

Building America 2012 Technical Update Meeting



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Creating Energy Independence



Challenges with Mechanical Codes for Existing Homes: Examples from Florida

July 26, 2012



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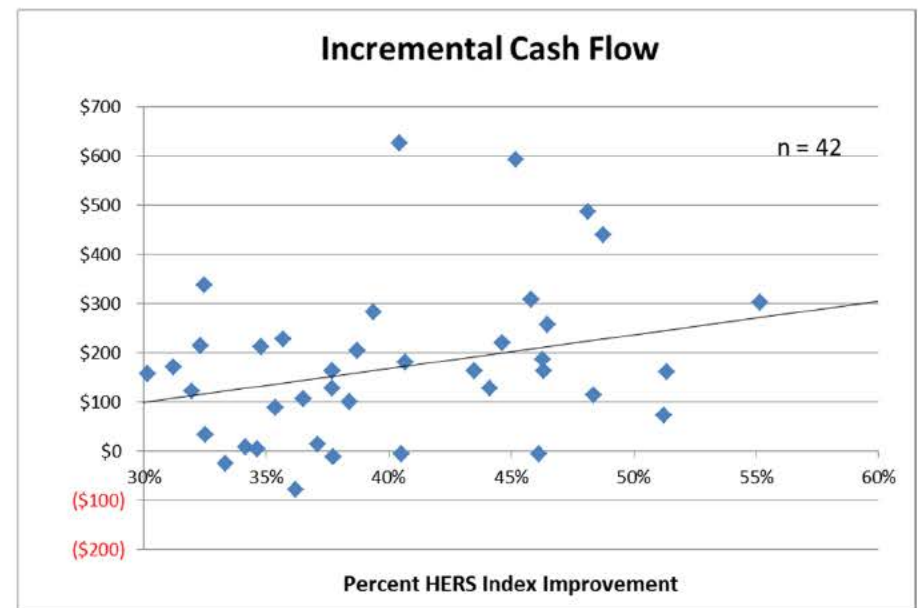
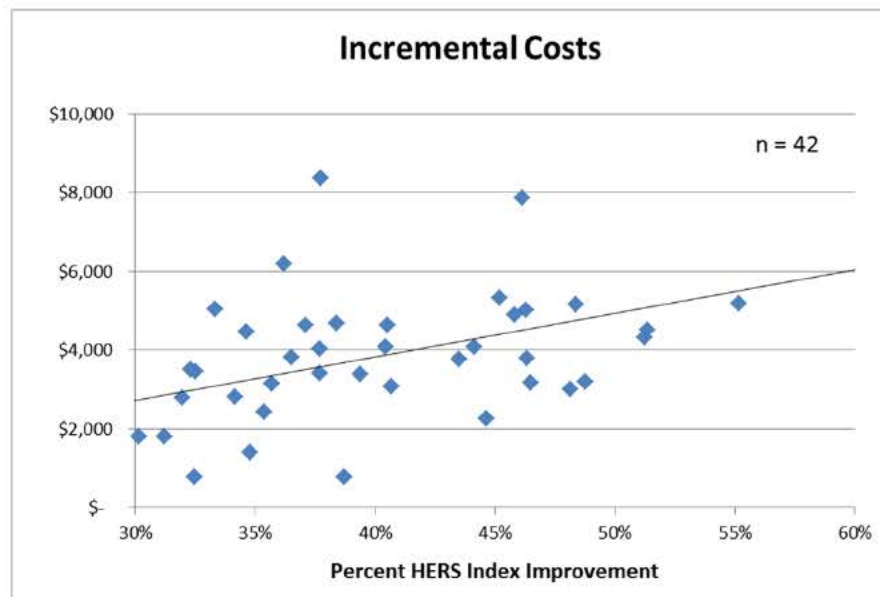
Partnership for Improved Residential Construction
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Comprehensive Foreclosure Renovations



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- 100 total \Rightarrow 80 completed \Rightarrow 70 final data set \Rightarrow 46 Deep Retrofits \Rightarrow 42 with costs
- HERS Index improvement range: 6% to 60% (avg 34%)
- Incremental cost range: \$780 to \$8,382 (avg \$3,854)
- 61 included HVAC change out





