Building Science:
It's Not Just for the Academics
Table R402.4.1.1

energyLogic

Presented By Robby Schwarz

Focus on House Performance

Fundamental Questions

Is It There?

Does It Work?

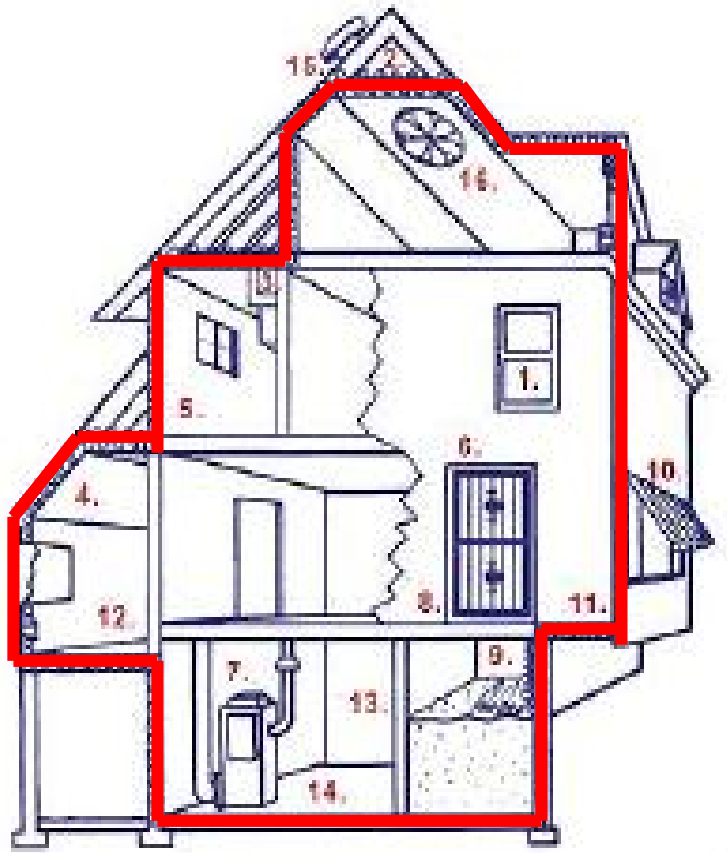
Fundamental Questions

Is It There?

Does It Work?

What / Where is the Thermal Envelope?

- Control and Predictability
  - Air Flow
  - Moisture Flow
  - Thermal Flow



IECC®

INTERNATIONAL ENERGY CONSERVATION CODE®

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	—
Narrow cavities	—	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	—
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring	—	In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Table 402.4.1.1
Component – General Air barrier/Thermal barrier

Air Barrier Criteria

- A continuous air barrier shall be installed in the building envelope
- Exterior thermal envelope contains a continuous air barrier.
- Breaks or joints in the air barrier shall be sealed

Insulation Installation Criteria

- Air-permeable insulation shall not be used as a sealing material

General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.

IECC® INTERNATIONAL ENERGY CONSERVATION CODE®

Section R202 General definitions

The Air Barrier is an assembly not a specific component

Air Barrier

- One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the *building thermal envelope* and its assemblies

Continuous Air Barrier

- A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope

Building Thermal Envelope

- The *basement walls, exterior walls*, floors, ceiling, roofs and any other *building* element assemblies that enclose *conditioned space* or provide a boundary between *conditioned space* and exempt or unconditioned space.

5 key Air Barriers Attributes

- **Continuity**: The most important element in 3D structures with so many different components
- **Impermeability:** The ABS must be impermeable to Air
- **Strength**: The ABS must be designed to transfer the full designed wind load and continue to be impermeable
- **Durability**: The ABS must continue to be impermeable throughout its service life
- **Stiffness**: The ABS must be stiff enough so that irregularities do not change its permeance

