

DOE Zero Energy Ready Home

U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy

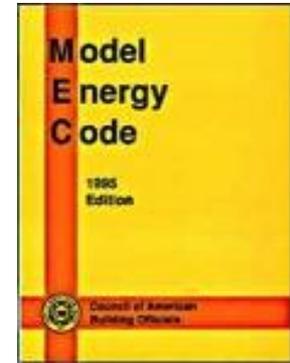
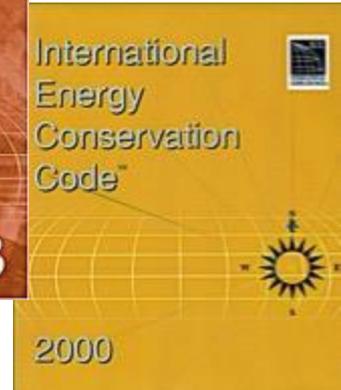
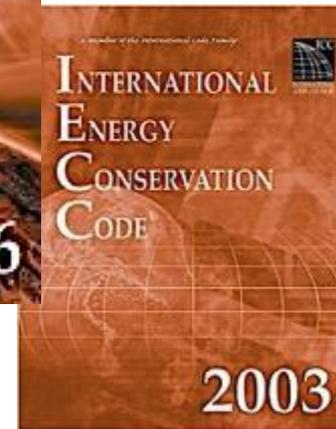
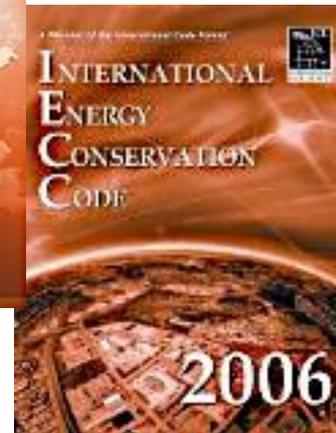
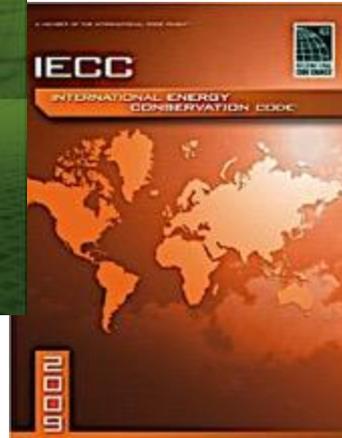
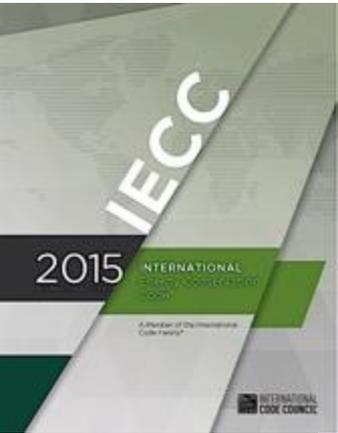


2015 IECC and DOE Zero
Energy Ready Home

Wednesday, July 19 2017

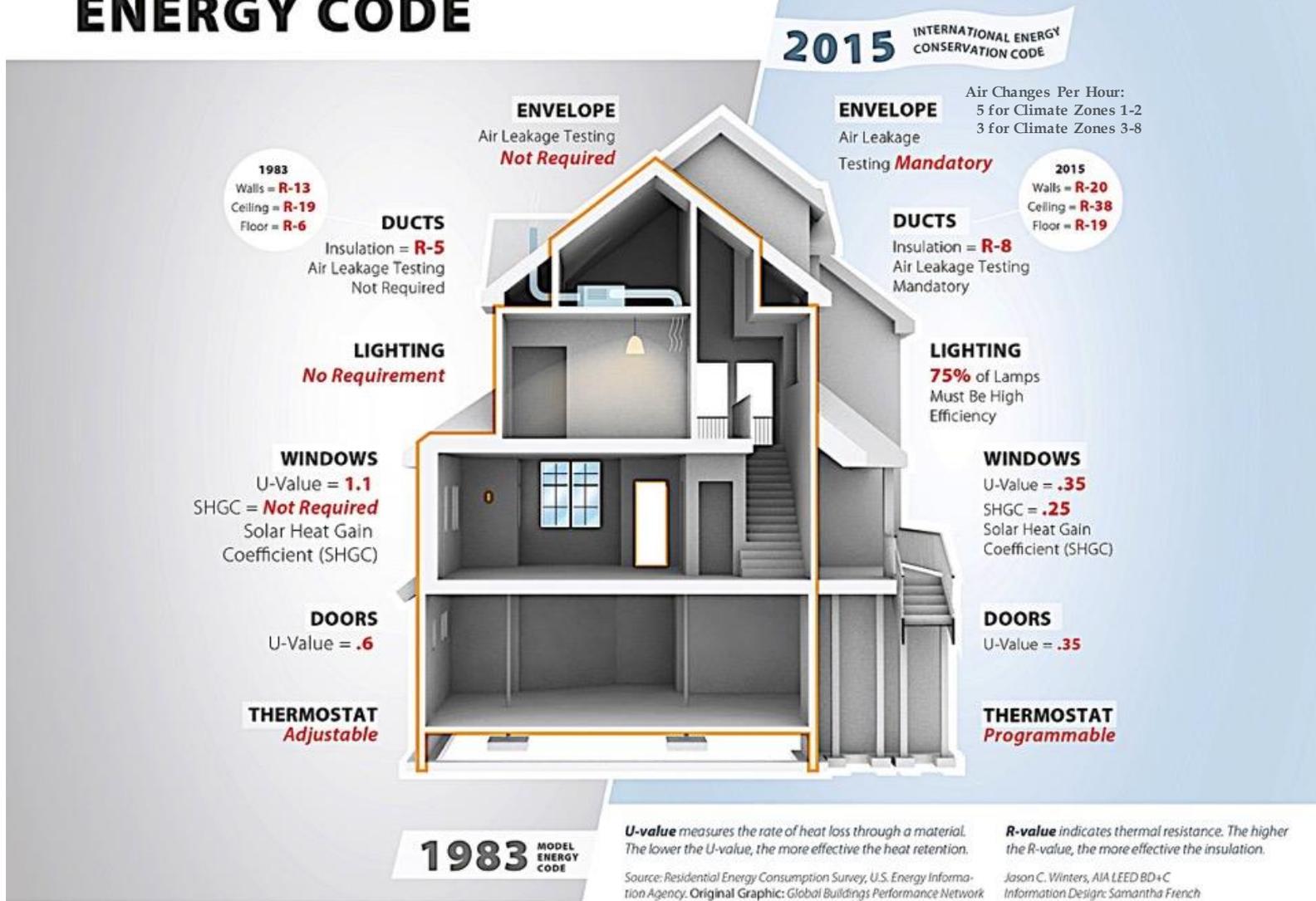
1:30-2:30 pm

The IECC 2015 was published in May of 2014



Evolution of Energy Use

Then & Now 1983-2015 ENERGY CODE



U-value measures the rate of heat loss through a material. The lower the U-value, the more effective the heat retention.

