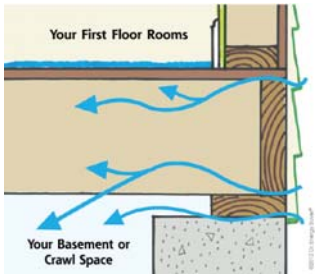
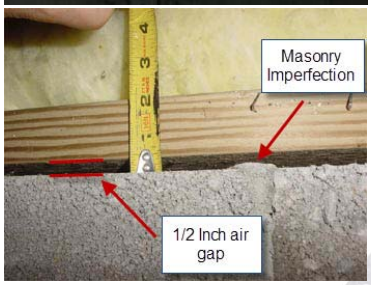
What Does Air Barrier Mean?





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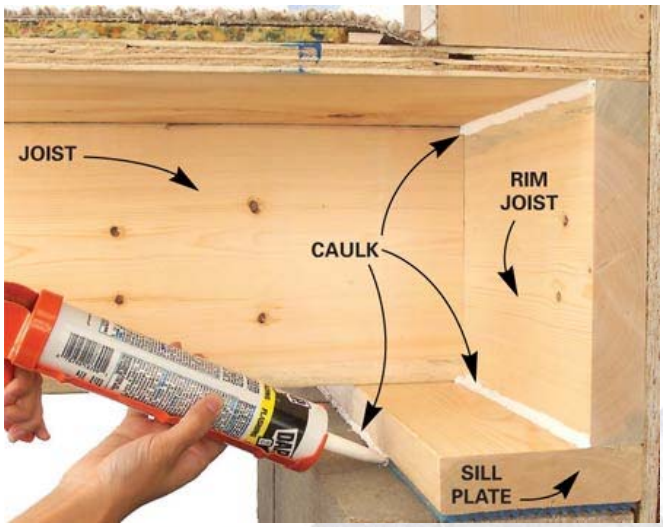
Rim Joist Air Sealing



1. Rim board to subfloor
2. Rim board to sill plate
3. Sill plate to foundation

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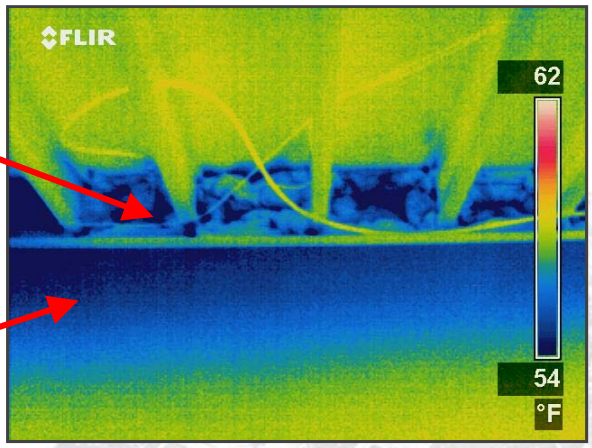
Rim Joist / Box Sill

Rim joists shall be insulated, batts need to be installed well (no crescent fitting)

Insulated rim joist

Uninsulated concrete wall



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Rim Joist Insulation

Consider other materials at the rim

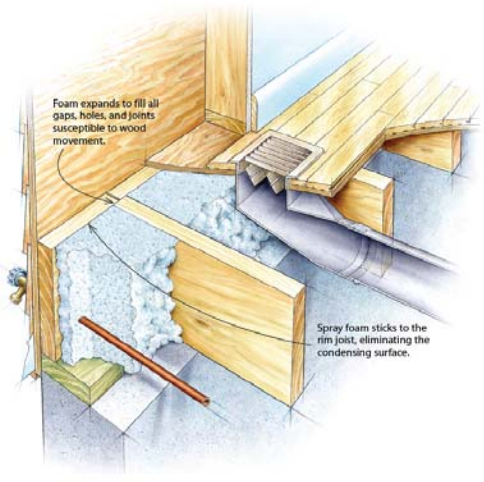

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Table 402.4.1.1

Component – Floors (including above garage & cantilever floors)

Air Barrier Criteria

- The air barrier shall be installed at any exposed edge of insulation.

Insulation Installation Criteria

- Floor framing cavity insulation shall be installed **to maintain permanent contact with underside of subfloor decking.**
- 2015 IECC introduction
  - **or** floor framing cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing and extends from the bottom to the top of all perimeter floor framing members.

Floors (including above garage and cantilevered floors)	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, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.

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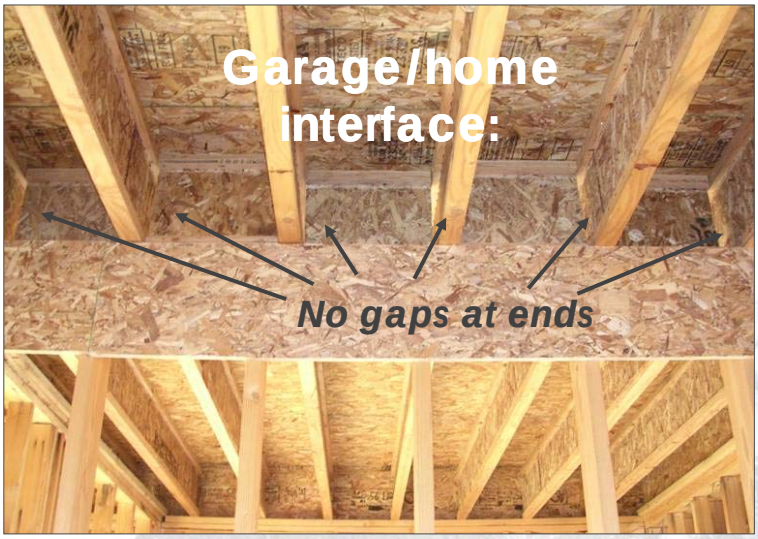
The Air Barrier Shall Be Installed at Any Exposed Edge of Insulation



