Multi-Family Above-Code Certifications in the Southeast: Real World Things You Need to Know To Do Them Right

Ray Ivy, LEED-AP
Multi-Family Technical Advisor and Trainer, Southface

Andrew Hewitt
EC QAD, Southface

Program Goals

- Increase health and safety for occupants
- Promote best-practice design and procedures
  - Designed to Earn the ENERGY STAR
- Above-code building performance
- Enhance building durability
- Reduce unit resource usage for life of structure (energy and water)
- Lower operating costs
- Reduce resources needed to construct

What programs are available

- LEED…
  - For Homes (Low and Mid-Rise)
  - BD + C (High-Rise)
- ENERGY STAR Low and High Rise
- EarthCraft MF
  - New Construction
  - Renovation
- Utility Rebate Programs
  - Georgia Power EarthCents/HEIP for Renovations

Types of projects

- New Construction
- Renovation
- Gut Rehab
- Adaptive Re-use
- Condo and Apartment
- Low, Mid and High Rise
- Affordable and Market Rate

Developer Benefits

- Design assistance
- Value engineering
- Independent third-party verification
- Technical expertise
- Performance testing
- Enhanced durability
- Reduced risk- “gold standard”

Typical Approaches to Meet Standards

- Improved air sealing of unit building enclosure
- Better duct sealing
- Enhanced insulation levels and installation quality
- Higher efficiency HVAC systems
- Better than “code” windows
- Increased % of CFL and pin-based lighting
- ENERGY STAR appliances

Team Members

- Multi-Family Developer MFD
- Technical Advisor TA
- General Contractor GC
- Trades (in order of importance)
  - HVAC
  - Insulation/air sealing
  - Framer
  - Electrician/plumber/drywall

Remember…

- Many, many details- make checklists and have Standard Operating Procedure (SOP)
- Review worksheets and program documents on a regular, scheduled basis
- Establish expectations early and often
- Make examples of early errors
- Keep your mistakes original
- Determine how to get installation information pushed down to field workers

Project Process

Pre-Construction

1	Project Registration
2	Project Information Submittal
3	Preliminary Energy Model(s)
4	Preliminary Energy Model(s) Report Submittal(s)
5	EarthCraft Design Review
6	EarthCraft Design Review Report Submittal

Pre-Drywall

7	Kick-Off Meeting
8	Kick-Off Meeting Report Submittal
9	Air Sealing Inspection(s)
10	Air Sealing Inspection Report Submittal(s)
11	HVAC Initial Diagnostics/Inspection(s)
12	HVAC Initial Diagnostics/Inspection Report Submittal(s)
13	Insulation Inspection(s)
14	Insulation Inspection Report Submittal(s)

Project Closeout

15	Final Inspection(s)
16	Confirmed Energy Model(s)
17	Final Inspection & Confirmed Energy Model Report Submittal(s)
18	Certification

Project Information Submittal

- Plans
  - MF projects usually provide detailed plans
  - Should have unit number and type per floor
  - Start a Inspection Checklist before Design Review (per unit type):
    - Square footage
    - Perimeter
    - Volume
    - Square Footage of Building Envelope (SFBE)
  - Unit square footage from plans usually inside dimensions, RESNET says use outside

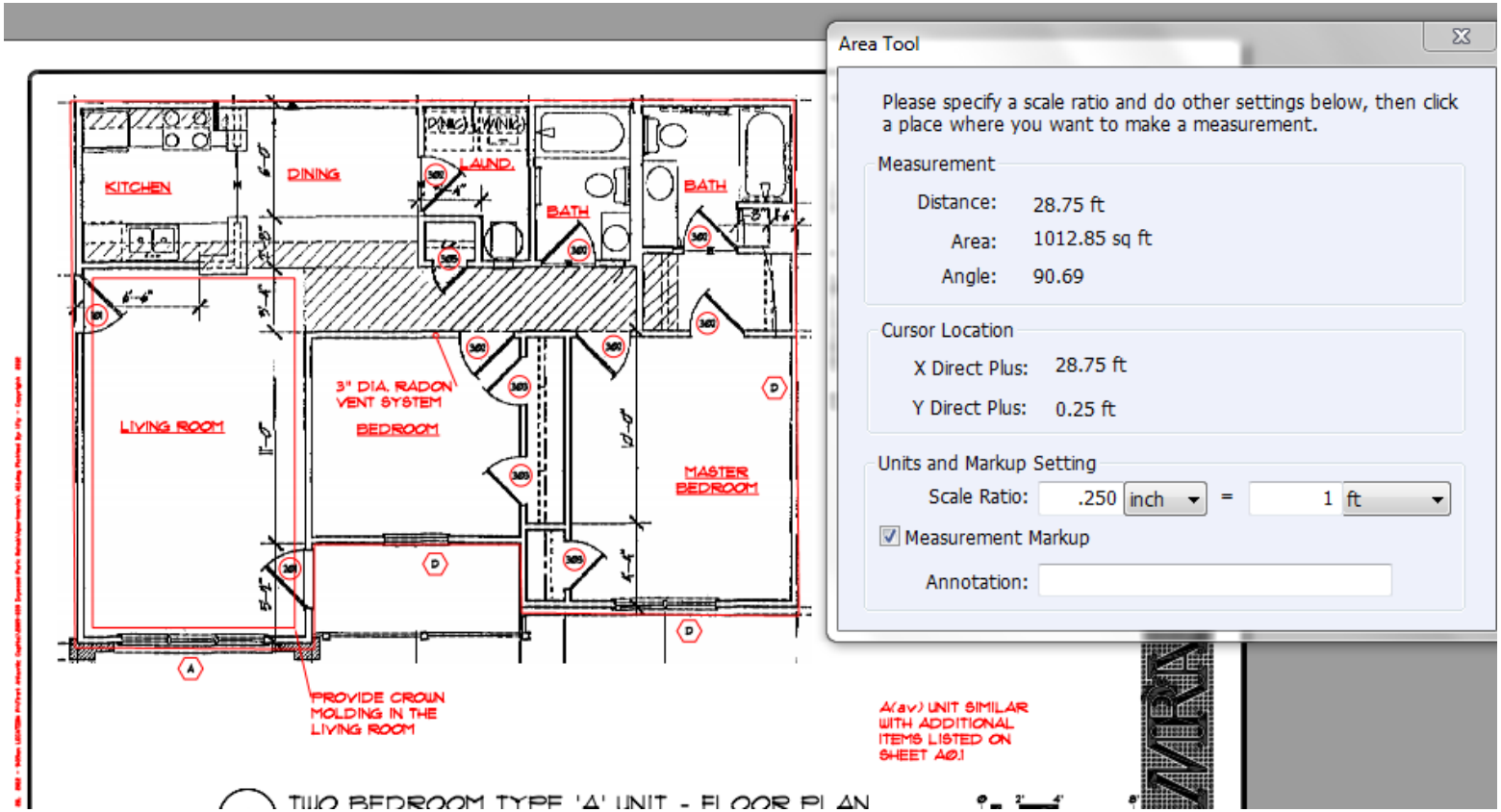
Project Information Submittal

- If band areas well sealed, use in volume and sfbe for all but top floor
- Helps blower door test results for small units