R-value indicates thermal resistance. The higher the R-value, the more effective the insulation.

Source: Residential Energy Consumption Survey, U.S. Energy Information Agency. Original Graphic: Global Buildings Performance Network

Jason C. Winters, AIA LEED BD+C
Information Design: Samantha French

IECC Residential Provisions R-1

Chapter 1	Scope & Administration
Chapter 2	Definitions
Chapter 3	General Requirements
Chapter 4	Residential Energy Efficiency
Chapter 5	Existing Buildings
Chapter 6	Reference Standards

All Mandatory Items

+

Performance

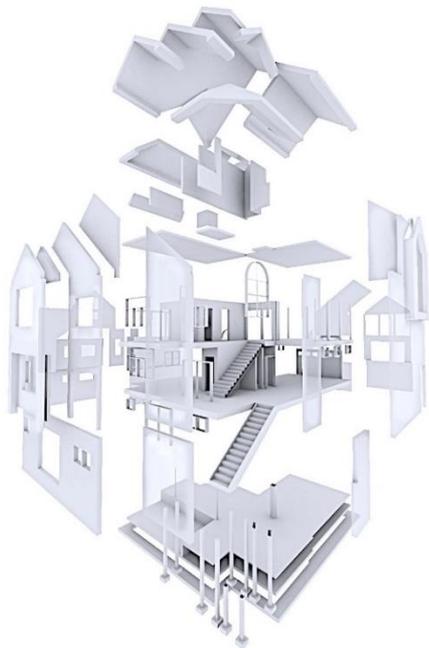
Section R405

ERI Analysis

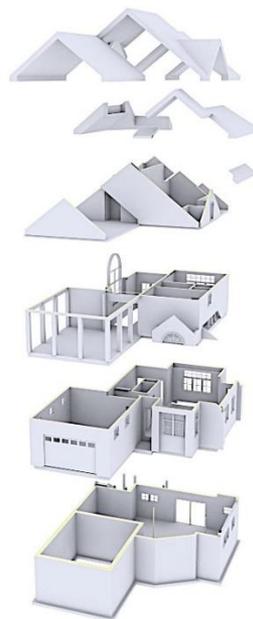
Section R406

Prescriptive

Sections R402-R404



Limited Flexibility



Some Flexibility



Maximum Flexibility

Mandatory Items

Certificate

Duct Sealing

Efficient Lighting

Air Barrier

Duct Testing

Some Controls

Air Tightness Test
and Target

Mechanical Pipe
Insulation

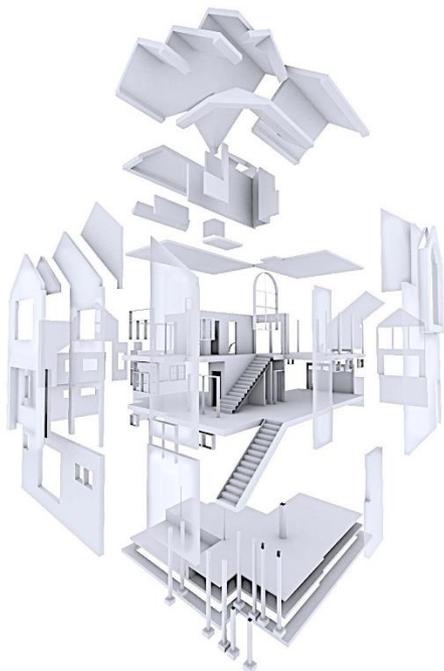
Some Controls

Maximum
Window U &
SGHC

Mechanical
Ventilation

Manual J &
Manual S

**Mandatory
Items
+
Prescriptive
Sections R402-R404**



Limited Flexibility

Insulation

- Assembly U-factor Alternative
- Whole Building UA
- Type of Insulation
- Other Specific Exceptions

Windows

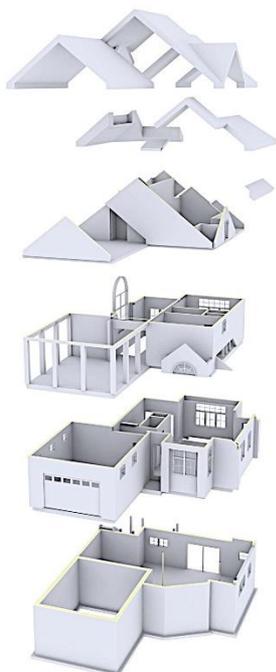
- Area-Weighted U-Factor
- Area Weighted SHGC
- Decorative Glass/Dynamic Glazing

Duct Insulation

- Varies by Location
- Varies by Size of Duct

Mandatory Items + Performance

Section R405



Permit Application Compliance Report



CO Compliance Report



Standard Reference Design and Proposed Design Characteristics



Actual Proposed Design Values



Test Result Documentation

Can Trade off Above Minimums

- Building Air Leakage Rate
- Duct Insulation
- Duct Location

Can Trade off Above or Below – Any Prescriptive Item

- Insulation (ceiling, wall, floor, basement/slab, hot water pipe)
- Window U or SHGC
- Window Orientation
- Shading
- Window area*
- Roof Qualities
- Ventilation Efficiency
- Duct Leakage Rate
- A few other items

No Credit Given for Above Minimums

- Heating Equipment
- Cooling Equipment
- Water Heating Equipment
- Thermostat

Mandatory Items + ERI Analysis

Section R406



Requirements

ERI Achieved per Specific Climate Zone

Maximum Flexibility

Software

- Documentation that Software Meets Parameters
- 406.6.1-406.6.3

Compliance Report

- Documentation that Building Meets Required ERI
- Inspection Checklist
- Reference Design & Rated Design Results

Compliance Report Additional Documentation

- Address
- Name of Individual Completing Report
- Name and Version of Software Tool

