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What You Need To Know About the 2018 IECC

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AIA Course #: BECPWS0318
ICC PP
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Course Description

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This webinar, which is part of DOE's Building Energy Codes Program *Energy Codes Commentator* webinar-based training series, will provide an overview of the 2018 IECC residential provisions. The presentation will focus on the highlights of what has changed in the residential requirements since the preceding 2015 edition.

CONTINUING EDUCATION AIA

ICC PREFERRED EDUCATION PROVIDER

Learning Objectives

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At the end of this course, participants should be able to understand:

1. Understand the new residential provisions in the 2018 IECC compared to the previous version.
2. Be able to show compliance for buried ducts and vapor diffusion ports.
3. Apply the new criteria for the Energy Rating Index compliance path.
4. Access tools and resources available for compliance to the IECC provisions.

CONTINUING EDUCATION AIA

ICC PREFERRED EDUCATION PROVIDER

International Code Council

People Helping People Build a Safer World

Michelle Britt, LEED AP
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International Code Council

- **History**
  - 1994: Established as non-profit corporation
  - 1998: First international energy code
- **Vision**
  - Protect the health, safety and welfare of people by creating safe buildings and communities.
- **Mission**
  - To provide the highest quality codes, standards, products and services for all concerned with the safety and performance of the built environment.

International Building Code
(Third Printing: Oct 2015)

International Existing Building Code
(Fifth Printing: Nov 2015)

International Property Maintenance Code
(Fourth Printing: Dec 2015)

International Residential Code
(Second Printing: Jan 2016)

International Fire Code
(Fourth Printing: Jan 2016)

International Plumbing Code
(Third Printing: Aug 2015)

Private Sewage Disposal Code
(First Printing: May 2014)

International Swimming Pool and Spa Code
(Third Printing: Dec 2015)

International Mechanical Code
(Third Printing: Nov 2015)

International Fuel Gas Code
(Fourth Printing: Jan 2016)

International Green Construction Code
(First Printing: May 2015)

International Energy Conservation Code
(Third Printing: Jan 2016)

ICC Performance Code
(First Printing: May 2014)

Wildland-Urban Interface Code
(First Printing: May 2014)

International Zoning Code
(First Printing: May 2014)

International Solar Energy Provisions
(Second Printing: Nov 2015)

Codes and Resiliency

- Ability of communities to survive and recover from adverse natural and manmade events (IBC, IRC, IECC, IgCC, WUI, etc.)
- Review of infrastructure and building stocks within communities – Evolution of use - Repurposing (IEBC)

Industry Statement on Resilience

Representing more than 750,000 professionals, America's design and construction industry is one of the largest sectors of this nation's economy, generating over $1 trillion in GDP. We are responsible for the design, construction, and operation of the buildings, homes, transportation systems, landscapes, and public spaces that enrich our lives and sustain America's global leadership.

We recognize that natural and manmade hazards pose an increasing threat to the safety of the public and the vitality of our nation. Aging infrastructure and disasters result in unacceptable losses of life and property, straining our nation's ability to respond in a timely and efficient manner. We further recognize that contemporary planning, building materials, and design, construction and operational techniques can make our communities more resilient to these threats.

Drawing upon the work of the National Research Council, we define resilience as the **ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.**

As the leaders of this industry, we are committed to significantly improving the resilience of our nation's buildings, infrastructure, public spaces, and communities.

- We research materials, design techniques, construction procedures, and other methods to improve the standard of practice.
- We educate our professions through continuous learning. Through coordinated and continuous learning, design, construction and operations professionals can provide their clients with proven best practices and utilize the latest systems and materials to create more resilient communities.
- We advocate at all levels of government for effective land use policies, modern building codes, and smarter investment in the construction and maintenance of our nation's buildings and infrastructure.
- We respond alongside professional emergency managers when disasters do occur. Industry experts routinely work in partnership with government officials to survey damage, coordinate recovery efforts, and help communities rebuild better and stronger than before.
- We plan for the future, proactively envisioning and pursuing a more sustainable built environment.

The promotion of resilience will improve the economic competitiveness of the United States. Disasters are expensive to respond to, but much of the destruction can be prevented with cost-effective mitigation features and advanced planning. Our practices must continue to change, and we commit ourselves to the creation of new practices in order to break the cycle of destruction and rebuilding. Together, our organizations are committed to build a more resilient future.

– ICC takes a "Whole-Community Approach"

2018 IECC – The Process

[httww.iccsafe.org/codes-tech-support/codes/code-development-process/2018-2019-group-aps://w/](#)

Current Code Development Cycle

< Go Back

- About ICC
- Membership
- Education & Certification
- Codes & Tech Support
  - Codes
  - Code Development
    - cdpACCESS
    - Councils & Committees
    - Current Cycle
    - Current Group
    - Archives
  - Standards
  - Technical Support
- Forum

ICC / The I-Codes / Code Development / cdpACCESS / Councils & Committees / Current Cycle

News

Proposed Changes for Group A. The proposed changes to the Group A codes, to be presented at the Committee Action Hearings on April 15-25, 2018, have been posted.

Committee Action Hearing Schedule. The 2018 Committee Action Hearing (CAH) schedule is now posted. Review the schedule here.

Register for Committee Action Hearings. Join us at the International Code Council's 2018 Committee Action Hearings, April 15-25, in Columbus, Ohio. This year's hearings offer ICC Members and other building safety professionals the opportunity to provide input on proposed code changes to the 2018 Group A International Codes®. The Hearings are free to attend. Register now!

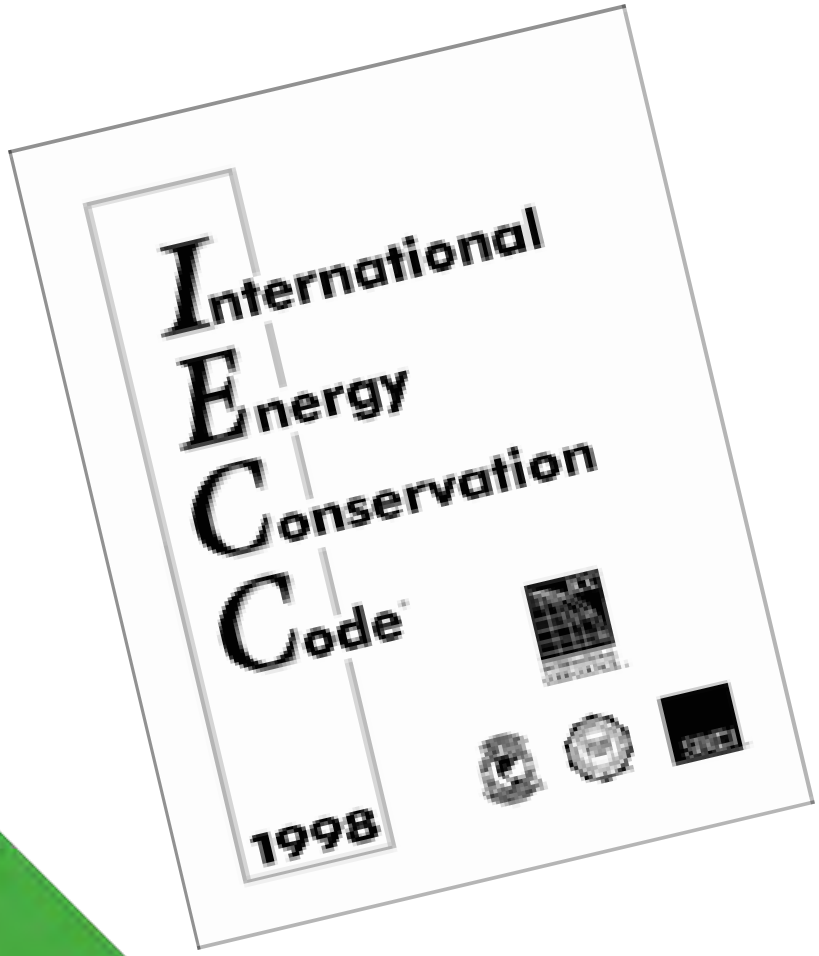
2018 / 2019 Code Development Cycle

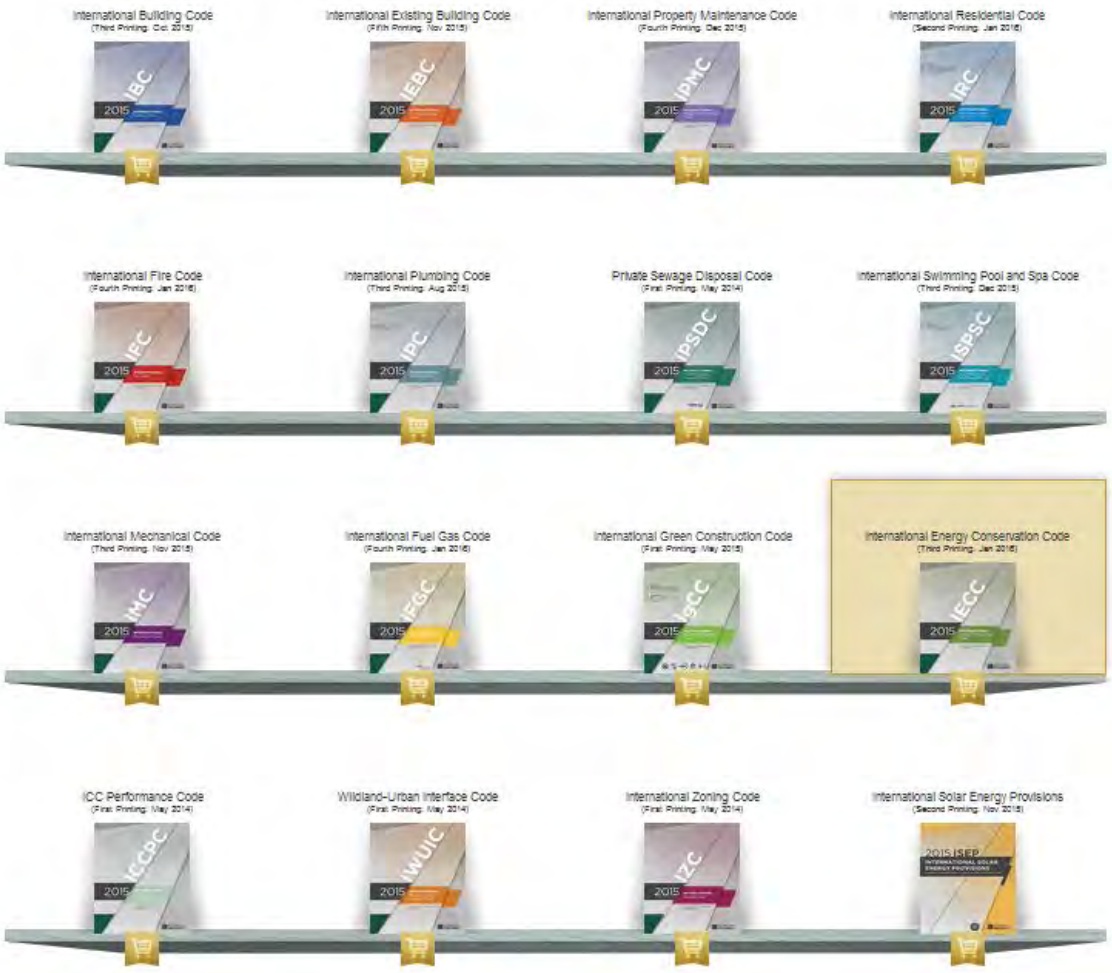
ICC Committee Activities

Throughout the current cycle, ICC committees have been put in place to study specific technical issues and participate in the ICC Code Development Process. Below is a list of current committees and a link to their respective web pages:

- Ad Hoc Committee on Healthcare (AHC)

ICC
INTERNATIONAL CODE COUNCIL®




International Building Code
(Third Printing: Oct. 2015)
IBC
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Wildland-Urban Interface Code
(First Printing: May 2014)
IWUIC
2015
International Zoning Code
(First Printing: May 2014)
IZC
2015
International Solar Energy Provisions
(Second Printing: Nov 2015)
2015 ISEP

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Outline

- Run-through of the major energy features of the IECC
- Summary of what changed between 2015 and 2018
- Focus on two key 2018 changes
  - Buried ducts in vented attics
  - Energy Rating Index compliance path

What is the IECC and why should I care?

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- The International Energy Conservation Code is one member of the International Code Council's family of building codes
- The IECC…
  - Applies to new and renovated buildings
  - Sets minimum requirements for energy features and performance
  - Reduces energy use and polluting emissions over the life of complying buildings
  - Benefits homeowners and society by improving cost-effectiveness, comfort, and durability
- The IECC covers both residential and commercial buildings, but we are focused on residential today

The Family of I-Codes

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- ✓ International Building Code
- ✓ International Mechanical Code
- ✓ International Fuel Gas Code
- ✓ International Property Maintenance Code
- ✓ International Fire Code
- ✓ International Zoning Code
- ✓ International Plumbing Code
- ✓ International Existing Building Code
- ✓ International Private Sewage Disposal Code
- ✓ International Performance Code
- ✓ International Residential Code
- ✓ **International Energy Conservation Code**
- ✓ International Wildlife-Urban Interface Code

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- ✓ International Wildlife-Urban Interface Code

Relationship Between IRC & IECC

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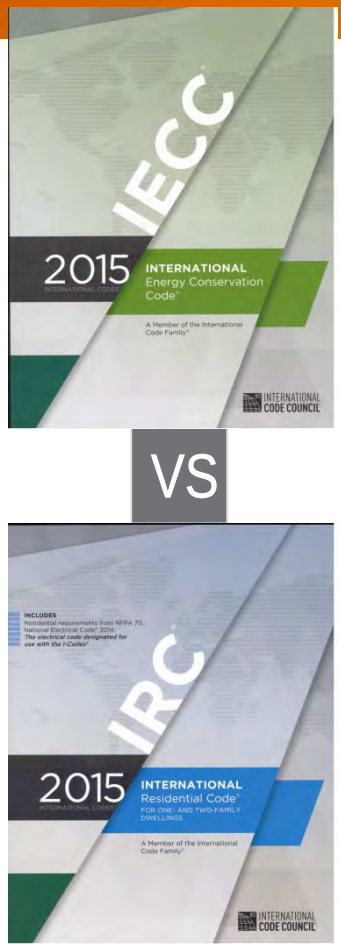
- ✓ IECC addresses only energy
- ✓ IRC addresses all topics *(structural, plumbing, etc.)*
  - Allows builder to carry only one code book
  - Chapter 11 covers energy efficiency
- ✓ As of 2015, IECC consolidated with IRC energy chapter (actually a change to the IRC, not the IECC).
- ✓ IECC addresses both residential and commercial; IRC addresses subset of residential, detached one- and two-family dwellings and townhouses 3 stories or fewer



Scope
Section R101

Residential Buildings:

- ✓ One- and two-family dwellings, townhouses of any size and R-2, R-3, R-4 ≤ 3 stories
- ✓ All buildings that are not “residential” by definition are “commercial”

Occupancy Classifications do not map cleanly to building types:

- ✓ R-2 involves more than 2 dwelling units and permanent occupancy (apartments, dorms, boarding houses, hotels/motels)
- ✓ R-3 includes 1- and 2-family dwellings
- ✓ R-4 includes assisted living, residential care, etc.

