Challenges and Solutions for Air Tightening Multistory Homes; Addressing Breaches in Floor Cavity Air and Thermal Barriers

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How Does This Support Zero Energy Ready Homes?

Goals:

• recognize inadequate air and thermal barriers at floor cavity /attic perimeters (wind washing)
• methods to avoid (or repair) wind washing
• understand consequences of wind washing
What is Wind Washing?

It is air movement around or through a thermal barrier causing diminished thermal energy control.
Poorly Installed Batts at Floor Cavity

Can you seal this effectively using batts?

Image by C. Withers, Jr.
Floor Cavity is Sealed by Plywood, But Little Clearance Between Roof Truss and Kneewall.
Interior of This Wall Is Not Good Location for Batts!
2nd Floor System Refrigerant Floor Cavity Penetrations Need to Be Sealed.

Return Duct Leaks Into Floor Cavity
Floor Cavity Covered by Plywood With Adequate Clearance Between Roof Truss and Kneewall For Insulation
- Field test 56 homes
- Find 12 candidates for repair and monitor
- Evaluate impacts
Examples of Wind Washing Into Floor Cavities
Home with High WW Potential
IR Image of Exterior Heated by Sun

Image by C. Withers, Jr.

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PREVAILING WIND

Wind driven attic air can flow through floor cavity

Floor cavity open to east and west attics
2nd Story Floor Space Open to Vented Attic

West side attic view

East side attic view
2nd story floor surface is heated by attic air movement into floor space
Floor space on other side of very warm wall section.
2\textsuperscript{nd} Story Floor Cavity

Image by C. Withers, Jr.
IR Image Taken Inside Floor Cavity
House Repair With Low Density Foam
House Repair With Low Density Foam
House Floor Cavity Repair Impact

Cooling savings 10.5%; floor cavity dewpoint drops; no heating savings.
Floor Cavity Repair Using Batt Insulation
Floor Cavity Repair Using Batt Insulation

As found, open pathways due to dropped kitchen ceiling area (right) and around utility penetrations (below).
Floor Cavity Repair Using Batt Insulation

Faced batts can be used if installed carefully. Cut edges to fit penetrations. Mechanically fasten and seal at perimeter. (Duct tape does neither of these).
Floor Cavity Repair Using Batt Insulation

Faced batts can be used if installed carefully.
Paper face should not be exposed to attic according to building code (fire safety).
Floor Cavity Repair Using Batt Insulation

1. Insulated vapor retarder (0.1-0.5 perms) against the cold supply duct, before placing any vapor permeable insulation directly against duct.
2. Batt insulation sealed in place between duct and surrounding area.

Results: 6% cooling savings and 20% heating savings
Improving Home Moisture Damaged From WW
Complimentary Pathway Through Floor East to West

NE corner view

NW corner view
Home Had History of Moisture Control Problems

- Mildew stains and moisture on supply grills
- Condensation on duct in floor space dripping onto first floor ceiling.

- Warped pocket door
Moisture Damaged Stairs, Floors and Ceilings

- Moisture damage before repair on stair risers
Wind Wash Floor Cavity Inspection

- Inside east attic view of open floor space

Insulation in direct contact with cold supply duct results in condensation on duct and insulation. Sealing floor space around ducts must be done right.
Wind Wash Repair

Insulation with vapor retarder placed around ducts before spray foam application.
Wind Wash Inspection

Access into west side soffit open to floor space
• Cooling energy results: 8.2% (est. 2,771 Kwh/yr)
• Peak power reduction 1.8 kW (15%)
• Low cooling setpoint = high cooling energy use
Summary of Impacts from WW Repair

- House tightness - 11.1% tighter (ACH50)
- Infiltration rate (AHUon) decreased 30%
- Return leakage decreased 37%
- Indicated supply duct leakage decreased 38% (Ppan values 1st floor)

(Based on average of 10 houses that had no direct duct repairs made to them.)
Energy Impacts of Floor Cavity Wind Washing Repair

WW repair saves about:

- 13% seasonal cooling energy
- 11% peak cooling energy (0.5 kW)
- 14% seasonal heating energy
- 2% peak heating energy
Repair Costs

- Project repair costs avg. $573 per house (169 ft\(^2\))
- Predict avg. repair cost about $350 possible.
- Average Payback in about 4 years.
Selecting Floor Cavity Barrier Material

Floor cavity can be insulated/sealed with variety of materials. Primary considerations are how limited the work space is and sensitivity to cost.

- Generally, using materials readily available at home improvement stores will be less expensive.
  - May not be able to effectively seal some retrofits.
  - Less durable, paper tears easily.
Selecting Floor Cavity Barrier Material

- Low density foam may be the only practical option when making repairs from within small vented attic spaces or when the area to be sealed is not a simple planar-type geometry.
- Foam is more likely to result in better air seal on non-rectangular, non-planar surfaces.
1. There are several variables that affect WW impact.
   - (roof type, size and location of floor cavity holes, average wind speed and direction)
2. WW is costly to performance of ZERH.
3. WW is cost-effective energy conservation measure and a potentially viable utility energy conservation program.
Thank You

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References


References

  http://rsmeansonline.com/References/CREW/1-Year%202014%20Crews/Crew%20Residential.PDF


  http://www.americanbuildingtechnologies.com/weatherization/insulation/insulation-price-list/
# Phase I Wind Wash Energy Reductions

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<th>House ID</th>
<th>Annual Cooling Energy</th>
<th>Summer Peak Hour Demand</th>
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