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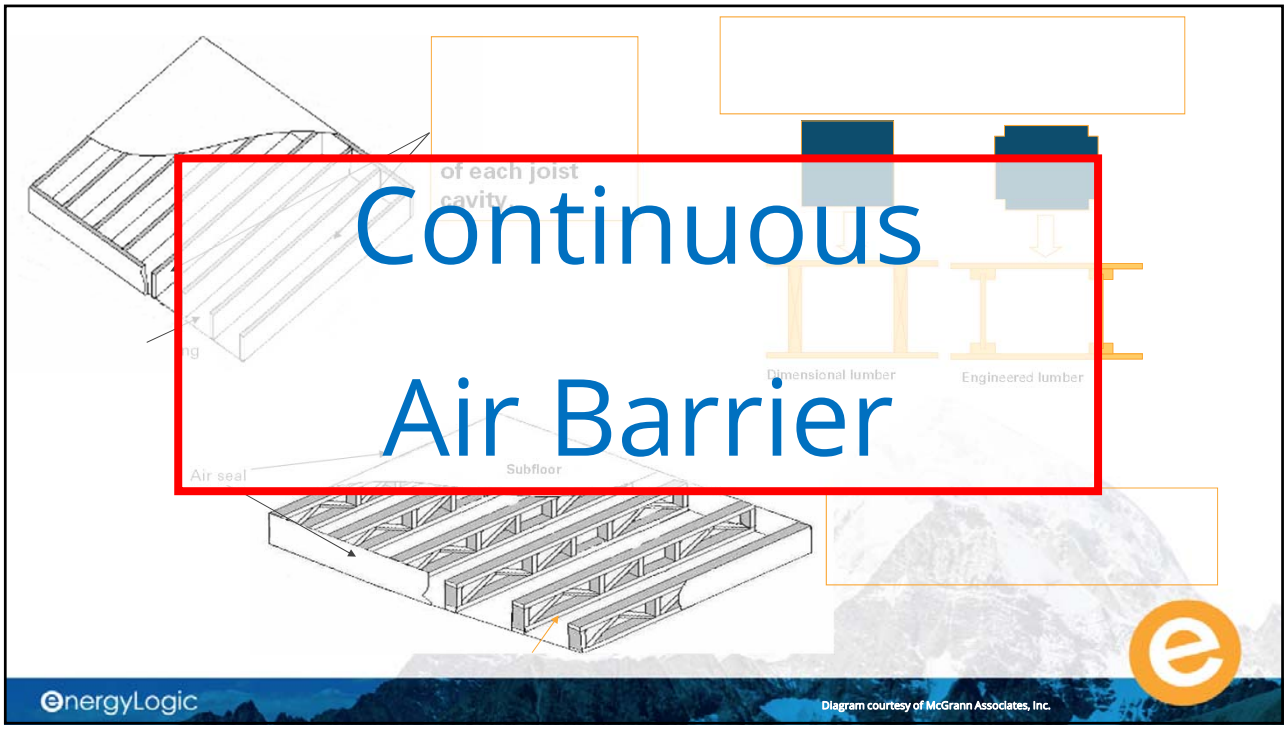
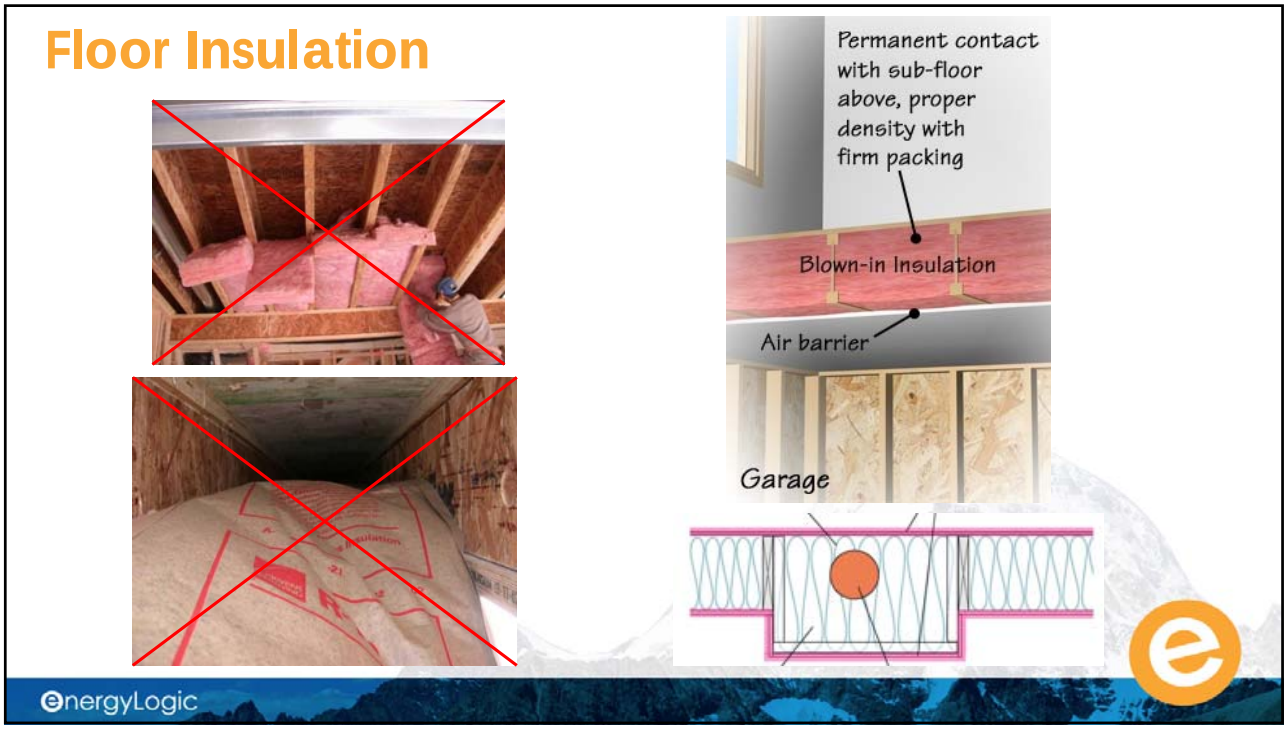
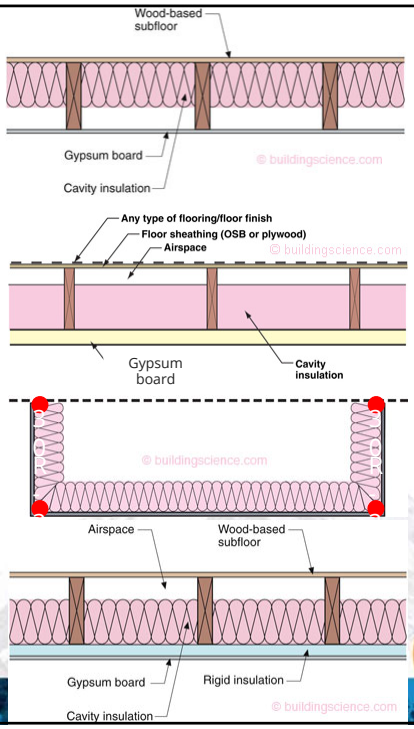

Continuous
Air Barrier
of each joist
cavity
Dimensional lumber
Engineered lumber
Air seal
Subfloor
energyLogic
Diagram courtesy of McGrann Associates, Inc.


