



Providing effective energy strategies for buildings and communities

Residential Energy Code Basics & 2018 IECC Updates

4.30.2019



Who we are

We assist buildings and communities in achieving energy efficiency, saving money, and becoming more sustainable.

We are an applied research program at University of Illinois, working in collaboration with 360 Energy Group.

Our goal: Reduce the energy footprint of Illinois.



SEDAC is the Illinois Energy Conservation Code Training Provider

This training program
is sponsored by
Illinois EPA
Office of Energy



Energy Code Assistance



- Technical support
 - 800.214.7954
 - energycode@sedac.org
- Online resources at sedac.org/energy-code
- Workshops
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Energy Code Training

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Energy Code Training

SEDAC is the Illinois Energy Conservation Code training provider

The Smart Energy Design Assistance Center (SEDAC) is providing training to increase awareness of the Illinois Energy Conservation Code and to improve the energy efficiency of new construction and renovation in Illinois. Community code officials, construction professionals and trades, and design professionals such as architects and engineers are invited to participate. SEDAC will be offering [workshops](#), [webinars](#), [online training](#), [resources](#), and [technical support](#). This program is funded by the Illinois Environmental Protection Agency (IEPA), in compliance with Illinois law.

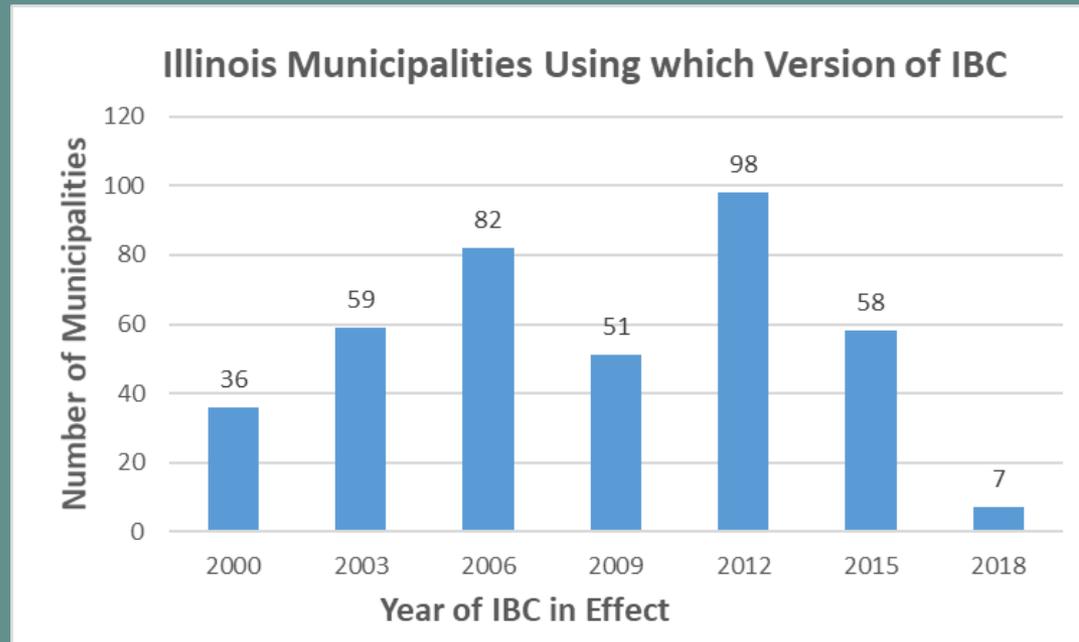
Smart Energy Design Assistance Center
University of Illinois
1 St Mary's Road | Champaign, IL 61820
800.214.7954 | Info@sedac.org

 Department of
LANDSCAPE ARCHITECTURE

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Hodge-podge of Building Codes Being Used

Many municipalities are using dated versions of Building Codes, however, **the most current versions of the Illinois Energy Conservation Code and the Illinois Plumbing Code are both required to be followed by Illinois statute.***



*<https://www2.illinois.gov/cdb/business/codes/Pages/BuildingCodesRegulations.aspx>



Access to 2018 IECC

<https://codes.iccsafe.org/public/document/iecc2018>

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2018 International Energy Conservation Code

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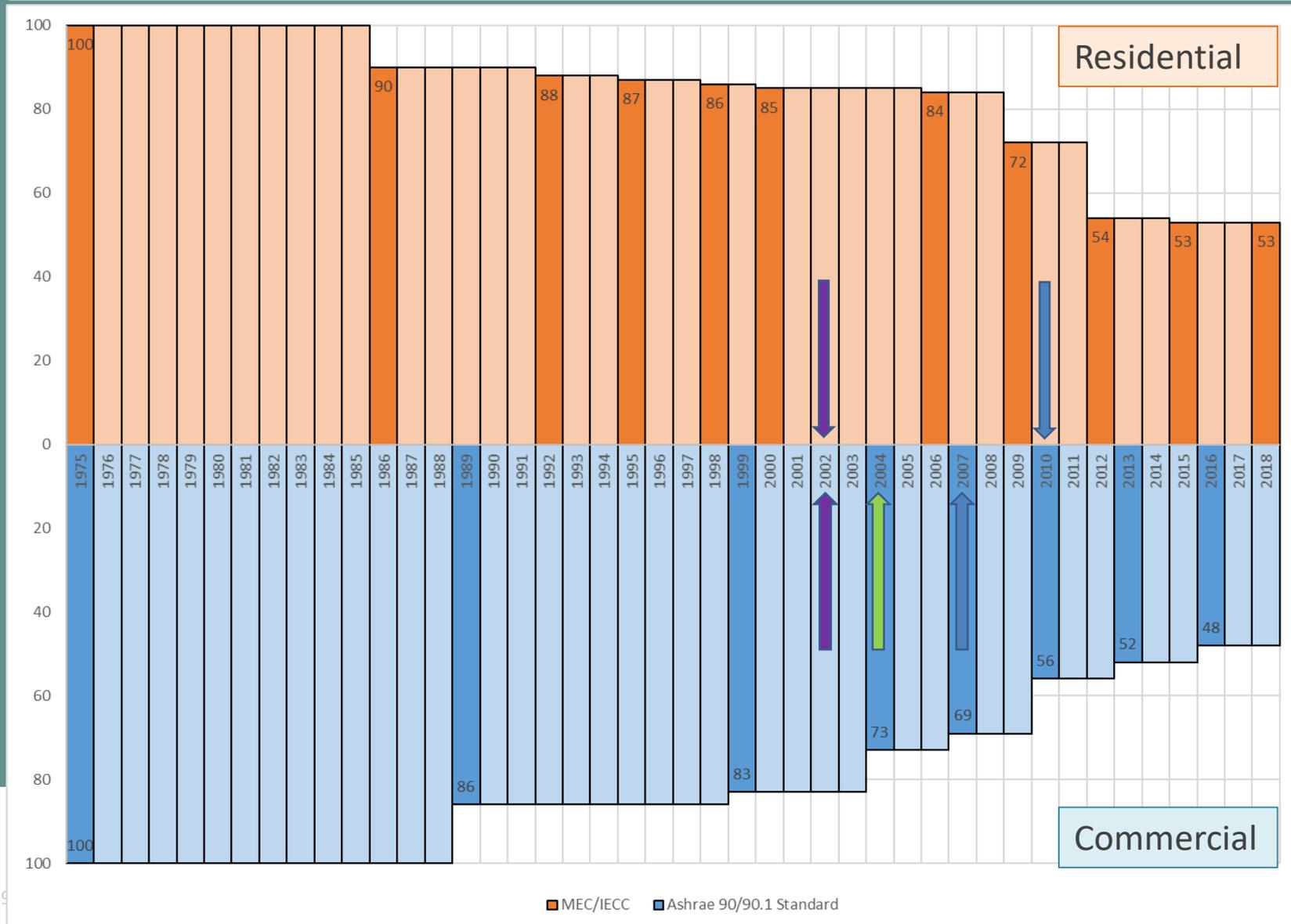
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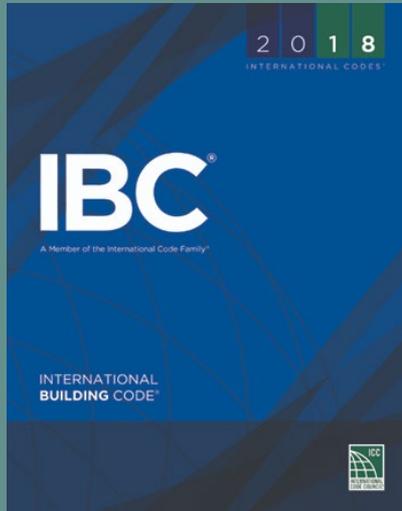
- LEGEND
- COPYRIGHT
- PREFACE
- EFFECTIVE USE OF THE INTERNATIONAL ENERGY CONSERVATION CODE
- IECC—COMMERCIAL PROVISIONS
- CHAPTER 1 [CE] SCOPE AND ADMINISTRATION



History of Model Codes Improvement



What are the different I-Codes?



The International Code Council (ICC) family of codes covers all aspects of construction and includes (but is not limited to):

- International Building Code (IBC): Applies to new and existing buildings, except those residential buildings covered under the International Residential code.
- International Residential Code (IRC): Applies to new and existing one- and two-family dwellings and townhouses of not more than three stories in height.



IRC now contains IECC-R



- IRC and IECC are two of several International codes
- The IRC addresses all topics (structural, plumbing, mechanical, energy, etc.)
- The IECC contains energy provisions for both residential and commercial buildings (building envelope, mechanical, electrical, and service water heating)
- In 2015, IRC incorporated the International Energy Conservation Code – Residential Provisions (IECC-R) as Chapter 11 – Energy Efficiency



What does the IECC-R apply to?



