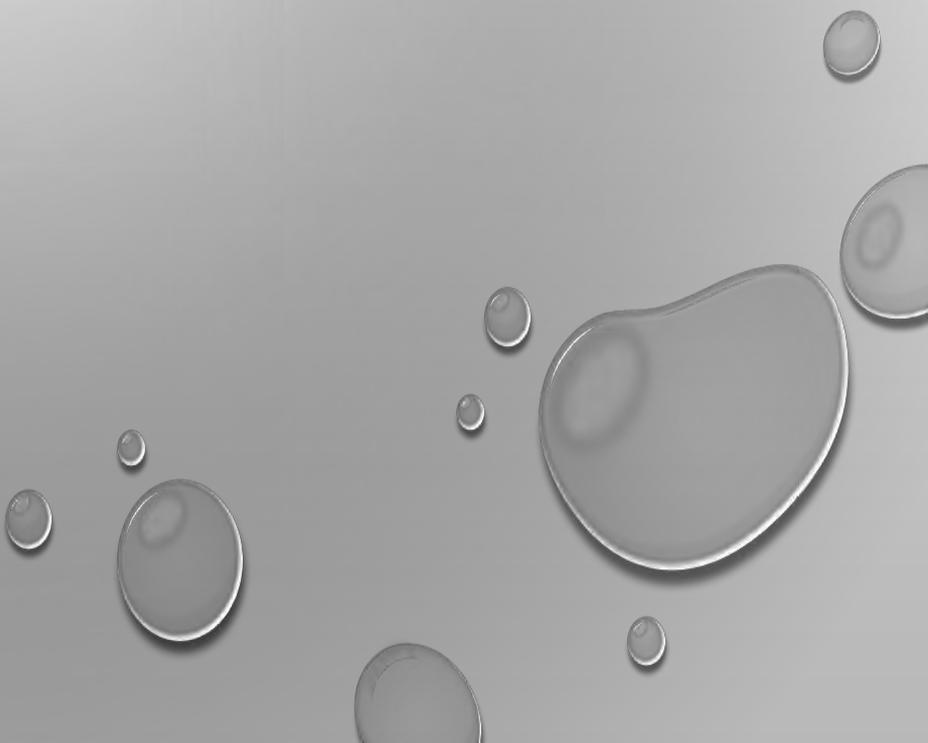




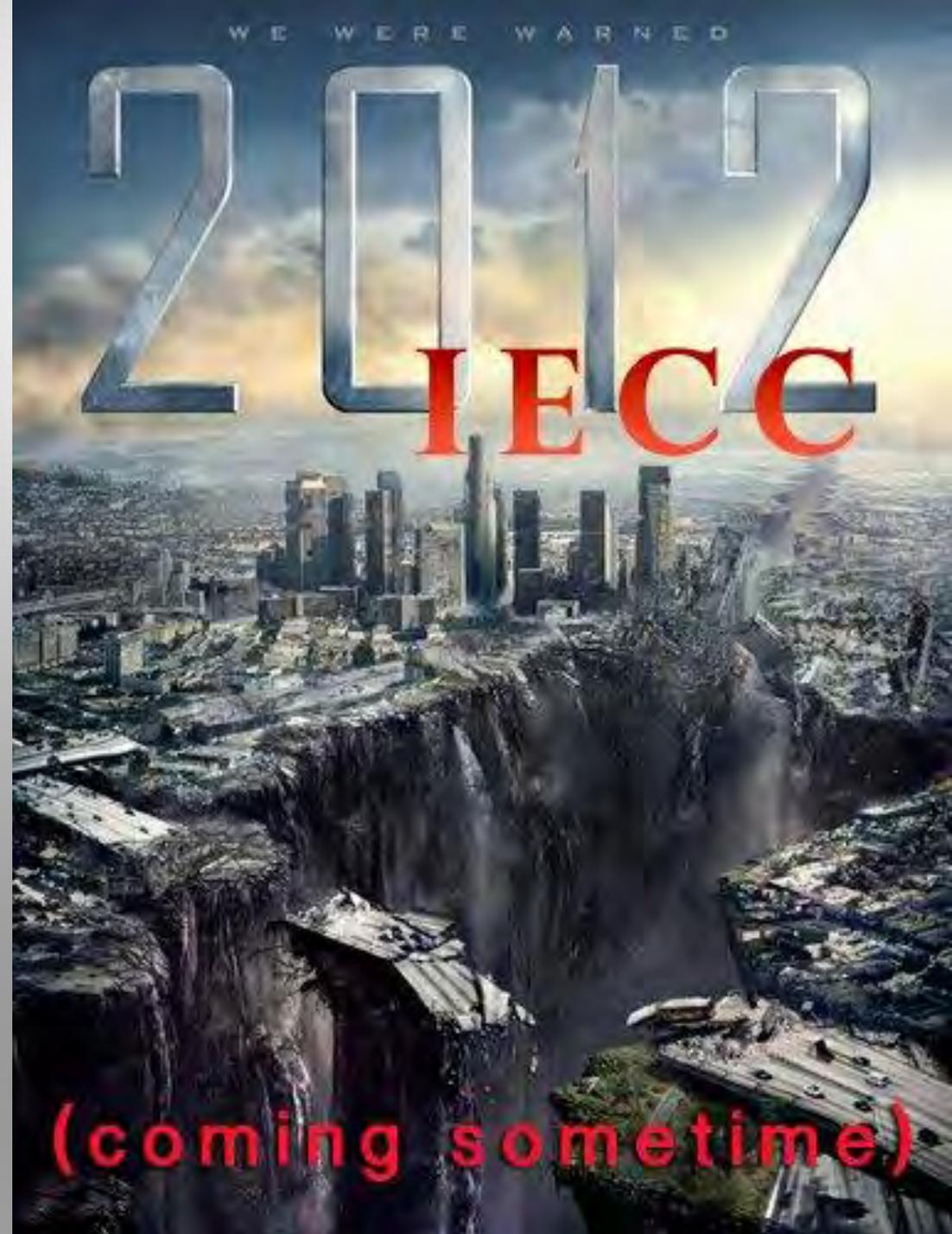
# MICHAEL BROWNE

Principal, Advanced Building Analysis, LLC

President, Energy Raters of Massachusetts, Inc.

- ✓ RESNET HERS RATER
  - ✓ USGBC GREEN RATER
  - ✓ PHIUS+ RATER
  - ✓ NGBS GREEN VERIFIER
  - ✓ ENERGY STAR HOMES RATER
- 