Section R101.4.1 - Mixed Residential and Commercial Buildings
Section R101.5 - Compliance

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- ✓ Treat the residential building portion under the applicable residential code
- ✓ Treat the commercial building portion under the commercial code
- ✓ Code Official has final authority
  - Compliance materials, software, worksheets

Structure of the 2018 IECC

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Ch. 1 Scope and Application / Administrative and Enforcement
Ch. 2 Definitions
Ch. 3 General Requirements
Ch. 4 Commercial Energy Efficiency
Ch. 5 Existing Buildings
Ch. 6 Referenced Standards
Index

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Scope/Construction Documents
Section R103

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- ✓ Documentation shall be prepared by a registered design professional (where required)
- ✓ Electronic media can be used
- ✓ Information required:
  - ✓ Insulation materials and R-values
  - ✓ Fenestration U-factors, SHGC
  - ✓ Area-weighted U-factor and SHGC calculations
  - ✓ Mechanical, SWH, equipment types, sizes, and efficiencies
  - ✓ Equipment and system controls
  - ✓ Duct sealing, duct and pipe insulation and location
  - ✓ Air sealing details

Certificate
Section R401.3

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- ✓ Permanently posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building
- ✓ Don't cover or obstruct the visibility of other required labels
- ✓ Includes the following:
  - R-values of insulation installed for the thermal building envelope, including ducts outside conditioned spaces
  - U-factors and SHGC for fenestration
  - Area-weighted U-factor and SHGC calculations
  - Results from any required duct system and building envelope air leakage testing
  - HVAC efficiencies and types
  - SWH equipment
  - Duct sealing, duct and pipe insulation and location
  - Air sealing details

Overview of Structure

Climate-Specific Prescriptive Requirements (mostly envelope)

- ✓ Roofs, walls, foundations
- ✓ U-factors of windows, doors, skylights
- ✓ Solar Heat Gain Coefficient in warm climates
- ✓ Duct leakage rate

Performance Based Alternatives

Mandatory Requirements (sometimes climate-specific)

- ✓ Infiltration control
- ✓ Duct insulation, sealing & testing, no use of building cavities
- ✓ HVAC controls
- ✓ Piping Insulation and circulating service hot water requirements
- ✓ Equipment sizing
- ✓ Dampers
- ✓ Lighting

Compliance

IECC Terminology

- ✓ Prescriptive
  - Component-specific requirements that can be lessened or eliminated in trade for compensating improvements elsewhere
- ✓ Mandatory
  - Required and cannot be traded down, even in the simulated performance path or Energy Rating Index path
- Note: Unlike simulated performance path, ERI path is not directly based on the prescriptive requirements

Some elements have “hard limits”

- ✓ AKA, “trade-off limits” or "backstops"
- ✓ Put limits on how far a component-specific prescriptive requirement can be reduced in trade-offs against other components

Climate Zones for the 2018 IECC

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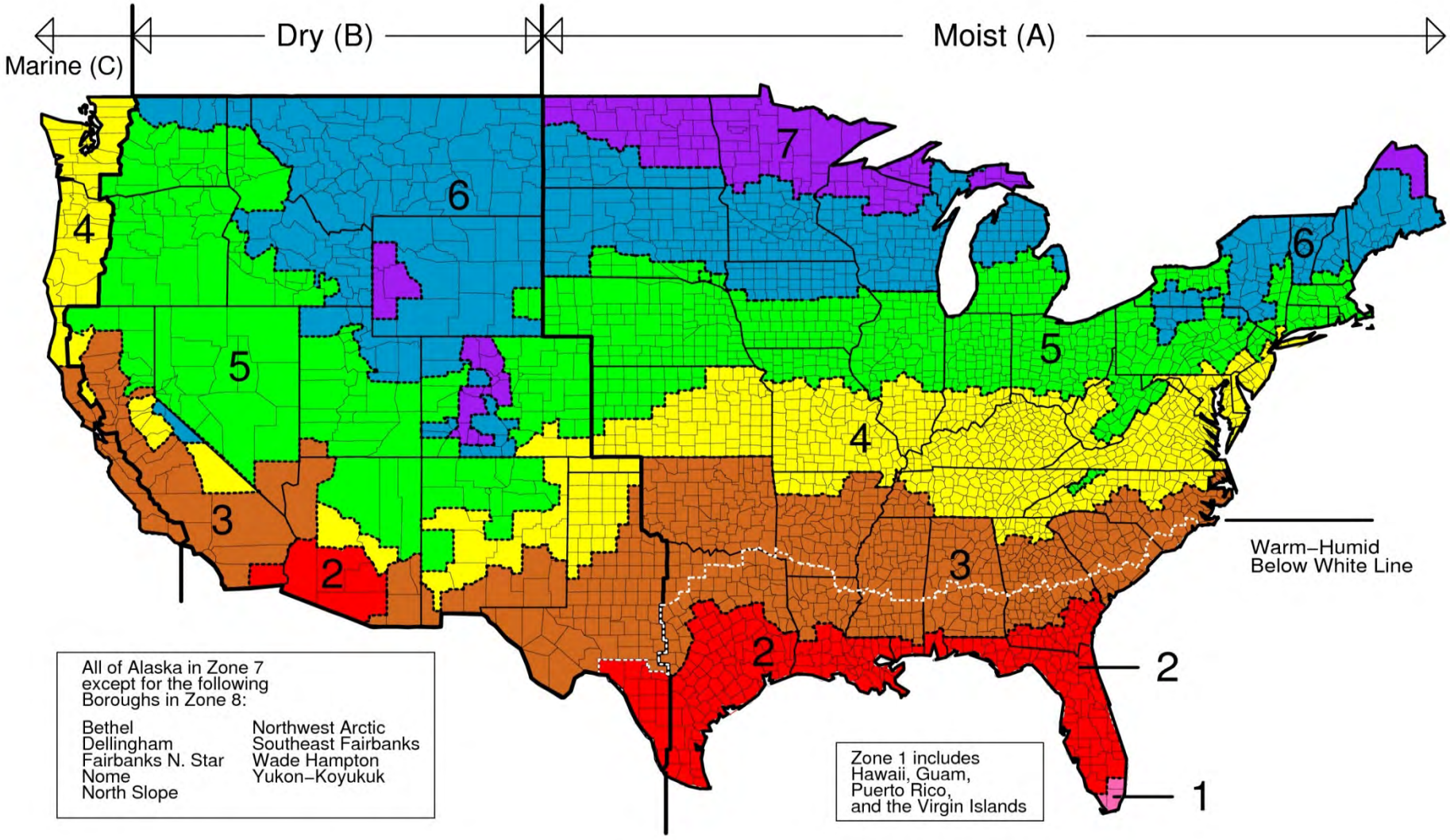

Climate Zones

IECC Terminology

- ✓ "Climate Zone" has two primary components
  - Eight temperature-oriented zones (1-8)
  - Three named moisture regimes (moist, dry, marine)
  - Theoretically 8x3=24 distinct zones, but only 15 occur in U.S.
- ✓ Two additional climate specifications influence requirements
  - Warm-Humid line delineates counties that are warm-humid as defined by ASHRAE, with exceptions (affects only basement requirements)
  - The "Tropical Climate Zone" (not a separate zone) defines areas in which simplified/relaxed requirements apply under some conditions

Climate Zones in the U.S. are entirely geographical

- ✓ Defined along state/county lines
- ✓ International locations defined by local climate data (mean Temp., precipitation, humidity, etc.)

Tropical Zone
Section R401.2.1

- Buildings deemed to comply at elevation < 2,400 feet above sea level where the following conditions are met:
  - < ½ space is air conditioned
  - Occupied space is not heated
  - ≥ 80% solar, wind, or other renewable energy source supplies service water heating
  - SHGC on fenestration ≤ 0.40 or overhang projection factor ≥ 0.30
  - Lighting in accordance with R404
  - Exterior roof complies with Table C402.2.11 (commercial cool roof) or insulation of ≥ R-15, if present, attics above insulation are vented and attics below insulation unvented
  - Roof surface slope of not less than ¼ unit vertical in 12 units horizontal (i.e., 1/48 or 2.1% [code says 21%])

Tropical Zone
Section R401.2.1 Continued

- Operable fenestration provides ventilation of not less than 14% of floor area for each room or equivalent ventilation is provided by a ventilation fan
- Bedrooms with 2 exterior walls facing different directions have operable fenestration
- Interior doors to bedrooms capable of being secured open
- Ceiling fan or rough-in provided for bedrooms and the largest space that is not used as a bedroom

Climate Zones for the 2018 IECC

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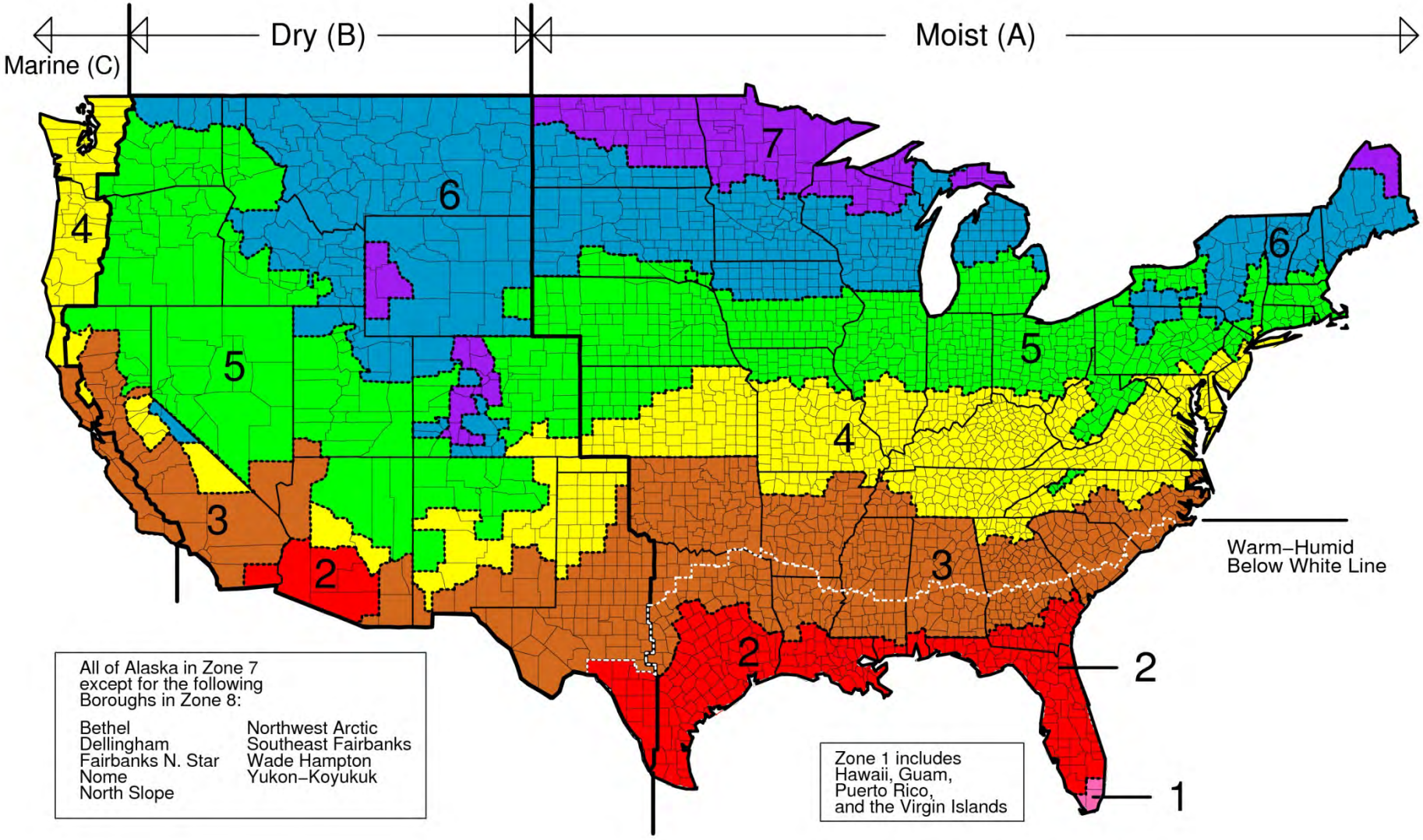

Climate Zones for the 2018 IECC

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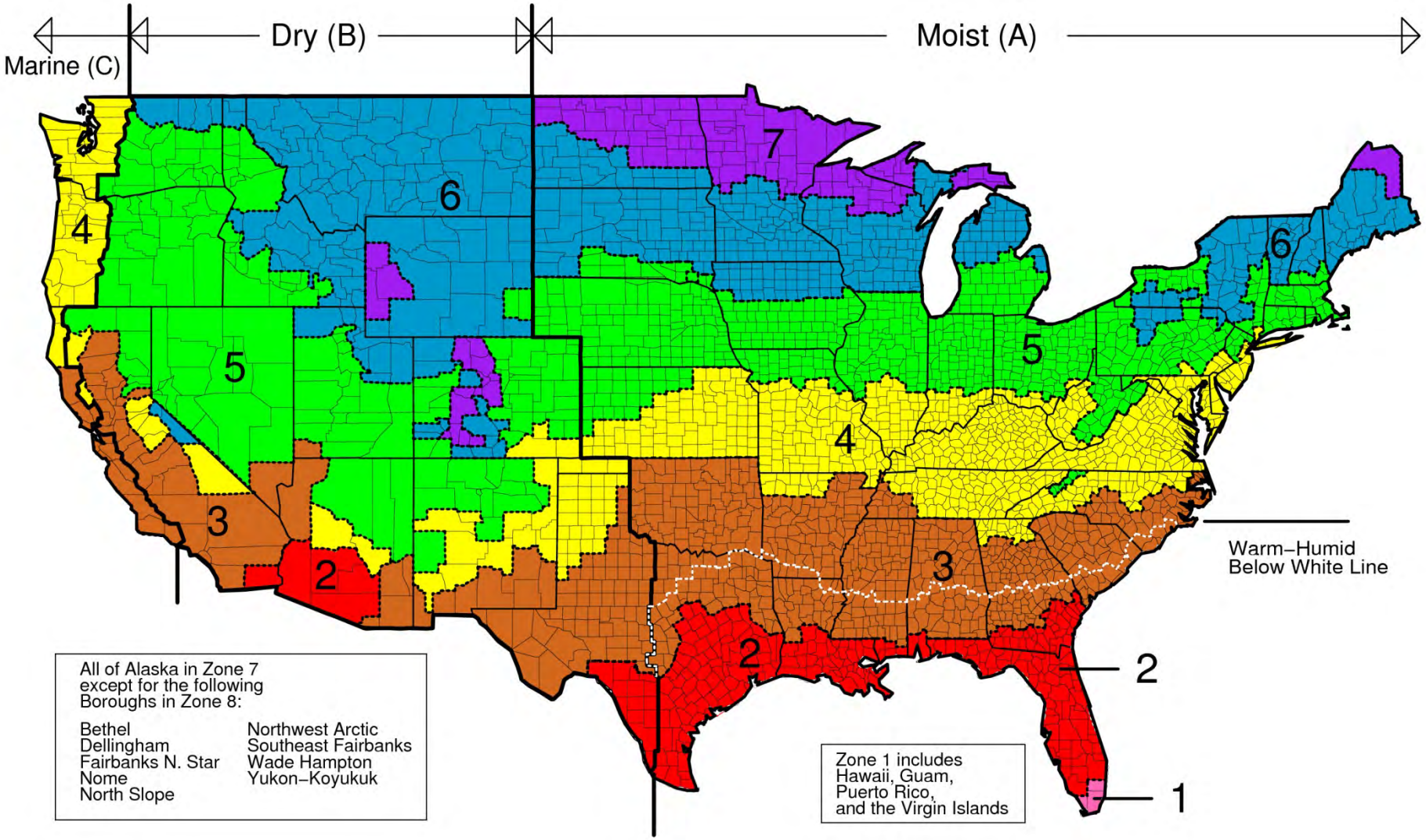