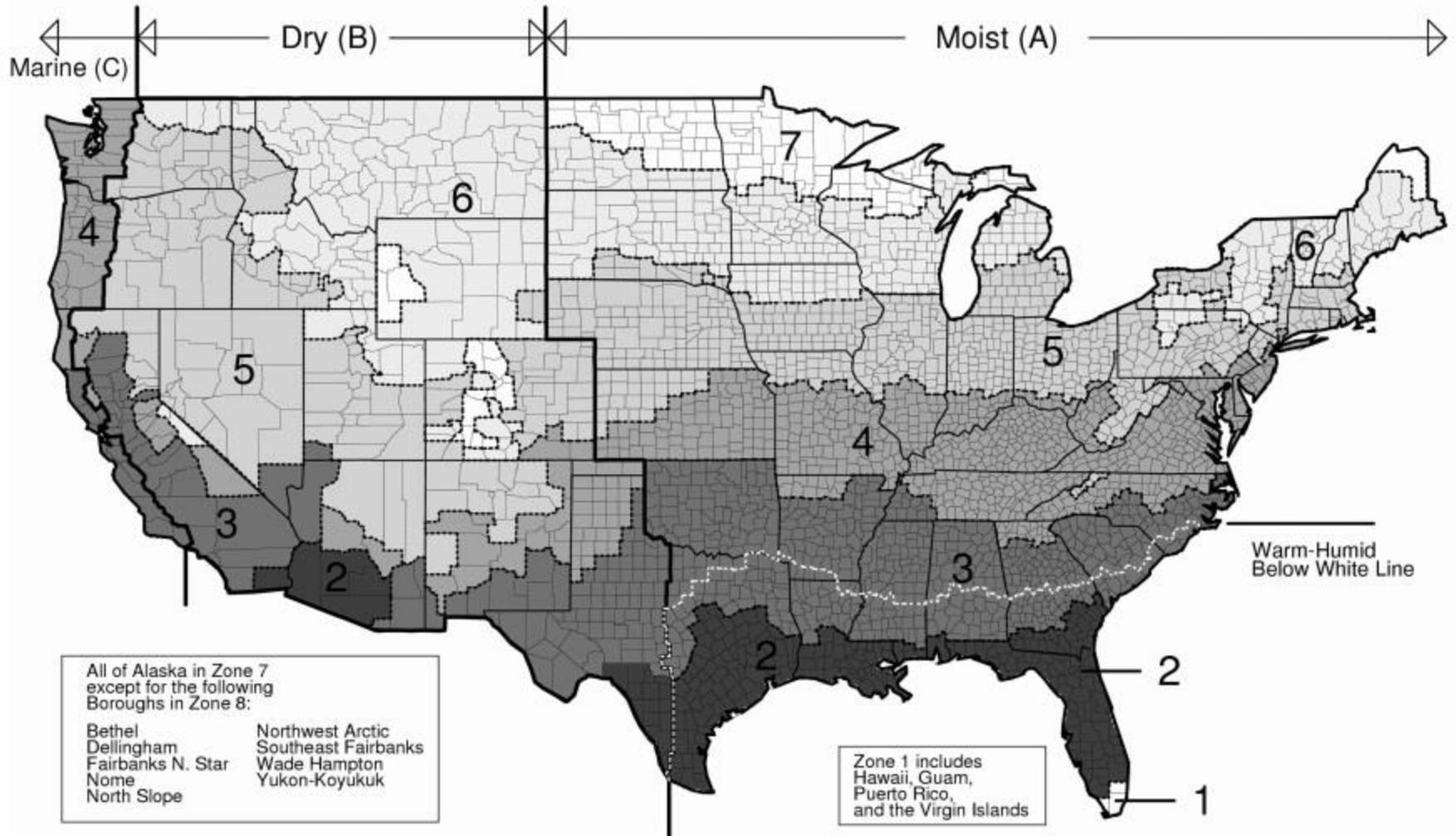
Testing

- Air Leakage Test Result Documentation
- Duct Leakage Test Result Documentation

Overview of the ERI compliance alternative:

<https://www.energycodes.gov/resource-center/training-courses/2015-iecc—energy-rating-index-eri-compliance-alternative>

Table R301 Climate Zones



Requirements by Climate Zone

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALU E & DEPTH	CRAWL SPACE ^c WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^h	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 ^h	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

TABLE R402.1.4 EQUIVALENT U-FACTORS^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

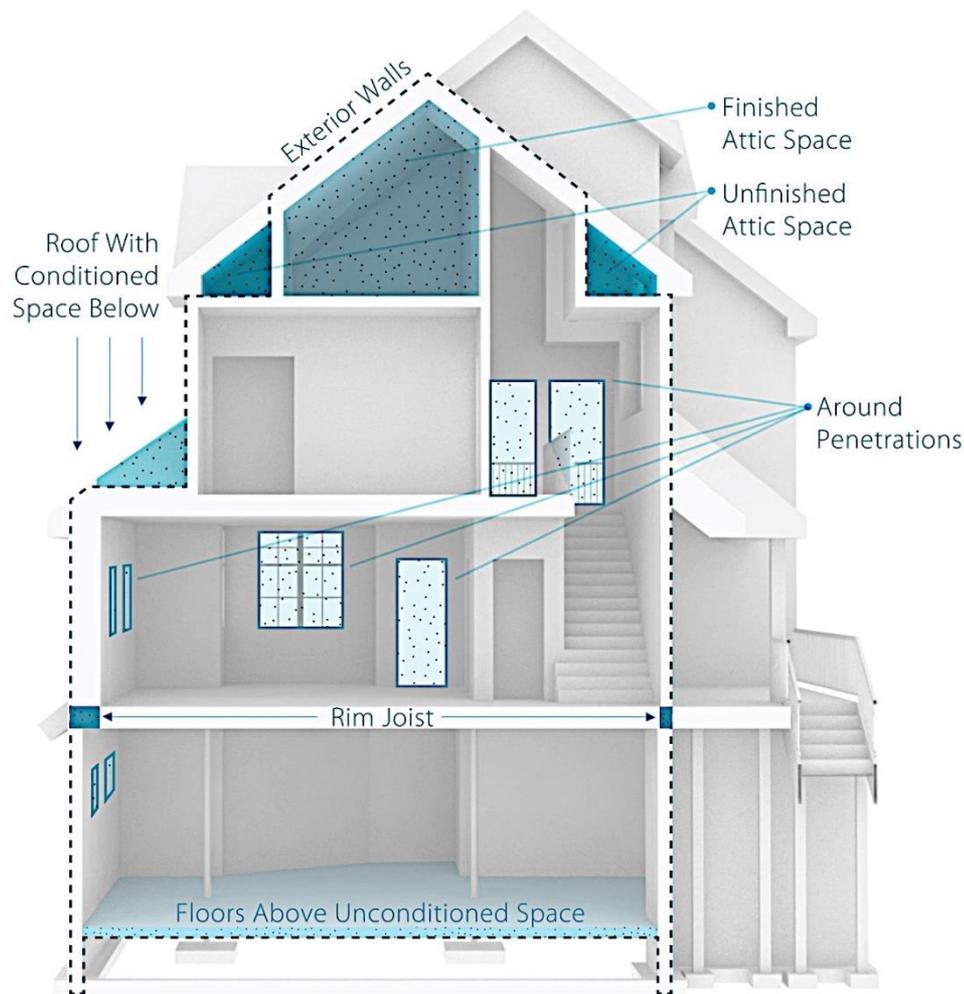
Acts as the Building's Thermal Control Layer

