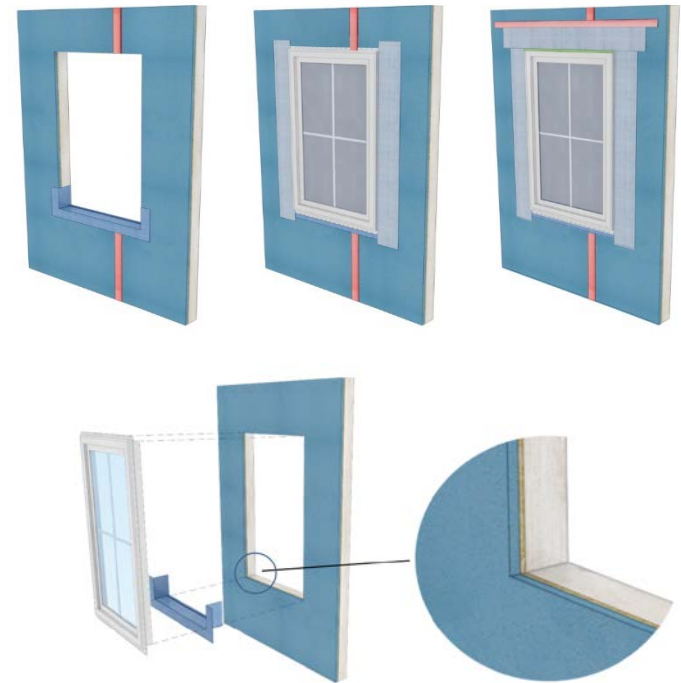


Durability of Windows in Walls with Continuous Insulation (CI)

2017 Building Technologies Office Peer Review



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Project Summary

Timeline:

Start date: 01/08/2016

Planned end date: 7/31/2018

Key Milestones

1. Plan of Evaluation – March 2017
2. Testing Complete – March 2018
3. Solutions and recommendations – July 2018

Budget:

Total Project \$ to Date:

- DOE: \$75,600
- Cost Share: \$50,000

Total Project \$:

- DOE: \$399,908
- Cost Share: \$100,000

Key Partners:

American Chemistry Council (ACC)
American Architectural Manufacturers Association (AAMA)
Window and Door Manufacturers Association (WDMA)
National Association of Home Builders

Project Outcome:

1. A simplified set of window installation solutions that ensure durability of the water and air barriers at the window-wall interface for walls with exterior foam sheathing (i.e., continuous insulation)
2. Broad industry acceptance for the proposed solutions to facilitate code acceptance

Purpose and Objectives

Problem Statement: The window industry published a standard with conservative methods for installation of windows in walls with exterior foam sheathing that creates a significant barrier to the use of continuous insulation (CI).

Target Market and Audience: Residential designers and builders with light-frame projects in Climate Zones 3-8 (>70% of all single-family housing starts in the country) who are using or considering the use of exterior foam sheathing.

Impact of Project:

1. Project outputs:
 - a. Laboratory-tested performance of windows in walls with various types of foam, foam thicknesses, and installation methods
 - b. Recommended solutions for installation of windows in walls with CI
 - c. Testing procedures for evaluation of the window-wall interface in walls with CI
2. Contribution to BA and market goals:
 - a. Opaque walls contribute up to 10% of energy savings (whole-house) or up to 20% of heating load savings to support DOE goals for energy use reduction
 - b. Accelerated adoption of walls with higher insulation values
 - c. Accelerated adoption of 2012/2015 codes w/o envelope amendments

Approach

Approach:

1. Assemble a broad industry advisory group
2. Perform inventory assessment of windows and foam sheathing products
3. Develop/adopt an evaluation protocol
4. Conduct testing and evaluate results
5. Develop solutions and establish applicable limitations

Key Issues: The long-term performance of conventional window installation practices in walls with CI has not been verified leading to a concern that in certain installation configurations and exposure conditions it can lead to unacceptable performance

Distinctive Characteristics: Building broad industry consensus on evaluation protocols; focusing on an identified set of critical variables in terms of material properties and system configurations to validate performance

