Lessons Learned From New Energy Code Testing

Ross Anderson
The Energy Network

In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors code/energy** continuing education requirements."

For additional continuing education approvals, please see your credit tracking card.

Background

Ross Anderson

- *Builder Remodeler*
- *HERS Rater*
- *Energy Rater Trainer*
- *Performed Training for Builders and Code officials*
- *Currently Performing Code Compliance testing and Training*

Requirements Under Minnesota's New Energy Code.

A modified version of the IECC 2012

IECC 2012 More Challenging than ever

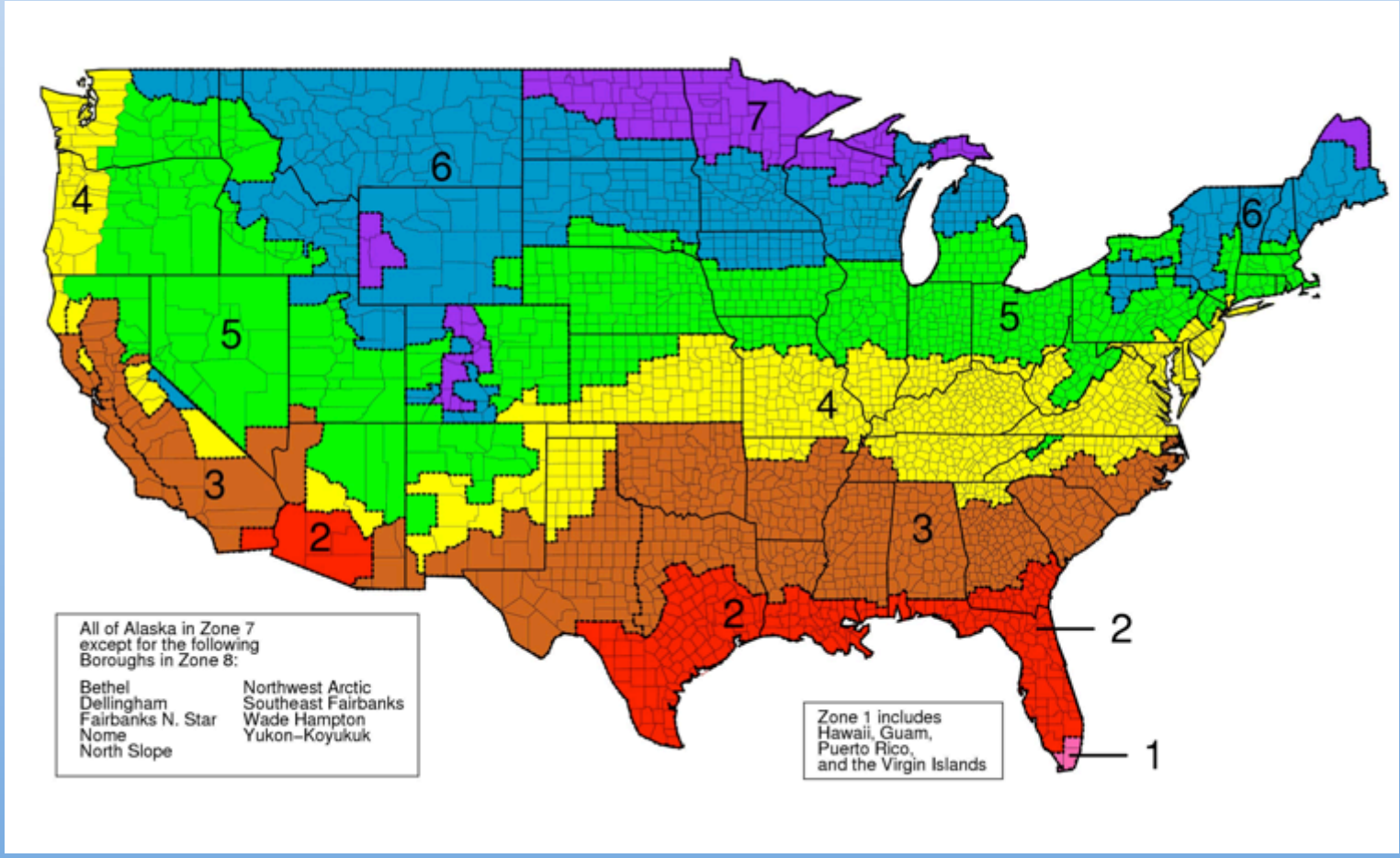
The Energy Code keeps raising the bar :

