

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

EEBA 2014 St. Louis, Mo
Day 1 Session - 10:30 AM-11:15 AM
September 23, 2014



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Addressing Breaches in Floor Cavity Air and Thermal Barriers in Multi-Story Homes

How Does This Support Zero Energy Ready Homes?

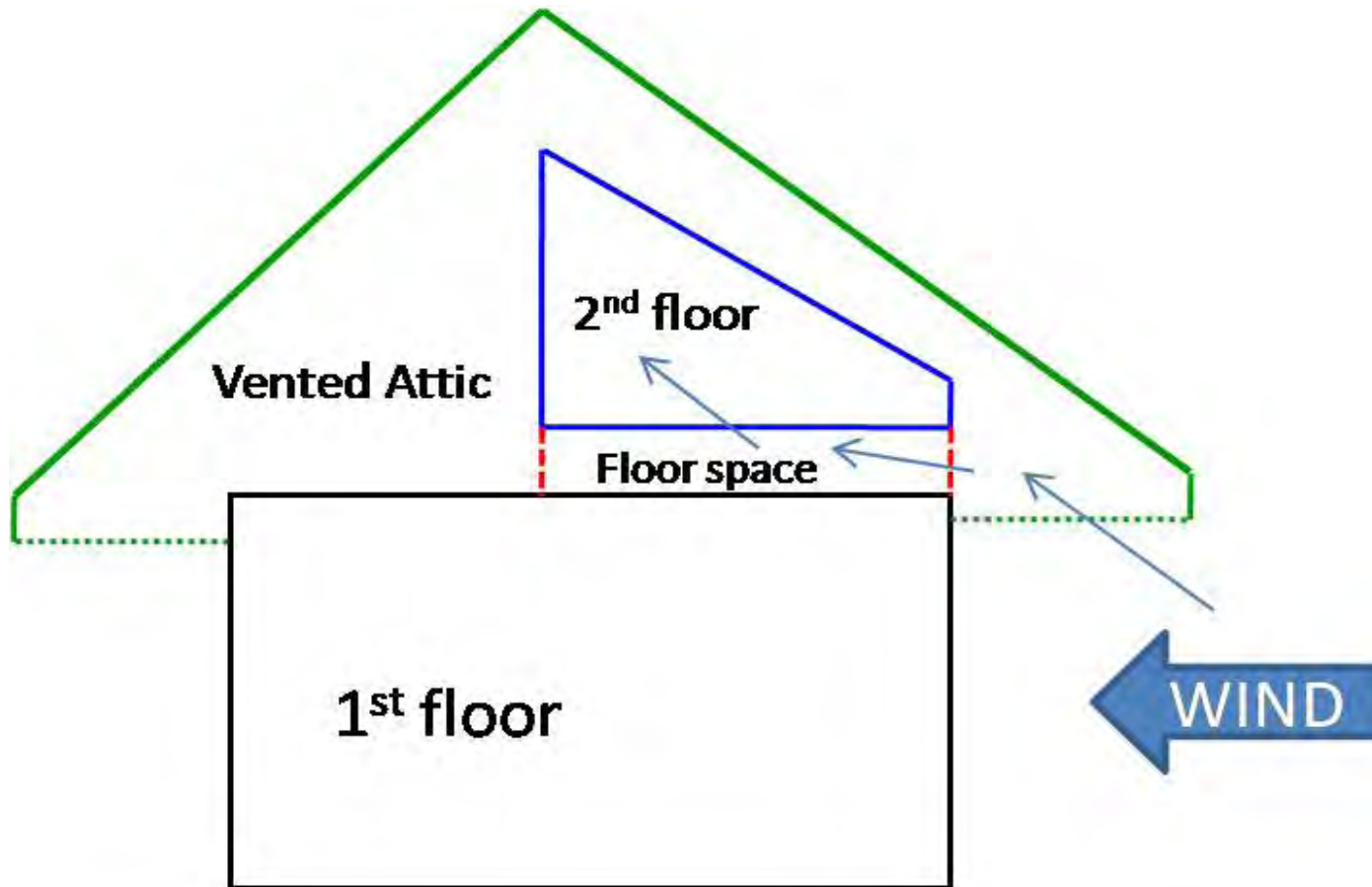
Goals:

- 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



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

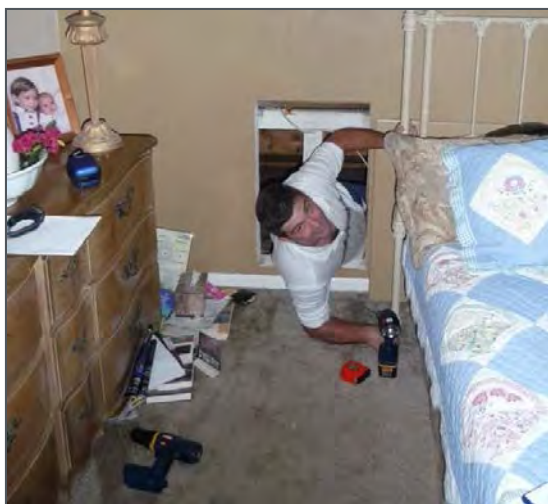


Floor Cavity Covered by Plywood With Adequate Clearance Between Roof Truss and Kneewall For Insulation





- 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

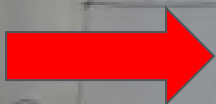


IR Image of Exterior Heated by Sun



Floor cavity open to east and west attics

PREVAILING WIND



Wind driven attic air can flow through floor cavity

2nd Story Floor Space Open to Vented Attic

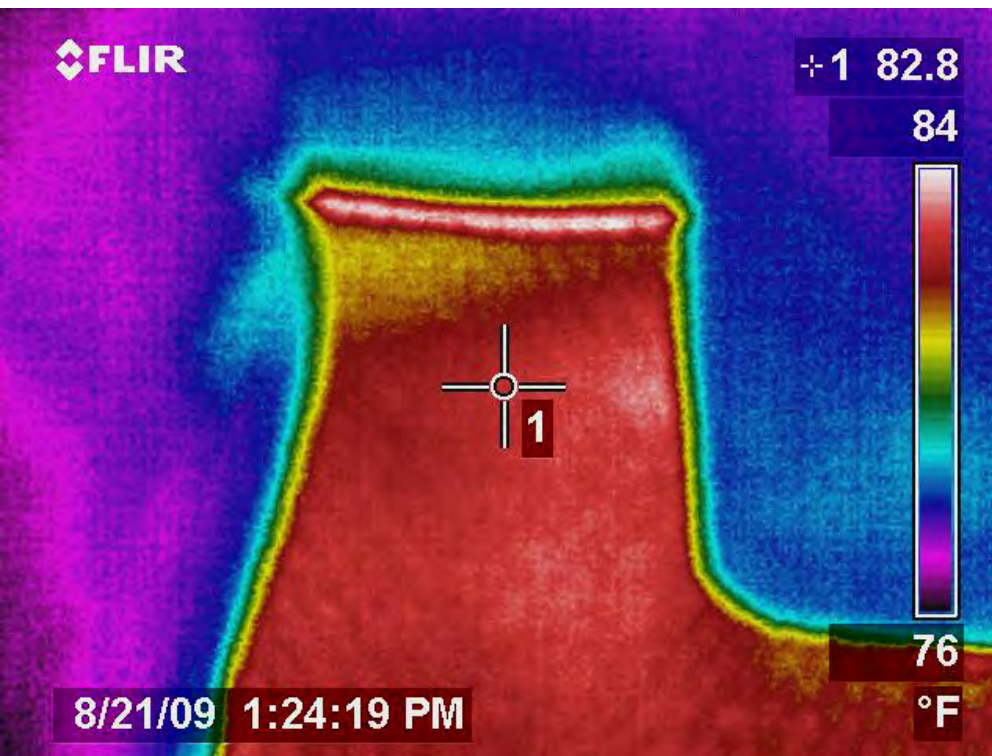


East side attic view

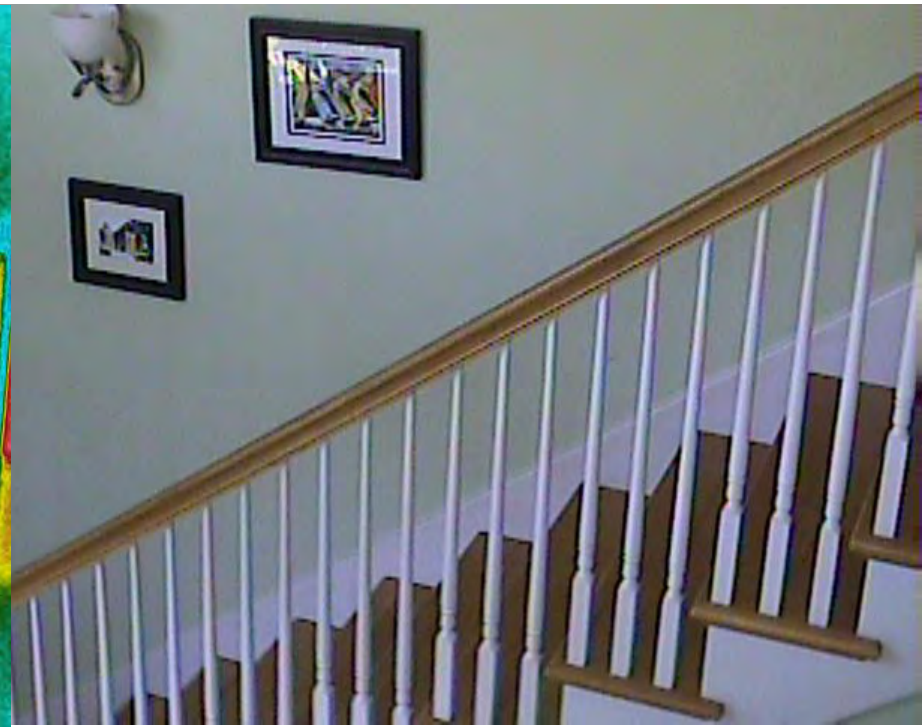
West side attic view



2nd story floor surface is heated by attic air movement into floor space

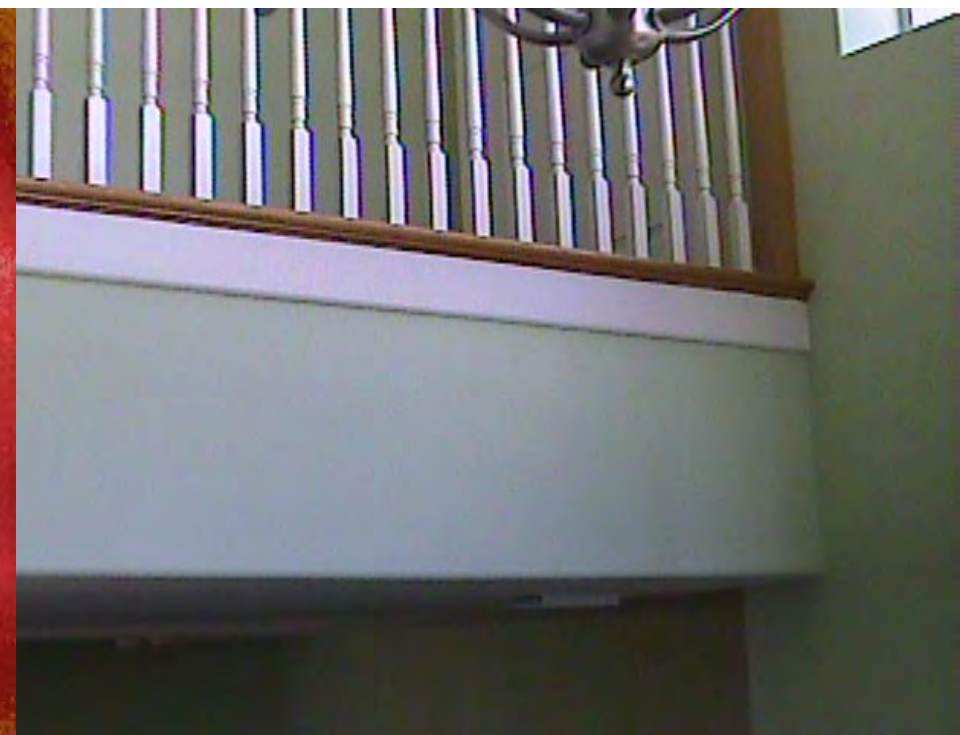
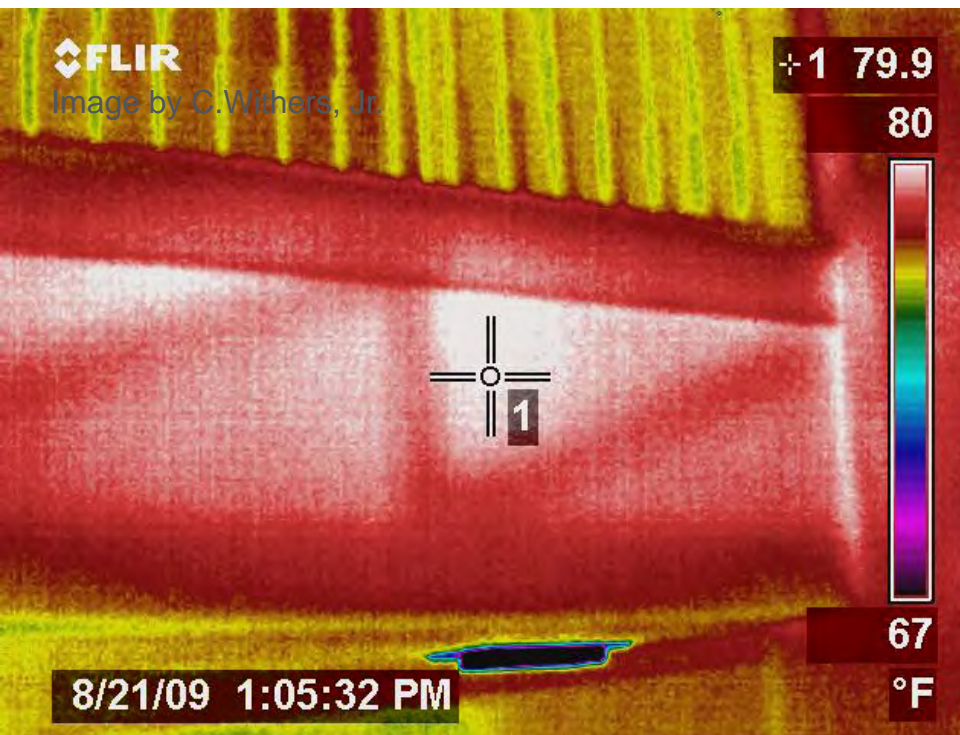


