



# Residential Provisions of the 2012 International Energy Conservation Code

July 2011

# The Family of I-Codes



- ✓ 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



Codes and standards listed in Chapter are considered part of the requirements of this code to the “prescribed extent of each such reference and as further regulated in Sections R106.1.1 and R106.1.2”

- Conflicts, R106.1.1 – where differences occur between this code and the referenced codes and standards, provisions of this code apply
- Provisions in reference codes and standards, R106.1.2 – “where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard”

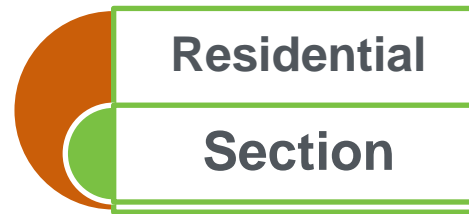
- ✓ IECC addresses only energy
- ✓ IRC addresses all topics (*structural, plumbing, etc.*)
  - Allows builder to carry only one code book
  - Chapter 11 covers energy efficiency
- ✓ In 2012, consolidated with IRC energy chapter (actually a change to the IRC, not the IECC)
- ✓ IECC addresses both residential and commercial; IRC addresses subset of residential, detached one- and two-family dwellings and townhouses 3 stories or fewer



A graphic consisting of a brown semi-circle on the left and a white rounded rectangle on the right. The rectangle is divided into two horizontal sections. The top section contains the word "Commercial" and the bottom section contains the word "Section".

## Commercial Section

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

A graphic consisting of a brown semi-circle on the left and a white rounded rectangle on the right. The rectangle is divided into two horizontal sections. The top section contains the word "Residential" and the bottom section contains the word "Section".

## Residential Section

- Ch. 1 Scope and Application /  
Administrative and  
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- Ch. 2 Definitions
- Ch. 3 General Requirements
- Ch. 4 Residential Energy Efficiency
- Ch. 5 Referenced Standards
- Index

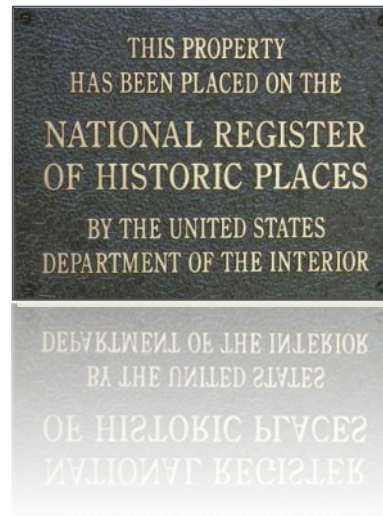


## Residential Buildings:

- ✓ 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”
- ✓ Includes additions, alterations, renovations and repairs



- ✓ Existing buildings (*Section R101.4.1*)
- ✓ Buildings designated as historic (*Section R101.4.2*)
- ✓ Very low energy use buildings [ $<3.4 \text{ Btu/h-ft}^2$  or  $1 \text{ watt/ft}^2$ ] (*Section R101.5.2*)



# Scope

## Section R101.4.3 - Additions

- ✓ Treat as a stand-alone building
- ✓ Additions must meet the prescriptive requirements in Table 402.1.1 (*or U-factor or total UA alternatives*)





# Scope

**Section R101.4.3/R402.3.6** - Additions, Alterations, Renovations, Repairs



Code applies to any new construction

Unaltered portion(s) do not need to comply

Additions can comply alone or in combination with existing building

(R402.3.6) Replacement fenestration that includes both glazing and sash must meet

- ✓ 0.25 SHGC in **Climate Zones 1-3**
- ✓ 0.40 SHGC in **Climate Zone 4 except Marine**
- ✓ U-factors in all **Climate Zones 2-8**

### Exceptions

- ✓ Storm windows over existing fenestration
- ✓ Glass-only replacements
- ✓ Exposed, existing ceiling, wall or floor cavities if already filled with insulation
- ✓ Where existing roof, wall or floor cavity isn't exposed
- ✓ Reroofing for roofs where neither sheathing nor insulation exposed
  - Insulate above or below the sheathing
    - Roofs without insulation in the cavity
    - Sheathing or insulation is exposed
- ✓ Lighting alterations if:
  - <50% of luminaries in a space are replaced
  - Only bulbs and ballasts within existing luminaries are replaced (provided installed interior lighting power isn't increased)

Any nonconditioned space that is altered to become conditioned space shall be required to be brought into full compliance with this code

### Examples:

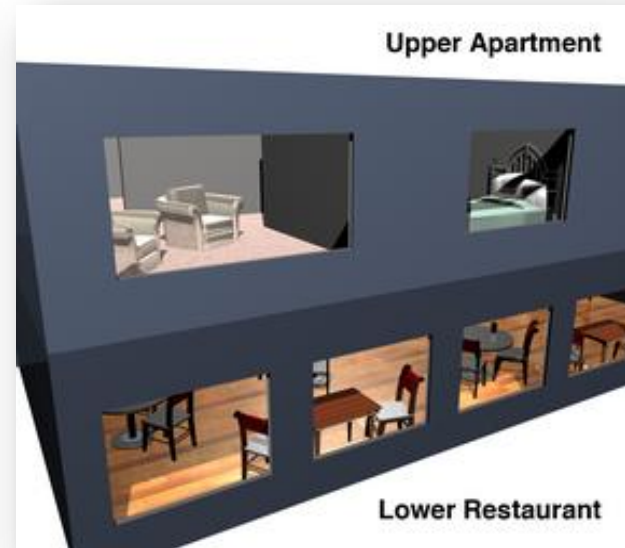
- ✓ Converting a garage to a family room
- ✓ Heating an unfinished basement



# Scope

## Section R101.4.6 - Mixed Use Buildings

- ✓ Treat the residential occupancy under the applicable residential code
- ✓ Treat the commercial occupancy under the commercial code



## 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, and testing
- ✓ HVAC controls
- ✓ Piping Insulation
- ✓ Equipment sizing
- ✓ Dampers
- ✓ Lighting

## IECC Terminology

### ✓ Prescriptive

- Required but can be lessened or eliminated in trade for compensating improvements elsewhere

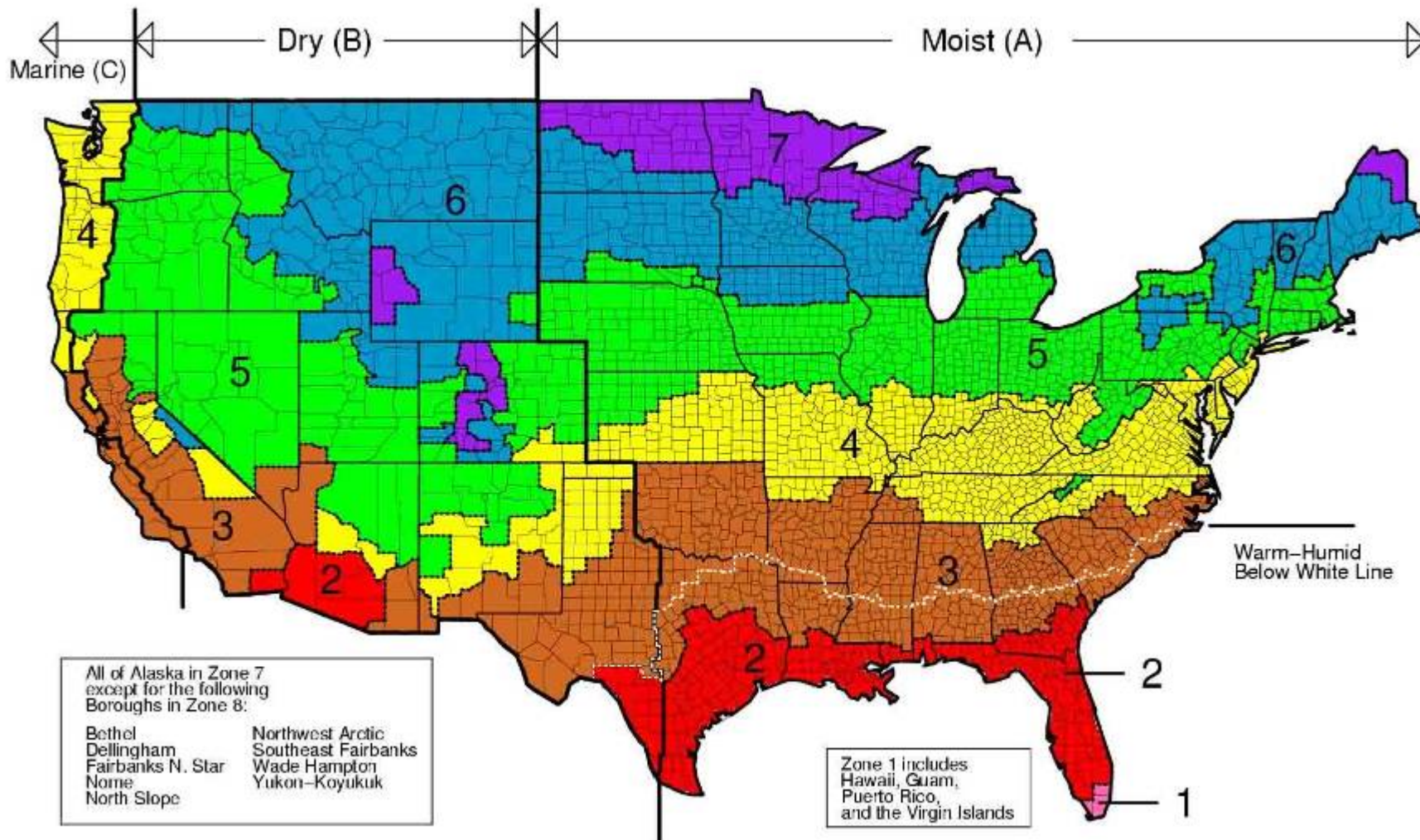
### ✓ Mandatory

- Required and cannot be traded down, even in the simulated performance path

## Some elements have “hard limits”

- ✓ aka, “trade-off limits”
- ✓ a prescriptive requirement that can only be traded so far
- ✓ performance requirements can only be traded so far

