Energy Code Lessons Learned

2/24/2021

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Providing effective energy strategies for buildings and communities

Presentation Education Credits

SEDAC is a Preferred Education Provider with the International Code Council (ICC). Credits earned on completion of this program will be reported to ICC for ICC members. Certificates of Completion will be issued to all participants.

ICC PREFERRED EDUCATION PROVIDER

This workshop is approved for 1 LU/HSW CES credits from the American Institute of Architects (AIA). Credits earned on completion will be reported for AIA members.

AIA Continuing Education Provider

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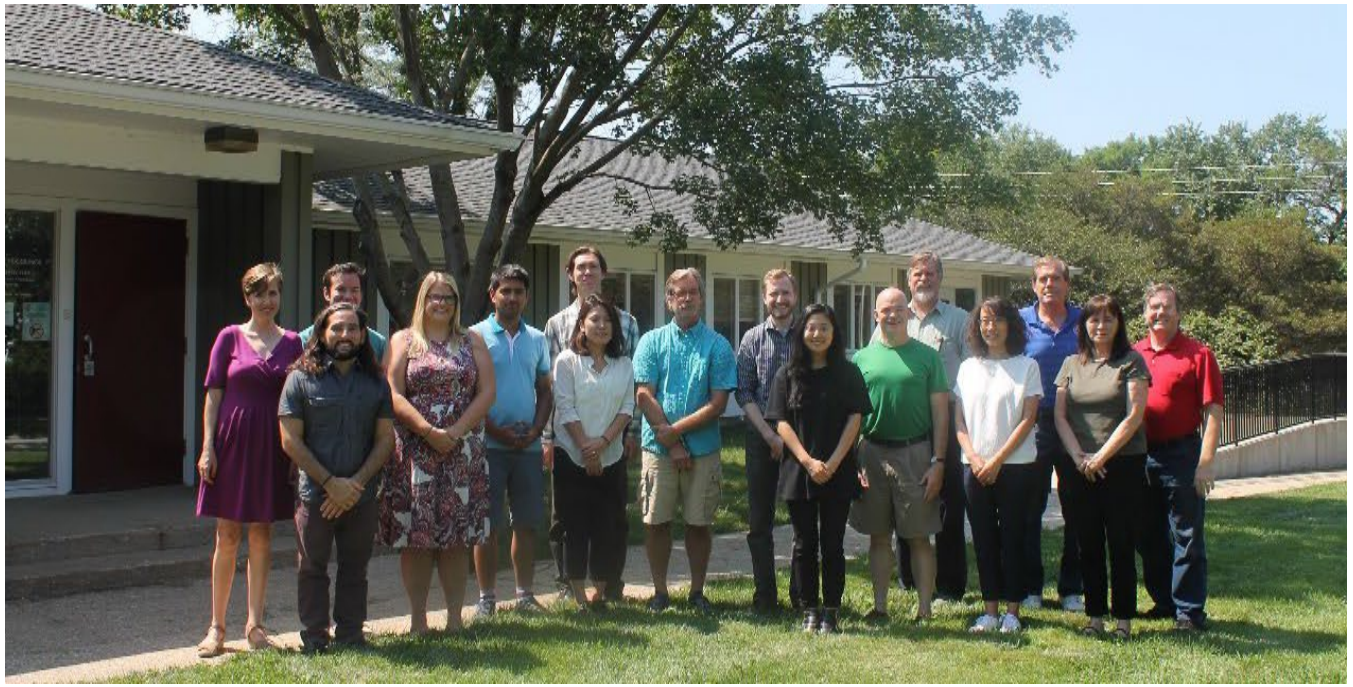
Learning Objectives

1. Learn about Commercial Energy Code compliance documentation best practices
2. Understand difference between Commercial and Residential Energy Code drivers
3. Learn about common Residential Energy Code compliance errors

Who We Are

The Smart Energy Design Assistance Center (SEDAC) is an applied research program at University of Illinois.