Residential Buildings includes:

- Detached one and two-family dwellings and townhouses as well as Group R-2, R-3, and R-4 buildings three stories or less in height above the grade plane.
- Section 310 of the 2018 International Building Code (IBC) provides definitions of what type of occupancies fall under which category
- The 2018 IBC can be examined here: <https://codes.iccsafe.org/content/IBC2018>
- All buildings that are not classified as Residential, are considered Commercial

IECC Terminology

Prescriptive

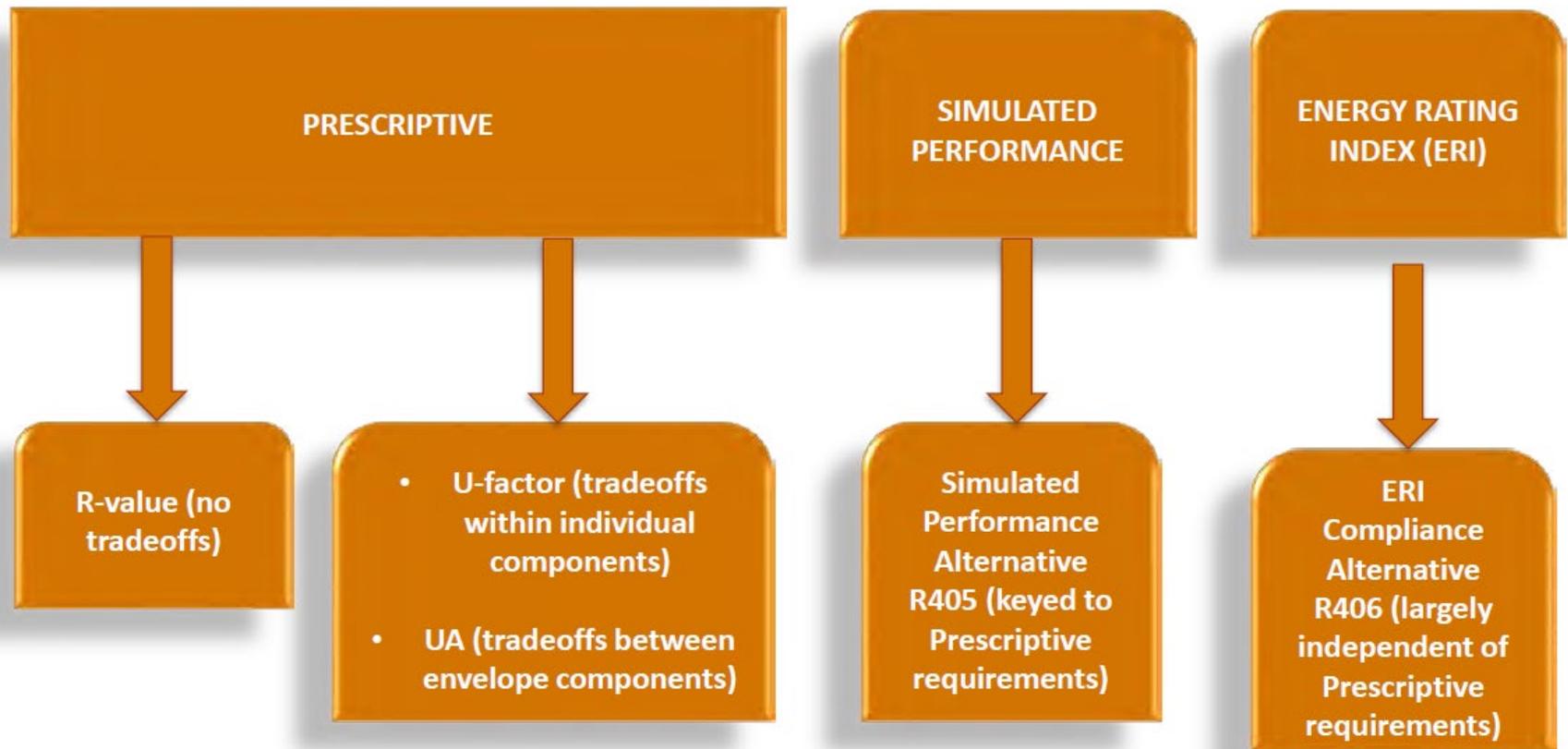
- Compliance path using a set of specifications, like a shopping list, that all must be met individually.

Mandatory

- Provisions required regardless of compliance path
- **Note: Unlike simulated performance path, ERI path is not directly based on the prescriptive requirements of the current code version**



IECC Compliance paths



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



IECC Chapter 2 Definitions



IECC Chapter 2 Definitions



- Illinois Specific Amendment change
- **Residential Building:** Means a detached one-family or two-family dwelling or any building that is three stories or less in height above grade that contains multiple dwelling units, in which the occupants reside on a primarily permanent basis, such as a townhouse, a row house, an apartment house, a convent, a monastery, a rectory, a fraternity or sorority house, a dormitory, and a rooming house; provided, however, that when applied to a building located within the boundaries of a municipality having a population of 1,000,000 or more (City of Chicago), the term “RESIDENTIAL BUILDING” means a building containing one or more dwelling units, not exceeding four (4) stories above grade, where occupants are primarily permanent.

IECC Chapter 2 Definitions

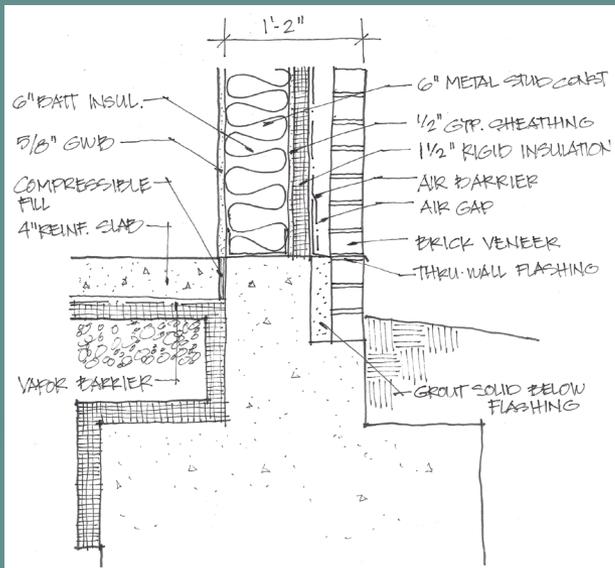


Improved definition of **Approved** 2012/15 IECC

- Approval by the code official as a result of investigation and tests conducted by him or her, or by a reason of accepted principles or tests by nationally recognized organizations.
- 2018 IECC
 - Acceptable to the code official



IECC Chapter 2 Definitions

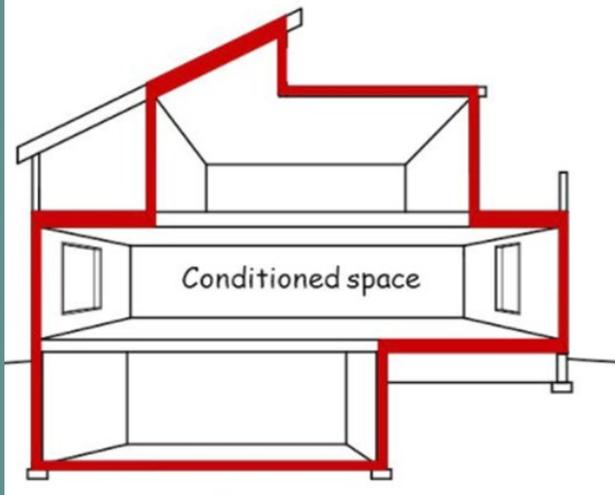


Air Barrier – Rewording 2012/15 IECC

- Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials.

• 2018 IECC

- One or more materials joined together in a **continuous manner** to restrict or prevent the passage of air through the *building thermal envelope* and its assemblies.



Question: What type of air barrier do you commonly use or specify?



Question for the audience:

What type of air barrier do you commonly specify, see specified, or use, and what do you find its strengths to be?

Type of air sealing method	Specify, see specified, or use the most	Most effective	Easiest to apply	Lowest installed cost
Fluid applied (spray or paint)				
Trowel applied				
Sheathing w/sealed joints & penetrations				
Adhesive sheet products (membrane)				

Air Leakage Requirements (Mandatory)

Residential (R402.4.1.2 Testing)

The building shall be tested and verified as having an air leakage rate of not exceeding **4 ACH**. The building shall be provided with a whole-house mechanical ventilation system as designed in accordance with Section R403.6. Testing shall be conducted in accordance with ASTM E 779 or ASTM R 1827 and reported at a pressure of 0.2 inches w.g. (50pa)

(text as found in Illinois Amendments)



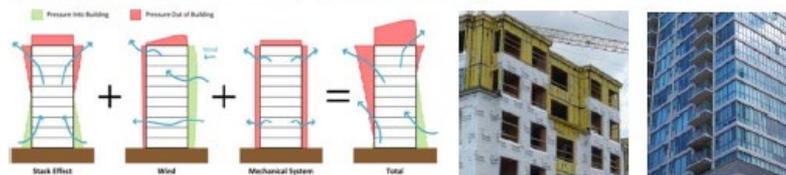
Air Leakage Control

Canada Mortgage and Housing Corporation has sponsored a lot of building design and performance research.

This publication addresses Air Leakage Control and is a good source of information on how to design, build, and test for air leakage control.

Link:

<https://rdh.com/wp-content/uploads/2014/04/Air-Leakage-Control-in-Multi-Unit-Residential-Buildings.pdf>



CLIENT Silvia Plescia
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa ON K1A 0P7

SUBMITTED BY RDH Building Engineering Ltd.
224 West 8th Avenue
Vancouver BC V5Y 1N5

Air Leakage Control in Multi-Unit Residential Buildings
Development of Testing and Measurement Strategies to Quantify Air Leakage in MURBS

IECC Chapter 2 Definitions



New to 2018 IECC

Air-Impermeable Insulation

- An insulation that functions as an air barrier

Opaque Door

- A door that is not less than 50 percent opaque in surface area.

IECC Chapter 2 Definitions



Demand Recirculation Water System - rewording

2015 IECC

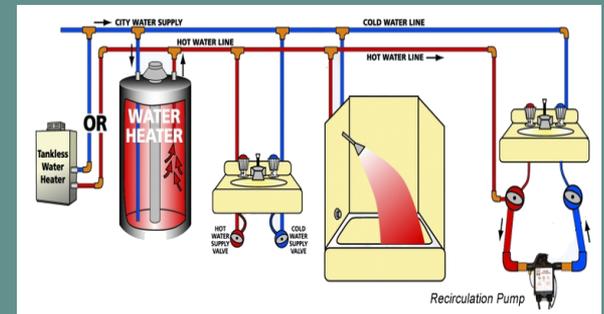
- A water distribution system where pump(s) prime the service hot water piping with heated water upon demand for hot water.

2018 IECC

- A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply line.

IECC Commentary:

Demand recirculation water systems are more energy efficient than other recirculation systems. Systems are so designed that the water returning to the heating source returns via the cold water piping. The code specifies unique control and insulation requirements for these systems.



