

IECC 2015: Impact on Insulation



Outline

- ▶ The Big Picture
- ▶ What's New
- ▶ Pathways to Comply
- ▶ Difficult Details
- ▶ Q&A

The Big Picture

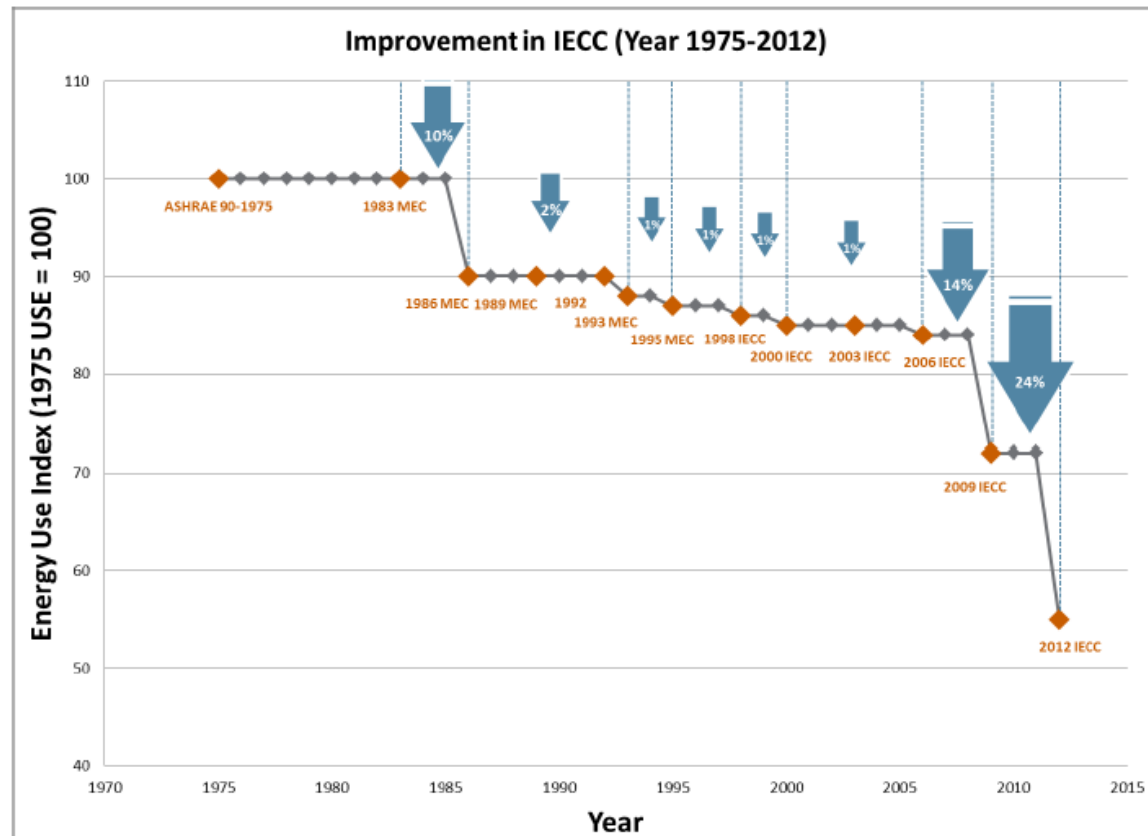
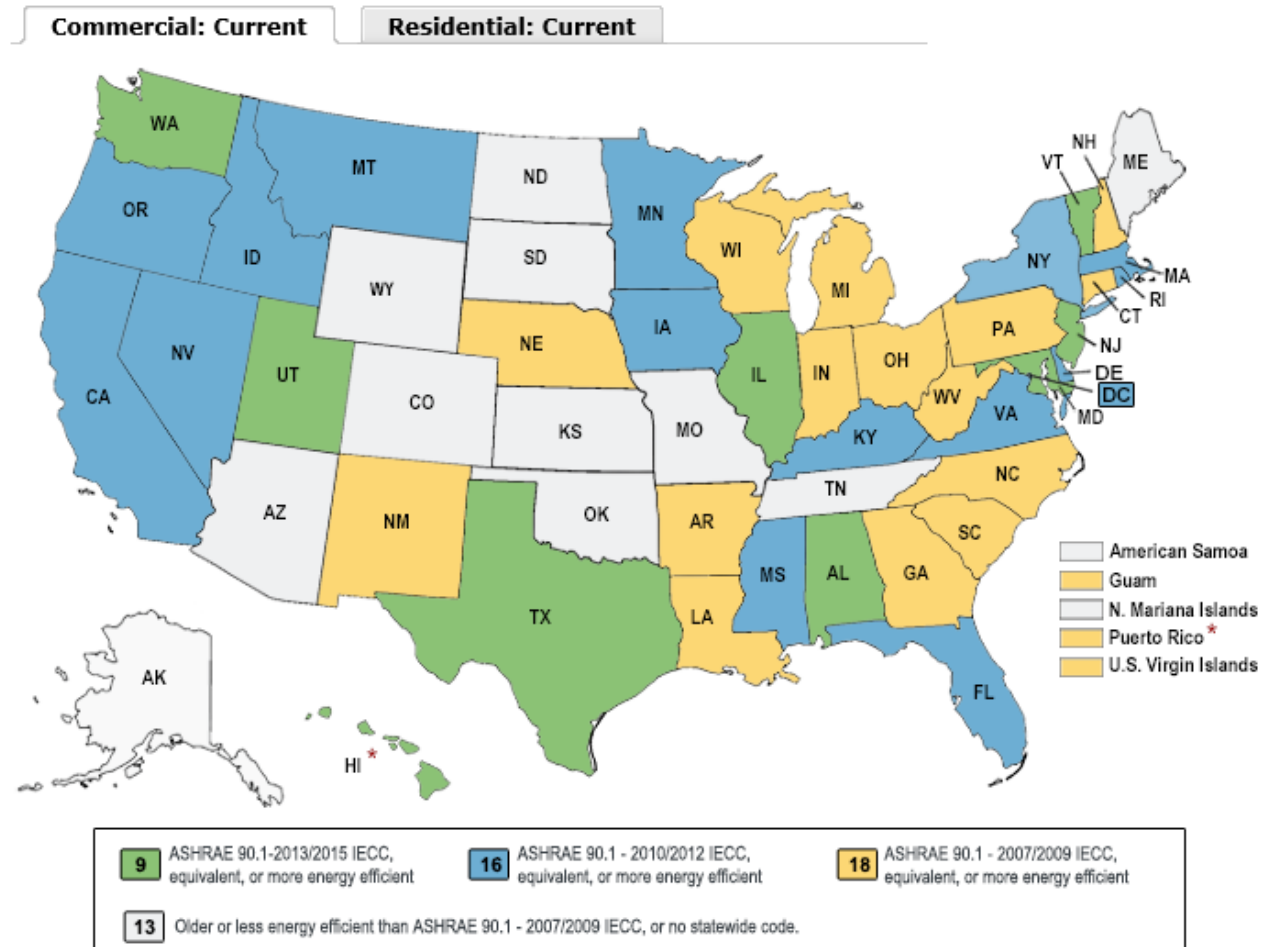


