

GreenStar Qualification Training

Module 3



Version 6.1.d WT

Copyright Minnesota GreenStar 2015

House Keeping

- Plug in headset before logging in
- This meeting will be recorded
- Everyone is muted to ensure sound quality
- Click the raise hand button at the top to vocally speak once approved. **We encourage dialogue during this session!**
- Put questions, comments or concerns in chat box if you don't want to speak
- Did you fill out your checklist?

GreenStar Qualification Training

Module 3



Version 6.1.d WT

Copyright Minnesota GreenStar 2015

Moderator

Brett Little, LFA,APH,GHP

Executive Director
GreenHome Institute
Grand Rapids, MI
info@greenhomeinstitute.org
888 LEED APH ext 1





CINDY OJCZYK



 **More Than A
BEAUTIFUL HOME**

 **NorthernSTAR**
A Building America partner in research, innovation, and real home solutions.



 **SIMPLY
GREEN
DESIGN**
YOUR HOME, YOUR WORLD, ReIMAGINED

 **greenstar**
Certified Green Homes
and Remodeling



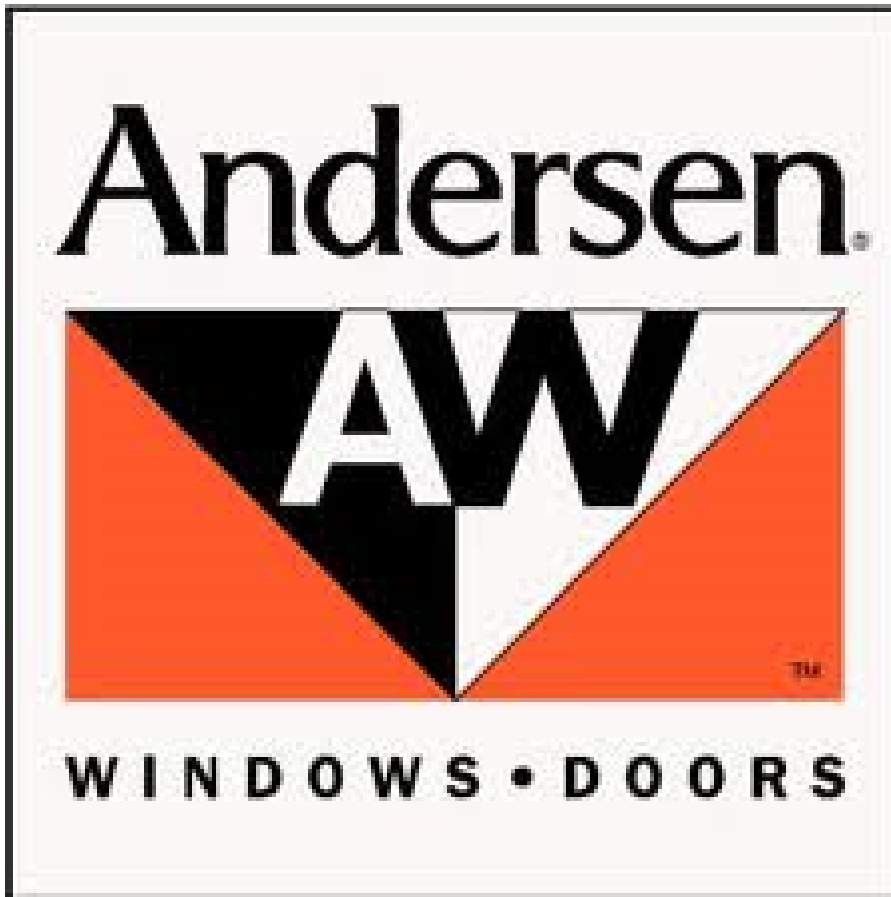


**Certified Green Homes
and Remodeling**

OUTCOMES

- Understand GreenStar Principles**
- Exposure to the GreenStar Checklist and process for certification**
- Eligible to Register a project for GreenStar certification**
- Achieve Step 1 of Professional Designation**
- Encourage attendance at live training: personal assistance, peer experience**

Platinum + Sponsor



Renewal by Andersen®



WINDOW REPLACEMENT

an Andersen Company

Panasonic

WhisperRecessed™
VENTILATION FAN

WhisperGreenSelect™
VENTILATION FAN

ecovent™



WhisperCeiling™
VENTILATION FAN

WhisperValue™
VENTILATION FAN

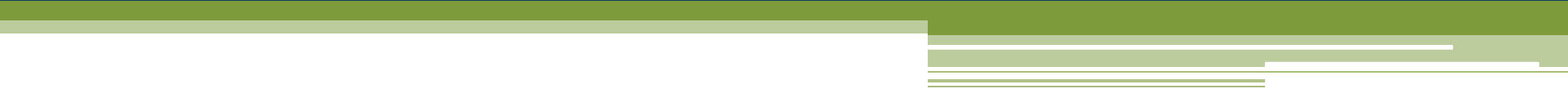


Brought to you by:

- 501 c3 non profit
- Celebrating 15 years!
- Midwest green home education,
training and programs
 - **LEED**
- Oversees GreenStar program



Module 3 - Beyond Energy Efficiency: Crafting Comfortable, Durable, Healthy Homes



Group Activity: 30 minutes

“RIGHT” ORDER for homes

- A. Insulate
- B. Duct sealing
- C. Furnace and A/C efficiency update
- D. Airseal
- E. Combustion Safety
- F. New or repaid windows
- G. Moisture/bulk water control
- H. Fresh Air Supply
- I. Ventilation/exhaust



“The Remodeling Conundrum: When the Order Matters” by Patrick Huelman

- ❑ University of Minnesota, Cold Climate Housing
- ❑ *Cityscape: A Journal of Policy Development and Research*, Volume 16, Number 3
- ❑ <http://www.huduser.org/portal/periodicals/cityscpe/vol16num3/ch8.pdf>

Exhibit 1

Improper Insulation Can Lead to Convective Looping, Thermal Bridging, and Air-Transported Heat and Moisture



Good intention: Installed high levels of insulation to the attic.

Unintended consequence: Concentrated heat loss due to air leakage around the plumbing stack contributed to snow melt and future ice dams.

Solution: Air-seal all holes before installing the insulation so both transmission losses and air leaks are properly managed.

Exhibit 2

Air-Transported Moisture Can Lead to Condensation and Subsequent Mold Growth or Wood Decay



Good intention: Heavily insulated wall cavities and rim (band) joists.

Unintended consequence: Air-transported moisture (because of elevated interior humidity and indoor pressures) condensed on the cooler sheathing.

Solution: Install a continuous air barrier to prevent exfiltration of moisture air during winter.

Source: Patrick H. Huelman, 1995

Exhibit 3

Over Time, With Poor Water Management, Walls Can Take on Exterior Water



Good intention: Framed wall with good insulation, air barrier, and vapor retarder.

Unintended consequence: Water leaked into a window cavity that had limited drying potential.

Solution: Provide proper exterior water management to limit water infiltration.

Source: Steve Klossner, 1998

Exhibit 4

Proper Exterior Water Management Can Limit Water Infiltration



Good intention: Constructed 2-x-6 frame walls with good insulation, air barrier, and vapor retarder.
Unintended consequence: Improper stucco cladding added moisture to a cavity that had low drying potential because of reduced heat and airflow.
Solution: Provide proper exterior water management to limit water infiltration and a wall design with improved drying potential.

Source: Richard Stone, 2009

Exhibit 5

When Air Exchange Is Reduced, Indoor Humidity and Window Condensation Increase



Good intention: Weatherized house (added insulation and airtightness).

Unintended consequence: Amount of indoor humidity and window condensation became elevated.

Solution: Control interior moisture sources; add source point and whole-building ventilation.

Source: Joe Nagan, 2004



Exhibit 6

Good Insulation and Air Sealing Can Cause Backdrafting of Combustion Byproducts Into a House



Good intention: Ensured the house was well insulated and air sealed and added exhaust devices.

Unintended consequence: Negative pressure in the combustion zone caused backdrafting of combustion byproducts into the house.

Solution: Reduce the negative pressure with makeup air or switch to sealed or power-vented appliances.

REORDER THE PRIORITY FOR PEOPLE AND HOMES

- A. Combustion Safety
- B. Ventilation
- C. Moisture Management
- D. Air Sealing
- E. Insulation
- F. Windows, Mechanical systems,
Appliances, Lighting,
Renewables.....

PROTECTING PEOPLE AND HOMES

1. Always follow proper order
 - i. Easy in new construction
 - ii. May be difficult or costly in existing
2. Always Test In/Test During/Test Out
 1. Will do all 3 in new
 2. Have options in Existing:
 - i. Consider change being made
 - ii. Test In to determine **fragility of house**
 - iii. Determine tests during and after

REORDER THE PRIORITY FOR PEOPLE AND HOMES

A. Combustion Safety

B. Ventilation

C. Moisture Management

D. Air Sealing

E. Insulation

Combustion Safety

2.1.11 (required)

- **No NEW atmospherically vented combustion appliances allowed. (use direct vented, power vented or sealed combustion). Existing atmospherically vented appliances can remain.**

2.1.12 (required)