2nd Story Floor Cavity Heated By Attic Air

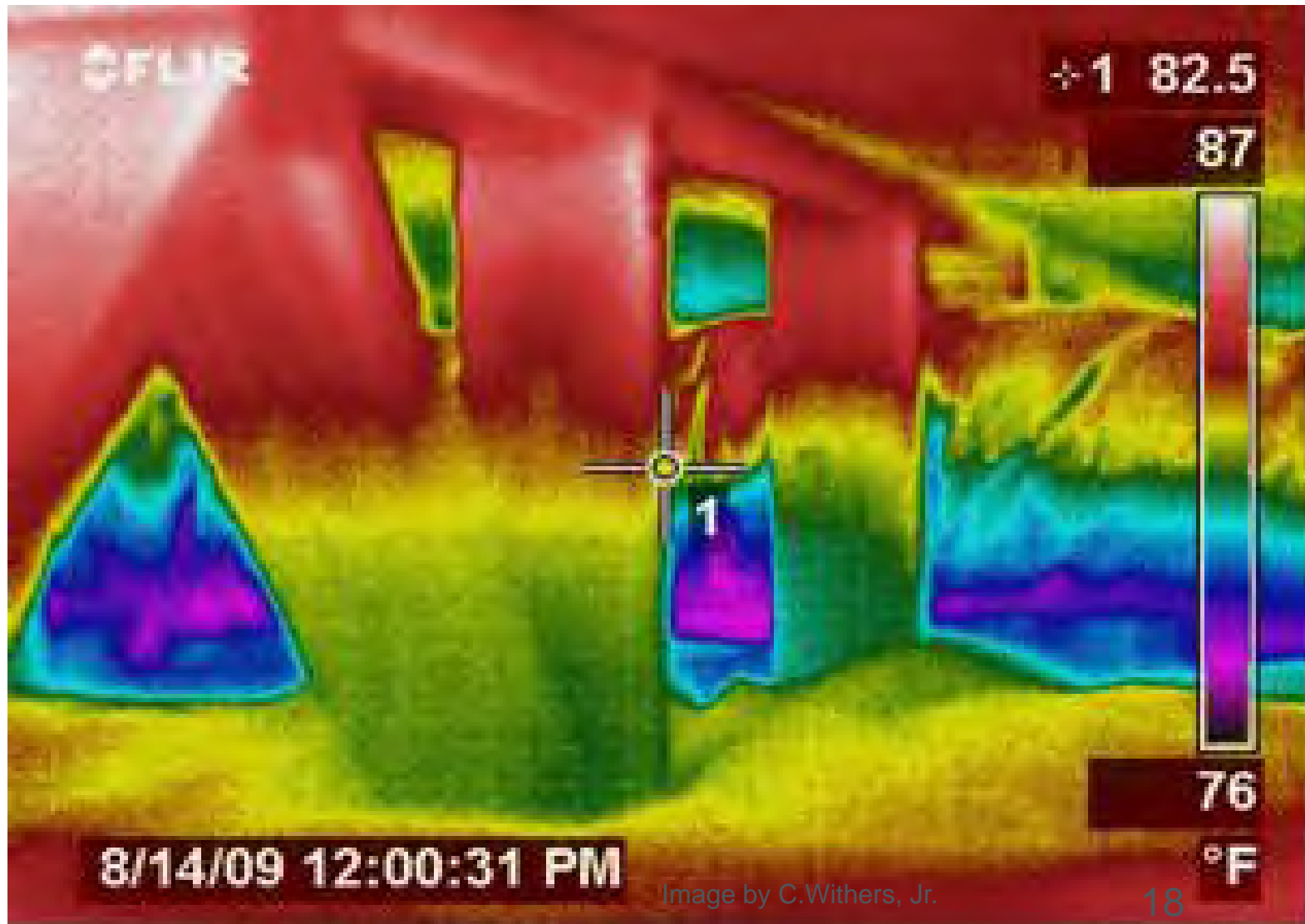


Floor space on other side of very warm wall section.