IECC Compliance – Three (or Four or Five) Options

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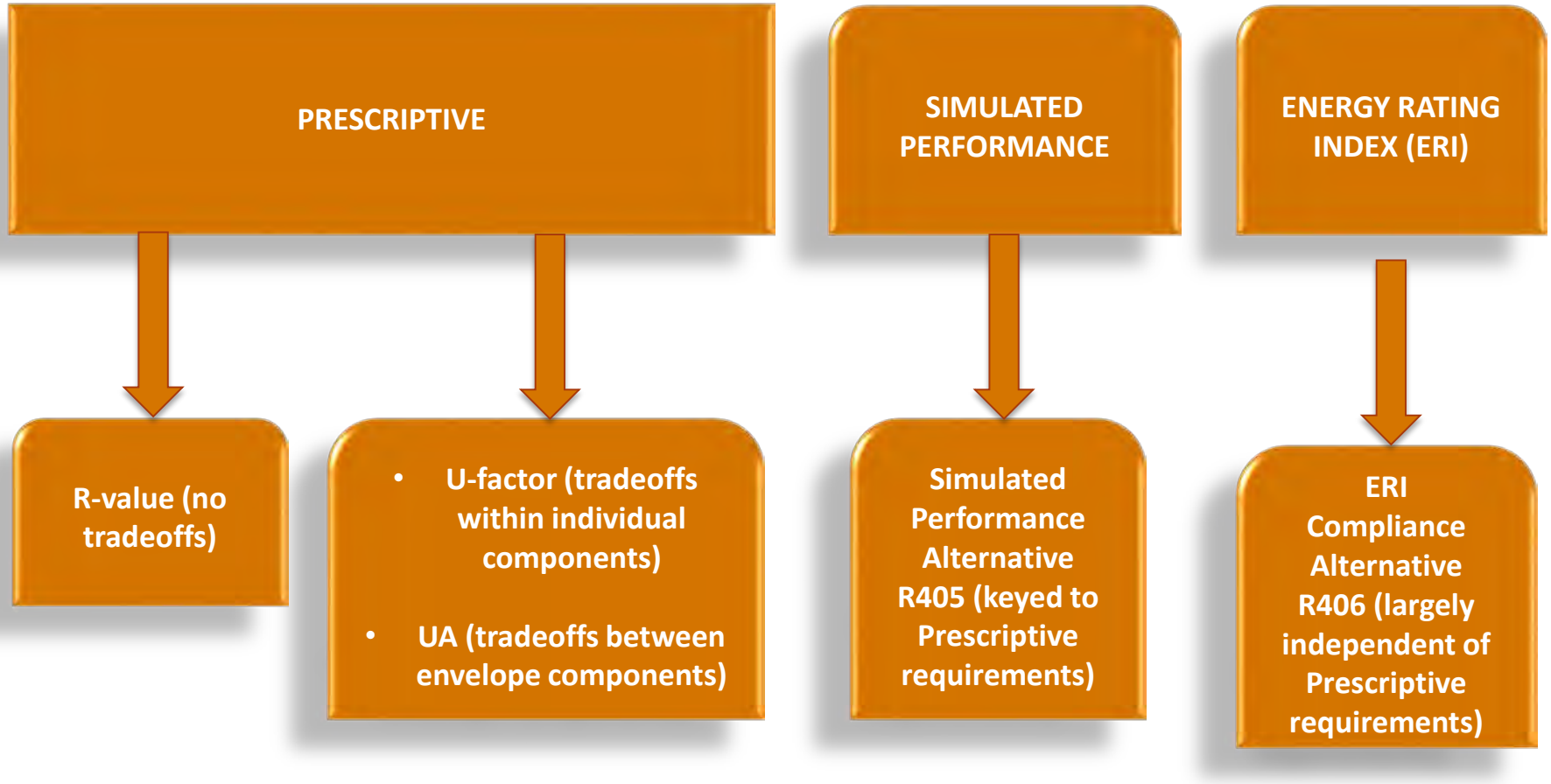

IECC Compliance – Three (or Four or Five or Six) Options

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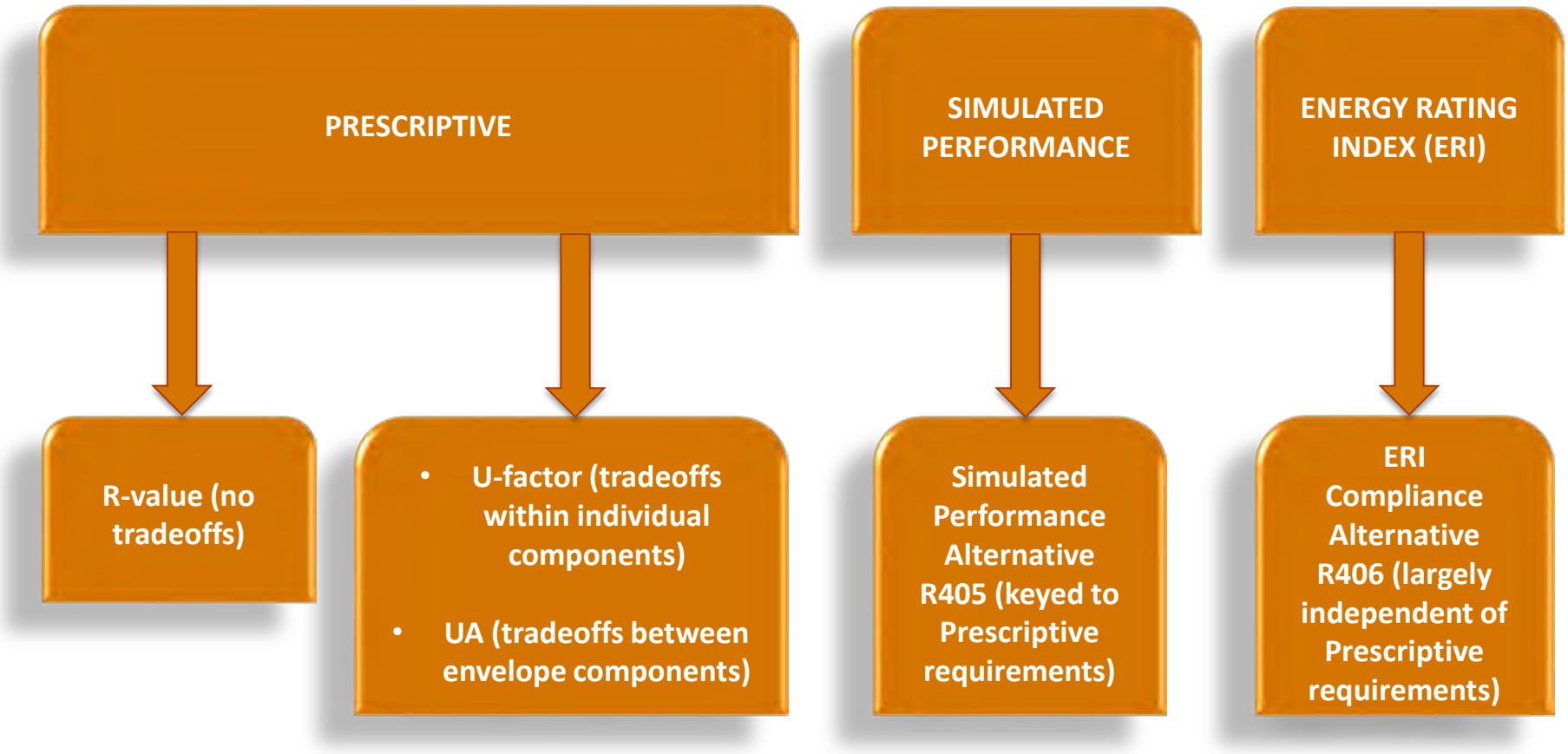

Log homes comply if envelope designed in accordance with ICC 400

What is included in a typical component requirement?

- Prescriptive requirement—the fundamental energy- and/or durability-oriented mandate of the code
  - Maybe one or more usability- or convenience-oriented exceptions or exclusions
  - Maybe one or more practicality-oriented alternative allowances

  Must look in the tables, footnotes, AND code text!

- Performance-based alternative compliance path(s) that allow trade-offs across building components that ensure equal energy performance

Building Envelope Specific Requirements

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Building Thermal Envelope consists of:

- ✓ **Fenestration**
- ✓ Ceilings
- ✓ Walls
  - Above grade
  - Below grade
  - Mass walls
- ✓ Floors
- ✓ Slabs
- ✓ Crawlspaces

Exceptions:

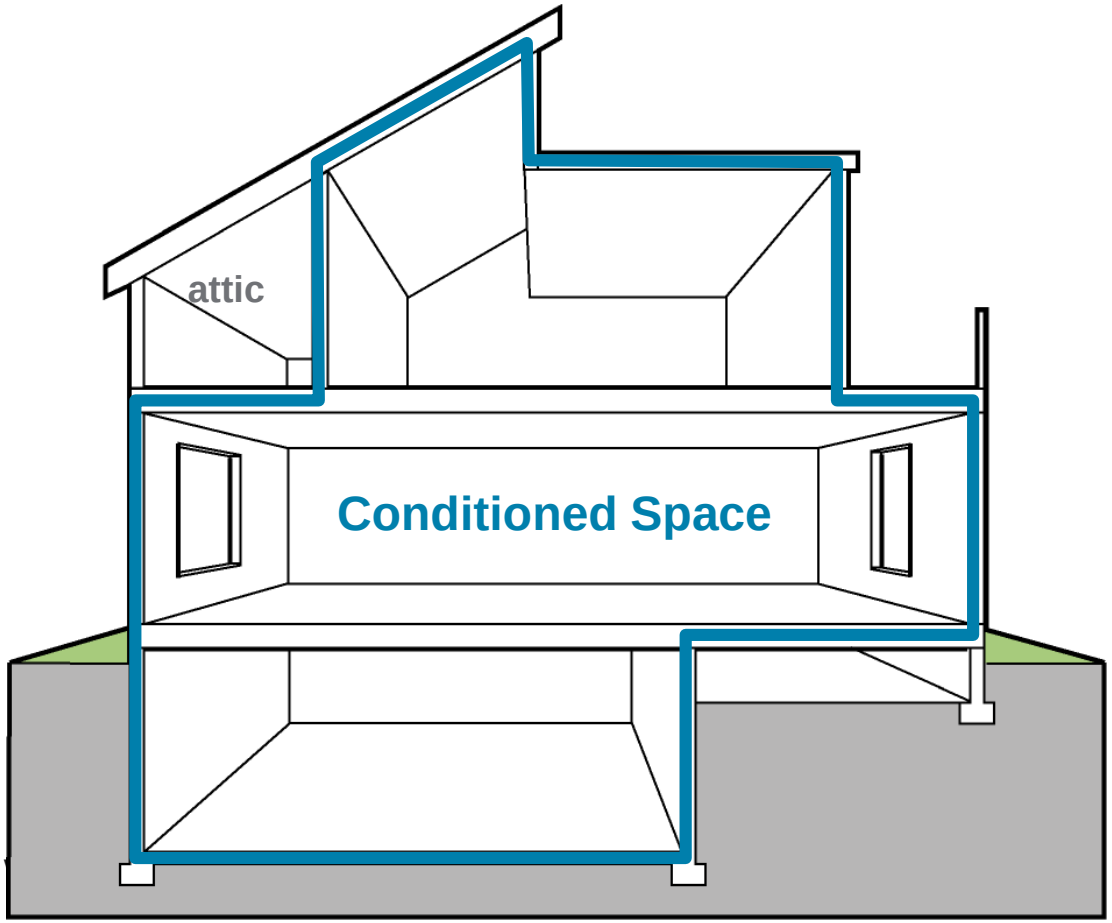
Low energy usage

< 3.4 Btu/h/sq.ft. OR

1 watt/sq.ft. of floor area OR

unconditioned spaces OR

log homes designed in accordance



Insulation and Fenestration Requirements by Climate Zone

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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*-VALUE & 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	0.32	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.32	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20+5[h] or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20+5[h] or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

NR = Not Required.

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall be not less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation *R*-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an *R*-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. Mass walls shall be in accordance with Section R402.2.5. The second *R*-value applies where more than half of the insulation is on the interior of the mass wall.