	Ivywood Inspection Checklist Unit Data				
		sf	perimeter	volume	sfbe
	2BR-A	1000	140'		
Floors	1, 2			10500	3330
"	3			9000	3120
	3BR-B	1200	160'		
Floors	1, 2			12600	3920
"	3			10800	3680
	3BR-C	1240	160'		
Floors	1, 2			13020	4000
"	3			11160	3760

Project Information Submittal

- We use Foxit PDF Reader to determine perimeter (sfbe of walls) and area (volume)
- View - Toolbars - Drawing



Project Information Submittal

- Spec Sheet
- Load Calcs (Manual J)
- Preliminary Worksheet
- Ventilation Strategy (must meet ASHRAE 62.2)
- Do a worst-case unit analysis to determine which units need energy modeling
- Create a sampling plan
- Create an Inspection Checklist

Spec Sheet

INSULATION	R-value or Inches of Foam		Insulation Type
Location Circle or explain where appropriate	Cavity	Continuous	Fiberglass, Cellulose, Open-cell foam, Closed-cell foam
Exterior Walls			
Floor over Bsmt/Crawl/Garage			
Cantilevered Floors			
Flat Ceilings			
Tray Ceilings			
Vaulted or Sloped Ceilings			
Attic Kneewalls			
Rim/Band Joists			
Poured Bsmt or Crawl Walls Specify whether int. or ext. sheathed			
Framed Bsmt Walls			
Under slab or slab edge, specify			

Note: Add section for wall framing thickness

HVAC SYSTEMS **-Air handler location,** **Include make & model number**	**Unit Type** **1bd,** **2bd,etc…**	**AFUE or HSPF**	**SEER**	**Capacity –** **Output in btu/h or tons**	
				Heating	Cooling

Spec Sheet

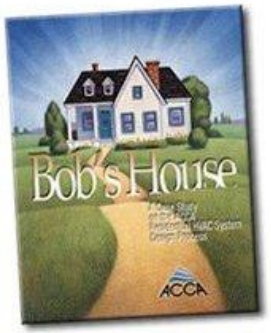
MECHANICAL VENTILATION		On which unit types? List below.	
Fresh/outside air intakes			
Type, circle or underline	Supply Only	Exhaust Only	Balanced
Duct size:	Rate (CFM):	Hours/Day:	Fan Watts:
When using ventilation controllers, check here_____. When using ERV/HRV, enter specs below.			
Sensible Recovery Efficiencies (%):		Total Recovery Efficiencies (%):	

Try to get diagram of layout and specs on components to be used (vent pipe size, electrical damper, controller, etc…

Fluorescent Lighting - Unit type	% Pin-Based Fluorescent Lighting Used	% Compact Fluorescent Lighting

Can be a big influence on MF HERS index

Load Calc Check



REQUIRED AT ALL LEVELS			
ES 1.0	Size and select all HVAC equipment in accordance with ACCA Manuals J and S:		All
	1.	Complete load calculation with accredited ACCA Manual J 8th Edition Software or stamp by a Professional Engineer	-
	2.	Based on worst case unit orientation	-
	3.	Use 2009 ASHRAE Handbook of Fundamentals Climate Design Information for outdoor design temperatures	-
	4.	Indoor temperatures 70°F for heating and 75° for cooling	-
	5.	Base infiltration on "average"	-
	6.	Use actual area, U-factor and SHGC for windows and doors, actual area and R-values of floors, walls , and ceilings	-
	7.	Base on ASHRAE 62.2-2007 ventilation requirements	-
	8.	Cooling equipment and/or single-stage heat pump between 95%-115% (≤125 for heat pump in Climate Zone 4)	-
	9.	Provide OEM data for each unique system type	-

Load Calc Check

Design Information

Weather: Atlanta, GA, US

Winter Design Conditions

Outside db	23	°F
Inside db	70	°F
Design TD	47	°F

Summer Design Conditions

Outside db	91	°F
Inside db	75	°F
Design TD	16	°F
Daily range	M	
Relative humidity	50	%
Moisture difference	38	gr/lb

Heating Summary

Structure	6761	Btuh
Ducts	406	Btuh
Central vent (2 cfm)	111	Btuh
Humidification	0	Btuh
Piping	0	Btuh
Equipment load	7277	Btuh

Sensible Cooling Equipment Load Sizing

Structure	10460	Btuh
Ducts	628	Btuh
Central vent (2 cfm)	37	Btuh
Blower	0	Btuh
Use manufacturer's data	n	
Rate/swing multiplier	0.96	
Equipment sensible load	10646	Btuh

Infiltration

Method	Simplified
Construction quality	Average
Fireplaces	0

	Heating	Cooling
Area (ft²)	650	650
Volume (ft³)	5850	5850
Air changes/hour	*0.49*	*0.49*
Equiv. AVF (cfm)	48	48

Latent Cooling Equipment Load Sizing

Structure	1196	Btuh
Ducts	54	Btuh
Central vent (2 cfm)	56	Btuh
Equipment latent load	1306	Btuh
Equipment total load	11952	Btuh
Req. total capacity at 0.70 SHR	1.3	ton

Heating Equipment Summary

Make		
Trade		
Model		
AHRI ref		
Efficiency	0	HSPF
Heating input		
Heating output	0	Btuh @ 47°F
Temperature rise	0	°F
Actual air flow	585	cfm
Air flow factor	0.082	cfm/Btuh
Static pressure	0.50	in H2O
Space thermostat		

Cooling Equipment Summary

Make		
Trade		
Cond		
Coil		
AHRI ref		
Efficiency	0	SEER
Sensible cooling	0	Btuh
Latent cooling	0	Btuh
Total cooling	0	Btuh
Actual air flow	585	cfm
Air flow factor	0.053	cfm/Btuh
Static pressure	0.50	in H2O
Load sensible heat ratio	0.89	

Preliminary Worksheet

- Completed by developer with help from Technical Advisor (TA) and others
- First big opportunity for TA to influence design and as-built
- Keeping up with different versions of programs can be a challenge
- Have team members download latest version from the website for each project