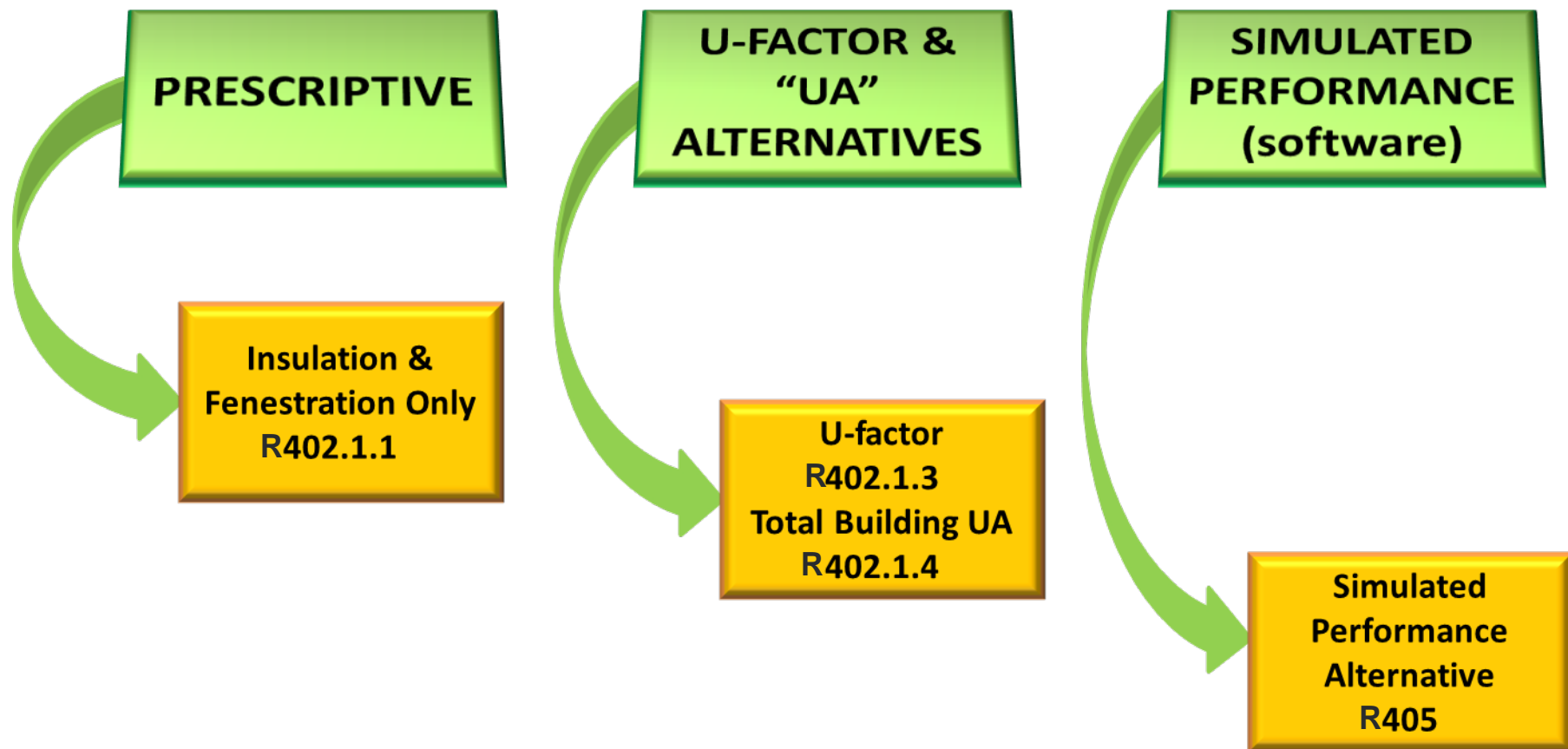
# Climate Zones for the 2012 IECC

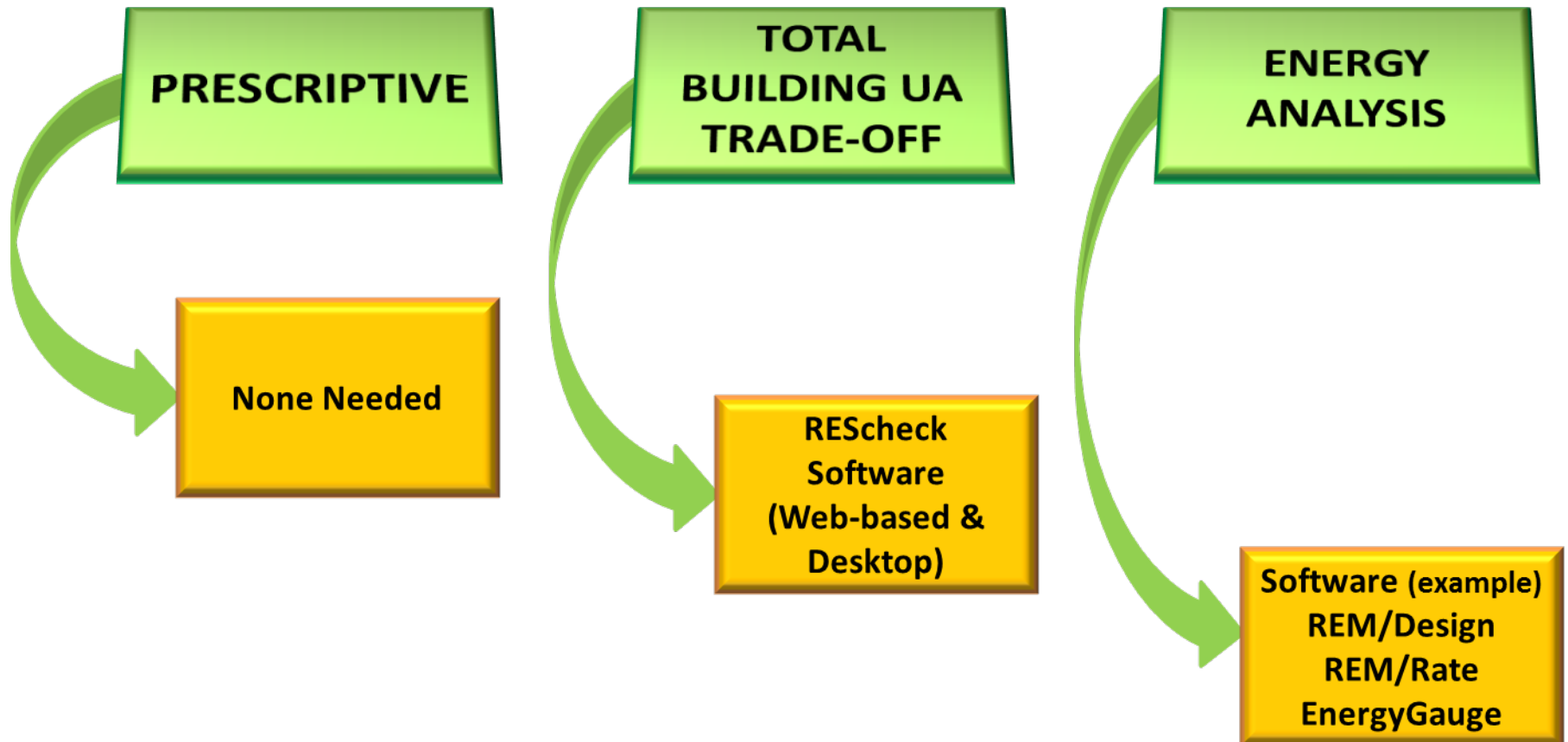


- ✓ Focus is on building envelope
  - Ceilings, walls, windows, floors, foundations
  - Sets insulation and fenestration levels, and solar heat gain coefficients
  - Infiltration control - caulk and seal to prevent air leaks, and test
- ✓ Ducts, air handlers, filter boxes – seal, insulate, and test
- ✓ Limited space heating, air conditioning, and water heating requirements
  - Federal law sets most equipment efficiency requirements, not the I-codes
- ✓ No appliance requirements
- ✓ Lighting equipment – 75% of lamps to be high-efficacy lamps or 75% of lighting fixtures to have only high-efficacy lamps



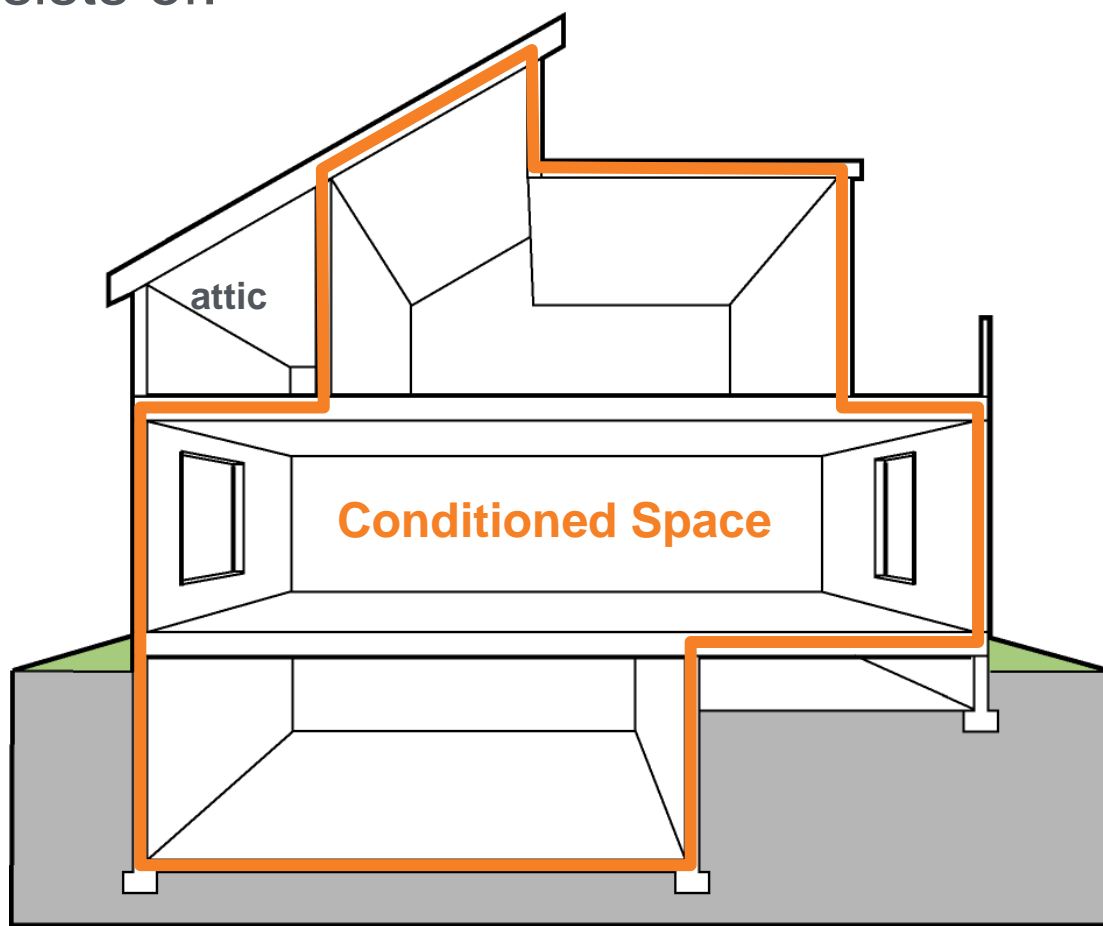
# IECC Compliance - Three Options





Building Envelope consists of:

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



# Insulation and Fenestration Requirements by Climate Zone

**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT\***

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

For SI: 1 foot = 304.8 mm.

