



## Building America Case Study

# Initial and Long-Term Movement of Cladding Installed Over Exterior Rigid Insulation

### PROJECT INFORMATION

**Project Name:** Initial and Long-Term Movement of Cladding Installed Over Exterior Rigid Insulation

**Partners:**

Building Science Corporation,  
[buildingscience.com](http://buildingscience.com)

The Dow Chemical Company, [dow.com](http://dow.com)  
James Hardie Building Products,  
[jameshardie.com](http://jameshardie.com)

**Building Component:** Building envelope component

**Application:** New and/or retrofit; single and/or multi-family

**Year Research Conducted:** 2011 through 2013

**Applicable Climate Zone(s):** All

Changes in the International Energy Conservation Code (IECC) from 2009 to 2012 have resulted in an increase in minimum insulation levels required for residential buildings. In addition, the use of exterior rigid insulation has become part of the prescriptive code requirements. With more jurisdictions adopting the 2012 IECC, builders will be required to incorporate exterior insulation in the construction of their exterior wall assemblies.

For exterior insulation thicker than 1.5 in., many contractors and designers are using wood furring strips attached through the insulation back to the structure to provide a convenient cladding attachment location.

However, there is some resistance to widespread adoption of this technique because of the lack of engineering research supporting it, along with the fact that this technique is not specifically addressed by the current International Residential Code. Some of the biggest questions being raised involve long-term performance due to potential creep in the system.

To help answer these questions, the U.S. Department of Energy's Building America team, Building Science Corporation, conducted research over 3 years that examined both the system mechanics of this approach as well as long-term performance of this approach under sustained loads in exterior exposed environments.

## Full-Scale Assembly Tests



Full-scale assemblies were used to limit variations in installation from affecting the test results. Over the course of the testing, several test iterations were completed that varied insulation type and fastener spacing.

For more information, see the Building America research report, *Initial and Long Term Movement of Cladding Installed Over Exterior Rigid Insulation*, at: [buildingamerica.gov](http://buildingamerica.gov)

Image credit: All images were created by the BSC team.



Exterior environmental exposure testing examined four types of insulation materials. Each test panel was constructed with two layers of 2 in. thick insulation, and loaded to three different load magnitudes (8 lbf, 15 lbf, and 30 lbf per fastener). The vertical movement of the furring strip (downward and upward) was recorded over a period of approximately 450 days.

## Lessons Learned

- Results from short-term, full-scale wall assembly tests (initial load response) with 4 in. of rigid insulation have consistently been between 40 pound-force (lbf) to 55 lbf per fastener at 1/16 in. deflection, except for one outlier test of mineral fiber insulation that was 65 pounds at 1/16 in. of deflection.
- Research found that the total system capacity is directly related to the number of fasteners used in the system. This allows for heavier claddings to be supported by using additional fasteners.
- Friction between layers can play a significant role in the total system capacity (possibly 50% or more under initial loading); however, the forces that affect the amount of friction can be highly variable both under initial installation and long-term use due to expansion and contraction of materials. Measured force variations were around  $\pm 50$  lbf of compression force per fastener over a 160°F temperature variation.
- Long-term performance of the assemblies in exposed environments did demonstrate system creep under heavy loads (30 lbf per fastener). For lighter loads (8 lbf per fastener), the assemblies demonstrated stable performance. At 15 lbf per fastener, the assemblies were still within acceptable deflection limits; however, some indication of slight system creep may have occurred.

## Looking Ahead

Based on the results of the research, the BSC team recommends using a maximum load per fastener of no more than 10 lbf based on a standard #10 wood screw installed through up to 4 in. of insulation. Higher capacities will be expected with larger screws or reduced insulation thickness.