Progress and Accomplishments

Accomplishments:

1. Advisory Group met to discuss the gaps and provide direction for the project
2. An inventory of windows has been conducted
3. A draft evaluation protocol has been developed

Market Impact:

- 1) Improved level of confidence for practitioners using walls with CI
- 2) Minimized risk of potential durability issues for high performance homes in Climate Zones 3-8
- 3) Accelerated adoption of 2012/2015 I-codes without envelope amendments
- 4) Through broad stakeholder engagement, significant improvement in awareness across the entire building industry about proven durable solutions for high-R walls

Lessons Learned: The window industry requested that the evaluation be broadened to include performance attributes (in addition to structural aspects) related to temperature fluctuations, air tightness, and water leakage

Window Inventory



Awning



Casement



Garden



Jalousie



Hung (Single and Double)



Horizontal Slider/Glider



Dual Action



Pivoted



Fixed

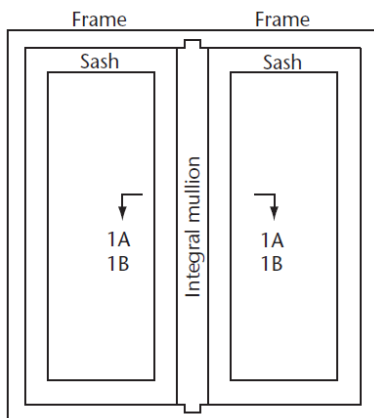
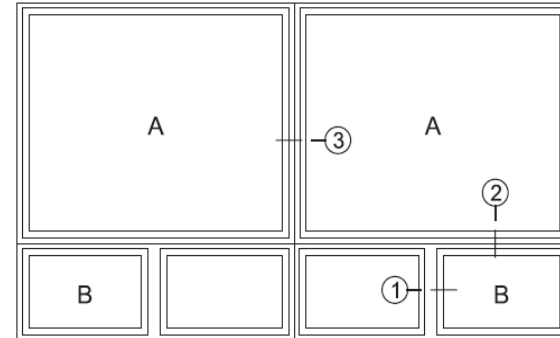


Vertical Slider

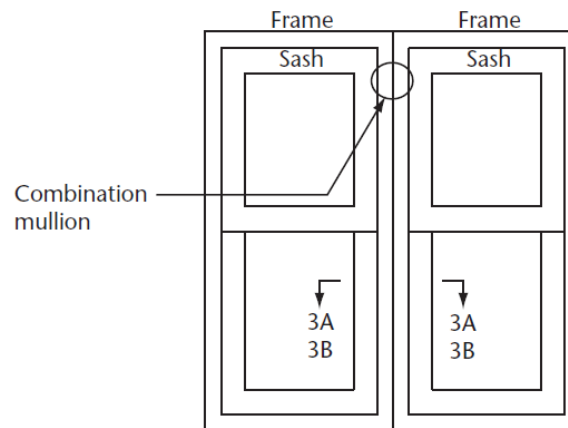
Window Inventory - Continued

Mulled Assemblies

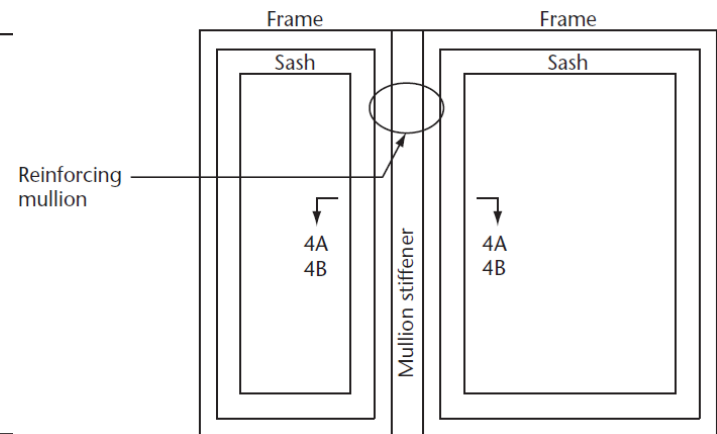
- Mullions: connecting members between two or more window units
- Vertical or horizontal
- Three types