Should Align with the Air Control Layer

Continuous Separation of Conditioned/Unconditioned Space

Use R-Value & U-Value Tables R402.1.2 & R402.1.4

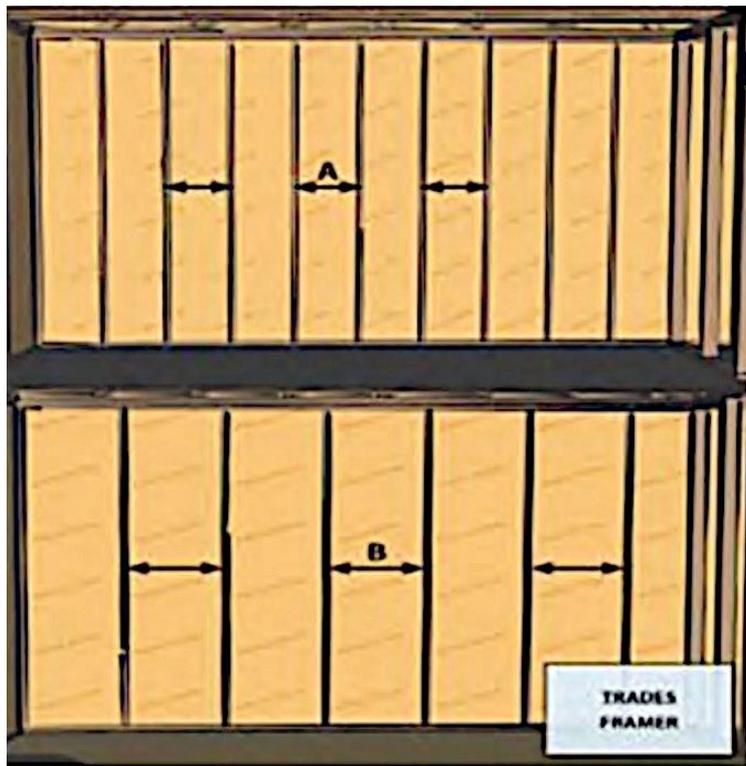
Mandatory Installation Details R402.4.1.1



Examples of **WHERE TO INSULATE**

More Framing Lowers Effectiveness of Insulation

More Framing Yields more Caulking

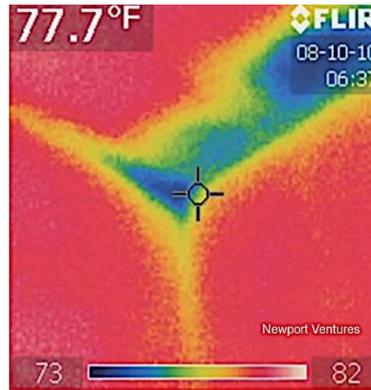


Building America Solution Center



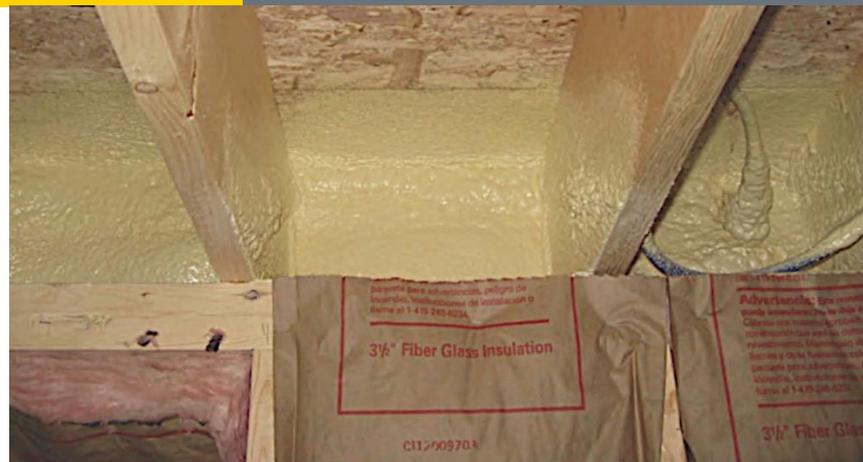
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Deficient Insulation Installations

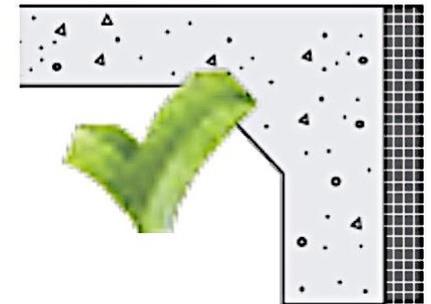
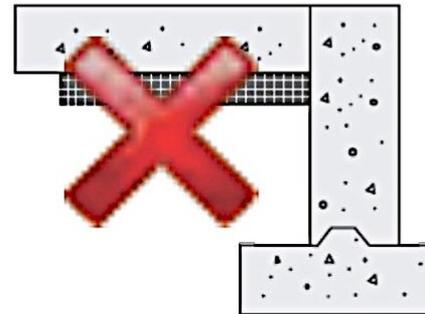
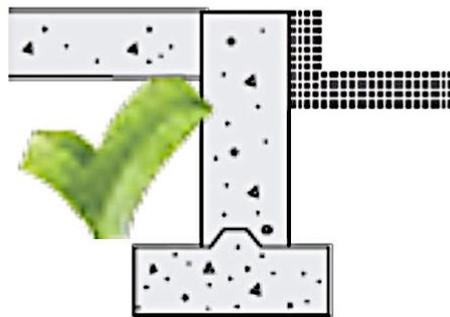
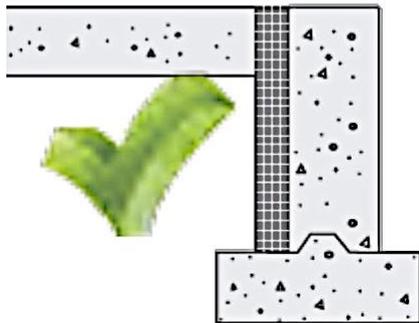
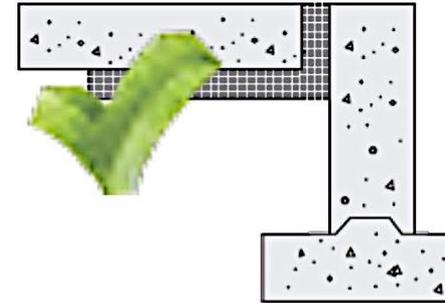
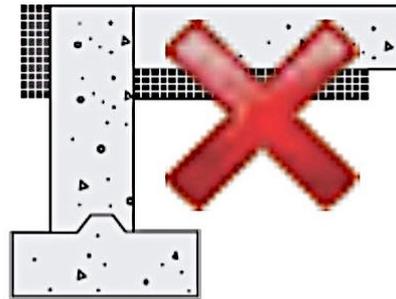
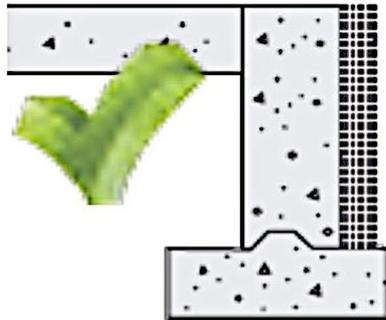