2nd Story Floor Cavity



IR Image Taken Inside Floor Cavity



House Repair With Low Density Foam



Image by ©.Withers, J

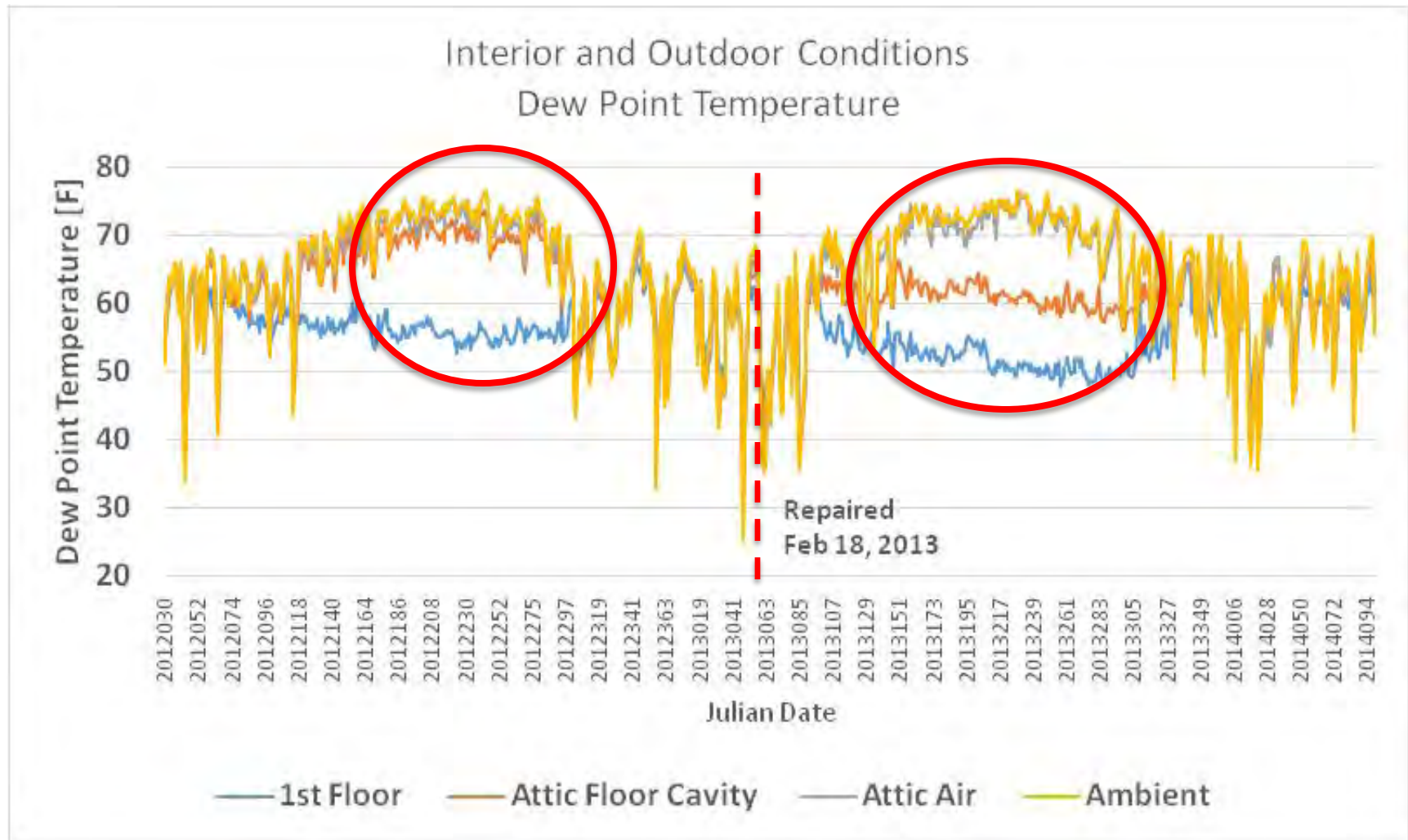
House Repair With Low Density Foam



Image by © Withers, Jr.

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.





