. This study was sponsored by the U.S. Department of Energy's (DOE) *Building America Program*, which aims to improve residential building energy performance, durability, quality, affordability, and comfort for new and existing homes in all climates.

Installation on the house in Georgia.

The roof once complete in Georgia.

SIPs installation on the Michigan house.

Installing the eaves troughs on the Michigan house.

Nail-base panels – also known as Retrofit Insulated Panels (RIPs) – provide the same qualities as a regular SIPs from a thermal perspective but lack the structural attributes. The purpose of Home Innovation's study was to develop, demonstrate, and assess a roof/attic energy retrofit solution using these nail-base insulated panels for existing homes where traditional attic insulation approaches are not effective or feasible.

"The primary goals of the project were to develop design details for two residential demonstration homes, one in a cold climate and one in a hot-humid climate, and then demonstrate the retrofit panel installations," says David Mallay, an Engineer at Home Innovation Research Labs. "We would subsequently assess the energy performance, moisture performance, costs, and feedback from contractors and homeowners."

An advisory group was established that included industry experts representing industry associations, product manufacturers, builders, contractors, and consultants. The advisory group considered several demonstration sites and selected two; one in the hot-humid climate of coastal Georgia, and one in the cold climate of Ann Arbor, Michigan.

The Georgia house is a two-story cottage design with an HVAC system within the attic, which was converted from vented to unvented during the project. The Michigan house is a two-story contemporary design with cathedral ceilings. This cold climate house contained two distinctly different conditions:

- The roof/ceiling assembly of the main house consisted of two-inch thick fiberboard panels supported by a timber frame; and
- The roof/ceiling assembly of a large addition to the home was a more conventional enclosed rafter assembly that was converted from vented to unvented.

The project teams for each site included the contractor, energy rater, homeowner, panel manufacturer, representatives from the Structural Insulated Panel Association (SIPA), and Home Innovation staff. During the initial

site visits, the teams gathered detailed information on the houses, discussed design considerations and options, installed sensors to monitor conditions indoors, outdoor, as well as within the Georgia attic, and conducted house tightness and duct leakage testing. Sensors were also installed within the retrofit panels during installation to monitor moisture conditions at the OSB skin. After the site visits, the teams developed design specifications based on energy and moisture analyses.

The results of this study showed that an attic retrofit – using nail-base insulated panels – can be an energy efficient and durable solution for many existing homes. Modeled energy savings were 23 percent heating and 13 percent cooling for Michigan, and 11 percent heating and cooling for Georgia, but an evaluation of the energy bills has indicated that the actual savings may actually be considerably higher. Monitored data collected for one winter and one summer showed that moisture conditions at retrofit panels and existing roof decks sat well within acceptable limits.

The overall house tightness was also improved by 29 percent for the house in Michigan, but only 12 percent for Georgia, where a permeable wall envelope skewed the results.

"The walls of this cottage are completely un-insulated, unsheathed, and are made with tongue-and-groove paneling inside and out, so the wall systems are extremely leaky," says Frank Baker, Board Director at PFB Corporation and owner of the retrofitted home in Georgia. "While measurable, the effect on the overall energy use in this structure has not been extremely large. We would also have to take care of the floor and wall systems to really see a greater impact."

The average relative humidity (RH) within the Georgia attic was higher during the summer after installation compared to the previous summer, but the attic dew point temperature was somewhat lower after installation. In addition, the shingles installed directly on top of the ventilation mat looked normal – without waves – and the ventilation gap appeared to be maintained at full depth.

"With the use of temperature monitoring equipment, we were able to confirm just how much cooler the shingles were being kept than if they were unventilated, which is a common issue we face in the SIPs industry," says Al Cobb, President of PanelWrights and Director of SIPschool. "We were able to ascertain that the decrease in temperature was approximately 10 degrees Fahrenheit, which may not sound like a lot, but any time when you can drop the temperature you will receive a much-improved shingle-life."

The incremental installed cost range was $8.00 to $9.00 per square foot of roof area. In addition to energy savings, the value of the demonstrated solutions included a significant improvement in comfort and durability of the roof assembly.

"My son [the owner of the Michigan house] is very pleased with the results of this study and the comfort in their house has increased dramatically," says Baker. "For most of the winter, they were getting severe ice-damming, huge icicles, and, really, the house was just not very comfortable. This made a real noticeable difference; there is no ice-damming, the

snow blanket stays on the roof until the sun melts it, and they are seeing real energy savings."

Home Innovation is continuing to collect data from the two demonstration houses and, when the project concludes later this summer, the study will have data from one additional winter and one additional summer beyond what was reported in the Building America report. An interim presentation has been prepared to summarize data collection through February 2018. It notes that the retrofit panels continue to perform well.

"RIPs are a beautiful way to improve an old house with subpar insulation and thermal performance," says Cobb. "You install the insulated panels from the outside while replacing the siding or the roofing, so there is no need to violate the interior of the space; it's like wrapping your old structure in a nice, comfortable winter coat."

Once the monitoring period ends this year, Home Innovation will prepare a final presentation for SIPA that will summarize all project data and help serve as an addendum to the Building America report. The final Building America report will be available on both the Building America and Home Innovation websites later this year.

LEARN MORE!

A draft report from Building America U.S. Department of Energy, specific to these test homes, is available for free online: www.sips.org/downloads/RIPs-Attic-Retrofit-Panels---Al-Cobb-revised-FINAL.pdf

Several other reports on retrofit insulated panels are available for download here: www.sips.org/retrofit-insulated-panels