Ventilation Strategy

REQUIRED AT ALL LEVELS			
ES 4.0	Install exhaust fans in all bathrooms and duct to outside		-
ES 4.1	Gas kitchen range vented to exterior ≥100 cfm fan		-
ES 4.2	Ventilation strategy compliant with ASHRAE 62.2-2007		-
ES 4.3	When installed, fresh air intakes must achieve the following standards:		All
	1.	≥10' away from exhaust outlets , vehicle idling zones, parking garages	-
	2.	When run to soffit the duct must be extended and affixed through soffit	-
	3.	Fresh air duct may not be run to the roof	-
	4.	Fresh air shutoff may not be controlled by humidistat	-
	5.	Install rigid duct with insulation	-
	6.	All intakes must be ducted to exterior of building	-
ES 4.4	Seal seams of all intake and exhaust ducts with mastic		-
ES 4.5	Duct clothes dryers to outside		-
ES 4.6	No power roof vents		-
ES 4.7	Back-draft dampers for kitchen and bathroom exhaust		-

Ventilation Strategy

- ASHRAE 62.2 required by all programs
- Will be more expensive as programs start requiring testing of airflow (62.2-2010)
- Use ASHRAE 62.2-2010 Addendum j
  - Q = .03 (CFA) + 7.5 (#BR + 1)
- Whole-house is required in addition to local ventilation (kitchen and baths)
- **4.1.2 Alternative Ventilation.** Other methods may be used to provide the required ventilation rates (of Tables 4.1a and 4.1b) when approved by a licensed design professional.

Ventilation Strategy

- What we have seen in the past:
  - Outside air with manual and electric damper only

-Electric damper opens when system is on, closes when system is off

-Lack of negative pressure in AH closet severely impacts ventilation airflow

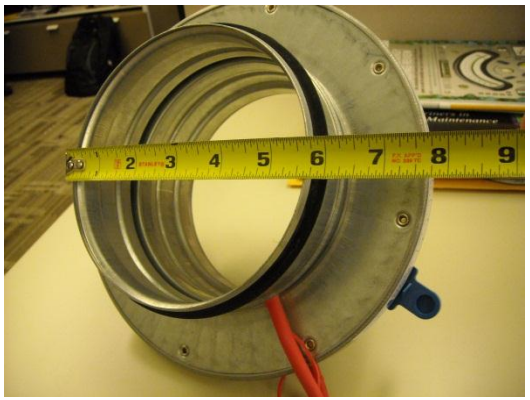
-Little ventilation during shoulder seasons

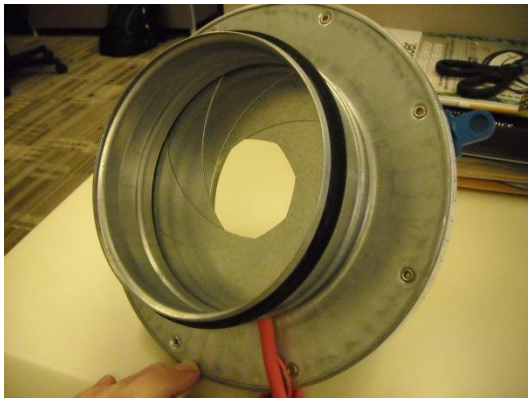
Ventilation Strategy

- Popular current option:
  - Outside air with manual damper, electric damper and controller (AirCycler VS, Aprilaire 8126, Honeywell Y8150)

Ventilation Strategy

- Issues with outside air strategy with controller
  - Lack of negative pressure in AH closet still an issue
  - Uses big AH fan for small amount of ventilation air
  - Vent pipe should be insulated
  - Exterior vent location and spacing





FanTech iris manual damper

Ventilation Strategy

- Exhaust only
  - Usually larger, more quiet bath exhaust fan
  - Negative pressure pulls unconditioned air from largest, most available hole
  - Inexpensive to buy and operate (DC motor); run continuously
  - If quiet, occupant might not unplug it
  - Vent layout and installation is critical to airflow
  - Oversize fan to be sure of airflow

Ventilation Strategy

- Likely future balanced options:
  - OA controller coordinates with bath fan
    - AirCycler g2-k
  - OA with inline fan, coordinates with bath fan
    - Honeywell Prestige HD Comfort System
  - Panasonic WhisperComfort ERV
    - 40 cfm max with current model

Ventilation Strategy

- Testing ventilation airflow
  - Energy Conservatory Exhaust Fan Flow Meter
  - Large vane anemometer
  - Flow hood/balometer
- Who controls ventilation?
  - Unit occupant or management?
  - Accessibility of controls
    - 62.2-2010 Occupant must have accessible control

Preliminary Energy Model

- Worst-case unit analysis
  - Model each unit type on each floor, use unit with the highest HERS Index in the building
- Improvement analysis
  - Modify preliminary HERS model
  - Must do if a unit type fails to pass ES Target Index
  - If you show how to improve HERS index with minimum price increases, you show the value of your services!

Preliminary Energy Model

ENERGY STAR v2.5 Home Verification Summary

Property
Decatur Housing Authority
Decatur, GA

Organization
Southface Energy Rated Homes
Matt Monroe

HERS
Projected Rating
9/12/2012
Rater ID:

Weather:Atlanta, GA
AWIII BLDG3
AWIII 1BR Flat btm floor MM existing specifications.blg

Builder
Norsouth

Projected Rating: Based on Plans - Field Confirmation Required.

Building Information

Conditioned Area (sq ft)	688
Conditioned Volume (cubic ft)	7279
Insulated Shell Area (sq ft)	1244
Number of Bedrooms	1
Housing Type	Apartment, end unit
Foundation Type	Slab

Rating

HERS Index	84
HERS Index w/o PV	84
HERS Index Target (SAF Adjusted)	76
HERS Index of Reference Design Home	76
Size Adjustment Factor	1.00

This home DOES NOT MEET the EPA's requirements for an ENERGY STAR Home.
HERS Index w/o PV <= HERS Index of Reference Design Home AND HERS Index <= HERS Index Target to comply.

Building Shell

Ceiling w/Attic	None
Sealed Attic	None
Vaulted Ceiling	None
Above Grade Walls	R-13 G1.0C foam $ U=0.083

Window Type	.36U/.30 SHGC0**
Window	U-Value: 0.360, SHGC: 0.300
Window/Wall Ratio	0.17
Infiltration Type	Blower door test

Preliminary Energy Model

ENERGY STAR v2.5 Home
Verification Summary

Property
Decatur Housing Authority
Decatur, GA

Organization
Southface Energy Rated Homes
Rivy

HERS
Projected Rating
9/12/2012
Rater ID:

Weather:Atlanta, GA
AWIII BLDG3
AWIII 1BR Flat btm
floor-RI-improv-15SEER HP-passes
ESv2.5.blg

Builder
Norsouth

Projected Rating: Based on Plans - Field Confirmation Required.