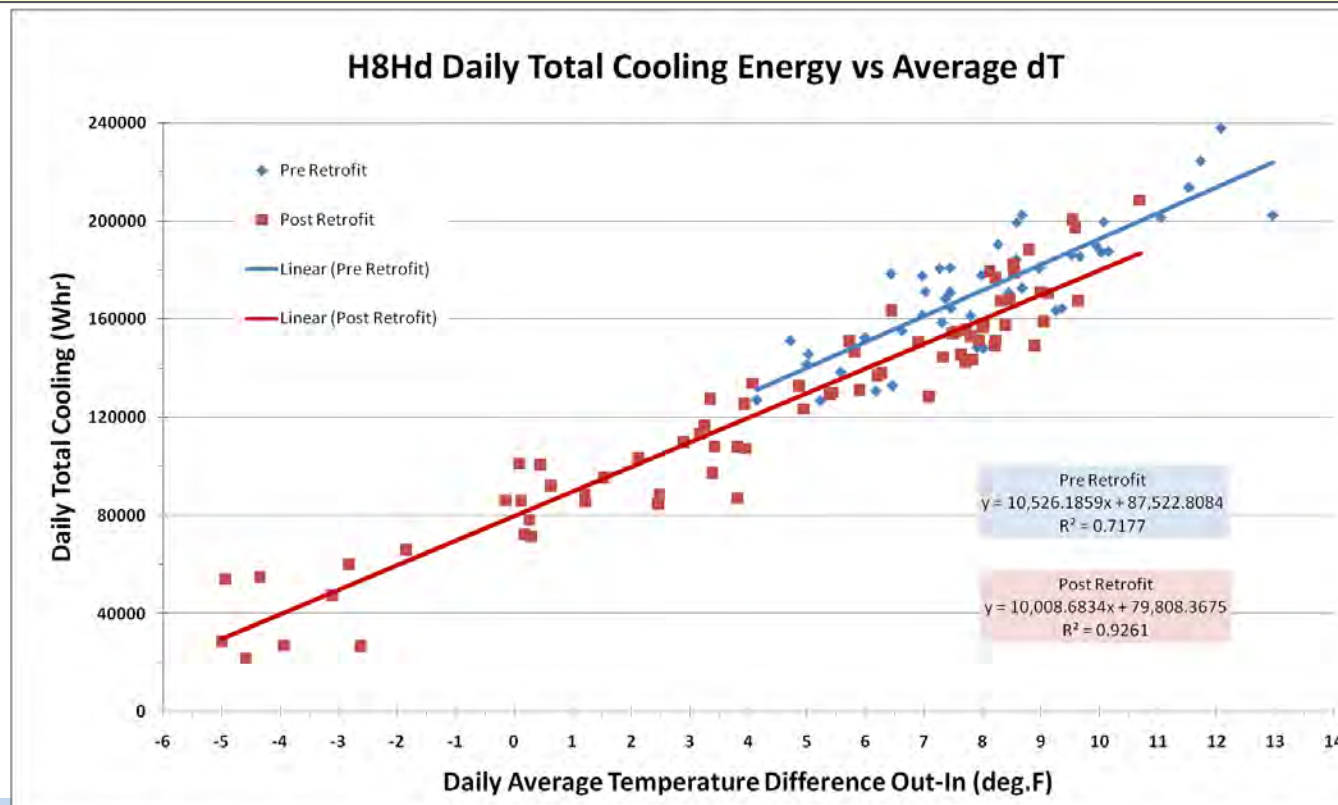
Wind Wash Inspection

Access into west side soffit open to floor space

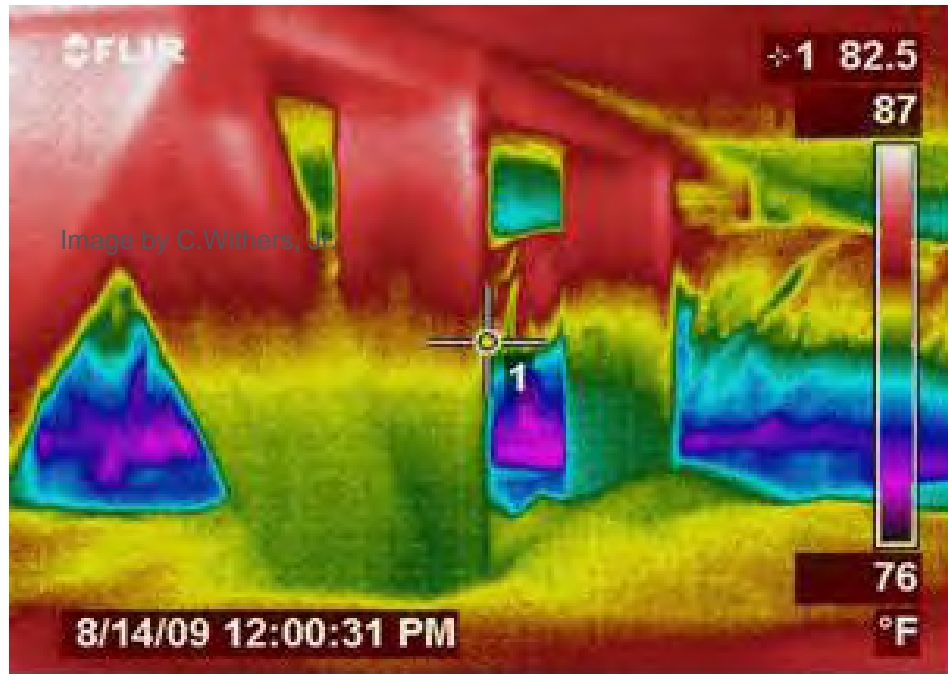


WW Repair Energy Impacts at House 8

- 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.)



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 ft²)
- 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.



Residential Wind Wash Summary

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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Phase I Wind Wash Energy Reductions

House ID	Annual Cooling Energy					Summer Peak Hour Demand			
	Pre-repair kWh	Post-repair kWh	kWh savings	% savings	\$ Savings (@ \$0.115/kWh)	Pre-repair Peak kW	Post-repair Peak kW	kW Reduction	% Reduction
H10H	4629	3793	836	18.1%	\$96	2.10	2.00	0.10	4.5%
H7G	6743	4511	2232	33.1%	\$257	2.40	2.16	0.24	9.9%
H14Y	2806	2605	201	7.2%	\$23	2.27	2.09	0.18	7.8%
H8Hd	33852	31081	2771	8.2%	\$319	11.9	10.2	1.80	15.0%
H16B	5103	4421	682	13.4%	\$78	2.25	1.86	0.39	17.3%
H11C	4710	4145	565	12.0%	\$65	2.02	1.59	0.43	21.3%
<i>Average</i>			<i>1214.5</i>	<i>15.3%</i>	<i>\$140</i>	<i>Average</i>		<i>0.52</i>	<i>12.6%</i>