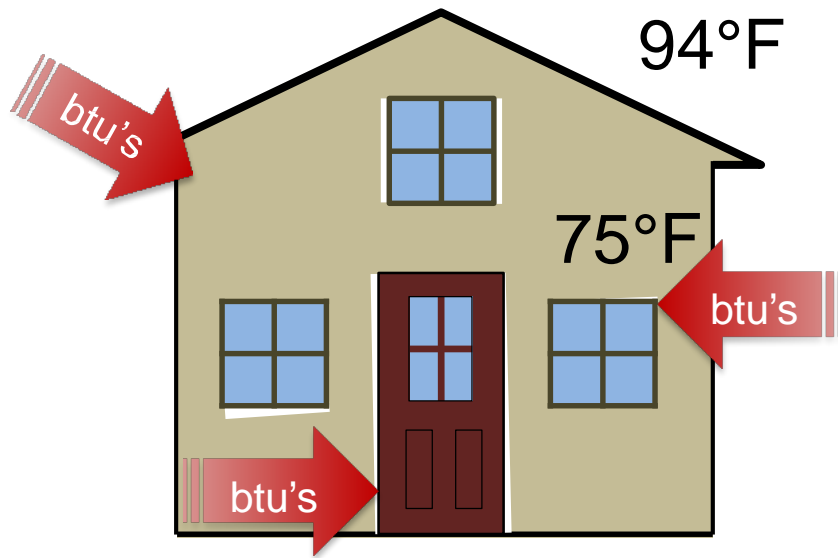
- **Pass Fresh Air Supply (FAS) and Worst Case Combustion Spillage (WCCS) tests at end of the project. Include any fireplace in WCCS**

Blower Door

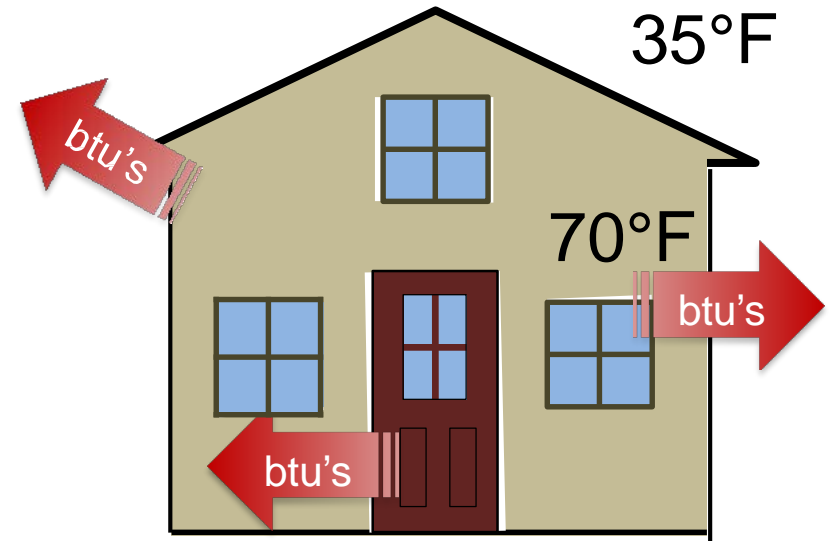


Basic Concepts Behind Air Sealing: Benefits – Energy Savings

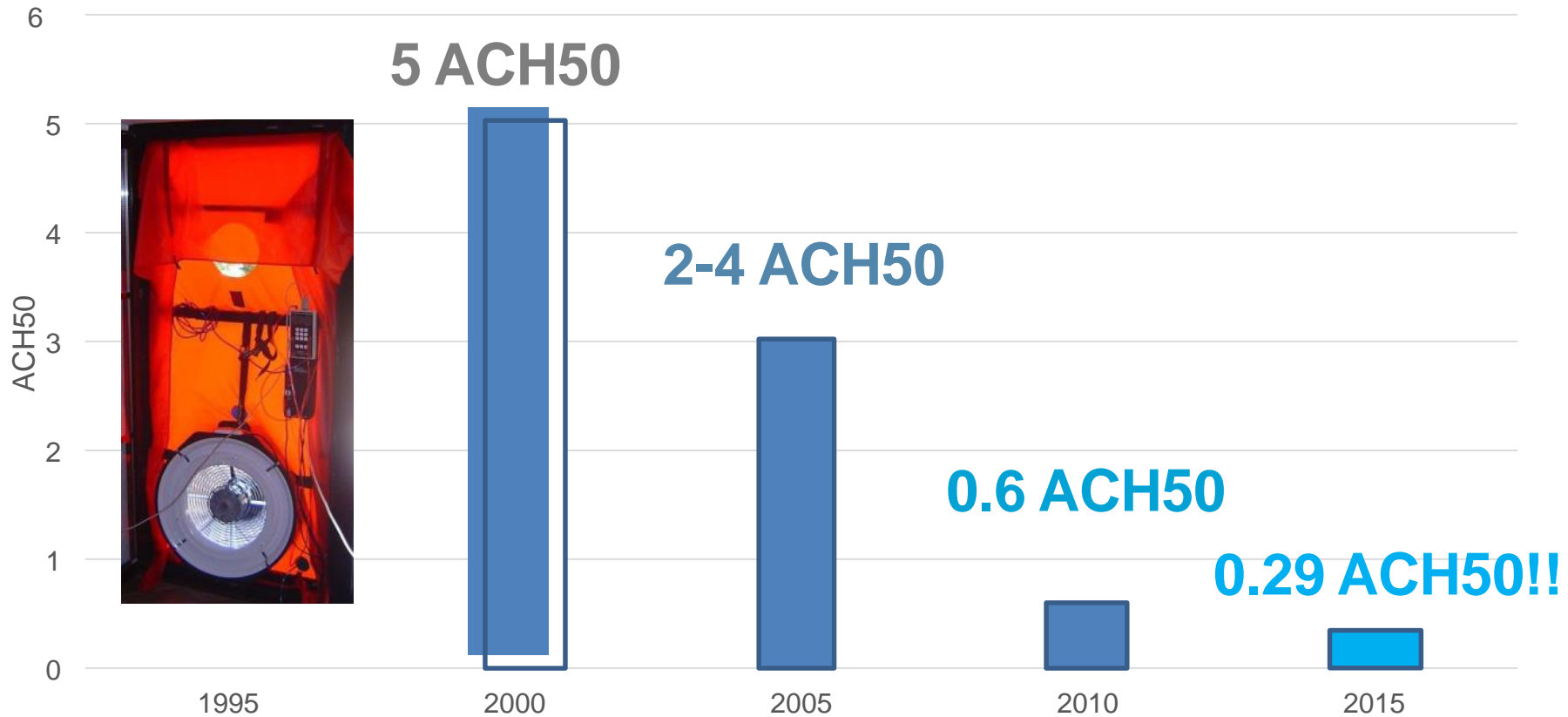
Summer



Winter



Air Sealing Trends



Improperly Drafting Appliances



Safety is the number one concern.

Always address improperly drafting combustion appliances, and consider all combustion appliances when recommending upgrades.



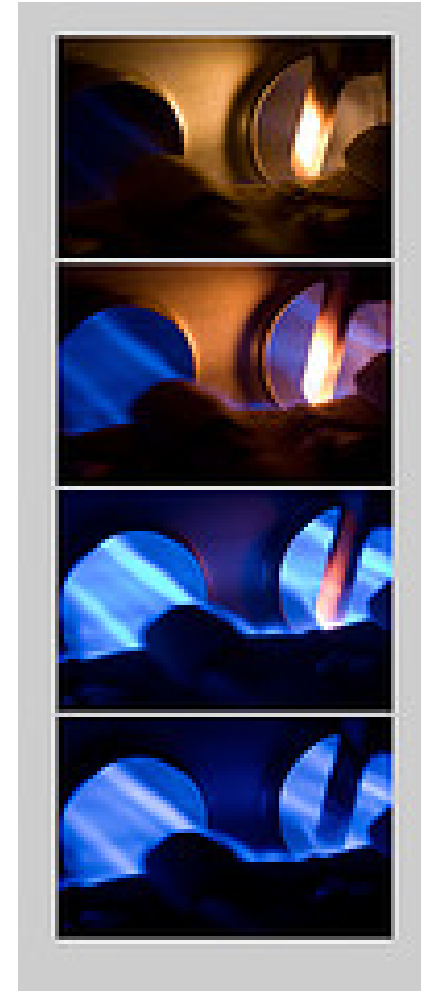
Detecting gas leaks

- Part of BPI audit
- Gas lines and appliances
- Stoves
- Test interior even before it hits the meter
- Consider removal of gas lines for electric





Combustion Safety



- Requirements – End of Project Worst Case Combustion Spillage**
- **Combustion spillage testing**
 - **2.1.12**
 - **No new natural draft appliances**
 - **2.1.11**