## What HERS Raters Help:

### Energy Code

MA Base Code  
MA Stretch Code

### Monetary Incentives

MA New Homes  
Tax credits  
Commonwealth Solar  
SREC's

### Marketing and QA

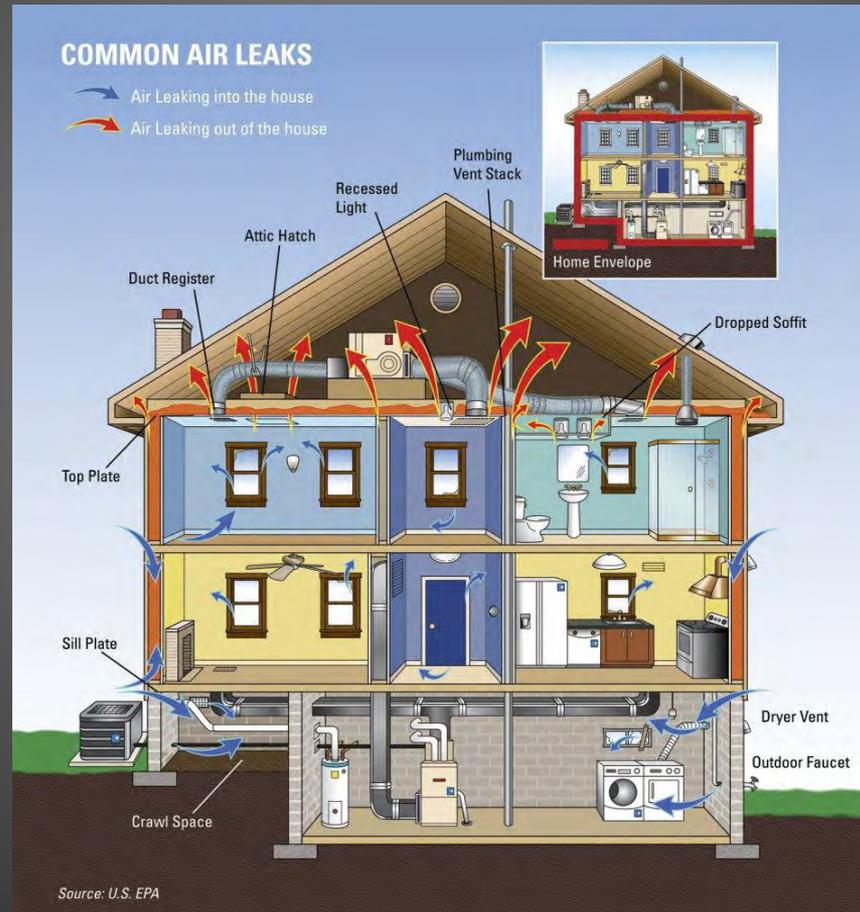
ENERGY STAR  
Homes  
National Green  
Building Standard  
LEED for Homes  
Passive House

# Infiltration Testing

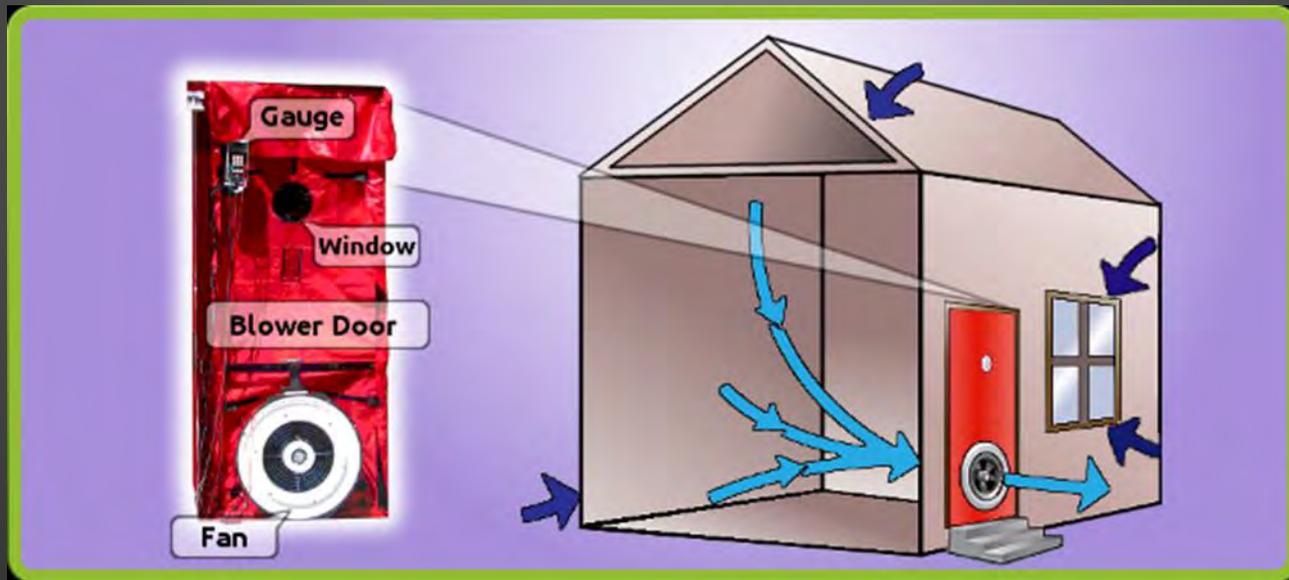
Program	Leakage to Outside
2009 IECC- Test OR	< 7ACH <sub>50</sub>
2009 IECC- Checklist	Builder self-verified
2012 IECC- Test AND	< 3ACH <sub>50</sub>
2012 IECC- Visual Checklist	Builder self-verified
Stretch Code	same as base code
MA Rebates	<0.35 ACH <sub>nat</sub> (~5ACH <sub>50</sub> )
ENERGY STAR Homes	No mandatory limit
LEED for Homes	No mandatory limit
Passive House	<0.60 ACH <sub>50</sub>

Remodelling and Additions – Requirement for infiltration testing is impractical.

# Strategies for Envelope Tightness



# Strategies for Envelope Tightness



# Strategies for Ventilation



# Strategies for Ventilation



## **Inline Exhaust Fans**

Fantech FG series inline fans give your home buyers something they really want ... quiet, energy efficient bathroom ventilation. And with these fans you won't have any call backs. They're designed for dependable, problem-free operation year after year.



## **Ventech Controls**

Fantech's new patent-pending Ventech Programmable Controls are designed to turn the exhaust fan into a continuous or intermittent low level ventilation system for the entire home. 20 minute boost feature brings fan to full speed with a touch of a button.



## **Accessories**

Fantech stocks all the accessories you need to complete your installation. 90° elbows, grilles and duct accessories like wye-adapters and wall caps.