Figure 4.1. IECC Residential Energy Improvement Index

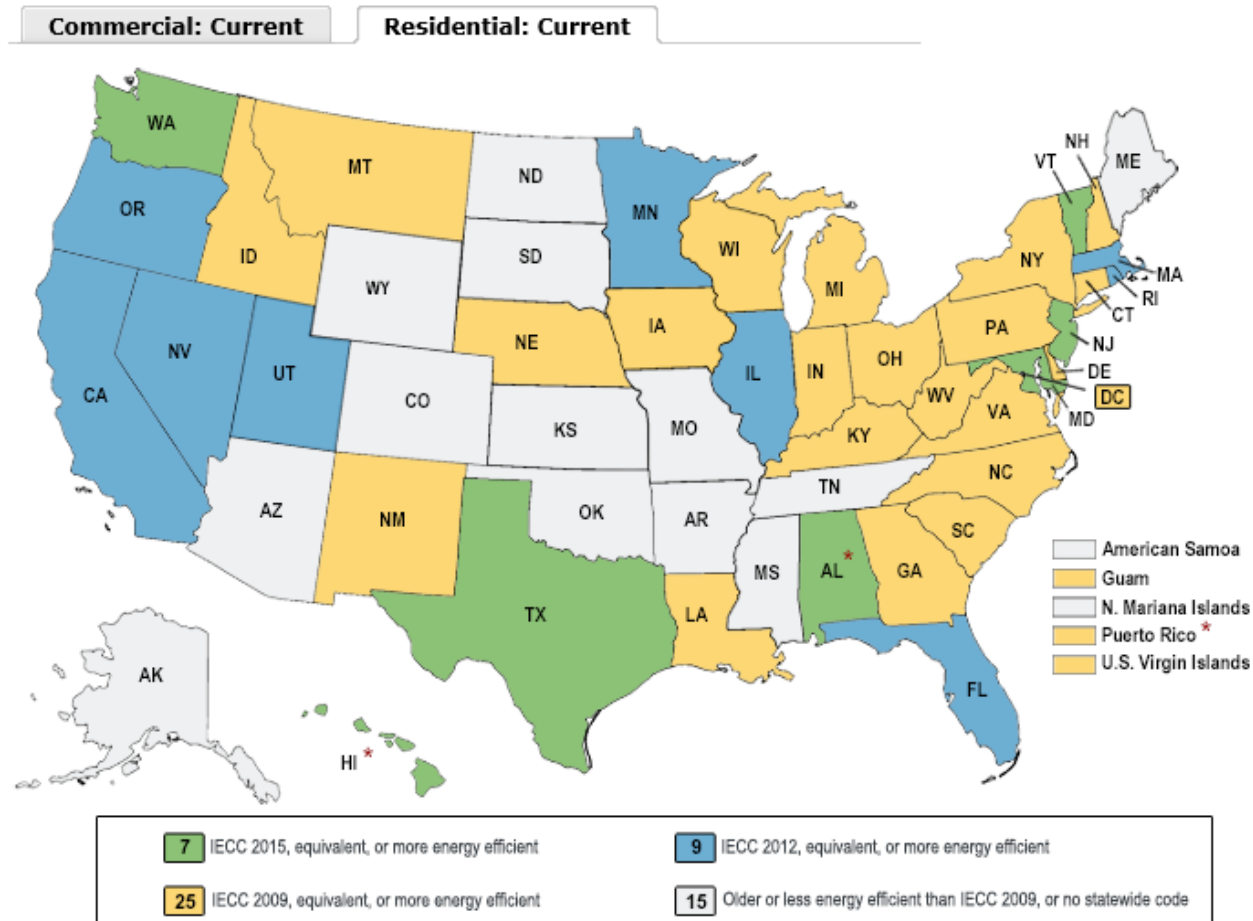
The Big Picture



* Adopted new Code to be effective at a later date

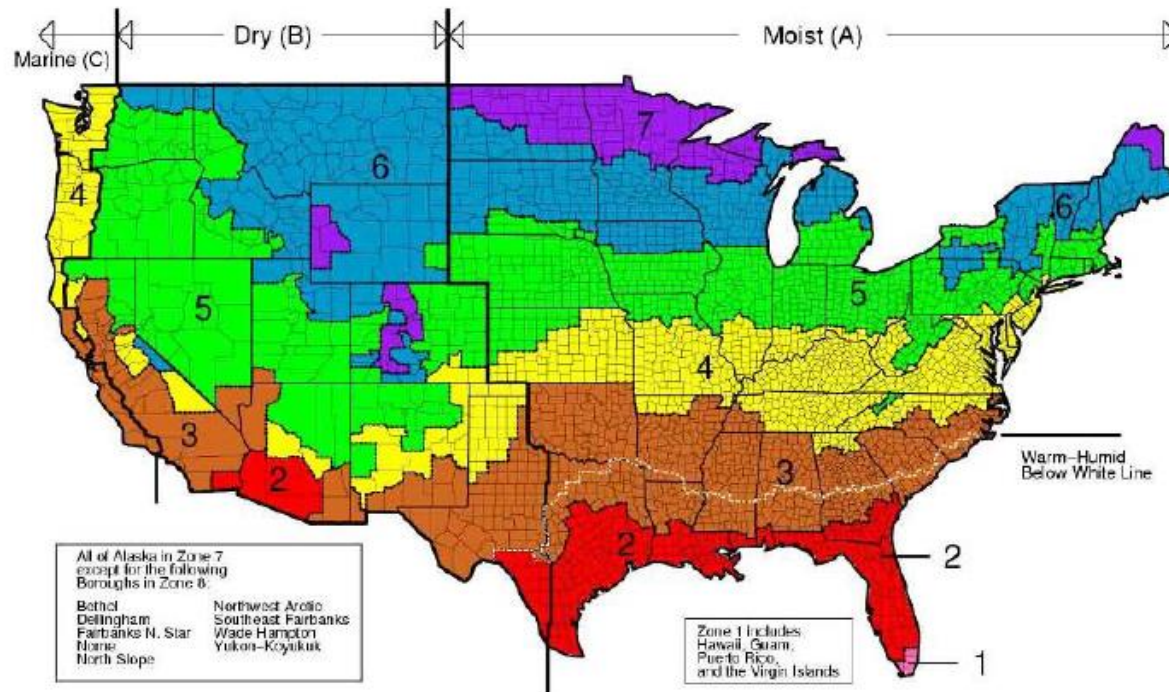
As of September 2016

The Big Picture



As of September 2016

The Big Picture



New – Tropical climate zone now defined

What's New

▶ **Margin Markings within the 2015**

- ▶ **Solid vertical lines** indicate a technical change from the requirements of the 2012 (2009) edition.
- ▶ **Arrows** indicate where a section, paragraph, item in a list, exception or table has been deleted.
- ▶ **A single asterisk** [*] indicates that text or a table has been relocated elsewhere in the code.
- ▶ **A double asterisk** [**] indicates that the section or table immediately following has been relocated here from a different section.

What's New: Residential

- **Major change: RE-188**
 - Institutes an Energy Rating Index compliance path
- **New exemption to § R402.2.7**
 - Allows for floor framing cavity insulation not to be in contact with the underside of the subfloor decking as long as it is in contact w/ the topside of sheathing or continuous insulation installed on the bottom side of floor framing
- **New section R402.2.13**
 - Addresses “walls with partial structural sheathing”
- **Significant revision to R402.4.1.1 'Air Barrier and Insulation Installation'**
 - Splits the 'criteria' column into separate 'air barrier' and 'insulation installation' criteria.
- **Testing for building envelope air leakage under § 402.4.1.2 revised to require that all testing been done in accordance w/ ASTM E 779 or ASTM E 1827**

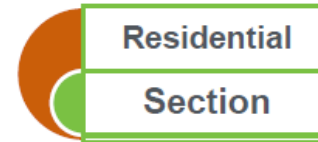
What's New: Commercial

- **Several changes to the Commercial Code yield incremental efficiency gains**
 - The rest reorganize and clarify the code
- **Most changes concentrated in Lighting and HVAC**
- **C103.2.1 Building thermal envelope depiction**

