

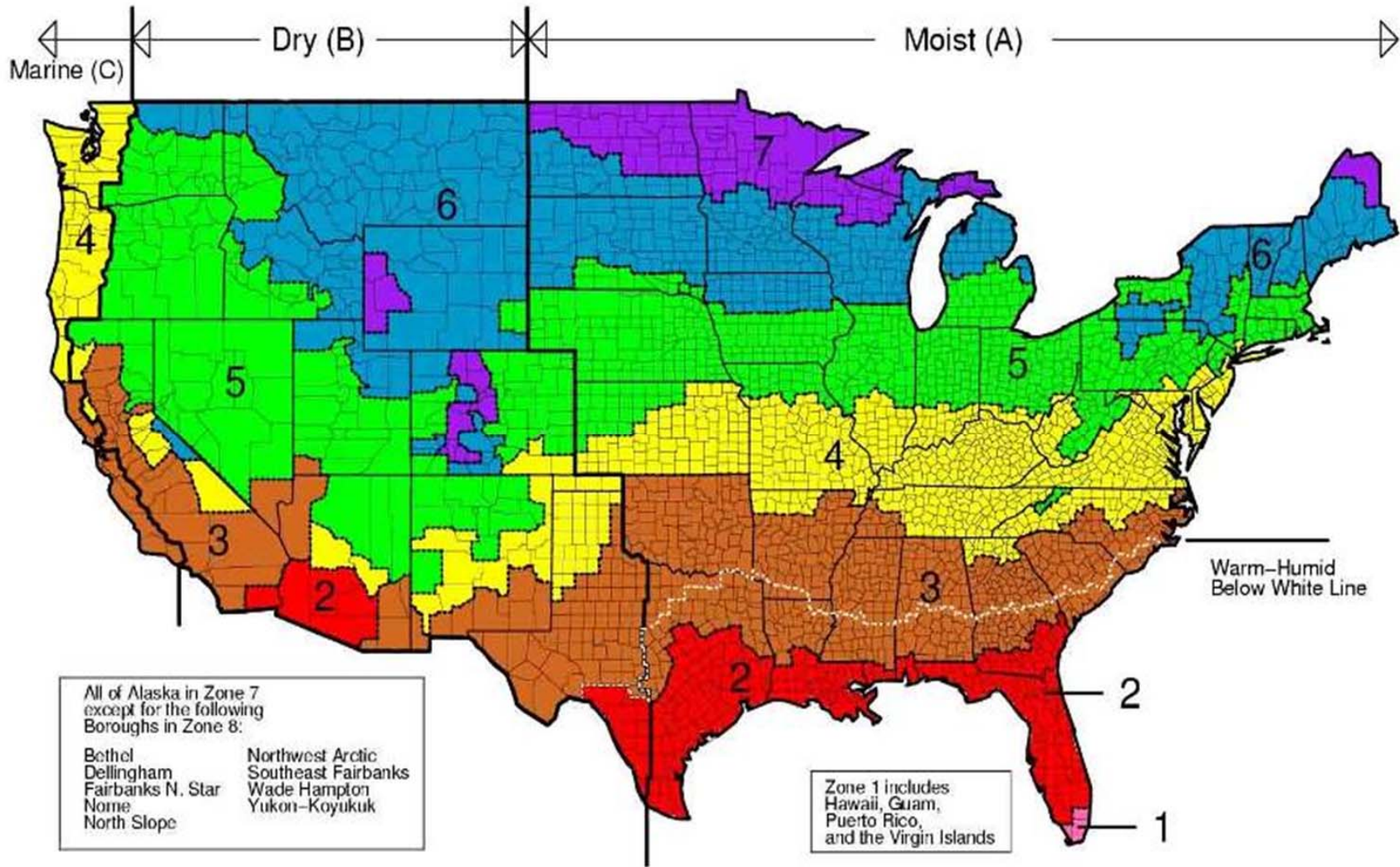


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2015 Residential IECC Significant Changes

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Space Conditioning

Any non-conditioned 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 a basement

Chapters in the IRC that Impact Energy Usage



Chapter 5

- Frost protected shallow foundations



Chapter 6

- Advanced wall framing

Chapter 4

- Foundation water and damp-proofing;
- Foundation venting

Chapter 3

- Insulation installation
- Glazing types

Chapters in the IRC that Impact Energy Usage (cont'd)



Chapter 14

- Heating and cooling sizing calculation



Chapter 16

- Duct sizing and design requirements

Chapter 8

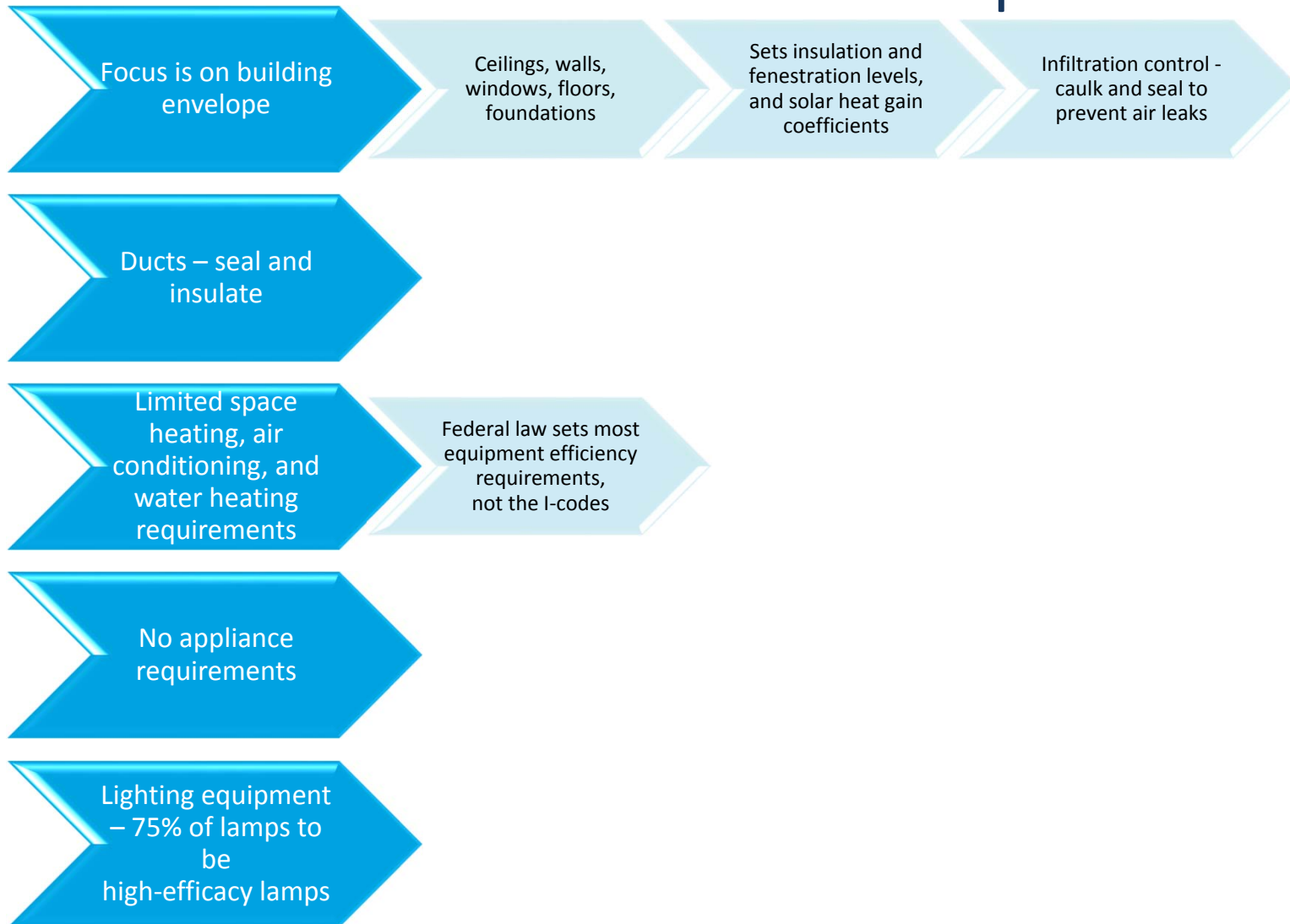
- Weather resistant roof assemblies;
Conditioned attic assemblies