Our mission: Reduce the energy footprint of Illinois and beyond.



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SEDAC is the Illinois Energy Conservation Code Training Provider

This training program is sponsored by **Illinois State Energy Office**

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

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Energy Code Training Program

- Technical support
  energycode@sedac.org
  800.214.7954
- Online resources at
  sedac.org/energy-code
- Workshops
- Webinars
- Online on-demand training modules

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www.smartenergy.Illinois.edu/energy-code/

TRAINING AND SUPPORT SERVICES

Workshops

Webinars

Online courses

Technical support

ENERGY CODE RESOURCES

What is the Illinois Energy Conservation Code?

Frequently asked questions

Useful websites

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Upcoming SEDAC Webinars

Code Compliance Webinar Series

- Commercial Lighting Plan Review and Site Inspections (March 24th)
- Commercial HVAC Plan Review and Site Inspections (May 26th)

Registration: https://smartenergy.illinois.edu/energy-code/energy-code-webinars/

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Upcoming SEDAC Workshops

Code Compliance Workshops and Panel Discussions

- Key Items for Residential Plan Review (February 9th)
- Key Items for Residential Site Inspection (March 9th)
- Key Items for Commercial Plan Review (April 13th)
- Key Items for Commercial Site Inspection (May 11th)
- Commercial Code Compliance Panel Discussion (June 15th)

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Today's Guest Speakers

Don Plass

HR Green – Energy Code Consultant

Nelson Sjostrom

Building Code Official – City of Rockford

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Commercial Compliance Best Practices

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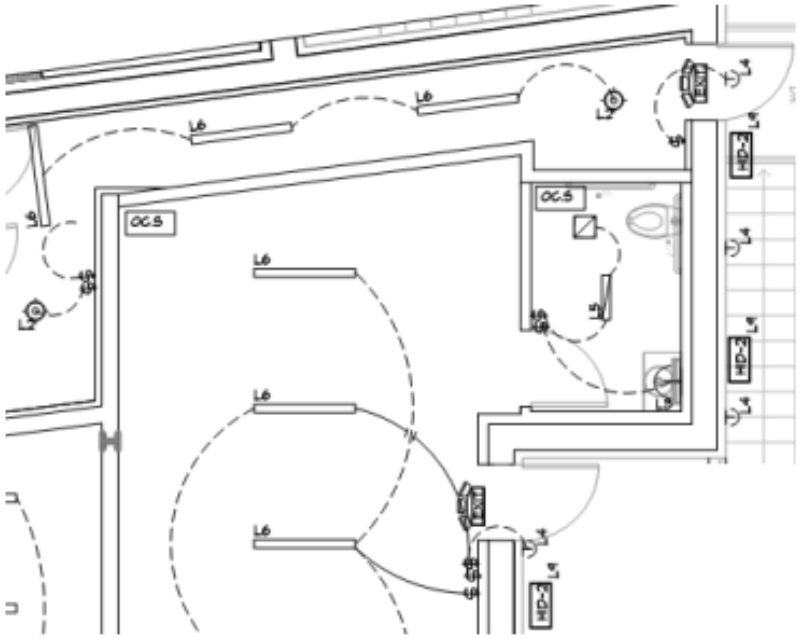
Examples from SEDAC



LEGEND FOR ALL LIGHT FIXTURES USED ENTIRELY FOR THE BUILDING			QUANTITY RESIDENTIAL	QUANTITY RETAIL
TAG	DESCRIPTION	FIXTURE WATT.		
L1	HIGH HAT 4" SQUARE TRIM LED	13 W	44	
L2	CEILING LIGHT ROUND LIGHT FIX COMPACT FLORESCENT	40W	21	7
L3	BATHROOM SCONCE LED	11W	18	4
L4	EXTERIOR SCONCE COMPACT FLORESCENT BALCONIES/ EXTERIOR DOORS	28 W	2/ EXT DOORS 29/ BALC.	7/ EXT DOORS
L5	CLOSET FIXTURE FLUORESCENT T8 24"	17W	30	4
L6	TEMP. FLUORESCENT T8 32W, 2 LAMPS PER FIXTURE, 48"	64W	20	79
	CEILING MOUNTED 14" ROUND FIX 3			