Air Barrier Continuity vs Function

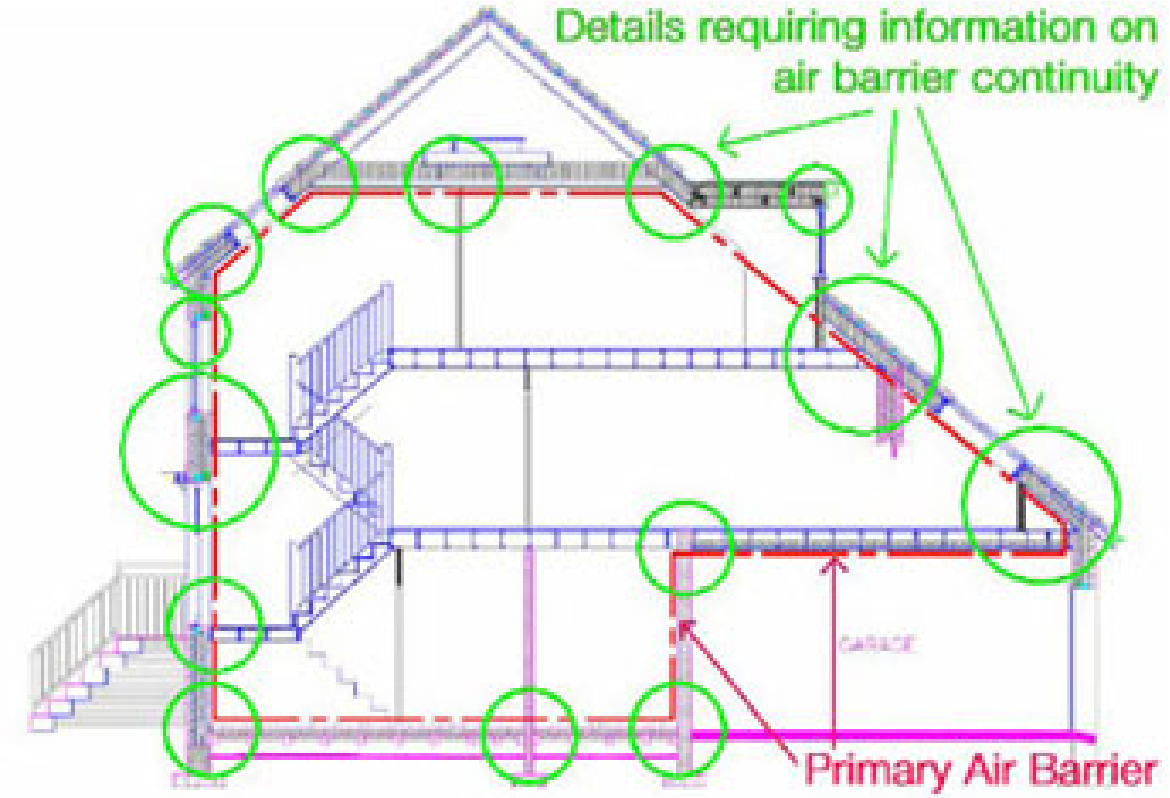
Interior vs. Exterior air barrier

At its simplest form

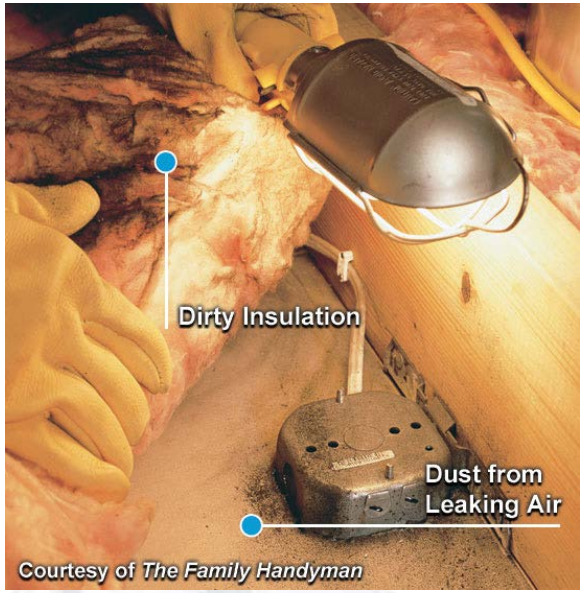
- Interior drywall
- Exterior sheathing
  - House Wrap?
  - Drainage Plan

Function

- Enclosing Insulation
- 6 sided encapsulation
- Control & Predictability
  - Air control
  - Thermal Control
  - Moisture Control



Air-permeable insulation shall not be used as a sealing material



Can a House Be Too Tight?