REORDER THE PRIORITY FOR PEOPLE AND HOMES

A. Combustion Safety

B. Ventilation

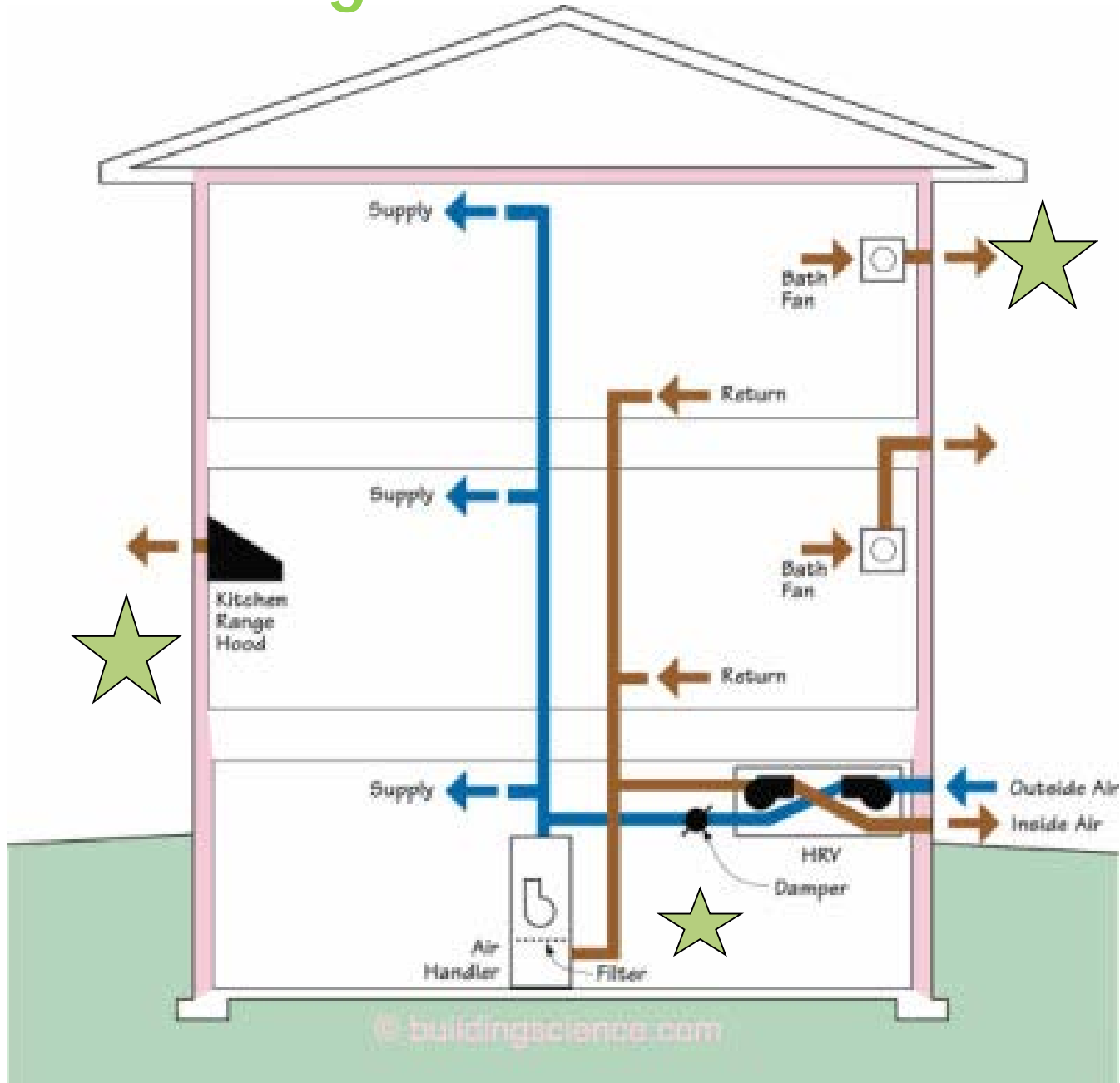
C. Moisture Management

D. Air Sealing

E. Insulation

Ventilate it Right

Make it Tight





Copyrig



Fresh Air Supply Test: 2.1.12 (required)

- Blower door to determine ACH natural
 - **Before and After**
- Consider fresh air intake
 - **Exhaust only**
 - **Supply only**
 - **HRV/ERV**
 - **Balanced system**
- Adequate fresh air must be present
- ASHREA 62.2 – Air Exchange



REORDER THE PRIORITY FOR PEOPLE AND HOMES

- A. Combustion Safety
- B. Ventilation
- C. Moisture Management**
- D. Air Sealing
- E. Insulation



Moisture Management

- Basement finishing => Basement Risk Assessment **2.1.0 (required)**
 - **Concrete moisture test required**
 - **Basement Risk Assessment Worksheet**
 - **Document bulk water intrusion**
 - **Document drying mechanism for walls and floor**
 - **New - Properly install Class 1 or 2 Vapor Retarder on top of basement and/or crawl space soil or gravel**

Moisture Management: Rater to Visually Inspect Site **3.2.2 (option)**

- Slope: grade, sidewalks, driveways, patios
- Visible Flashing
- Water Damage
- Foundation cracks
- Roof Condition
- Gutters/downspouts

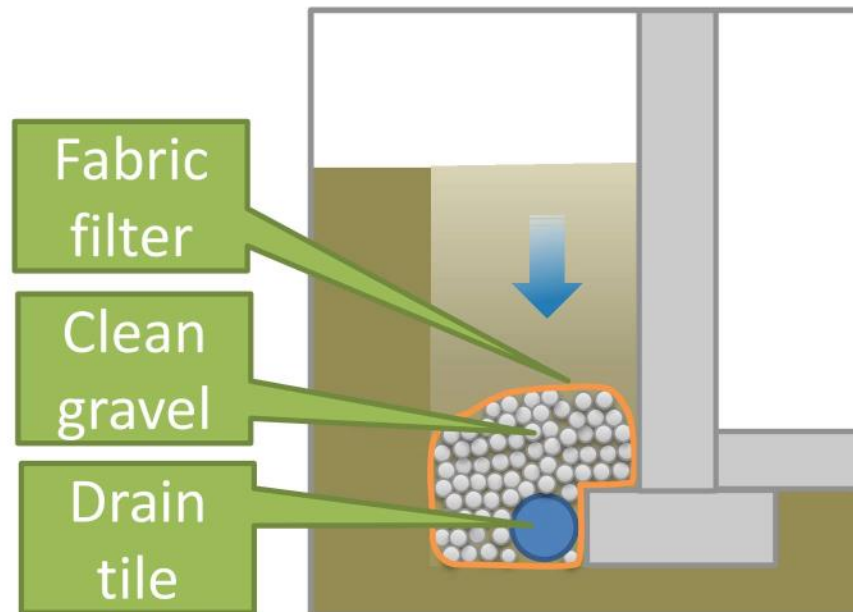


Capillary Break 6.2.17

Provide capillary breaks 1) between top of footings and bottom of foundation wall, 2) below slabs, and 3) where cementitious products connect to framing material (e.g., garage floors, stoops, and porches)

Item 1.8: Drain tile (6.2.14)

- Drain tile surrounded with clean gravel and fabric filter.
- Alternatives include:
 - A drain tile pre-wrapped with a fabric filter.
 - A Composite Foundation Drainage System (CFDS) evaluated for use by ICC-ES per AC 243.



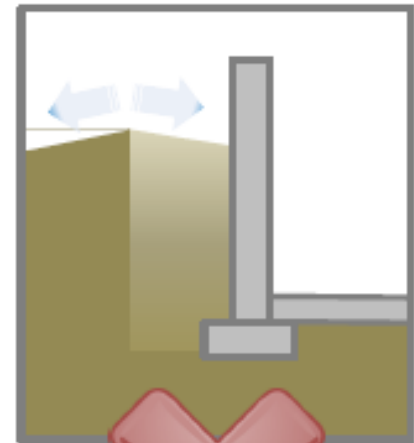
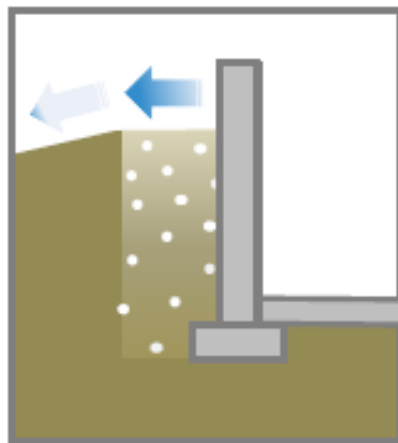
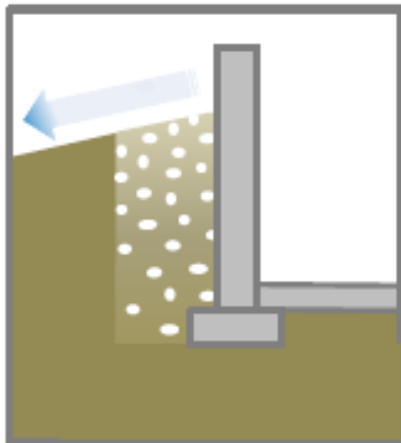
Item 1.2: Tamp backfill & slope 4.8.6



- Tamp backfill, and,
- Slope final grade ≥ 0.5 in per ft. away for ≥ 10 ft.



Untamped backfill may settle over time...

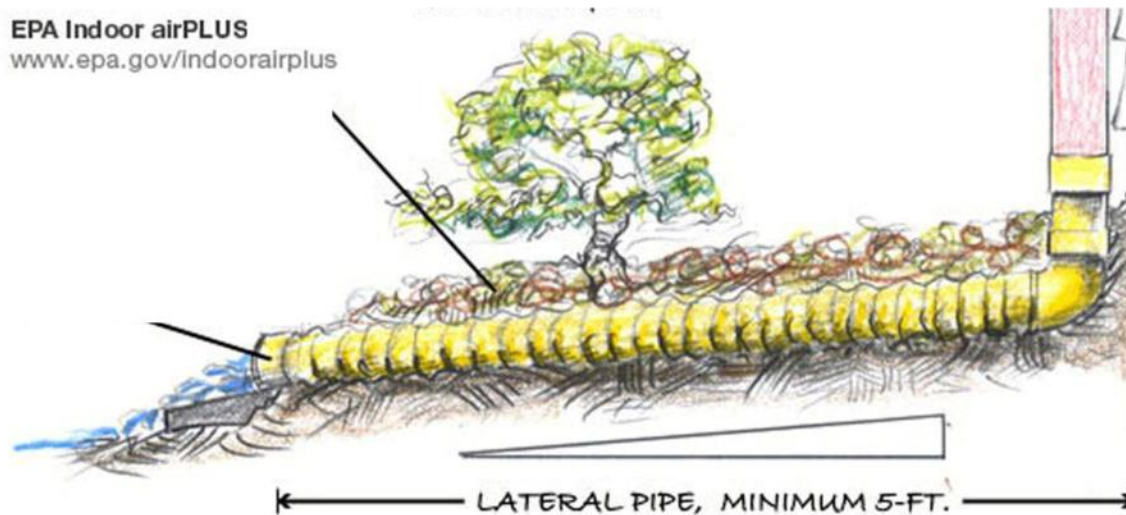


Item 3.2: Gutters & downspouts (6.11.21)