2018 IECC R403.5 Service hot water systems

2015 IECC

- **R403.5.2 Demand recirculation systems.** A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a *Demand recirculation water system*. Pumps shall have controls that comply with both of the following:
 - #1 & #2 are same as in 2018 IECC (below)

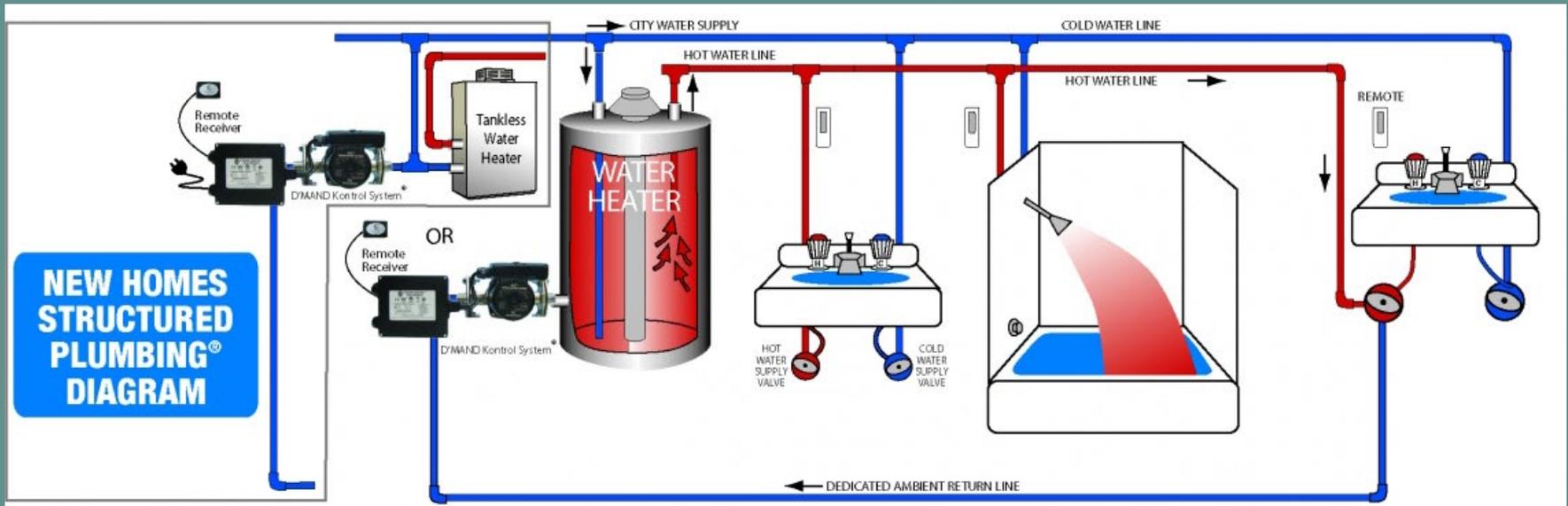
2018 IECC

- **R403.5.2 Demand recirculation systems.** *Demand recirculation systems* shall have controls that comply with both of the following:
 1. The controls shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot water to a fixture fitting or appliance.
 2. The controls shall limit the temperature of the water entering the cold water piping to not greater than 104°F (40°C).



Hot water demand recirculating systems

An alternative to using the cold water line as a return for the hot water is to install a dedicated return line.



IECC Chapter 2 Definitions

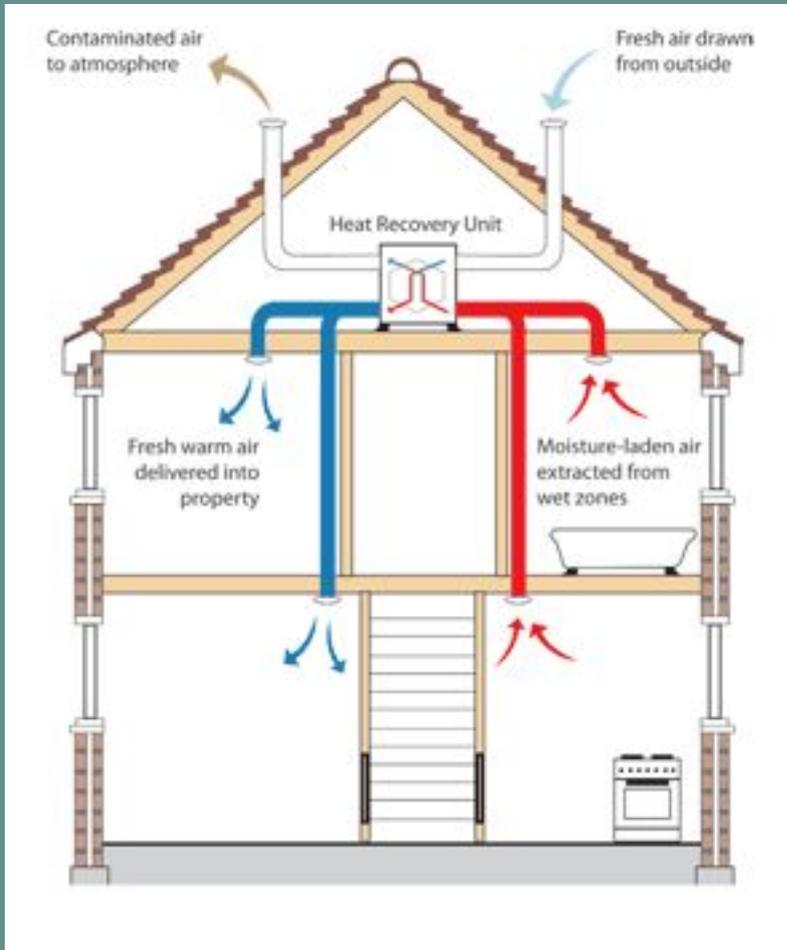


- Illinois Specific Amendment additions to code:

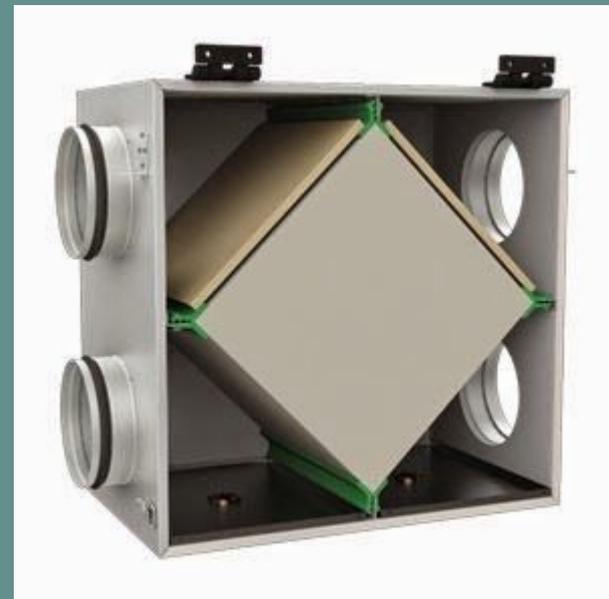
Local Exhaust. An exhaust system that uses one or more fans to exhaust air from a specific room or rooms within a dwelling.

Whole House Mechanical Ventilation System. An exhaust system, supply system, or combination thereof that is designed in accordance with Section R403.6 to mechanically exchange indoor air for outdoor air when operating continuously or through a programmed intermittent schedule to satisfy the whole house ventilation rate. 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



Heat recovery ventilation (HRV) or Energy recovery ventilation (ERV) systems transfer heat (and moisture if ERV) from exhaust air to incoming air. They have very energy efficient motors and can save far more energy than they consume.



IECC Chapter 3 General Requirements



IECC Chapter 3 General Requirements

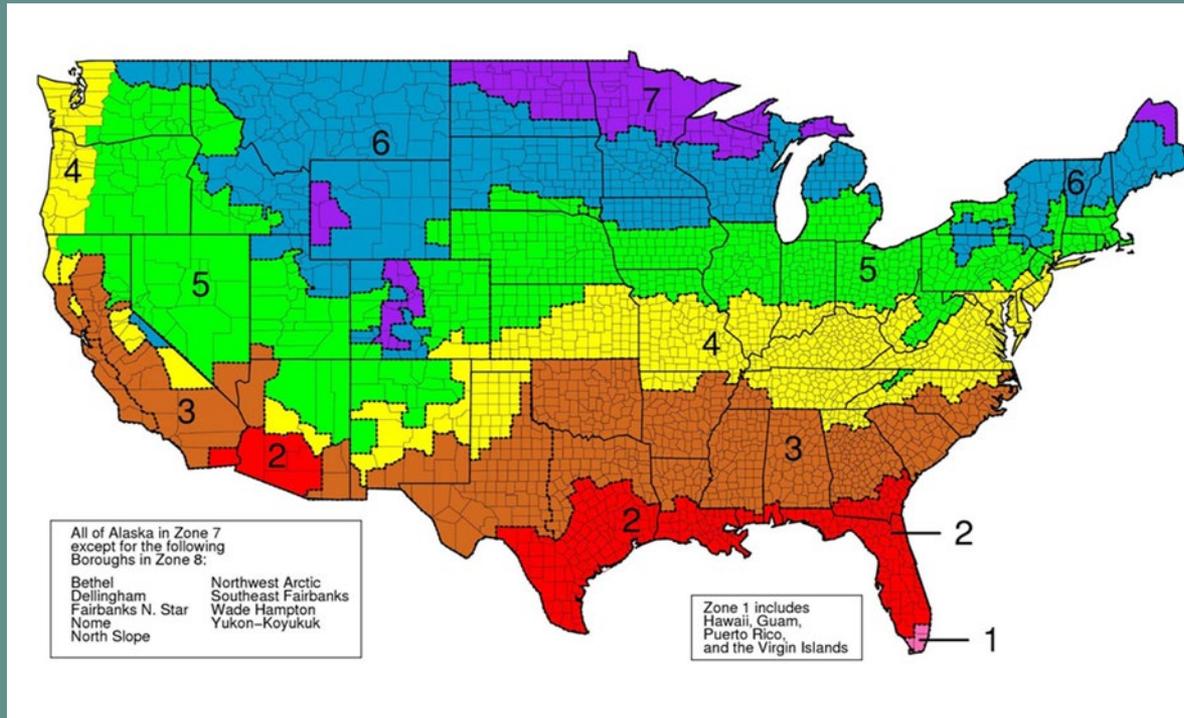


Illinois has climate zones 4A and 5A

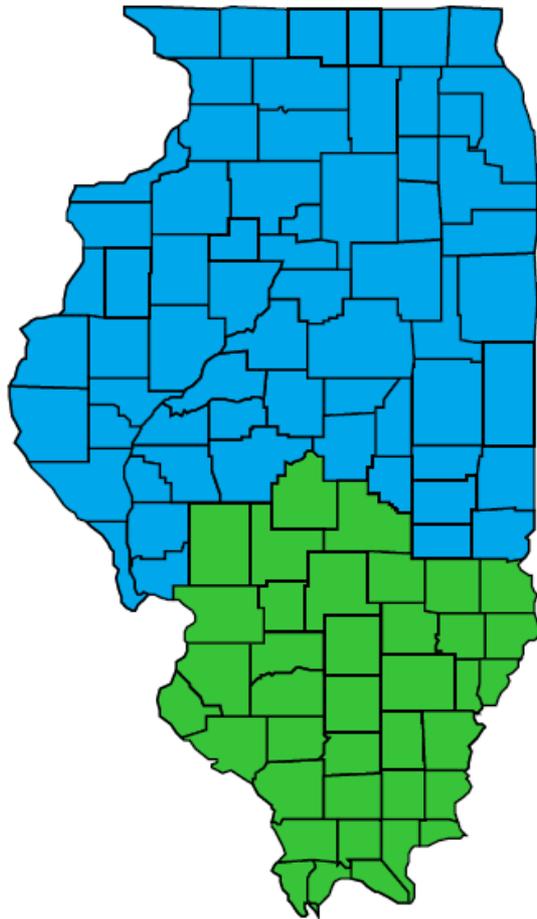
5A – Cool Humid $5400 < \text{HDD}65^{\circ}\text{F} \leq 7200$