2009 Code is 15% more stringent than the 2006 version

2012 Code is 30% more stringent than the 2006 version

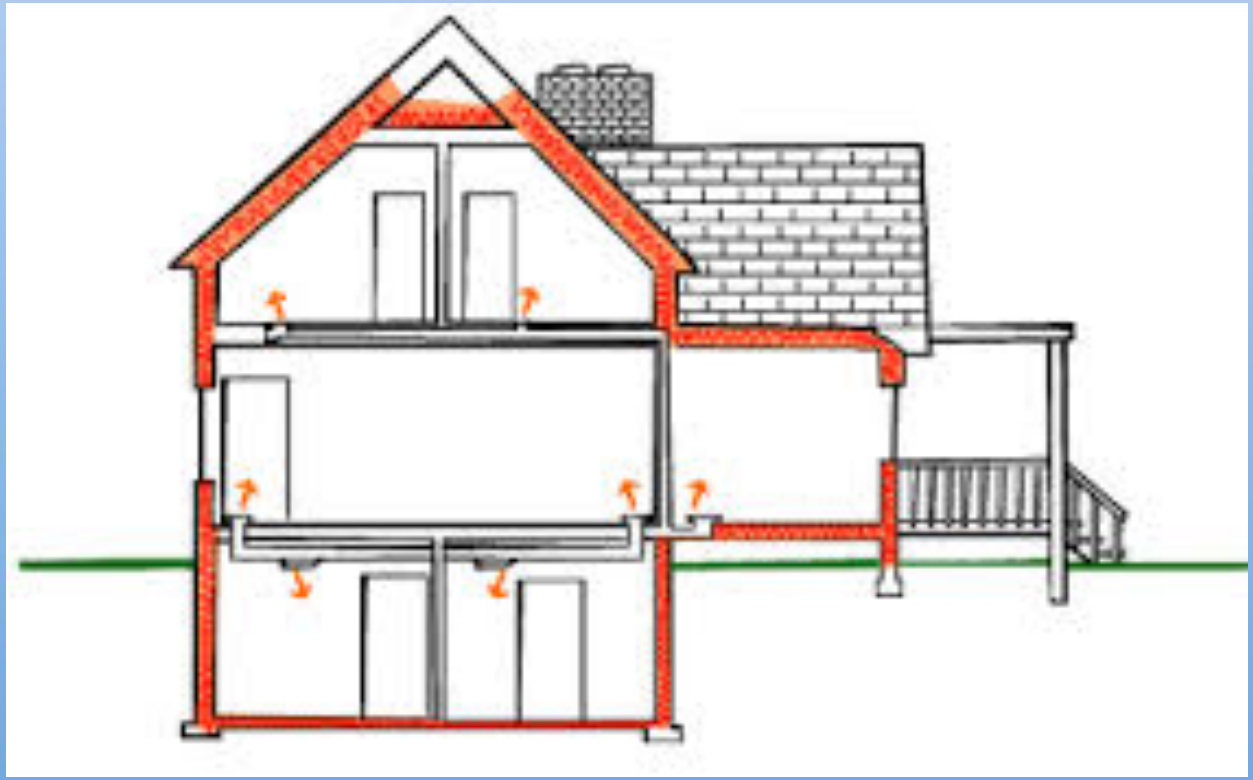
2015 target Code is 50% or greater than the 2006 Version

Climate Zones



Building Thermal Envelope

The Building Thermal Envelope is the Barrier that Separates conditioned space or inside from unconditioned space or outside



Increased Wall Insulation for climate Zone 6

Frame Wall R-20 or R13+5

Wall Insulation for climate zone 6

Minnesota Minimum is R-20 Cavity Insulation

Attic Insulation Level for climate zone 6

R-49 or R-38 continuous with raised heel framing

Attic Insulation Level for climate zone 6

R-49 or R-38 continuous with raised heel framing

Attic Insulation Level for climate zone 6

Attic Insulation Strategies for Special Areas

Foundation Insulation Level for climate zone 6

Basement foundation insulation R-15

Building Air Barrier

Building Envelope tightness

Building Air Barrier

Building Envelope tightness

Air Tightness Requirements

R402.4.1.2 Building thermal envelope testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 3 air changes per hour. Testing shall be conducted with a blower door at a pressure of 50 Pascals (0.2 inches w.g.) Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

Air Tightness Requirements

House must test out at 3 ACH 50 or better To Receive a Certificate of Occupancy

(Lower is better)

Air Tightness Requirements

Blower Door Testing

- Highly calibrated fan
- Air flow at 50 Pa WRT outside
  - Depressurize
  - Pressurize

Air Tightness Requirements

Blower Door Testing

Air Tightness Requirements

Blower Door Testing

Blower Door set up

1. Exterior windows and doors, fireplace and stove doors shall be closed.
2. Dampers shall be closed.
3. Interior doors shall be open.
4. Exterior doors for HRVs and ERVs shall be closed.
5. Heating and cooling systems shall be turned off.
6. Supply and return registers shall be fully open.

(CHAPTER 8 OF THE RESNET STANDARDS ARE A GREAT REFERENCE)

Air Tightness Requirements

Blower Door Testing

- There are 2 types of Tests
  - Single point test
  - Multipoint test (Requires a computer and testing Software)

Date of Test: 9/25/2015 Test File: Demo Tec file

Building Information

Volume	**29073**
Surface Area	
Floor Area	**3409**
Height	**15**
# of Bedrooms	
# of Occupants	
Year of Construction	**2015**
Wind Shield	**M**

Location Climate Information

Ventilation Weather Factor	**0.97**
Energy Climate Factor	**17.00**
Heating Degree Days	**7876**
Cooling Degree Days	**315**
Design Winter Wind Speed	**8.4 mph**
Design Summer Wind Speed	**13.4 mph**
Design Winter Temp Diff	**81 deg F**
Design Summer Temp Diff	**13 deg F**

Heating and Cooling Cost and Efficiency Information

Heating Fuel	**Gas**
Heating Fuel Cost	
Heating Efficiency %	
Cooling Fuel Cost	
Cooling SEER	

Equipment Information

Type	Manufacturer	Model	Serial Number	Custom Calibration Date
Fan	Energy Conservatory	Model 3 (110V)	4753-5-700	6/16/2015
Micromanometer	Energy Conservatory	DG700	4753-5	6/16/2015

BUILDING LEAKAGE TEST Page 3 of 4

Date of Test: 6/18/2013 Test File: presentation file

Depressurization Test:

Environmental Data

Indoor Temperature (°F)	Outdoor Temperature (°F)	Altitude (ft)
73.0	73.0	841.0

Data Points

Nominal Building Pressure (Pa)	Baseline Adjusted Building Pressure (Pa)	Fan Pressure (Pa)	Nominal Flow (cfm)	Adjusted Flow (cfm)	% Error	Fan Configuration
0.8	n/a	n/a				
-58.7	-58.8	111.2	626	632	1.5	Ring B
-52.0	-52.2	93.5	575	580	0.8	Ring B
-46.1	-46.3	78.1	526	530	-0.2	Ring B
-41.5	-41.6	66.8	486	491	-1.0	Ring B
-37.3	-37.4	57.2	450	454	-1.7	Ring B
-29.3	-29.5	41.1	382	386	-2.2	Ring B
-22.9	-23.1	32.9	342	345	2.8	Ring B
-0.5	n/a	n/a				

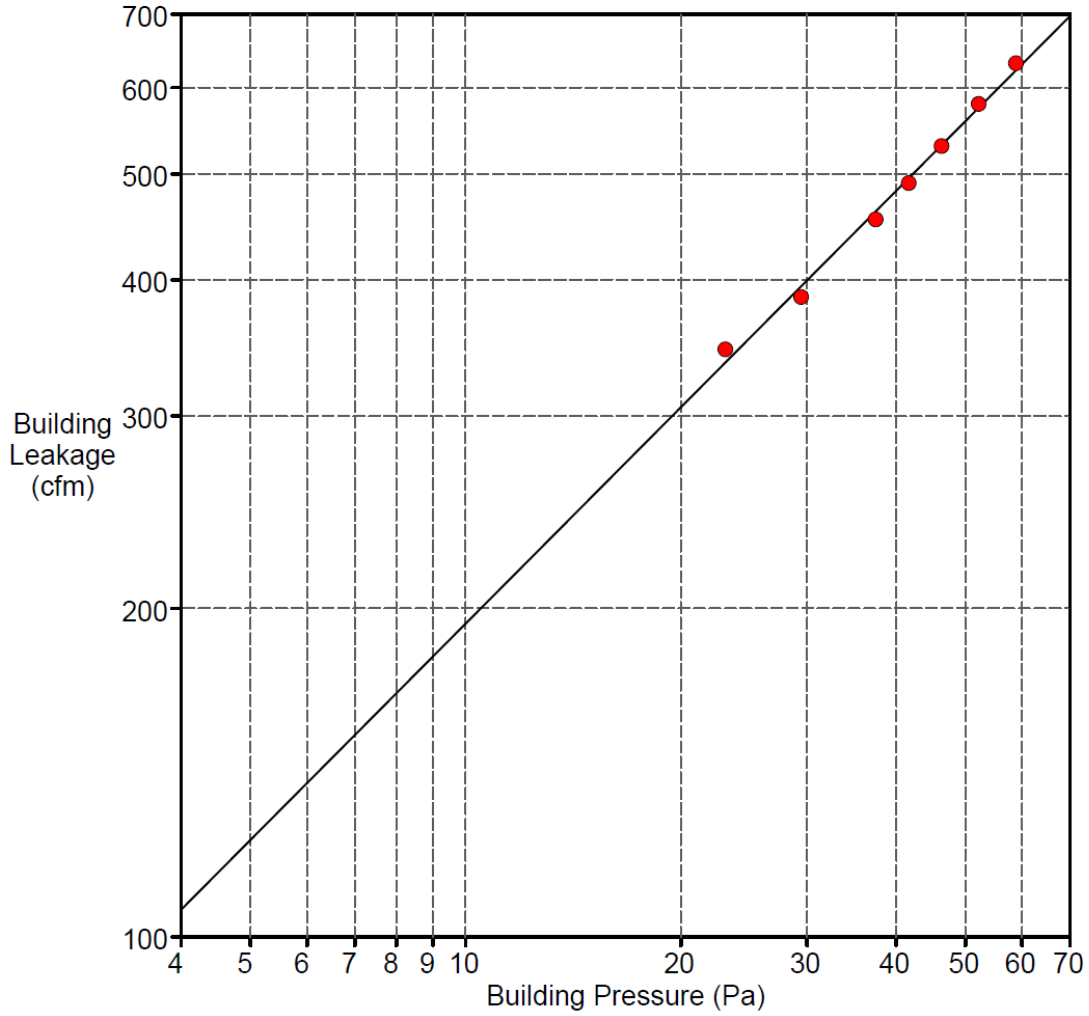
Time Averaging Period: 0

Deviations from Standard RESNET Multi-Point Test - Test Parameters

- Fewer than 8 data points were taken.

Building Leakage Curve

Date of Test: 6/18/2013 Test File: presentation file



BUILDING LEAKAGE TEST

Date of Test: 9/25/2015

Customer: MR. Smith
1234 1st street
Scandia, MN

Test File: Demo Tec file
Technician: Ross Anderson
Project Number:

Building Address: 1234 1st street
Scandia, MN

Test Results

1. Airflow at 50 Pascals: 797 CFM50 (+/- 1.4 %)
   (50 Pa = 0.2 w.c.) 1.64 ACH50
2. Leakage Area: 43.8 in2 LBL ELA @ 4 Pa
3. Building Leakage Curve: Flow Coefficient (C) = 63.8 (+/- 10.0 %)
   Exponent (n) = 0.645 (+/- 0.028)
   Correlation Coefficient = 0.99908
4. Test Settings: Test Standard: RESNET Multi-Point Test
   Test Mode: Depressurization
5. Accuracy Level: Standard Level of Accuracy Test