# Combustion Appliance Testing

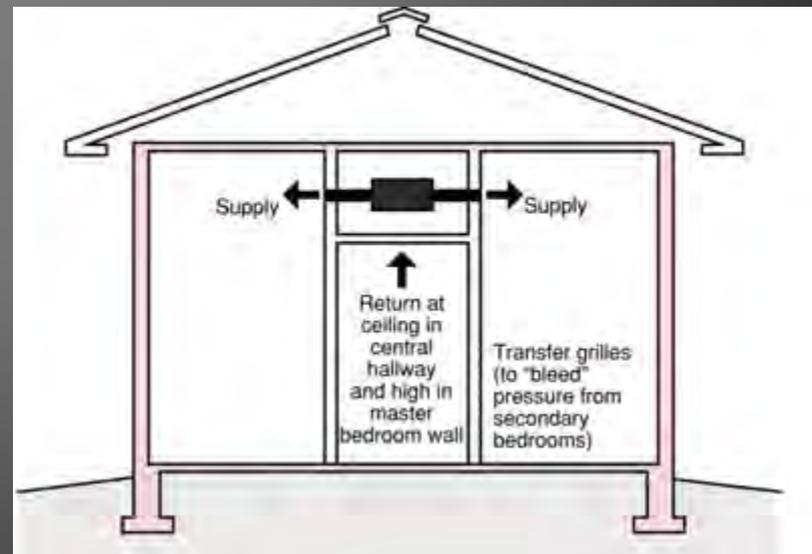
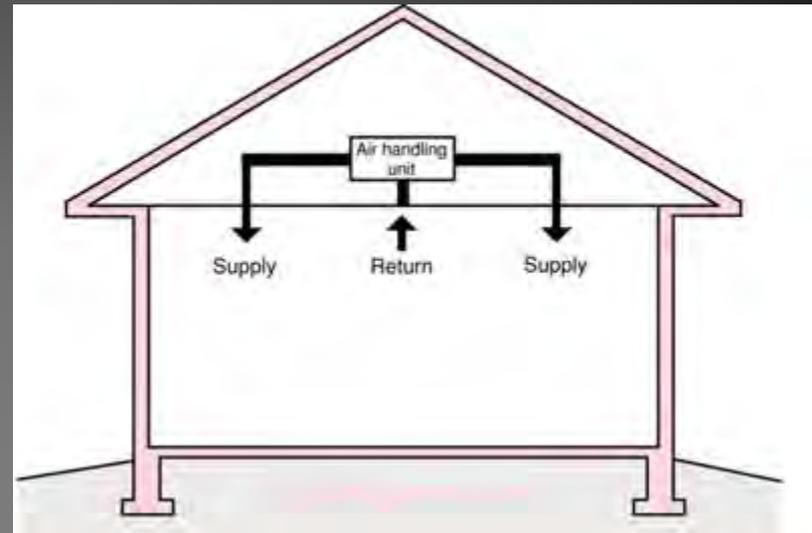
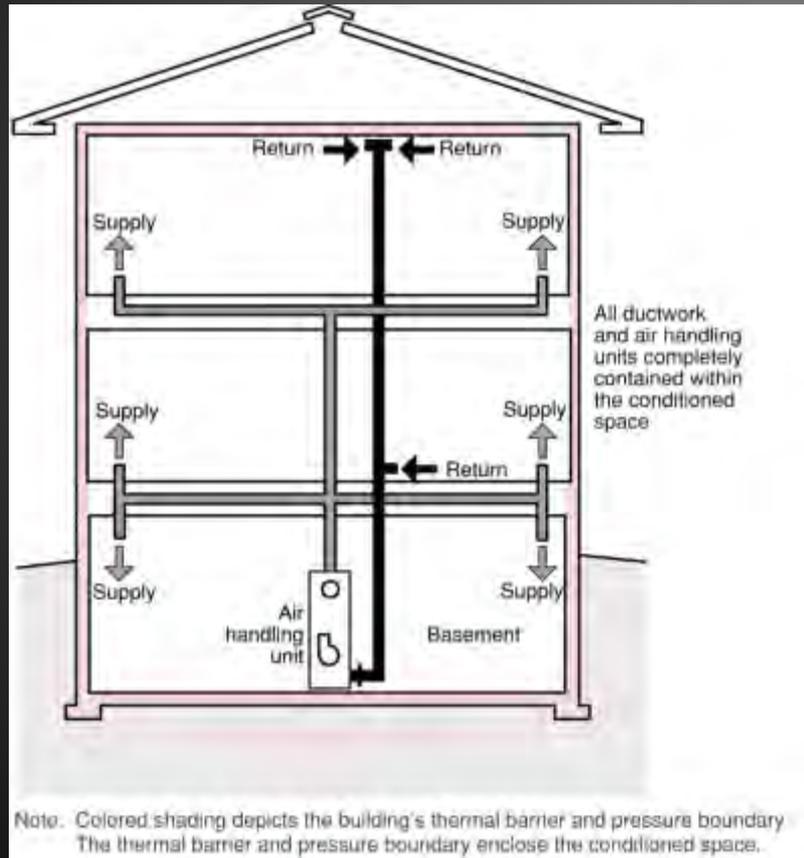


# Duct Sealing and Testing

Program	Leakage to Outside	Total Leakage
2009 IECC- Rough with Air handler	n/a	≤4%
2009 IECC- Rough without Air handler	n/a	≤6%
2009 IECC- Final	≤8%	≤12%
2012 IECC- Rough or Final	n/a	≤4% (≤3% w/o air handler)
Stretch Code	same as base code	same as base code
MA Rebates	≤6% Mandatory	n/a
ENERGY STAR Homes	≤4% Mandatory	<8% Mandatory
LEED for Homes	≤6% Mandatory	n/a
Passive House	n/a	n/a

2012 IECC : Building framing cavities shall not be used as ducts or plenums. (R403.2.3)

# Duct Location?



# Prescriptive Requirements

- **Prescriptive** OR **Performance** path may be chosen in Base Code Community
- **Prescriptive** Path may not be used in the Stretch Code Communities
- 3 **Prescriptive** alternatives to insulation
  1. Insulation R-values
  2. Assembly U-values
  3. Overall UA Calculation (RESCheck without Mechanicals)

# HERS Rating Process

1. Preliminary HERS Rating before issuance of Construction Permit
2. Insulation inspections for Thermal Bypasses and RESNET “Insulation grading”
3. Final Inspections including:
  - Infiltration, Duct, and Ventilation Testing,
  - Verification of all installed energy related features
4. Final HERS Rating before issuance of Occupancy Permit.

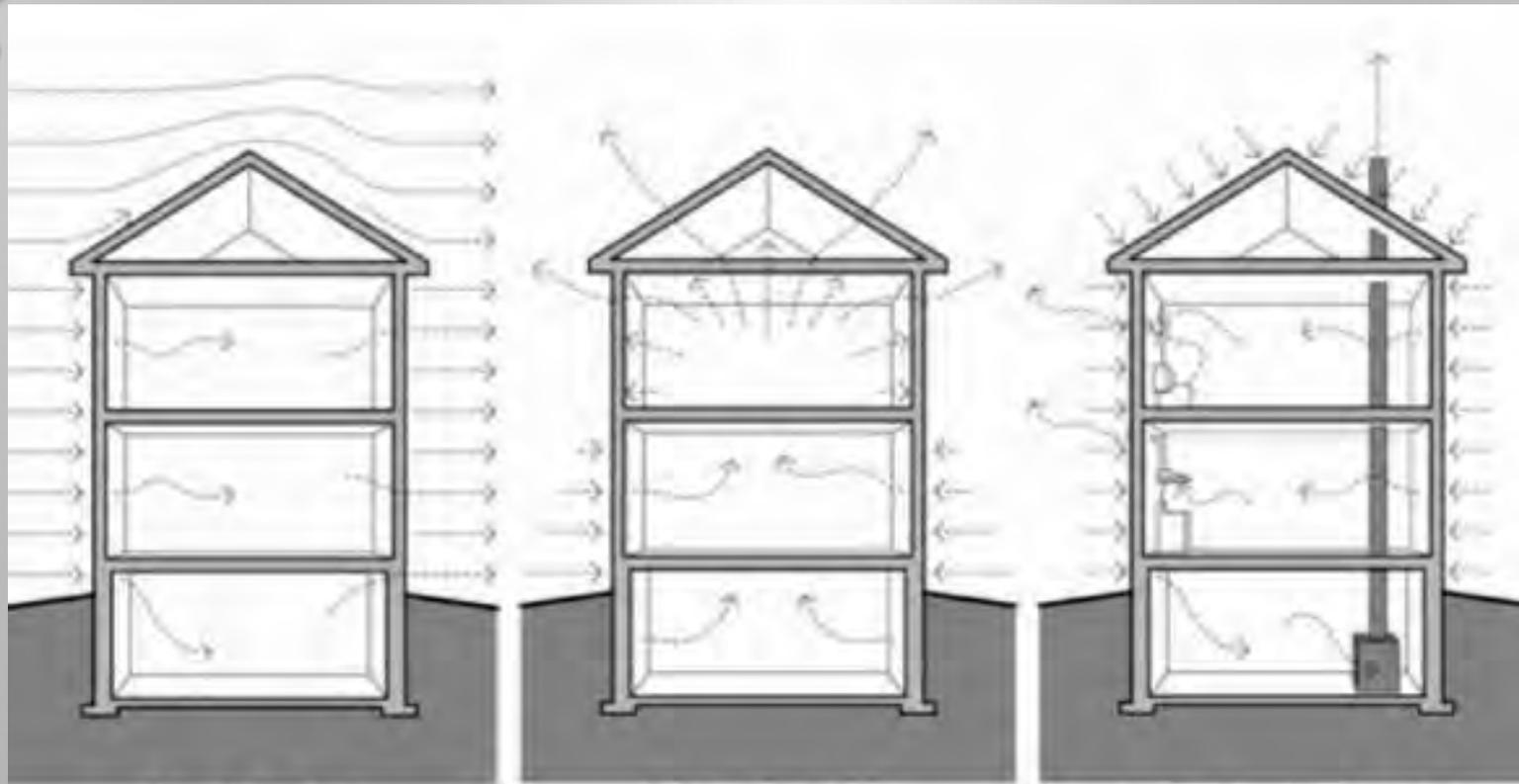
U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