4A – Mixed Humid $\text{CDD}50^{\circ}\text{F} \leq 4500$ and $\text{HDD}65^{\circ}\text{F} \leq 5400$

Moist (A) Definition - Location that are not marine and not dry



Illinois climate zone map



CLIMATE ZONE 5

Adams	De Witt	Jo Daviess	McDonough	Sangamon
Boone	Douglas	Kane	McHenry	Schuyler
Brown	DuPage	Kankakee	McLean	Scott
Bureau	Edgar	Kendall	Menard	Stark
Calhoun	Ford	Knox	Mercer	Stephenson
Carroll	Fulton	La Salle	Morgan	Tazewell
Cass	Greene	Lake	Moultrie	Vermilion
Champaign	Grundy	Lee	Ogle	Warren
Clark	Hancock	Livingston	Peoria	Whiteside
Coles	Henderson	Logan	Piatt	Will
Cook	Henry	Macon	Pike	Winnebago
Cumberland	Iroquois	Marshall	Putnam	Woodford
DeKalb	Jersey	Mason	Rock Island	

CLIMATE ZONE 4

Alexander	Fayette	Johnson	Perry	Union
Bond	Franklin	Lawrence	Pope	Wabash
Christian	Gallatin	Macoupin	Pulaski	Washington
Clay	Hamilton	Madison	Randolph	Wayne
Clinton	Hardin	Marion	Richland	White
Crawford	Jackson	Massac	Saline	Williamson
Edwards	Jasper	Monroe	Shelby	
Effingham	Jefferson	Montgomery	St. Clair	





New in 2015 IECC

R303.1.3. Fenestration Product Rating.

- Exception: Where required, garage door U-Factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

R303.1.4.1 Insulated Siding.

- Insulated Siding. The thermal resistance (R-value) of insulated siding shall be determined in accordance with ASTM C 1363. Installation for testing shall be in accordance with the manufacturers instructions.

IECC Chapter 4 Residential Energy Efficiency



IECC Chapter 4 Residential Energy Efficiency



Section	Title	Compliance Path
R401	General	1
R402	Building Thermal Envelope	1
R403	Systems	1
R404	Electrical Power and Lighting Systems	1
R405	Simulated Performance Alternative	2
R406	Energy Rating Index Compliance Alternative	3

Mandatory requirements need to be complied with regardless of Compliance Path

IECC R401 - General



R401.2 Compliance

2012 IECC

- Compliance. Projects shall comply with sections identified as “mandatory” and with either sections identified as “prescriptive” or the performance approach in Section R405

2015 IECC & 2018 IECC

- Compliance. Projects shall comply with one of the following:
 1. Sections R401 through R404
 2. Section R405 and the provisions of Section R401 through R404 labeled “Mandatory.”
 3. An energy rating index (ERI) approach in Section R406



R402.1 General (Prescriptive)

New in 2015 IECC

- Exceptions:

1. The following low-energy buildings, or portions thereof, separated from the remainder of the building by the *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of section R402.
 - 1.1 Those with a peak design rate of energy usage less than 3.4 Btu/h. ft² (10.7 W/m²) or 1.0 watts/ft² of floor area for space-conditioning purposes.
 - 1.2 Those that do not contain a conditioned space.



R402.1 General (Prescriptive)

Revised in 2018 IECC

- Exceptions:

1. The following low-energy buildings, or portions thereof, separated from the remainder of the building by the *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of section R402.
 - 1.1 Those with a peak design rate of energy usage less than 3.4 Btu/h. ft² (10.7 W/m²) or 1.0 watts/ft² of floor area for space-conditioning purposes.
 - 1.2 Those that do not contain a conditioned space.
2. **Log homes designed in accordance with ICC 400. (added in 2018)**

For a copy of: 2017 ICC 400-2017: Standard on the Design and Construction of Log Structures,
See: https://codes.iccsafe.org/content/ICC4002017/copyright?site_type=public

IECC R402 – Building Thermal Envelope



- Fenestration U-Factor change from 2012/15 IECC to 2018 IECC
- Fenestration U-Factor has decreased

Zone	Component	2012/15 IECC	2018 IECC
4	Fenestration U-factor	0.35	0.32
5	Fenestration U-factor	0.32	0.30

Table R402.1.1 from 2012/15 IECC

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT*

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

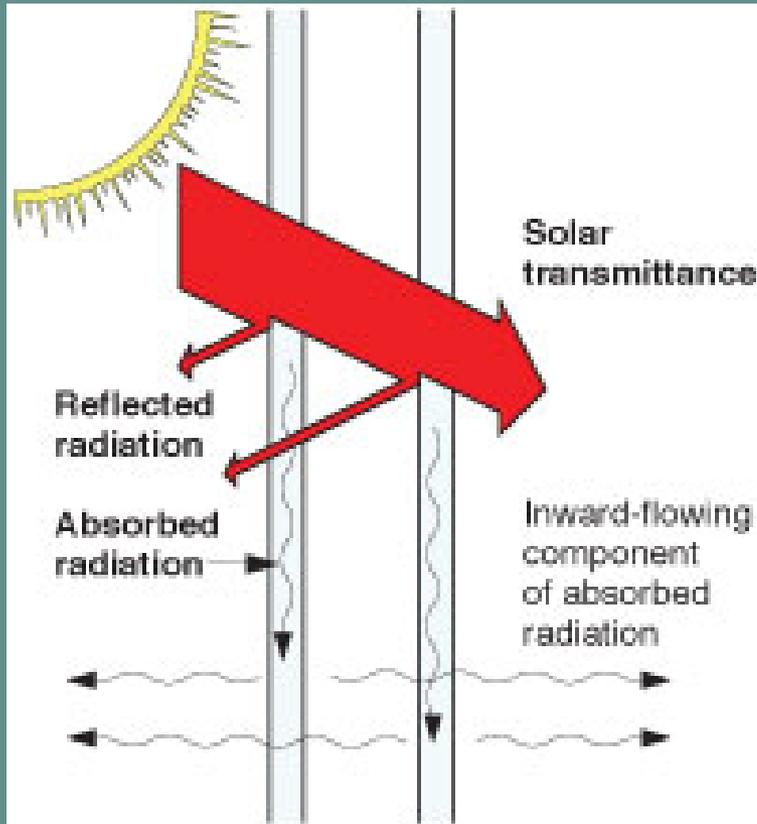
Illinois Specific Amendment in 2015 to No Requirement, IL Amendment proposed to be removed in 2018

Illinois Specific Amendments changed this to 10/13

NFRC Label Example



Solar heat gain coefficient (SHGC)



- Solar Heat Gain Coefficient (SHGC), which is defined as that fraction of incident solar radiation that actually enters a building through the entire window assembly as heat gain.
- SHGC is expressed as a dimensionless number from 0 to 1.
- Solar heat gain is influenced by the glazing type, the number of panes, and any glass coatings. Solar heat gain of glazing ranges from above 80% for uncoated water-white clear glass to less than 20% for highly reflective coatings on tinted glass. A typical double-pane IGU has a SHGC of around 0.70. This value decreases somewhat by adding a low-E coating and decreased substantially when adding a tint



IECC R402 – Building Thermal Envelope



Footnote d For **Slab R-Value & Depth** has changed

2012/15 IECC

- 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.

2018 IECC

- R-5 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.

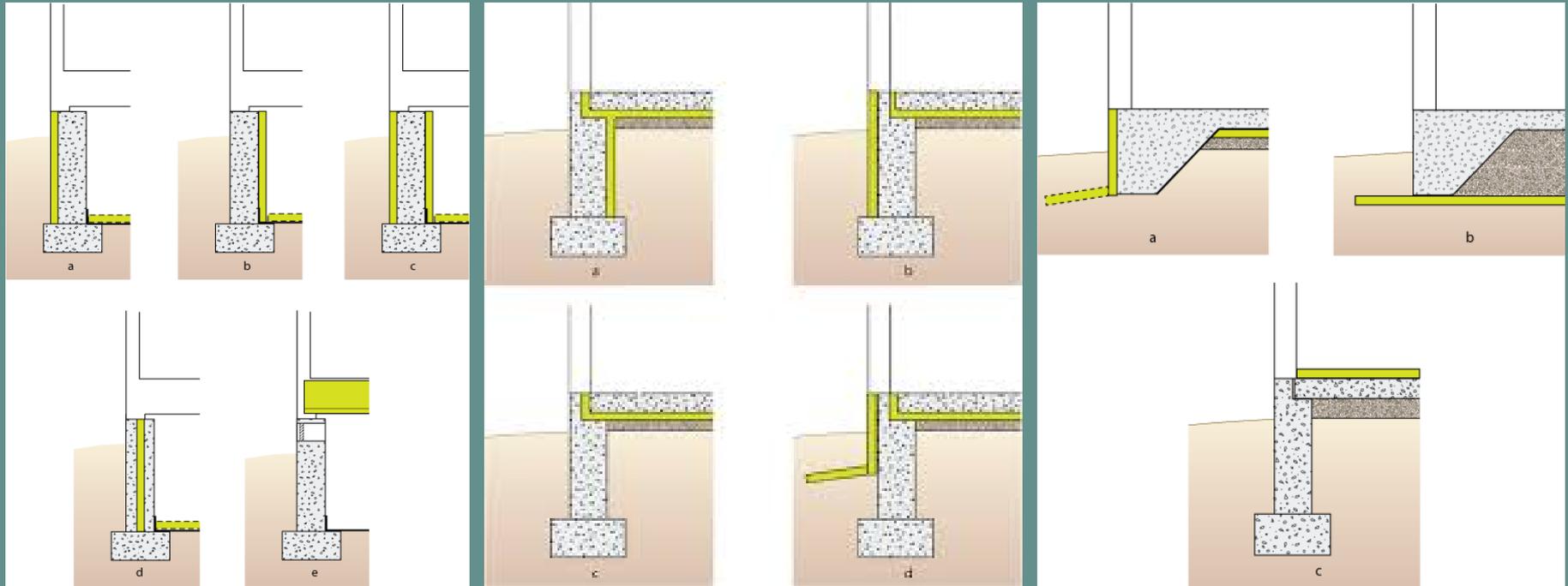
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1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 ^b	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^b	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 ^b	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

IMC 1209.5 – Thermal Barrier Required

Insulation R-values for slab-on-grade and suspended floor insulation shall be in accordance with the IECC



Heated Slab Insulation

Added to the 2018 IECC: R-5 continuous insulation required under heated slabs for both commercial and residential