Infiltration Estimates

1. Estimated Average Annual Infiltration Rate: 47.5 CFM
   0.10 ACH
2. Estimated Design Infiltration Rate: Winter: 77.7 CFM
   0.16 ACH
   Summer: 60.9 CFM
   0.13 ACH

Cost Estimates

1. Estimated Cost of Air Leakage for Heating:
2. Estimated Cost of Air Leakage for Cooling:

Mechanical Ventilation Guideline (based on ASHRAE 62.2-2010)

Recommended Whole Bldg Rate: 41.6 CFM

Base Rate: 41.6 CFM

Air Tightness Requirements

Blower Door Testing

- ACH 50
  - Air Exchange in building at 50 Pa of pressure WRT outside

    ACH50 = [CFM50 x (60)] / Volume

- Variables
  - Volume
  - CFM 50

Air Tightness Requirements

Blower Door Testing

Variables that Can Effect the Blower Door Results

– Improper Volume calculations

– Faulty Equipment

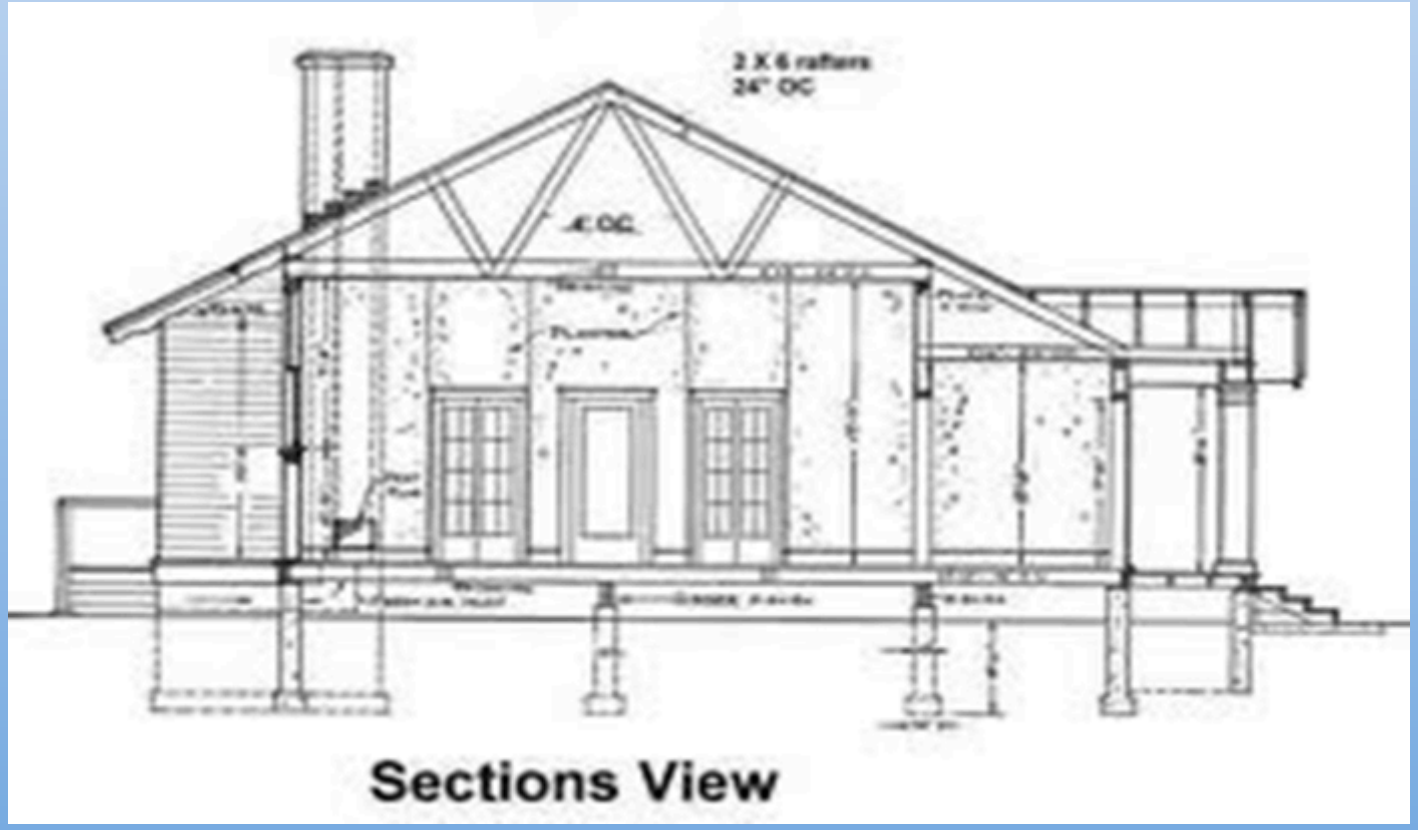
– Extreme Weather conditions

– Improper House Set-up

Blower Door Testing

Figuring out Square footage and volume for Blower Door test

Plan Review



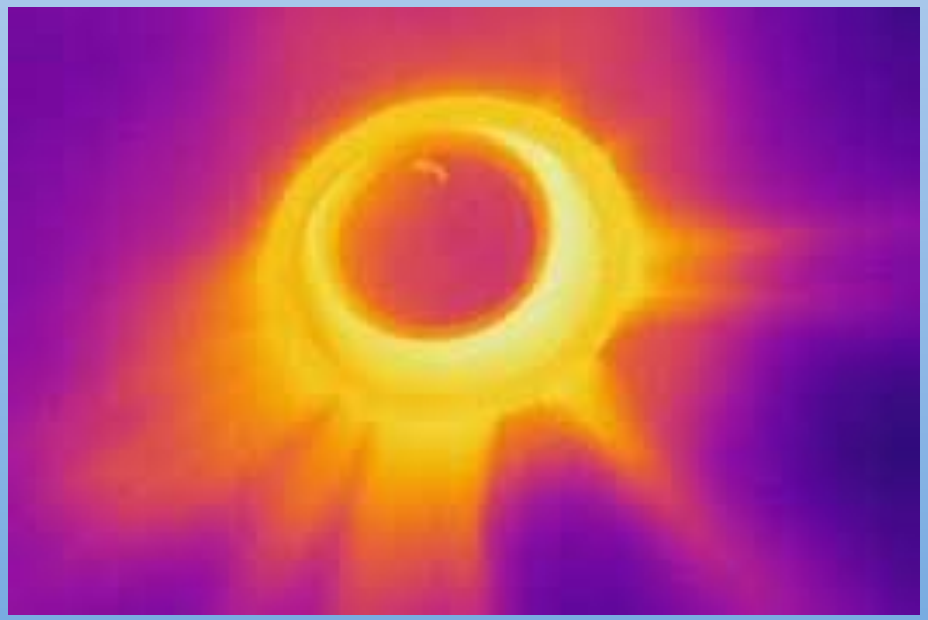
Sections View

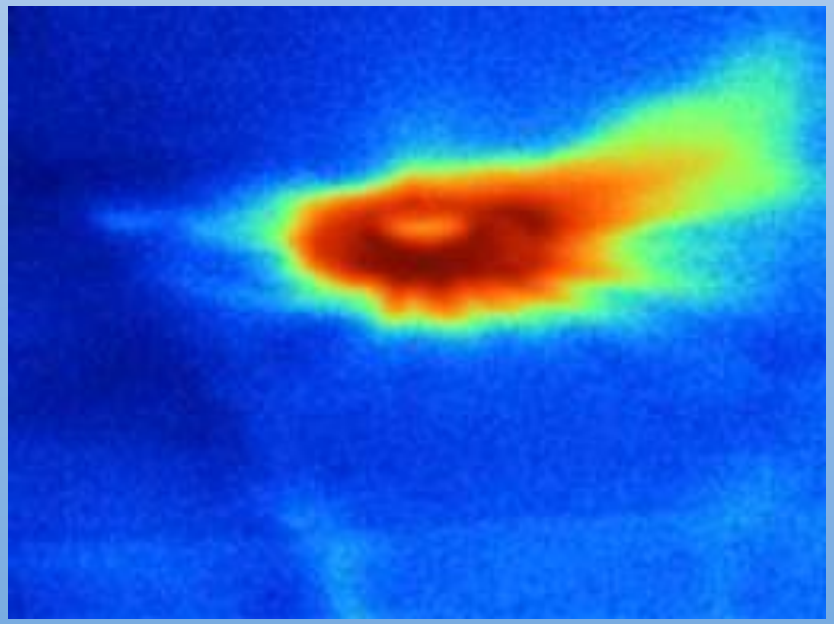
Air Tightness Requirements

Air Barrier opportunities