Floor Insulation
Permanent contact with sub-floor above, proper density with firm packing
Blown-in Insulation
Air barrier
Garage
energyLogic

R402.2.8 Exception

Joseph Lstiburek exception and details

1. Complete & tight air barrier system, **and**
2. R-30 insulation on the bottom sheathing of the assembly, **or**
3. Continuous R-20 bathtub insulation including floor rim joist insulation, **or**
4. Continuous insulation below framing with cavity insulation ≥ R-20



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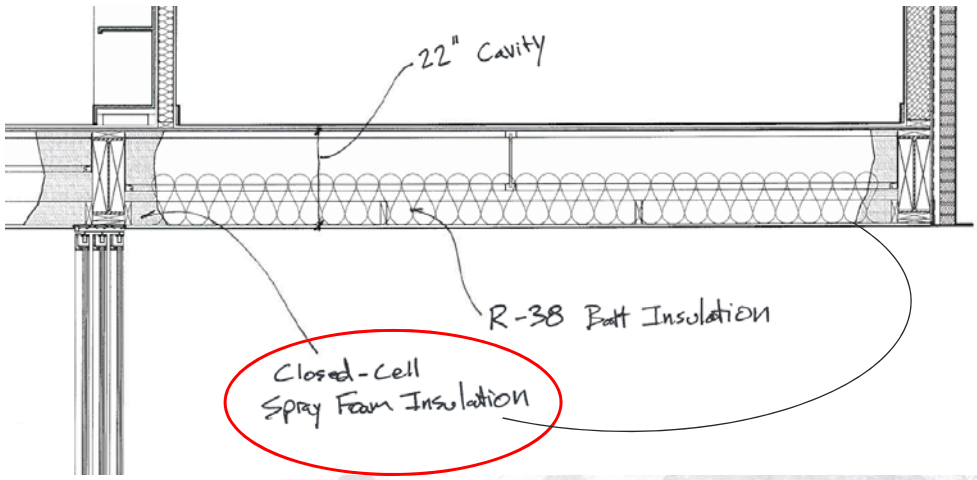
Floor Over Garage



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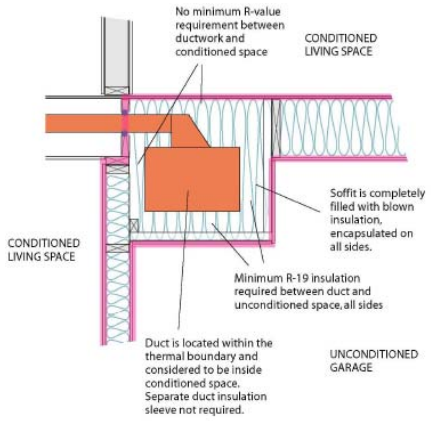
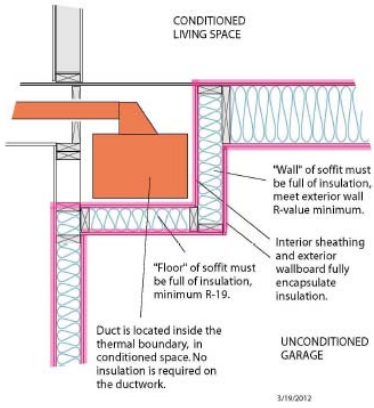
Ducts in Garage Soffits

Ductwork in garage soffit, adjoining conditioned space, living space above - Solution 1



NOTE: This approach is only approved if BLOWN insulation is used to completely fill the soffit.

Ductwork in garage soffit, adjoining conditioned space, living space above - Solution 2



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It Can Be Done

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Details: Cantilever Floor

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Bad Cantilevers

Poor detailing

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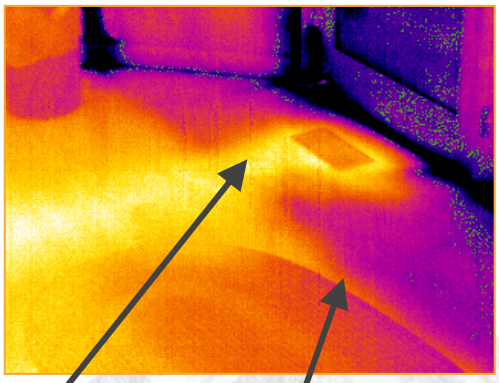
Cantilevers:

*Just say **no** to heat runs in cantilevers*



Heat loss from heat run in cantilever

Cantilever boundary

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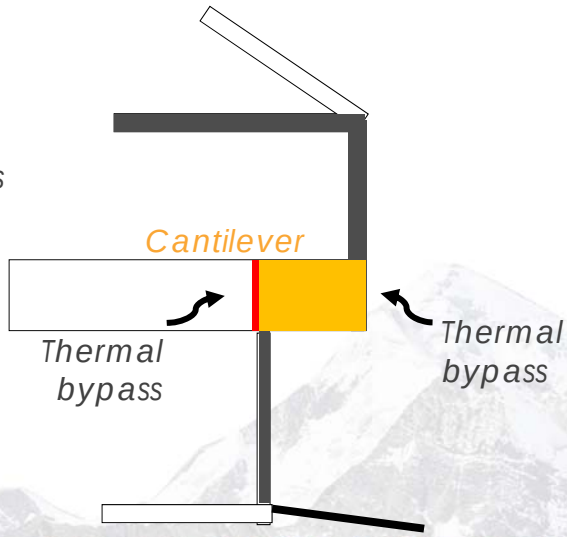
Cantilevered Floor

Solution:

- *Align insulation*
- *Add air barriers*



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Cantilevers

Effective detailing

1. Framed cavity
2. Air barrier to inside
3. Fully insulated cavity
4. Soffit board

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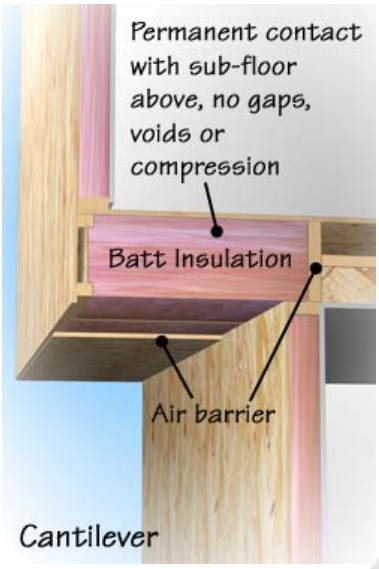
Making the Floor Work



Wall laid flat still needs six-sided air barrier

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Table 402.4.1.1

Component – Crawl Space Walls

Air Barrier Criteria

- Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.