Chapter 7

- Weather resistant coverings for walls



Overview of Residential Code Requirements



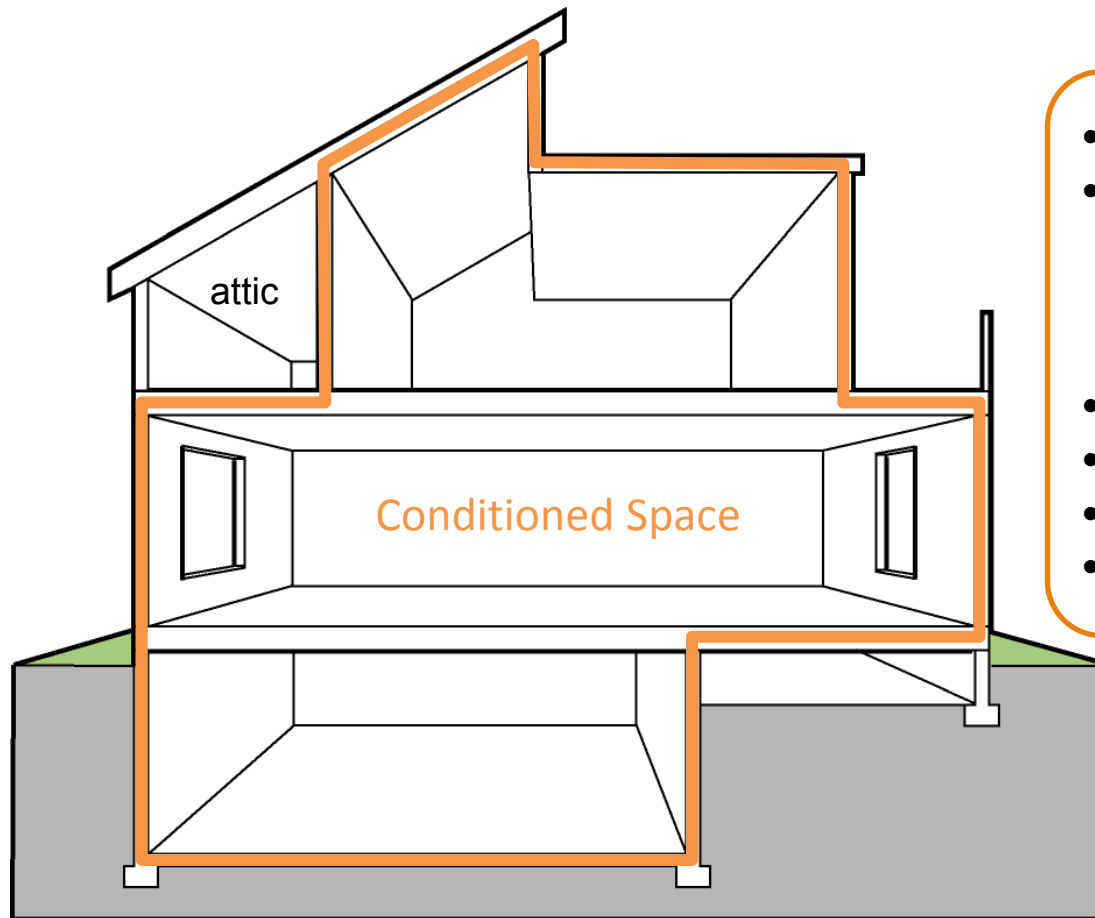


Building Envelope



Building Envelope Specific Requirements

Building Envelope consists of:



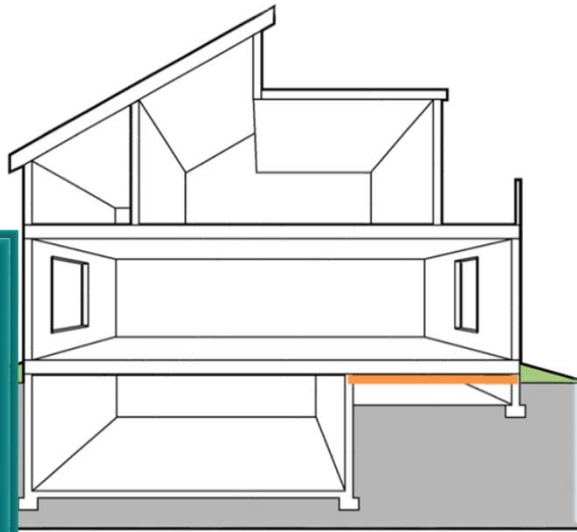
- Ceilings
- Walls
 - Above grade
 - Below grade
 - Mass walls
- Fenestration
- Floors
- Slab
- Crawl space

Table R402.1.2
Insulation and Fenestration Requirements by Component

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value	Floor R-Value	Basement R-Value	Slab R-Value	Crawl Space Wall R-Value
3	0.35	0.55	0.25	38	20 or 13+5	8/13	19	5/13	0	5/13
5 & Marine 4	0.32	0.55	NR	49	20 or 13+5	13/17	30	15/19	10, 2ft	15/19