Integral



Combination



Reinforcing

Home Innovation Testing Facility

Wind Pressure



Air and Water Leakage



Temp Fluctuations



Project Integration and Collaboration

Project Integration: Home Innovation brings key stakeholders including associations to the table as co-sponsors (cash and product) and as advisory group members. Broad industry participation includes builders (including high production builders), window manufacturers, standard-writing bodies, insulation product manufacturers, and building science experts. As an example of engagement and integration, the photo below shows an industry meeting on evaluating practices for use of CI in walls that prompted the current project.

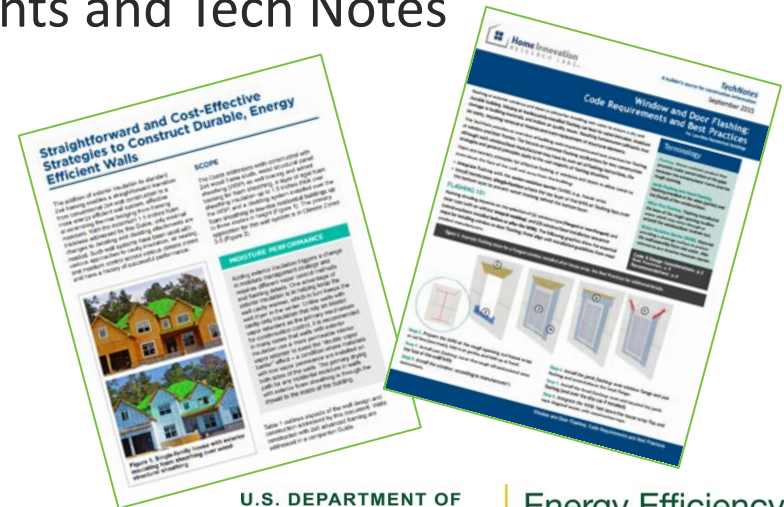
Partners, Subcontractors, and Collaborators: Home Innovation formed an Advisory Group that includes broad stakeholder representation

Communications: The project was announced at NAHB's International Builders' Show, ACC meetings, Home Innovation website; results will be broadly disseminated to industry partners as well as organizations that develop relevant standards and codes.



Next Steps and Future Plans

- 1) Finalize the evaluation protocol
- 2) Conduct laboratory testing
- 3) Perform evaluation of the results
- 4) Make recommendations for installation methods and define applicable limitations
- 5) Broadly disseminate results of the study through various industry media channels and through stakeholders
- 6) Revise applicable guidance documents and Tech Notes
- 7) Monitor the rate of adoption of walls with CI via Home Innovation's Annual Builder Practices Survey



REFERENCE SLIDES

Project Budget – Windows in Walls with CI

Project Budget: see Table below; Total: \$399,908 (DOE) \$100,000 (Cost Share)

Variations: None

Cost to Date: See Table below

Additional Funding: None for the described scope of work

Budget History

FY 2016 (past)		FY 2017 (current)		FY 2018 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$10,376	\$0	\$229,624	\$75,000	\$159,908	\$25,000

Project Plan and Schedule: Windows in walls with CI

Project Schedule - Windows Installed Over Continuous Insulation

Project Start: 8-1-2016	Completed Work											
Projected End: 7-31-2018	Active Task (in progress work)											
	◆ Milestone/Deliverable (Originally Planned)											
	◆ Milestone/Deliverable (Actual)											
	FY2016				FY2017				FY2018			
Task	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
Past Work												
Q1: Advisory Group Established					◆							
Q1: Window Inventory					◆							
Current/Future Work												
Q2: Literature Review - Research Plan					■	■						
Q2: Initial Test Matrix / Performance Criteria - Research Plan						■						
Q4: Testing							■	■				
Q4: Updated Test Matrix / Performance Criteria								■				
GO/NO-GO: Further Testing Given Initial Results								■				
Q2: Continued Testing								■	■	■		
Q3: Evaluation of Results - Report											■	
Q4: Set of Solutions for Dissemination												■