Fenestration
Sections R303.1.3/R402.3

Doors and windows

- ✓ NFRC rating or default table
  - If no labeled U-factor and SHGC, use default table
- ✓ No glass area limits
- ✓ Exemptions
  - Up to15 ft^2 of glazing per dwelling unit *(Section R402.3.3)*
  - One side-hinged opaque door assembly not greater than 24 ft^2 *(Section R402.3.4)*

Fenestration
Sections R402.3.1/R402.3.2 - Area-weighted Average

An area-weighted average

- ✓ Can be used to satisfy U-factor and SHGC requirements
- ✓ Subject to hard limits, even in trade-offs

Fenestration
Section R402.3.2 – Dynamic Glazing

- ✓ Dynamic glazing
  - ✓ Ratio of higher to lower labeled SHGC ≥ 2.4
  - ✓ Automatically controlled to modulate amount of solar gain into space in multiple steps
  - ✓ Shall be considered separately from other fenestration (area weighted average)
  - ✓ Exception – not required to comply when both high and low rated SHGC meet Table R402.1.2

Building Envelope Specific Requirements

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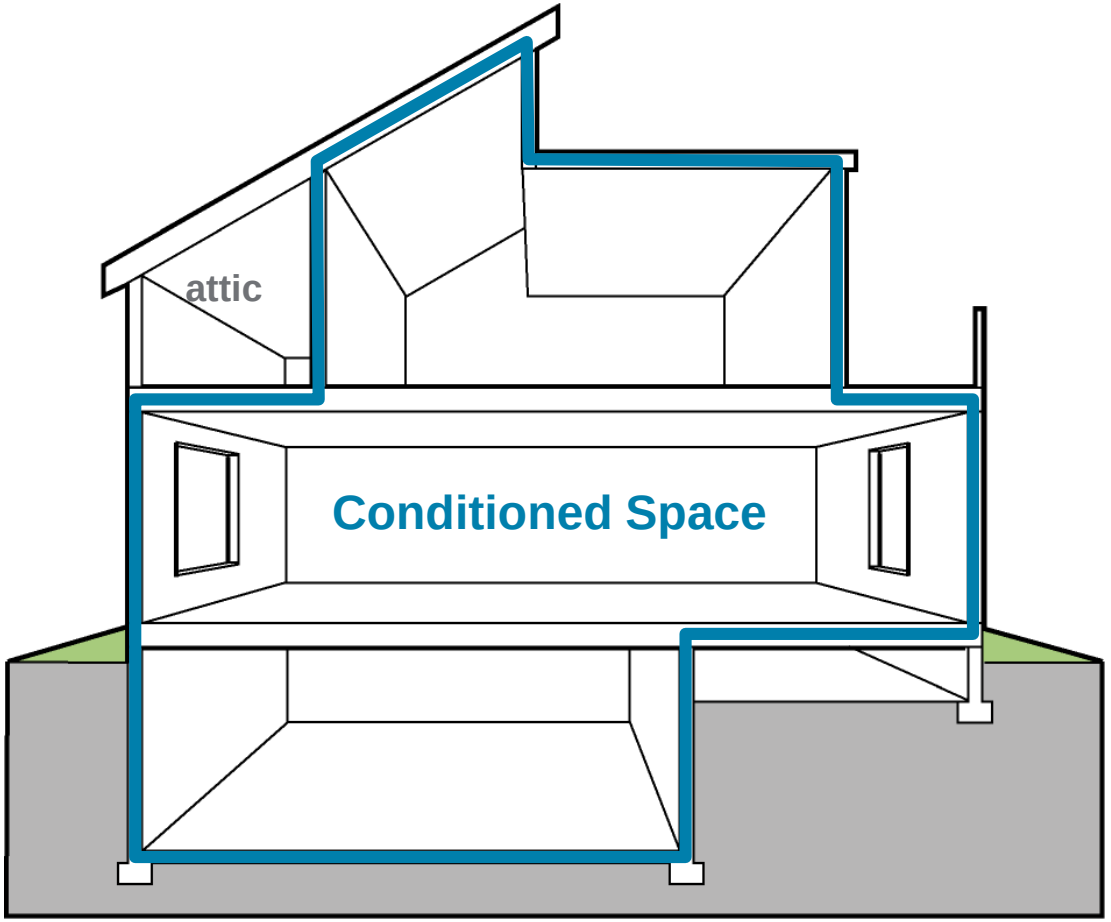
Building Envelope consists of:

- ✓ Fenestration
- ✓ **Ceilings**
- ✓ Walls
  - Above grade
  - Below grade
  - Mass walls
- ✓ Floors
- ✓ Slabs
- ✓ Crawlspaces



Ceilings
Section R303.1

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R-values are to be printed on the batt insulation or rigid foam board.

Blown-in insulation must have an insulation certificate at or near the opening of the attic.

The certificate should include:

- ✓ R-value of installed thickness
- ✓ Initial installed thickness
- ✓ Installed density
- ✓ Settled thickness/settled R-value
- ✓ Coverage area
- ✓ Number of bags installed

Insulation markers must be installed every 300 square feet and be marked with the minimum installed thickness and affixed to the trusses or joists.

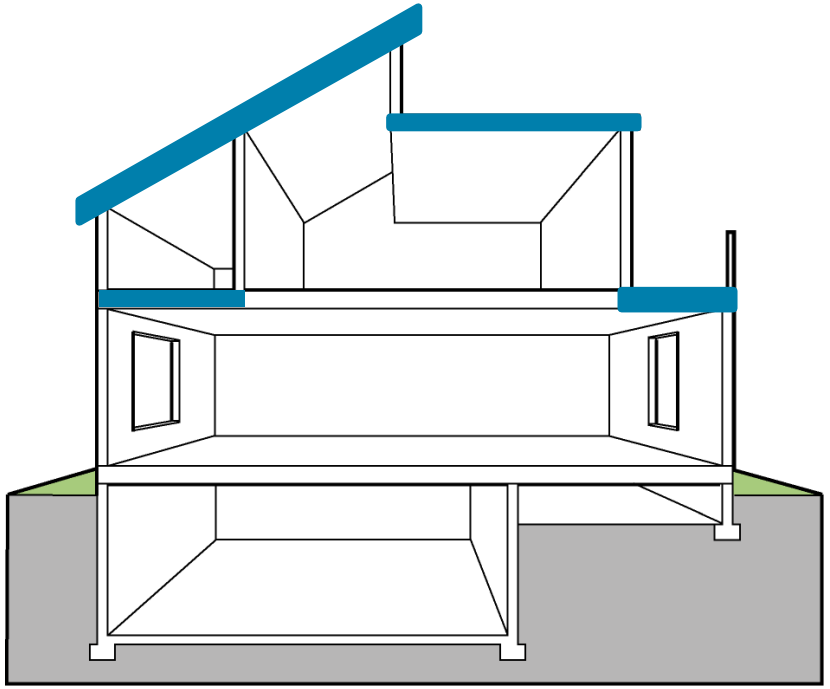
Ceilings

Requirements based on

- ✓ Assembly type
- ✓ Continuous insulation
- ✓ Insulation between framing (cavity insulation)

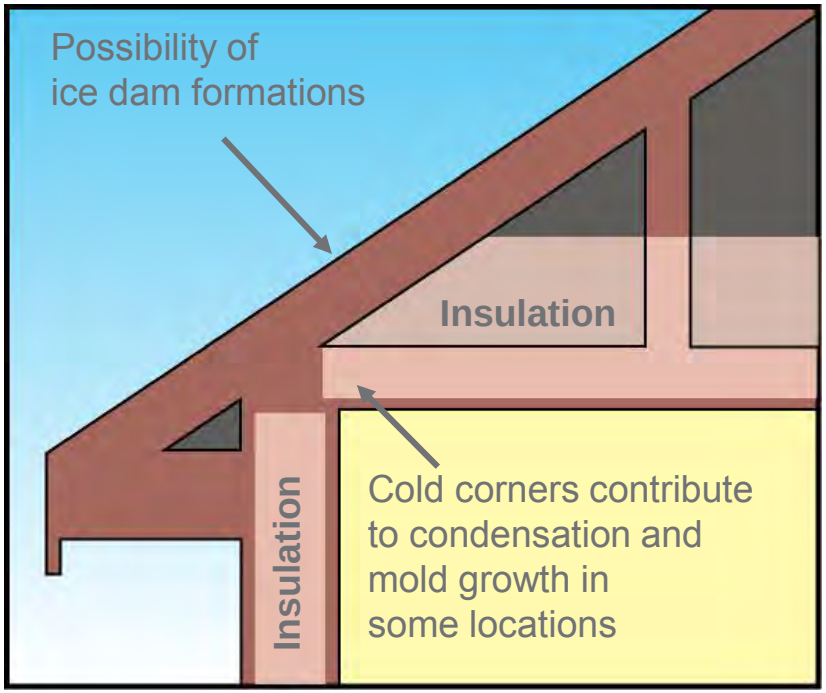
Meet or exceed R-values

- ✓ With some exemptions, exclusions



Ceilings with Attics
Section R402.2.1

Ceiling insulation requirements in R-value table assume standard truss systems



Ceilings with Attics, Cont'd.
Section R402.2.1

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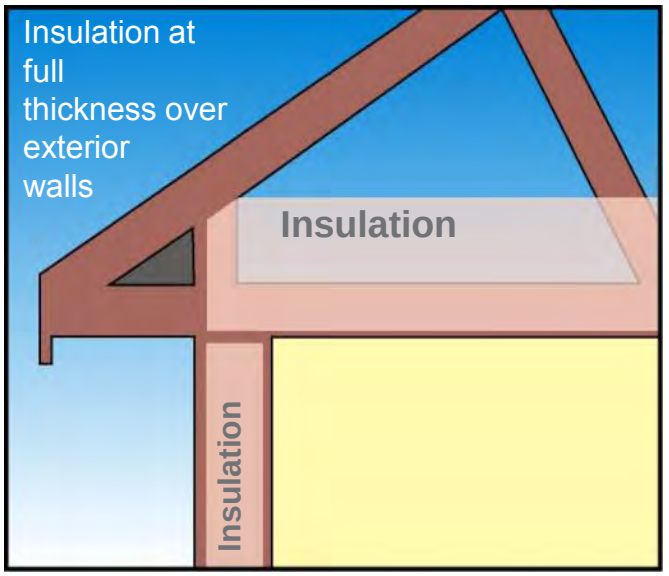
Prescriptive R-value path encourages raised heel truss *(aka, energy truss)*



✓ If insulation is full height uncompressed over exterior wall top plate, covering 100% of ceiling area

- R-30 complies where R-38 is required
- R-38 complies where R-49 is required

Note: This reduction ONLY applies to the R-value prescriptive path, not the U-factor or Total UA alternatives

Ceilings without Attic Spaces
Section R402.2.2 - (e.g., vaulted)

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- ✓ If insulation is full height uncompressed over exterior wall top plate
  - ✓ R-30 allowed for up to 500 ft^2 or 20% total insulated ceiling area, whichever is less, where
    - ✓ Required insulation levels exceed R-30
    - ✓ Design of roof/ceiling assembly does not provide sufficient amount of space to meet higher levels

Note: This reduction ONLY applies to the R-value prescriptive path, not the U-factor or Total UA alternatives

Steel-Frame Ceilings
Section R402.2.6

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Table keys on the wood-frame requirement for the corresponding building component

- ✓ "R-X + R-Y" means R-X cavity plus R-Y continuous
- ✓ In ceilings, insulation that exceeds the height of the framing must cover the framing

Table R402.2.6
Steel-Frame Ceiling, Wall and Floor Insulation (R-Value)

Wood Frame R-value Requirement	Cold-Formed Steel Equivalent R-value[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2x4, or 2x6, or 2x8 R-49 in any framing
R-38	R-49 2x4, or 2x6, or 2x8, or 2x10
Steel Framed Wall, 16 inches on center	
R-13	R-13 + 4.2 or R-21 +2.8, or R-0+9.3 or R-15+R-3.8 or R-21 + 3.1
R-13+3	R-0 + 11.2 or R-13 +6.1, or R-15 +5.7 or R-19+5.0 or R-21+4.7

Access Hatches and Doors
Section R402.2.4 - Prescriptive

Weatherstrip and insulate doors from conditioned spaces to unconditioned spaces *(e.g., attics and crawl spaces)*

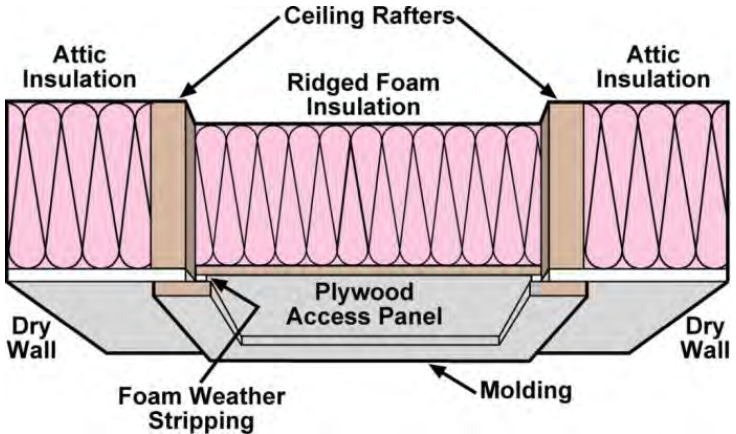
- ✓ Insulate to level equivalent to surrounding surfaces
  - e.g., required ceiling insulation = R-38, then attic hatch must be insulated to R-38

Provide access to all equipment that prevents damaging or compressing the insulation

Install a wood framed or equivalent baffle or retainer when loose fill insulation is installed

Exception:

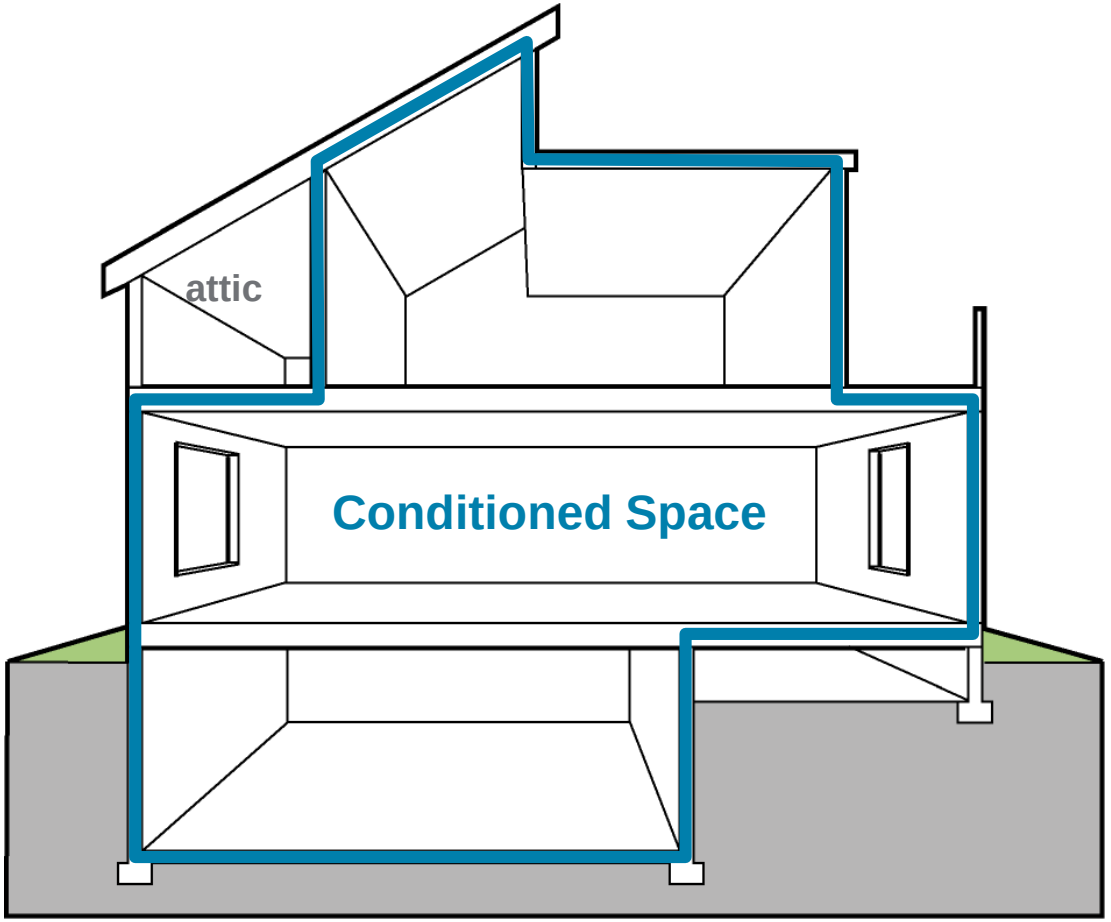
Vertical doors that provide access can meet Table R402.1.2