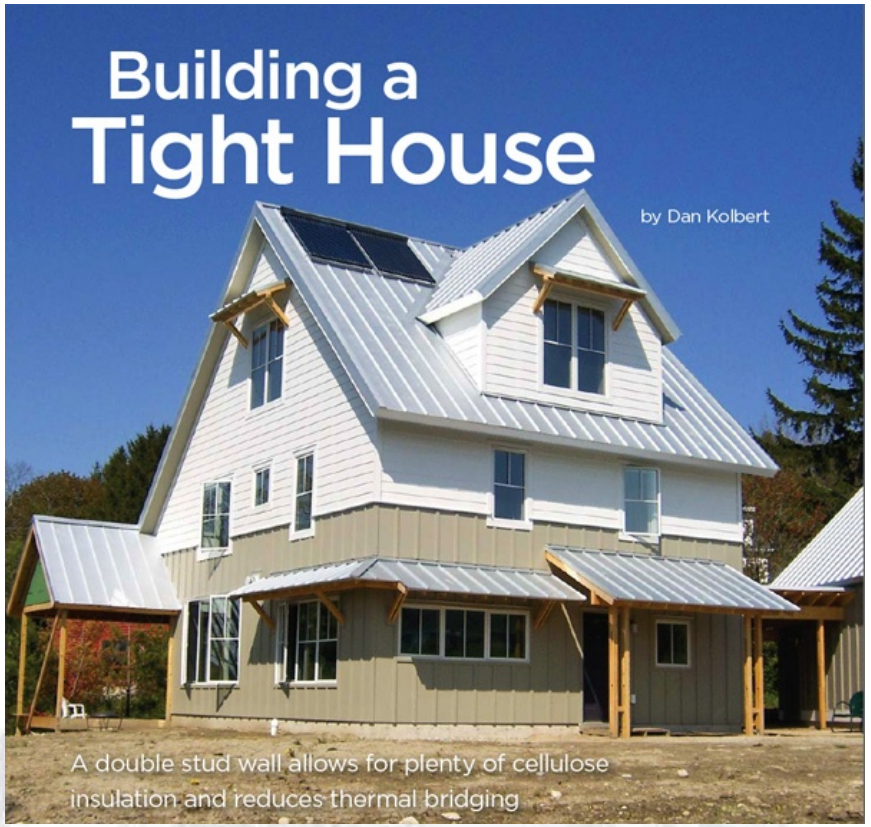
NO!

- Wrong question
- Control **air flow**
- In order to control the air

Real question .....

- Can houses be under-ventilated?

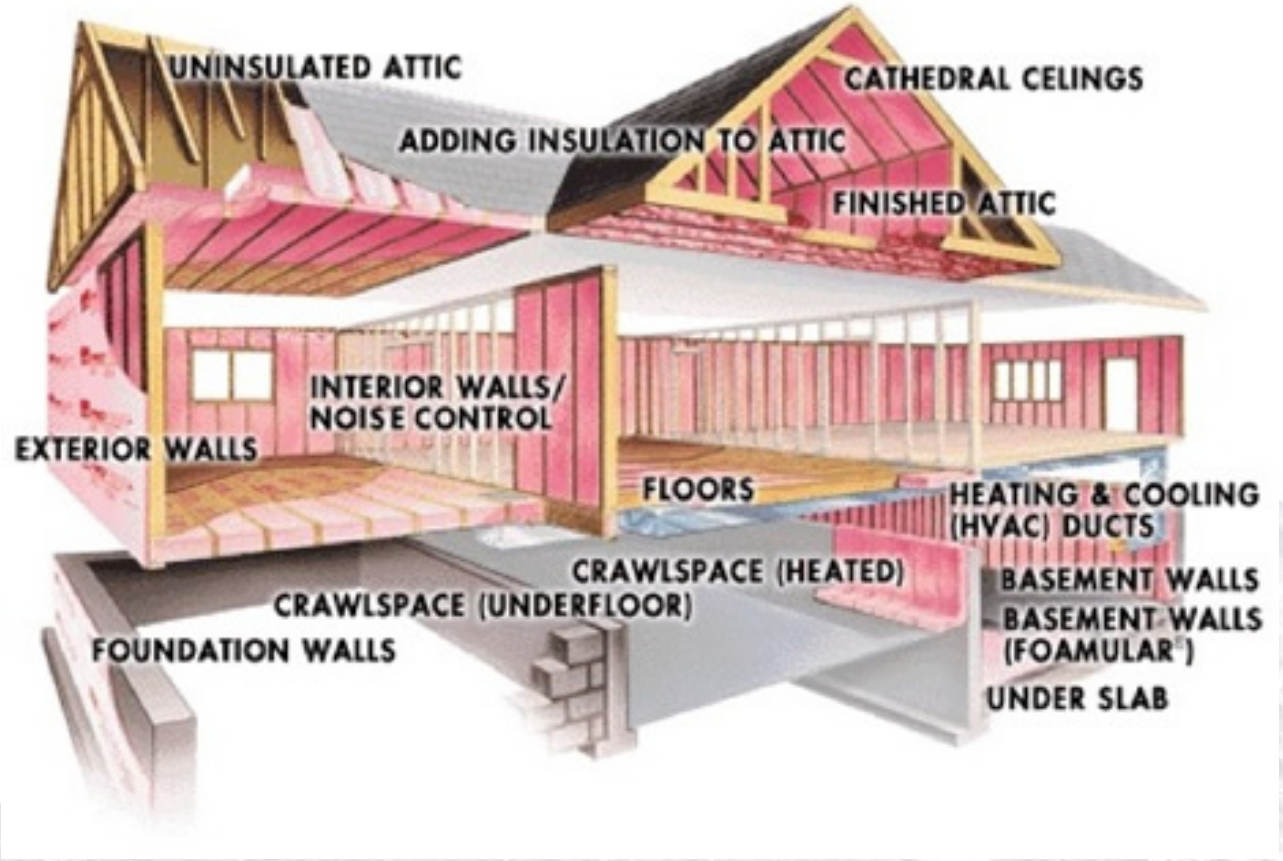
YES!