Building Air Barrier

Recessed can lights



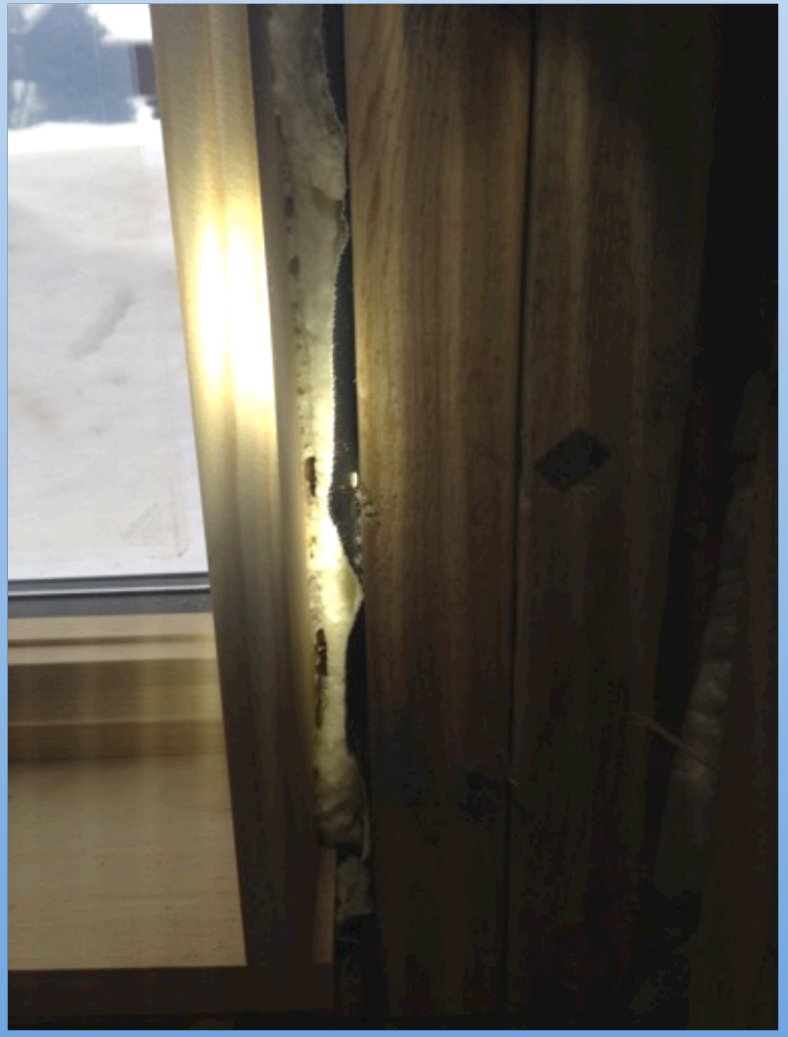


Building Air Barrier

Bottom plate leakage

Building Air Barrier

Insulating and Air sealing around windows



FAILURE TO EXECUTE

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Failures to Execute

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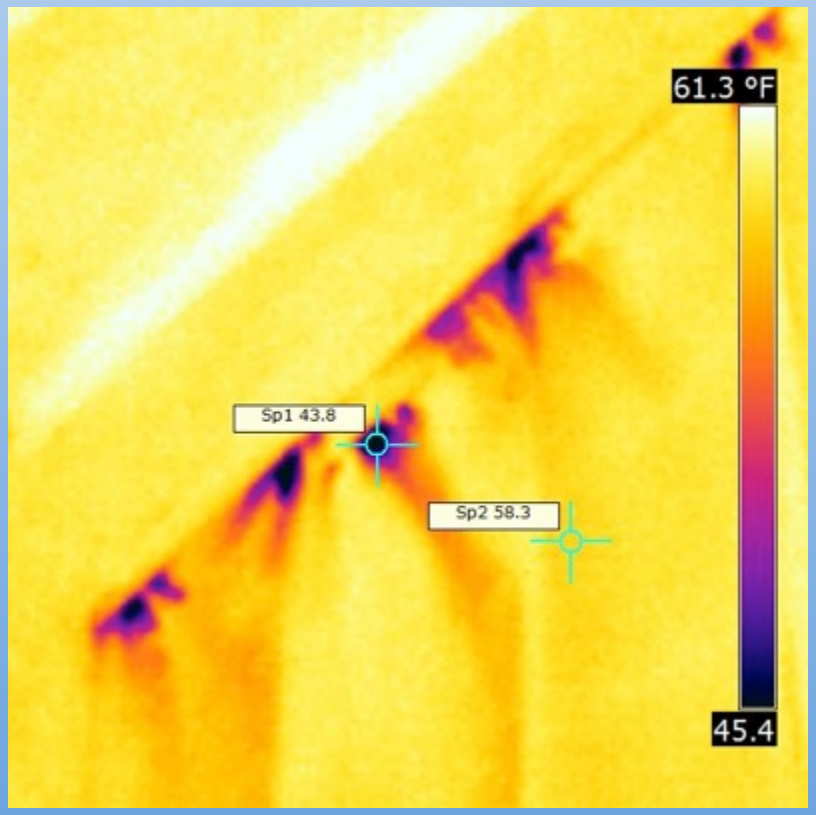
Insulation Strategies



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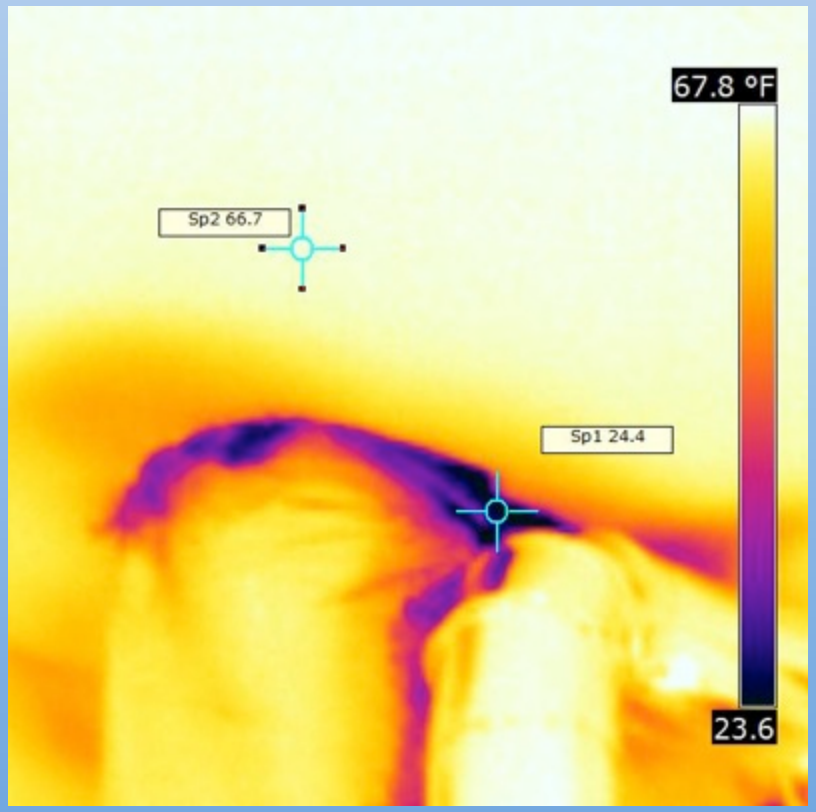
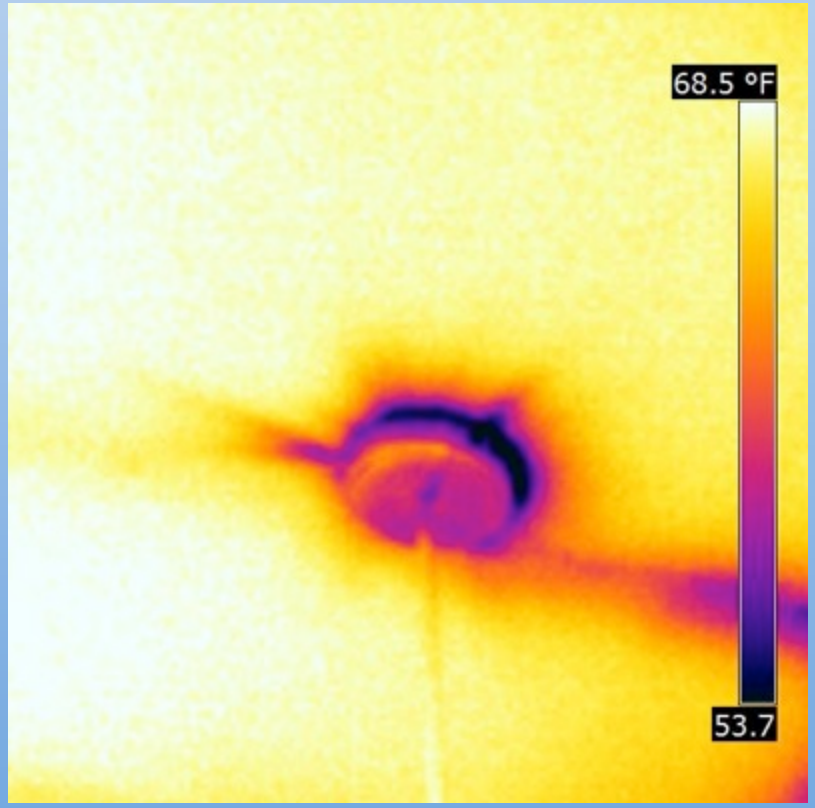