# Air Leakage GUIDE





**Wind Effect**

**Stack Effect**

**Combustion and Ventilation**

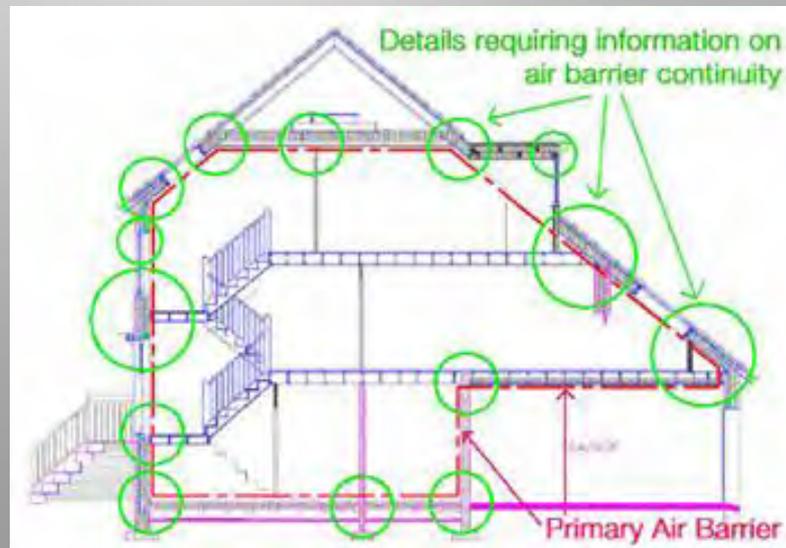
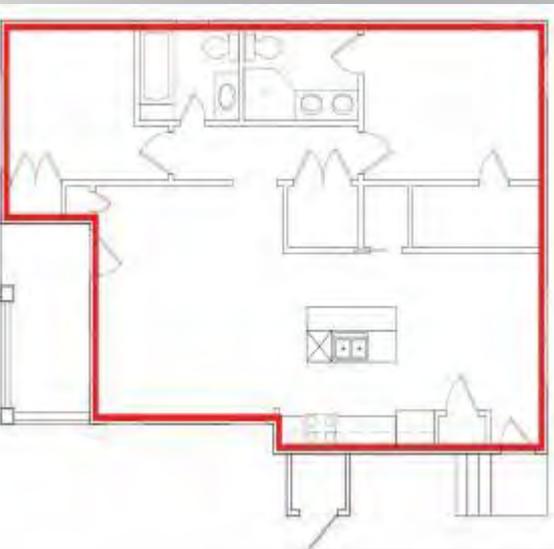
T: Examples of infiltration. Image courtesy: Building Science Corporation, [www.buildingscience.com](http://www.buildingscience.com)

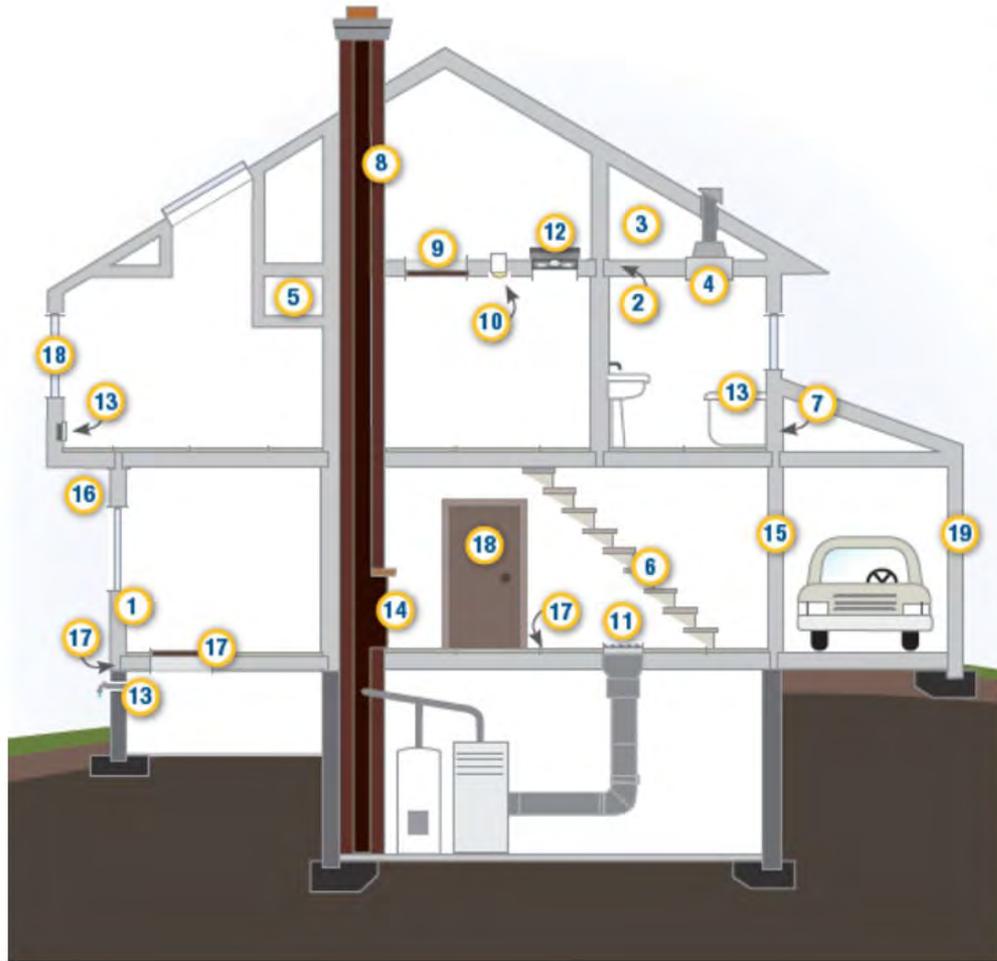
### A tight house will:

- » Have lower heating bills due to less heat loss
- » Have fewer drafts and be more comfortable
- » Reduce the chance of mold and rot because moisture is less likely to enter and become trapped in cavities
- » Have a better performing ventilation system
- » Potentially require smaller heating and cooling equipment capacities.