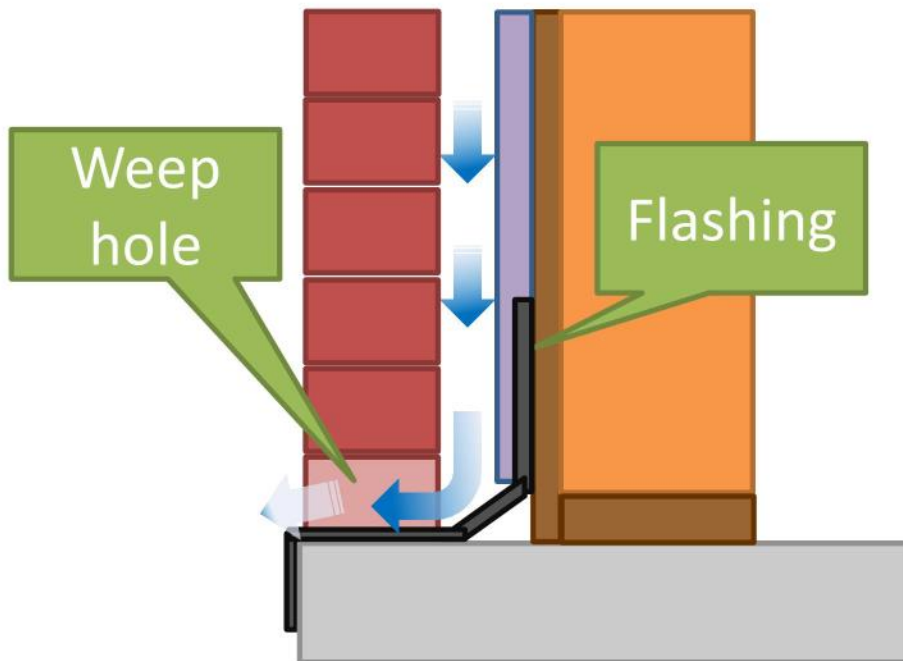
- Gutters & downspouts provided that empty to lateral piping that deposits water on sloping final grade ≥ 5 ft. from foundation, or to underground catchment system ≥ 10 ft. from foundation.
- Only required for homes that don't have a slab-on-grade foundation and do have expansive or collapsible soils.

EPA Indoor airPLUS
www.epa.gov/indoorairplus



Item 2.1: Flashing at bottom of walls (4.5.6)

- Flashing at bottom of exterior walls.
- Also include weep holes for masonry veneer.
- Also include weep screed for stucco cladding systems.



Item 2.3:

Windows & doors fully flashed

(6.1.11)



- Windows & doors fully flashed:
 1. Apply pan flashing over sill framing, inclusive of corners.
 2. Apply side flashing over pan flashing.
 3. Apply top flashing over side flashing.
- ASTM E2112 provides additional helpful guidance.



Item 3.1: Step & kick-out flashing (5.22.4)



- Step and kick-out flashing at all roof-wall intersections, extending ≥ 4 " on wall surface about roof deck and integrated with drainage plane above.
- Step flashing goes behind the water barrier on wall and under shingles on the roof.



Item 3.3:

Self-sealing bituminous membrane (5.22.2)



- Self-sealing bituminous membrane or equivalent at all valleys & roof deck penetrations.
- Provides layer of protection at areas prone to failure.
- Alternatively, metal flashing that utilizes a cement backer is permitted.



Bituminous
membrane
installed

Item 4.2:

Cement board at tub & shower walls (10.1.3)



- Cement board or equivalent moisture-resistant backing material installed on all walls behind tub and shower enclosures composed of tile or panel assemblies with caulked joints.
- Paper-faced backer-board shall not be used.



Moisture resistant
backer board
installed

REORDER THE PRIORITY FOR PEOPLE AND HOMES

- A. Combustion Safety
- B. Ventilation
- C. Moisture Management
- D. Air Sealing**
- E. Insulation

Air and Vapor Flow

<http://www.constructioninstruction.com/videos/air-and-vapor-flow>

Air Sealing

2.1.5 (required)

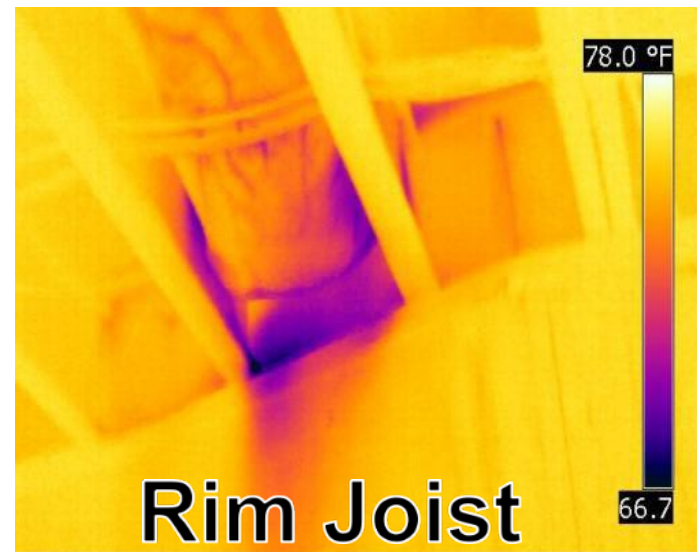
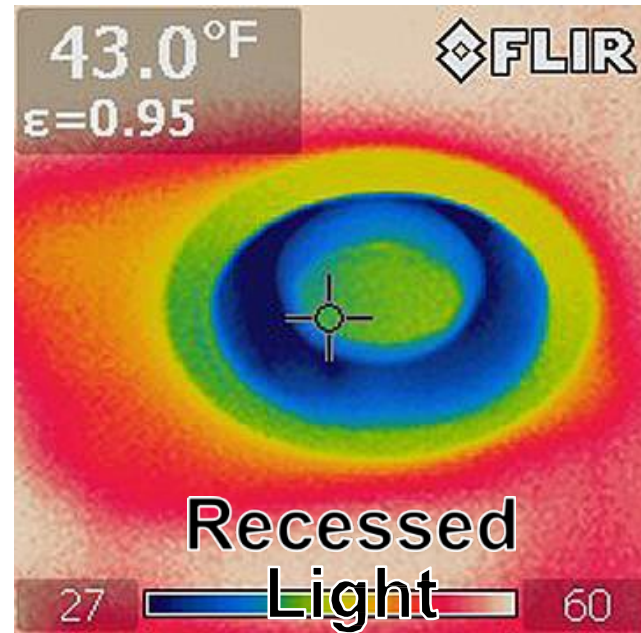
- **If recessed light fixtures are being added or replaced where they penetrate into the unconditioned area of the attic, then new fixtures must be installed to prevent air and thermal leakage.**

2.1.7 (required)

- **All new connecting doors between living space and attached garage must be gasketed or made substantially air-tight with weather stripping and an automatic closer**