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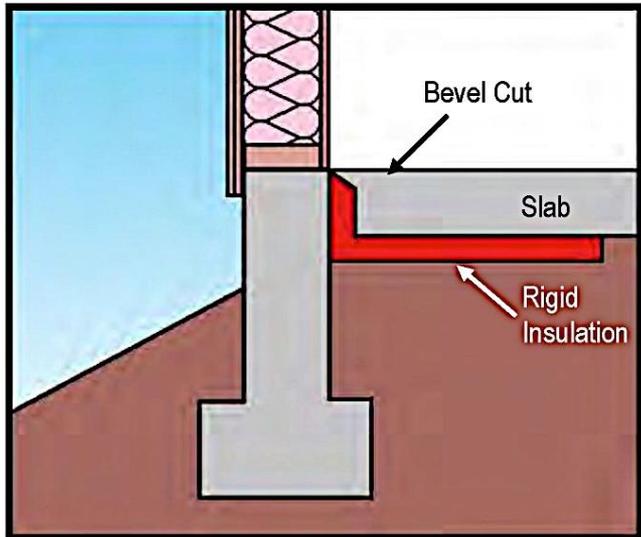
Appropriate Insulation Installation



Slab Edge Insulation



Slab Edge Insulation



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Table R303.1.3(1) Default Glazed Fenestration U-Factors

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

Table R303.1.3(2) Default Door U-Factors

DOOR TYPE	U-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

Table R303.1.3(3) Default Glazed Fenestration SHGC and VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

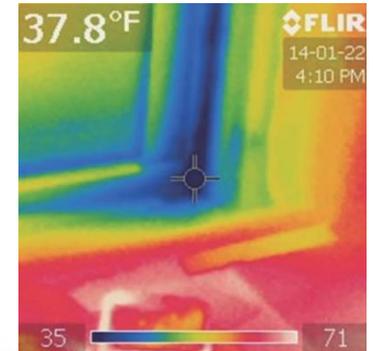
Moisture Control - Preventing Condensation



Low U-Factor



Air Tightness



Steve Easley and Associates

Air Barrier

Continuous

Aligned with
Thermal Envelope

Visual Inspection
Required

Air Tightness

Testing Required

ACH 50

Specific Details

Air Barrier and
Insulation
Installation Table

Fire Places,
Fenestration,
Recessed Lighting

Rooms with Fuel-
Burning
Appliances

Exterior Sealing

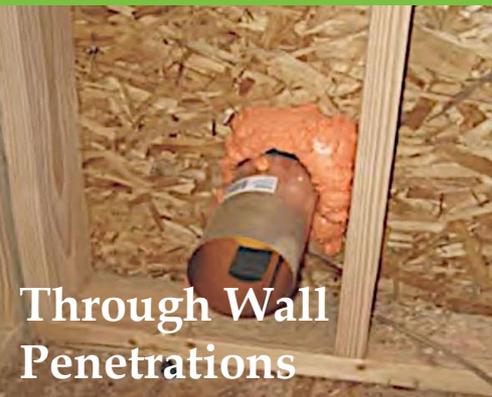


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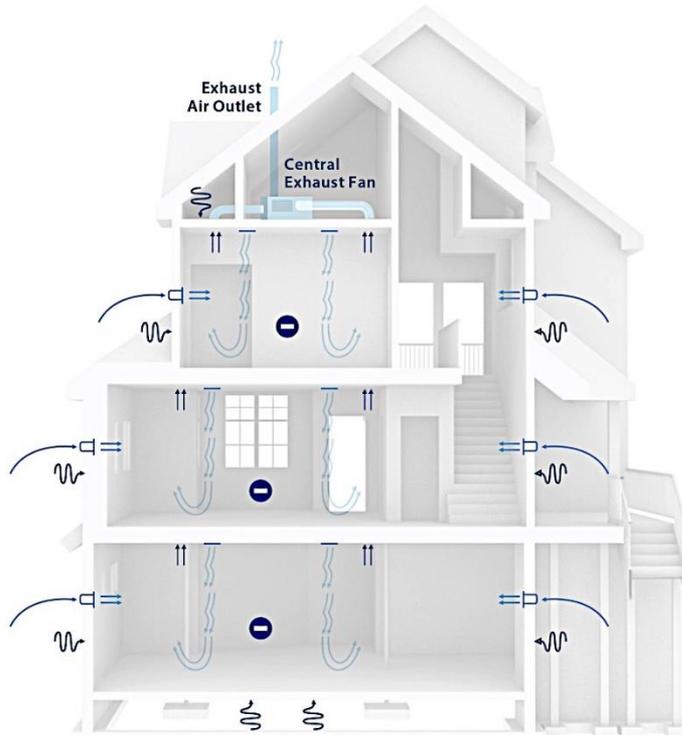


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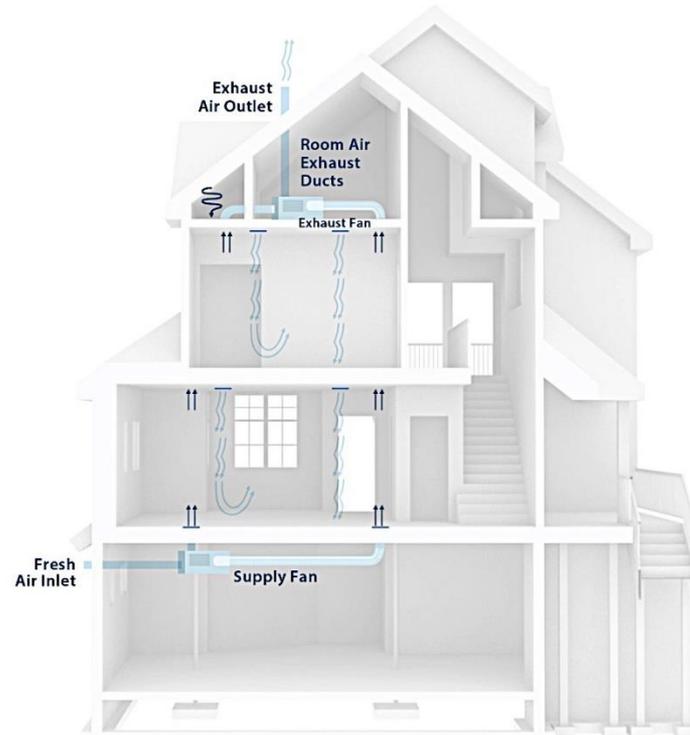
Interior Sealing