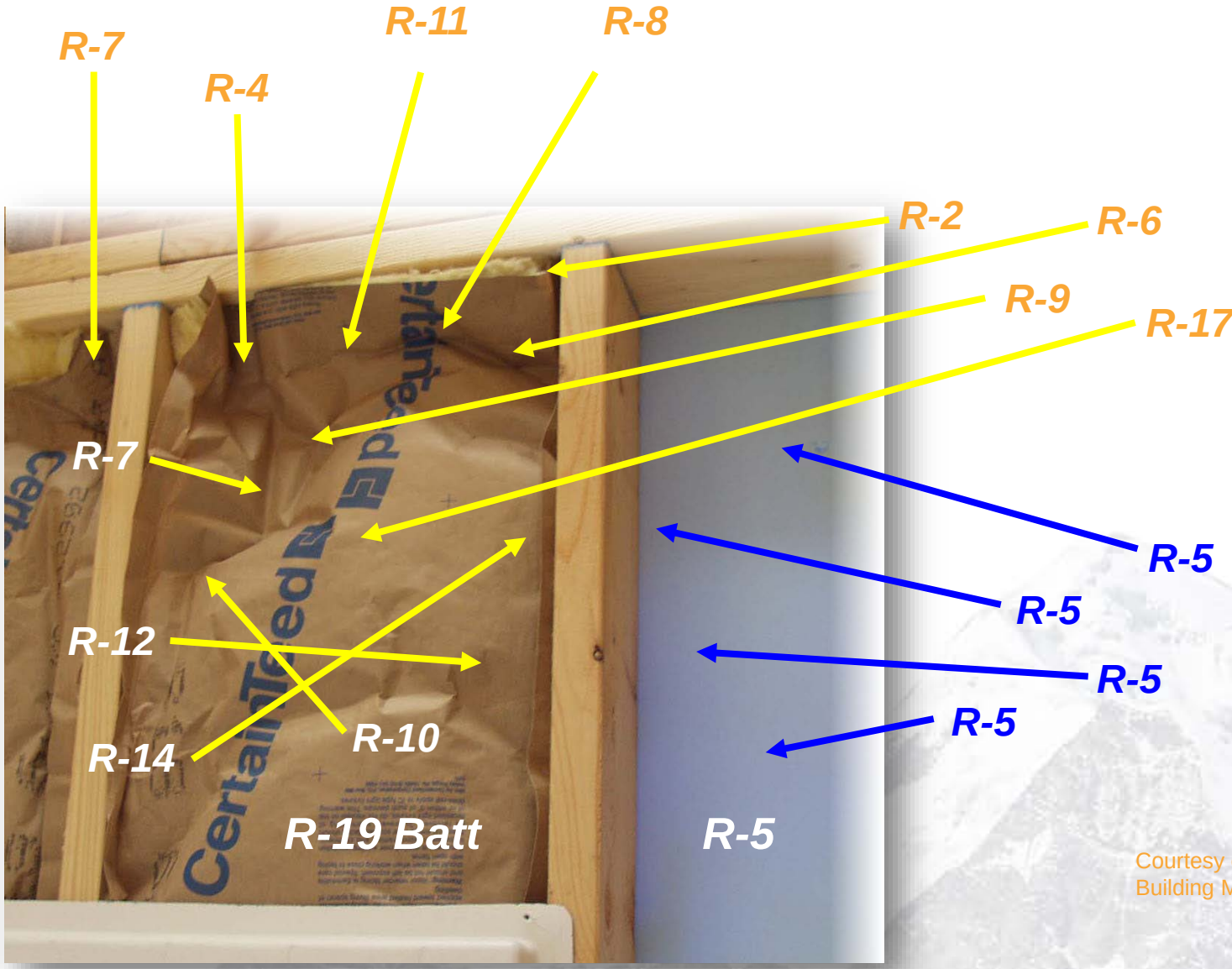


Build Tight and Ventilate Right

Thermal Envelope vs. HVAC

- Is it there and does it work?