# IECC DEFINITION

AIR BARRIER: MATERIAL(S) ASSEMBLED AND JOINED TOGETHER TO PROVIDE A BARRIER TO AIR LEAKAGE THROUGH THE BUILDING ENVELOPE. AN AIR BARRIER MAY BE A SINGLE MATERIAL OR A COMBINATION OF MATERIALS





## Air Sealing Trouble Spots

- 1 Air Barrier and Thermal Barrier Alignment
- 2 Attic Air Sealing
- 3 Attic Kneewalls
- 4 Shaft for Piping or Ducts
- 5 Dropped Ceiling/Soffit
- 6 Staircase Framing at Exterior Wall
- 7 Porch Roof
- 8 Flue or Chimney Shaft
- 9 Attic Access
- 10 Recessed Lighting
- 11 Ducts
- 12 Whole-House Fan
- 13 Exterior Wall Penetrations
- 14 Fireplace Wall
- 15 Garage/Living Space Walls
- 16 Cantilevered Floor
- 17 Rim Joists, Sill Plate, Foundation, Floor
- 18 Windows & Doors
- 19 Common Walls Between Attached Dwelling Units

Table R402.4.1.1 (2012 IECC). Air Barrier and Insulation Installation\*

COMPONENT	CRITERIA*
Air barrier and thermal barrier	<p>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. Air-permeable insulation shall not be used as a sealing material.</p>
Ceiling/attic	<p>The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.</p>
Walls	<p>Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed.</p> <p>The junction of the top plate and top of exterior walls shall be sealed.</p> <p>Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</p> <p>Knee walls shall be sealed.</p>
Windows, skylights and doors	<p>The space between window/door jambs and framing and skylights and framing shall be sealed.</p>
Rim joists	<p>Rim joists shall be insulated and include the air barrier.</p>
Floors (including above-garage and cantilevered floors)	<p>Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.</p>
Crawl space walls	<p>Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawl space walls. Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</p>

<b>Shafts, penetration</b>	Duct shafts, utility penetrations and flue shafts opening to exterior or unconditioned space shall be sealed.
<b>Narrow cavities</b>	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.
<b>Garage separation</b>	Air sealing shall be provided between the garage and conditioned spaces.
<b>Recessed lighting</b>	Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and sealed to the drywall.
<b>Plumbing and wiring</b>	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.
<b>Shower/tub on exterior wall</b>	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.
<b>Electrical/phone box on exterior walls</b>	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.
<b>HVAC register boots</b>	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.
<b>Fireplace</b>	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.

In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.