- R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.
- The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.
- "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. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.
- There are no SHGC requirements in the Marine Zone.
- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.
- The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

## Doors and windows

- ✓ NFRC rating or default table
  - If no labeled U-factor and SHGC, use default table
- ✓ No glass area limits
- ✓ Exemptions (*prescriptive path only*)
  - Up to 15 ft<sup>2</sup> of glazing per dwelling unit (*Section R402.3.3*)
  - One side-hinged opaque door assembly up to 24 ft<sup>2</sup> (*Section R402.3.4*)

# Skylights

## Section R402.3

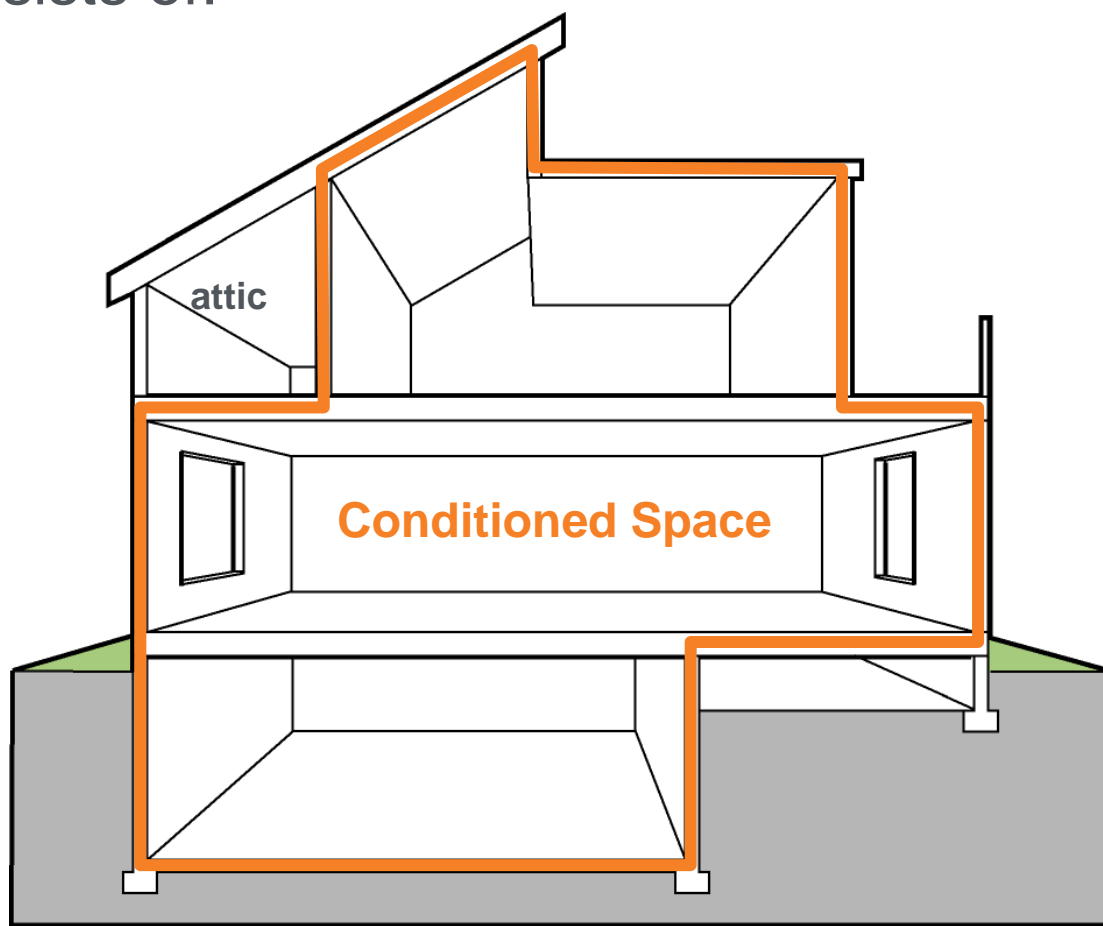
- ✓ Meet U-factor
- ✓ Meet SHGC



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

Building Envelope consists of:

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





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

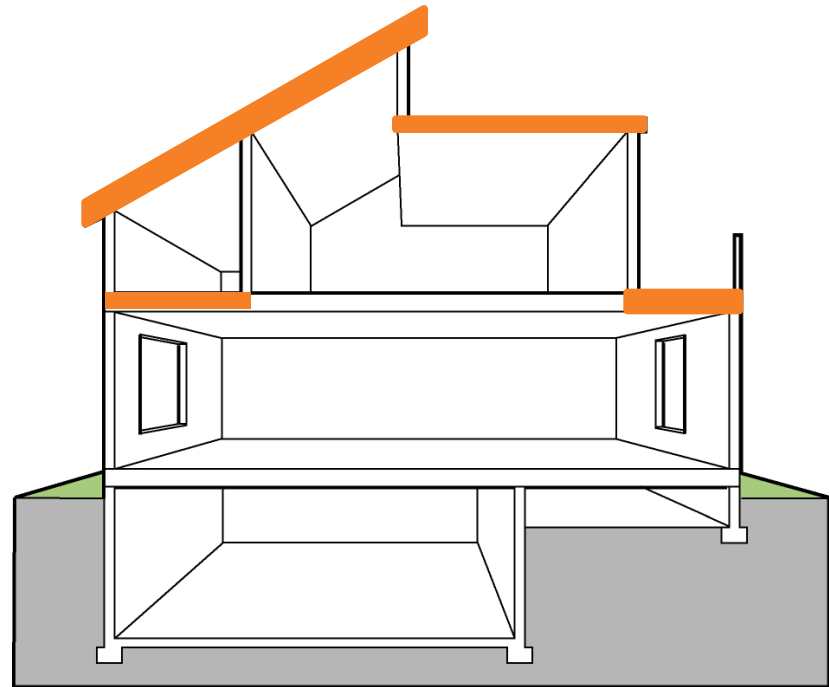


Insulation markers must be installed every 300 square feet and be marked with the minimum installed thickness and affixed to the trusses or joists.

## Requirements based on

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

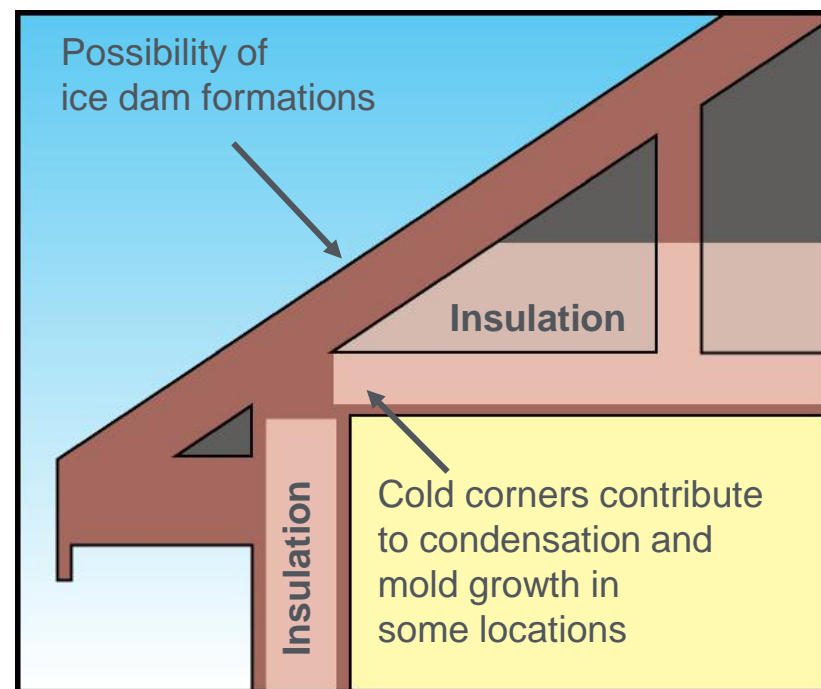
Meet or exceed R-values



# Ceilings with Attics

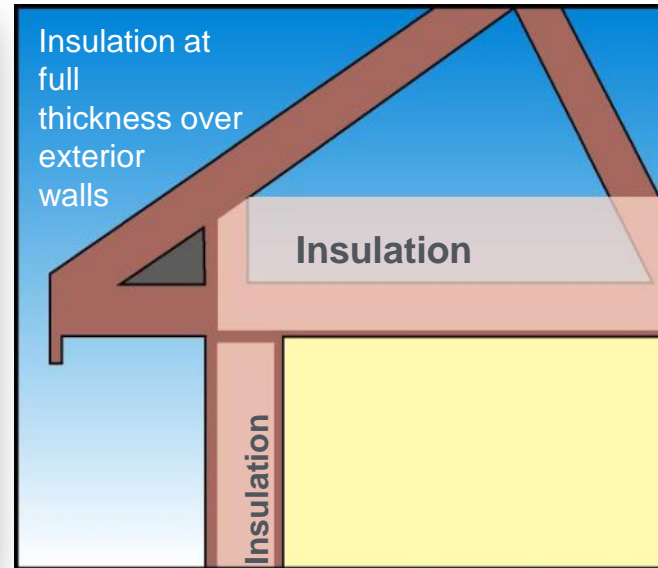
## Section R402.2.1

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



# Ceilings with Attics, Cont'd.

## Section R402.2.1



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

- ✓ If insulation is full height over exterior wall top plate
  - 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)

- ✓ R-30 allowed for 500 ft<sup>2</sup> or 20% total insulated ceiling area, whichever is less, where
  - ✓ Insulation levels are required > R-30
  - ✓ Not 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*

# Eave Baffle

## Section R402.2.3

For air permeable insulations in vented attics, baffle

- ✓ 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

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

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

Wood Frame R-value Requirement	Cold-Formed Steel Equivalent R-value <sup>a</sup>
<b>Steel Truss Ceilings<sup>b</sup></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
<b>Steel Joist Ceilings<sup>b</sup></b>	
	R-38 in 2x4, or 2x6, or 2x8 R-49 any framing
	R-49 2x4, or 2x6, or 2x8, or 2x10
<b>Steel Framed Wall</b>	
	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-0 + 11.2 or R-13 + 6.1, or R-15 + 5.7 or R-19+5.0 or R-21+4.7