Building Information

Conditioned Area (sq ft)	688
Conditioned Volume (cubic ft)	7279
Insulated Shell Area (sq ft)	1244
Number of Bedrooms	1
Housing Type	Apartment, end unit
Foundation Type	Slab

Rating

HERS Index	74
HERS Index w/o PV	74
HERS Index Target (SAF Adjusted)	74
HERS Index of Reference Design Home	74
Size Adjustment Factor	1.00

This home MEETS OR EXCEEDS the EPA's requirements for an ENERGY STAR Home.
HERS Index w/o PV <= HERS Index of Reference Design Home AND HERS Index <= HERS Index Target to comply.

Building Shell

Ceiling w/Attic	None
Sealed Attic	None
Vaulted Ceiling	None

Window Type	.36U/.30 SHGC0***
Window	U-Value: 0.360, SHGC: 0.300
Window/Wall Ratio	0.17

Sampling Plan

Project:	Ivywood Park											
Total Units:	106											
Buildings:	8						LEGEND					
Notes:	ECMF- 30% units per building						Crawlspace					
	HEAP- 15% per floor per building: 1 unit per floor required						Slab					
	Left Side Elevation		Right Side Elevation				HEAP Sample Units					
	Rear	Front	Front	Rear			Additional ECMF Sample Units					
						Front	Front			Front	Front	
Building Five	528C	527B	526B	525C	518C	517B	516B	515C	508C	507B	506B	505C
30 units	524C	523B	522B	521C	514C	513B	512B	511C	504C	503B	502B	501C
9 tests=30%		530B	529B			520B	519B			510B	509B	
Building Six	606A	605A	608A	607A								
10 units	602A	601A	604A	603A								
3 tests=30%	609A			610A								

Design Review

- Critical design and planning meeting
- Discussion guided by Preliminary Worksheet and Man J
- Goals are to confirm (in order of importance)…
  - Roles and expectations
  - Communication procedures
  - Construction specs and procedures
  - Documentation and submittal timelines
  - Inspection and testing parameters
- Participants
  - TA, developer; GC, Project Manager, Site Super (if known)
  - Architect, HVAC designer, civil engineer
  - Optional: Landscape architect, trade reps (esp. HVAC, insulation and air sealing)

Design Review-Agenda

- Review
  - Documentation requirements including program forms
  - Sampling procedures (if applicable)
  - Load calcs and ventilation strategy
  - Preliminary energy model (s)
  - Set dates for Kick-off Meeting and Inspections/Testing
- Line-by-line Worksheet Review
  - Confirm project meets mandatory items and minimum point totals
- Review updated Energy Model at end of discussion if initial did not meet HERS target

Pre-Drywall Phase

- Stress importance of scheduling inspections
- Site super and trade rep should accompany TA on all inspections
- TA gives on-site verbal report to GC on issues identified during inspections
- TA submits written report to EarthCraft (EC), developer and GC within 1 day of inspections
- Any units failing an inspection must be reinspected prior to next step in process

Kick-Off Meeting

- Should occur on-site just before framing start
- Required attendees:
  - Project manager and site super(s)
  - HVAC, insulation, air sealing, framing, weather barrier trades
  - Optional but recommended: Plumber, electrician, drywall
- Review program requirements, details, techniques and expectations with GC personnel and trade project managers

Kick-Off Meeting

- Confirm unit access procedures
- Stress MRII
- Ask about required PPE
  - Hard hat
  - Safety glasses and vest
  - Boots
- Use mock-ups if possible

HVAC Initial Inspection

- Confirm 1 week in advance; reconfirm the day before; should be on Master Schedule
- Every unit
  - Visual inspection per checklist items
  - Visual inspection of 1 duct connection per system
  - Worksheet point items
- Selected units
  - Total leakage duct test on 10% of total units; include 1 of each unit type per floor if possible

Inspection Tools

- Review OSHA regs
- 15’ tape measure
- Digital camera
- Digital tape measure
- Good flashlight with extra battery
- Drill driver with nut driver and regular bits
- Ladder- 4’, 6’, 8’?
- Basic hand tools

HVAC Initial Inspection

- GC QA Rep/Site Supervisor must inspect units prior to TA inspection; don't make punch lists!
- Site Super and HVAC trade rep must accompany TA on all inspections
- Review Inspection Checklist and Worksheet items
- Verbally review issues with Site Super and HVAC trade rep
- Take lots of pictures- good and bad stuff!
- Include descriptions and pictures of issues to email in written report

HVAC Initial Inspection Report

Jordan, Unit 101 had 6.5% leakage which is a bit higher than the 6% maximum we like to see for this test. Sealing the 2 piece boots might get this number below 6% if some joints are not tight now. Units 105 and 107 were under 6% (see attached Inspection Sheet).

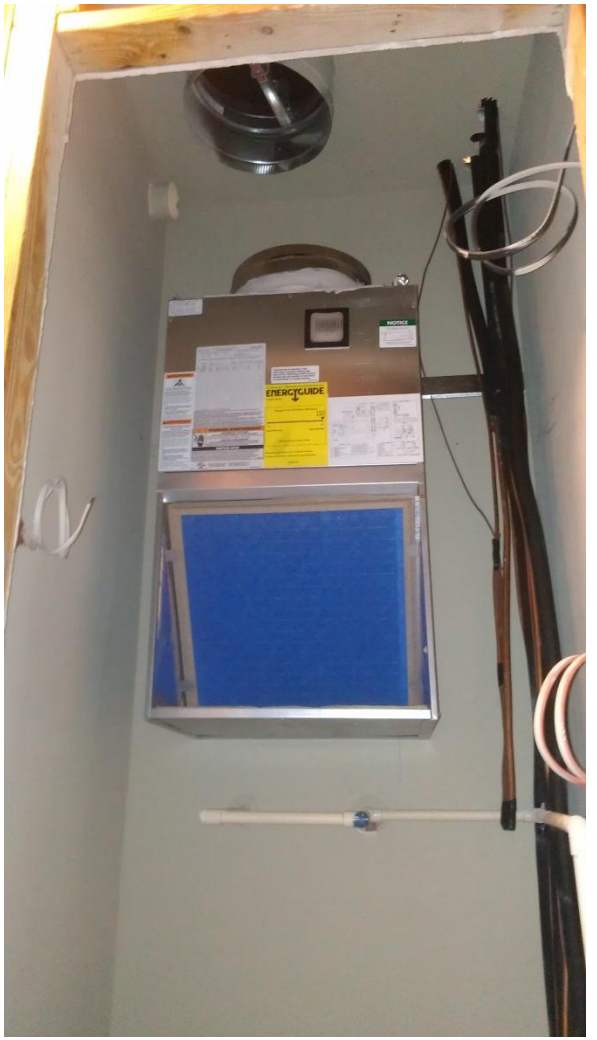
The big things we saw during the inspection were:

-Supply boots need to be taped or mastic applied at the seam where the 2 pieces snap together. One boot came apart as was checking for mastic on the liner. This has caused major air leaks in several other projects. We discussed with Ray and the HVAC installer.