Implications of a Tight Home



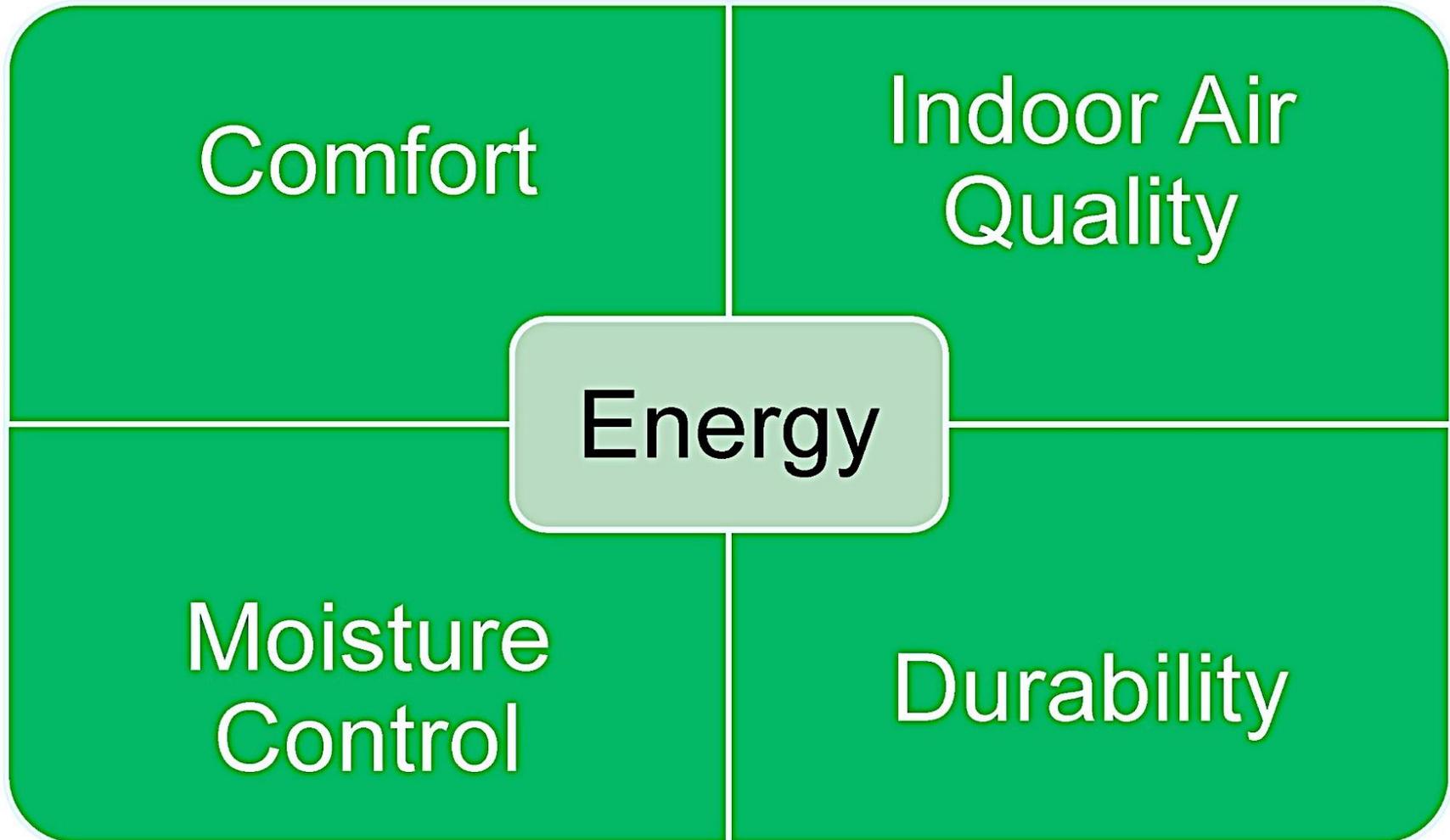
EXHAUST VENTILATION



BALANCED VENTILATION

Implications Of A **TIGHT HOME**

- | | |
|------------------|-----------------------|
| Air Flow | Positive Air Pressure |
| Air Infiltration | Negative Air Pressure |



Sealing

- Duct Sealing is Mandatory
- Duct Testing is Mandatory
- Duct Tightness Target is Prescriptive

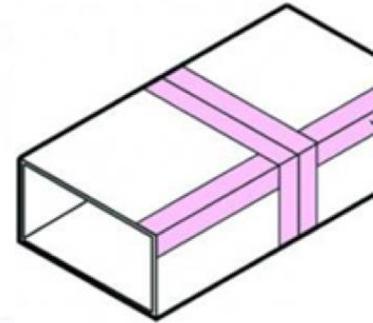
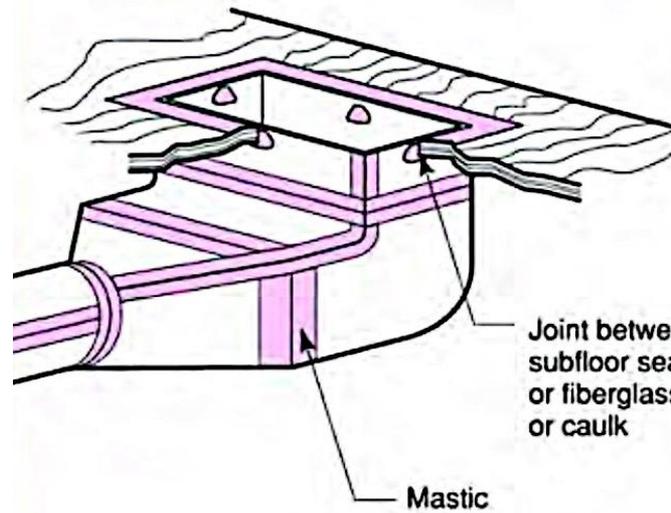
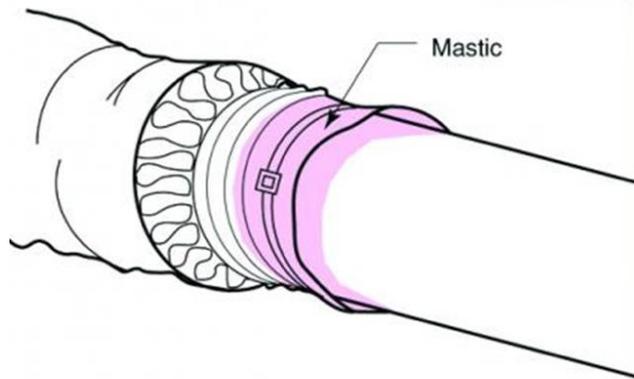
Insulation

- Insulation is Prescriptive
- Varies by Size and Location
- Section 405 and 406 minimums

Duct Location

- Ducts in Building Thermal Boundary eliminates duct insulation and testing
- No Building Cavities as Ducts - Mandatory