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

# Access Hatches and Doors

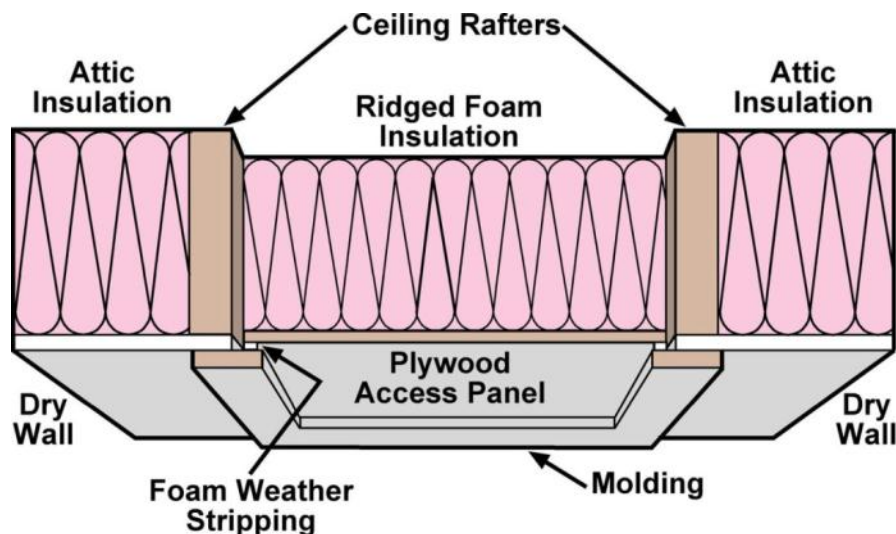
## Section R402.2.3 - Prescriptive

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

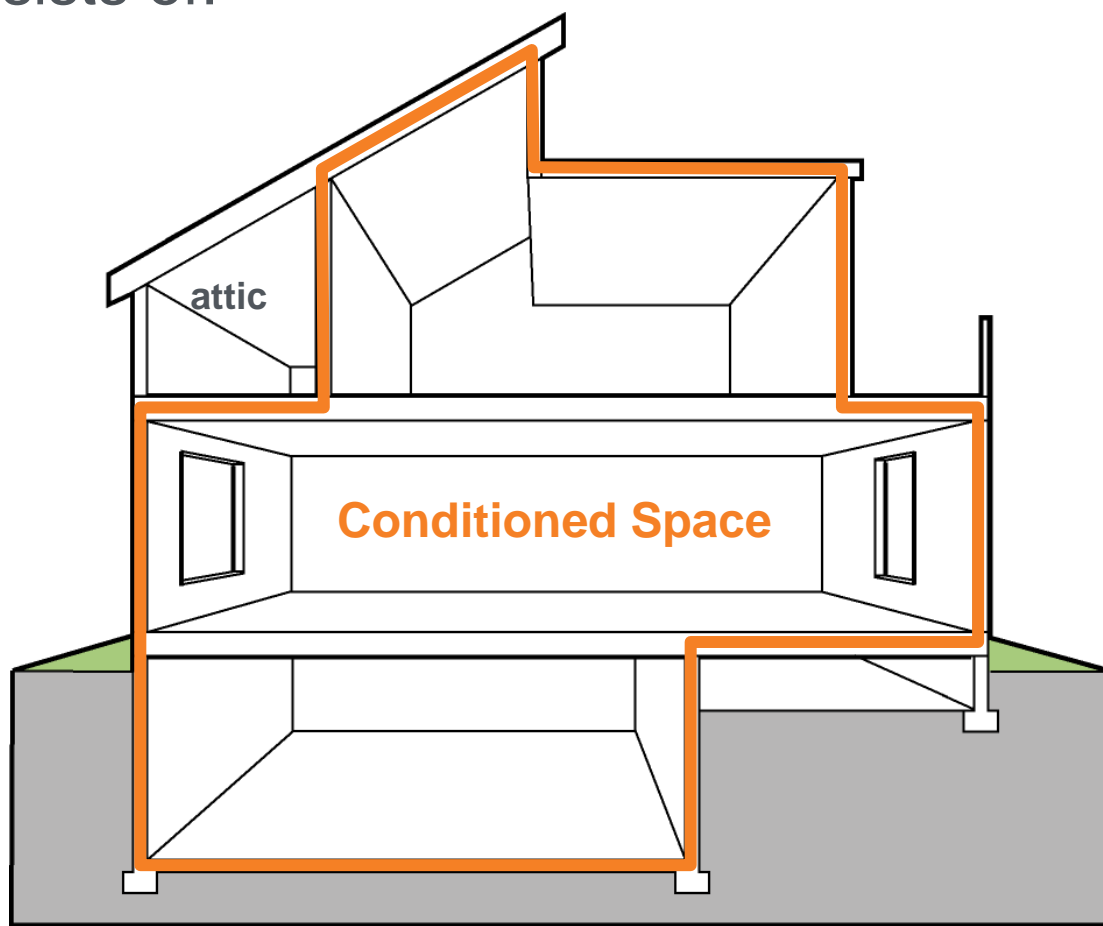
Install a wood framed or equivalent baffle or retainer when loose fill insulation is installed



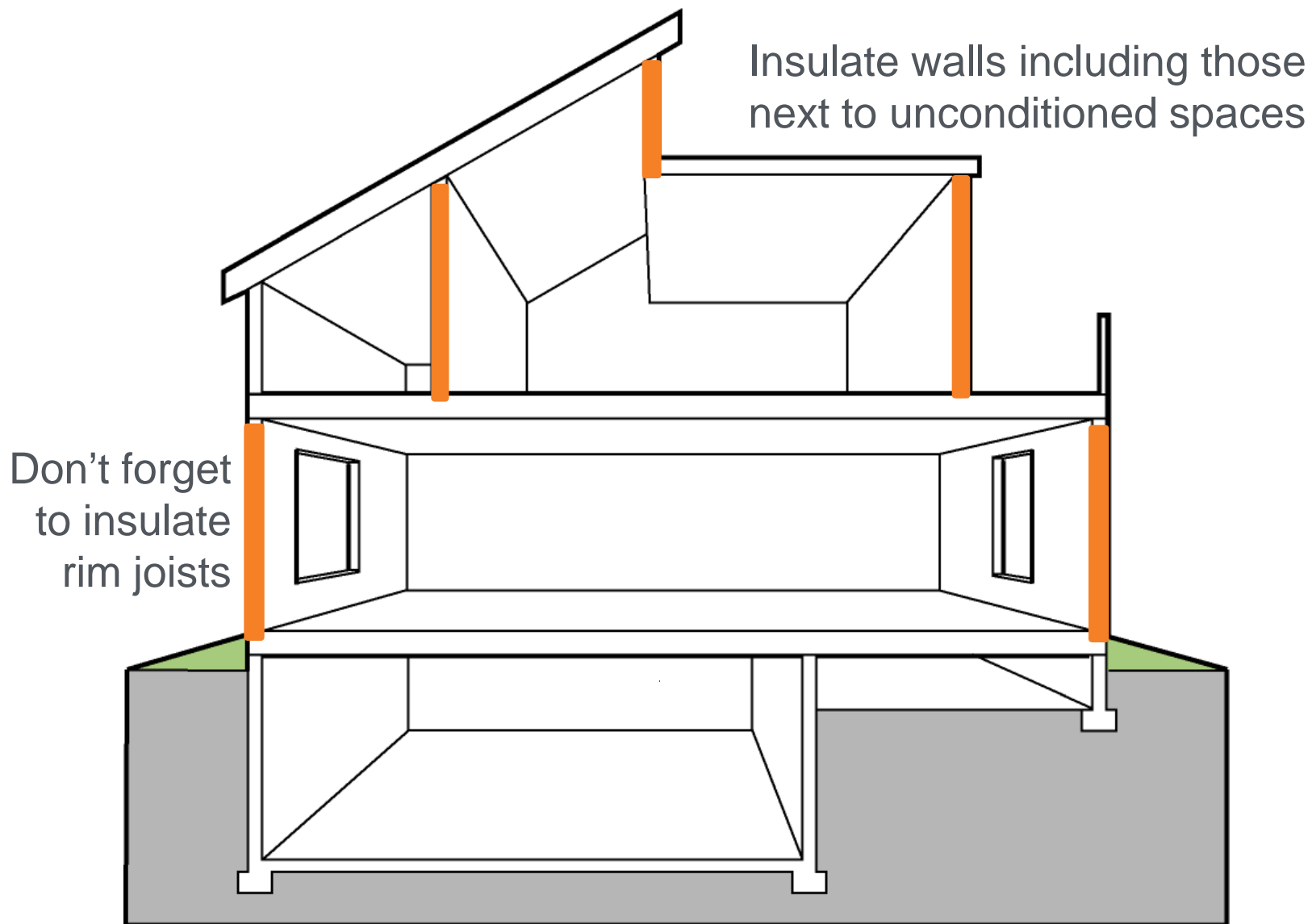


Building Envelope consists of:

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



- ✓ Exterior above-grade walls
- ✓ Attic kneewalls
- ✓ Skylight shaft walls
- ✓ Perimeter joists
- ✓ Basement walls
- ✓ Garage walls (*shared with conditioned space*)



# Wood-Frame Walls

## Section R402

Table R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b, e</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE
1	NR	0.75	0.25	30	13
2	0.40	0.65	0.25	38	13
3	0.35	0.55	0.25	38	20 or 13+5 <sup>h</sup>
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 <sup>h</sup>
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 <sup>h</sup>
6	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>

h. First value is cavity insulation, second is continuous insulation or insulated siding, so “13+5” means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

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

Wood Frame R-value Requirement	Cold-Formed Steel Equivalent R-value <sup>a</sup>
<b>Steel Truss Ceilings<sup>b</sup></b>	
R-30	R-38 or R-30 +
R-38	R-49 or R-38 +
R-49	R-38 + 5
<b>Joist Ceilings<sup>b</sup></b>	
	R-38 in 2x4, or
	R-49 any fram
	R-49 2x4, or 2
<b>Steel Framed Wall</b>	
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 + Y” means R-X cavity plus R-Y continuous

# Mass Walls

## Section R402.2.5

### What type

- ✓ Concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth, and solid timber/logs

### Provisions

- ✓ Are assumed to be above grade walls



# Mass Wall Requirements

## Section R402.2.5

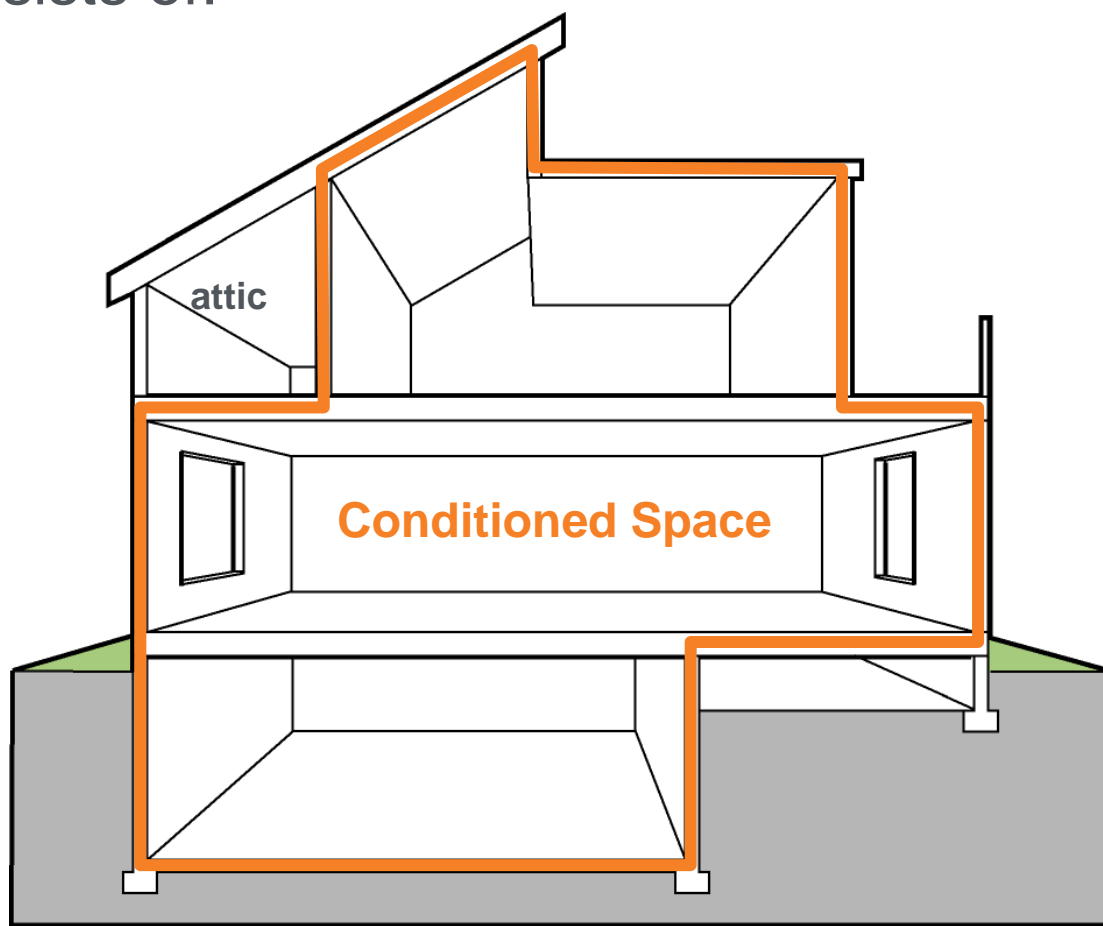
Table R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b, e</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>i</sup>
1	NR	0.75	0.25	30	13	3/4
2	0.40	0.65	0.25	38	13	4/6
3	0.35	0.55	0.25	38	20 or 13+5 <sup>h</sup>	8/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 <sup>h</sup>	8/13
5 and Marine 4					20 or 13+5 <sup>h</sup>	13/17
6					0+5 or 13+10 <sup>h</sup>	15/20
7 and 8					0+5 or 13+10 <sup>h</sup>	19/21