Floors over Unconditioned Space

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



Insulation must maintain permanent contact with underside of subfloor



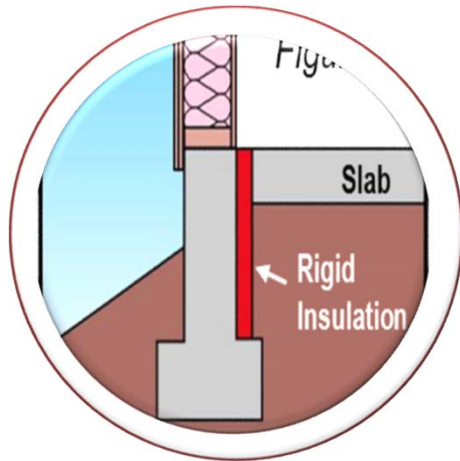
Climate Zones	R-Value
1-2	13
3-4 a,b	19
4c-6	30
7-8	38

Exception:

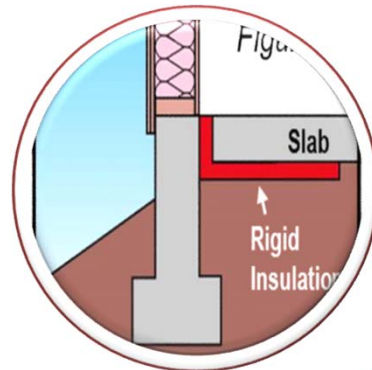
Climate Zones 4c-8
R-19 permitted if
cavity completely
filled

Slab Edge Insulation

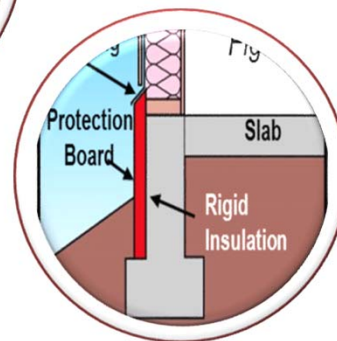
Applies to slabs with a floor surface < 12 inches below grade



Insulating depth of the footing or 2 feet, whichever is less in Zones 1-3 for heated slabs



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)

An additional R-5 is required for heated slabs

Insulation extending outward must be under 10 inches of soil or pavement

Insulation can be vertical or extend horizontally under the slab or out from the building

Vented and Unvented Crawlspace

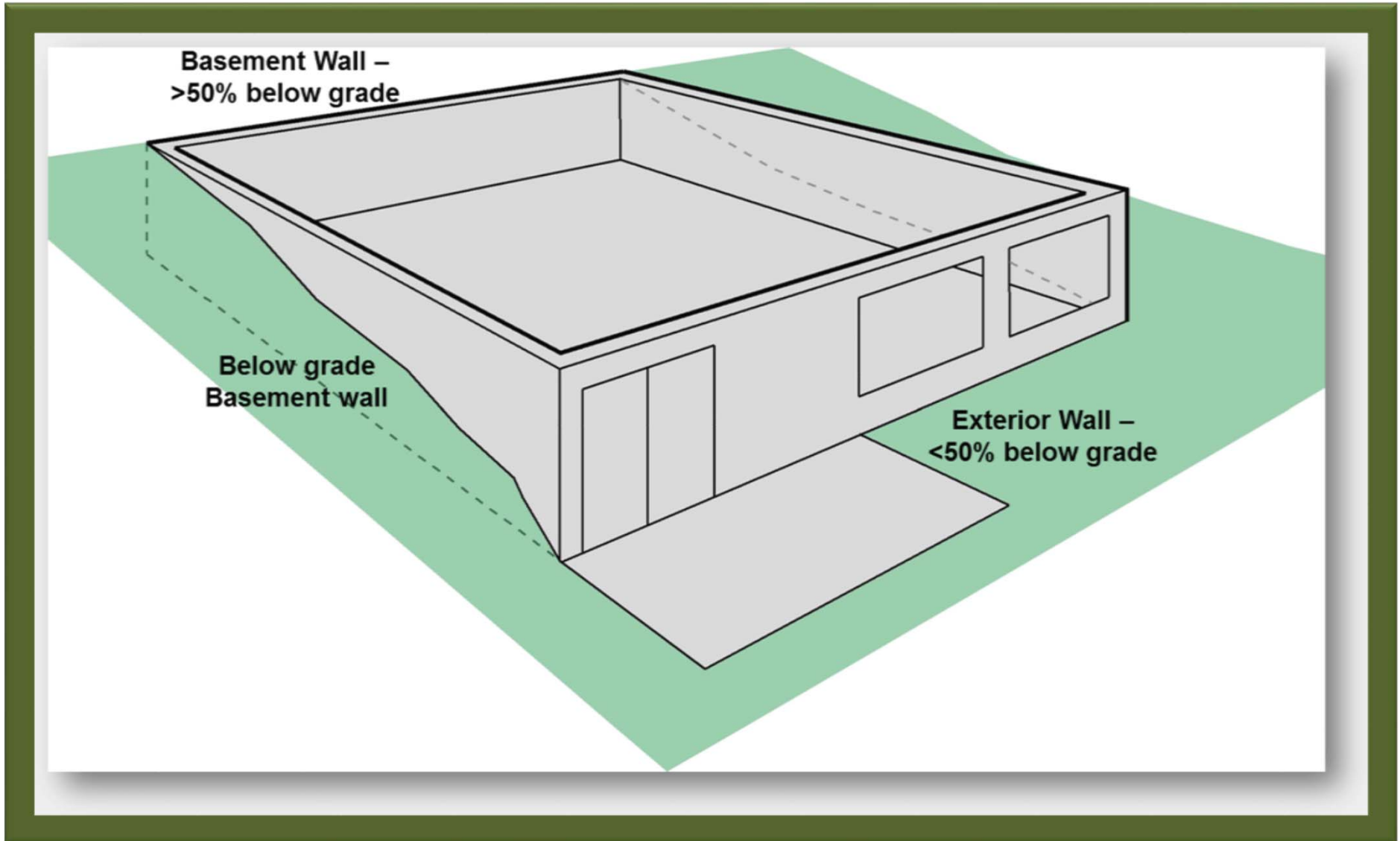
Vented Crawlspace Requirements:

- 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.
- 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:

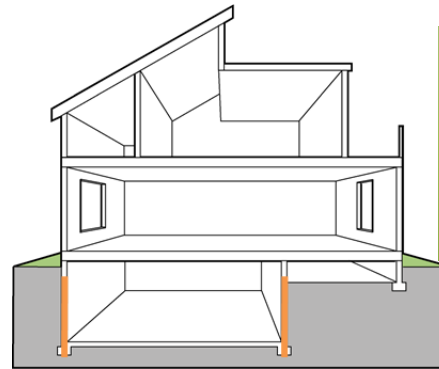
- The crawlspace ground surface must be covered with an approved vapor retarder (*e.g., plastic sheeting*).
- Crawlspace walls must be insulated to the R-value requirements specific for crawlspace walls (*IECC Table 402.1.1*).
- Crawlspace wall insulation must extend from the top of the wall to the inside 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.