Building Envelope Specific Requirements

Building Envelope consists of:

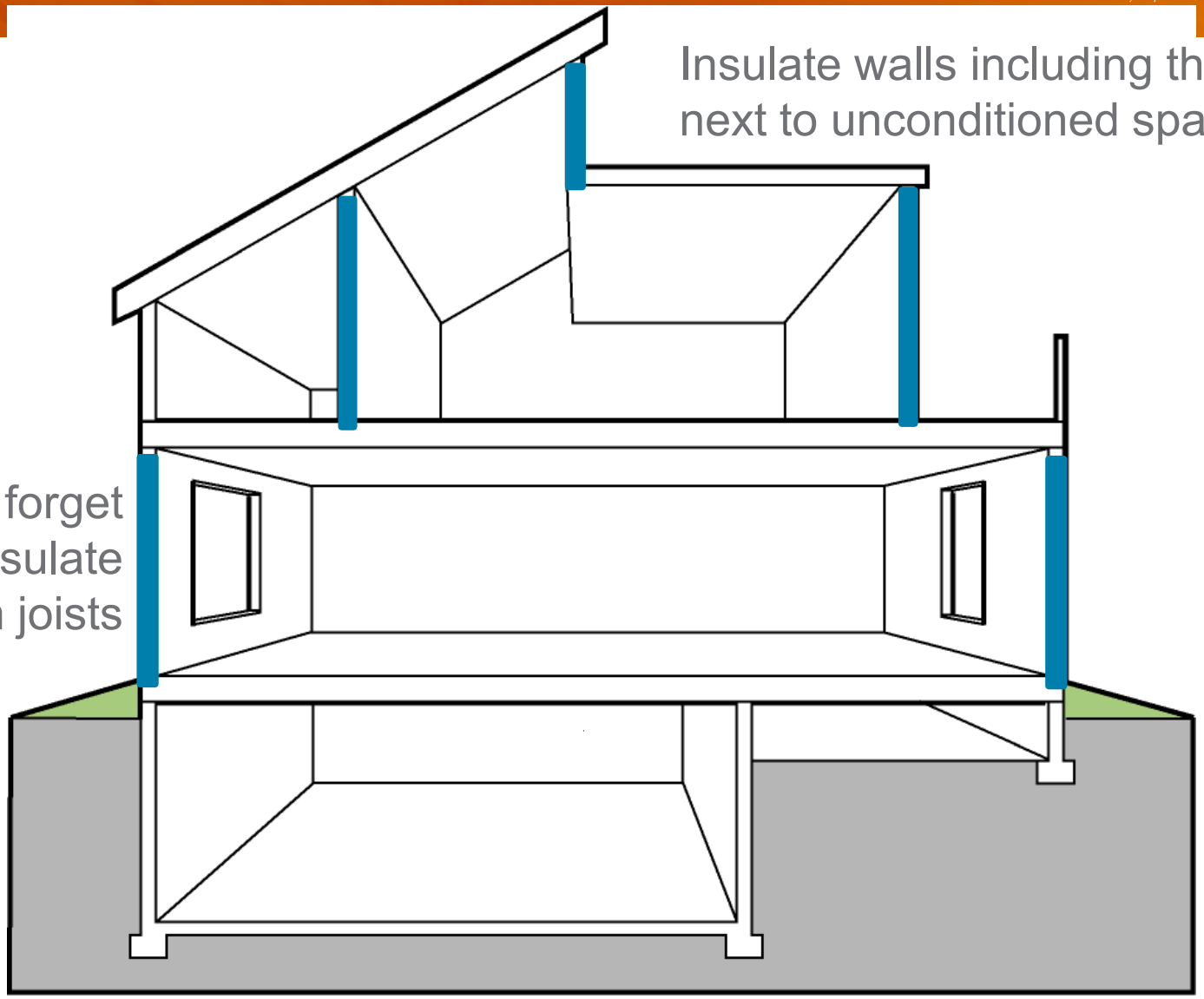
- ✓ Fenestration
- ✓ Ceilings
- ✓ **Walls**
  - Above grade
  - Below grade
  - Mass walls
- ✓ Fenestration
- ✓ Floors
- ✓ Slabs
- ✓ Crawlspaces



Above Grade Walls

Insulate walls including those next to unconditioned spaces

Don't forget to insulate rim joists



Wood-Frame Walls
Section R402

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Table R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	…	WOOD FRAME WALL R-VALUE
1		13
2		13
3		20 or 13+5[h]
4 except Marine		20 or 13+5[h]
5 and Marine 4		20 or 13+5[h]
6		20+5 or 13+10[h]
7 and 8		20+5 or 13+10[h]

h. First value is cavity insulation, second is continuous insulation so. Therefore, as an example, “13+5” means R-13 cavity insulation plus R-5 continuous insulation

Steel-Frame Walls
Section R402.2.6

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Table R402.2.6
Steel-Frame Ceiling, Wall and Floor Insulation (R-Value)

Wood Frame R-value Requirement	Cold-Formed Steel Equivalent R-value[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2x4, or 2x6, or 2x8 R-49 any framing
R-38	R-49 2x4, or 2x6, or 2x8, or 2x10
Steel Framed Wall	
R-13	R-13 + 4.2 or R-19 +2.1, or R-21 +2.8 or R-0+9.3 or R-15+R-3.8 or R-21 + 3.1
R-13+R-3	R-0 + 11.2 or R-13 +6.1, or R-15 +5.7 or R-19+5.0 or R-21+4.7

Table keys on the wood-frame requirement for the corresponding building component

✓ "R-X + R-Y" means R-X cavity plus R-Y continuous

Mass Walls
Section R402.2.5

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What type

- ✓ Concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), adobe, compressed earth block, rammed earth, and solid timber/logs
- ✓ Any other walls having a heat capacity $\geq$6 Btu/ft^2/ºF

Provisions

- ✓ Are assumed to be above grade walls

Mass Wall Requirements
Section R402.2.5

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Second (higher) number applies when more than half the R-value is on the interior of the mass (i.e., when the thermal mass is insulated from the conditioned space)

Table R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	…	MASS WALL R-VALUE[i]
1		3/4
2		4/6
3		8/13
4 except Marine		8/13
5 and Marine 4		13/17
6		15/20
7 and 8		19/21

Walls with Partial Structural Sheathing Section R402.2.7

If structural sheathing covers ≤40% of gross wall area…

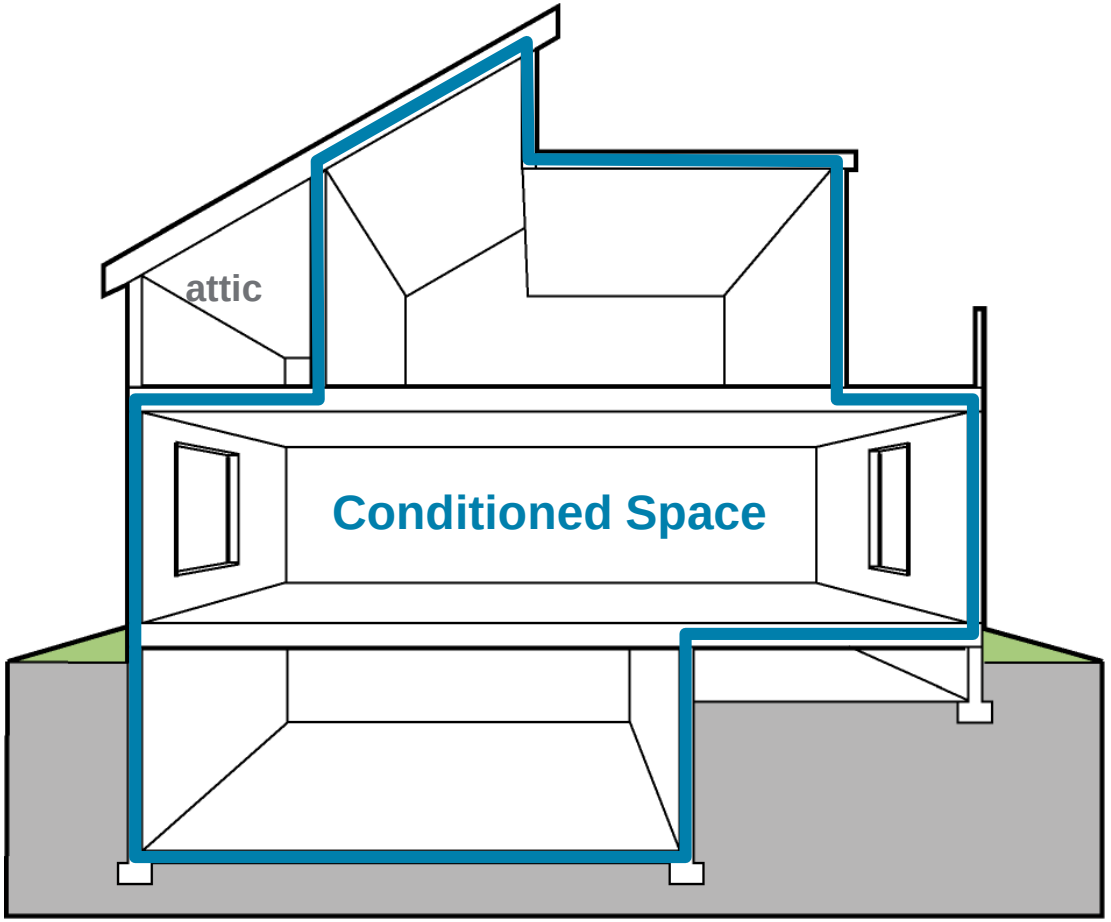
> The continuous insulation R-value can be reduced by as much as R-3 if necessary to result in a consistent total sheathing thickness on areas of walls covered by structural sheathing

This reduction does not apply to the U-factor alternative or Total UA alternative

Building Envelope Specific Requirements

Building Envelope consists of:

- ✓ Fenestration
- ✓ Ceilings
- ✓ Walls
  - Above grade
  - Below grade
  - Mass walls
- ✓ **Floors**
- ✓ Slabs
- ✓ Crawlspaces



Floors Over Unconditioned Space
Section R402.2.8

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Table R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	…	FLOOR R-VALUE
1		13
2		13
3		19
4 except Marine		19
5 and Marine 4		30[g]
6		30[g]
7 and 8		38[g]

Exception: If framing members are too small to accommodate R-30, insulation that fills the framing cavity, not less than R-19, complies

Floors (Over Unconditioned Space)
Section 402.2.8

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Unconditioned space includes unheated basement, vented crawlspace, or outdoor air

Climate Zones	R-Value
1-2	13
3-4ab	19
4c-6	30*
7-8	38*

Exception: cavity insulation in contact with the topside of sheathing or continuous insulation installed on the bottom of floor framing where combined with insulation that meets or exceeds Table R402.1.2 requirements for wood frame walls and that extends from bottom to the top of all perimeter floor framing members

Insulation must maintain permanent contact with underside of subfloor

*** Exception**

Climate Zones 4c-8
R-19 permitted if cavity completely filled

Steel-Frame Floors
Section R402.2.6

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Table R402.2.6
Steel-Frame Ceiling, Wall and Floor Insulation (R-Value)

Wood Frame R-value Requirement	Cold-Formed Steel-Frame Equivalent R-value[a]
Steel Joist Floor[b]	
R-13	R-19 in 2x6, or R-19 + 6 in 2x8 or 2x10
R-19	R-19 + 6 in 2x6, or R-19 + 12 in 2x8 or 2x10

Table keys on the wood-frame requirement for the corresponding building component

- ✓ "R-X + R-Y" means R-X cavity plus R-Y continuous

Defining Below-Grade Walls

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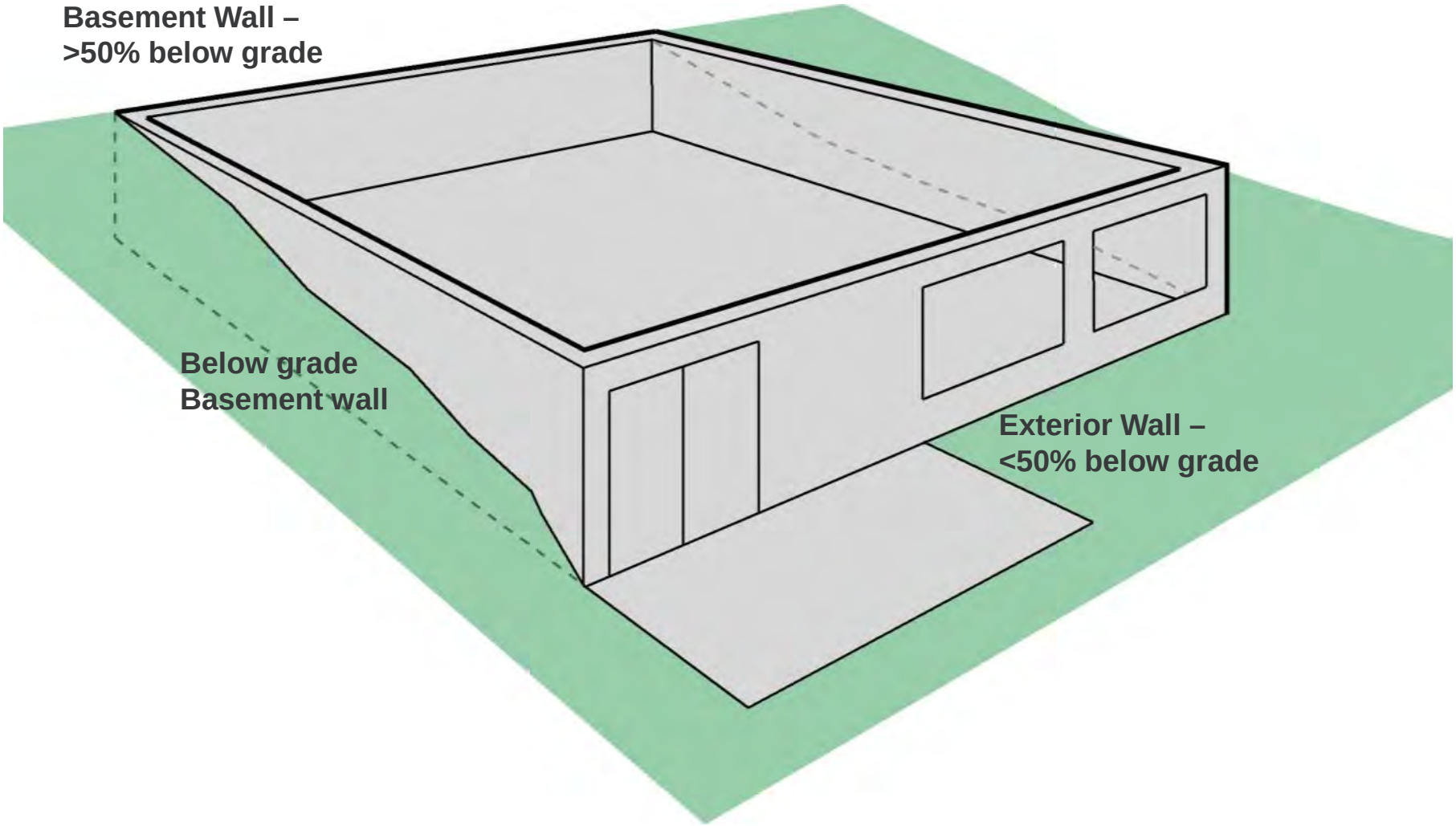
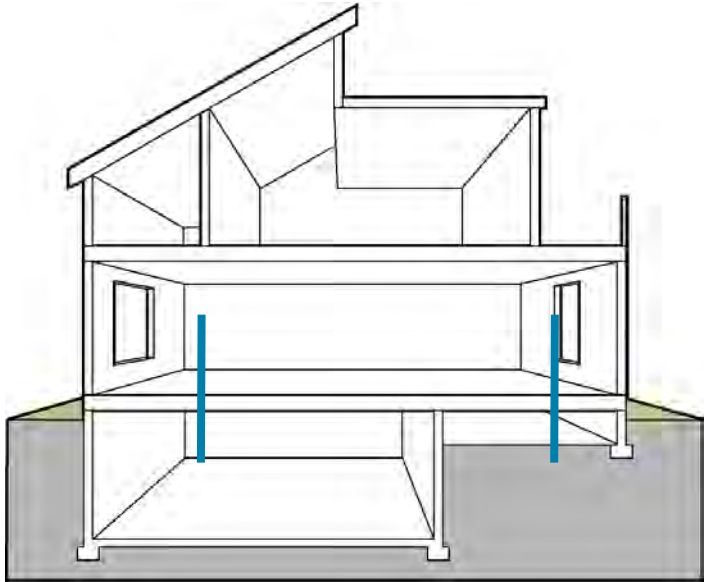