Infrared Camera

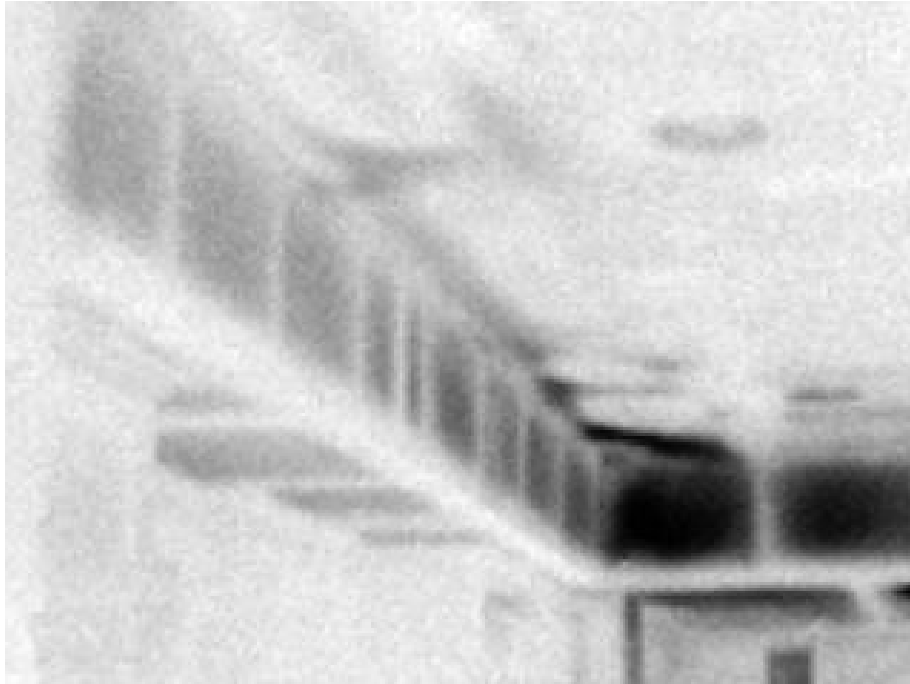




Infrared Scanning



Dropped Soffit



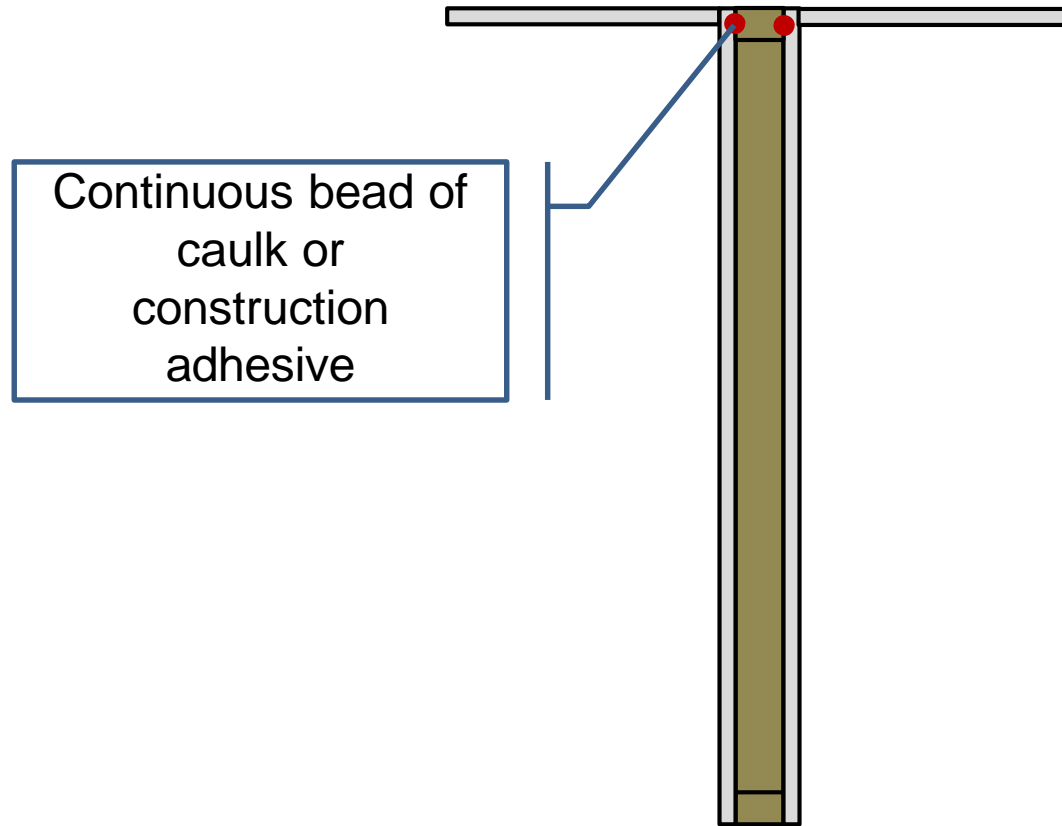
Have a Plan

- Thermal Enclosure System Rater Checklist
- Section 3 – Fully-Aligned Air Barriers
 - Walls
 - Floors
 - Ceilings
- Section 5 – Air Sealing
 - Penetrations
 - Cracks
 - Openings



Critical Details

2. Item 5.2.3 – Sealing drywall to top plates **(5.6.19)**



How to hit 3 ACH50 more consistently: Critical Details

3. Item 5.2.7 – Sealing common walls



How to hit 3 ACH50 more consistently: Critical Details

2. Item 5.2.3 – Sealing drywall to top plates



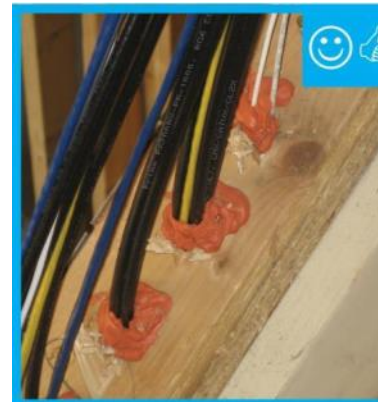
How to hit 3 ACH50 more consistently: Critical Details

2. Item 5.2.3 – Sealing drywall to top plates



How to hit 3 ACH50 more consistently: Critical Details (5.6.18)

4. Item 5.1 – Penetrations to unconditioned space



How to hit 3 ACH50 more consistently: Critical Details (5.6.6)

1. Item 3.1.1 – Air barrier behind tub/shower enclosure



Other areas

- Airseal attic
- Existing walls are difficult – Drill n fill provides some air seal ability
- Tighten doors
- Repair old windows by caulking & foam
<https://www.youtube.com/watch?v=1N7QOvwmKh8>
- Outlet gaskets

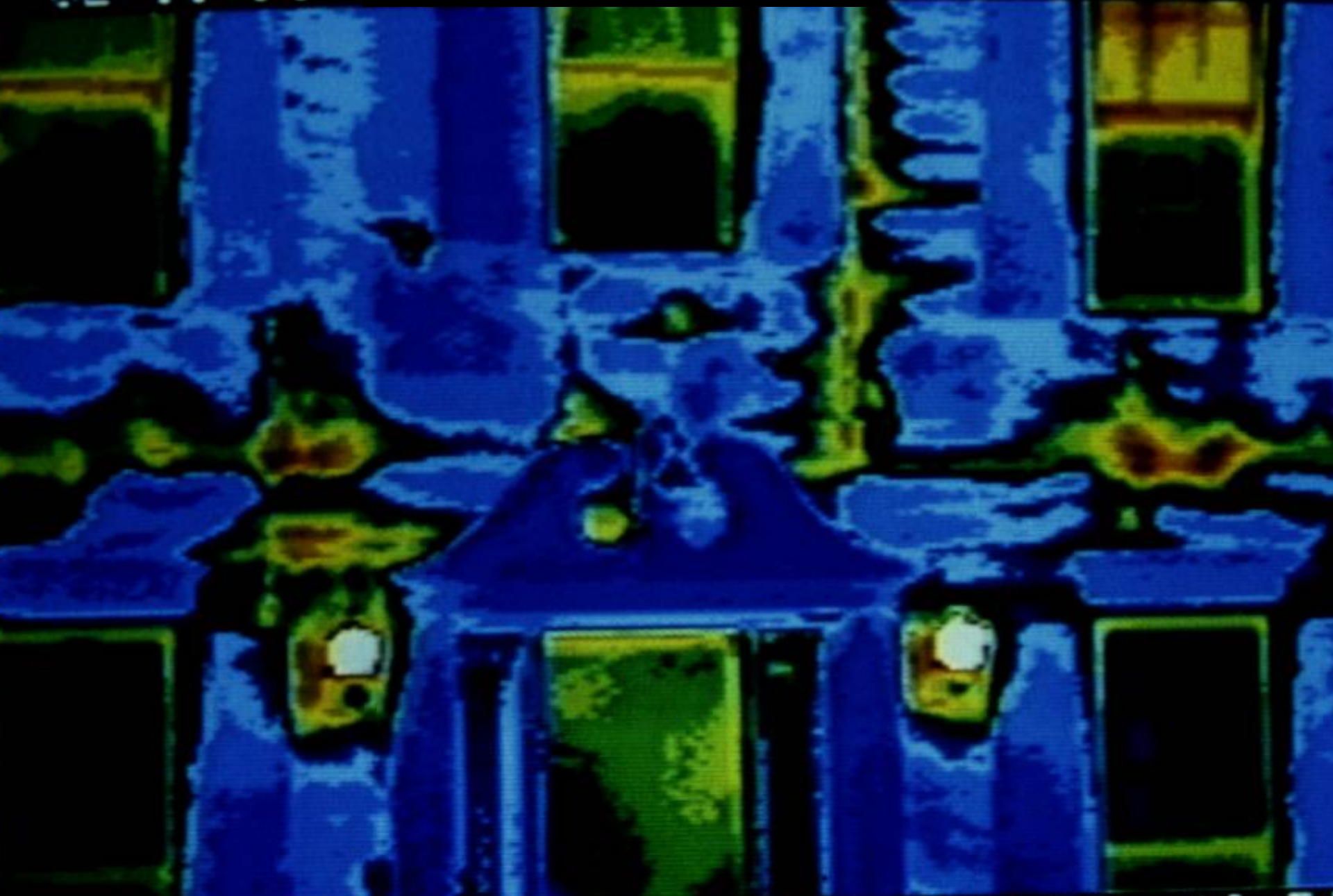
REORDER THE PRIORITY FOR PEOPLE AND HOMES

- A. Combustion Safety
- B. Ventilation
- C. Moisture Management
- D. Air Sealing
- E. Insulation**