**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)**

Building Envelope consists of:

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





# Floors Over Unconditioned Space

## Section R402.2.7

Table R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	...	FLOOR R-VALUE
1		13
2		13
3		19
4 except Marine		19
		30 <sup>g</sup>
		30 <sup>g</sup>
		38 <sup>g</sup>

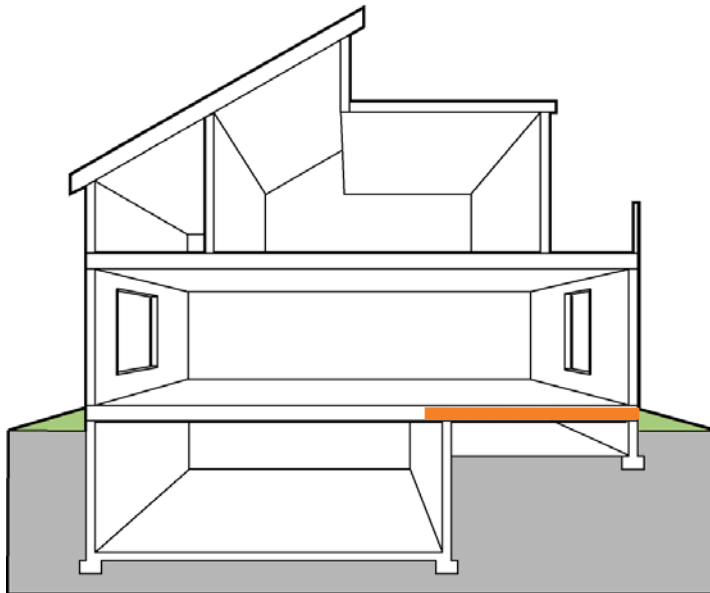
**Exception:** If framing members are too small to accommodate R-30, insulation that fills the framing cavity, not less than R-19, complies

# Floors (Over Unconditioned Space)

## Section 402.2.7

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 *



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

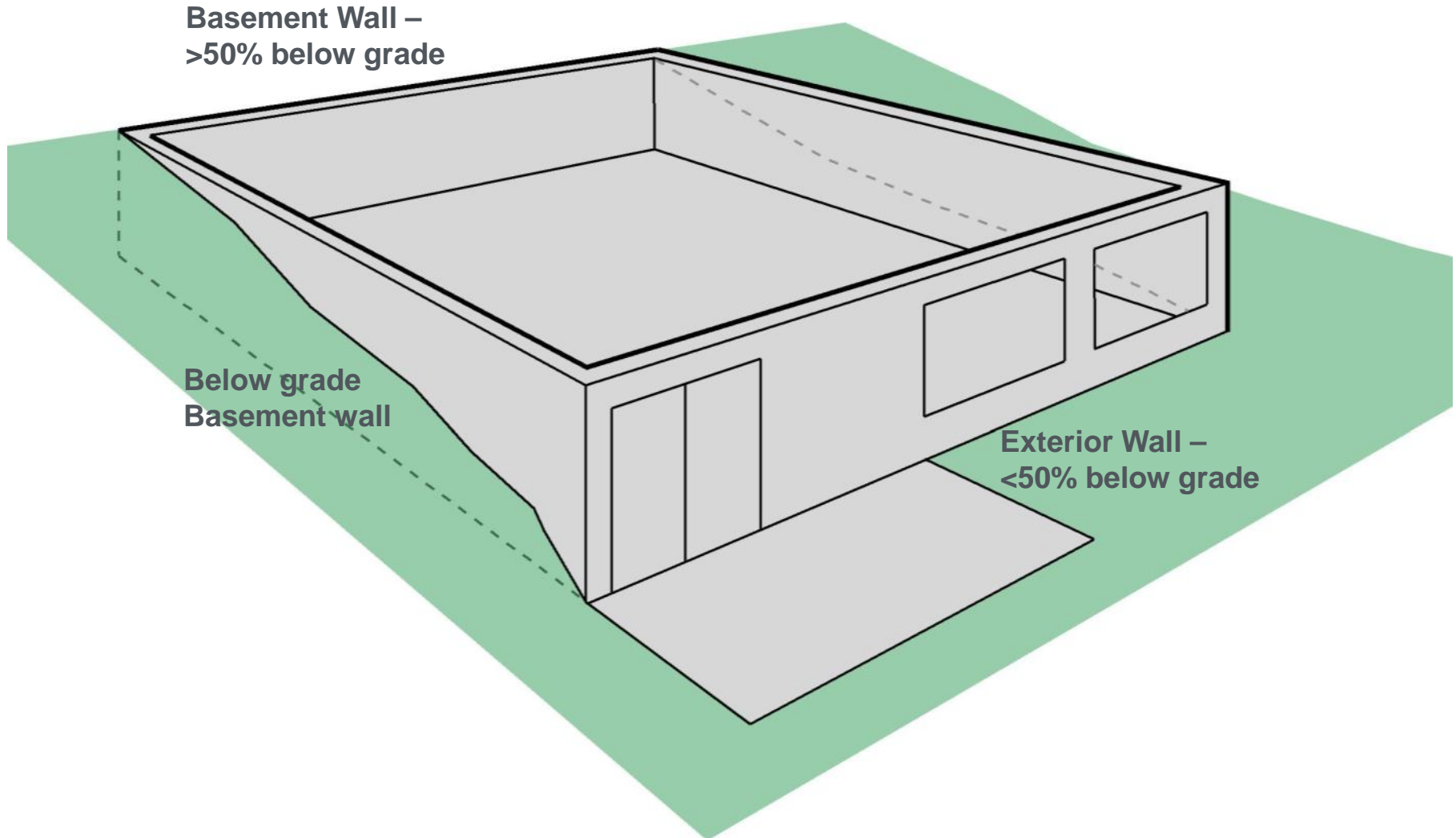
Table R402.2.6  
Steel-Frame Ceiling, Wall and Floor Insulation  
(R-Value)

Wood Frame R-value Requirement	Cold-Formed Steel Equivalent R-value <sup>a</sup>
Steel Joist Floor <sup>b</sup>	
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 + Y” means R-X cavity plus R-Y continuous

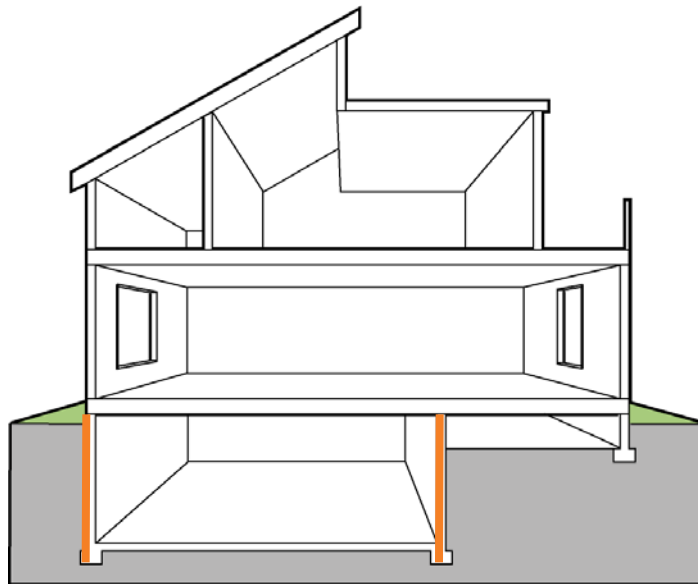
# Defining Below-Grade Walls



# Below-Grade Walls

- ✓  $\geq 50\%$  below grade
- ✓ Otherwise treat as above-grade wall

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



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

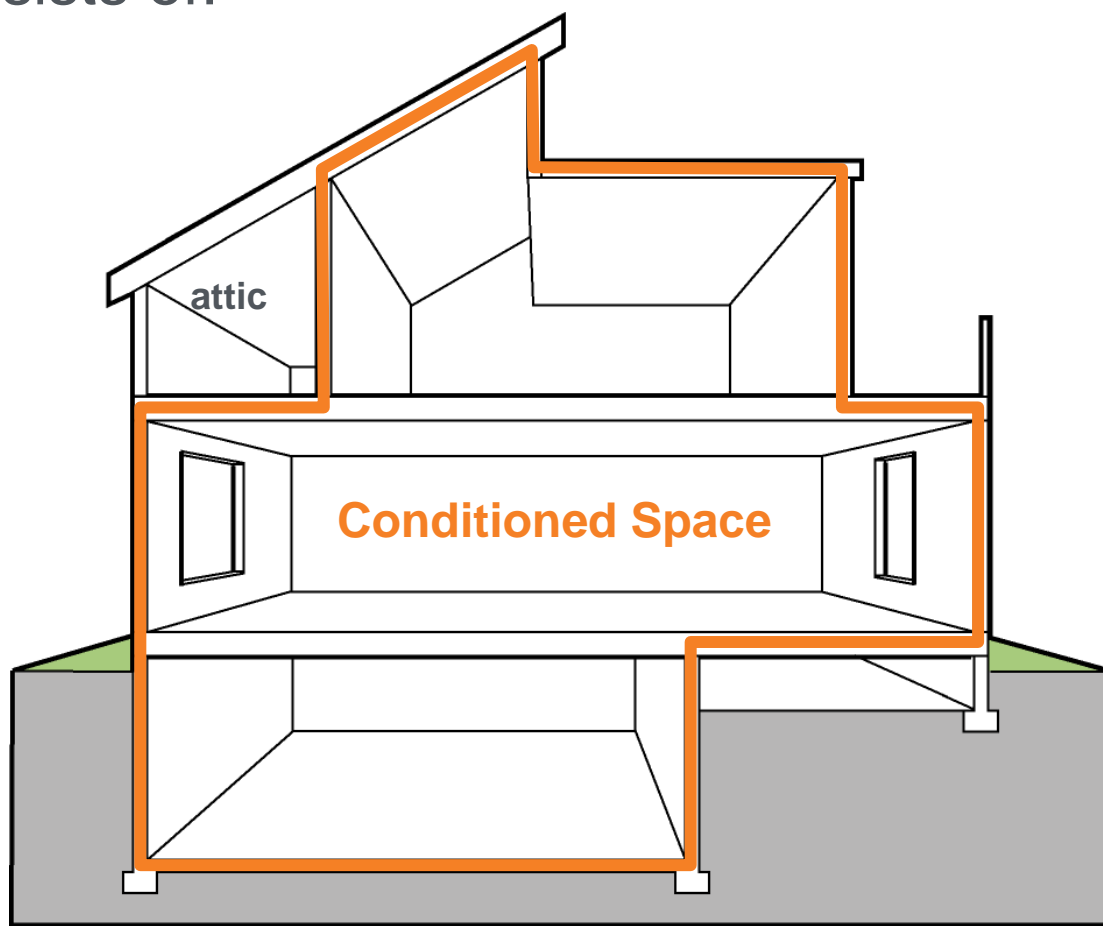
Table R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	...	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE
1		13	0
2		13	0
3		19	5/13 <sup>f</sup>
4 except			10/13
			15/19
			15/19
			15/19