Below-Grade Walls

- ✓ ≥ 50% below grade
- ✓ Otherwise treat as above-grade wall

Climate Zones	R-Value
1-2	0
3	5/13
4ab	10/13
4c-8	15/19

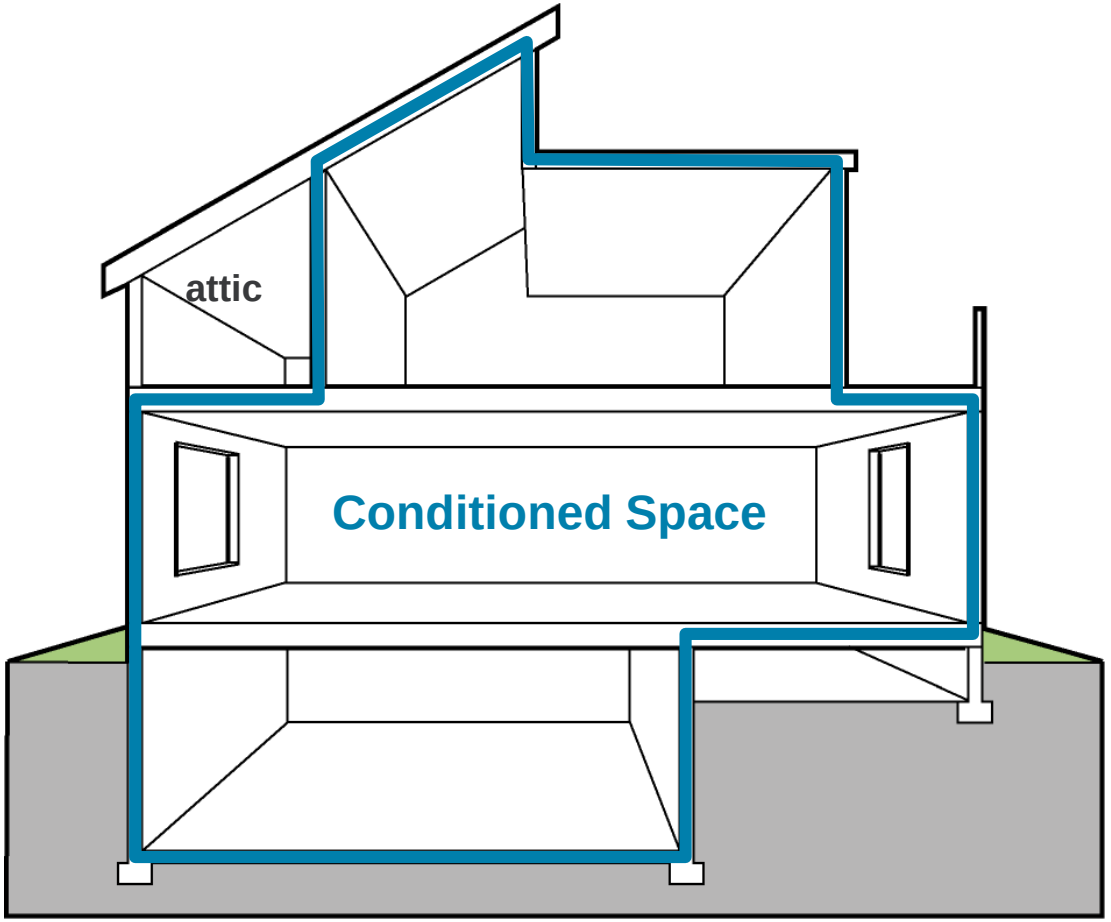


Insulated from top of basement wall down to 10 ft below grade or basement floor, whichever is less

Building Envelope Specific Requirements

Building Envelope consists of:

- ✓ Fenestration
- ✓ Ceilings
- ✓ Walls
  - Above grade
  - Below grade
  - Mass walls
- ✓ Floors
- ✓ **Slabs**
- ✓ Crawlspaces



Slab Edge Insulation
Section R402.2.10

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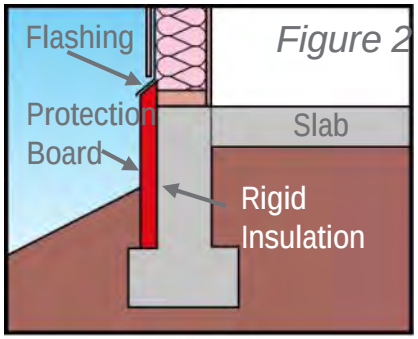
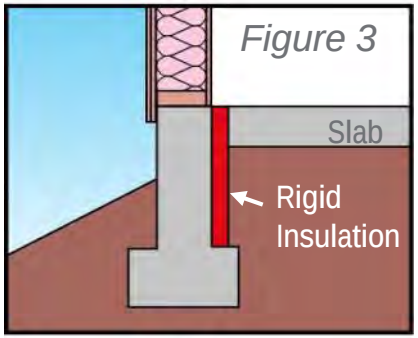
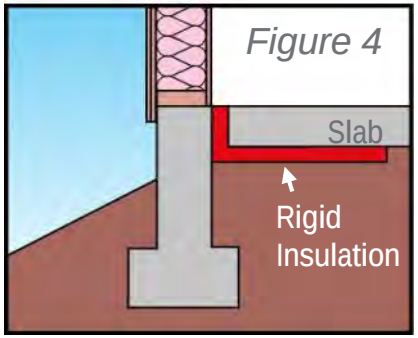
Applies to slabs with a floor surface < 12 inches below grade

- ✓ R-10 (typically 2 inches) insulation in Zones 4 and above
- ✓ Must extend downward from top of slab a minimum of 24” (Zones 4 and 5) or 48” (Zones 6, 7, and 8)
- ✓ Insulation can be vertical or extend horizontally under the slab or out from the building
- ✓ Insulation extending outward must be under 10 inches of soil or pavement
  - An additional R-5 is required for heated slabs
  - Insulation to depth of the footing or 2 feet, whichever is less in Zones 1-3 for heated slabs







Slab Edge Insulation
Section R402.2.10

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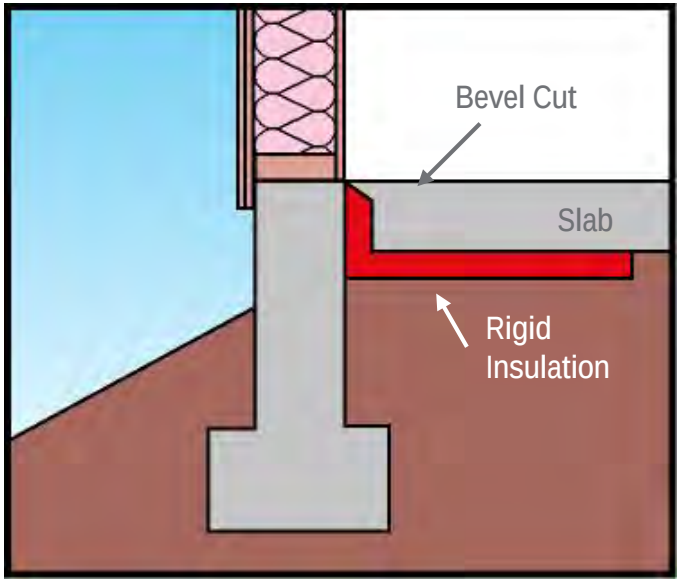

Building Envelope Specific Requirements

Pacific Northwest NATIONAL LABORATORY
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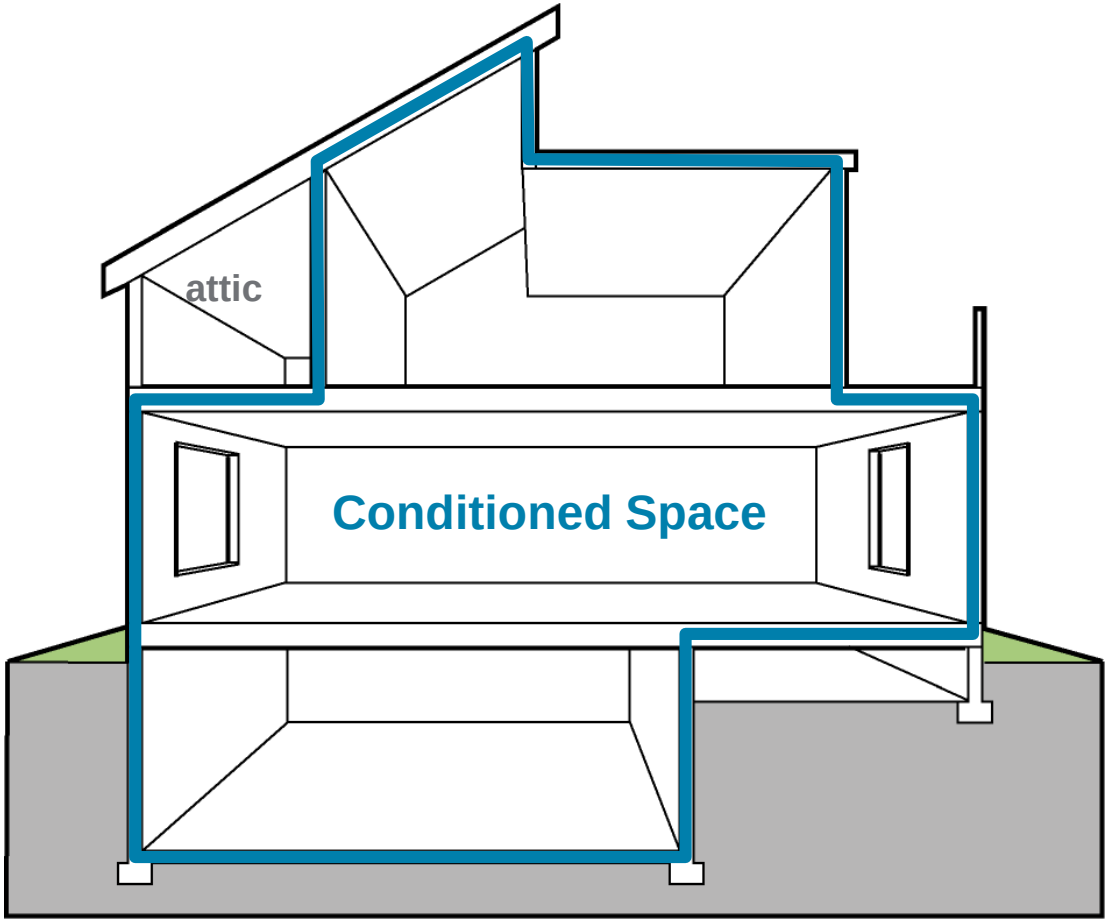
Building Envelope consists of:

- ✓ Fenestration
- ✓ Ceilings
- ✓ Walls
  - Above grade
  - Below grade
  - Mass walls
- ✓ Floors
- ✓ Slabs
- ✓ **Crawlspaces**



Crawlspace Wall Insulation
Section R402.2.11

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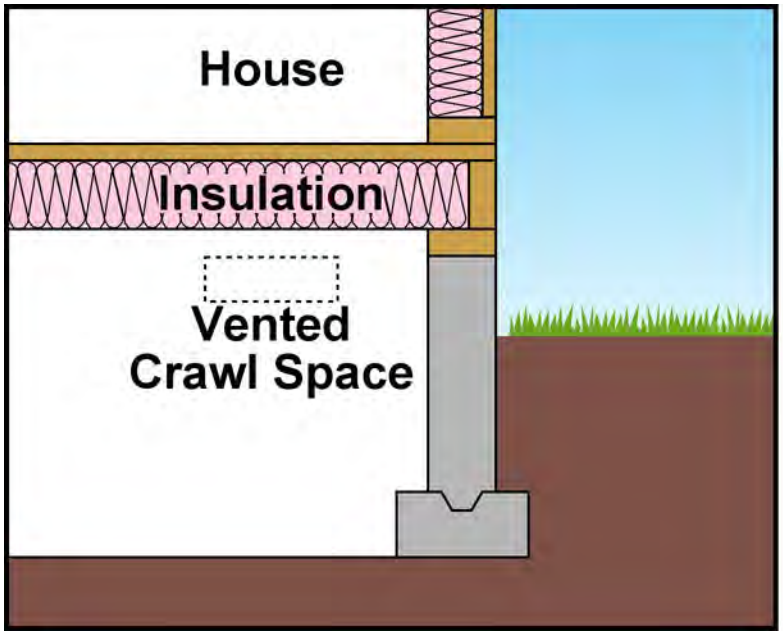
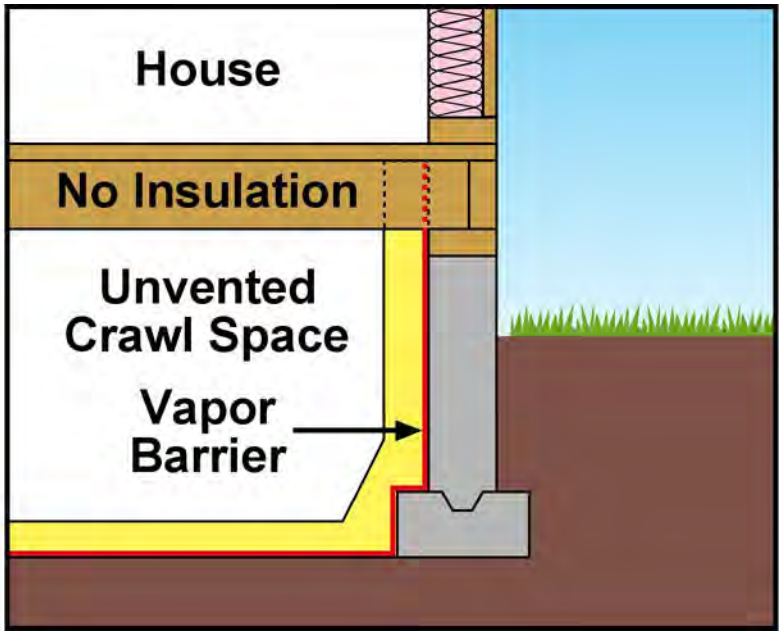
Implies an unvented crawlspace *(aka, conditioned crawlspace)*

- ✓ Space must be mechanically vented or receive minimal supply air *(Refer to IRC)*
- ✓ Exposed earth must be covered with a continuous Class I vapor retarder





Vented & Unvented Crawlspaces
Section R402.2.11

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Vented Crawlspace Requirements:

- ✓ The raised floor over the crawlspace must be insulated.
- ✓ A vapor retarder may be required as part of the floor assembly.
- ✓ Ventilation openings must exist that are equal to at least 1 square foot for each 150 square feet of crawlspace area and be placed to provide cross-flow *(IRC 408.1, may be less if ground vapor retarder is installed).*
- ✓ Ducts in crawlspace must be sealed and have R-6 insulation.