Defining Below-Grade Walls



Below-Grade Walls

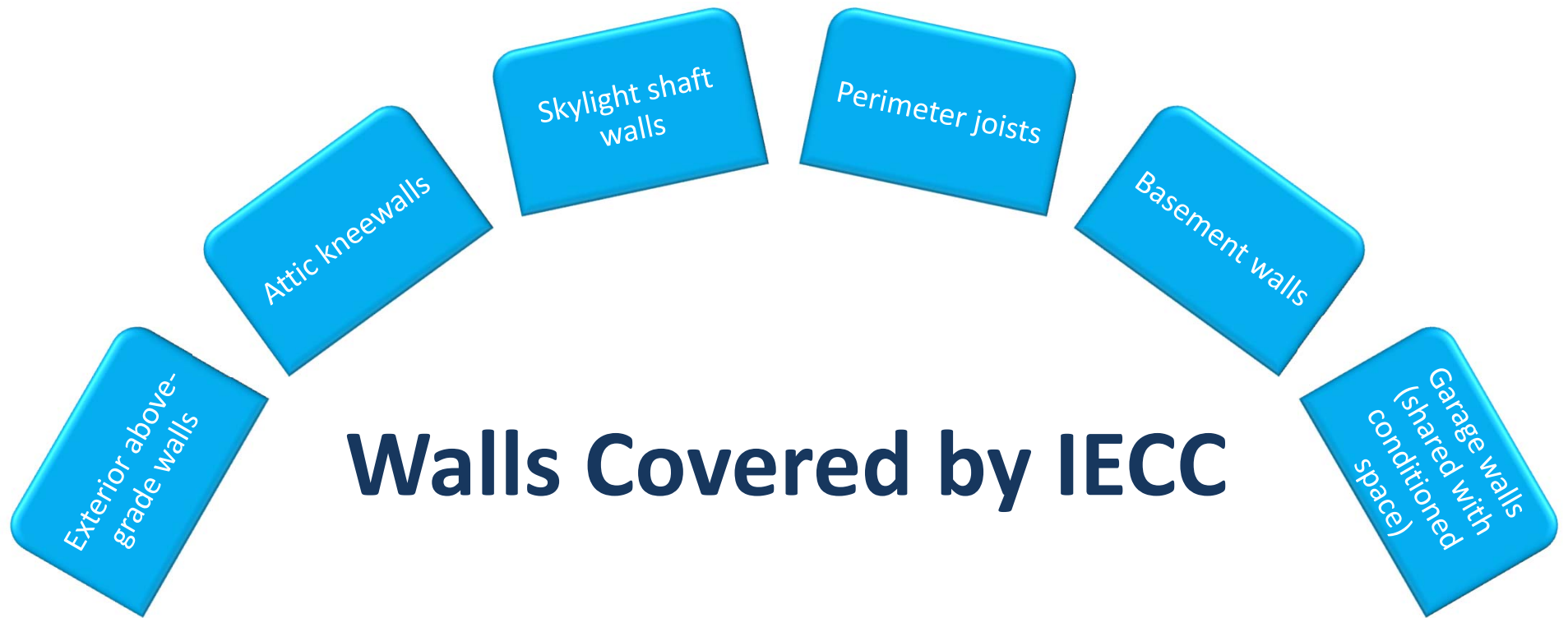
Insulated from top of basement wall down to 10 ft below grade or basement floor, whichever is less



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

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

Walls Covered by IECC



Wood Frame Walls

Table 402.1.1

Insulation and Fenestration Requirements by Component

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Glazed Fenestration	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value	Floor R-Value
1	<p>Required R-value can be met with any combination of cavity or continuous insulation</p> <p>Exception in zones 5-6: R-13 cavity plus R-5 sheathing meets R-20 requirement</p>				13	3 / 4	13
2					13	4/6	13
3					20 or 13 + 5	5/8	19
4 except Marine					20 or 13 + 5	5/10	19
5 & Marine 4	0.35	0.60	NR	38	20 or 13 + 5	13/17	30
6	0.35	0.60	NR	49	20 + 5 or 13 + 10	15/19	30
7 and 8	0.35	0.60	NR	49	20 + 5 or 13 + 10	19/21	38

Mass Wall Requirements

Table 402.1.1

Insulation and Fenestration Requirements by Component

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Glazed Fenestration	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value	Floor R-Value
1					13	3 / 4	13
2					13	4/6	13
3					20 or 13 + 5	5/8	19
4					20 or 13 + 5	5/10	19
except Marine					20 or 13 + 5	5/10	19
5 & Marine 4	0.35	0.60	NR	38	20 or 13 + 5	13/17	30
6	0.35	0.60	NR	49	20 + 5 or 13 + 10	15/19	30
7 and 8	0.35	0.60	NR	49	20 + 5 or 13 + 10	19/21	38

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)