Insulation Installation Criteria

- Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawlspace walls.
- Perforated Vinyl Drape is ideal.

Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.

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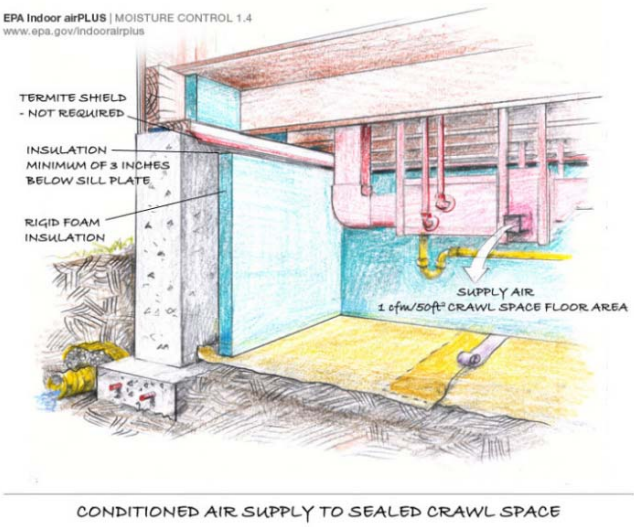

CONDITIONED AIR SUPPLY TO SEALED CRAWL SPACE

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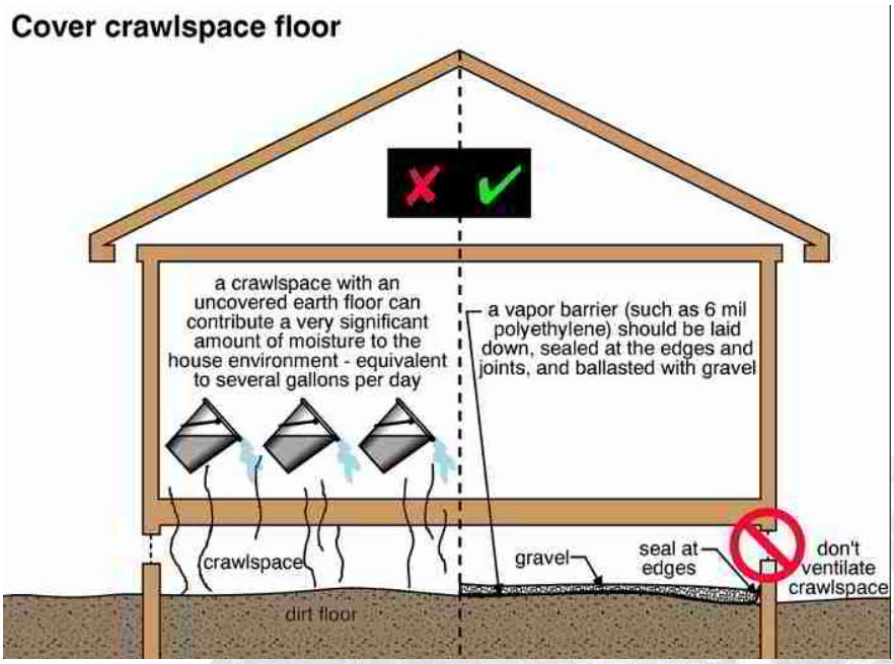

2015 IECC table 402.4.1.1

Crawl – Insulation is permanently attached to walls, earth covered and sealed with Class 1 vapor barrier

Table 402.4.1.1

Component – Shafts, Penetrations

Air Barrier Criteria

- Duct shafts, utility penetrations, fireplace chases and flue shafts opening to exterior or unconditioned space shall be sealed.

Insulation Installation Criteria

- In the 2015 IECC the Fireplace section was consolidated into this section.

Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	

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Duct/Flue Shafts & Utility Penetrations

Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.

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Sequencing

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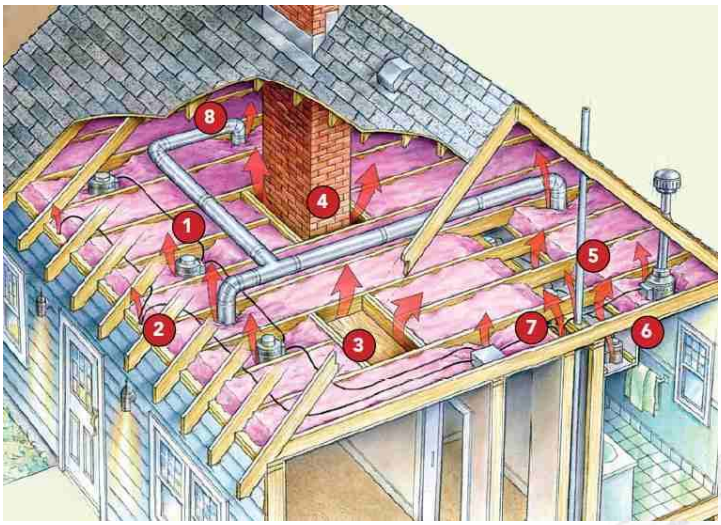

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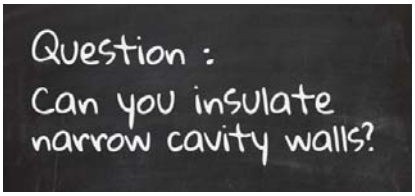
Table 402.4.1.1

Component – Narrow Cavities

Air Barrier Criteria



Insulation Installation Criteria

Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space. Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.

Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.

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Table 402.4.1.1

Component – Garage Separation

Air Barrier Criteria

- Air sealing shall be provided between the garage and conditioned spaces.

Insulation Installation Criteria

Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	

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Garage Separation

What does this mean?

Table 402.4.1.1

Component – Recessed lighting

IECC

Air Barrier Criteria

- Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.

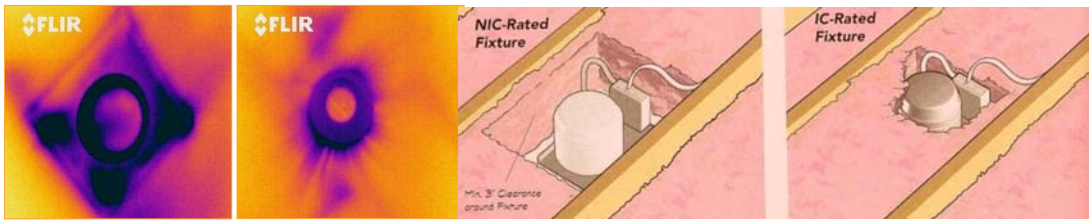
Insulation Installation Criteria

- Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated.

Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.

Recessed Lighting Fixtures

Air tight IC rated and sealed to drywall



New LED Recessed Lights

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Table 402.4.1.1

Component – Plumbing and Wiring

IECC

Air Barrier Criteria

Insulation Installation Criteria

- Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.

Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.

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Plumbing and Wiring

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Plumbing and Wiring

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Table 402.4.1.1

Component – Shower/Tub on Exterior Wall

Air Barrier Criteria

- The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.

Insulation Installation Criteria

- Exterior walls adjacent to showers and tubs shall be insulated.

Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.

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Tubs and Showers

Sequencing

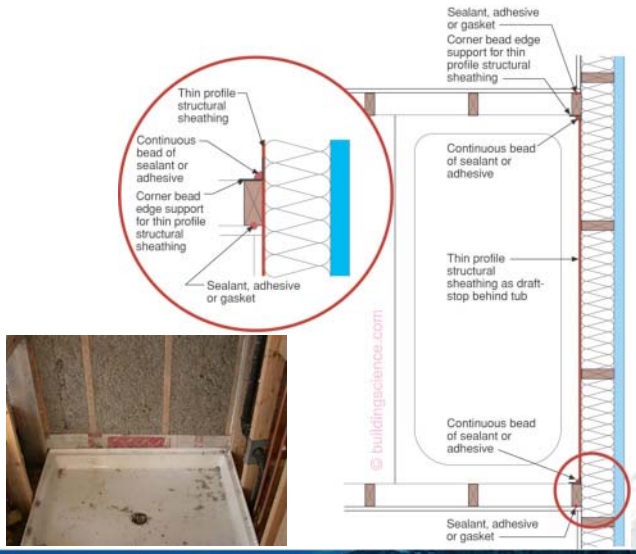

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Table 402.4.1.1

Component – Electrical/Phone Box on Exterior Walls

Air Barrier Criteria

- The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.

Insulation Installation Criteria

Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.

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Electrical/Phone Box on Exterior Walls

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Table 402.4.1.1

Component – HVAC Register Boots

Air Barrier Criteria (2018 IECC)

- 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.

HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.

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A Portion of the Supply Air Hits the Register Cover and Bounces Back into the Cavity

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Table 402.4.1.1

Component – Fireplace

Air barrier criteria

- This section was moved in the 2015 IECC
- An air barrier shall be installed on fireplace walls
- Fireplaces shall have gasketed doors

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Fireplace

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Sequencing Is the Issue

Air barrier 1st, then over framing

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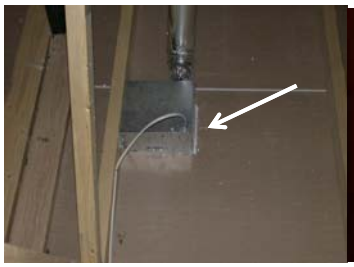
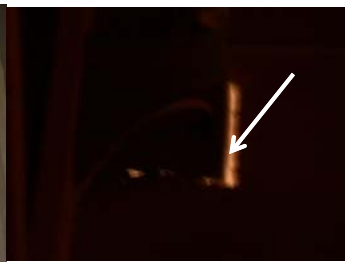
Other Potential Problem Areas





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Traps: Seal Them!

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Table 402.4.1.1

Component – Concealed Sprinklers

IECC

Air Barrier Criteria

- When 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.

Insulation Installation Criteria

Concealed sprinklers	When 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.

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Fire Sprinklers and Air Leakage?





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Fire Sprinklers and Insulation





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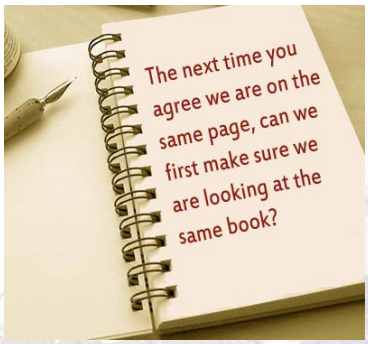
Fire Code and Energy Code

Not on the same page

- 2009 IECC
  - Common wall: Air barrier is installed in common wall between dwelling units
- 2012, 2015, & 2018 IECC
  - Not mentioned in the table



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Single Family vs. Attached Housing

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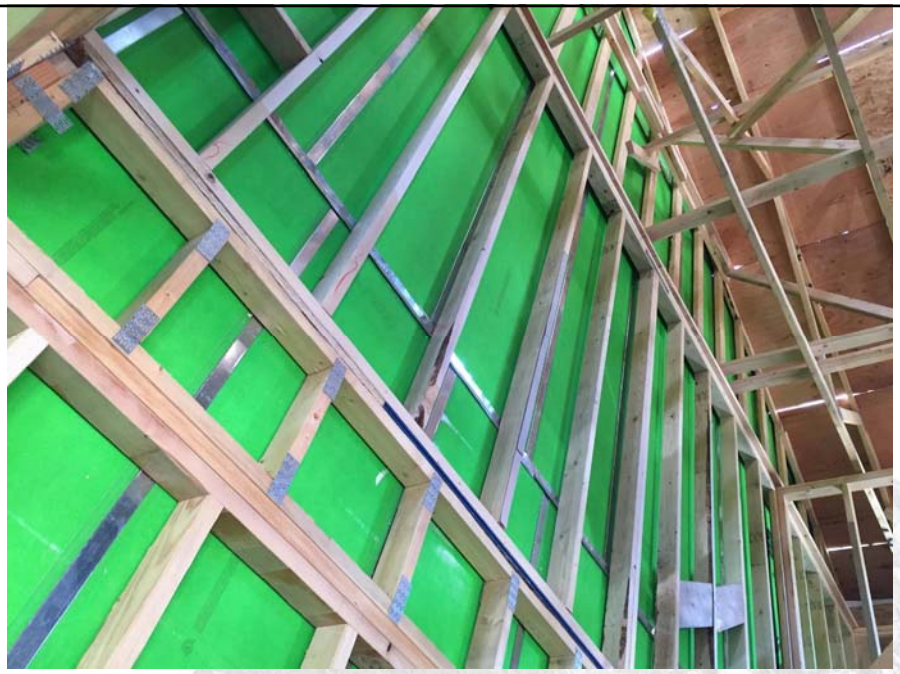

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Other Mandatory Items

- HVAC controls
  - Programmable thermostat
- Building cavities **shall not** be used as ducts or plenums
- Hot water circulation and pipe insulation
  - If installed
- CFL or LED lighting
  - 2015 IECC 75%
  - 2018 IECC 90%

Shedding light on bulbs

Federal law taking effect Jan. 1 bans the manufacture of incandescent light blubs of 40 watts or more, although sale of existing inventory will continue, and bulbs rated just under 40 watts probably will be available.