Pathways to Comply

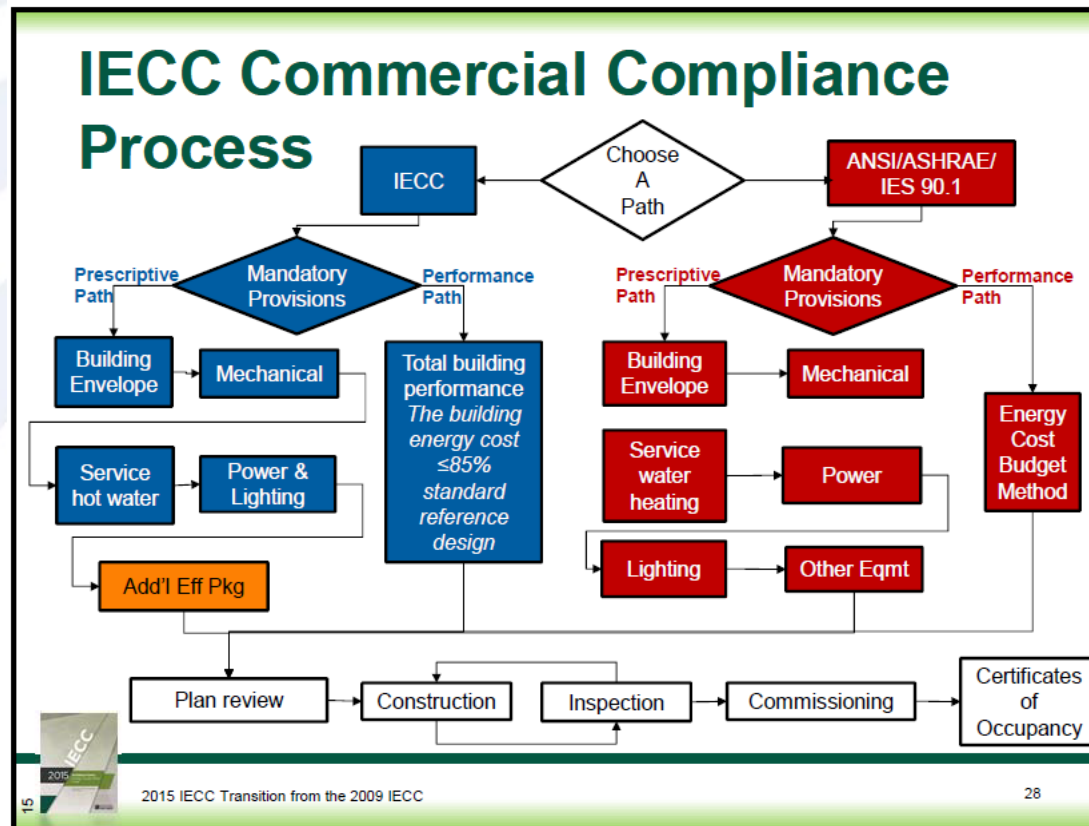


Ch. 1 Scope and Application /
Administrative and
Enforcement
Ch. 2 Definitions
Ch. 3 General Requirements
Ch. 4 Commercial Energy Efficiency
Ch. 5 Existing Buildings - **NEW**
Ch. 6 Referenced Standards
Index



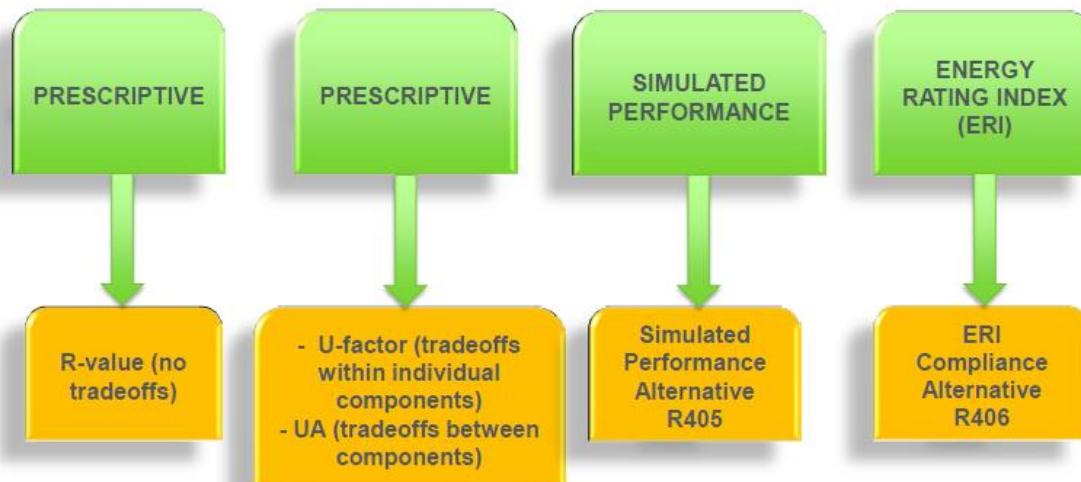
Ch. 1 Scope and Application /
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Pathways to Comply



Pathways to Comply

► Residential Options



Pathways to Comply

► Residential Options: Prescriptive

Climate-Specific Requirements:

- ✓ Roofs
- ✓ Above grade walls
- ✓ Foundations
 - Basements
 - Slabs
 - Crawlspace
- ✓ Skylights, windows, and doors
- ✓ Solar Heat Gain Coefficient in warm climates