Proposed Interior Lighting Power

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
1-Multifamily				
LED 1- L1 HIGH-HAT 4" FIX: LED PAR 13W:	1	44	13	572
2-Retail				
Linear Fluorescent L6: 48" T8 32W: Electronic:	2	79	64	5056
Compact Fluorescent -L2: Twin Tube 40W: Electronic:	1	7	40	280
Linear Fluorescent L5: 24" T8 17W (Super T8): Electronic:	1	4	17	68
L3-BATHROOM SCONCE: LED A Lamp 11W:	1	4	11	44
			Total Proposed Watts =	11538

Figure GE-3.
Sample Lighting Fixture Layout Plan *(top left),*
Matching Fixture Schedule *(top right),* ***and***
Matching Interior Lighting COMcheck Report *(bottom right)*

- Sample documents from NYC.gov compliance guide.

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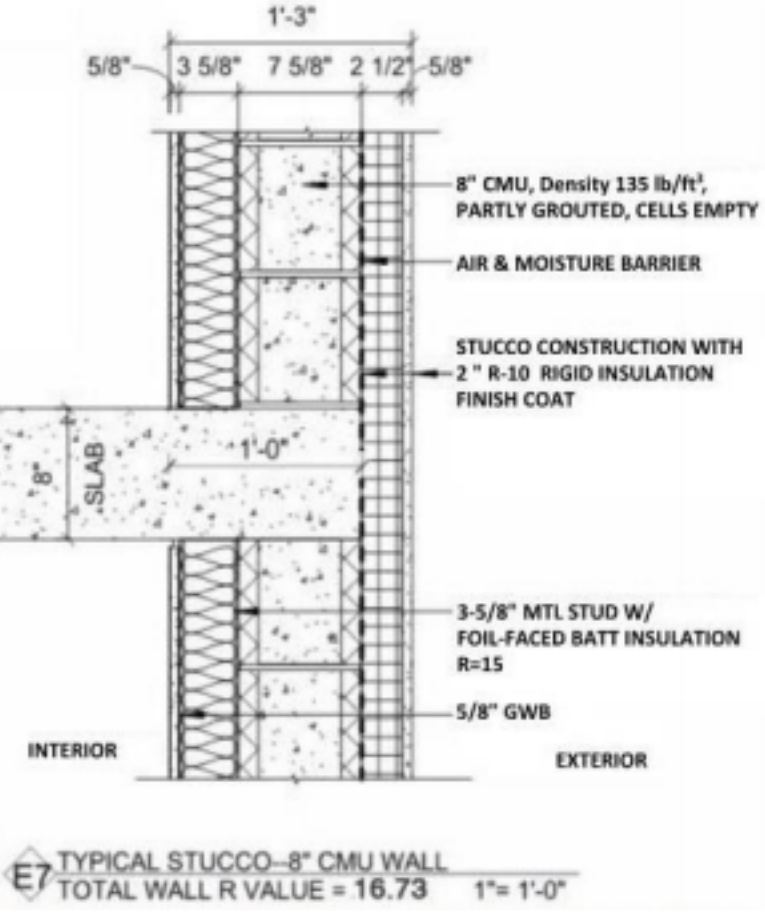
Envelope Example