A comparison of a 40-watt bulb and alternatives that produce the same amount of light:	Incandescent bulb	Compact fluorescent lamp (CFL)	Light-emitting diode (LED)
Energy used	40 watts	11 watts	7 watts
Lifespan*	1 year	9 years	22 years
Price per bulb	$1-2	$4-6	$10-25
Annual cost to operate*	$4.82	$1.32	$0.84

* Based on three hours use a day at 11 cents per kilowatt hour.

Source: Batteries Plus Bulbs; U.S. Department of Energy Chronicle

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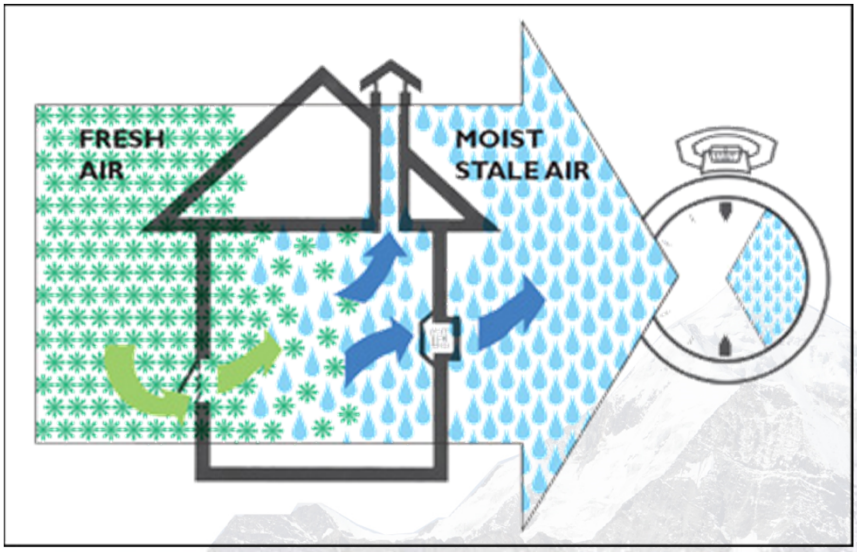
Ventilation & HVAC Design



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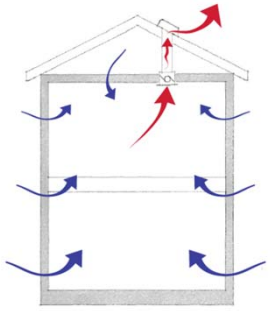
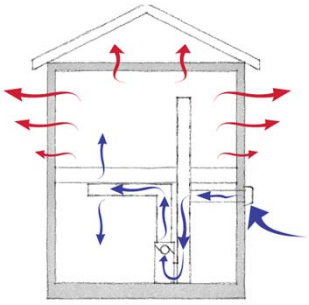
HVAC V = Ventilation

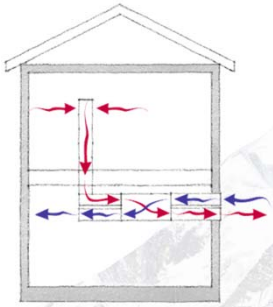
Exhaust Ventilation



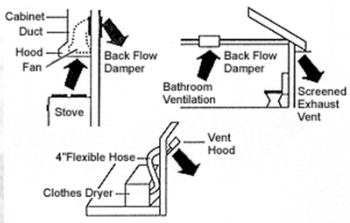
Supply Ventilation



Balanced Ventilation



Spot Ventilation



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R403.6 Mechanical Ventilation

IECC

(Mandatory)

- The building shall be provided with ventilation that meets the requirements of the International Residential Code or International Mechanical Code.
- Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

R403.6.1 Whole-house mechanical ventilation system fan efficacy

- Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.5.1. (**efficient fans needed**).
- Exception: Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an **electronically commutated motor.**

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Local Exhaust Ventilation Sometimes referred to as "Spot Ventilation"

Removes pollutants, moisture, to the odors at the source

M1501.1 Outdoor discharge

- The air removed by **every** mechanical exhaust system **shall be discharged to the outdoors** in accordance with Section M1506.2
- Air **shall not** be exhausted into an attic, soffit, ridge vent or crawl space

- Appliance
  - Dryer
  - Range hoods
  - Bath fans

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Local Exhaust Ventilation Sometimes referred to as "Spot Ventilation"

Removes pollutants, moisture, to the odors at the source

TABLE M1507.4

- Kitchens:
  - 100 CFM intermittent
  - 25 CFM continuous
  - Ducted to outside

- Baths:
  - 50 CFM intermittent
  - 20 CFM continuous

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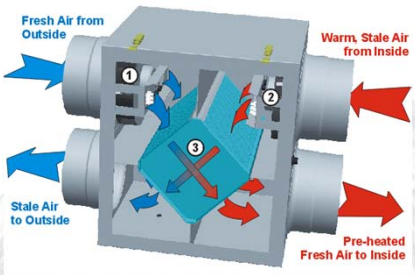
M1507.3 Whole-House Mechanical Ventilation System

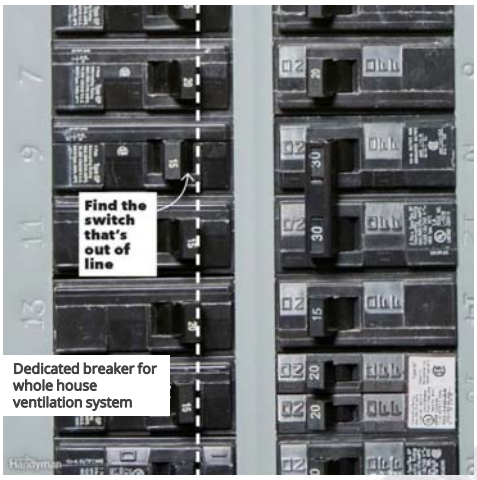
- **M1507.3.1 System design:** The whole-house ventilation system shall consist of: Supply Side, Exhaust Side, Balanced systems, or combination there of.
- **M1507.3.2 System controls:** The whole-house mechanical ventilation system shall be provided with controls that enable manual override.
- **M1507.3.3 Mechanical ventilation rate: The whole house** mechanical ventilation system shall provide outdoor air at a continuous rate of not less than that determined in accordance with Table M1507.3.3(1).
- **Exception:**
  - **Permitted to operate intermittently** where the system has controls that enable operation for not less than 25-percent of each 4-hour segment and the ventilation rate prescribed is multiplied by the factor determined in accordance with Table M1507.3.3(2).