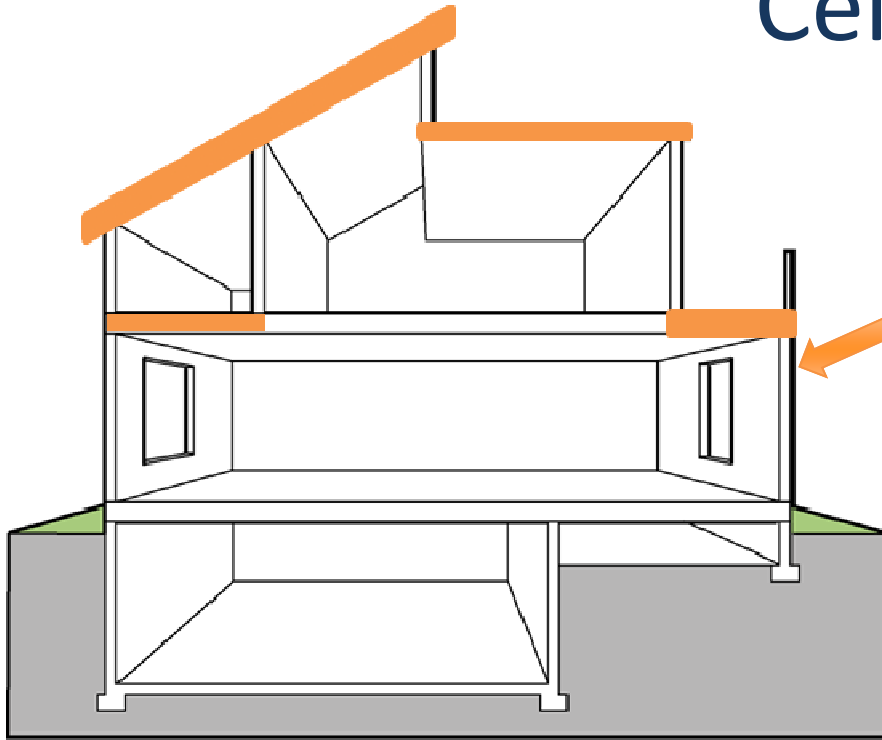


Fenestration

Doors and Windows

- Climate Zone 3 U-Factor – 0.35
- Climate Zone 5 & Marine 4 U-Factor – 0.32
- No glass area limits
- Exemptions (prescriptive path only)
 - Up to 15 ft² of glazing per dwelling unit (Section 402.3.3)
 - One side-hinged opaque door assembly up to 24 ft² (Section 402.3.4)

Ceilings



- Requirements based on
- Assembly type
 - Continuous insulation
 - Insulation between framing (cavity insulation)



Meet or exceed R-values

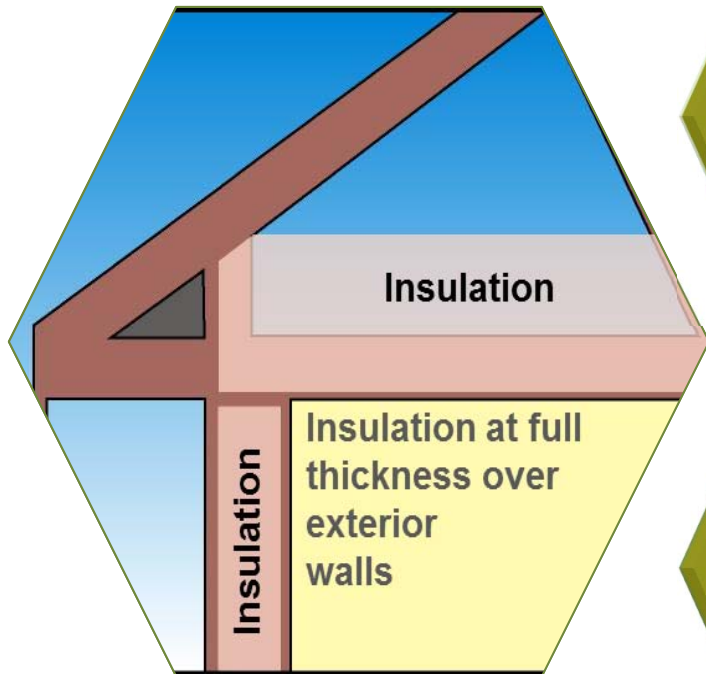
Climate Zone	R-Value
1	30
2 - 3	38
4 - 9	49

Ceilings without Attics (e.g., vaulted)



- Where Insulation levels are required $> R-30$
- Not sufficient amount of space to meet higher levels
- R-30 allowed for 500 ft² or 20% total insulated ceiling area, whichever is less

Ceilings with Attics



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

- R-38 complies where R-49 is required

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

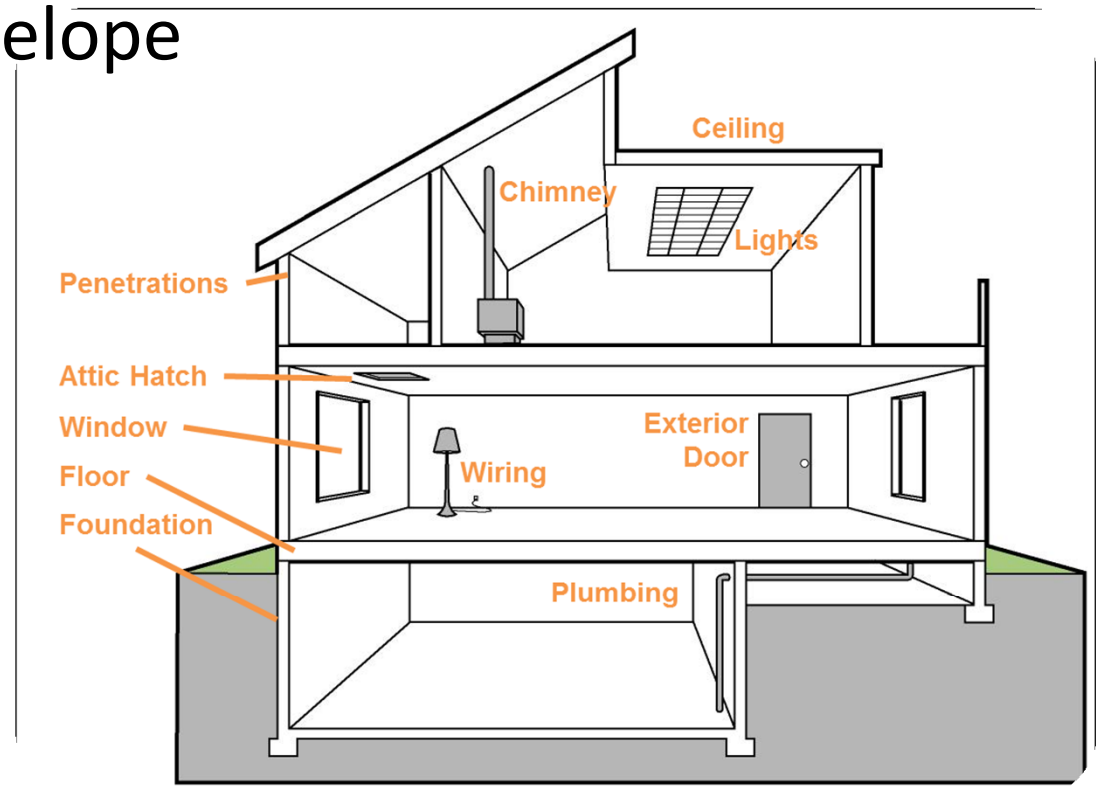
If insulation is full height over exterior wall top plate

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



Mandatory Requirements – Air Leakage

- Building thermal envelope
 - (Section 402.4)
- Recessed lighting
- Fenestration
- Fireplaces



Air Sealing and Insulation

Compliance Requirements for Climate Zones 3 to 8

Whole-house pressure test

- Air leakage ≤ 3 ACH when tested at pressure differential of 0.2 inches w.c.
Testing may occur any time after rough in and installation of building envelope penetrations