Equipment Efficiency (SEER avg increase = 49%)

Duct Air Tightness (qn,out avg improvement = 41%)

Other Mechanical System Considerations



Lack of Control = Risk



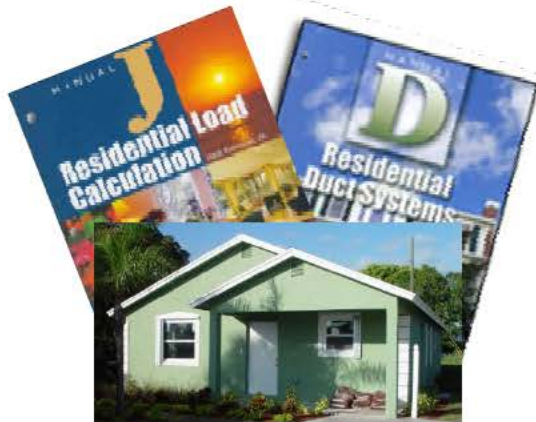
- Florida Residential Mechanical Code embraces building science
- “Baked in goodness” in every new Florida home
- Specifically...

Baked in Goodness...



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~ Good Sizing, Good Design, & Good Installation ~



Sizing per ACCA
Manuals J, D, & S



Sealed Return Plenums



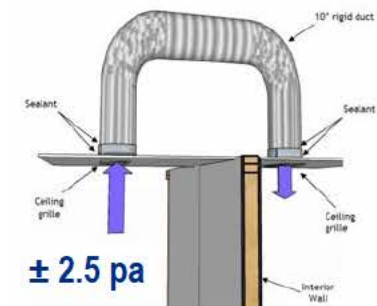
Finished Closet with
≥4" clearance



Assembly Requirements



No Building Cavities as Ducts



Passive Return
Air Pathways

- "All HVAC work shall be done in compliance with prevailing codes."
- Great! The renovations will get the goodness!
 - Fundamental to control of heat, air, and moisture flow
- Upon inspection at post-retrofit audits, we were perplexed to see that the goodness was MISSING!
- Code is different for existing homes

Double Standard



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- The code is different for existing homes
- *Instead of baked in goodness, existing homes...get “the crumbs...”*
 - New Energy Code mechanical requirements (March of 2012)
 - Manual J equipment sizing
 - Seal accessible ducts
- Double Standard – a code gap in expectations
 - We don’t expect or mandate good building science in existing homes
 - Places aging homes at a performance disadvantage

What does it look like?



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~ Crumby Design & Crumby Installation ~



Return grille



Mysterious return plenum



Never Connected Duct



Unsealed closet
= return plenum



Unsealed, Crowded Air
Handler Closet



Unsealed, undersized
platform return plenum

Crumby is OK for existing homes



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What does it mean?



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~ Crumby Design & Crumby Installation ~

Lower Performance for Existing Homes Including...

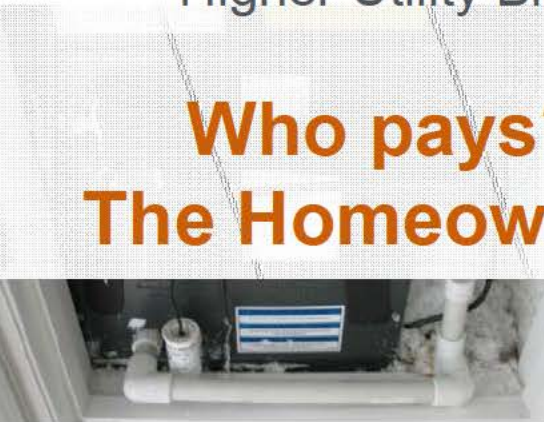
Health Implications
Building Durability Risks
Reduced Machine Life
Lower Comfort
Higher Utility Bills

Who pays?
The Homeowner!