- “X/Y” means R-X continuous or R-Y cavity
- 15/19 requirement can be met with R-13 cavity (interior) plus R-5 continuous (exterior)
- In zone 3, no insulation required in warm-humid counties (footnote f)

Building Envelope consists of:

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

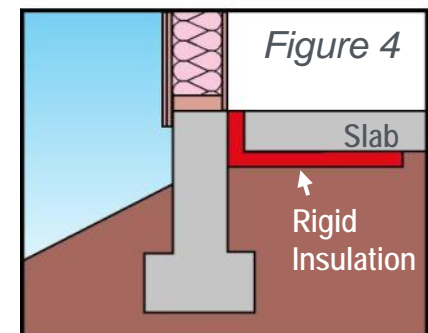
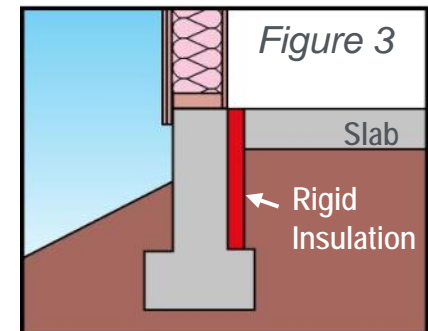
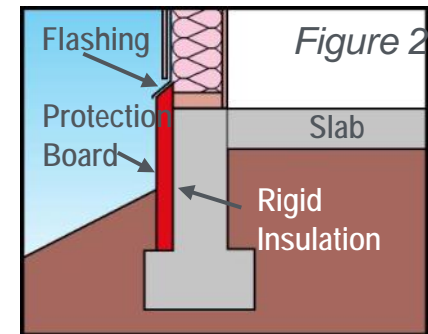


# Slab Edge Insulation

## Section R402.2.9

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

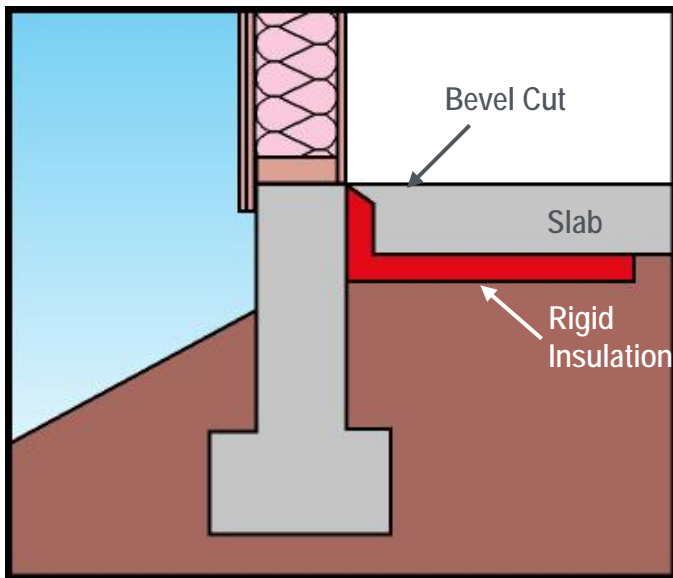
- ✓ R-10 (typically 2 inches) insulation in Zones 4 and above
- ✓ Must extend downward from top of slab a minimum of 24" (Zones 4 and 5) or 48" (Zones 6, 7, and 8)
- ✓ Insulation can be vertical or extend horizontally under the slab or out from the building
- ✓ Insulation extending outward must be under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





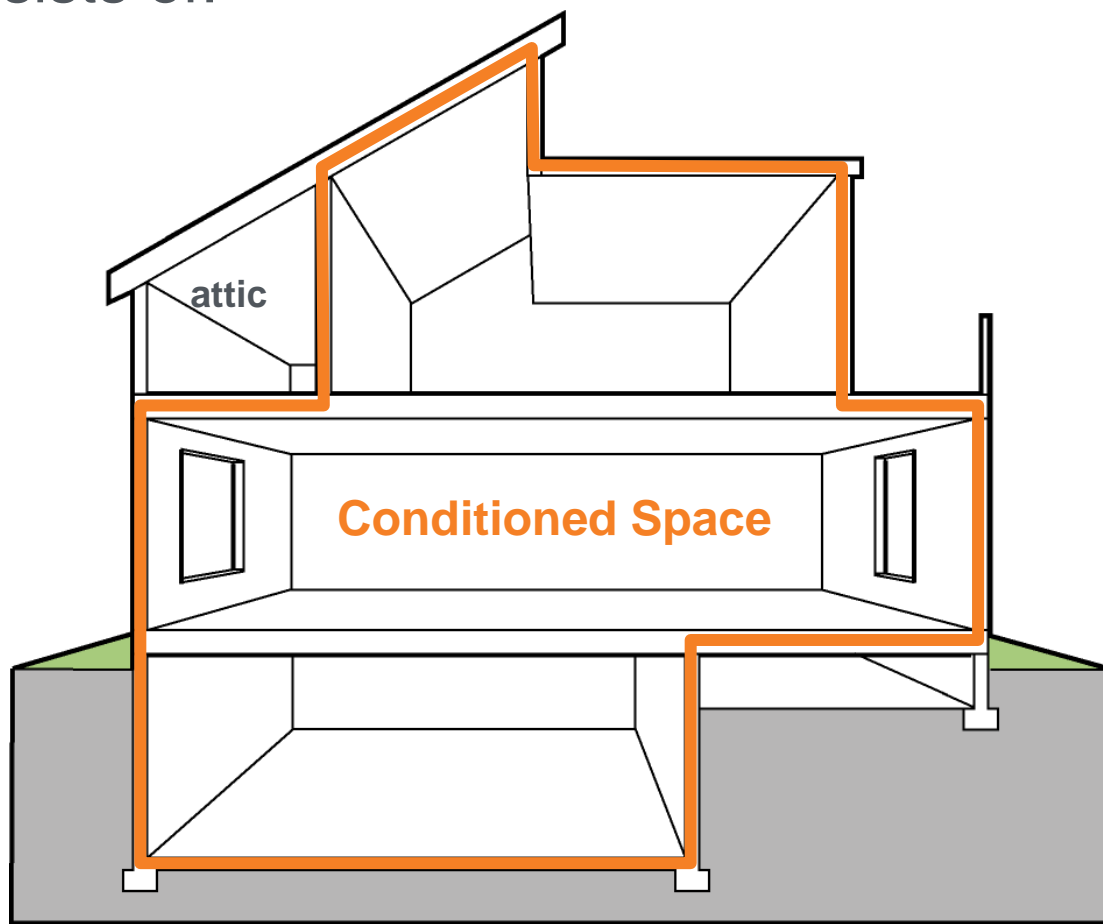
# Slab Edge Insulation

## Section R402.2.9



Building Envelope consists of:

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

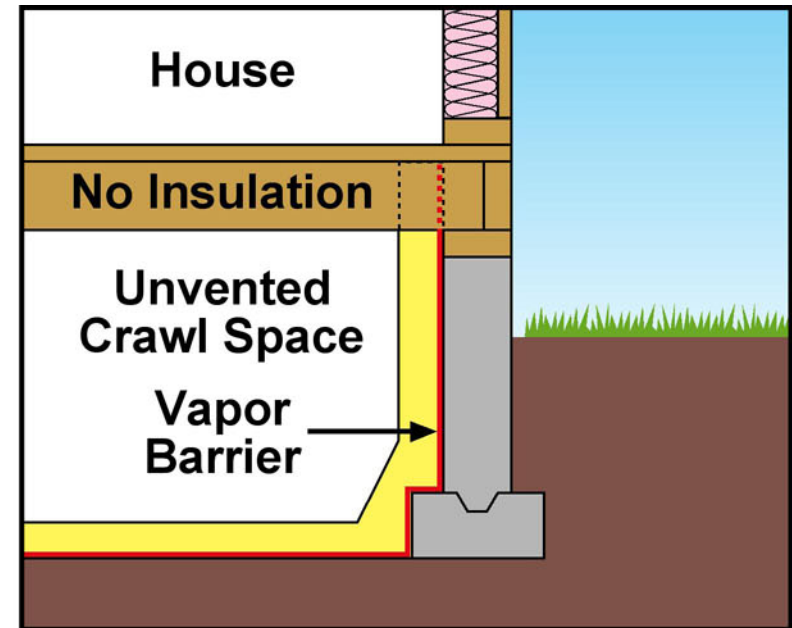
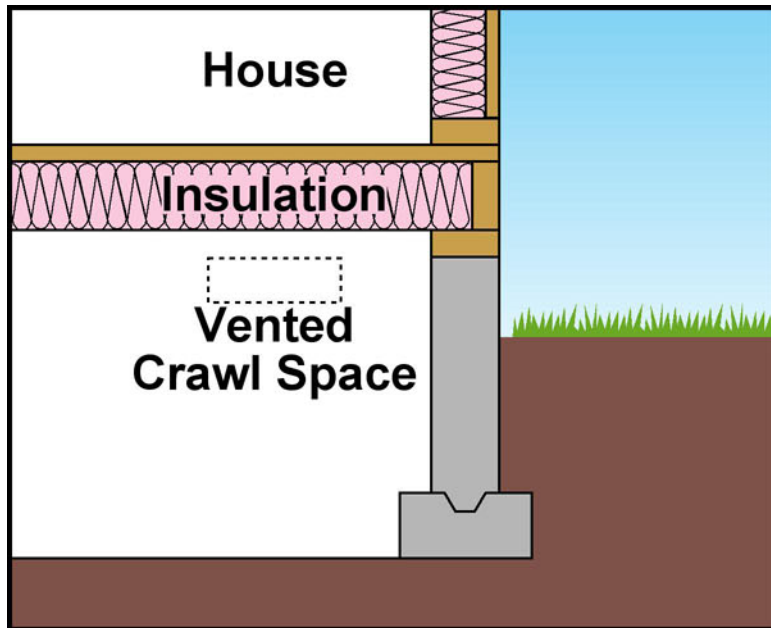


# Crawlspace Wall Insulation

## Section R402.2.10

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 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 R402.1.1*).
- ✓ 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.