Field verification of items listed in Table
402.4.1.1

Table R402.4.1.1

Air Barrier and Insulation Installation

- Reformatted table to increase usability

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

<u>COMPONENT</u>	<u>AIR BARRIER CRITERIA</u>	<u>INSULATION INSTALLATION CRITERIA</u>
<u>General Requirements</u>	<p><u>A continuous air barrier shall be installed in the building envelope.</u></p> <p><u>Exterior thermal envelope contains a continuous air barrier.</u></p> <p><u>Breaks or joints in the air barrier shall be sealed.</u></p>	<p><u>Air-permeable insulation shall not be used as a sealing material..</u></p>
<u>Ceiling / attic</u>	<p><u>The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed.</u></p> <p><u>Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.</u></p>	<p><u>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</u></p>
<u>Walls</u>	<p><u>The junction of the foundation and sill plate shall be sealed.</u></p> <p><u>The junction of the top plate and top</u></p>	<p><u>Corners and headers shall be insulated.</u></p> <p><u>Exterior thermal envelope insulation for framed walls shall be installed in</u></p>

Mandatory Requirements Systems (Section 403)

Controls

Pools

Heat pump supplementary heat

Snow melt controls

Systems serving multiple dwelling units

Ducts

- Sealing (Mandatory)
- Insulation (Prescriptive)

Equipment sizing

HVAC piping insulation

Circulating hot water systems

Ventilation

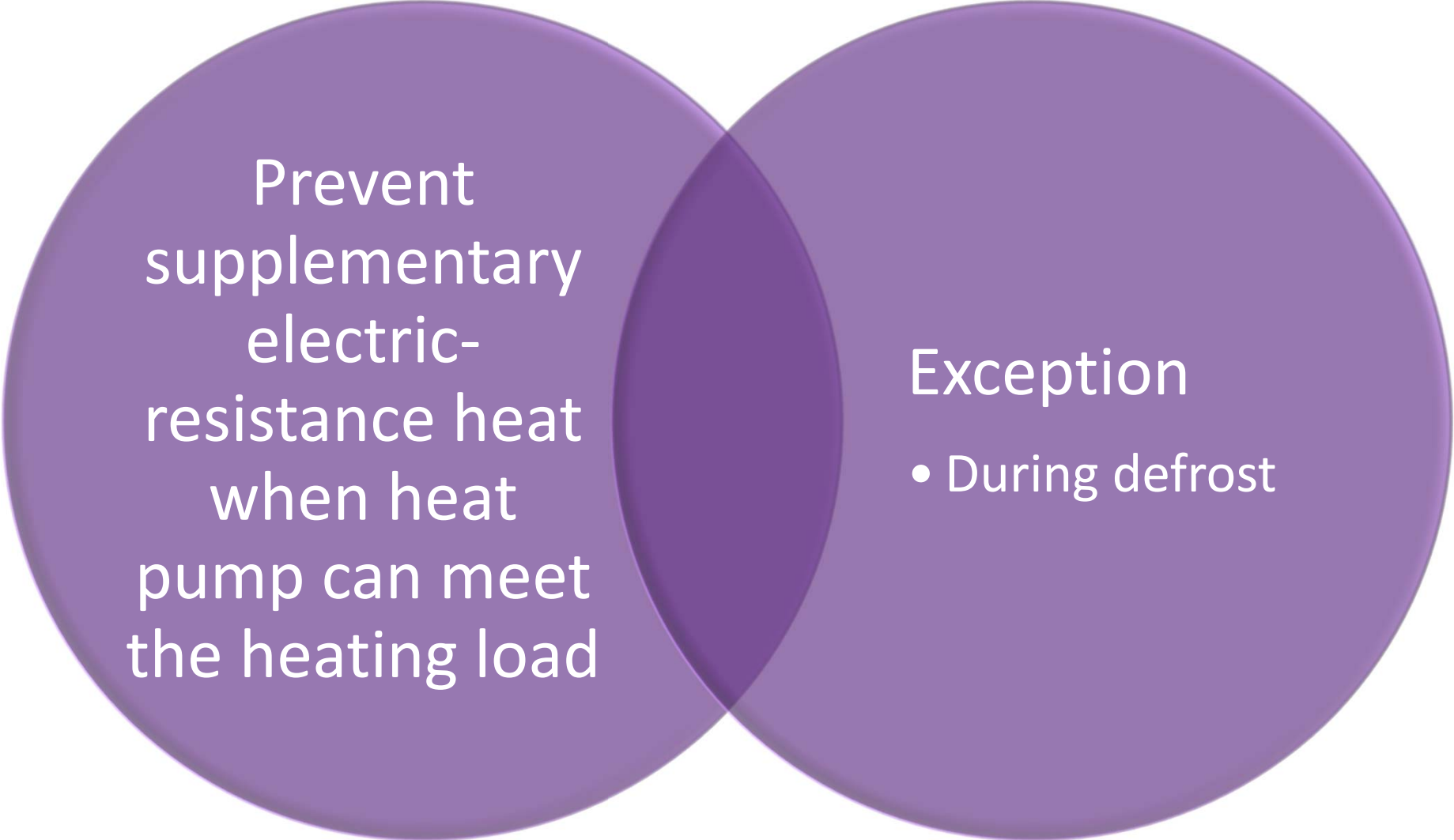
Programmable Thermostat - Controls

- At least one programmable thermostat per 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)

If primary heating system is a forced-air furnace



Heat Pump Supplementary Heat - Control



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

Exception

- During defrost

Ducts



Insulation (Prescriptive)

Supply ducts in attics: R-8 for 3" in diameter and greater

R-6 where less than 3" in diameter

All other ducts: R-6

Sealing (Mandatory)

Joints and seams shall comply with IRC, Section M1601.4.1

Building framing cavities shall not be used as ducts

Ducts 2012



Insulation (Prescriptive)

Supply ducts in attics: R-8

All other ducts: R-6

Sealing (Mandatory)

Joints and seams shall comply with IRC, Section M1601.4.1

Building framing cavities shall not be used as supply ducts

Duct Tightness Tests

All ducts, air handlers, and filter boxes shall be sealed (Section 403.3.4)



Duct tightness shall be verified *by either*

Post construction test

- Leakage to outdoors: ≤ 4 cfm/per 100 ft² of conditioned floor area or
- Total leakage: ≤ 4 cfm/per 100 ft² 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 ≤ 4 cfm/per 100 ft² 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 is not installed at time of test, total air leakage ≤ 3 cfm/per 100 ft²

Exceptions:

Duct tightness test is not required if the air handler and all ducts are located within conditioned space

Duct Tightness Tests 2012

All ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed
(Section 403.2.2)



Duct tightness shall be verified *by either*

Post construction test

- Total leakage: ≤ 6 cfm/per 100 ft² 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 ≤ 6 cfm/per 100 ft² 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 ≤ 4 cfm/per 100 ft²