WALL TYPE E7	
Wall Assembly	**R-Value**
2" R-10 Rigid Insulation	10
8" CMU, Partly Grouted, Cells Empty	1.83 [a]
3-1/2 " R-15 Foil-faced Batt Insulation	4.9 [b]
Total R-Value of Wall Assembly	16.73
U-Factor of Wall Assembly (= 1/16.73)	**0.060**
(a) Assembly R_U for Concrete Block Walls from ASHRAE Table A3.1-3	
(b) Effective R-Value from ASHRAE Table A3.1-4	
Slab Assembly	**R-Value**
2 " R-10 Rigid Insulation	10
12"-Thick Solid Concrete Wall (Density: 144 lb/ft³)	1.60 [c]
Total R-Value of Slab Assembly	11.60
U-Factor of Slab Assembly (=1/11.60)	**0.086**
(c) Assembly R_U for Concrete from ASHRAE Table A3.1-2	

Area-Weighted Assembly U-factor Calculation for the Unit Wall			
Typical 10'-6" floor to floor height (8" slab + 9'-10" wall height)			
Assembly	**U-Factor**	**Height (in)**	**UA**
Wall Assembly	**0.060**	118	7.053
Slab Assembly	**0.086**	8	0.690
Total		126	7.743
Area-Weighted Assembly U-factor (=7.743/126)			**0.061**
Code-Allowed Maximum U-Factor (ASHRAE Table 5.5-4)			*0.090*

- *NOTE: One common error in the U-factor calculation is misrepresenting thermal values of assembly layers (e.g., face brick, gypsum board, air films, etc.) from unapproved sources.*

Figure BE-1. ***Sample Wall Assembly & Area-Weighted U-factor Calculation***

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COMcheck Reports

- Many designers make good use of the notes to document location of compliance documentation.

COMcheck Software Version 4.1.4.0

Envelope Compliance Certificate

Project Information

Energy Code:	2018 IECC
Project Title:	[redacted]
Location:	Rockford, Illinois
Climate Zone:	5a
Project Type:	New Construction
Vertical Glazing / Wall Area:	3%

Construction Site: [redacted] Owner/Agent: [redacted] Designer/Contractor: [redacted]

Additional Efficiency Package(s)

High efficiency HVAC. Systems that do not meet the performance requirement will be identified in the mechanical requirements checklist report.

Building Area	Floor Area
1-Retail : Nonresidential	707
2-Office : Nonresidential	176
3-Automotive Facility : Nonresidential	3208

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Roof 1: Insulation Entirely Above Deck: High Albedo Roof Required, [Bldg. Use 1 - Retail]	707	---	30.0	0.032	0.032
Roof 2: Insulation Entirely Above Deck: High Albedo Roof Required, [Bldg. Use 2 - Office]	176	---	30.0	0.032	0.032
Roof 3: Insulation Entirely Above Deck: High Albedo Roof Required, [Bldg. Use 3 - Automotive Facility]	2150	---	30.0	0.032	0.032
Floor - Sales: Slab-On-Grade:Unheated, Horizontal with vertical 4 ft., [Bldg. Use 1 - Retail] (c)	147	---	7.5	0.650	0.540
Floor - Office: Slab-On-Grade:Unheated, Horizontal with vertical 4 ft., [Bldg. Use 1 - Retail] (c)	92	---	7.5	0.650	0.540
Floor - Auto Service Bays: Slab-On-Grade:Unheated, Horizontal with vertical 4 ft., [Bldg. Use 1 - Retail] (c)	72	---	7.5	0.650	0.540
Floor - Basement: Slab-On-Grade:Unheated, [Bldg. Use 1 - Retail] (c)	136	---	---	0.730	0.540
Floor - Oil Service Bays: Concrete Floor (over unconditioned space), [Bldg. Use 1 - Retail]	136	---	7.5	0.094	0.074
NORTH					
South - Sales: Wood-Framed, 16" o.c., [Bldg. Use 1 - Retail]	261	19.0	10.0	0.038	0.064
Window 2: Metal Frame with Thermal Break:Fixed, Perf. Specs.: Product ID NA, SHGC 0.25, [Bldg. Use 1 - Retail] (b)	13	---	---	0.650	0.380
South - Office: Wood-Framed, 16" o.c., [Bldg. Use 2 - Office]	173	19.0	10.0	0.038	0.064
South - Service: Wood-Framed, 16" o.c., [Bldg. Use 3 - Automotive	530	19.0	10.0	0.038	0.064