**Achieving Grade 1 Insulation with  
fiberglass batts**

<http://www2.owenscorning.com/literature/pdfs/GradeOneWithFiberglassBatts.pdf>



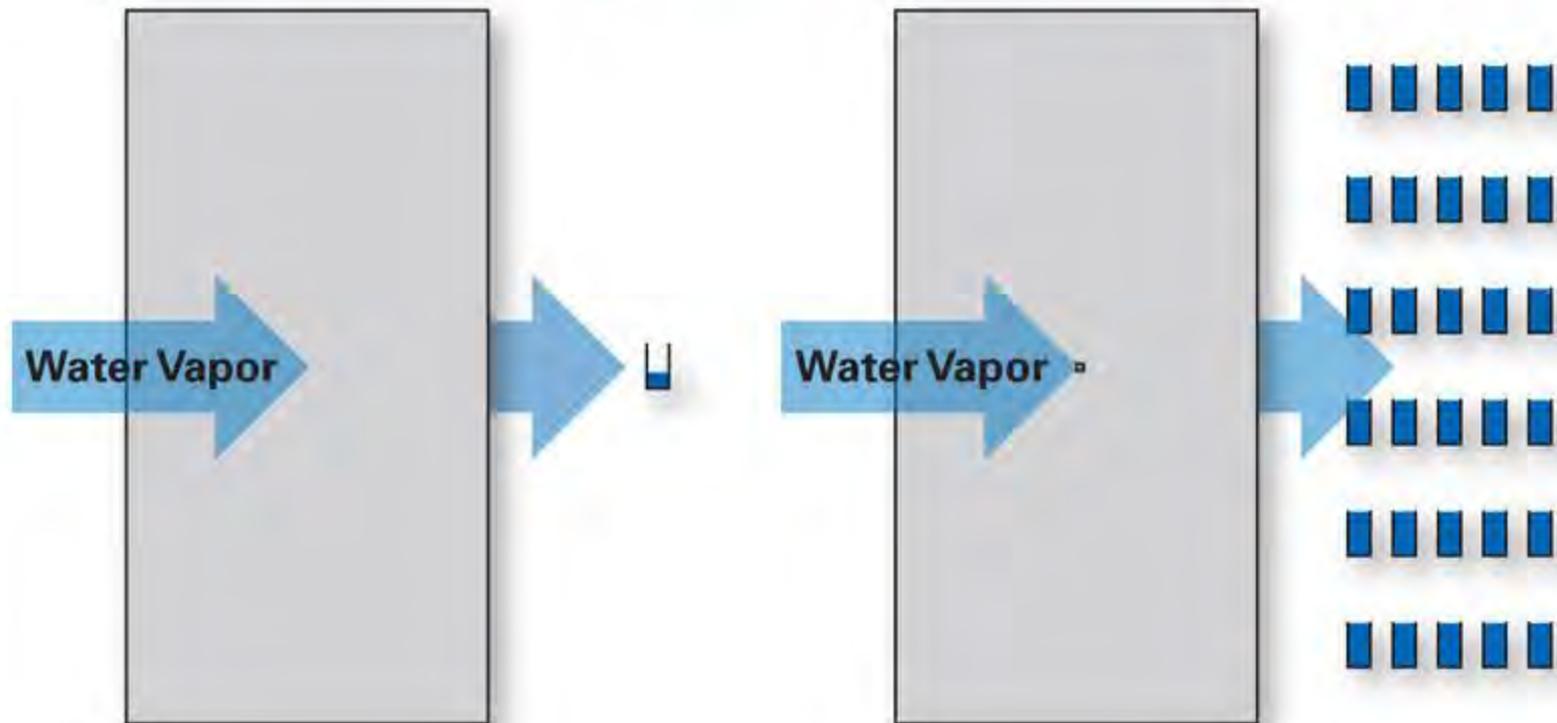




# REDUCED THERMAL BRIDGING



# Air Leakage & Moisture

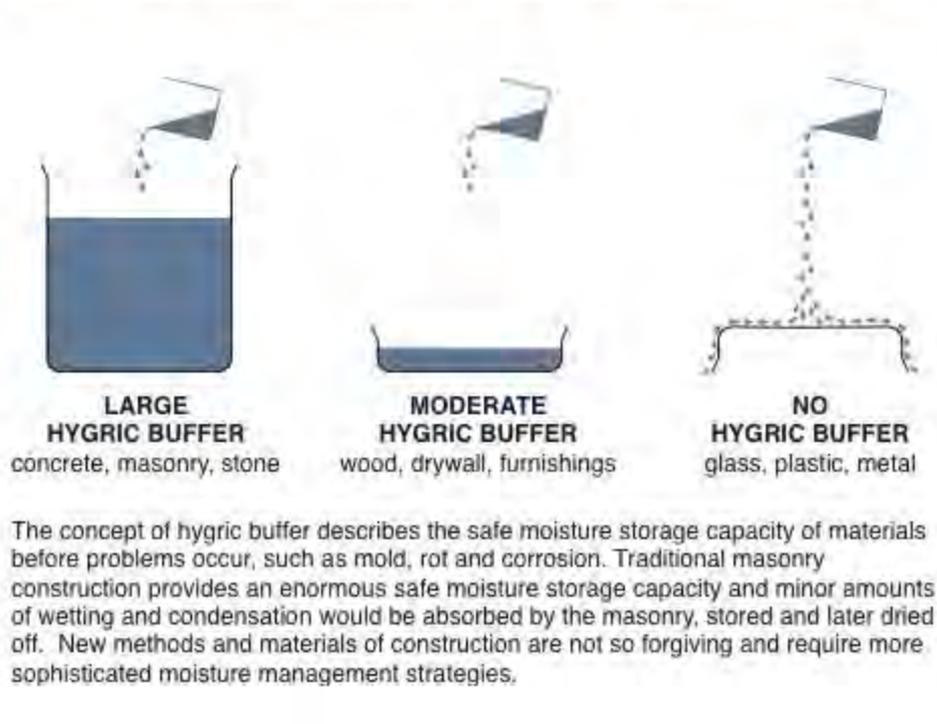


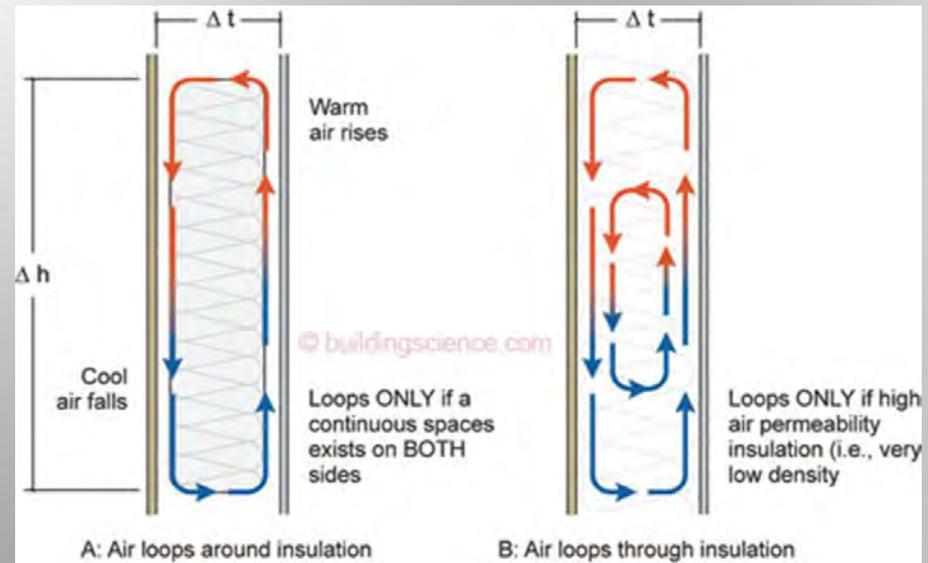
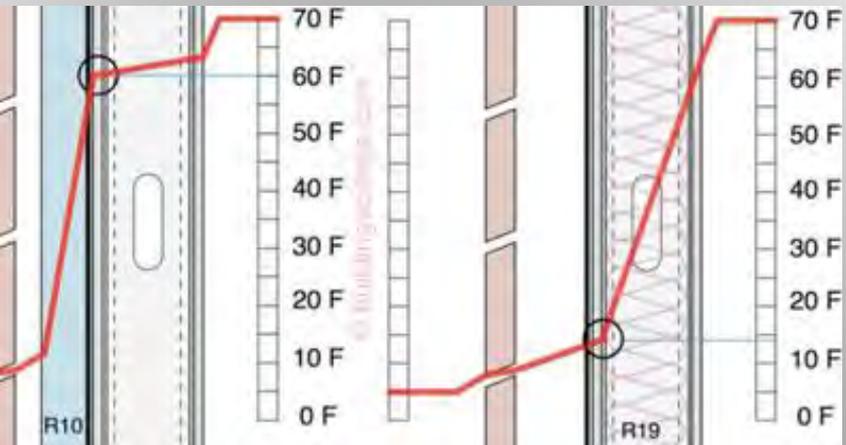
**Only  $\frac{1}{3}$  quart of water vapor is transmitted through a 4- by 8-foot sheet of gypsum board during a typical heating season (left). But with a 1-square-inch open gap (right), more than 30 quarts of water vapor will be transmitted.**

### Hygic Buffer Capacity for 2,000 ft<sup>2</sup> (186 m<sup>2</sup>) Home

Steel Frame with Gypsum Sheathing	Approx. 5 gallons (19 L)
Wood Frame with Wood Sheathing	Approx. 50 gallons (189 L)
Masonry Wall	Approx. 500 gallons (1892 L)

[Source: J. Lstiburek. *Moisture Control in Buildings*. ASHRAE Journal, February 2002, pp. 36-41.]





## 63: Controlling Cold-Weather Condensation Using Insulation

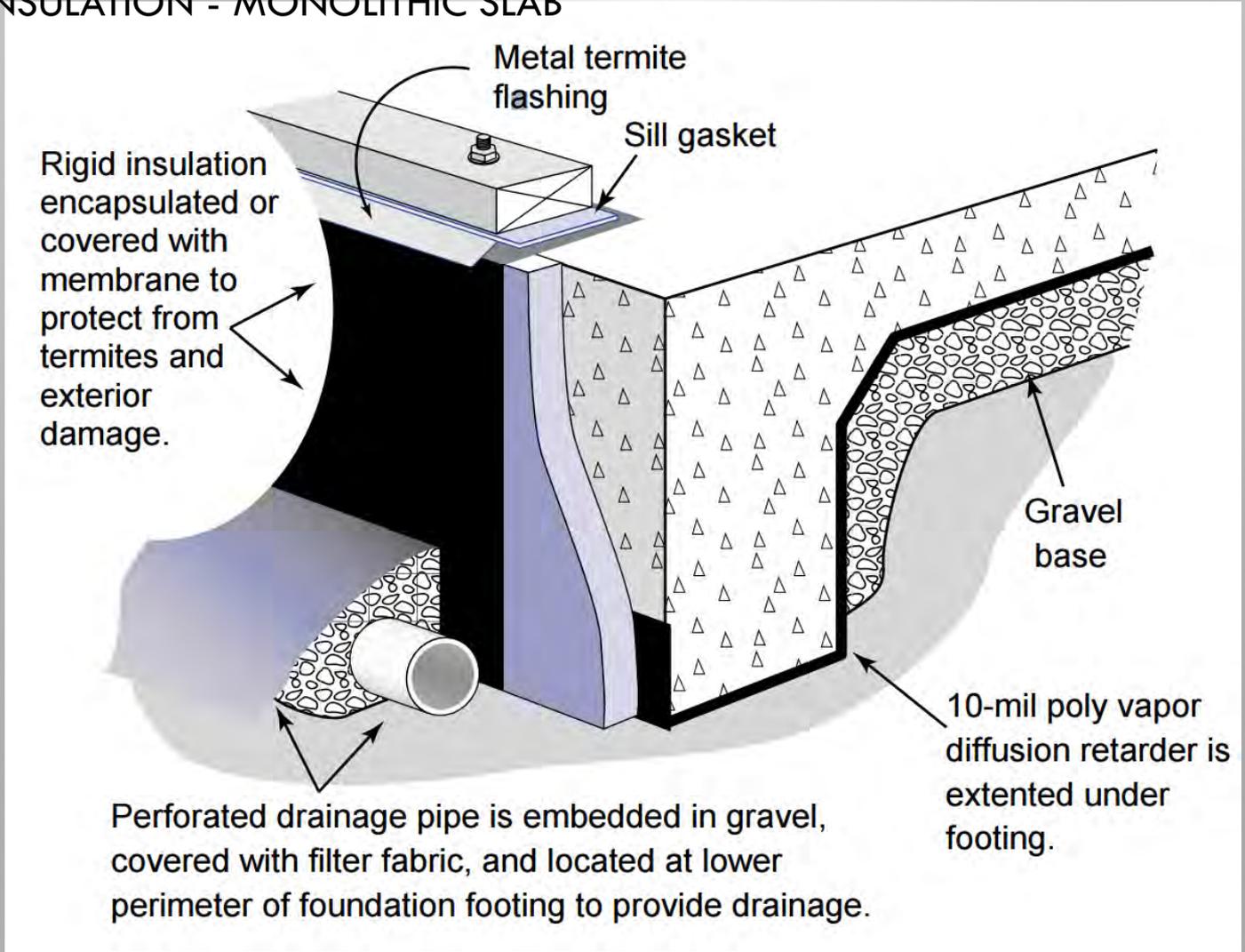
in Straube

Slab-on-grade (including slabs <12 inches below grade)