Courtesy of DOW
Building Materials

IECC®

INTERNATIONAL ENERGY CONSERVATION CODE®

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, *R*-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	—
Narrow cavities	—	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	—
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring	—	In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Table 402.4.1.1
Component – Walls – High side holes

Air Barrier Criteria

- The junction of the foundation and sill plate shall be sealed
- The junction of the top plate and top of exterior walls shall be sealed
- Knee walls shall be sealed

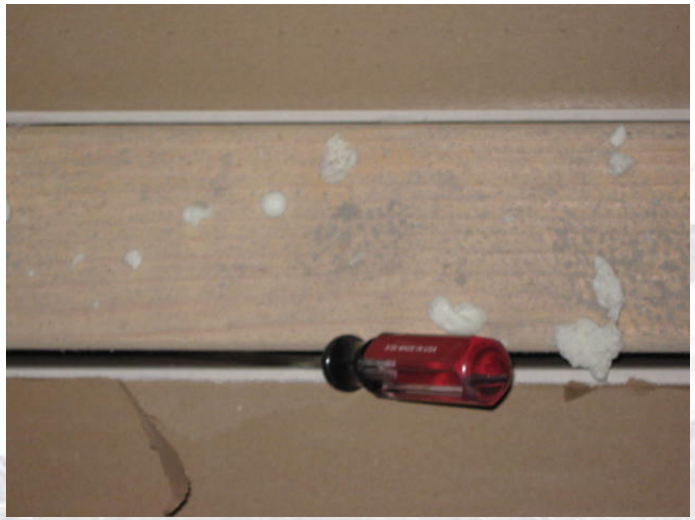
Insulation Installation Criteria

- Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R3 per inch minimum
- Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier

Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.

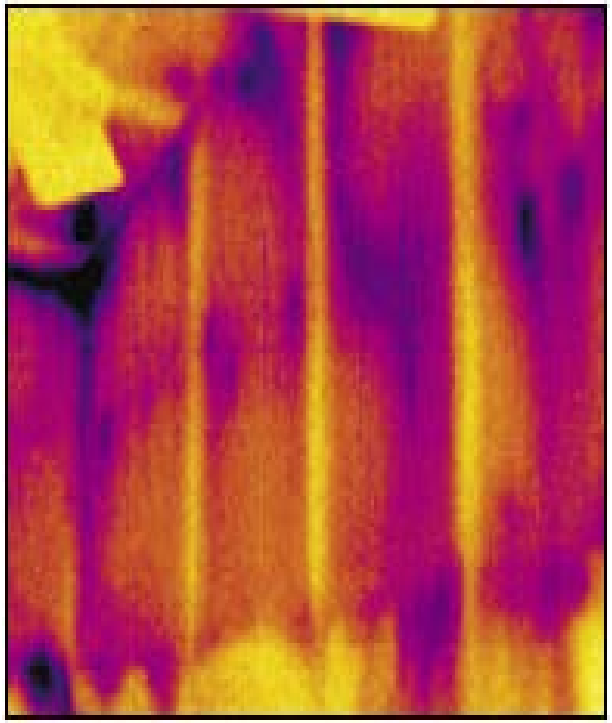
The junction of the top plate and top of exterior walls shall be sealed