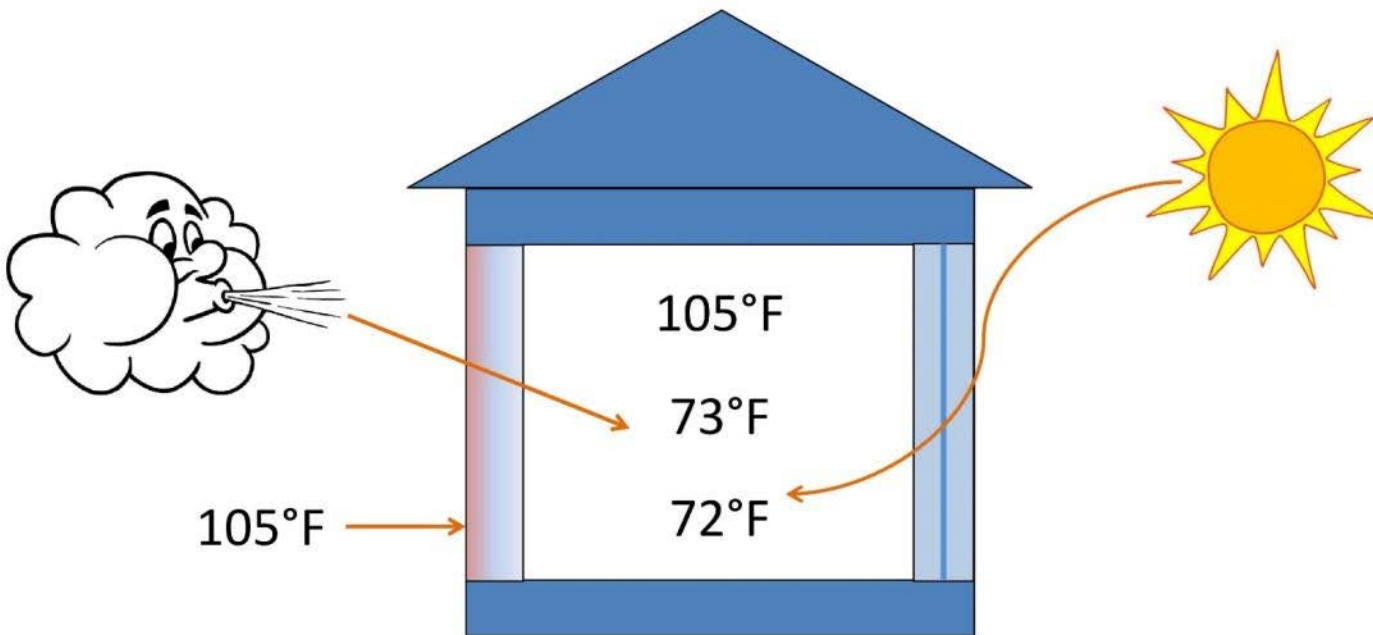
02/15/93

Defects Visible

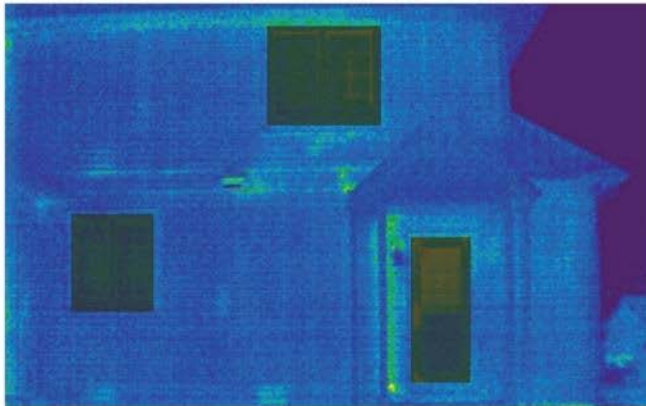
08 BB 20:41:59



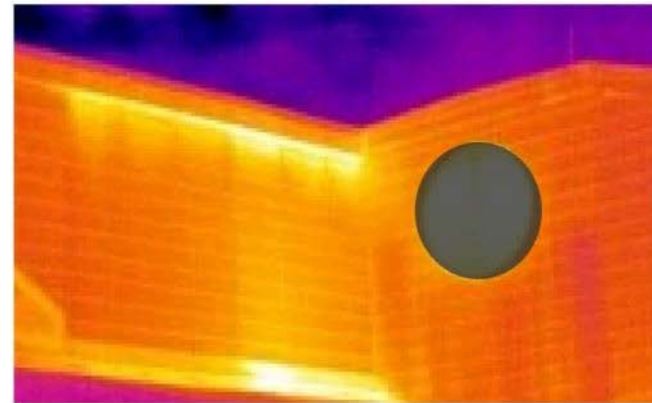
Thermal enclosure system



Section 2: Quality-installed insulation



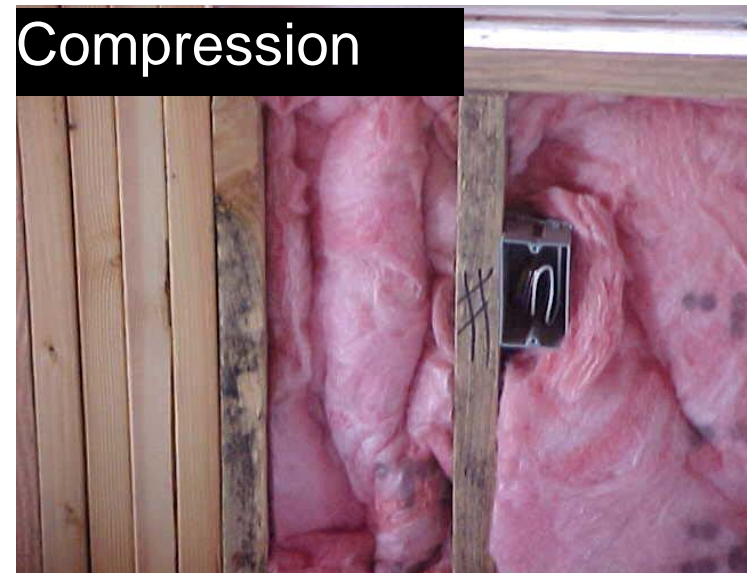
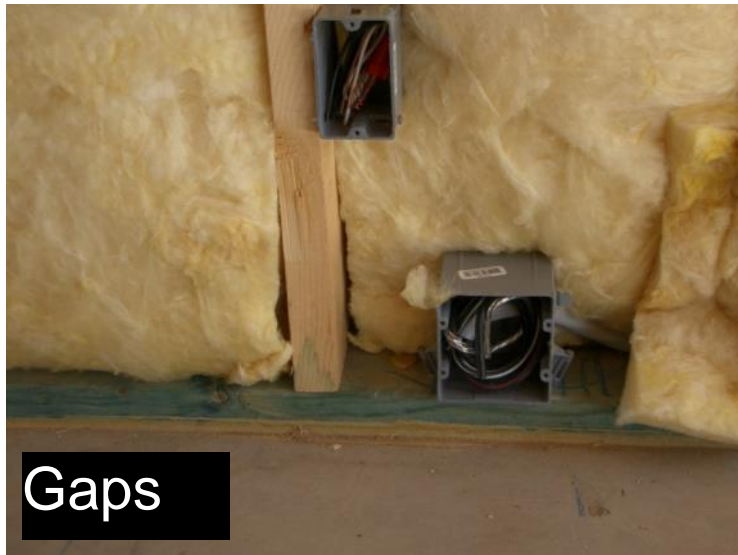
Quality-installed
insulation



Poorly installed
insulation

Common installation defects

reduce fiberglass insulation performance



Quality Control





Copyright Minnesota GreenStar
2009

Fireplace Assemblies



Fireplace Assemblies



Copyright Minnesota GreenStar
2009

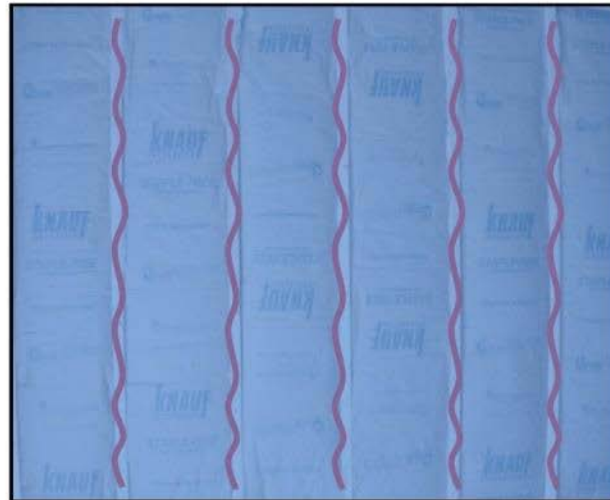


No ROOF Wood FLOOR FRAMING

Section 4: Reduced thermal bridging



Studs conduct heat more easily than insulation



Continuous rigid insulation is one strategy to reduce thermal breaks

Copyright Minnesota GreenStar
2009








REORDER THE PRIORITY FOR PEOPLE AND HOMES

- A. Combustion Safety
- B. Ventilation
- C. Moisture Management
- D. Air Sealing
- E. Insulation
- F. Windows, Mechanical systems,
Appliances, Lighting,
Renewables.....

Windows & Doors



Least opportunity for energy improvement compared to cost

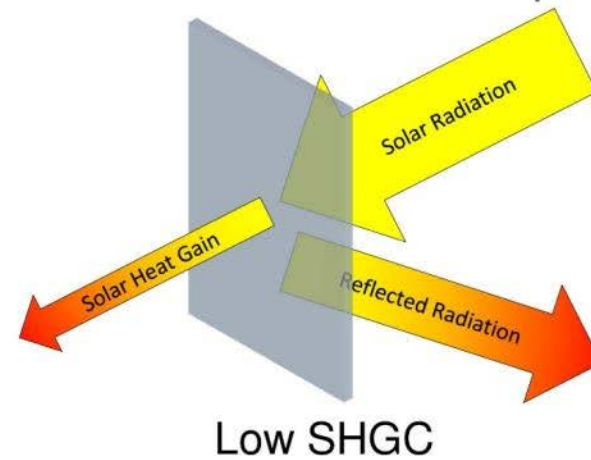
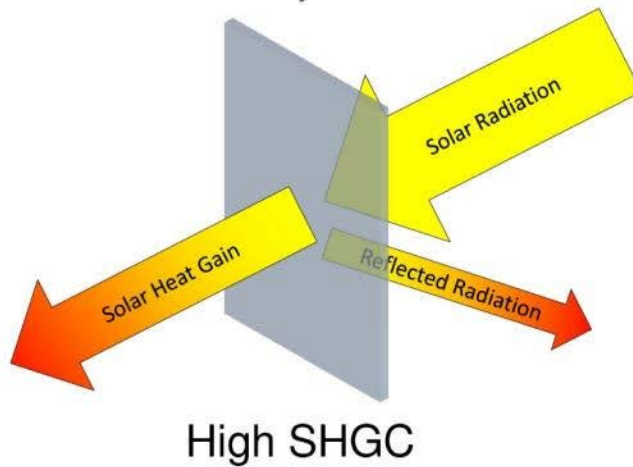
	Andersen <small>WINDOWS • DOORS</small> 	
	Picture Window Vinyl-Clad Wood Frame Dual-Pane Low-E Glazing with Argon <small>RES97</small>	
ENERGY PERFORMANCE RATINGS		
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient	
0.30	0.36	
ADDITIONAL PERFORMANCE RATINGS		
Visible Transmittance	_____	
0.59		
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>		
	ENERGY STAR® Qualified in All 50 States	
		
Design Pressure (PSF)	HALLMARK <small>CERTIFIED</small>	
DP 50	F-C50 60" x 72" <small>Tested to ANSI/AAMA/NWDA 101/I.S.2-97 or NAFS-1</small>	
<small>Meets or exceeds M.E.C., C.E.C., & I.E.C.C. Air Infiltration Requirements WDMA Hallmark Certification Program Rev. 1/04 Part # 4780682</small>		



Strategy #3: Use more efficient windows



- Use low SHGC windows in hot and mixed climates. Consider advanced design strategies in cold climates.
- Benefits include:
 - Improved thermal enclosure.
 - Potentially reduced or offset costs due to smaller AC capacity.



energyvanguard.com



Release the Kraken!

Monsters live in your basement!

Three major steps to design an HVAC system

1. Calculate the heating and cooling loads.
2. Select equipment that meets those loads.
3. Design a duct system that gets air from the heating & cooling equipment to the rooms in the house, and then from the rooms back to the equipment.