An issue that will be difficult to address at this point is the poor insulation installation behind drywall in HVAC closets and showers. The pieces need to be cut to fit the stud cavities, not just crammed into place. This is Grade 3 work at best. Let's redo the insulation in the areas we can reach and focus on doing a better job on the second floor.

Frequent HVAC Issues

- Duct Sealing at plenum connections; design

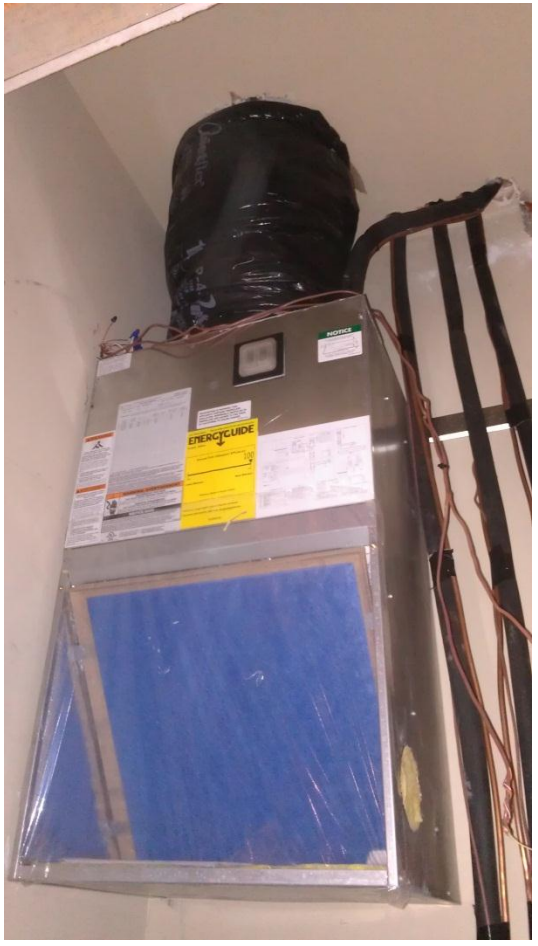


Frequent HVAC Issues

- Alignment issues

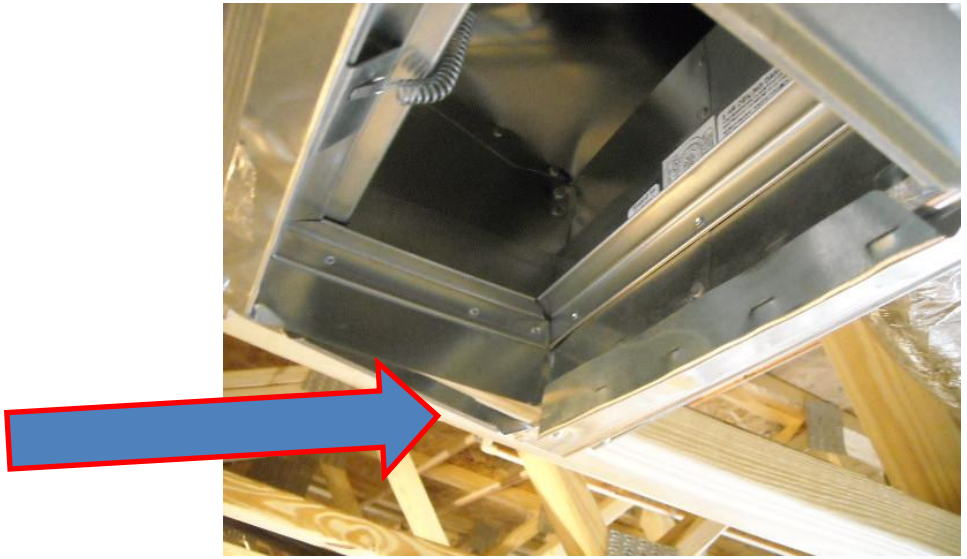
Frequent HVAC Issues

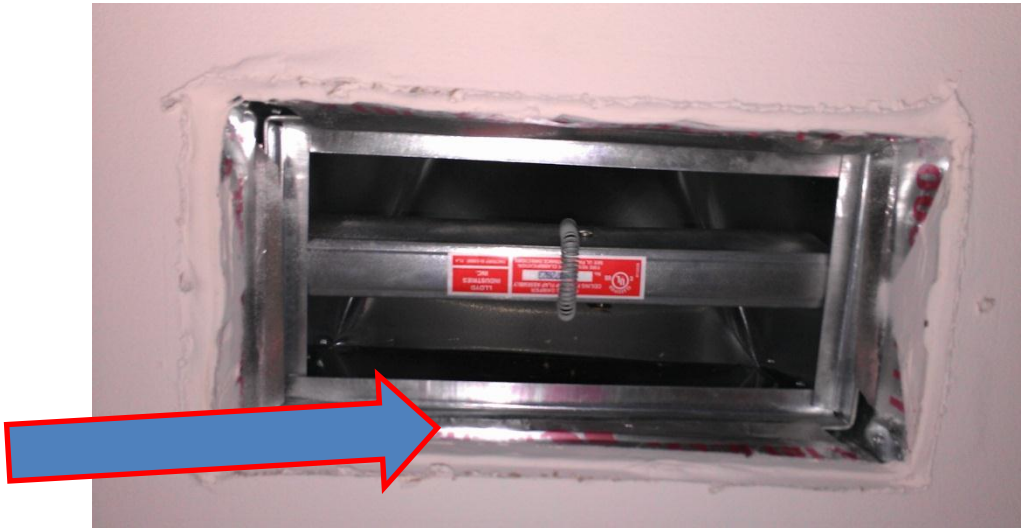
- Filthy, nasty, dirty filters (thus blower fans and coils)



Frequent HVAC Issues

- 2-piece supply boot not sealed
- Especially in attic can easily be kicked loose
- Tape or mastic seam all the way around