Return



Abandoned
Equipment Cavity



Unsealed, Crowded Air
Handler Closet



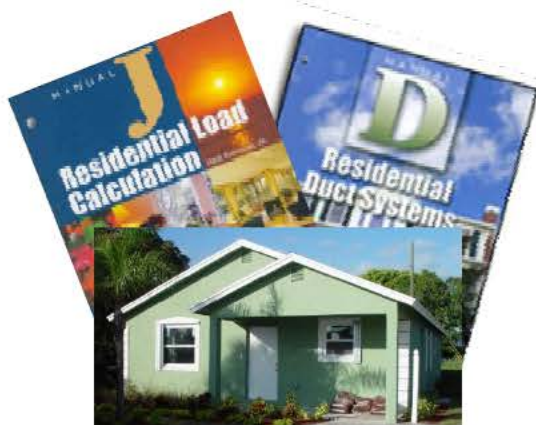
Undersized Return
Plenum Open to Walls

Technical Approach (Very Short Story)



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~ Good Sizing, Good Design, Good Installation, **& More** ~



Sizing per ACCA
Manuals J, D, & S



Sealed Return Plenums



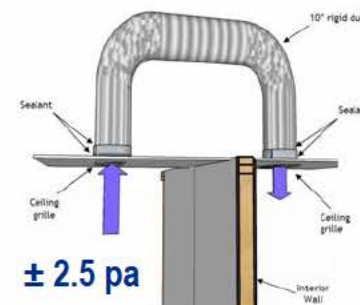
Finished Closet with
 $\geq 4"$ clearance



Assembly Requirements



No Building Cavities as Ducts



Passive Return
Air Pathways

Technical Approach (Short Story – Excerpt from draft Best Practices)



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Components and Strategies	Replacement Specifications	Non-Replacement Specifications
Combustion Safety	Locate combustion appliances in unconditioned space when feasible; if combustion appliances are in conditioned space or attached unconditioned space, perform combustion zone safety procedures to verify adequate supply of combustion air and disconnection conditioned space and install CO detectors.	
Mechanical Equipment and Air Distribution	<p>A three-part guideline details specifications for replacing mechanical equipment. The guideline is segmented into the following sections:</p> <ol style="list-style-type: none"> 1. HVAC Assessment, Design, and Specifications 2. HVAC Installation 3. Post-retrofit HVAC Testing and Verification <p>Key components:</p> <ul style="list-style-type: none"> • ENERGY STAR (min. SEER 14.5) equipment • Ensure ducted returns • Ensure flex duct collars are fully insulated • Seal of all joints and edges (preferably with mastic) in supply ducts, return plenum, and connections to air handler • Ensure new duct work strapped to trusses to achieve clearance over anticipated ceiling insulation • Ensure any new ducts insulated to R-Value ≥ 6 or higher • Perform ACCA Manual J load calculation and size system accordingly • When feasible, install a dampered, passive mechanical ventilation duct to provide outside air to return plenum • Ensure pressure balance between main body of the house and each bedroom (± 2.5 pa) • Ensure pressure in main body wrt outside $\leq \pm 5$pa • Ensure duct leakage to the outside $\leq 6\%$ ($Q_{n,out} \leq 0.06$) 	<p>A four-part guideline details specifications when keeping an existing mechanical system. The guideline is segmented into the following sections:</p> <ul style="list-style-type: none"> • HVAC Return Plenum and Passive Return Air Pathways • HVAC Service Mechanical Equipment • HVAC Test Duct System Air Tightness Pre-retrofit. • Post-retrofit HVAC Duct Testing and Verification <p>Key components:</p> <ul style="list-style-type: none"> • If an atmospheric combustion furnace exists, provide adequate supply of combustion air • When feasible, retrofit a duct board plenum into platform returns, otherwise fully seal platform return • When feasible, replace louvered doors on air handler closets with a correctly sized central return grille mounted in the wall (if adjacent to a living space) or in a solid door. • When feasible, replace air handler stands with ducted return plenum • Service by HVAC contractor • Ensure pressure balance between main body of the house and each bedroom (± 2.5 pa) • If measured duct leakage exceeds 6% ($Q_{n,out} \geq 0.06$), identify and seal leakage points • Ensure pressure in main body wrt outside $\leq \pm 5$pa
Ventilation	In addition to the passive mechanical ventilation system in the HVAC section, install kitchen and bathroom exhaust fan ducted to outdoors.	Install kitchen and bathroom exhaust fans ducted to outdoors.
Infiltration	Conduct pre- and post-retrofit blower door test to assess whole-house air tightness and identify leakage points. Target test result is 6 or less air changes per hour at the test pressure of 50 pa ($ACH_{50} \leq 6.0$). Measure combustion zone pressure differences. Identify and repair duct and/or whole-house infiltration points if necessary to achieve proper balance. A list of common infiltration points is provided.	