Mandatory Requirements (*apply everywhere*):

- ✓ 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

Pathways to Comply

► Residential Minimums

TABLE N1102.1.2 (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	0.35	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

Pathways to Comply

► Residential Minimums

	Wood Frame Walls				Ceilings				Floors			
	2006	2009	2012	2015	2006	2009	2012	2015	2006	2009	2012	2015
1	13	13	13	13	30	30	30	30	13	13	13	13
2	13	13	13	13	30	30	38	38	13	13	13	13
3	13	13	20 or 13+5	20 or 13+5	30	30	38	38	19	19	19	19
4 except Marine	13	13	20 or 13+5	20 or 13+5	38	38	49	49	19	19	19	19
5 and Marine 4	19 or 13+5	20 or 13+5	20 or 13+5	20 or 13+5	38	38	49	49	30	30	30	30
6	19 or 13+5	20 or 13+5	20+5 or 13+10	20+5 or 13+10	49	49	49	49	30	30	30	30
7 and 8	21	21	20+5 or 13+10	20+5 or 13+10	49	49	49	49	30	38	38	38

Pathways to Comply

► Steel Framing

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

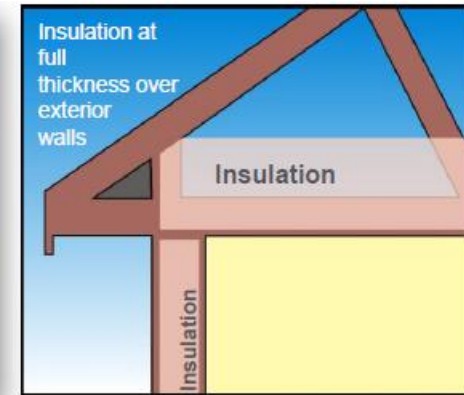
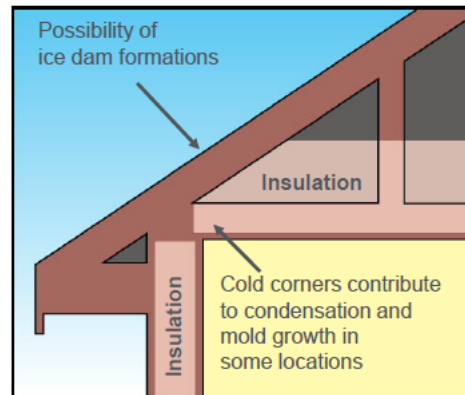
Table R402.2.6
Steel-Frame Ceiling, Wall and Floor Insulation
(R-Value)

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 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

Pathways to Comply

► Truss Exception 1

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



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

Pathways to Comply

▶ Truss Exception 2

- ✓ R-30 allowed for up to 500 ft² 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

Pathways to Comply

► Residential Options: Prescriptive Alt.

U-factor Alternative

- ✓ Similar to Prescriptive R-Value but uses U-factors instead
 - Allows for innovative or less common construction techniques such as structural insulated panels or advanced framing
 - Allows no trade-offs between building components

Total UA Alternative

- ✓ Same as U-factor alternative but allows trade-offs across all envelope components
 - Primary approach used in REScheck software
 - UA – U-factor x area of assembly

Pathways to Comply

► Minimum U-Factors

TABLE N1102.1.4 (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

Pathways to Comply

► Residential Options: Performance

Simulated Performance Alternative *Section R405*

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

- Proposed design to be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design
- Specifications for standard reference and proposed design are in Table R504.5.2(1)

Pathways to Comply

Simulated Performance Alternative

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

- ✓ Requires computer software with specified capabilities (local official may approve other tools)
- ✓ Includes both envelope and some systems
 - Equipment treated equally in standard and proposed design
- ✓ Allows greatest flexibility
 - Can trade off tight duct systems
- ✓ Defines compliance based on equivalency of calculated energy cost or source energy
- ✓ Section R405 specifies “ground rules”
 - These will generally be “hidden” in compliance software calculation algorithms
 - Similar ground rules are used in home federal tax credits and ENERGY STAR Home guidelines