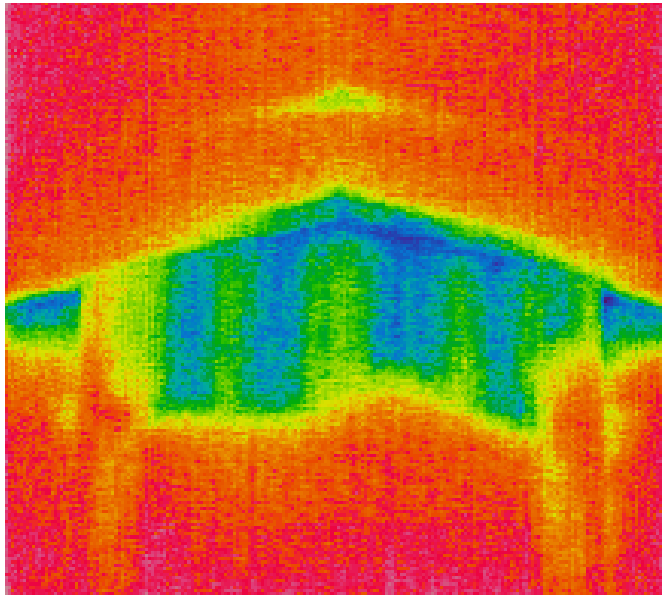
High Side Holes

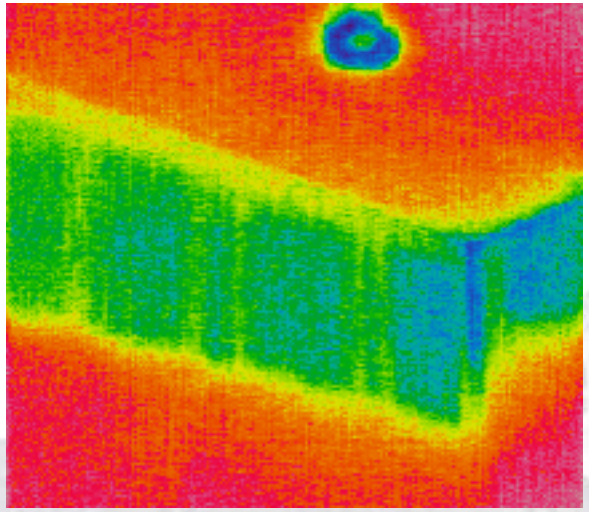


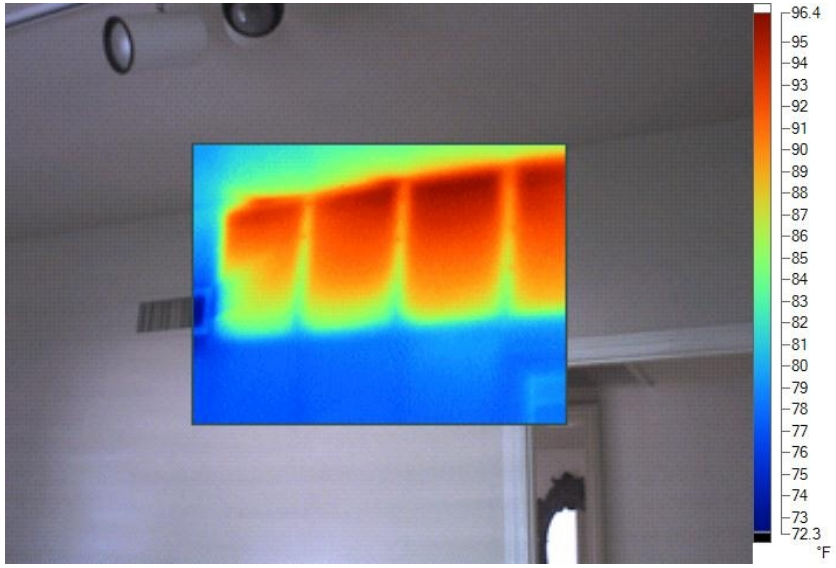
Attic Knee Walls

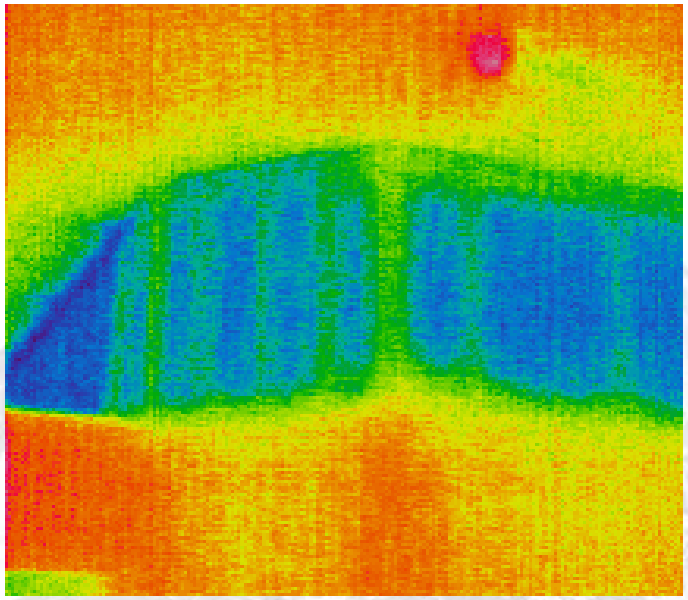
Attic Knee Walls











Doing it Right

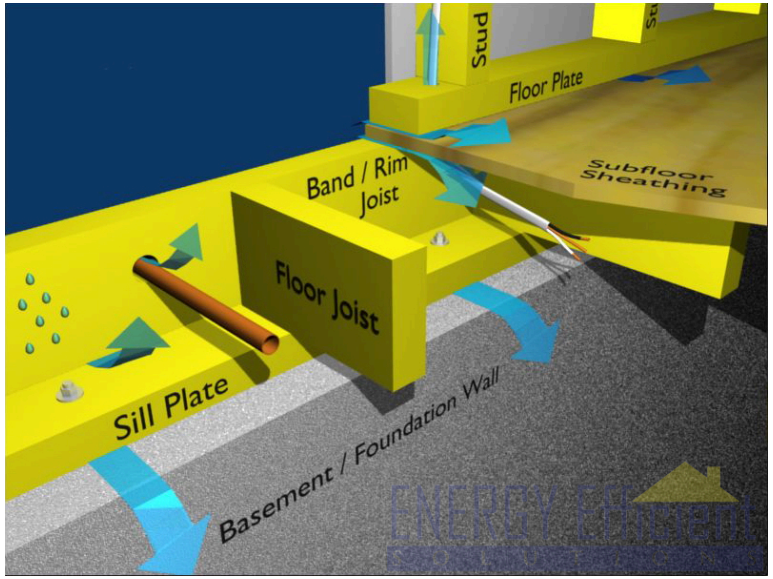
Sequencing 95% Framers Job:

1. Top plate
2. Bottom plate
3. Side Studs
4. Attic side sheathing