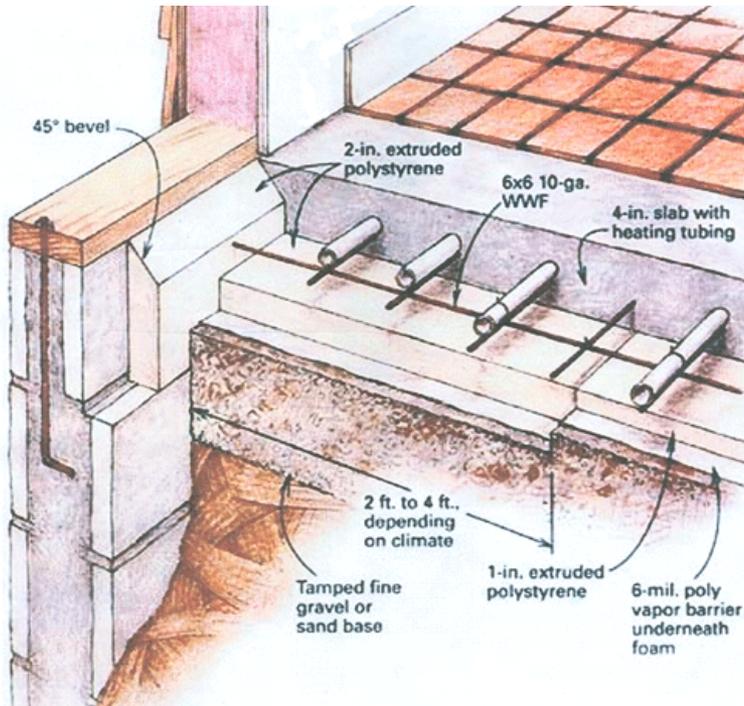


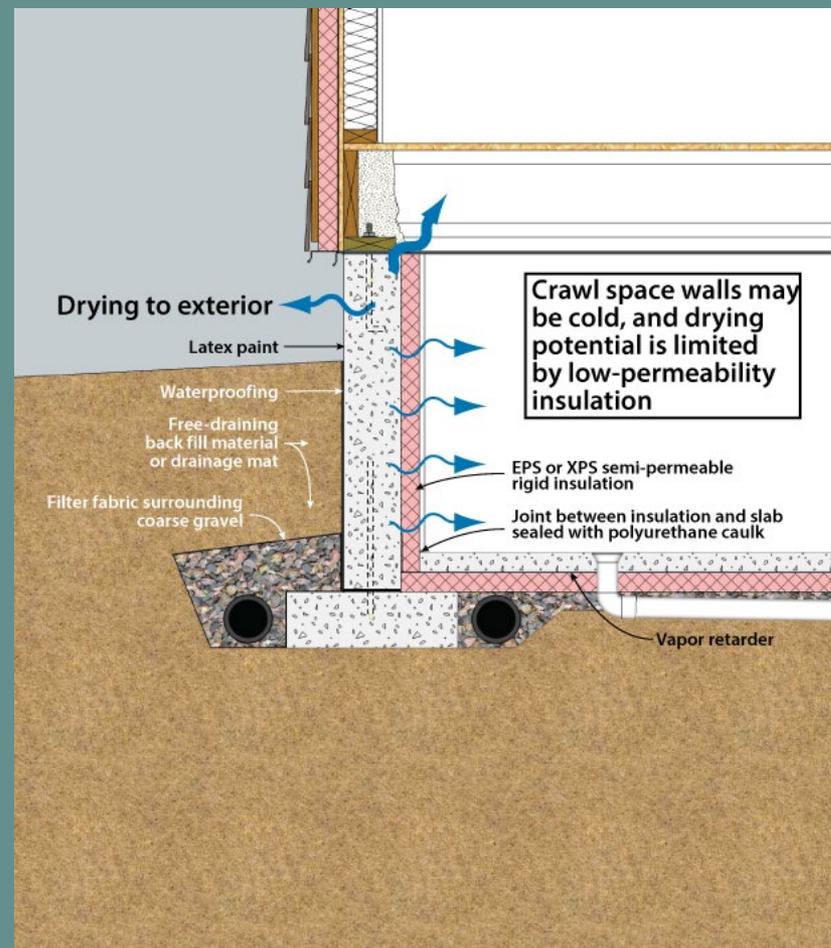
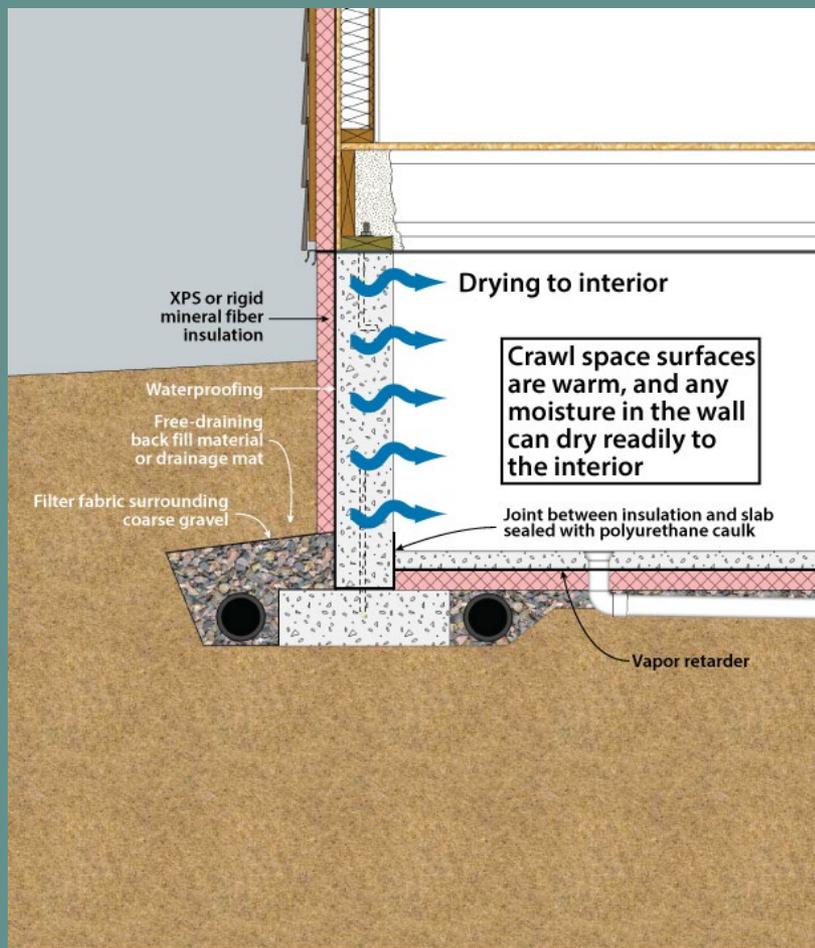
Table R402.1.2
Opaque Thermal Envelope Insulation Component
Minimum Requirements, R-Value Method

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4	
	All other	Group R	All other	Group R
Floors				
Mass ^e	R-10ci	R-10.4ci	R-10ci	R-12.5ci
Joist/framing	R-30	R-30	R-30	R-30
Slab-on-grade floors				
Unheated slabs	R-10 for 24' below			
Heated slabs ^h	R-15 for 24' below + R-5 full slab	R-15 for 24' below + R-5 full slab	R-15 for 36' below + R-5 full slab	R-15 for 36' below + R-5 full slab

h. The first value is for the perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.