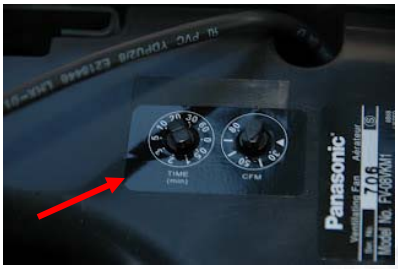
Ventilation Systems

Supply / Exhaust / Balanced



There Must Be a Control





Adjustable fan control highly recommended

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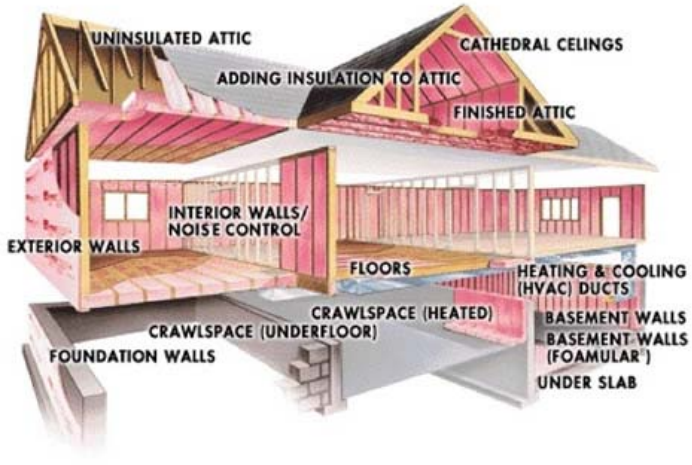
Thermal Envelope vs. HVAC

- Is it there and does it work?



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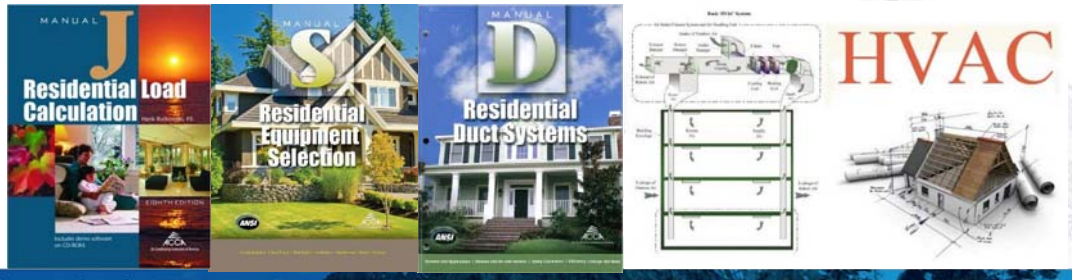
HVAC Design

The HVAC design process has three major steps:

- **Step 1:** Calculate the heating and cooling loads (Manual J).
- **Step 2:** Select equipment with capacity to meet those loads (Manual S).
- **Step 3:** Design a duct system that can get air from the equipment to the rooms and back (Manual D).



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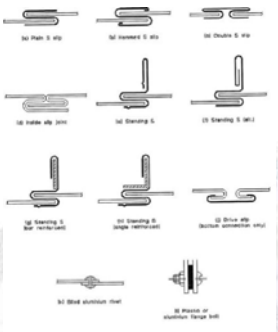
R403.3.2 Sealing

(Mandatory)

- Ducts, air handlers, AC coil, and filter boxes shall be sealed
- Joints and seams shall comply with either the *International Mechanical Code* or *International Residential Code*, as applicable



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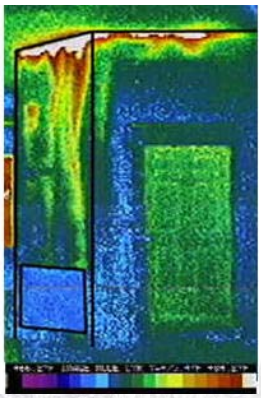
R403.3.5 Building

(Mandatory)

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

R101.4 Applicability

- Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.
- Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.



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R403.3.3 Duct Testing

(Mandatory)

Total Duct Leakage

Duct tightness shall be verified by either of the following:

Rough In Test

- ≤ 4 CFM 25 per 100 sqft of conditioned floor area
  - 2000 sqft house ≤ 80 CFM 25 total
- ≤ 3 CFM 25 per 100 sqft of conditioned floor area if air handler has not been installed
  - 2000 sqft house ≤ 60 CFM 25 total

Post Construction

- ≤ 4 CFM 25 per 100 sqft of conditioned floor area
  - 2000 sqft house ≤ 80 CFM 25 total

Exception: if the air handler and all ducts are entirely within the building thermal envelope.

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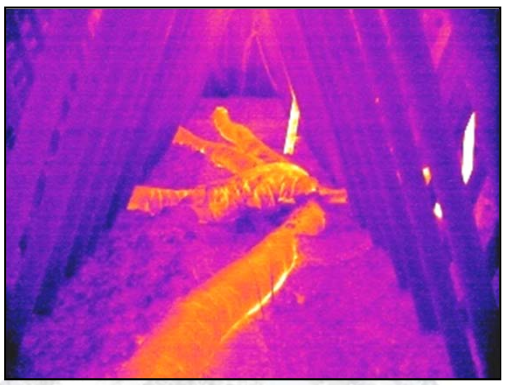
R403.3.3 Duct testing

(Mandatory)

Leakage testing required when <u>any portion</u> of ductwork is in unconditioned space

- Attic
- Unconditioned crawl space
- Isolated mechanical room
  - with natural draft appliance
- Floor over garage?
- Exterior wall?



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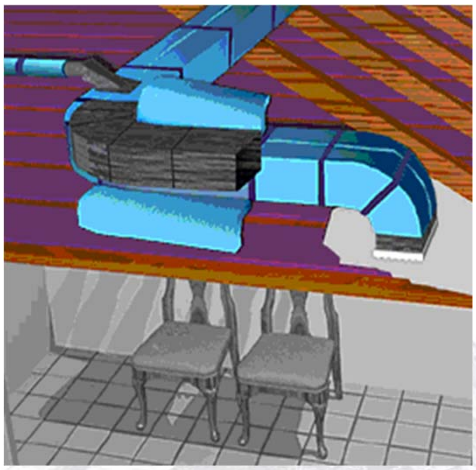
Duct Leakage to Outside

Not included in the 2012, 2015, 2018 IECC / Kinda??