Role of the Thermal enclosure system

1

Thermal Enclosure System

- A well-insulated and air-sealed home, with good windows and doors, reduces the amount of energy needed to keep the home comfortable.

Role of the Heating & cooling systems

2

**Heating,
Cooling, &
Ventilation
System**

System
Ventilation

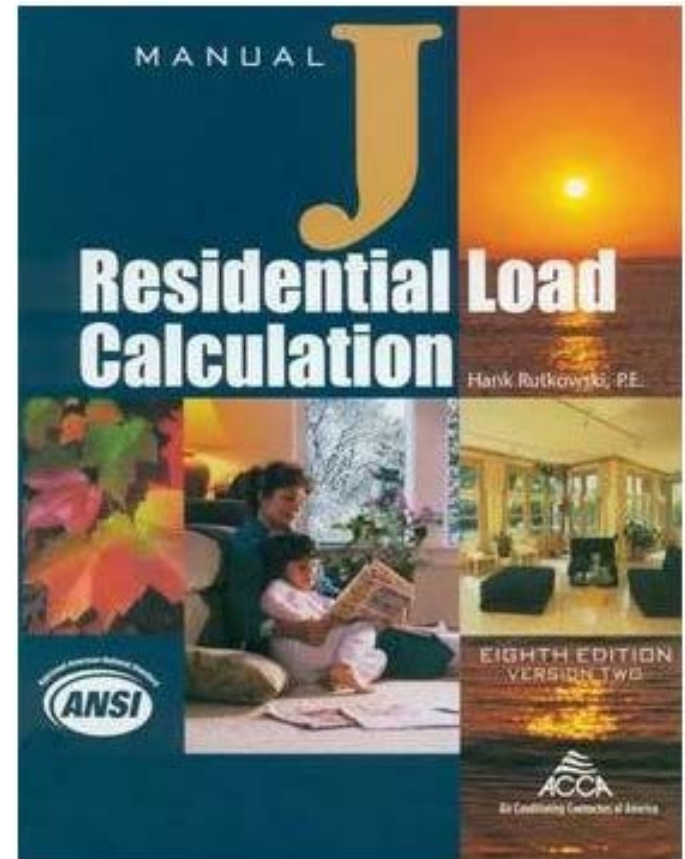
- Heating and cooling equipment that is:
 - High efficiency
 - Properly designed and installed
 - Combined with a duct system that's insulated, sealed, and balanced
- ... maintains comfort with less energy.



Step 1: (7.6.3)

Calculate heating & cooling loads

- Standard process to calculate loads.
- Provides a checklist of all input variables that can affect a home's comfort level.



Step 1:

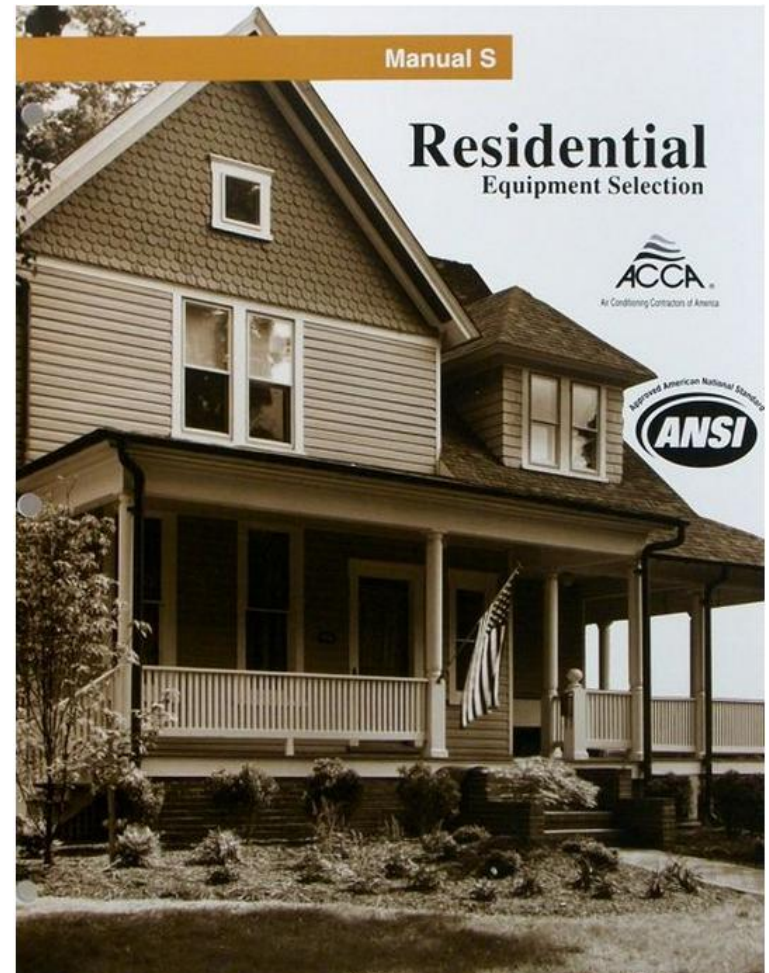


Important to document window performance characteristics

Step 2: Select equipment that meets loads



- Standard process to select equipment using the calculated loads.



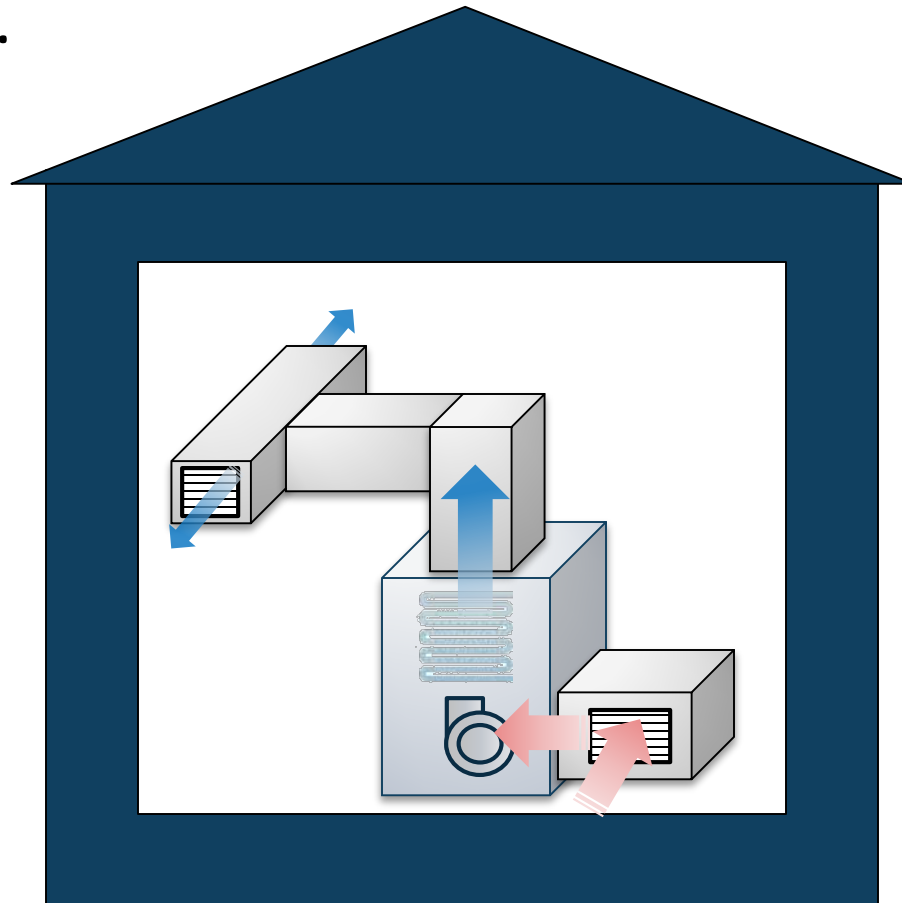
Summary of Step 2: Select equipment that meets loads

- The second major step in the design process is to select equipment using the calculated heating & cooling loads.
- ACCA **Manual S** provides a reliable standard process for doing this and includes limitations on over-sizing.

Step 3:

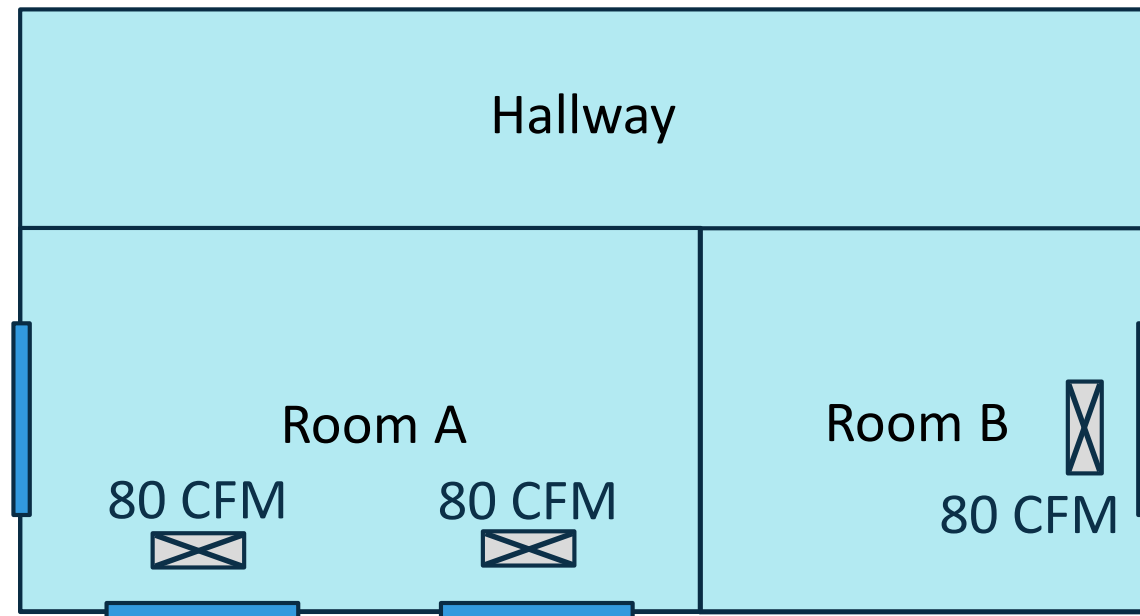
Design the duct system (7.5.2)

- Design a duct system that distributes air from the heating & cooling equipment to each room, and back to the equipment.