Mandatory Ductwork Sealing



DOE Zero Energy Ready Home

U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy



2015 IECC and DOE Zero
Energy Ready Home

Wednesday, June 19 2017

1:30-2:30 pm

Above Code Programs

- Must meet all Mandatory Items
- Must be approved by Jurisdiction

Code Conflicts

- If Direct Conflict, Code Rules

How Code Helps DOE ZERH



How Code Helps DOE ZERH

2012 &
2015 &
2018 IECC
Insulation

How Code Helps DOE ZERH



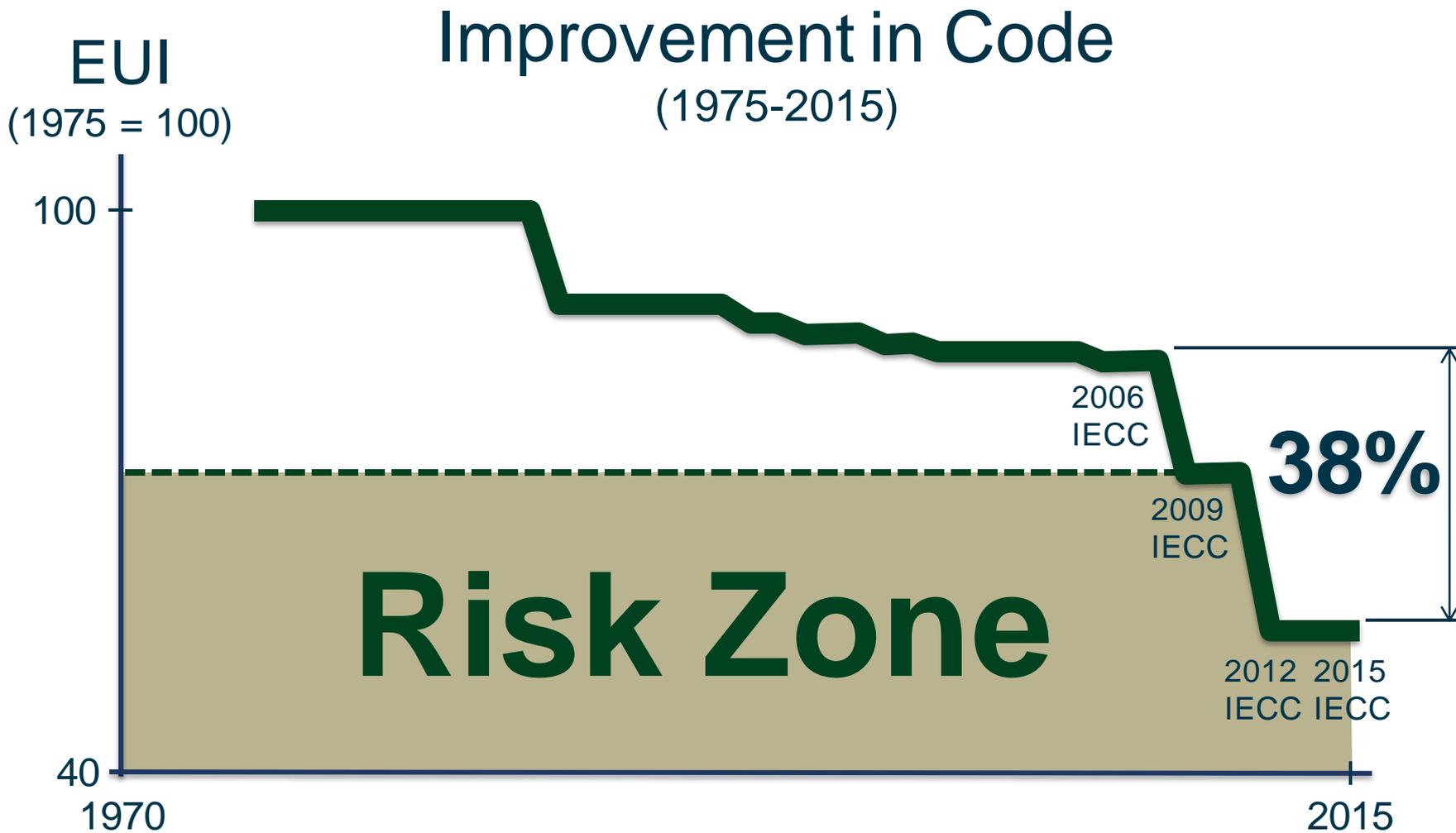
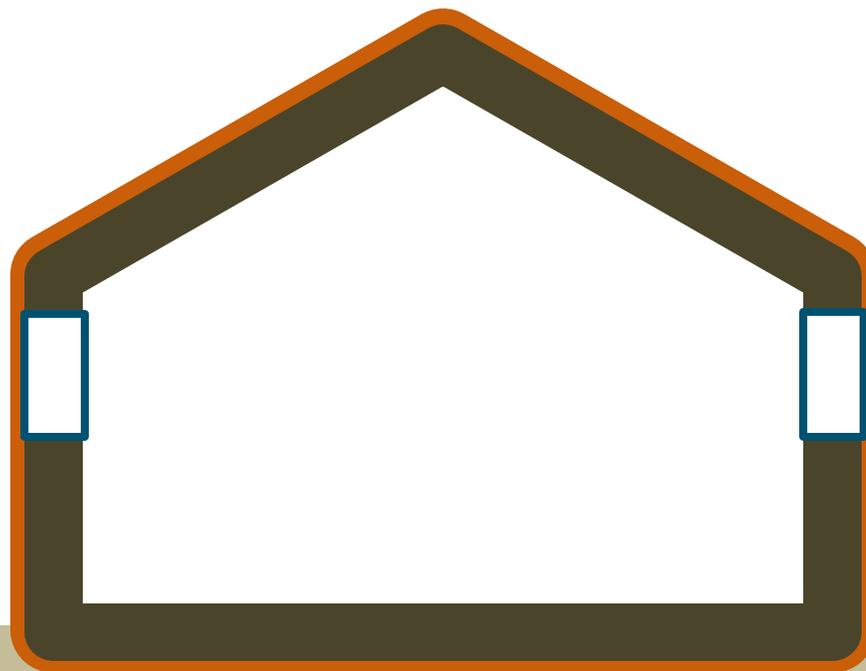


Image Basis: Building Energy Codes Program: National Benefits Assessment, 1992-2040,
https://www.energycodes.gov/sites/default/files/documents/BenefitsReport_Final_March20142.pdf