Why not close the gap?



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- Proposed Action: Apply new home mechanical code requirements to existing home change outs (& more)
- Cons
 - You could make things worse than a standard change out
 - The good things in the code do not adequately reduce potential risk
 - Requires OTJ analysis
 - Extra QC – no existing protocol w/in industry
 - May involve multiple contractors - blurring of responsibility
 - Inconvenience and additional cost (perhaps significantly)
 - Urgency! “My in-laws will be here tomorrow night.”
- Pros
 - Unique opportunity - the HVAC contractor is already there!
 - Extend life of equipment & housing stock
 - Reduced operating costs, durability risks, cleaner, happier homes and people

Market ready for Florida?



- Not for the masses – risk factors outweigh the benefits
- Can we make it market ready?
- Maybe...
 - Practical, replicable solutions for common details & issues
 - Similar to BSC air sealing guide
 - Practical method for “exit testing”
 - Clear chain of responsibility and metric(s) for success
- Draft code-like language for trial run



- 2010 Florida Building Code Residential, chapters 13-16.
- 2010 Florida Building Code, Energy Conservation.
- Cummings, J. B., Tooley, J. J., Moyer, N. A. and Dunsmore, R., "Impacts of Duct Leakage on Infiltration Rates, Space Conditioning Energy Use, and Peak Electrical Demand in Florida Homes," Proceedings of the ACEEE 1990 Summer Study, Pacific Grove, CA, August 1990.
- Moyer moisture
- Cummings, J., Withers, C., Martin, E., and Moyer, N. "Measure Guideline: Managing the Drivers of Air Flow and Water Vapor Transport in Existing Single-Family Homes," U. S. Department of Energy, Building America program, February 2012.
- McIlvaine, J., Sutherland, K., Schleith, K., and Chandra, S. Exploring Cost-Effective, High Performance Residential Retrofits for Affordable Housing in the Hot Humid Climate. Seventeenth Symposium on Improving Building Systems in Hot and Humid Climates, August 24-26, 2010, Austin, TX.



- For programs, do this...
 - Identify potential risks in your building types – systems engineering
 - Write a master HVAC specification based on local code req's for new construction (and more!) with flexibility
 - “Must have” verses “would like to have”
 - Develop practical, replicable solutions for common details
 - Write a scope of work for each house (get actual cost estimates)
 - Adjust optional elements of scope
 - Develop procedure for verifying compliance – home inspector or energy rater
 - Make payment contingent on test-out findings
 - Document what actually got done & actual cost, revise master specs periodically



- For General and HVAC contractors, do this...
- Establish credibility & protect yourself
 - Get training – understand the risks and how to prevent disaster
 - Work with a home inspector or energy rater
 - Explain how your tools work
 - Do it for free in 10 houses, document annual savings & intangibles, & turn it into a website of “what was wrong” and how you fixed it. Now you’re the expert.
- Become a building scientist
- Develop “off-season” business model – avoid urgency
- Sell the value -
 - Better breathing, less dust, high tech home calibration (like a race car)
- Take Advantage of Opportunity – you’re already there!
 - Any other problems in your home?
 - HVAC system inspection (like your car) at the time of replacement
 - List of inspection points & advise of high priority issues
- Methodology - Show is better than tell...
 - Watch this... (as you unload testing equipment)
 - “See that dust? Rust? Corrosion? Tangle of spider webs? Mushrooms? The way your bedroom door slams when you turn on the AC?”