Failures to Execute

Insulation Strategies



Failures to Execute

Insulation Strategies

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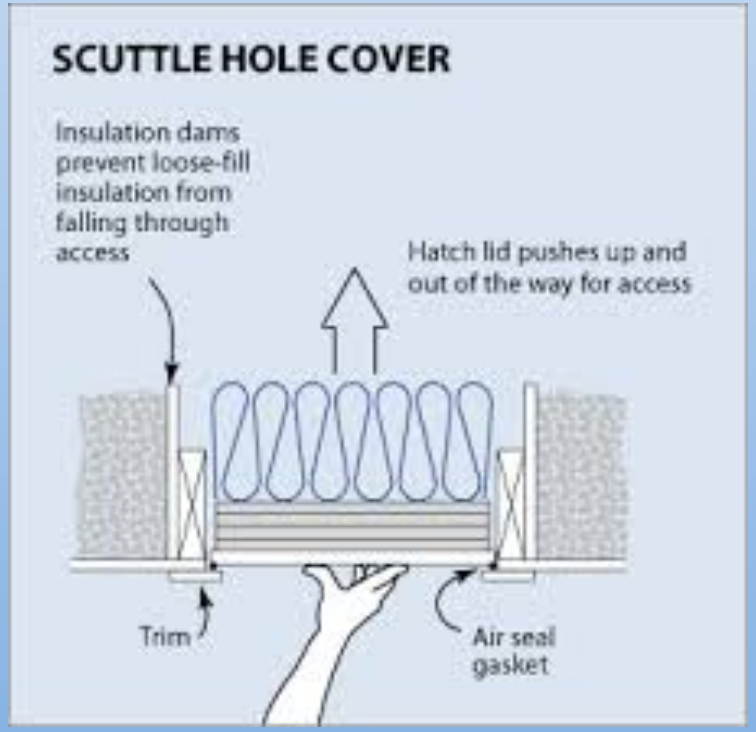
Failures to Execute

Insulation Strategies

Attic Access

Weather strip and insulate access doors to match surrounding R-Value



6. Attic Access

Weather strip and insulate access doors to match surrounding R-Value

Tightness Testing for Duct Work

R403.2.2 (#1) Duct tightness post construction test. Total leakage shall be less than or equal to 4 cfm per 100 square feet of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. across the entire system, including the air handler enclosure. All register boots shall be taped or sealed.

Tightness Testing for Duct Work

R403.2.2 (#2) Duct tightness rough-in test. Total leakage shall be less than or equal to 4 cfm per 100 square feet of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. across the entire system, including the air handler enclosure. All register boots shall be taped or sealed. If the air handler is not installed at the time of test, total leakage shall be less than or equal to 3 cfm per 100 square feet of conditioned floor area.

Tightness Testing for Duct Work

Total Duct leakage testing will be required to be 4 CFM per 100 sq.' of conditioned floor area.

Exception: If all ductwork and air handler is within conditioned space

Seal Duct Work

R403.2.3 Building cavities. Building framing cavities shall not be used as ducts or plenums.

Seal Duct Work

Ductwork is the low hanging fruit to be addressed in all new Energy Codes

Duct mastic is currently the best method of sealing duct work that needs to be tested that I have seen.

Seal Duct Work

All ductwork must be hard piped and sealed. No more use of sheet rock cavities as returns

Seal Duct Work

Seal Duct Work

Tightness Testing for Duct Work

Total Duct Leakage Setup

- Returns and Supplies sealed up
- Turn off equipment
- Remove filters
- Intention openings as is, dampers closed
- Zone dampers open
- Measure in main supply and main return

Tightness Testing for Duct Work

Tightness Testing for Duct Work

What will be considered conditioned space?