## 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

# Requirements by Climate Zone

## *U-Factor Table*

**TABLE R402.1.3  
EQUIVALENT *U*-FACTORS<sup>a</sup>**

CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR	SKYLIGHT <i>U</i> -FACTOR	CEILING <i>U</i> -FACTOR	FRAME WALL <i>U</i> -FACTOR	MASS WALL <i>U</i> -FACTOR <sup>b</sup>	FLOOR <i>U</i> -FACTOR	BASEMENT WALL <i>U</i> -FACTOR	CRAWL SPACE WALL <i>U</i> -FACTOR
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

### Provisions

- ✓ When more than half the insulation is on the interior, the mass wall U-factors:

<b>Climate Zones</b>	<b>U-Factor Maximum</b>
1	0.17
2	0.14
3	0.12
4 except Marine	0.087
4 Marine and 5	0.065
6-8	0.065

Hard limits on U-factor in northern U.S. (cannot be exceeded, even in trade-offs)

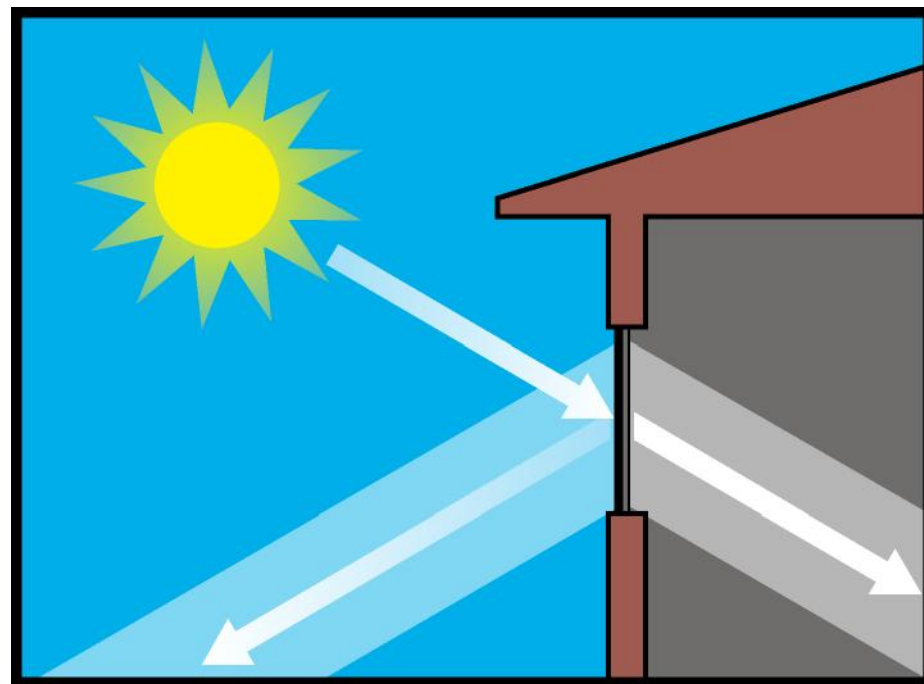
Climate Zones	U-Factor Maximum
4-5	0.48
6-8	0.40

- ✓ U-0.75 for skylights in **Zones 4-8**
- ✓ U-factors of individual windows or skylights can be higher if maximum area-weighted average is below these limits.



## Hard limit on Solar Heat Gain Coefficient in southern U.S. (Zones 1-3)

- ✓ SHGC cannot exceed 0.50, even in performance trade-offs



**Solar Heat Gain Coefficient**

Less stringent insulation

R-value and glazing

U-factor requirements

Sunroom definition:

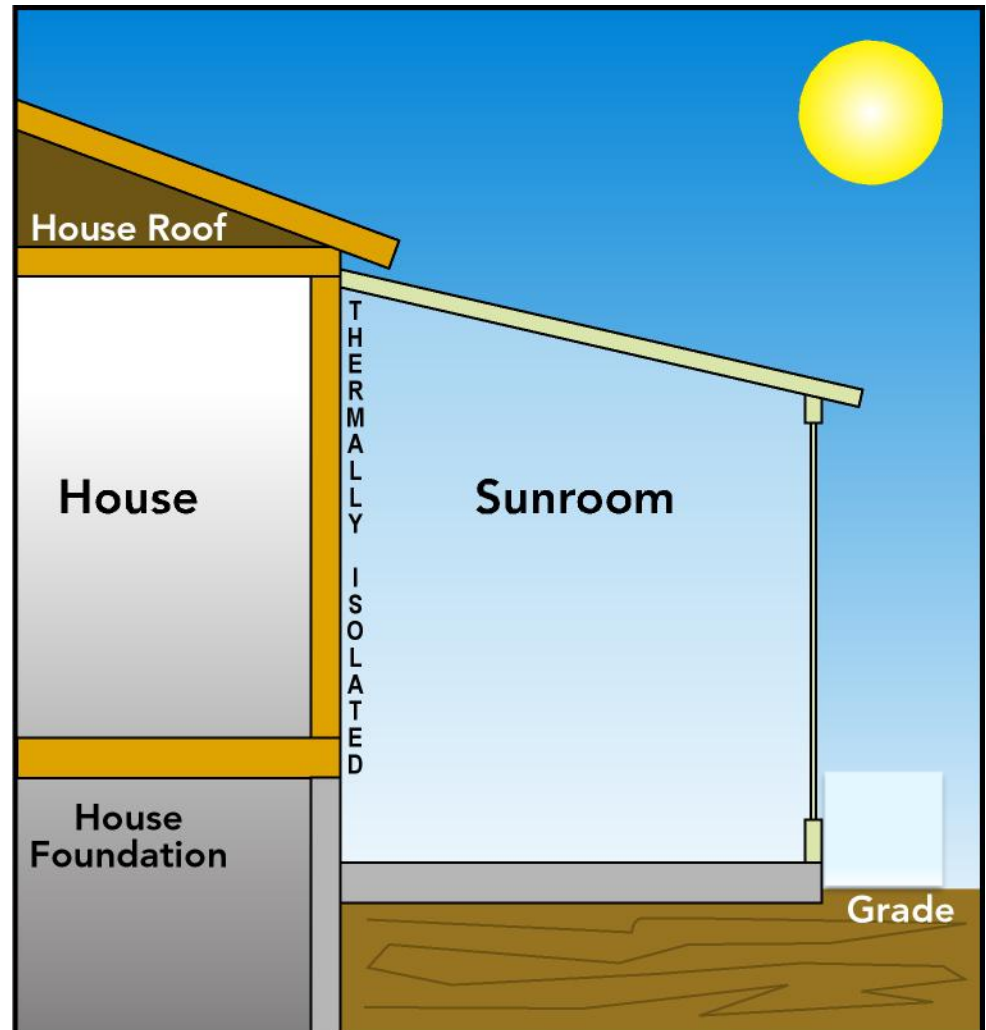
- ✓ One story structure
- ✓ Glazing area >40% glazing of gross exterior wall and roof area
- ✓ Separate heating or cooling system or zone
- ✓ Must be thermally isolated (closeable doors or windows to the rest of the house)
- ✓ Can always meet Table R402.1.1 requirements with unlimited glass



# Sunroom Requirements

## Section R402.2.12

- ✓ 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

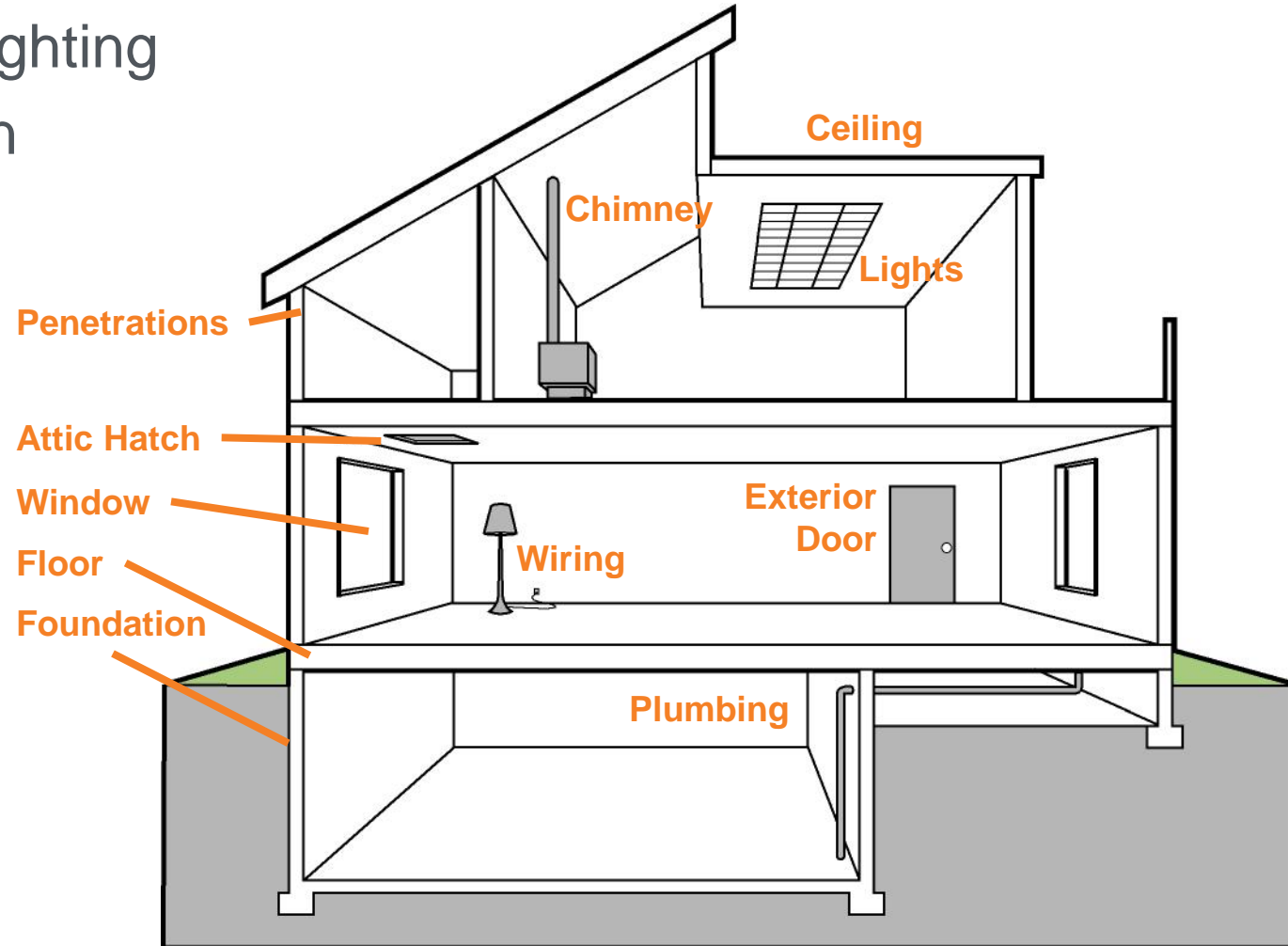


- ✓ Requires computer software with specified capabilities (local official may approve other tools)
- ✓ Includes both envelope and some systems
  - Are treated equally in standard and proposed design
- ✓ Allows greatest flexibility
  - Can trade-off tight duct systems
- ✓ Defines compliance based on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

# Mandatory Requirements

## Section R402.4 - Air Leakage

- ✓ Building thermal envelope (Section R402.4.1)
- ✓ Recessed lighting
- ✓ Fenestration
- ✓ Fireplaces