Project Title: [redacted] Report date: 01/13/21
Data filename: Page 1 of 12

Section # & Req.ID	Footing / Foundation Inspection	Complies?	Comments/Assumptions
C303.2 [FO2][2]	Below-grade wall insulation installed per manufacturer's instructions.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C303.2 [FO4][2]	Slab edge insulation installed per manufacturer's instructions.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C303.2.1 [FO6][1]	Exterior insulation protected against damage, sunlight, moisture, wind, landscaping and equipment maintenance activities.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C402.1.4 [FO1][2]	Below-grade wall insulation R-value.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	*See the Envelope Assemblies table for values.*
C105 [FO3][2]	Installed slab-on-grade insulation type and R-value consistent with insulation specifications reported in plans and COMcheck reports.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	*See the Envelope Assemblies table for values.*
C402.2.4 [FO7][2]	Slab edge insulation depth/length. Slab insulation extending away from building is covered by pavement or >= 10 inches of soil.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met. *See the Envelope Assemblies table for values.*
C402.2.6 [FO12][3]	Radiant heating systems panels insulated to >=R-3.5 on face opposite space being heated.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** Requirement does not apply. *See the Envelope Assemblies table for values.*

Additional Comments/Assumptions:

Commercial Lessons to Apply to Residential

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Commercial Process Flow for ILECC Compliance

- Architects build code compliance into plan drawings and initial designs.
  - By default, design to most current code to prevent having multiple redesigns depending on project location.
  - Allows compliance no matter municipality since designers target most recent and strictest energy codes for regions they cover.
- Possible to set up similar process for residential?
  - Difficult with multiple small design/build firms, many in municipalities that don't enforce code.
  - Could Rater Industry be tapped as source of training/assistance, or code compliance verification support?
    - Examples include AL, AR, CA, CT, FL, IN, IA, NY, MA, & VT – HERS ratings incorporated into State Energy Codes
    - ENERGY STAR Homes and Energy Mortgages can further drive improved compliance through market-driven efficiency

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Residential-focused Training

- Training on benefits of code could help drive builders to implement earlier in designs.
- Targeted training for Homebuilders Associations, Homeowners, etc...similar to trainings held for architects and engineers.
  - Code compliance shown to have economic benefits
  - Improved durability = fewer call-backs, longer lifespan
  - Reduced utility bills for clients
  - NAHB 2012 study found energy codes added ~$3.00/sf based on 2012 vs 2006 IECC, with payback of ~10.4 years
    - https://www.nahb.org/advocacy/top-priorities/building-codes/Energy-Codes

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Challenge for Residential

- Usually not a designer for homes, just the construction contractor
- Key component needed is training for home builders
  - Currently most training is in-field during site inspections
  - From commercial, if design is focused around compliance, the construction follows.
- Make sure inspectors have tools in field to answer questions and educate on the codes with builders.

Rockford Building Department Checklist

Energy Code Checklist for Residential Construction

(This form is required for New Residential Buildings, Additions, Alterations, Repairs and other Permits as Applicable)

Effective Jan. 1, 2016, the State of Illinois requires that all construction follow the Energy Efficient Building Act. This law requires the 2015 International Energy Conservation Code (IECC) be the energy code for all construction in Illinois. Code sections listed from the 2015 IECC-Residential Provisions.

Project Address:		*Permit #*
Applicant Name:	**Signature:**	*Checked By*
Phone #:	**Email:**	*Date*
Project Type: (Check One) ❑ New Building ❑ Addition ❑ Renovation		*Method*

Required Documentation with Permit Submittal:

1. **Energy Compliance Documentation** – Choose ONE method. All methods must meet mandatory requirements.