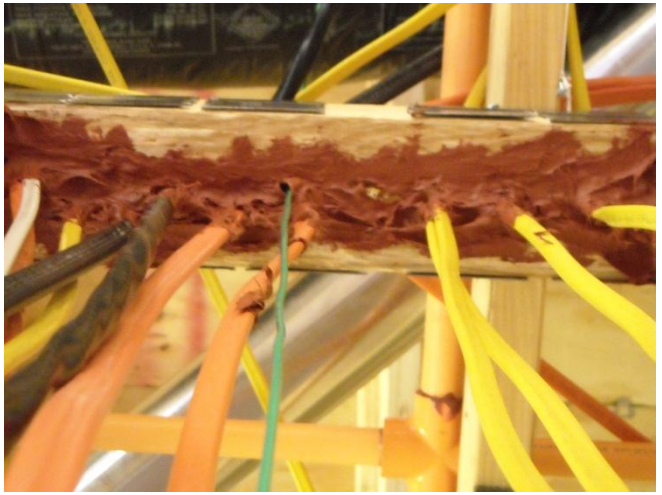


Infrequent HVAC Issues

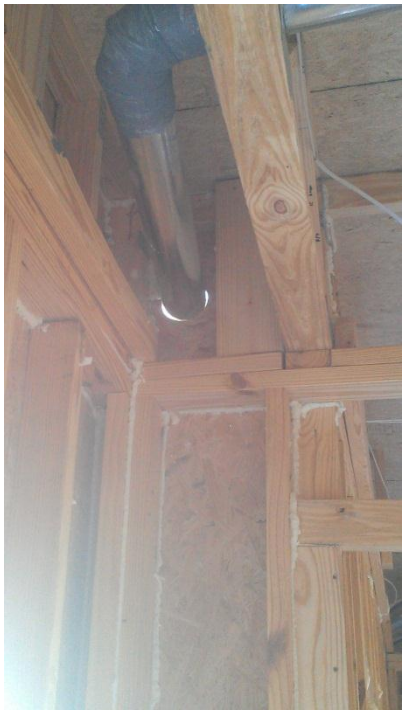
Air Sealing Inspection

- Must occur prior to insulation installation
- Confirm air sealing installation is complete and GC has inspected units to comply with EC standards before doing inspection
- Visually inspects all units for air sealing issues
- Have field tech present with foam gun, ladder and extra cans of foam
- Confirm air sealing items identified in Inspection Checklist and Worksheet

Exterior/Common Walls



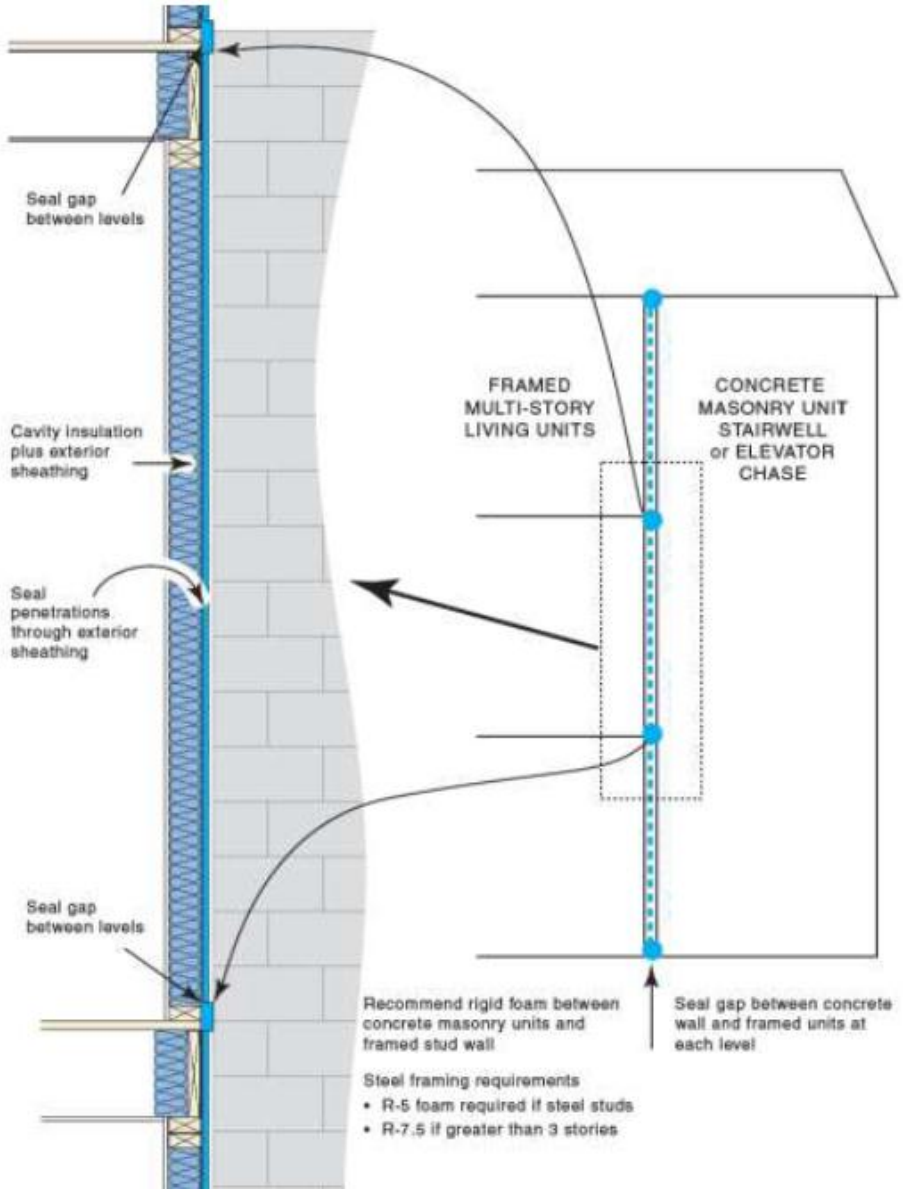
Band/Floor Joists



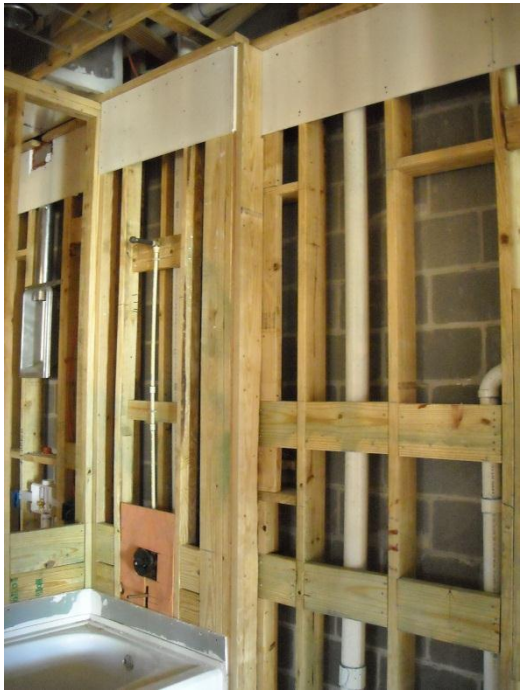
Vertical chases and Bump-outs

Stairs, Elevator Shafts, Fire Rated Walls

- Back side of walls against shaft should have sealed air barrier
- Seal penetrations, perimeter and between floors



