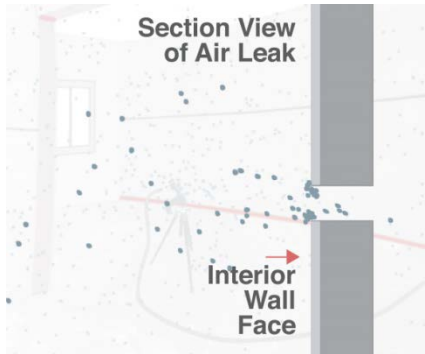


Aerosol Sealing in New Construction

2017 Building Technologies Office Peer Review



Project Summary

Timeline:

Start date: 8/1/2016

Planned end date: 7/31/2019

Key Milestones

1. Builder kickoff meetings; MN- 12/16, CA- 3/17
2. Identify sealing options; MN- 4/17, CA- 6/17
3. Seal 5 houses; MN- 8/17, CA- 10/17

Budget:

Total Project \$ to Date (1/31/17):

- DOE: \$44,244
- Cost Share: \$11,089

Total Project \$:

- DOE: \$535,037
- Cost Share: \$134,143

Key Partners:

University of California, Davis, WCEC (Western Cooling Efficiency Center)
Building Knowledge, Inc.
University of Minnesota, Cold Climate Housing Program
Aeroseal, LLC.

Project Outcome:

The project team will work with builders to optimize the integration of aerosol envelope sealing into the production building process. The sealing guides will enable builders to reduce air infiltration space conditioning energy use by over 50% which can reduce space conditioning energy use by over 10%.

Purpose and Objectives

Problem Statement: High performance moisture managed envelopes require more effective air barriers that require add cost, training, and quality control.

Target Market and Audience: Aerosol envelope sealing can improve the energy performance of all residential new construction. This project will focus on single family new construction, but many of the lessons learned could be applied to other residential units. Approximately 1 million new residential units were built in 2014. In 2009 40% of residential energy use was attributed to space heating and cooling which is impacted by air infiltration loads from leaky envelopes.

Impact of Project: This project will provide guides and builder case studies for optimal integration of aerosol envelope sealing for new home construction. The project team will work with builders in Minnesota and California to identify options for when to seal and what current sealing could be eliminated. The tightness and net cost of the aerosol sealed houses will be compared to results for their standard construction. The goal is to produce reliably tighter houses for equal or lower cost.

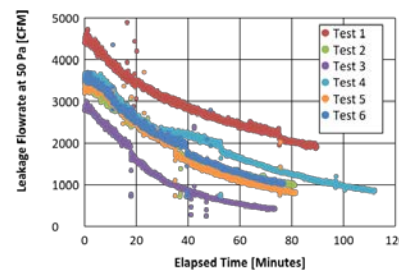
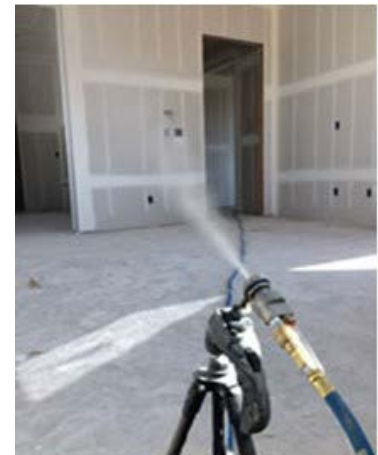
Aerosol Envelope Sealing

Technology:

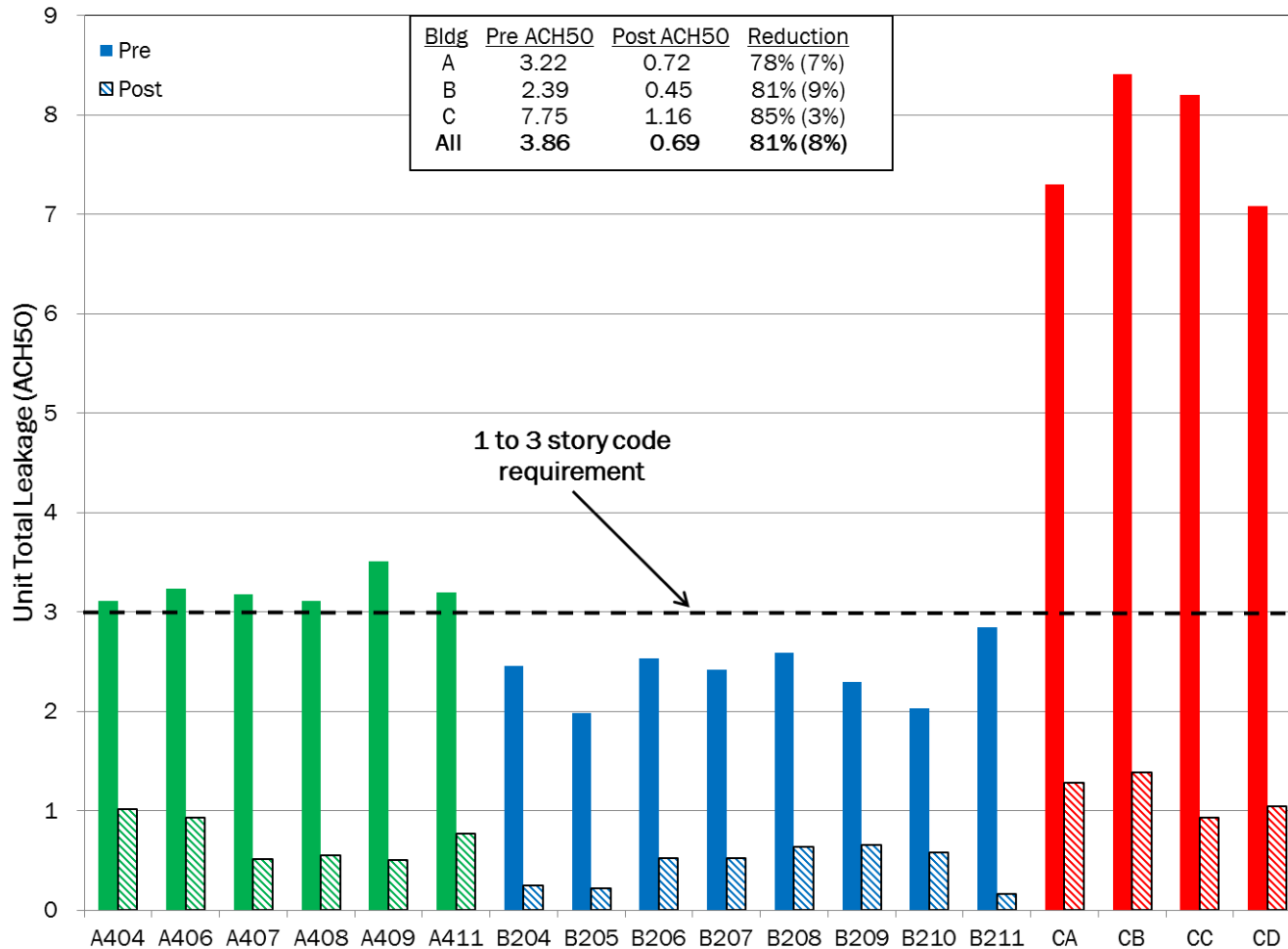
- Pressurize enclosure for 1 to 2 hours while applying aerosol “fog”
- Sealant particles find and seal leaks as air escapes house
- Capable of simultaneously measuring, locating, and sealing leaks in a building envelope.

Benefits:

- Envelope tightness improved by 60% to 95%
- Reduced training and quality control for eliminated conventional sealing
- Reliable tightness to meet requirements, know when to “stop”, and certification test



Leakage Results: 18 New Construction MF Units



Average leakage: pre= 3.9 ACH50, post= 0.7 ACH50
 54% to 95% below code requirement, average= 77%

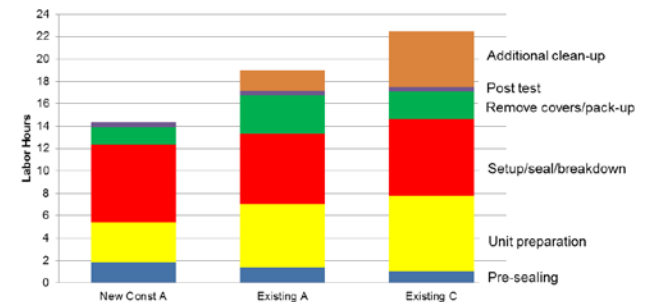
Approach

Key Issues:

- Previous Building America projects showed 60% to 95% improvements in envelope tightness.
- Sealing typically applied after drywall in place. No experience with ability to replace current sealing methods.

Approach:

- Iterative approach with multiple builders – when & what to eliminate
- Assess current sealing methods for a MN & CA builder and develop two approaches for each
- Net cost and tightness will be evaluated against standard methods
- Process repeated with second set of houses for first builders and a set of houses for additional builders.



Progress and Accomplishments

Accomplishments:

- Planning complete: Test Plan and Project Management Plan
- Held kickoff meeting for Minnesota builders and starting outreach for California meeting
- Developing assessment protocol
- Field work delayed – did not want to apply sealing under most challenging conditions (e.g. Minnesota winter)