❑ **Prescriptive Method**

❑ **Trade Off Method** Use this form and attach documentation to show compliance (i.e. ResCheck). ResCheck must include compliance form, inspection checklist and certificate. www.energycodes.gov/REScheck (it's free & easy!).

❑ **Simulated Performance Alternative**

❑ **Energy Rating Index**

2. **Mandatory Requirements** – All projects must meet the mandatory requirements of the IECC.

Mandatory Requirements	Compliance
a) **Certificate (R401.3)** Permanent certificate posted on/near elec. panel with energy values	❑ Will Comply (Provided by City)
b) **Building Thermal Envelope (R402.4.1)** Seal building envelope from air infiltration	❑ Will Comply
c) **Air Sealing and Insulation Testing/Insp. (R402.4.1.2)** Verify sealing and insulation-choose one method. **Blower Door Test Required for NEW BUILDINGS ONLY**	❑ Blower Door (provide report) ❑ Visual Inspection
d) **Fireplaces (R402.4.2)** Wood-burning have tight flue damper and outdoor combustion air	❑ Will Comply ❑ N/A
e) **Fenestration Air Leakage (R402.4.3)** Windows, sliding glass doors, skylights	❑ ≤ 0.3 cfm/sf (Check Label) ❑ N/A
f) **Fenestration Air Leakage (R402.4.3)** Exterior swinging doors	❑ ≤ 0.5 cfm/sf (Check Label) ❑ N/A
g) **Recessed Lighting (R402.4.5)** IC-rated and air tight when in thermal envelope	❑ Will Comply ❑ N/A
h) **Heating/Cooling System Controls (R403.1.1)** Programmable thermostat for furnace	❑ Will Comply ❑ N/A
i) **Duct Sealing (R403.3.2)** All ducts sealed with approved material(s)	❑ Will Comply ❑ N/A
j) **Building Cavities (R403.3.5)** Building framing cavities shall not be used as ducts both S&R	❑ Will Comply ❑ N/A
k) **Mechanical System Piping Insulation (R403.4)** R-3 minimum for > 105°F or <55°F	❑ Will Comply ❑ N/A
l) **Circulating Hot Water System (R403.5)** Piping insulated R-2 min. and on/off switch	❑ Will Comply ❑ N/A
m) **Mechanical Ventilation (R403.6)** See State of Illinois Amendments for requirements	❑ Will Comply ❑ N/A

3. **Building Wall Section** – Required for all new buildings and additions. Additional documents may be required by the Building Official. Minimum (1) section required. *For interior alterations include documents to illustrate code compliance as necessary.* Use City of Rockford BUILDING WALL SECTION sheet to help with this requirement.

4. **Floor Plan** – Required for all new buildings and additions. Floor plan must indicate thermal envelope, conditioned/unconditioned spaces and heating system location.

5. **Prescriptive Requirements – COMPLETE THIS TABLE**, if Prescriptive Method is chosen. Letters correspond to #3 above in regards to the City of Rockford BUILDING WALL SECTION sheet.