5. Interior drywall is the sixth side

Table 402.4.1.1
Component – Rim Joists – Low side Holes

Air Barrier Criteria

- Rim joists **shall include the air barrier**



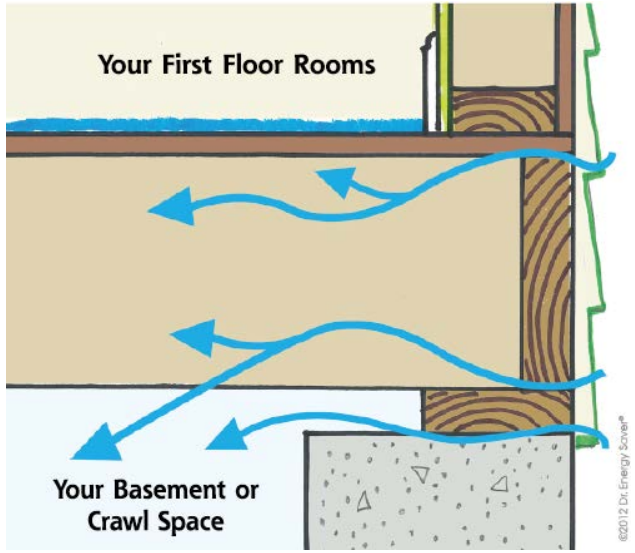
Insulation Installation Criteria

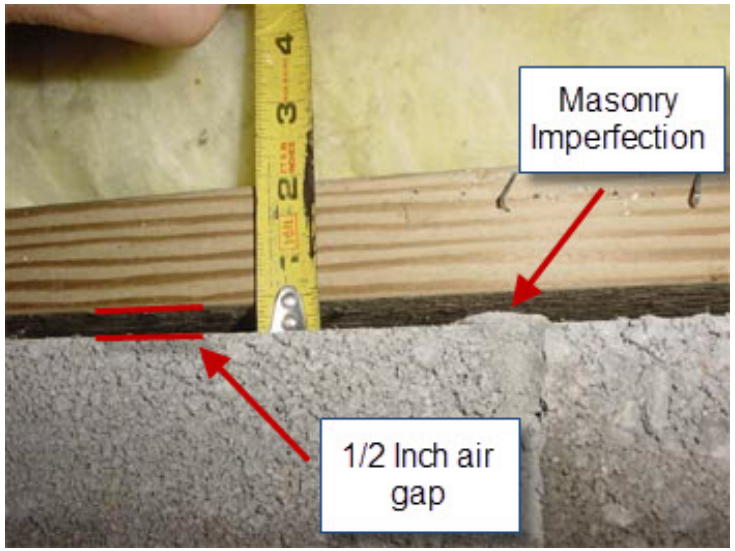
- Rim joists **shall be insulated**

Rim Joist **Box Sill**

Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.