# Air Leakage Control

## Section R402.4.1

## Building thermal envelope



## Two options to demonstrate compliance

- ✓ 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 R402.4.1.1

# Table R402.4.1.1

Component	Criteria
Air barrier and thermal barrier	<p>A continuous air barrier shall be installed in the building envelope.</p> <p>Exterior thermal envelope contains a continuous air barrier.</p> <p>Breaks or joints in the air barrier shall be sealed.</p> <p>Air-permeable insulation shall not be used as a sealing material.</p>
Ceiling/attic	<p>The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed.</p> <p>Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.</p>
Walls	<p>Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed.</p> <p>The junction of the top plate and top of exterior walls shall be sealed.</p> <p>Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</p> <p>Knee walls shall be sealed.</p>
Windows, skylights and doors	<p>The space between window/door jambs and framing and skylights and framing shall be sealed.</p>
Rim joists	<p>Rim joists shall be insulated and include the air barrier.</p>
Floors (including above-garage and cantilevered floors)	<p>Insulation shall be installed to maintain permanent contact with underside of subfloor decking.</p> <p>The air barrier shall be installed at any exposed edge of insulation.</p>

(partial table)



# Fireplaces

## Section R402.4.2

New wood-burning fireplaces shall have gasketed doors and outdoor combustion air



TYPE	AIR INFILTRATION RATE
Windows, sliding glass doors, and skylights	$\leq 0.3$ cfm/ft <sup>2</sup>
Swinging doors	$\leq 0.5$ cfm/ft <sup>2</sup>

### Exceptions

- ✓ Site-built windows, skylights, and doors

# Recessed Lighting Fixtures

## Section R402.4.4

- ✓ Type IC rated and labeled as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm of air movement
- ✓ Sealed with a gasket or caulk between the housing and interior wall or ceiling covering



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

- ✓ Controls
- ✓ Heat pump supplementary heat
- ✓ Ducts
  - Sealing (Mandatory)
  - Insulation (Prescriptive)
- ✓ HVAC piping insulation
- ✓ Circulating hot water systems
- ✓ Ventilation
  - Dampers
- ✓ Equipment sizing
- ✓ Systems serving multiple dwelling units
- ✓ Snow melt controls
- ✓ Pools and inground permanently installed spas

If primary heating system is a forced-air furnace

- ✓ At least one programmable thermostat/dwelling unit
- ✓ Capability to set back or temporarily operate the system to maintain zone temperatures
  - down to 55°F (13°C) or
  - up to 85°F (29°C)
- ✓ Initially programmed with:
  - heating temperature set point no higher than 70°F (21°C) and
  - cooling temperature set point no lower than 78°F (26°C)



Prevent supplementary electric-resistance heat when heat pump can meet the heating load

### Exception

- ✓ During defrost

# Duct Insulation

## Section R403.2.1 - Prescriptive

- ✓ Supply ducts in attics: R-8
- ✓ All other ducts: R-6

### Examples

Location	Requirement
Attic	R-8
Conditioned Space	NR
Vented Crawlspace	R-6
Conditioned Crawlspace	NR
Basement – Conditioned	NR
Basement – Unconditioned	R-6
Exterior Walls	R-6



### ✓ Sealing (Mandatory)

- Joints and seams to comply with IMC or IRC
- All ducts, air handlers, and filter boxes to be sealed (*Section R403.2.2*)



### • Exceptions

- No additional joint seals required for air-impermeable spray foam product
- Where duct connection is partially inaccessible, 3 screws or rivets to be equally spaced on exposed portion of joint to prevent a hinge effect
- Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures < 2 in. w.c. pressure classification don't require additional closure systems

Duct tightness shall be verified by either of the following:

✓ Post construction test

- Total leakage:  $\leq 4$  cfm/per 100 ft<sup>2</sup> of conditioned floor area
  - tested at a pressure differential of 0.1 in w.g. (25Pa) across entire system, including manufacturer's air handler enclosure
- All register boots taped or otherwise sealed

✓ Rough-in test

- Total leakage  $\leq 4$  cfm/per 100 ft<sup>2</sup> of conditioned floor area
  - tested at a pressure differential of 0.1 in w.g. (25Pa) across roughed-in system, including manufacturer's air handler enclosure
  - all register boots taped or otherwise sealed
  - if air handler not installed at time of test
    - » Total air leakage  $\leq 3$  cfm/per 100 ft<sup>2</sup>

**Exceptions:** Duct tightness test is not required if the air handler and all ducts are located within building thermal envelope

# Duct Tightness Tests

## Section R403.2.2



# Sealed Air Handler

## Section R403.2.2.1

Air handlers to have a manufacturer's designation for an air leakage of  $\leq 2\%$  of design air flow rate per ASHRAE 193



# Building Cavities

## Section R403.2.3 - Mandatory

Framing cavities cannot be used as ducts or plenums



- ✓ R-3 required on
  - HVAC systems
    - Exception: Piping that conveys fluids between 55 and 105°F
- If exposed to weather,
  - protect from damage, including
    - Sunlight
    - Moisture
    - Equipment maintenance
    - Wind
  - Provide shielding from solar radiation that can cause degradation of material
  - Adhesive tape is not allowed

# Piping Insulation

## Section R403.3

- R-3 required on
  - Piping >  $\frac{3}{4}$  in. nominal diameter
  - Piping serving more than one dwelling unit
  - Piping from the water heater to kitchen outlets
  - Piping located outside the conditioned space
  - Piping from the water heater to a distribution manifold
  - Piping under a floor slab
  - Buried piping
  - Supply and return piping in recirculating systems other than demand recirculation systems
  - Piping with run lengths > maximum run lengths for nominal pipe diameter in Table R403.4.2
- All remaining piping to be at least R-3 or meet run length requirements in Table R403.4.2



*Image courtesy of Ken Baker, K energy*

### ✓ Ventilation

- Building to have ventilation meeting IRC or IMC or with other approved means
- Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating

### ✓ Whole-house mechanical ventilation system fans to meet efficacy in Table R403.5.1

#### ✓ Exception

- ✓ When fans are integral to tested and listed HVAC equipment, powered by electronically commutated motor



### ✓ Equipment Sizing

- IECC references Section M1401.3 of the IRC
- Load calculations determine the proper capacity (size) of equipment
  - Goal is big enough to ensure comfort but no bigger
- Calculations shall be performed in accordance with ACCA Manual J & S or other approved methods

## Snow- and ice-melting system controls

- ✓ Automatic shutoff when pavement temperature is  $> 50^{\circ}\text{F}$  and no precipitation is falling
- ✓ Automatic or manual shutoff when outdoor temperature is  $> 40^{\circ}\text{F}$

# Pools and Inground Permanently Installed Spas

## Section R403.9

- ✓ Heaters
  - with a readily accessible on-off switch mounted outside heater so heater can be shut off without adjusting thermostat setting
  - fired by natural gas not allowed to have continuously burning pilot lights
- ✓ Time switches (or other control method) to automatically turn off and on heaters and pumps according to a preset schedule installed on all heaters and pumps
- ✓ Note: heaters, pumps, and motors with built-in timers meet the requirement
  - Exceptions
    - Public health standards requiring 24-hour pump operation
    - Pumps operating pools with solar-waste-heat recovery heating systems



On heated pools and inground permanently installed spas

- ✓ Vapor-retardant cover

### **Exception:**

- ✓ If >70% of energy from site-recovered energy



Systems serving multiple dwelling units shall comply with Sections C403 and C404 in lieu of Section R403



A minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or 75% of permanently installed lighting fixtures to contain only high efficacy lamps

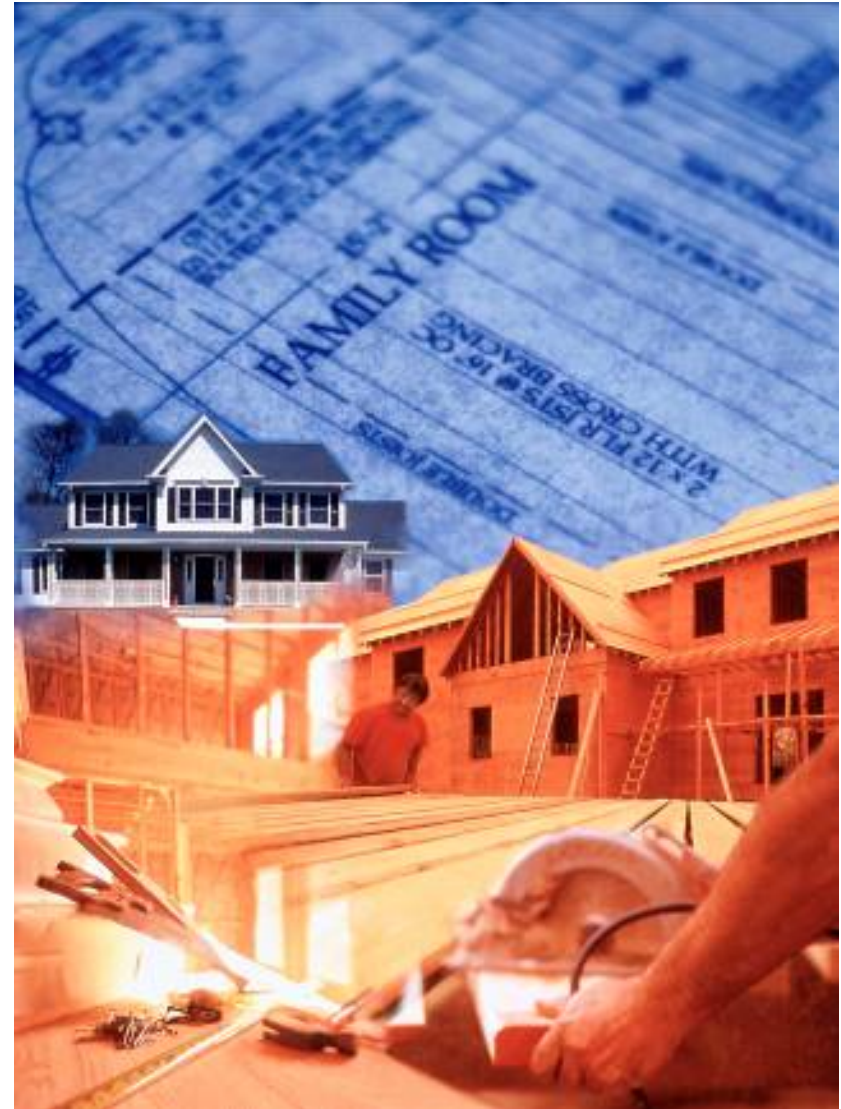
### Exception:

- ✓ Low-voltage lighting



Fuel gas lighting systems can't have continuously burning pilot lights

- ✓ Code Official has final authority
  - Software, worksheets
  - Above Code Programs
- ✓ Electronic media can be used
- ✓ Construction work for which a permit is required is subject to inspection
- ✓ Certificate is required





- ✓ Code Officials Inspection
  - Successive and final inspections, and reinspections if necessary
- ✓ Code Validity
  - Code deemed to be illegal or void shall not affect the remainder of the code
- ✓ Codes and standards considered part of the requirements of the code
  - Provisions take precedence
- ✓ Fees
  - Must be paid before permit is issued
  - Required in accordance with schedule

- ✓ Permanently posted on or in the electrical distribution panel
- ✓ 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 for fenestration
  - SHGC for fenestration
  - Results from any required duct system and building envelope air leakage testing
  - HVAC efficiencies and types
  - SWH equipment

Certificate lists “gas-fired unvented room heater”, “electric furnace”, or “baseboard electric heater”, rather than listing an efficiency for those heating types