Must be tested when using the performance paths of code.

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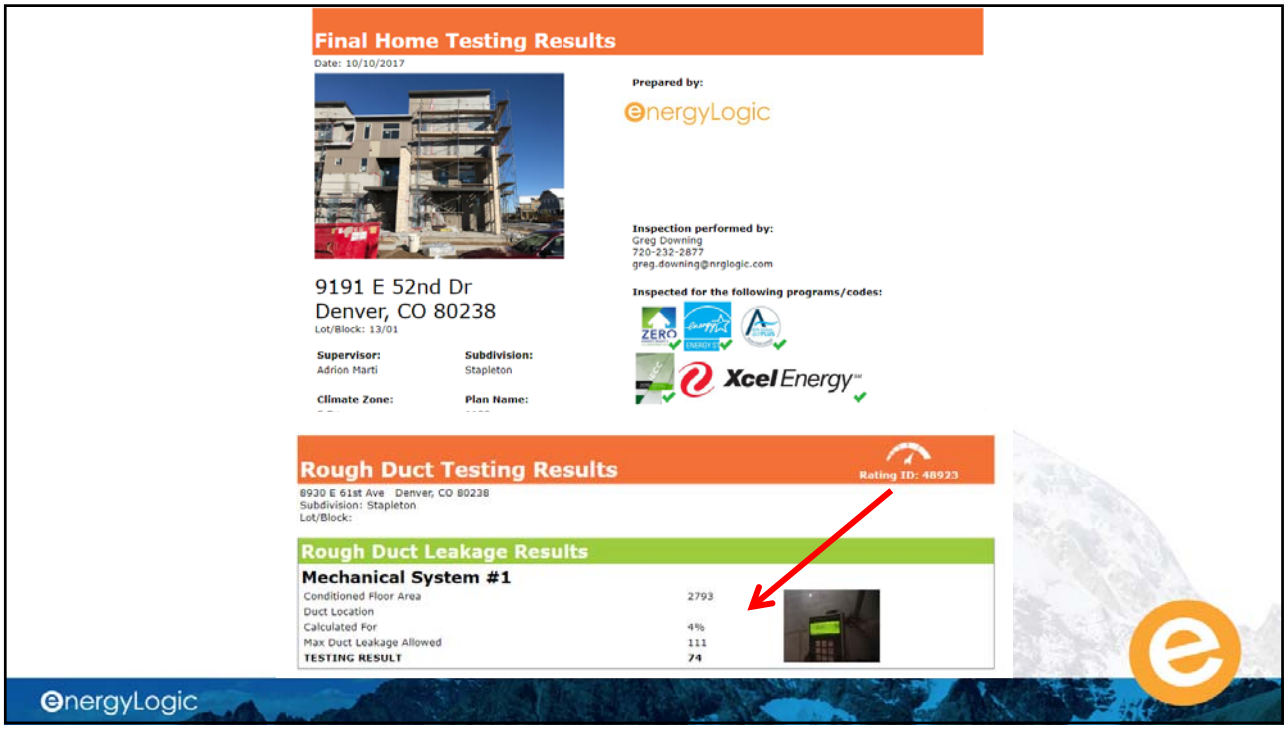

R402.4.4 Rooms Containing Fuel-Burning Appliances

- In climate zones 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel-burning appliances, the appliances and combustion air opening shall be located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope.
- **Such rooms shall be sealed** and insulated in accordance with the envelope requirements of Table N1102.1.2, where the walls, floors and ceilings shall meet a minimum of the basement wall *R*-value requirement.
- The **door into the room shall be fully gasketed** and any water lines and ducts in the room insulated in accordance with Section N1103.
- The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8.

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Conclusion

- The Energy code offers great flexibility
  - R405 Simulated Performance is the most flexible path
- Building science is embedded in Code
  - Air flow
  - Thermal flow
  - Moisture flow
  - Build tight / ventilate right
- HVAC design requires a sound thermal envelope
- The code ensures a sound thermal envelope
- Opportunity cost and consumer satisfaction to meet their core expectations

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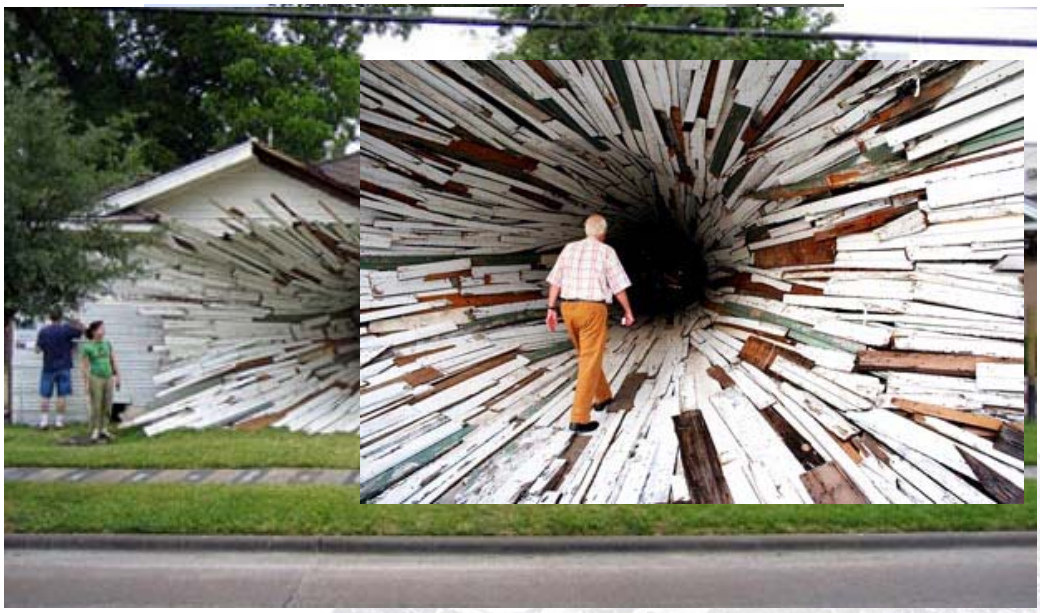

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Tunnel House

Robby Schwarz

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