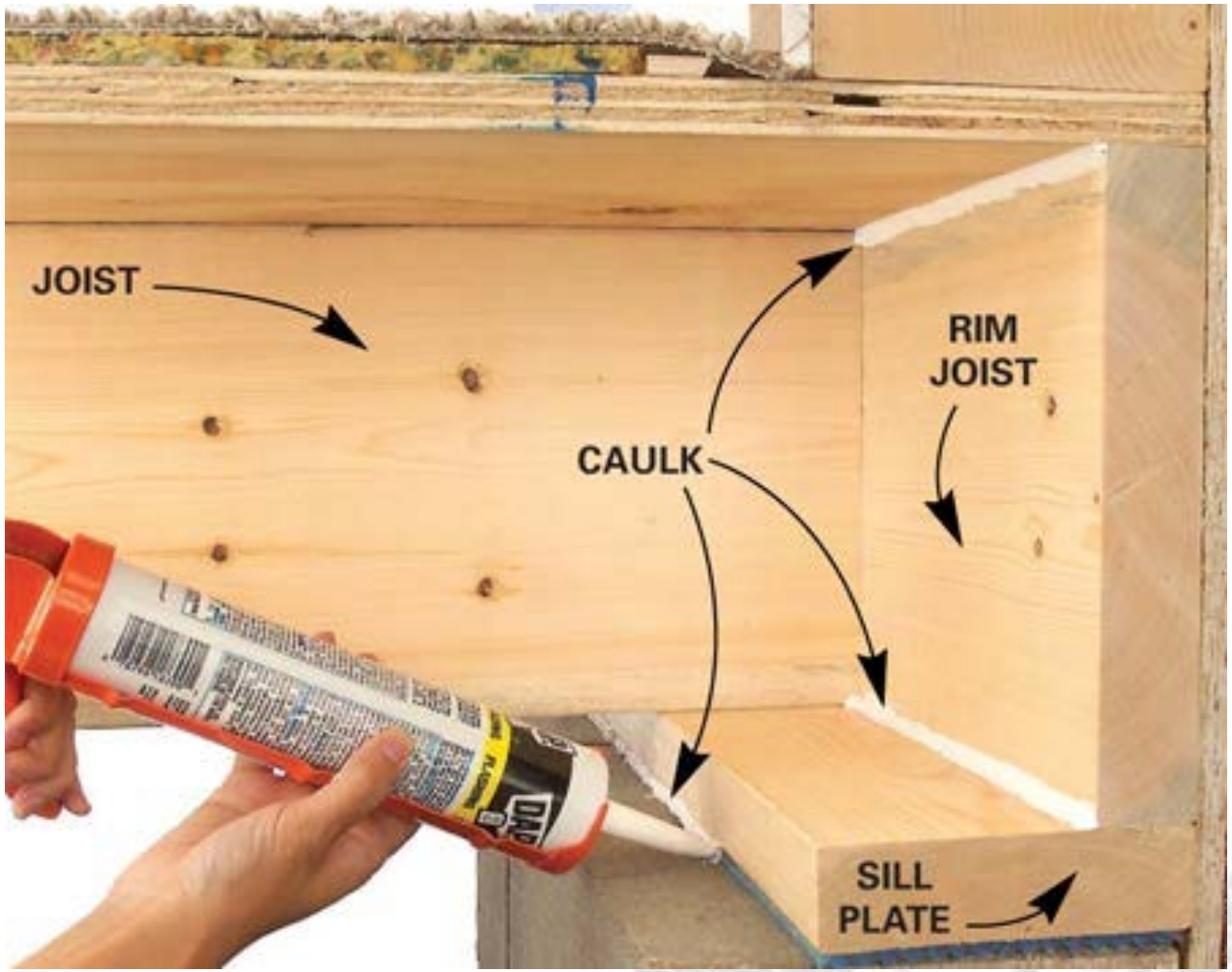
What Does Air Barrier Mean?





Rim Joist Air Sealing

Low side Holes



1. Rim Board to Sub Floor

2. Rim Board to Sill Plate

3. Sill Plate to foundation

Task at Hand – Break out session

Think about

- Do you understand table R402.4.1.1?
- Its Mandatory regardless of the path!
- What does an air barrier mean?
- What is code compliant installation of Insulation?

Exercise

- Pick out a component
- How would you describe what is required?
- Can you think of a detail that explains how to successfully complete?
- What common language is needed to be successful?

Robby Schwarz

Principle/Director of Builder Relations

robby@nrglogic.com

720-838-0677