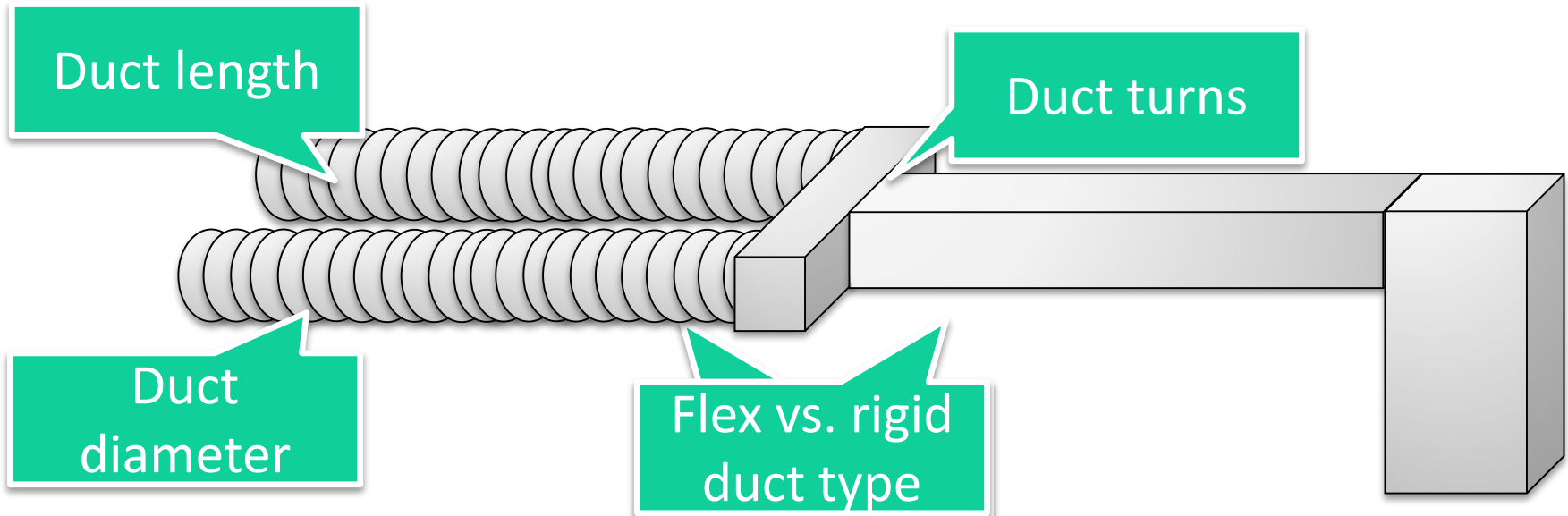
Step 3: Design the duct system

- The airflow needed by each room is directly related to its heating and cooling load.



Step 3: Design the duct system

- **Factors that influence duct system design:**
 - Duct length
 - Duct diameter
 - Duct type
 - Duct turns
 - Other components, like filters



Visually inspect ducts



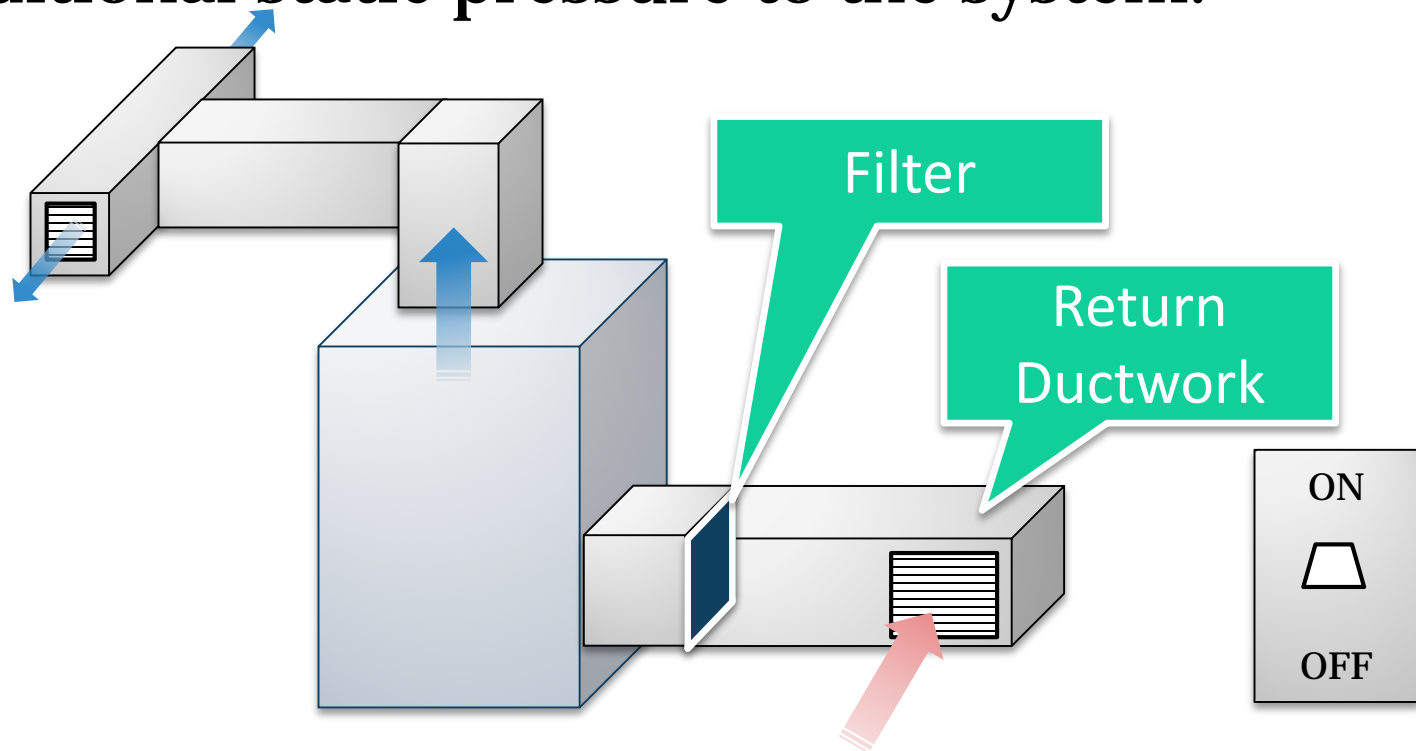
Avoid blower door if loose asbestos exists



Step 3:

Design the duct system

- **Example: Return side ducts and filters add additional static pressure to the system.**



Filtration - MERV

- 8
- 10
- 13 +
- **No electric filtration without conventional MERV**

Summary of Step 3: Design the duct system

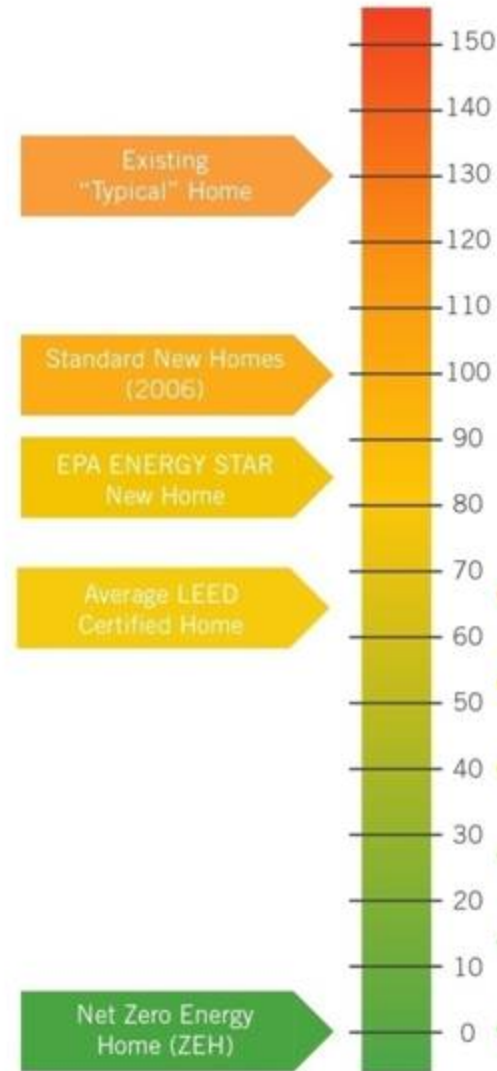
- The third major step in the design process is to design a duct system that works with the selected equipment.
- ACCA **Manual D** provides a reliable standard process for doing this. It ensures that the static pressure of the duct system and the air velocity are not too high.

Home Energy Rating System (HERS)



Performance Testing:

- Heating and cooling
- Water heating
- Lighting
- Appliances
- Building envelope



REORDER THE PRIORITY FOR PEOPLE AND HOMES

- A. Combustion Safety
- B. Ventilation
- C. Moisture Management
- D. Air Sealing
- E. Insulation
- F. Windows, Mechanical systems,
Appliances, Lighting,
Renewables.....

Activity: Homework

RETURN TO CHECKLIST

1. Open any sections
2. Select “Y” or “N” for all Prerequisites
3. Select enough MATERIALS points to create “Eligible Pillar”



Next Session

- Wednesday 12 pm to 2pm EST
 - **Beyond Energy**
 - **Concepts in Green**
 - **Case Studies**
 - **Opportunities in GreenStar**

Thank You!

Questions?