Stairs, Elevator Shafts, Fire Rated Walls



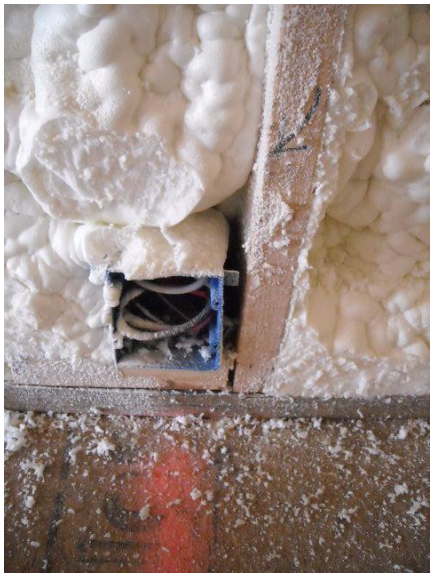
Insulation Inspection

- Must occur prior to drywall installation
- Confirm insulation installation is complete and GC has inspected units to comply with EC standards
- Visually inspect and grade insulation in all units
- Have field tech present ready to adjust insulation
- Confirm insulation items on Checklist and Worksheet are in compliance with program requirements
- Review any issues on-site with GC and trade rep

Batt Insulation

Foam Insulation

- Harder to screw up but it can be done
- Fill holes, gaps and low spots with foam gun



Blown Insulation- Walls

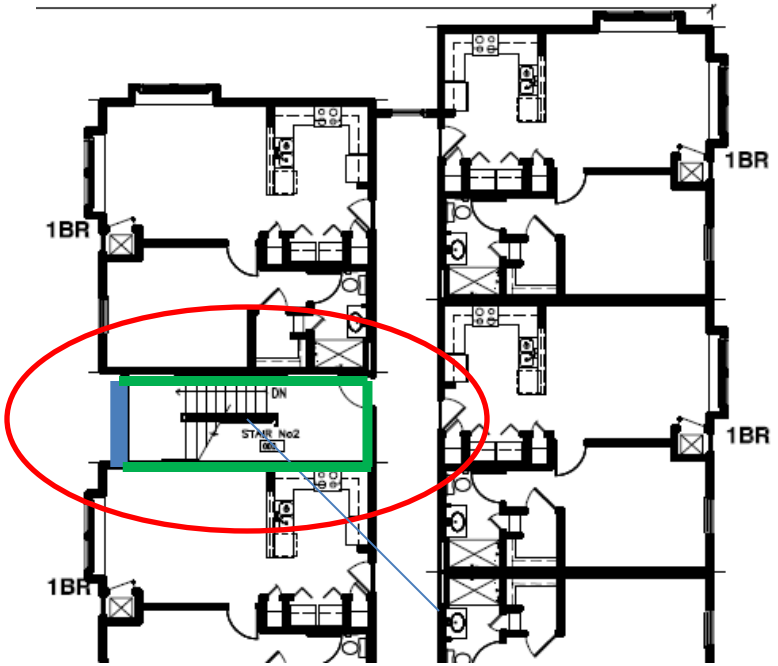
- Lack of bad BIBS photos is a hint…
- We have not seen blown cellulose walls yet

Kneewall Insulation

No Insulation

Insulation- Prep for Final

- Is attic ready for blown insulation?
- Are all exterior walls insulated?



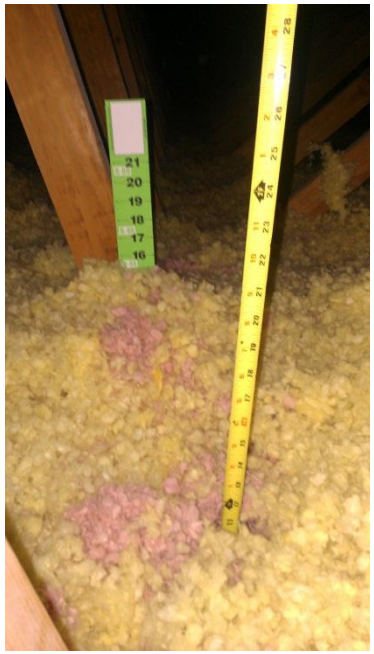
Final Inspection

- All units
  - Confirm plans represent the project as constructed
  - Requirements on Inspection Checklist are fulfilled
    - Air sealing at drywall penetrations- plumbing, bath fans, supply boots, washer/dryer, can lights
  - No items confirmed as compliant during pro-drywall have changed
  - Confirm model numbers and efficiencies of appliances, light and water fixtures
  - Confirm worksheet items are complete

Final Inspection

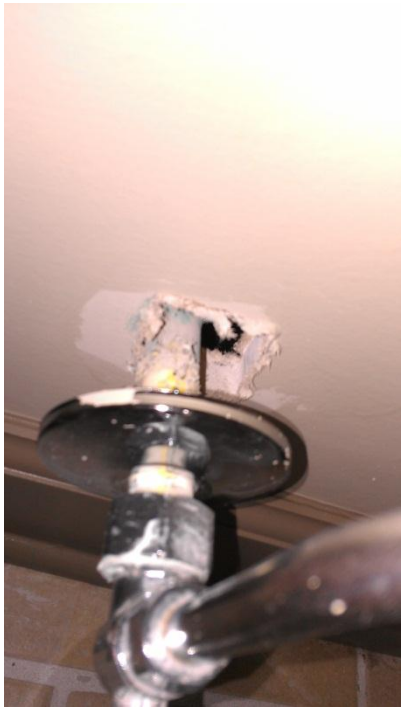
- Sampled units
  - Blower door and ducts testing of minimum 15% of total units
  - ~~Must include 50% of units with ducts outside BE;~~ now 100% of units for energy code compliance
  - If a unit type fails, all same unit types in building must be tested
  - If any of those fail, all units in the building shall be retested
  - Additional tests are not covered in standard scope and will add additional cost per unit tested