Unvented Crawlspace Requirements:

- ✓ The crawlspace ground surface must be covered with an approved vapor retarder *(e.g., plastic sheeting).*
- ✓ Crawlspace walls must be insulated to the R-value requirements specific for crawlspace walls *(IECC Table R402.1.2).*
- ✓ Crawlspace wall insulation must extend from the top of the wall to the inside finished grade and then 24” vertically or horizontally.
- ✓ Crawlspaces must be mechanically vented *(1 cfm exhaust per 50 square feet)* or conditioned *(heated and cooled as part of the building envelope).*
- ✓ Ducts are inside conditioned space and therefore don’t need to be insulated.

Air Leakage Control
Section R402.4.1

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Building thermal envelope




Building Thermal Envelope
Section R402.4.1 – Air Leakage

Requires BOTH:

- ✓Whole-house pressure test

Air Leakage Rate	Climate Zone	Test Pressure
≤ 5 ACH	1-2	50 Pascals
≤ 3 ACH	3-8	50 Pascals

  - Testing may occur any time after creation of all building envelope penetrations
- ✓Field verification of items listed in Table R402.5.1.1

Table R402.4.1.1

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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 sealed. Access openings, drop down stair 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.	

(partial table)

Mechanical Systems & Equipment

Equipment efficiency requirements are set by Federal law, not the I-Codes

Requirements for Systems
Section R403

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- ✓ Controls
- ✓ Heat pump supplementary heat
- ✓ Hot water boiler outdoor temperature reset
- ✓ Ducts
  - – Sealing (Mandatory)
  - – Insulation (Prescriptive)
- ✓ HVAC piping insulation
- ✓ Hot water systems
- ✓ Ventilation
  - Dampers
- ✓ Equipment sizing
- ✓ Systems serving multiple dwelling units
- ✓ Snow melt controls
- ✓ Pools and in-ground permanently installed spas

Programmable Thermostat
Section R403.1.1 - Controls

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- ✓ At least one programmable thermostat controlling the primary heating/cooling per dwelling unit
- ✓ Capability to set back or temporarily operate the system to maintain zone temperatures
  - Not less than 55ºF (13ºC) or
  - Not greater than 85ºF (29ºC)
- ✓ Initially programmed by manufacturer:
  - heating temperature set point not greater than 70ºF (21ºC) and
  - cooling temperature set point not less than 78ºF (26ºC)

Duct Insulation
Section R403.3.1 - Prescriptive

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- ✓ Supply and return ducts in **attics**: R-8 where ≥ 3" diameter, R-6 if < 3"
- ✓ Other areas: R-6 where ≥ 3" diameter, R-4.2 if < 3"

Examples

Location	Duct Diameter ≥3" or <3"
Attic	R-8 or R-6
Conditioned Space	NR
Vented Crawlspace	R-6 or R-4.2
Conditioned Crawlspace	NR
Basement – Conditioned	NR
Basement – Unconditioned	R-6 or R-4.2
Exterior Walls	R-6 or R-4.2

Duct Testing
Section R403.3.3 - Mandatory

- Ducts shall be pressure tested to determine air leakage by either of the following:
  - Rough-in test
    - Total leakage measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system including manufacturer's air handler enclosure
      - All registers taped or otherwise sealed
  - Postconstruction test
    - Total leakage measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system including manufacturer's air handler enclosure
      - All registers taped or otherwise sealed
  - Exceptions
    - Duct air leakage test not required where ducts and air handlers are entirely within the building thermal envelope
    - Test not required for ducts serving heat or energy recovery ventilators not integrated with ducts serving heating or cooling systems
- A written report of results of test signed by the party conducting test and provided to code official

Duct Leakage
Section R403.3.4 - Prescriptive

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Total leakage of ducts, where measured in accordance with Section 403.3.3 shall be as follows:

- ✓ Rough-in test
  - Total leakage ≤4 cfm/per 100 ft^2 of conditioned floor area
    - if air handler not installed at time of test
      - Total air leakage ≤3 cfm/per 100 ft^2
- ✓ Postconstruction test
  - Total leakage ≤4 cfm/per 100 ft^2 of conditioned floor area

Building Cavities
Section R403.3.5 - Mandatory

Framing cavities cannot be used as ducts or plenums

Lighting Equipment
Section R404.1 - Mandatory

A minimum of 90 percent of the permanently installed lighting fixtures shall contain only high efficacy lamps

What's Changed in the 2018 IECC (Summary)

- 46 (47) proposed changes were approved for 2018
  - 14 affect energy
    - 11 reduce energy use
    - 3 increase energy use
  - 33 are administrative or otherwise not energy related

What's Changed in the 2018 IECC (A few notable changes)

- Log home (walls) exempted if designed in accordance with ICC 400
- Heated slab-on-grade must have R-5 insulation under entire slab
- Fenestration U-factors improved in Zones 3-8
- New provisions for HRV/ERV fan efficacy
- High-efficacy lighting fraction raised from 75% to 90% of fixtures
- New provisions for buried ducts in attics
- Changes to ERI path
  - Now references ANSI/RESNET/ICC 301 -2014
  - ERI thresholds relaxed
  - More stringent envelope hard limits for homes with on-site generation

A Closer Look

- Buried Ducts in Attics
- Energy Rating Index (ERI) Compliance Path

Ducts Buried within Ceiling Insulation

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Prior to 2018, the IECC did not prohibit buried ducts, but neither did it define the practice or make specific allowance for it. The new provisions:

1. Define buried-duct practices that are explicitly allowed
2. Allow simplified credit for buried ducts in the performance path
   - Buried ducts incorporated into simulated performance rules
   - Provide a means to characterize the performance of a buried duct system as an equivalent duct insulation R-value
   - Buried duct system may be considered inside conditioned space if certain requirements are met (ceiling insulation, duct insulation, air leakage)

Ducts Buried within Ceiling Insulation
Section R403.3.6

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Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation *R*-value not less than R-8.
2. At all points along each duct, the sum of the ceiling insulation *R*-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the *R*-value of the duct insulation.
3. In *Climate Zones* 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an *R*-value of not less than R-13 and in compliance with the vapor retarder requirements of Section 604.11 of the *International Mechanical Code* or Section M1601.4.6 of the *International Residential Code*, as applicable.

- **Exception:** Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

Effective R-value of Deeply Buried Ducts
Section R403.3.6.1

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Where using a simulated energy performance analysis, sections of ducts that are…

- installed in accordance with Section R403.3.6
- located directly on, or within 5.5 inches (140 mm) of the ceiling
- surrounded with blown-in attic insulation having an *R*-value of R-30 or greater
- located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation

…shall be considered as having an effective duct insulation *R*-value of R-25.

Ducts Located in Conditioned Space
Section R403.3.7

For simulated performance path, buried ducts may be considered inside conditioned space if:

1. The duct system is actually located completely within the continuous air barrier and within the building thermal envelope, OR
2. The ducts are buried within ceiling insulation in accordance with Section R403.3.6 and all of the following conditions exist:
   - The air handler is located completely within the *continuous air barrier* and within the building thermal envelope.
   - The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section R403.3.4, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m2) of conditioned floor area served by the duct system.
   - The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.

Buried Ducts – Detailed Information

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Buried Ducts: Advantages, Challenges, and New Options in the 2018 IECC

Craig Drumheller, NAHB

U.S. Department of Energy Building Energy Codes Program
Energy Codes Commentator Webinar Series
AIA Provider #: I014 AIA Course #: BECPWS1117
ICC Provider Course # 14012
November 9, 2017

https://www.energycodes.gov/resource-center/training-courses/buried-ducts-advantages-challenges-and-new-options-2018-iecc

ERI Path Overview and Summary of Changes in 2018

Eric Makela
Associate Directory, New Buildings Institute

What You Need to Know About the 2018 IECC: ERI Approach

Eric Makela
Associate Director

March 8, 2018

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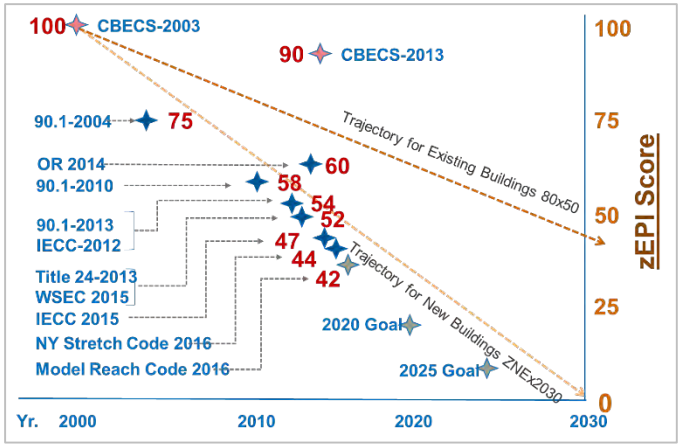
NBI: Advancing Codes and Policy



Need: Many states, municipalities and private organizations are seeking increased energy efficiency beyond minimum code levels—many establishing zero-energy goals

NBI Vision: Zero Energy performance is required in 80% of new construction in 2031 and in existing buildings by 2050

NBI Strategy: NBI leverages deep technical research and experience to influence the advancement of national, state and local codes and policies on the path toward zero energy buildings.

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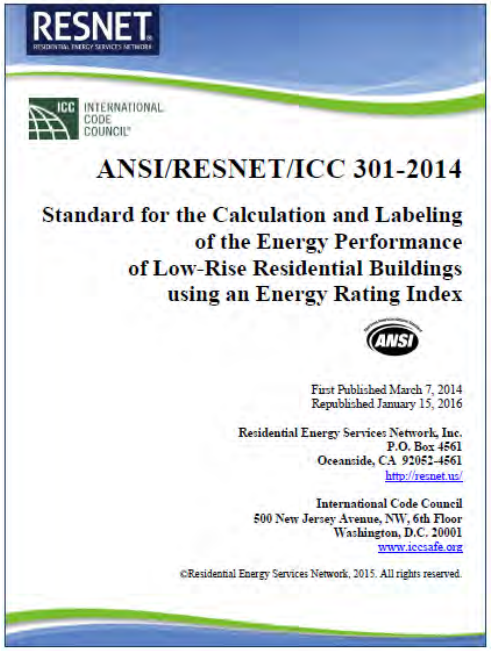
Goals of the ERI Concept

- Increase compliance for residential energy codes
- Provide additional flexibility for designers and builders
- Enable cost-effective options at equitable efficiency levels
- Create a metric that is easily understood by homeowners
- Increase building energy savings through increased compliance
- Complement existing performance-based residential efficiency programs
- Provide a platform to move code to zero energy

Changes to the 2018 ERI Requirements


RESNET

INTERNATIONAL CODE COUNCIL

ANSI/RESNET/ICC 301-2014

Standard for the Calculation and Labeling of the Energy Performance of Low-Rise Residential Buildings using an Energy Rating Index

ANSI

First Published March 7, 2014
Republished January 15, 2016

Residential Energy Services Network, Inc.
P.O. Box 4561
Oceanside, CA 92052-4561
http://resnet.us/

International Code Council
500 New Jersey Avenue, NW, 6th Floor
Washington, D.C. 20001
www.iccsafe.org

- RESNET/ICC Standard 301 now referenced at the basis for the ERI
  - Covers how to calculate the ERI score
  - Compliance software tool certification
  - Sources for input values not specified by the IECC
- ERI score excludes energy used to recharge vehicles

Changes to the 2018 ERI Requirements

- Changes to renewables requirements
  - 2015 “backstop” with renewable tradeoff
  - 2009 “backstop” without renewable tradeoff
- Changes to ERI Scores
  - Values increased from 2015

2018 IECC ERI Scores		
Climate Zone	2018 ERI Score	2015 ERI Scores
1 – 2	57	52
3	57	51
4	62	54
5	61	55
6	61	54
7-8	58	53

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Positives and Issues with ERI Approach

- Positives:
  - ERI has been used as the basis for a Stretch Code in Vermont and Massachusetts
  - There has been a discrepancy in ERI scores in large vs. small homes—RESNET Standard 301 is working to address this
  - ICC has partnered with RESNET to focus on ensuring raters understand the energy code
- Issues:
  - There has been significant debate about what the 'proper' ERI scores should be within the IECC
  - The ERI introduces new questions, such as tradeoffs with renewable energy systems
  - ERI scores that have been adopted in some states are higher (less stringent) than code
  - Quality assurance is crucial

Vermont Stretch Code Example

Stretch Code Target	54	Maximum HERS index to demonstrate code compliance
Sub Target	65	Maximum HERS Index without any renewables incorporated
Renewables Adder	11	Maximum HERS index points that can be counted toward Codes Target

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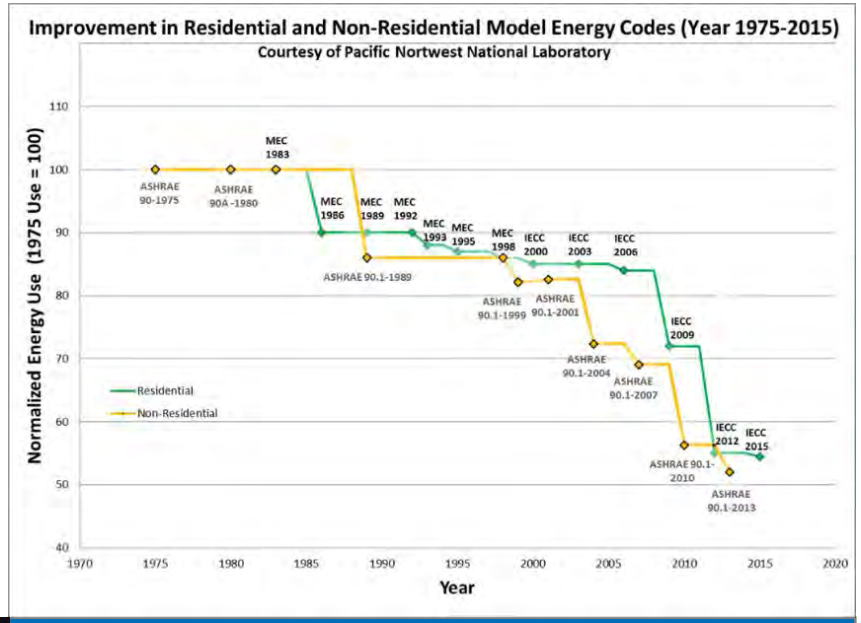
Massachusetts Stretch Code Example

Table N1106.4.1 (R406.4.1). Maximum HERS ratings with onsite renewable energy systems

Renewable Energy Source	Maximum HERS index	
	New construction	Whole house renovations; additions
None	55	65
Solar PV > 2.5kW; Renewable primary heating system	60	70
Solar PV; Renewable primary heating & solar thermal DHW	62	72
Solar PV & Renewable primary heating & solar thermal DHW	67	77

Example: NBI Stretch Code Support

Stretch energy codes are an above code standard that provides an alternative regulatory pathway that can result in more efficient commercial and residential building projects. To support the use of stretch codes, NBI provides technical development and implementation guidance for local jurisdictions and utilities. The NBI-developed Core Performance standard was the basis for the first Massachusetts stretch code, which later was adapted into the 2012 IECC. NBI has created stretch code recommendations for Washington State, the City of Boulder, and is leading the development of the New York State Stretch Energy Code.