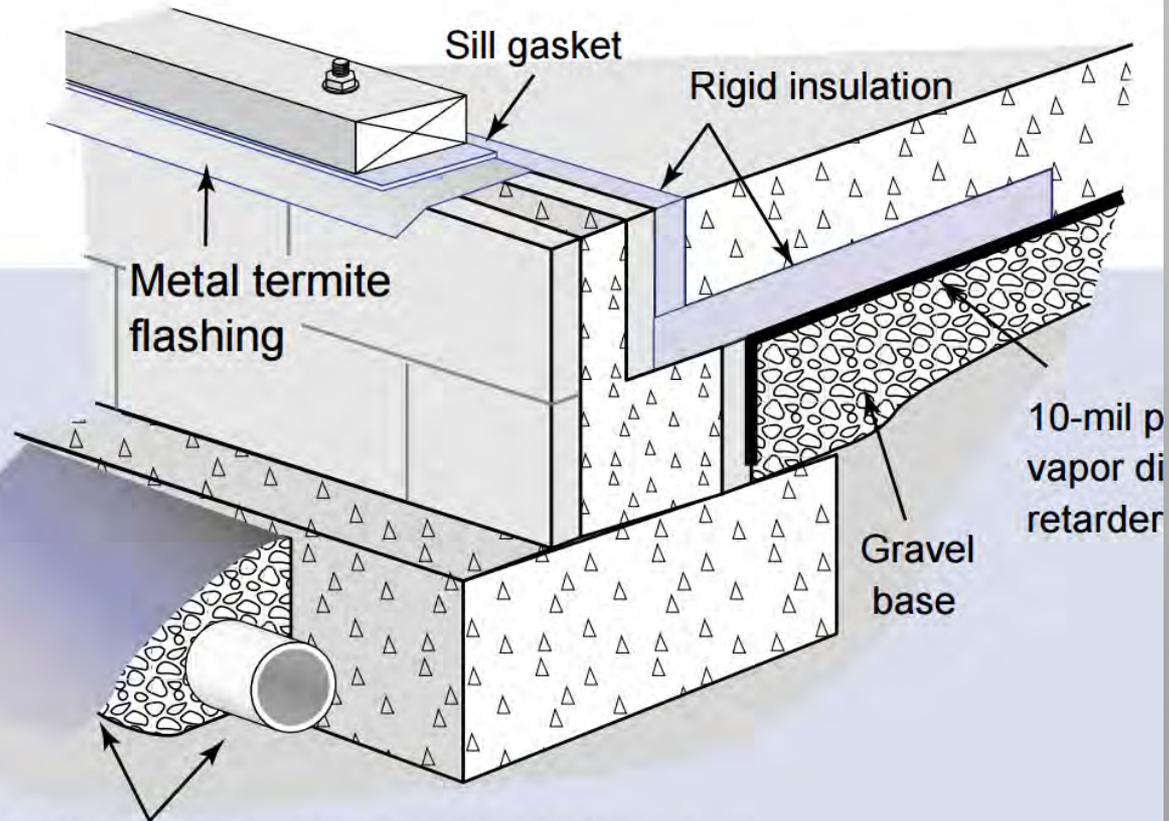
IECC Prescriptive Requirement - R10 Insulation 2' from the top of the slab



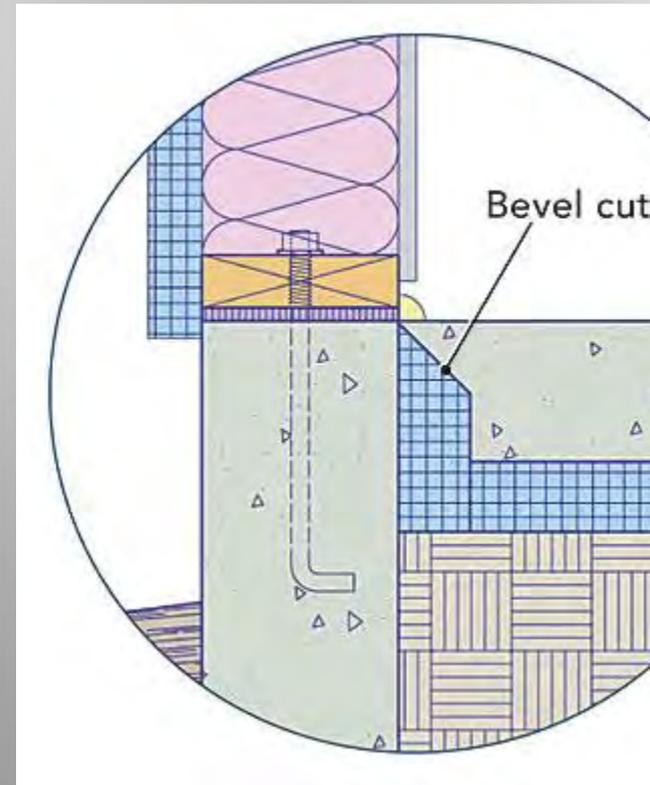
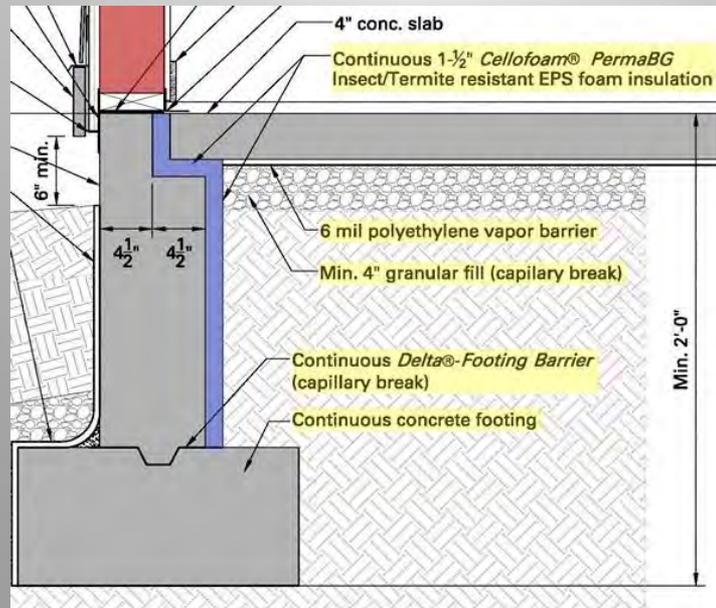
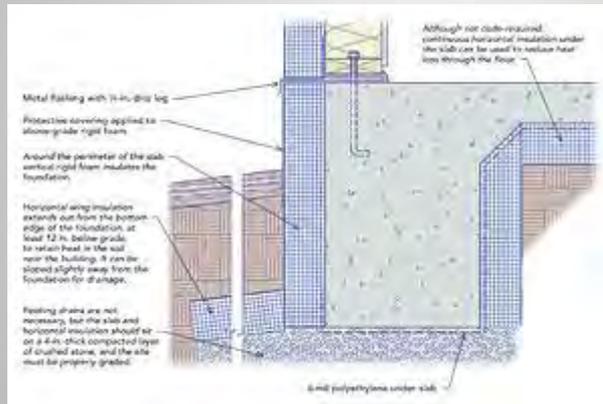
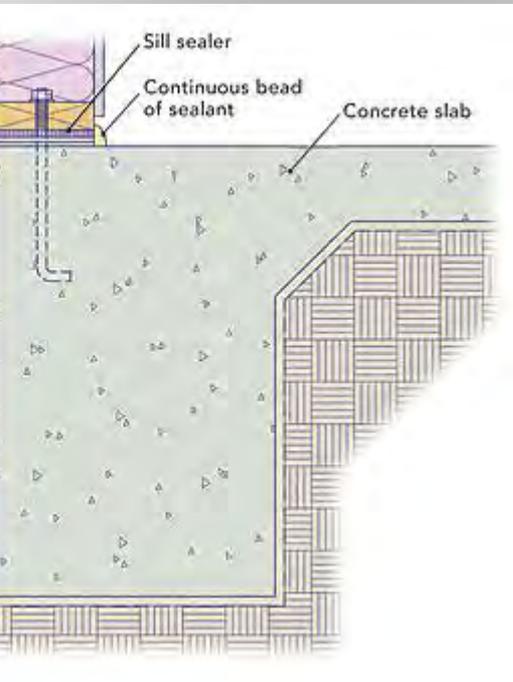
# PERIMETER INSULATION - MONOLITHIC SLAB