Exceptions:

Duct tightness test is not required if the air handler and all ducts are located within conditioned space

Ventilation and Equipment Sizing

Ventilation

- Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating

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 or other approved methods

Piping Insulation



R-3 required on
HVAC systems

Exception: Piping that conveys
fluids between 55 and 105°F

R-3 required on
All circulating domestic hot
water systems

Systems also require a readily
accessible manual switch

Piping Insulation

R-3 required on
HVAC systems

Exception: Piping
that conveys fluids
between 55 and
105°F



Insulation for hot water pipe with a minimum thermal resistance (R-value) of R-3 shall be applied to the following:

- **Piping larger than 3/4 inch nominal diameter.**
- **Piping serving more than one dwelling unit.**
- **Piping located outside the conditioned space.**
- **Piping from the water heater to a distribution manifold.**
- **Piping located under a floor slab.**
- **Buried piping.**
- **Supply and return piping in recirculation systems other than demand recirculation systems.**

Demand Recirculation System

Hot water circulation systems shall be a demand recirculation water system

- Control will start the pump upon receiving a signal by the user
- Control will limit the temperature of the water entering the cold water line to 104°F

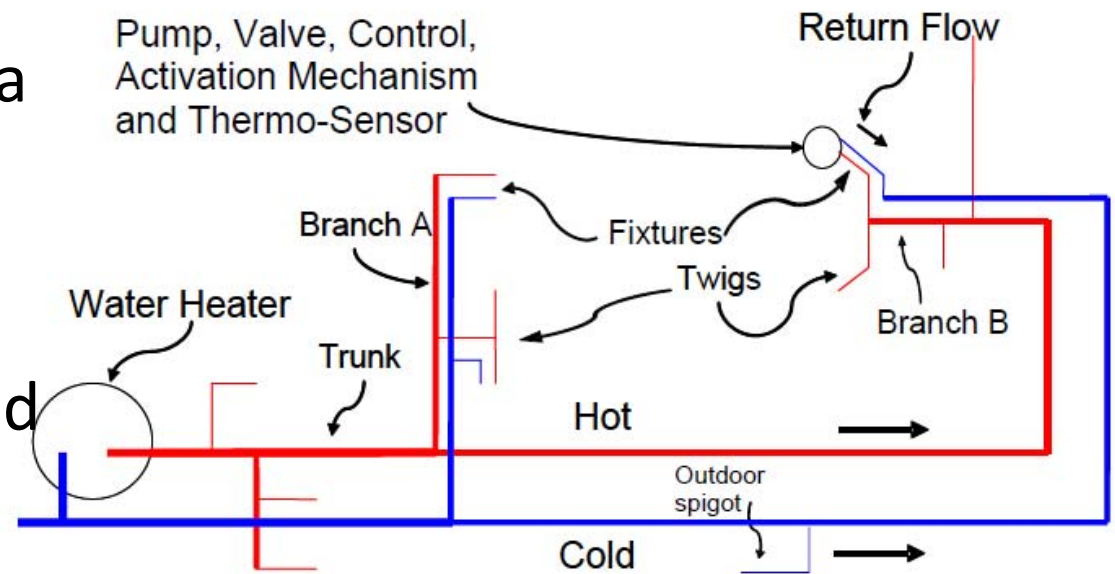


Figure 2 Single Trunk, Double Branch and Twig Plumbing Layout with Demand Controlled Pumping on Branch B, Using the Cold Water Line as the Return

Pools

Pool heaters

- with a readily accessible on-off switch
- fired by natural gas not allowed to have continuously burning pilot lights

Time switches to automatically turn off and on heaters and pumps according to a preset schedule installed on swimming pool heaters and pumps.

- Exceptions
 - Public health standards requiring 24-hour pump operation
 - Pumps operating pools with solar-waste-heat recovery heating systems

Pool Covers

- On heated pools
 - If heated to $>90^{\circ}\text{F}$, vapor-retardant pool cover at least R-12
 - Exception: If $>60\%$ of energy from site-recovered or solar energy source



Hot Water Boiler Outdoor Temperature Setback

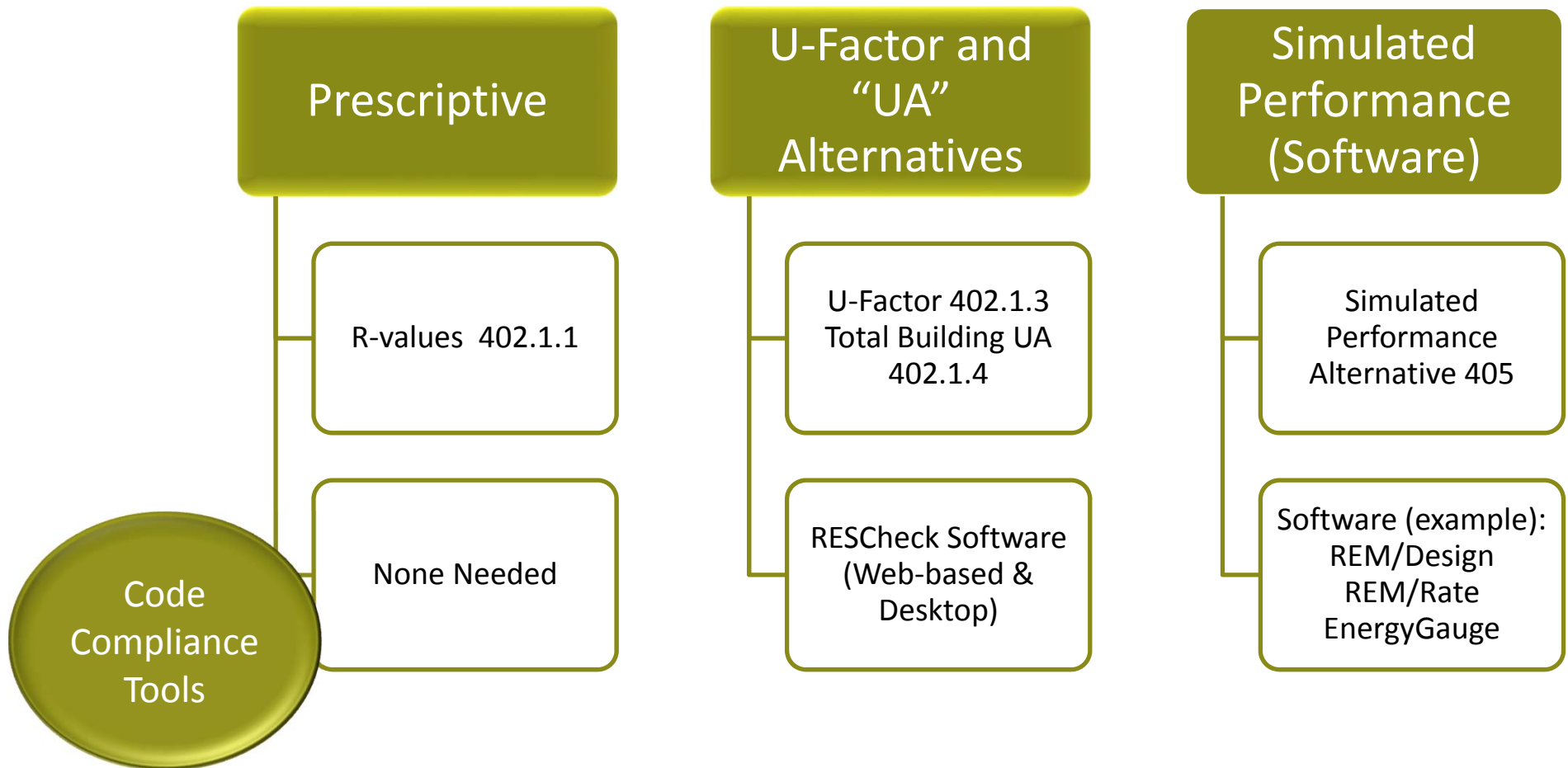
Hot water boilers that provide heat to the building shall have an outdoor temperature setback