New York Stretch Code

NBI is leading the New York Stretch/Energy Code imitative to develop an above-code standard that will provide an alternative regulatory pathway to result in more efficient commercial and residential building projects. This code can be adopted by any jurisdiction in New York State interested in ensuring that building owners and developers provide additional energy savings in homes and buildings. The residential and commercial provisions of the code were separately modeled to quantify energy savings beyond the 2016 NYSECCC.

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Thank you!


Marin Country Day School (Photo: Michael David Rose)

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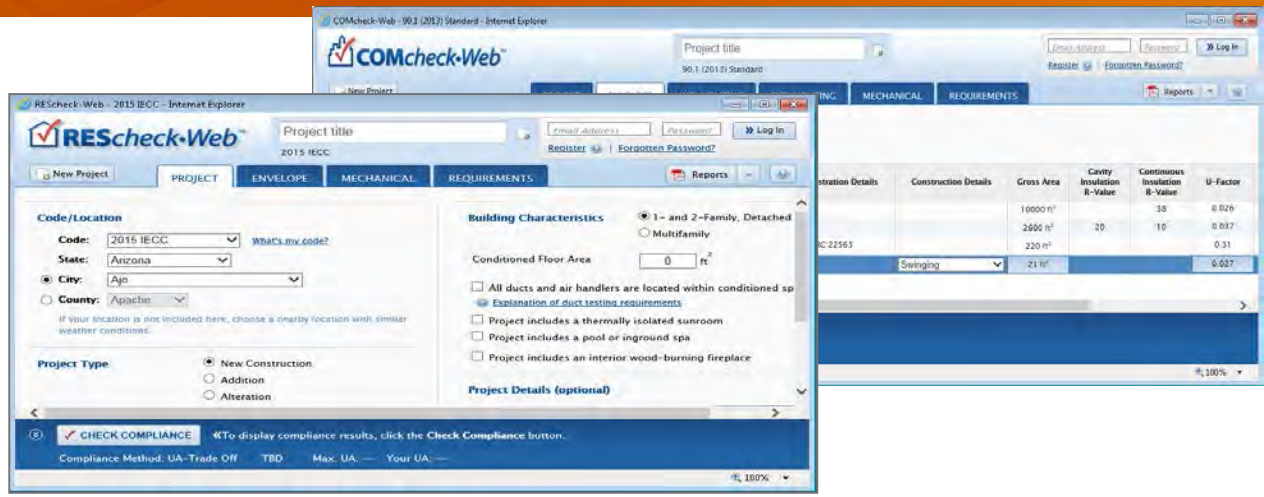

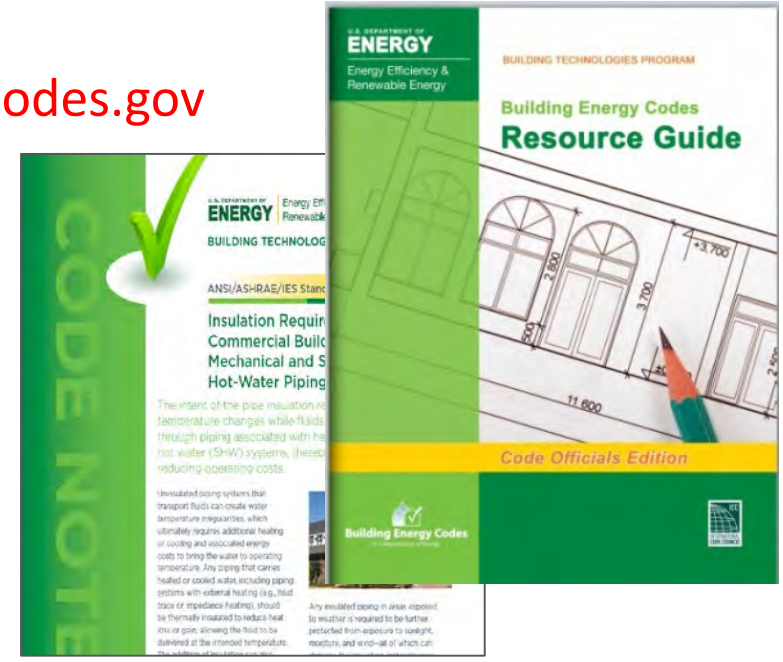

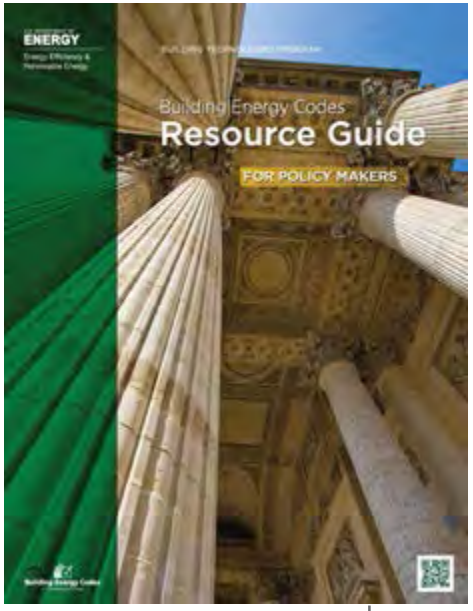

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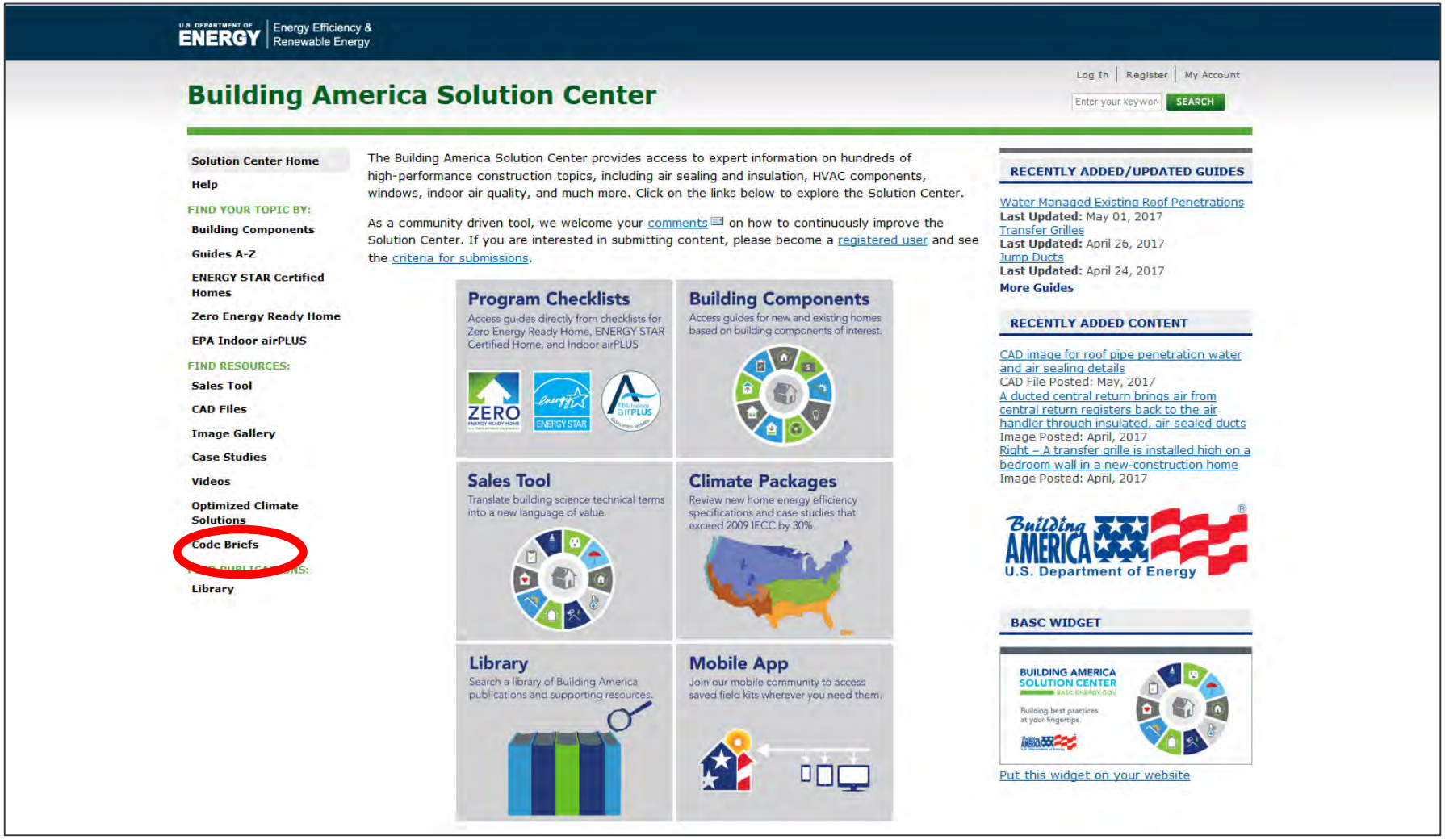

https://basc.energy.gov/

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Ducts Buried in Attic Insulation

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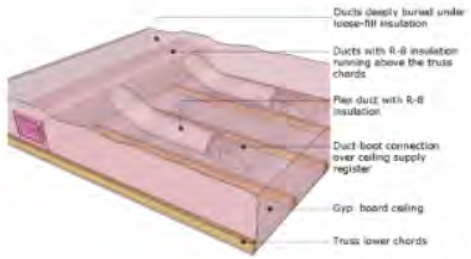
Scope

Buried ducts are installed in unconditioned attics. Ducts are installed in contact with the ceiling and/or truss lower cords. Loose-fill insulation is installed at the ceiling plane, covering the ductwork. This insulation serves as ceiling insulation and additional insulation for ductwork. The figure to the right provides a diagram of a finished buried duct installation. Buried Ducts should *not* be installed in moist and marine climate zones.



1. Install ductwork in direct contact with the ceiling and/or truss lower cords.
2. Mastic-seal all duct connections.
3. Test total duct leakage.
4. Install loose-fill ceiling insulation.

See Encapsulated Ducts and Ducts Buried in Attic Insulation & Encapsulated for more information.

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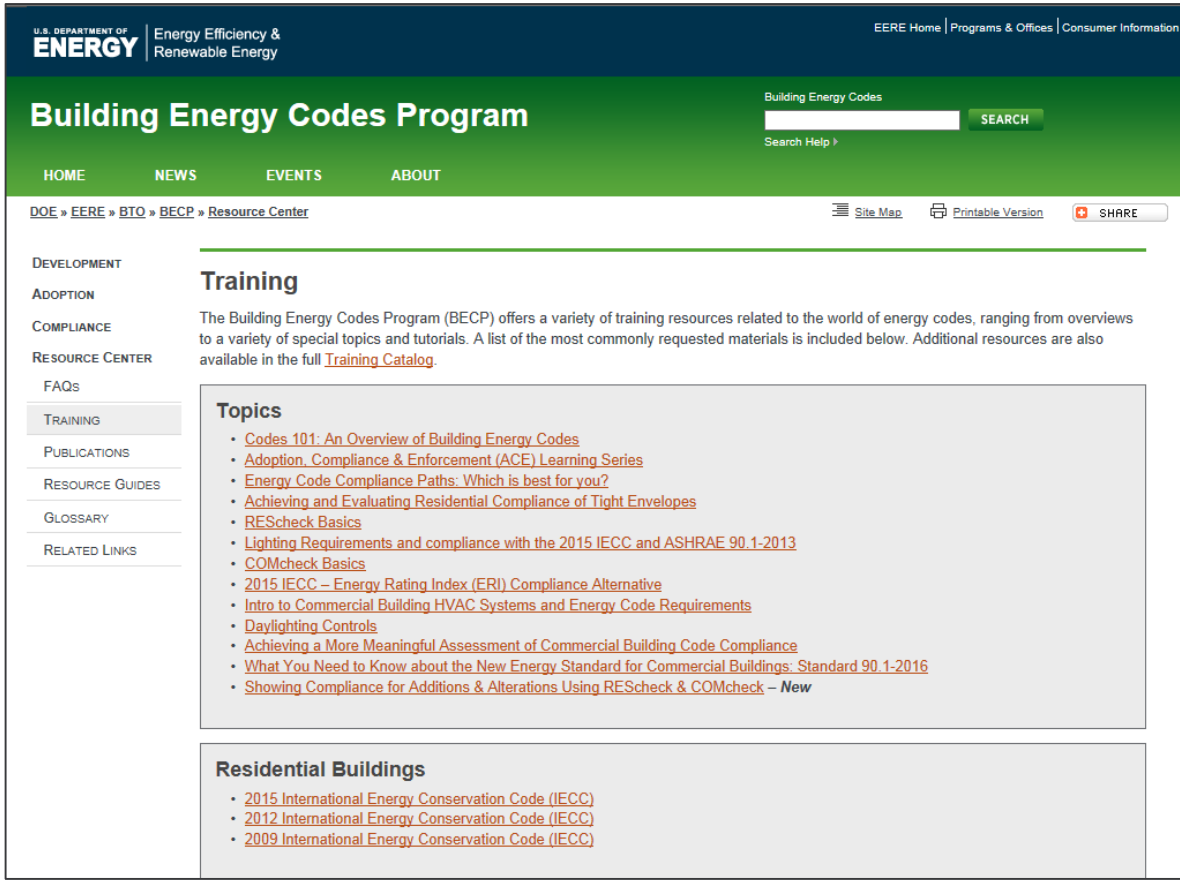

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