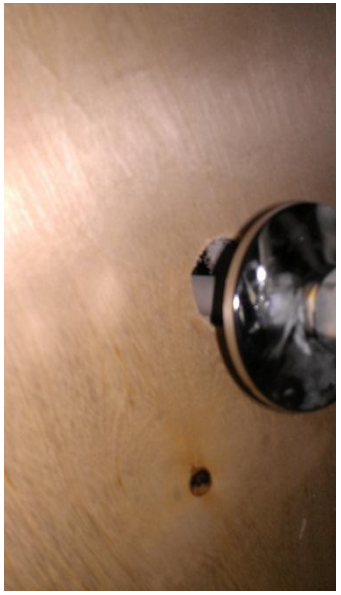
Insulation- Attics



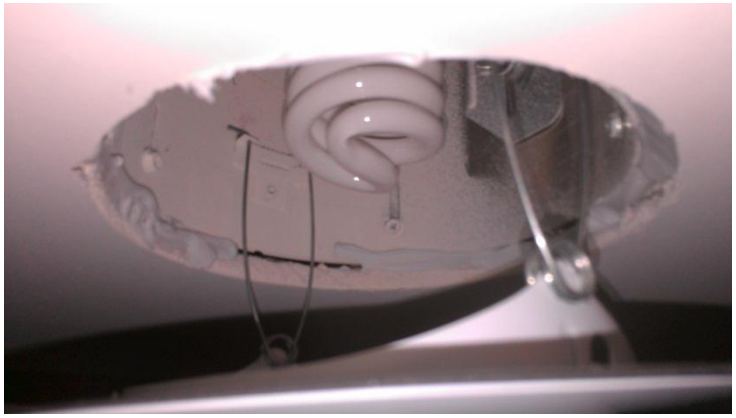
Final Inspection Air Sealing Issues

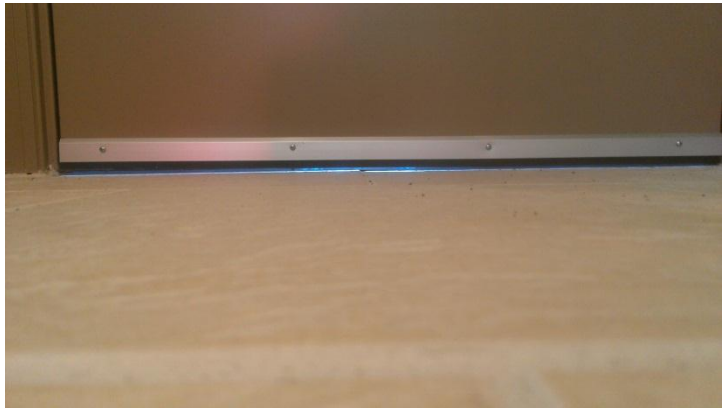
- Top floor!
- Common walls

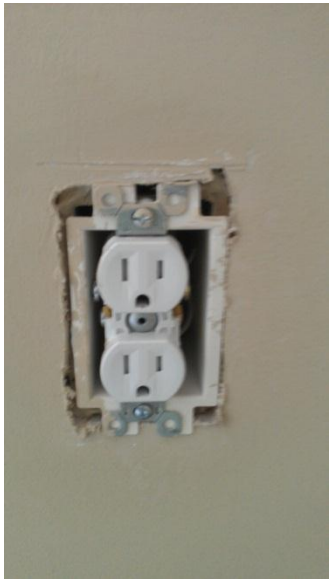




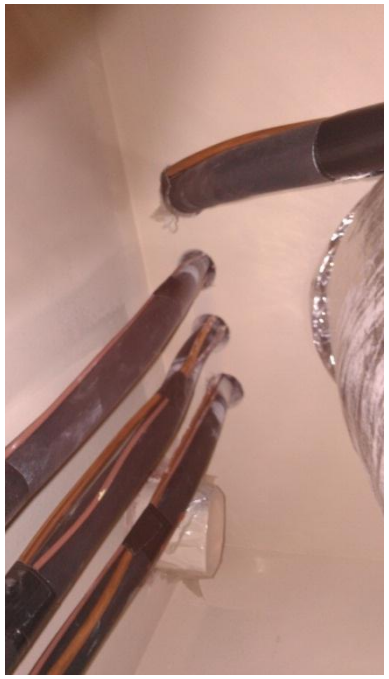
Final Inspection Air Sealing Issues





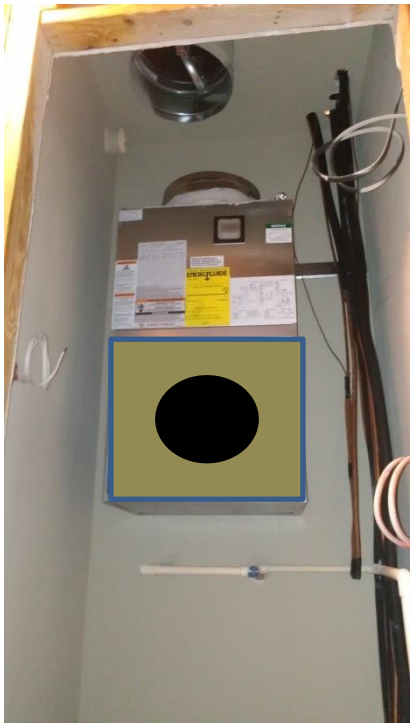


Air Sealing HVAC Closets



Final Inspection- Testing

- Pick units to be tested ahead of time
- Don’t test adjacent units
- Model #s, fixture rates on 1 unit/floor



Final Inspection- Checklist

Diagnostic Testing			
Unit Information			
Unit #	704A	709A	707A
Test	Test-in	Test-in	Test-in
Type	A	A	A
Building Level	MID	SLAB	TOP
# of bedrooms	2	2	2
Sample set #			
Sample subset			
Floor Area Served	1040	1040	1040
Ceiling Height	8	8	8
Band Height	1.2	1.2	0
Perimeter	140	140	140
Volume	9568	9568	8320
SFBE	3368	3368	3200
Blower Door Test			
Ring	A	A	A
Fan Pressure	59	78	48
Fan Flow	1359	1560	1227
ELR (CFM50/SFBE	0.40	0.46	0.38
ACH50 (CFM50x60/Volume)	8.52	9.78	8.85
PASS			

Data entered before Design Review

Data entered during testing

Visual inspection

#	Final Inspection
1	All fixtures and receptacle penetrations through drywall sealed on all floors (walls and ceilings)*
2	Bath fan penetrations through drywall sealed on all floors (walls and ceilings)
3	All plumbing penetrations through drywall sealed**
4	All drywall penetrations associated with washer/dryer sealed
5	HVAC boot penetrations through drywall sealed on all floors (walls and ceilings)
6	HVAC boots sealed to subfloor (if applicable)
7	Recessed can lights air-tight and sealed to drywall

* To include all drywall penetrations in exterior walls, tenant separation w
areas, corridors, stairwells, elevator shafts, etc.
**Penetrations around the edges of fire sprinkler systems may be exem

Confirmed Energy Model

- Revise energy model to reflect as-built
  - Enter BD and DB data
- Record final HERS Index
- Develop options if issues arise

Documentation

- Gather as early in the process as possible
- Ask GC to create an EC folder on their FTP site which all partners can access
- GC should add documentation on specific point items to FTP site
- Stress photo documentation by GC to minimize trips
- TA should take bunches of pictures

Questions?

- Ray Ivy, rivy@southface.org
- Andrew Hewett, ahewett@southface.org