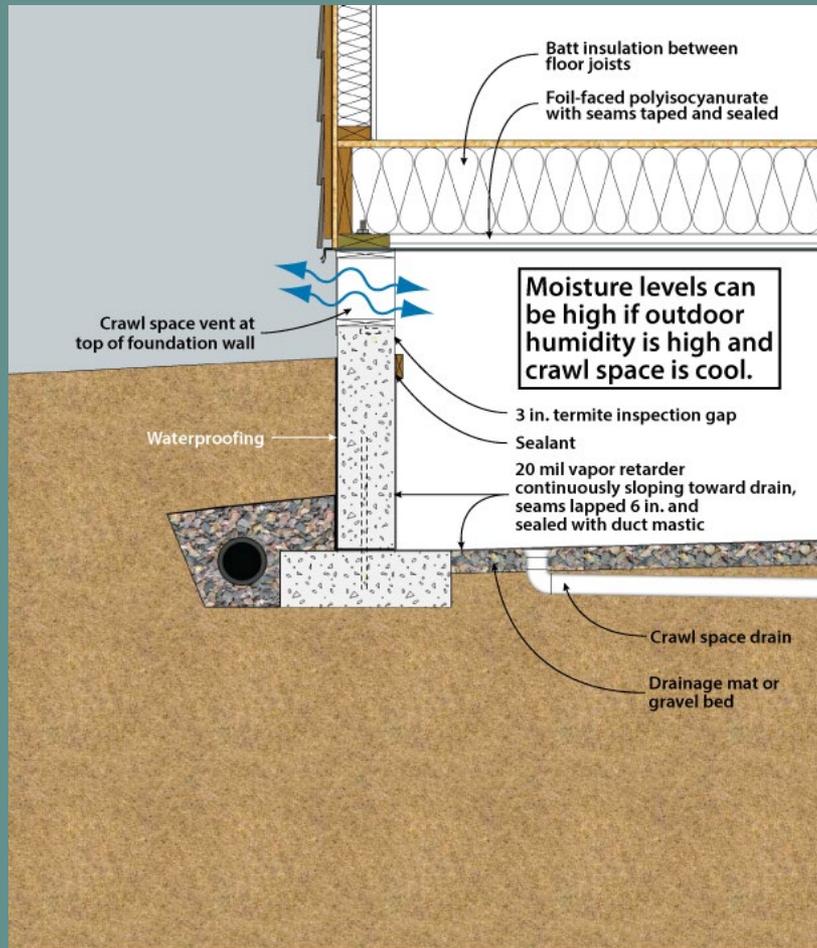
Crawl space insulation methods



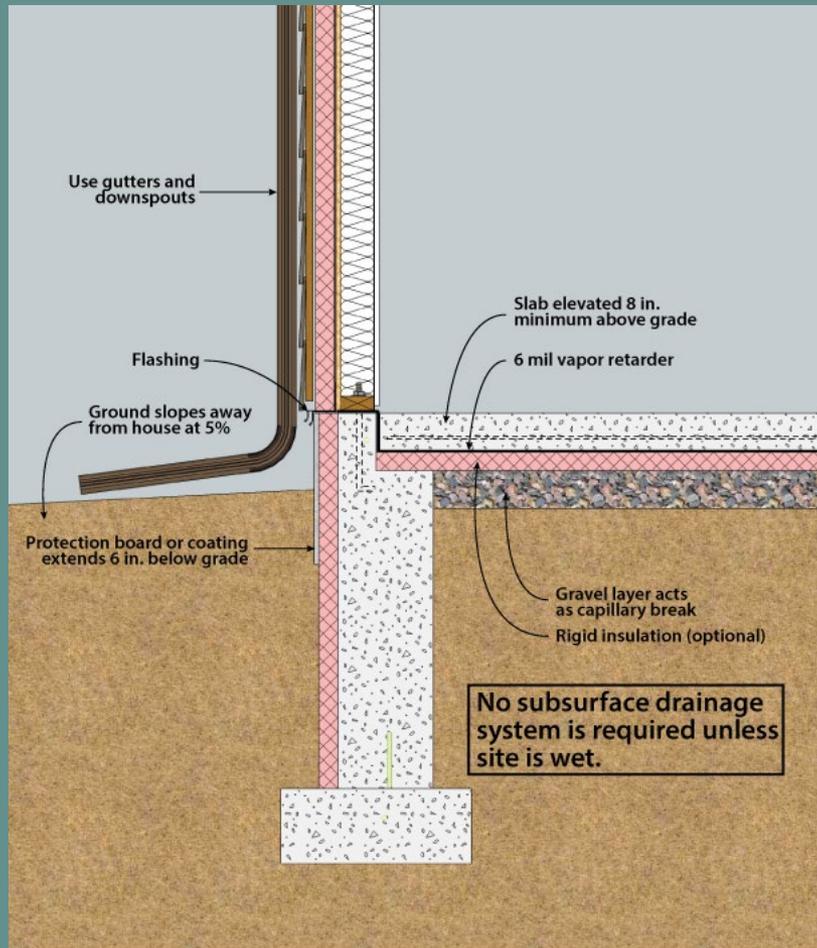
<https://foundationhandbook.ornl.gov/handbook/section3-1-insulation.shtml>



Uninsulated crawl space



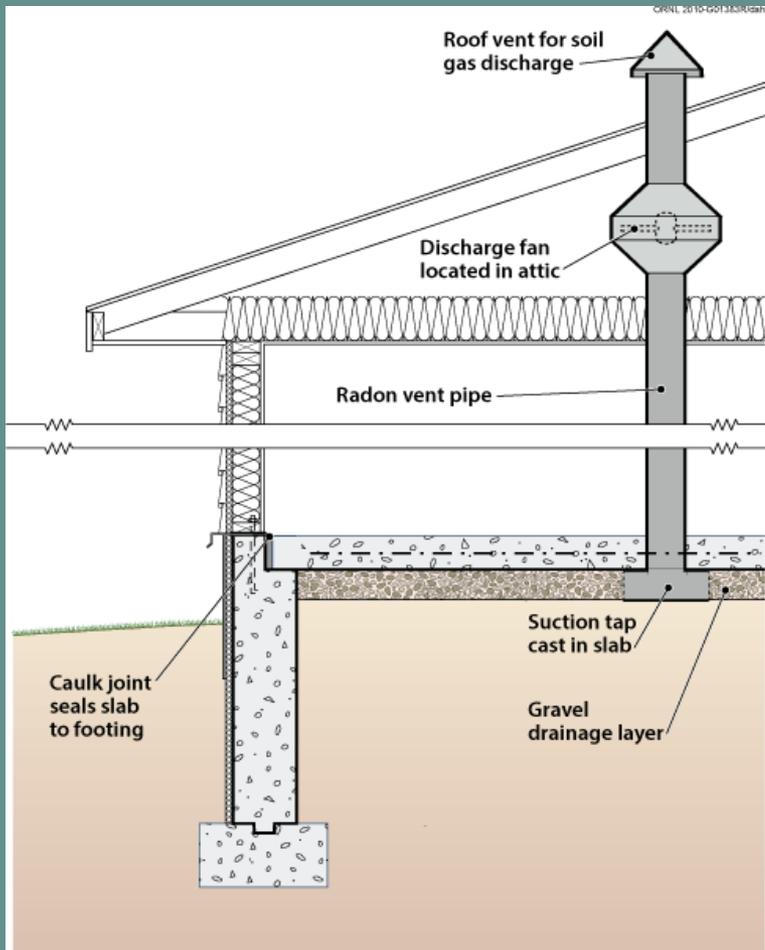
Slab-on-grade insulation method



<https://foundationhandbook.ornl.gov/handbook/section4-1.shtml>



Radon mitigation not in the code (yet)



Disclosure of Radon Information

The Illinois Radon Awareness Act and the Illinois Real Property Disclosure Act requires that a seller of a home disclose information if aware of unsafe concentrations of radon in the home.

The acts do not require that testing or remediation work be conducted.

However, many relocation companies and lending institutions, as well as home buyers, request a radon test when purchasing a house. Sellers and brokers are cautioned to err on the side of full disclosure of material facts prior to entering into a purchase agreement.

Drawing: <https://foundationhandbook.ornl.gov/handbook/section4-1.shtml>

Text: <https://www2.illinois.gov/iema/NRS/Radon/Documents/radontestguidelineforrealestate.pdf>



IECC R402 – Building Thermal Envelope



Text in Footnote h of 2012/2015 For **Wood Frame Wall R-value** was moved to R402.2.7 Walls with partial structural sheathing in 2018

2012 IECC

- ^h The 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.

2015/18 IECC

- ^h The 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.

Table R402.1.1 from 2012/15 IECC

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

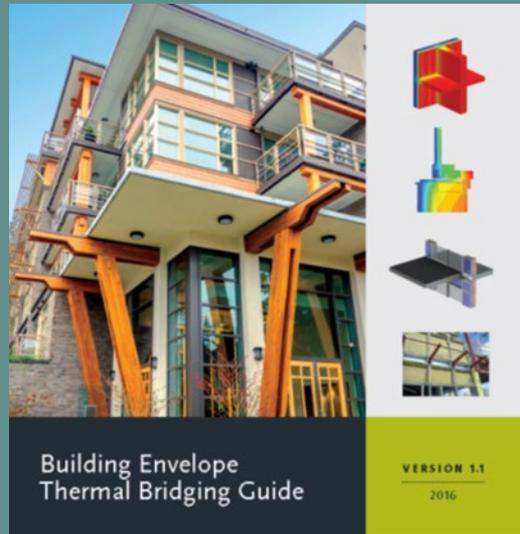
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1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^h	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 ^h	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

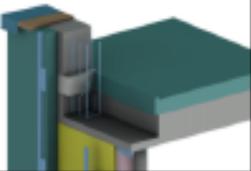
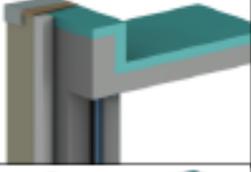
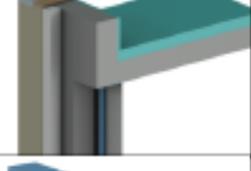
C406.8 Enhanced Envelope Performance

The total UA of the building thermal envelope as designed shall be not less than 15 percent below the total UA of the building thermal envelope in accordance with Section C402.1.5

Building Envelope Thermal Bridging Guide

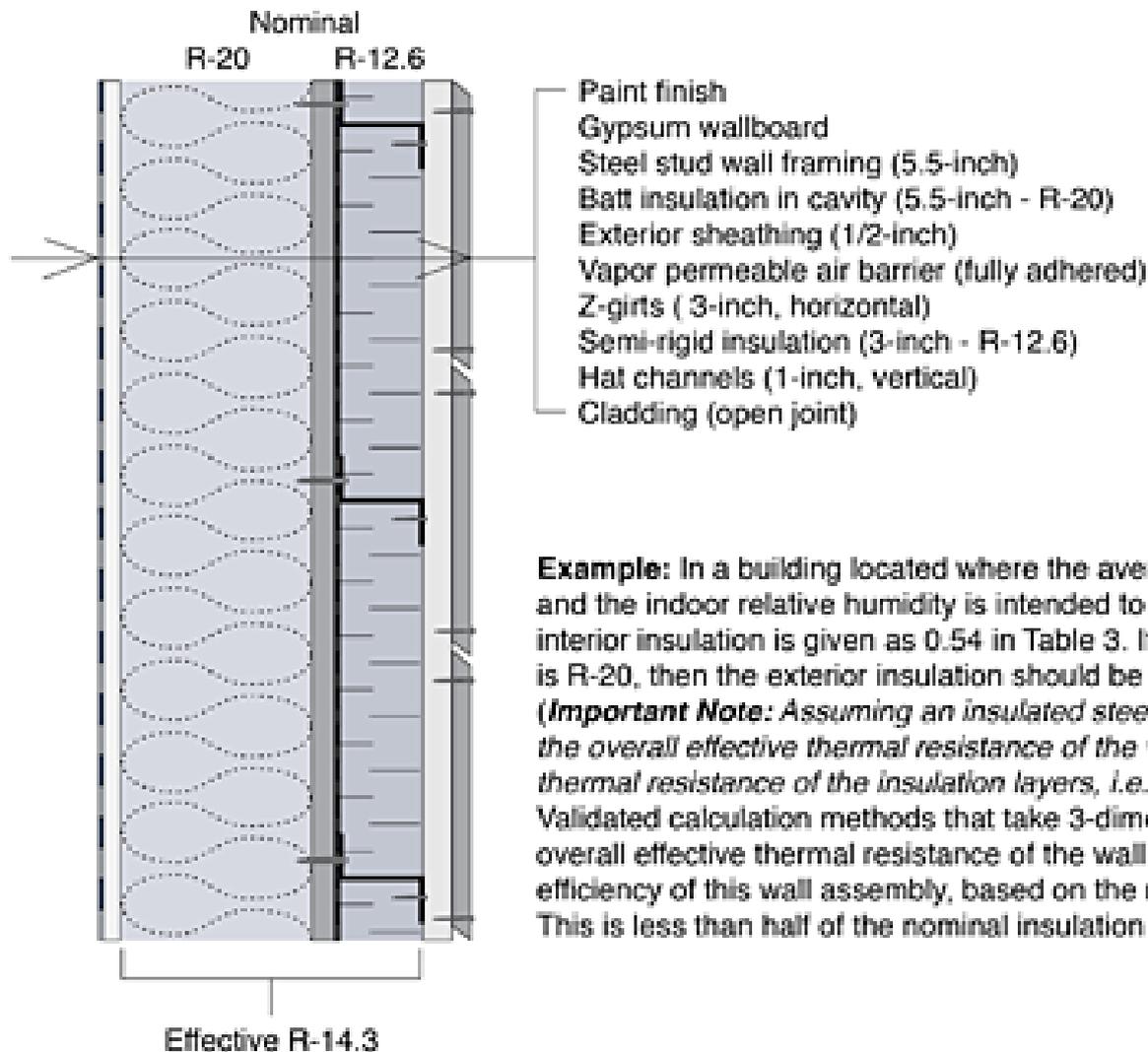
<https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/builders-developers/building-envelope-thermal-bridging-guide-1.1.pdf>