- Lowers the boiler water temperature based on the outdoor air temperature

IECC Compliance – Four Options

	Prescriptive	Trade-off	Performance	Energy Rating Index
Requirements	Sections 402.1 through 402.3, 402.5, and 403.2.1	REScheck, any accepted compliance software	Section 405, simulated performance alternative	Section 406
Tools	None Needed		REM/Rate /REM/Design, Energy Gage, etc	HERS

2012 IECC Compliance – Three Options



Section R406 Energy Rating Index Compliance Alternative

- ERI, or Energy Rating Index, is a third party compliance pathway to the 2015 IECC
- Allows homes to comply by achieving a target ERI score AND
- Meeting the code's mandatory measures, hot water pipe insulation requirements, and prescriptive envelope requirements from the 2009 IECC.
- Requires 3rd Party verification

Target ERI by Climate Zone

Climate Zones 1-2: 52

Climate Zone 3: 51

Climate Zone 4: 54

Climate Zone 5: 55

Climate Zones 6: 54

Climate Zones 7 -8: 53

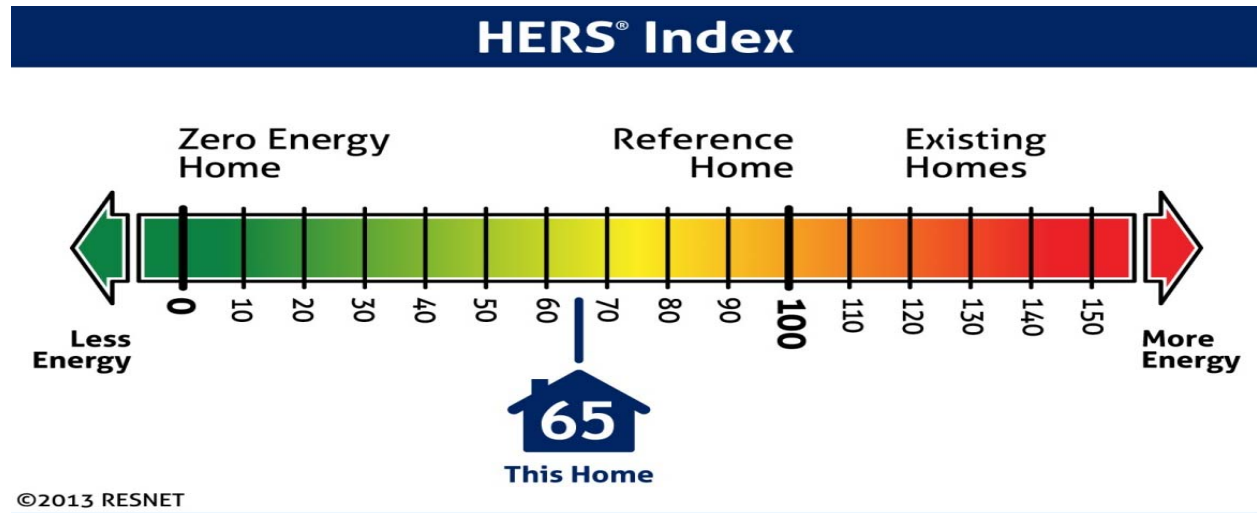
ERI Performance Path

- Additional option for IECC compliance
- Target ERI score is met through a wide range of performance options
- Requires builders to achieve the mandatory code requirements of the 2015 IECC and comply with minimum insulation and window envelope performance requirements of the 2009 IECC

Mandatory Requirements

- 2015 IECC provisions including:
 - Section R402.4 Air Leakage
 - Section R403 Systems
 - Section R403.5 Service Hot Water Systems
 - Section R404 Electrical Power and Lighting Systems
- Building Envelope requirements of the 2009 IECC

What is an ERI using the HERS Index and Score?



The scale is based on a 100 – 0 index

A home based on the 2006 IECC scores an ERI of 100

A score of 0 is equivalent to a net zero home

What is included in an ERI?

The ERI is based on a number of variables including the type and efficiency of each of the following:

- Equipment
- Appliance upgrades
- Exterior walls (both above and below grade)
- Floors over unconditioned spaces (such as garages or crawlspaces)
- Ceilings and roofs
- Attics, foundations and crawlspaces
- Windows and doors, vents and ductwork
- HVAC and water heating systems
- Air leakage of the home
- Leakage in the heating and cooling distribution system



What is included in an ERI?

The ERI also accounts for on-site renewables
On-site power production

2015 IECC Definition

“Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass or the internal heat of the earth.”



Residential Inspection

Footing and
foundation

*Insulation R-value,
location, thickness,
depth of burial and
protection of
insulation



Residential Inspection



Framing and rough-in inspection

- Types of insulation and corresponding R-values and their correct location and proper installation
- Fenestration properties (U-factor, SHGC)
- Proper installation of air leakage controls

Residential Inspection

- Plumbing rough-in inspection
 - Types of water heaters efficiency
 - Piping insulation placement and corresponding R-value
 - Controls



Residential Inspection



- Mechanical rough-in inspection
 - HVAC equipment type, size; required controls
 - Duct and piping insulation and corresponding R-value
 - Programmable thermostats
 - Dampers

Residential Inspection

- Final Inspection
 - High efficacy lighting
 - Ceiling insulation
 - Thermostats
 - Other efficiency features that were not reviewed during other inspections.





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