New Risk Reality Driver



Risk Driver:
Advanced
Enclosure

+ Insulation
+ Windows
+ Air Sealing

Rigorous Codes
<HERS Scores



**Good Ventilation
No Longer
Optional**



Construction
& Pre-
Occupancy
Ventilation



Verified
Flow Rates



ASHRAE
62.2



Code:
Whole-
House
Mechanical
Ventilation

Verified Flow
Rates



Ducted to
Outdoors



Code:
Kitchen
Ventilation Can
be Recirculation

Verified Flow
Rates



Ducted to
Outdoors



Code:
Bathroom
Ventilation and
Window Trade-
off

Pollutant Control



Code:
Pollutant
Source
Control –
Virtually
None

Accessible
Filters

MERV 8
Filter,
Inspected

Cabinet,
Carpet,
Composite
Wood, Paint
Emissions
and
pollutant
Controls

Radon and
Pest
Controls

No Building
Cavity Ducts

Bulk Moisture

Capillary Action

Moisture
Control

Vapor Control

Air Leakage

Moisture Control



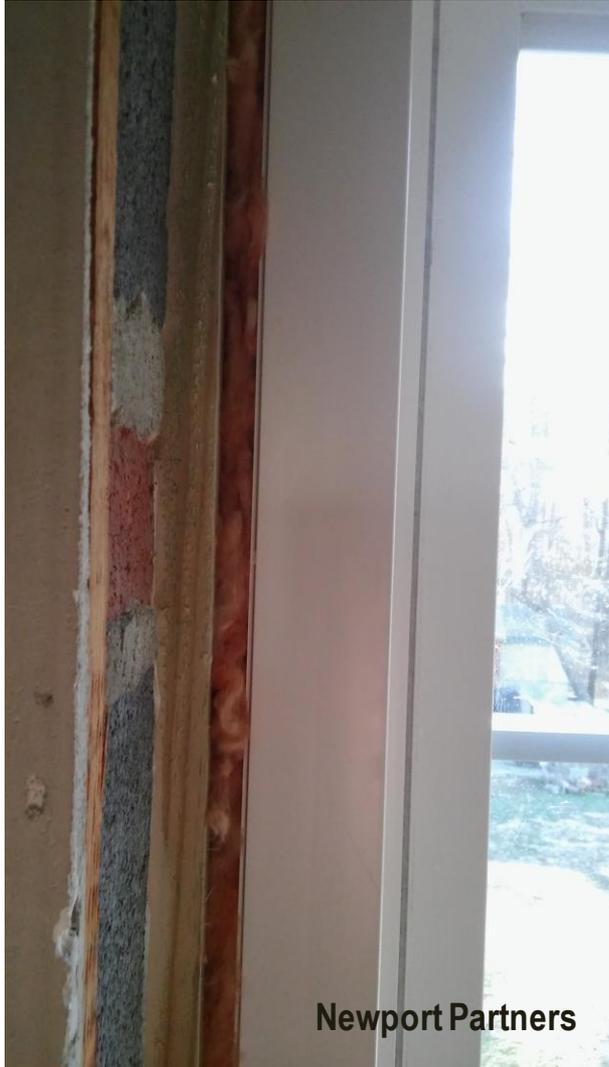
<p>Code: Moisture Control – Limited</p>	<p>Bulk Water Management: Foundation, Wall, Roof, Materials</p> <p>Capillary Breaks</p> <p>Vapor Control</p>	<p>Additional Bulk Water Management: Foundation, Gutters, Splash Protection</p> <p>Capillary Breaks</p> <p>Vapor Control</p>	<p>Humidity Control</p>
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- Building America Solution Center
 - <https://basc.pnnl.gov/>
- Excellence in Building Science Education
 - <http://buildingscienceeducation.net/>

Risk – Cost and Lost Opportunity



Risk – Cost and Lost Opportunity



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Risk – Cost and Lost Opportunity



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How ZERH Helps Code Compliance

Ducts in
Conditioned
Space



No Building
Cavity Ducts



Energy Star
Windows



Third Party
Verification:
Thermal
Inspection,
HVAC
Checklists,
Commissioning



Duct
Insulation
Flexibility

Better than
Code
Windows
will help with
Code
Compliance

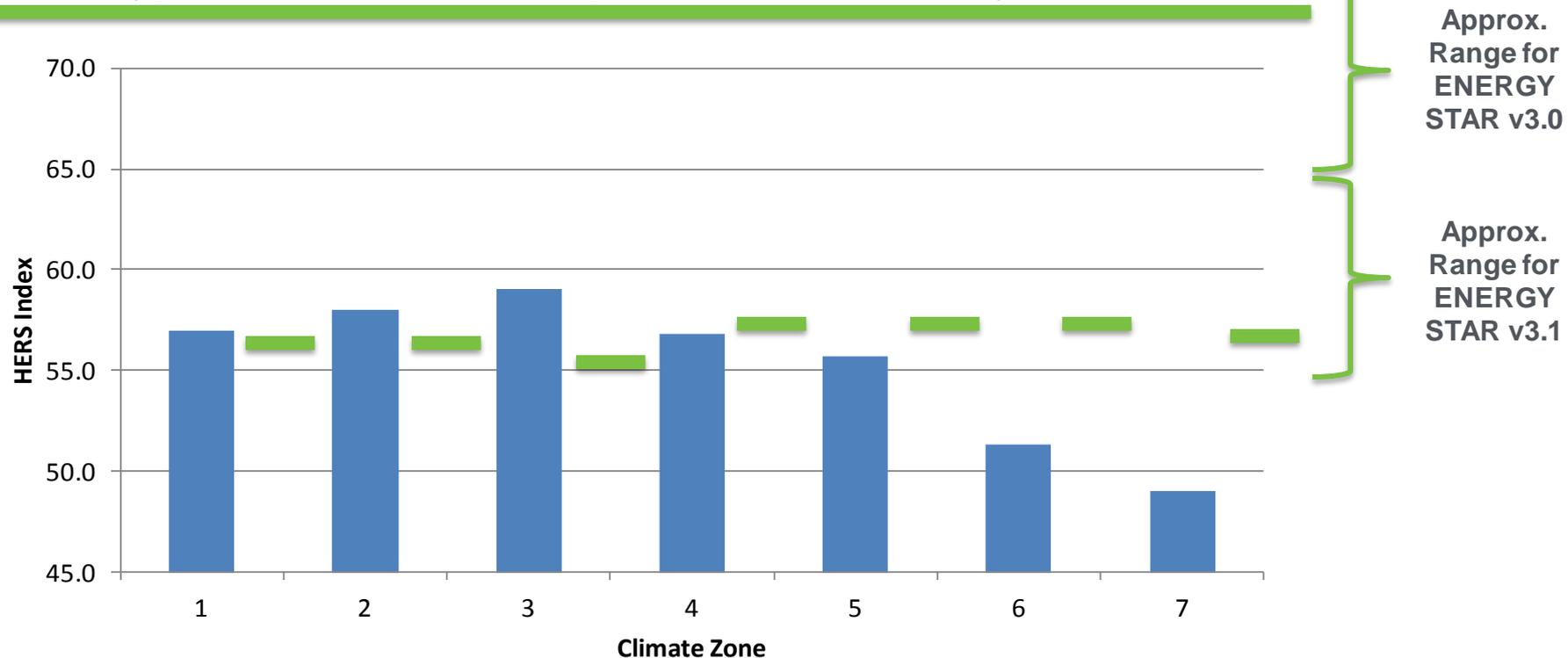
Better Assurance
of Performance
for Newly
Constructed
Home

Summary

			Solar Ready
			Eff. Comps. & H ₂ O Distrib.
			EPA Indoor Air Package
			Optimized Duct Location
	HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV
	Water Management	Water Management	Water Management
	Independent Verification	Independent Verification	Independent Verification
IECC 2012/15 Enclosure	IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2012/15 Enclosure
HERS 70-80	HERS 65-75	HERS 55-65	HERS 48-55
IECC 2012/2015	ENERGY STAR v3	ENERGY STAR v3.1	ZERH

ENERGY STAR to Zero Energy Ready Home HERS Threshold *(pre ANSI/RESNET 301)*

Typical DOE ZERH-Compliant HERS Index by Climate Zone



Based on 1800, 2400, and 3600 ft² prototypes on climate-appropriate foundations.

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