Performance Category	
	Efficient
	Improved
	Regular
	Poor



Thermal Bridging is a Big Deal



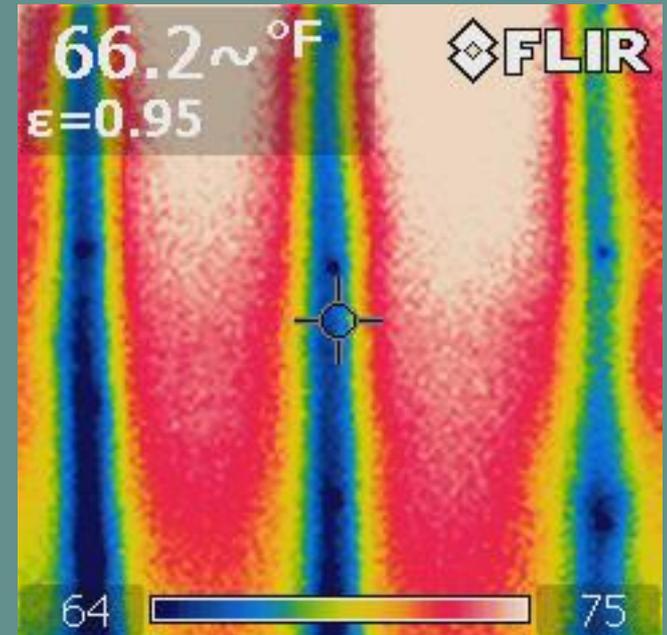
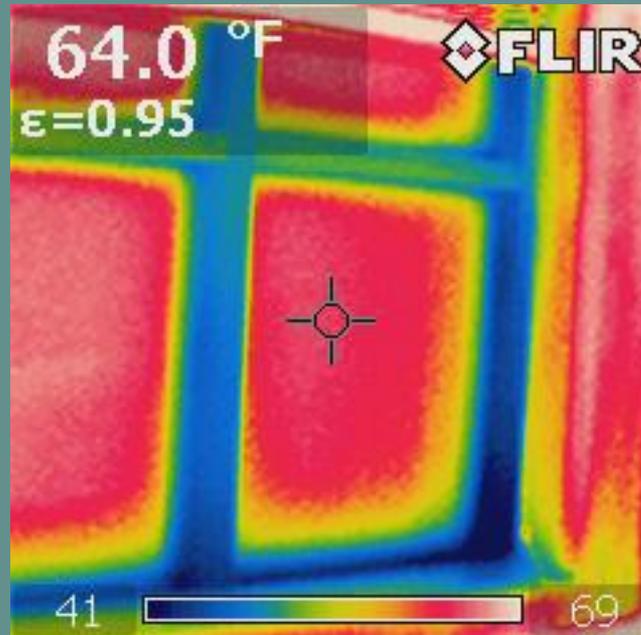
Example: In a building located where the average minimum January temperature is 14 °F, and the indoor relative humidity is intended to be maintained at 40%, the ratio of exterior to interior insulation is given as 0.54 in Table 3. If the interior insulation in a 5.5 inch wall cavity is R-20, then the exterior insulation should be at least R-10.8.

(Important Note: Assuming an insulated steel stud wall and metal cladding attachments, the overall effective thermal resistance of the wall will be significantly less than the nominal thermal resistance of the insulation layers, i.e., $20 + 12.6 = R-32.6$.)

Validated calculation methods that take 3-dimensional heat flows into account indicate the overall effective thermal resistance of the wall is only R-14.3. This means that the thermal efficiency of this wall assembly, based on the nominal insulation is $14.3/32.6 = 43.9\%$. This is less than half of the nominal insulation R-value and may not comply with codes.

Examples of thermal bridging

These thermographic pictures are from a new rural hospital that SEDAC audited in 2011. Note the extreme temperature variations in the photos: 28 degrees in the center picture and 11 degrees in the right picture. The interior window sills were stainless steel and we were told that they occasionally had frost on them in the winter.



IECC R402 – Building Thermal Envelope



Footnote i For **Mass Wall R-value** has changed

2012/15 IECC

- The second R-value applies when more than half the insulation is on the interior of the mass wall.

2018 IECC

- 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.

Table R402.1.1 from 2012/15 IECC

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

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

R402.2.5 Mass Walls

2015 IECC

- **R402.2.5 Mass Walls.** Mass walls for the purpose of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick, (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs, or any other walls having a heat capacity greater than or equal to $6 \text{ Btu/ft}^2 \times ^\circ\text{F}$ ($123 \text{ kJ/m}^2 \times \text{K}$).

2018 IECC

- **R402.2.5 Mass Walls.** Mass walls where used as a component of the building thermal envelope shall be one of the following:
 1. Above-ground walls of concrete block, concrete, insulated concrete form, masonry cavity, brick but not brick veneer, adobe, compressed earth block, rammed earth, solid timber or logs
 2. Any wall having a heat capacity greater than or equal to $6 \text{ Btu/ft}^2 \times ^\circ\text{F}$ ($123 \text{ kJ/m}^2 \times \text{K}$).



IECC R402 – Building Thermal Envelope

R402.1 General (Prescriptive)

New in 2015 IECC

- **R402.1.1 Vapor Retarder.** Wall assemblies in the building thermal envelope shall comply with the vapor retarder requirements of Section R702.7 of the International Residential Code or Section 1405.3 of the International Building Code, as applicable
- A vapor retarder is a material that has a [permeance](#) of 1.0 perm or less and greater than 0.1 perm. A vapor retarder is [vapor semi-impermeable](#) and is classified as a Class II vapor control layer. The test procedure for classifying vapor retarders is [ASTM](#) E-96 Test Method A (the desiccant or [dry](#) cup method).



IRC Chapter 7 (2018)

R702.7 Vapor Retarders

- Class I or II vapor retarders are required on the interior side of frame walls in Climate Zones 5, 6, 7, 8, and marine 4.
 - Exceptions:
 - Basement walls
 - Below-grade portion of any wall
 - Construction where moisture or its freezing will not damage the materials.



IRC Chapter 7 (2018)

R702.7.2 Material vapor retarder class.

The vapor retarder class shall be based on the manufacturer's certified testing or a tested assembly.

The following shall be deemed to meet the class specified:

1. Class I: Sheet polyethylene on perforated aluminum foil
2. Class II: Kraft faced fiberglass batts.
3. Class III: Latex or enamel paint

Vapor Retarders

Class I: > 0.1 perm (impermeable)

Class II: >1 perm (semi-permeable)

Class III: >10 perm (semi-permeable)

*"Incorrect use of vapor barriers is leading to an increase in moisture related problems. Vapor barriers were originally intended to prevent assemblies from getting wet. However, they often prevent assemblies from drying."
Joseph Lstiburek Phd, Building Science Corp*



Examples of vapor retarders

Class I vapor retarders (0.1 perms or less):	Class II vapor retarders (greater than 0.1 perms and less than or equal to 1.0 perms):	Class III vapor retarders (greater than 1.0 perms and less than or equal to 10 perms):
Glass	Unfaced expanded or extruded polystyrene	Gypsum board
Sheet metal	30 pound asphalt coated paper	Fiberglass insulation (unfaced)
Polyethylene sheet	Plywood	Cellulose insulation
Rubber membrane	Bitumen coated kraft paper	Board lumber
		Concrete block
		Brick
		15-pound asphalt coated paper
		House wrap

A vapor barrier or vapor diffusion retarder is a material that reduces the rate at which water vapor can move through a material. The older term "vapor barrier" is still used even though "vapor diffusion retarder" is more accurate.

<https://www.energy.gov/energysaver/weatherize/moisture-control/vapor-barriers-or-vapor-diffusion-retarders>



IRC Chapter 7 (2018)



R702.7.1 Class III vapor retarders.

- Class III vapor retarders shall be permitted where any one of the conditions in Table R702.7.1 is met.

Excerpt from Table R702.7.1

Climate Zone	Class III Vapor Retarders Permitted For: ^a
5	Vented cladding over wood structural panels
	Vented cladding over fiberboard
	Vented cladding over gypsum
	Continuous insulation with R-value ≥ 5 over 2 x 4 wall
	Continuous insulation with R-value ≥ 7.5 over 2 x 6 wall

a. Spray foam with a maximum permeance of 1.5 perms at the installed thickness applied to the interior cavity side of wood structural panels, fiberboard, insulated sheathing or gypsum is deemed to meet the continuous insulation requirement where the spray foam R-value meets or exceeds the specified continuous insulation R-value.



R702.7.3 Minimum clear airspaces and vented openings for vented cladding

For the purpose of this section, vented cladding shall include the following minimum clear airspaces. Other openings with the equivalent vent area shall be permitted.

1. Vinyl polypropylene or horizontal aluminum siding applied over a weather-resistive barrier as specified in Table R703.3(1)
2. Brick veneer with a clear airspace as specified in Table R703.8.4
3. Other approved vented claddings



R402.1.3 R-value computation

Additional text in 2015/18 IECC (R402.1.2 in 2012 IECC)

- **R402.1.3 R-value computation.** Insulation materials used in layers, such as framing cavity insulation, or continuous insulation shall be summed to compute the corresponding component R-value. The manufacturer's settled R-value shall be used for blown insulation. Computed R-values shall not include an R-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2, the manufacturer's labeled R-value for the insulated siding shall be reduced by R-0.6.

IECC R402 – Building Thermal Envelope

R402.2.9 Basement Walls

- Illinois Specific Amendment changes

Exception: Walls associated with conditioned basements may be insulated from the top of the *basement wall* down to 4 feet (1219 mm) below grade when the Basement Wall R-value is least 15/19, (Basement Wall U-Factor of 0.050).



IECC R402 – Building Thermal Envelope

R402.4 Air Leakage (Mandatory)

- Starting in 2012, air leakage testing was made mandatory. Mandated air leakage rate not exceeding three air changes per hour (ACH) in Climate Zones 3 through 8.
 - Illinois amended the requirement to $ACH_{50} \leq 5$ for 2015
 - Illinois anticipated amendment to $ACH_{50} \leq 4$ for 2018, pending JCAR approval
 - This amendment is anticipated to go away for 2021, moving the limit to 3 ACH₅₀ or less



IECC R402 – Building Thermal Envelope

R402.4.1.2 Testing – As Amended by the State of Illinois 2015

- The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding five air changes per hour (ACH) in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. 4 and 5. The building or dwelling unit shall be provided with a whole – house mechanical ventilation system as designed in accordance with Section R403.6.
- Exceptions:
 - 1. For additions, alterations, renovations or repairs to existing buildings, building envelope tightness and insulation installation shall be considered acceptable when the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer, shall inspect both air barrier and insulation installation criteria.



IECC R402 – Building Thermal Envelope

R402.4.1.2 Testing – Proposed IL Amendment 2018

- ~~The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding five air changes per hour (ACH) in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. 4 and 5. The building or dwelling unit shall be provided with a whole – house mechanical ventilation system as designed in accordance with Section R403.6.~~
- Exceptions:
 - 1. For additions, alterations, renovations or repairs to existing buildings, building envelope tightness and insulation installation shall be considered acceptable when the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer, shall inspect both air barrier and insulation installation criteria.