Exception: If all ductwork and air handler is within conditioned space

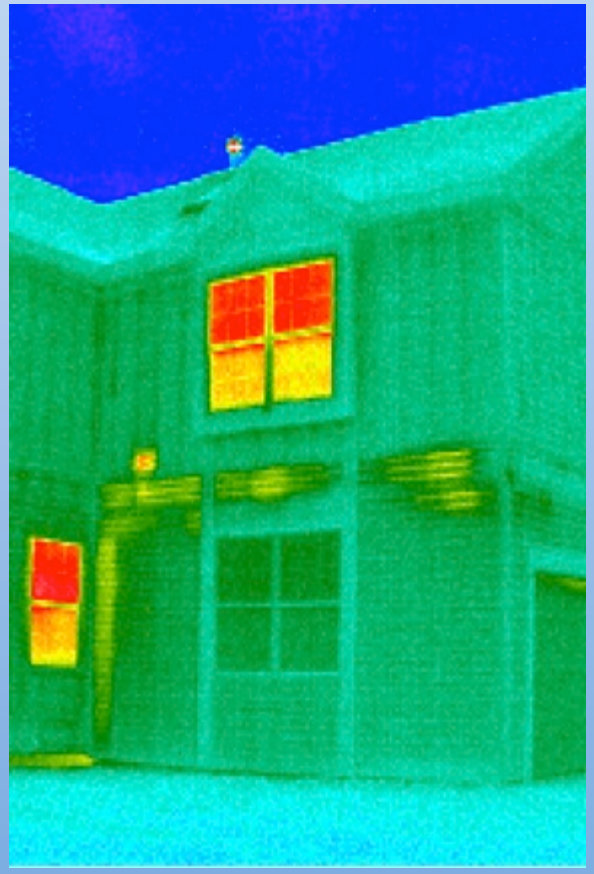
Tightness Testing for Duct Work

What will be considered conditioned space?

Tightness Testing for Duct Work

What will be considered conditioned space?

Avoid Ducts in Outside Walls

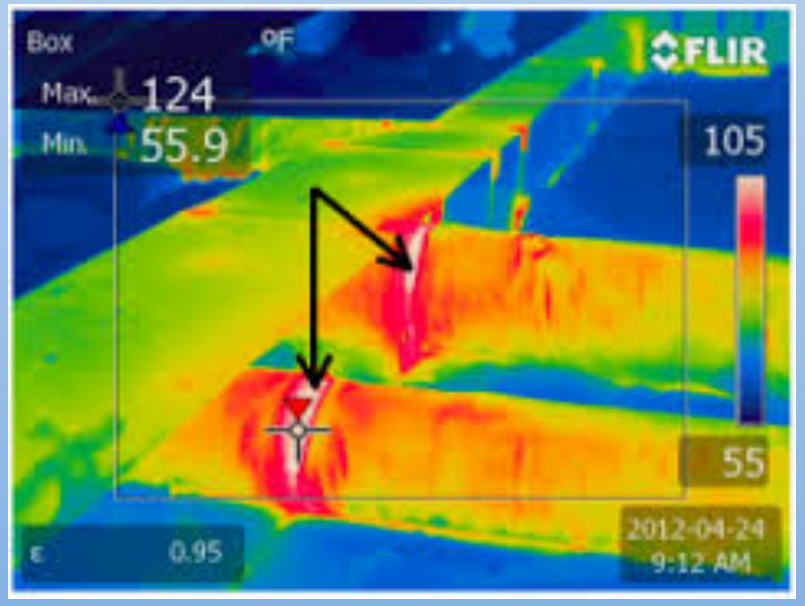


Tightness Testing for Duct Work

Avoid Ductwork outside conditioned space

Tightness Testing for Duct Work

All leaks will have to be repaired before Certificate of Occupancy will be Issued.



What is considered outside of building thermal envelope??

R403.2.2 Exception to duct tightness tests. The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.

Bonus Rooms Over Garage

R403.2.2 COMMENTARY ON DUCTS LOCATED ABOVE A GARAGE FOR A CONDITIONED BONUS ROOM/BEDROOM: Typically a supply duct serving a conditioned room above an attached garage would be considered to be located entirely within the building thermal envelope if it complies with the
following:

1. Duct joints, seams and connections shall be sealed per IMC 603.9.
2. Duct shall be insulated with minimum R-8 duct insulation and have a vapor retarder (per IMC 604.11) installed without respect to other building envelope insulation.
3. Duct shall be completely located above the floor insulation of minimum R-30.
4. HVAC register boots shall be sealed to the subfloor or drywall.

5a. If the space above the garage ceiling freely communicates with the ceiling cavity of the house,
an air and vapor impermeable R-30 building thermal envelope insulation shall be used.

5b. If the space above the garage ceiling is sealed at the junction of the house wall and garage wall with a durable continuous air barrier, creating a sealed six-sided building cavity, then either an air and vapor impermeable, or an air and vapor permeable, R-30 building thermal envelope insulation can be used. However, if an air and vapor permeable R-30 building thermal envelope insulation is used (such as fiberglass or cellulose), the R-8 duct insulation shall be installed in contact with bottom of the floor sheathing and shall be encapsulated with a minimum 1 ½ inch thickness of air and vapor impermeable closed cell spray foam. In addition, all duct joints, seams and connections shall be sealed with duct mastic listed to UL 181A-M or UL181B-M installed liberally with a minimum thickness of approximately 1/16 inch.

Bonus Room Over Garage

DUCT SEALING AFTER CONSTRUCTION

DUCT TESTING SET UP

DUCT TESTING SET UP

DUCT TESTING SET UP

Thank You

Ross Anderson
The Energy Network Worldwide
ross@tenww.com