Pathways to Comply

Energy Rating Index Section R406

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

Table R406.4
Maximum Energy Rating Index

Climate Zone	ERI
1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

Pathways to Comply

Energy Rating Index Section R406

U.S. DEPARTMENT OF
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Renewable Energy

- ERI is defined much like the RESNET HERS Index:
 - Integer value
 - 100 corresponds to an “ERI reference design”
 - 0 corresponds to a net zero energy home
 - Each integer value represents a one percent change in the total energy use of the rated design relative to the reference design
 - ERI considers all energy used in the residence
- ERI differs from traditional performance path
 - ERI considers all energy used in the residence, whereas the performance path includes only heating, cooling, lighting, and water heating (excludes appliances and other uses)
 - Equipment and appliance efficiencies can be involved in trade-offs
 - Credit toward compliance may be available for renewable energy

Pathways to Comply

► Commercial Minimums

TABLE R402.1.1 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT U-FACTOR ^b	GLAZED FENESTRATION SHGC ^{b, e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT WALL R-VALUE ^c	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^c WALL R-VALUE
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Challenging Details

► Labeling

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.

- A permanent certificate shall be posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building.
 - The certificate shall list the predominant *R*-values of insulation installed

Challenging Details

► Baffle Requirement

For air permeable insulations in vented attics, a baffle shall be installed

- ✓ Adjacent to soffit and eave vents
- ✓ To maintain an opening \geq size of vent
- ✓ To extend over top of attic insulation
- ✓ May be of any solid material

Challenging Details

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

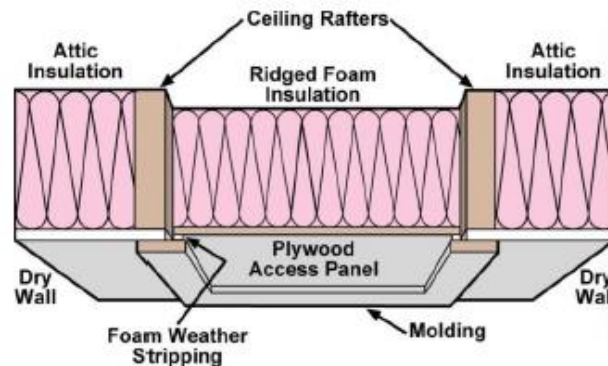
- ✓ Insulate to level equivalent to surrounding surfaces
 - *e.g.*, required ceiling insulation = R-38, then attic hatch must be insulated to R-38

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:

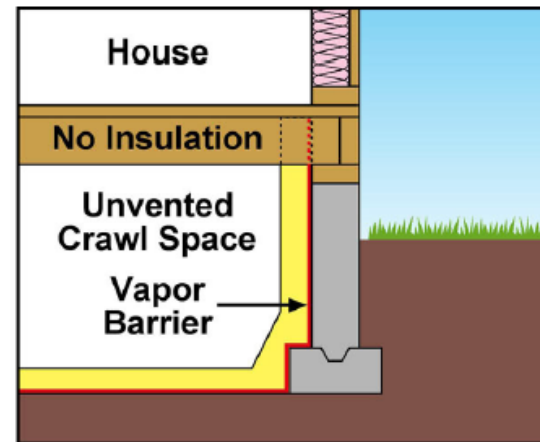
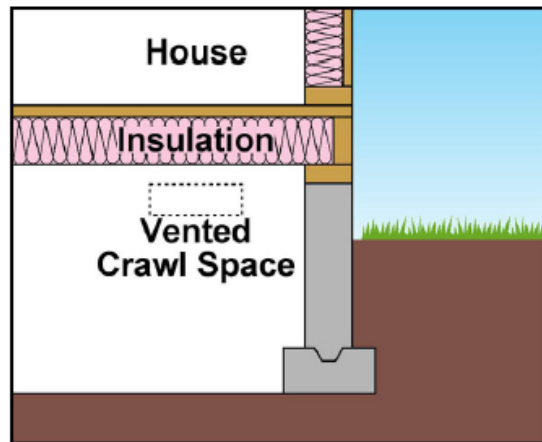
Vertical doors that provide access can meet Table 402.1.2



Challenging Details

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



Challenging Details

Vented Crawlspace Requirements:

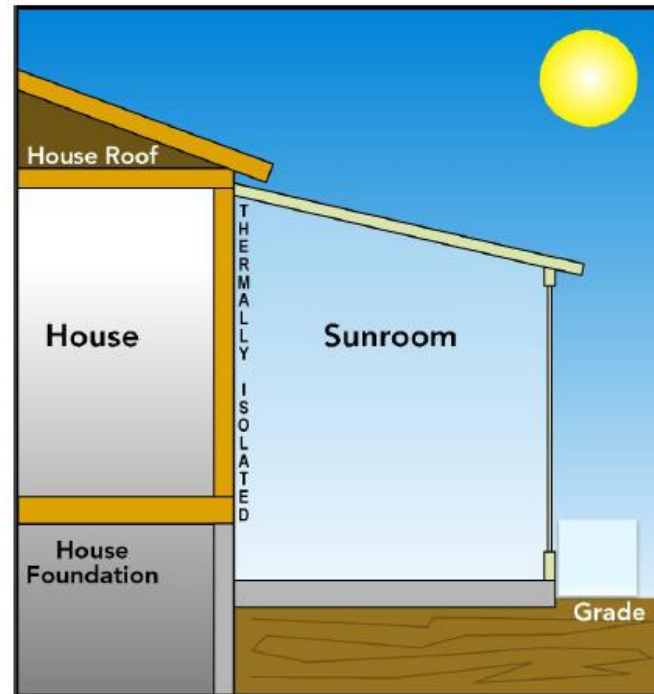
- ✓ The raised floor over the crawlspace must be insulated.
- ✓ A vapor retarder may be required as part of the floor assembly.
- ✓ Ventilation openings must exist that are equal to at least 1 square foot for each 150 square feet of crawlspace area and be placed to provide cross-flow (*IRC 408.1, may 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.
- ✓ Crawlspace 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.

Challenging Details

- ✓ Ceiling Insulation
 - Zones 1-4 R-19
 - Zones 5-8 R-24
- ✓ Wall Insulation
 - All zones R-13
- ✓ Fenestration U-Factor
 - Zones 4-8 0.45
- ✓ Skylight U-Factor
 - Zones 4-8 0.70



Challenging Details

**TABLE N1102.4.1.1 (402.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION**

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/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and extends from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawl space walls.

Challenging Details

Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	

Challenging Details



Challenging Details

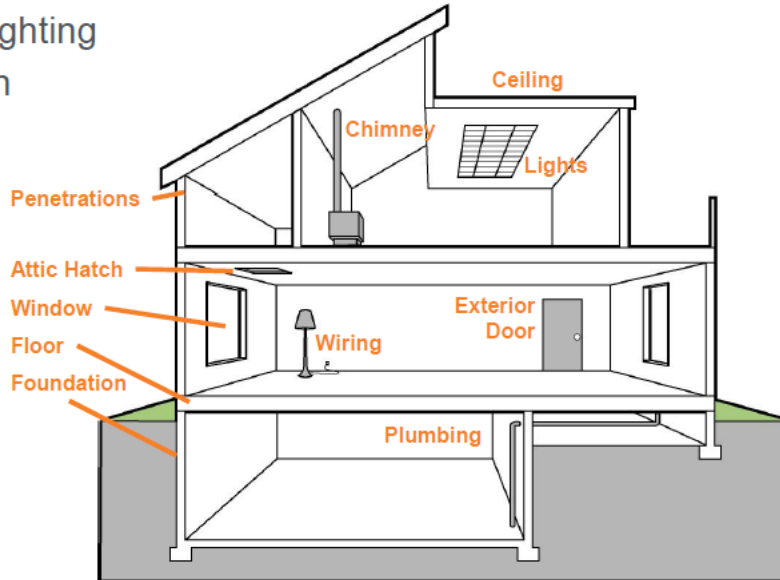


Challenging Details



Challenging Details

- ✓ Building thermal envelope (Section R402.4.1)
- ✓ Recessed lighting
- ✓ Fenestration
- ✓ Fireplaces
- ✓ Rooms with fuel burning appliances



Challenging Details

Building Thermal Envelope Section R402.4.1 – Air Leakage

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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

Q&A

Thank you

Q&A

Questions?

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