## PERIMETER INSULATION - FLOATING SLAB-ON-GRADE CONSTRUCTION



Perforated drainage pipe is embedded in gravel, covered with filter fabric, and located at lower perimeter of foundation footing to provide drainage.



[www.homebuilding.com/how-to/departments/building-skills/insulating-a-slab-on-grade.aspx](http://www.homebuilding.com/how-to/departments/building-skills/insulating-a-slab-on-grade.aspx)

[energypros.lbl.gov/group/bestpracticesresidential/forum/topics/designing-for-high-slab-on-grade-part-i-controlling?xg\\_source=activity](http://energypros.lbl.gov/group/bestpracticesresidential/forum/topics/designing-for-high-slab-on-grade-part-i-controlling?xg_source=activity)

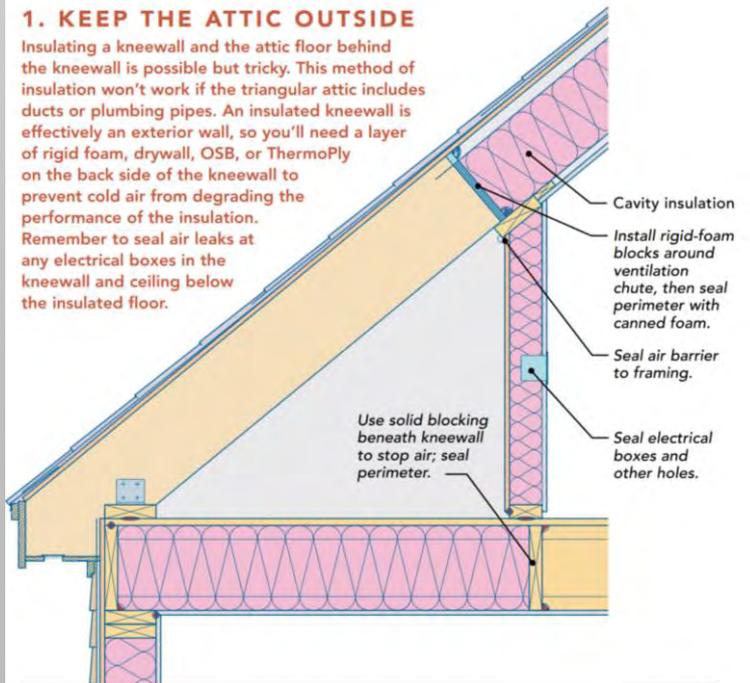
# ROOF/CEILING INSULATION STRATEGIES

## Two Ways to Insulate Attic Kneewalls by Martin Holladay

Read more: <http://www.finehomebuilding.com/how-to/departments/energy-smart-detwo-ways-to-insulate-attic-kneewalls.aspx#ixzz3VstKYzHF>

### 1. KEEP THE ATTIC OUTSIDE

Insulating a kneewall and the attic floor behind the kneewall is possible but tricky. This method of insulation won't work if the triangular attic includes ducts or plumbing pipes. An insulated kneewall is effectively an exterior wall, so you'll need a layer of rigid foam, drywall, OSB, or ThermoPly on the back side of the kneewall to prevent cold air from degrading the performance of the insulation. Remember to seal air leaks at any electrical boxes in the kneewall and ceiling below the insulated floor.



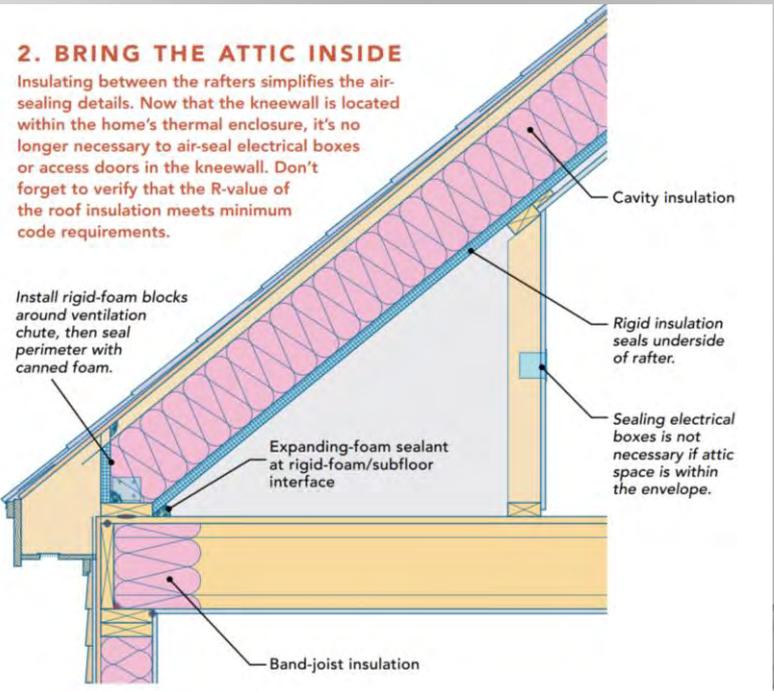
### 2. BRING THE ATTIC INSIDE

Insulating between the rafters simplifies the air-sealing details. Now that the kneewall is located within the home's thermal enclosure, it's no longer necessary to air-seal electrical boxes or access doors in the kneewall. Don't forget to verify that the R-value of the roof insulation meets minimum code requirements.

Install rigid-foam blocks around ventilation chute, then seal perimeter with canned foam.

Expanding-foam sealant at rigid-foam/subfloor interface

Band-joint insulation



THANKS. Questions?