IECC R402 – Building Thermal Envelope

R402.4.1.2 Testing – As Amended by the State of Illinois

- Exceptions (Continued)
 - 2. For heated attached private garages and heated detached private garages accessory to one- and two-family dwellings and townhouses not more than three stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable when the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer, shall inspect both air barrier and insulation installation criteria. **Heated attached private garage space and heated detached private garage space shall be thermally isolated from all other habitable, conditioned spaces.**



IECC R402 – Building Thermal Envelope

R402.4.4 Rooms containing fuel burning appliances

This provision was added to the IECC in 2015 but was amended out of the IL code for the 2015 and proposed to be amended out of the IL code for the 2018 version

This section required rooms where open air combustion ducts provide combustion air to fuel burning appliances such as furnaces and water heaters be isolated from the conditioned space.

Alternative is to use sealed combustion appliances (Furnace & water heater)



IECC R403 - Systems

R403.5.1 – Heated water circulation and temperature maintenance system (Mandatory)

- This requirement was added to the IECC in 2012.

In 2015 IECC addition of:

- R403.5.1.2 Heat trace systems
- R403.5.2 Demand recirculation water systems.



IECC R403 - Systems

New to 2018 IECC

R403.3.6 Ducts buried within ceiling insulation. 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 not be less than R-19, excluding the R-value of the duct insulation.

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



R403.3.7 – Ducts in Conditioned Space

Provides criteria to determine if ducts are inside conditioned space or not

- Completely inside air barrier OR
- Buried in the ceiling insulation AND
 - Air handler within air & thermal barrier
 - Duct leakage <1.5 cfm per 100 sf
 - Full depth insulation above duct



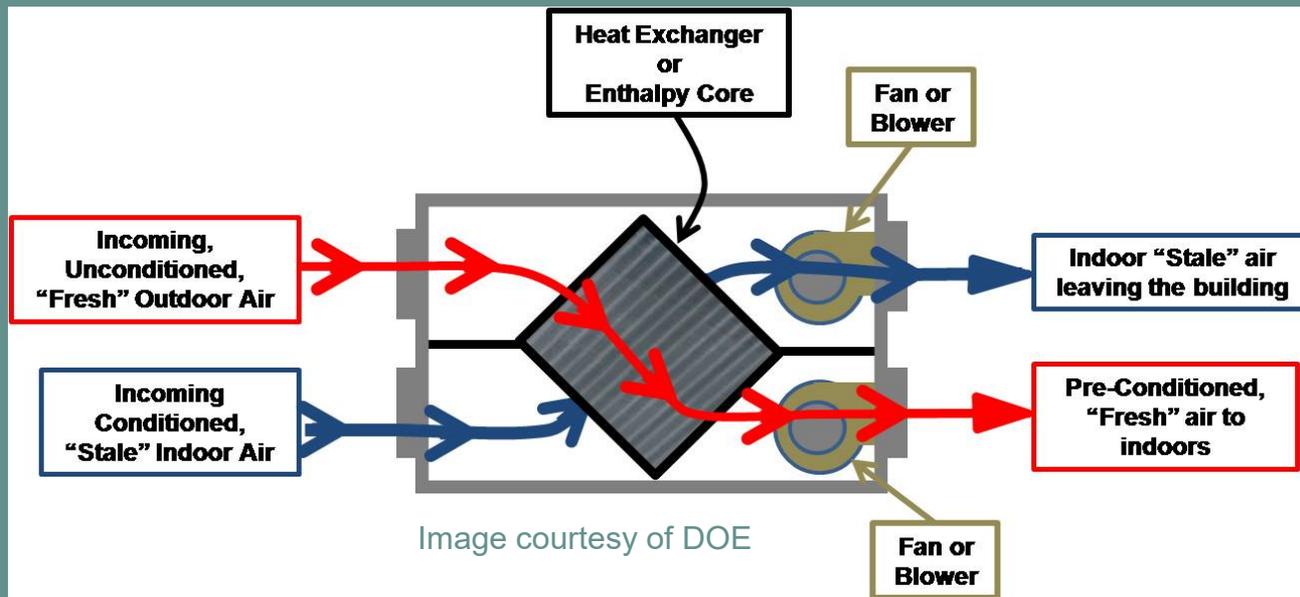
R403.3.6 – Ducts Buried in ceiling insulation

Provides allowance for duct insulation in buried duct work (for simulated energy performance)



R403.6.1 – HRV/ERV Fan Efficiency

Minimum fan efficiency of 1.2 cfm/w is added for Heat Recovery Ventilator and Energy Recovery Ventilator for whole house mechanical ventilation system.



IECC R403 Systems

Illinois Amendments to I(L)ECC (but not in IECC)

- **R403.6.2 Recirculation of air.** (M1507.2, 2015 IRC)
- **R403.6.3 Whole-house mechanical ventilation system**
R403.6.4 through R403.6.6. (M1507.3, 2015 IRC)
- **R403.6.4 System design.** (M1507.3.1, 2015 IRC)
- **R403.6.5 System controls.** (M1507.3.2, 2015 IRC)
- **R403.6.6 Mechanical ventilation rate.** (M1507.3.3, 2015 IRC)
- **R403.6.6.1 Different Occupant Density.**
- **R403.6.6.2 Airflow Measurement.**
- **R403.6.7 Local exhaust rates.** (M1507.4, 2015 IRC)



2018 IMC Section 504 Clothes Dryer Exhaust

- **New addition in 2018 IMC**
- **504.4.1 Exhaust termination outlet and passageway size.** The passageway of dryer exhaust duct terminals shall be undiminished in size and shall provide an open area of not less than 12.5 square inches (8065 mm²).

This new code text specifies a minimum terminal opening area. The minimum opening area of 12.5 square inches is equivalent to the area of a 4-inch round duct. Nothing in the code requires a reduction in the allowable length of the duct based on the resistance of the exhaust terminal; therefore, it was determined to be necessary to specify a minimum size terminal opening to account for the flow resistance offered by the terminal.

Testing of common roof vent caps disclosed that back pressures provided by some were equal to what three or more elbows would provide.



IECC R403 Systems

R403.5.3 Hot Water Pipe Insulation

- 2015 IECC Reduced requirements for pipe insulation from 2012 IECC

R403.10 Pools and permanent spa energy consumption (Mandatory)

- Increased requirement for pool covers. Exception raised from 70% to 75% of energy for heating being site-recovered to eliminate need for pool cover.



IECC R405 Electrical Power and Lighting Systems

R404.1 Lighting Equipment (Mandatory).

- Increased high efficacy lamp requirements from 75% to 90% of the permanently installed lighting fixtures
- Eliminates exception for low voltage lighting

From IECC 2018 Chapter 2 Definitions

High-Efficacy Lamps. Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or other lamps with an efficacy of not less than the following:

IL Amendment:

1. 65 lumens per watt for lamps
2. 55 lumens per watt for fixtures



IECC R405 Simulated Performance Alternative (Performance)

- Mechanical ventilation added in IECC 2018
- **R405.1 Scope.** This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall be included heating, cooling, **mechanical ventilation** and service water heating energy only.



IECC R405.4.2 Multifamily Unit Modeling

- Batch sampling is allowed for stacked multifamily units



IECC R406 Energy Rating Index Compliance Alternative

- Section R406 added to IECC in 2015
- **R406.2 Mandatory requirements.** Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as “Mandatory” and Section R403.5.3 be met.
- **R406.3 Energy Rating Index.** The Energy Rating Index (ERI) shall be determined in accordance with RESNETICC 301 except for buildings covered by the International Residential Code,.....
- 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*

* http://www.resnet.us/blog/wp-content/uploads/2016/01/ANSI-RESNET-ICC_301-2014-Second-Edition-Publish-Version.pdf



IECC R406.4 Maximum Energy Rating Index

Maximum energy rating index has increased from 2015 IECC to 2018 IECC

Climate Zone	2015 ERI Score	2018 ERI Score
4	54	62
5	55	61



Image courtesy of Energy IQ



IECC Chapter 5 Existing Buildings



IECC Chapter 5 Existing Buildings

- In 2015 IECC added Chapter 5 – Existing Buildings
- This new chapter covers alterations, repair, addition and change of occupancy of existing buildings and structures.
- **Section R501 General**
- **Section R502 Additions**
- **Section R503 Alterations**
- **Section R504 Repairs**
- **Section R505 Change of Occupancy or Use**



IECC R501 General

Same text in 2015 & 2018 IECC

R501.1.1 Additions, alterations, or repairs: General. Additions, alterations, or repairs to an existing building, building system or portion thereof shall comply with Section R502, R503, or R504. **Unaltered portions of the existing building or building supply system shall not be required to comply with this code.**



IECC R502 Additions



- Illinois Specific Amendment changes
- R 502.1.1.2 Heating and Cooling Systems

Exception: Where ducts from an existing heating and cooling system are extended to an addition, the new and existing duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3. New duct systems shall be sealed in accordance with Section R403.3.2.

IECC R503 Alterations



- Illinois Specific Amendment changes
- R503.1.1 Building Envelope.

Exception: 6. For roof replacement on existing buildings with a roof slope of **less than 2** units vertical in 12 units horizontal (2:12), and where the roof covering is removed and insulation remains, and **where the required R-value cannot be provided due to thickness limitations** presented by existing rooftop conditions, (including heating, ventilating and air-conditioning equipment, low door or glazing heights, parapet heights, weep holes, and roof flashing heights not meeting the manufacturer's specifications), **the maximum thickness of insulation compatible with the available space and existing uses shall be installed.** Insulation used shall be minimum R-3.5 per inch. In areas where flashing may be terminated a minimum of 8 inches above the roof covering (including required insulation) insulation shall be a minimum of R-20.

IECC R503 Alterations



- Illinois Specific Amendment changes
- R503.1.1 Building Envelope.

Exception: 7. R-value for roof assemblies with tapered insulation above deck with slope greater than 1/8 units vertical in 12 horizontal (1/8:12) shall average R-20.

IECC R503 Alterations



- Illinois Specific Amendment changes
- R503.1.2 Heating and Cooling Systems

Exception: Where ducts from an existing heating and cooling system are extended, the new and existing duct systems with less than 40 linear feet (12.19 in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3. Altered duct systems shall be sealed in accordance with Section R403.3.2.

IECC R504 Repairs



- Illinois Specific Amendment changes
- R504.2 Application

The following is considered a repair:

3. Insulation with new roof covering for roof slopes less than 2 units vertical in 12 units horizontal (2:12) inches only in areas where the tapered insulation is used above an existing roof covering to create slope between drains or upslope from obstructions to water flow.

Questions?

energycode@sedac.org
800-214-7954