Building Components	Prescriptive Standard	Proposed/ Actual Value	Remarks
Insulation (R402.2) ***Prescriptive Standard is Minimum R-Value***			
A. Ceilings with Attic Spaces (R402.2.1)	**R-49 / R-38**		*R-49 for standard truss, can be reduced to R-38 with Raised Heel/Energy Truss*
B. Ceilings without Attic Spaces (R402.2.2)	**R-30**		*Limited to 500 safe OR 20% of the total insulated ceiling area, whichever is less*
C. Wood Frame Wall (Table R402.1.1)	**R-20 or R-13+5**		***R-20 for interior cavity** or **R-13 for interior cavity plus R-5 insulated sheathing***
D. Floors Over Unconditioned Space (R402.2.7)	**R-30**		*Floor insulation shall maintain permanent contact with subfloor decking*
E. Basement Walls (R402.2.8)	**R-15 or R-19**		***R-15 continuous insulation** on the interior or exterior or **R-19 for interior wall cavity***
F. Slab-on-Grade Floors (R402.2.9)	**R-10**		*Insulation depth shall be the depth of the footing or 2 feet whichever is less*
G. Crawl Space Walls (R402.2.10)	**R-15 or R-19**		***R-15 continuous insulation** on the interior or exterior or **R-19 for interior wall cavity***
Fenestrations (R402.3) ***Prescriptive Standard is Maximum U-Factor***			
H. Windows, Sliding Glass Doors, and Swinging Doors with > 50% glazing	**U-0.32**		*An area weighted average may be used to satisfy the U-factor requirements but must include all windows, skylights, glass doors and opaque doors. Provide documentation if this is used.*
J. Skylights	**U-0.55**		

(The above table is based on wood frame construction and common building practices, if not addressed in the table above, please attach separate documentation to illustrate code compliance. See code book for sunrooms. Values are based on Climate Zone 5A in the 2015 IECC).

6. **Other Prescriptive Requirements:**

Other Prescriptive Requirements if applicable	Compliance
Duct Insulation (R403.3.1) Supply ducts in attic ≥ R-8, all other ducts outside thermal envelope ≥ R-6	❑ Will Comply ❑ N/A
Duct Tightness Test (R403.3.3) Required if furnace or any duct is outside of the thermal envelope	❑ Test 1 ❑ Test 2 ❑ N/A
Eave Baffle (R402.2.3) Vented attics with blown-in or fiberglass insulation shall have a baffle	❑ Will Comply ❑ N/A
Attic Hatches (R402.2.4) Access doors to attic must be weather-stripped and insulated	❑ Will Comply ❑ N/A

Residential Site Inspection Lessons

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Residential Site Inspection

- What to know to pass on first inspection?
  - Common insulation issues easy to correct
  - Air barrier continuity checks
  - Penetrations for electric/plumbing/HVAC should be checked closely for air sealing

Residential Insulation/Air Barrier Inspections

- Areas that may hide issues should be checked before site inspection to avoid any compliance issues.

Tubs on exterior walls should have full air barrier behind. Housewrap used here. Another option is to continue moisture-resistant drywall/finish materials down behind tub.

Spot-check behind faced insulation for gaps such as the one caused by not splitting around this wire. In this instance, the whole batt was too narrow for the cavity by ¼"

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Insulation/Air Barrier Inspections (cont.)

Fiberglass in rim joist covered this open, unsealed penetration.
Note: fiberglass should not be used in rim joists without an appropriate air barrier to prevent condensation on the rim joist behind it.

Spray foam house had missed this standard-framed corner.

Spray foam used as air barrier needs to be continuous and proper depth. This is open-cell application, 4.5"-5.5" qualifies as an air barrier.
Corners and utilities create pockets that can be poorly filled.

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Attic Connections

Attic access with sealed retention walls to prevent thinning of attic insulation around the hatch.
Make sure final hatch is weatherstripped and insulated, too.

Check penetrations from wall cavitied into the attic (plumbing/wiring/HVAC) for full and proper sealant. Usually this is a fire-rated spray foam product

Interior soffits often provide pathway for air circulation between attic and wall cavities, leading to comfort issues, and potential condensation problems in the wall cavities.

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Air Barrier Details

Don't miss top plates where vaulted ceilings meet side walls and interior partitions.

This garage forgot the air barrier between the joists in the cavities between the interior and garage area. Instead, fiberglass batts were installed and rolled down to meet the top plate of the wall assembly.

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Ventilation Considerations

Ensure vent fan ducts are as short and straight as possible to ensure fan achieve rated CFM of exhaust. Testing will be required in future code editions.

Ensure ventilation ducts are not crimped or compressed to ensure proper airflow out from furnace to spaces.

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Questions?

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