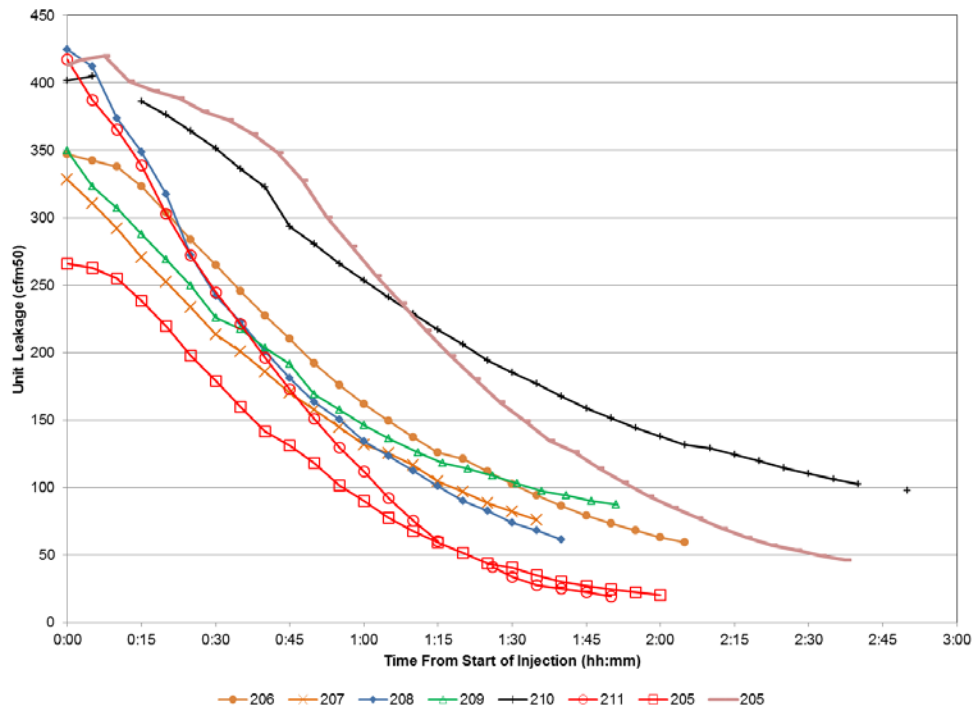
Market Impact:

- Working with manufacturer (Aeroseal) – direct application of results
- Aeroseal's duct sealing contractors seal about 15,000 systems/year & planning to develop envelope contractors by end of 2017
 - DOE Energy 100 award
 - ASHRAE 2016 Product of the Year Award
- Large and/or visible builders to improve credibility

Progress and Accomplishments

Lessons Learned (Builder Kickoff Meeting):

- Interested in sealing after mechanical penetrations/before insulation
- Eliminate 4 ml poly interior?
- Change rim joist spray foam approach?
- Seal ducts from outside > in?
- Likely to need help working with code officials to approve some changes
- Significant interest, but time for corporate approval & other priorities



MF New Construction

- 71% to 94% reduction
- Post ACH50: 0.16 – 0.66
- Post cfm50: 25 - 114

Project Integration and Collaboration

Project Integration and Key Partners:

- UC Davis Western Cooling Efficiency Center developed technology and working on other efforts to promote aerosol sealing in other markets
- AeroSeal corporation will be conduit to contractors who perform work
- Building Knowledge is established air sealing and energy efficiency consultant for homebuilding industry
- University Minnesota Cold Climate Housing experienced builder trainer/educator

Communications:

- Presentations at ACEEE Summer Study, Better Buildings Better Business, & Home Performance Conference: primarily previous MF results but discussing current BA project

Next Steps and Future Plans

- Agreement with first MN builder
- Assess houses and develop sealing options
1st MN builder (March/April)
- Seal 1st five MN houses (May – August)
- CA effort ~ 2 months after MN
- California builder kickoff meeting
(March/April)
- Seal 1st five CA houses (June – Sept)
- Repeat for second set of houses for first
builders
- Repeat for houses for another builder in MN
and CA



Waiting for the winter thaw

REFERENCE SLIDES

Project Budget

Project Budget: The total project budget is \$669,179 (DOE: \$535,037; Cost Share: \$134,143). About 7% of the funds will be used by AeroSeal staff to seal houses, 11% by Building Knowledge for builder engagement, and remainder split between CEE and WCEC to implement project. Current expenses were used primarily to generate the Test Plan and conduct first builder kickoff meeting.

Variations: Expenses in FY 2017 have been less than expected due to the decision to move back initial field work to warmer weather and delays in partner invoices.

Cost to Date: DOE: \$44,244, Cost Share: \$11,089; 8.3% of the project budget has been spent to date.

Additional Funding: Builder’s staff time for project was uncertain and has not been included as cost share.

Budget History

8/1/2016 – FY 2016 (past)		FY 2017 (current)		FY 2018 – 9/30/2018 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$11,218	\$2,813	\$224,169	\$58,761	\$200,103	\$47,872

Project Plan and Schedule

- Three year project that started August 2016 & planned to be completed July 2019.
- Final Test Plan and MN builder kickoff meeting complete.
- Split builder kickoff meetings for MN & CA, so CA meeting is being held later (closer to start of field work). Delayed initial sealing work to warmer weather- project put on 2 month hiatus.
- Work with first MN builder expected to start in March with sealing to start in April-May. CA work will start about 2 months after work in MN.
- First go/no-go decision point is to have first two builders recruited by July 2017.

Project Schedule												
Project Start: August 2016	Completed Work											
Projected End: July 2019	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 Milestone: Final version of Test Plan					◆							
Q1 Milestone: MN builder kickoff meeting					◆	◆						
Q1 Milestone: CA builder Kickoff meeting					◆	◆						
Current/Future Work												
Q2 Milestone: MN builder 1 sealing options						◆	◆					
Q3 Milestone: MN builder 1 seal five houses								◆				
Q? Milestone: CA builder 1 sealing options								◆				
Q? Milestone: CA builder 1 seal five houses									◆			