

RESNET 2018 Conference Illustrating the IECC



Presented by:

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Illustrating the Energy Code

Agenda

- Introductions
- Talk about communicating code concepts with just words – “my brain hurts after a few pages”
- Discuss why the code is written the way it is – legalese + “shall”, prescriptive vs. alternatives, audience: code officials, builders, etc.
- Guides that are available – Field and Success Guides + “Code Commentary”
- Diagrams and graphics from code education that we have used, short videos (BD, vestibules, ventilation), etc.
- Group exercise

R401.2 Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as "Mandatory."
3. The energy rating index (ERI) approach in Section R406.

SECTION R402 BUILDING THERMAL ENVELOPE

R402.1 General (Prescriptive). The *building thermal envelope* shall comply with the requirements of Sections R402.1.1 through R402.1.5.

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.

R402.1.2 Insulation and fenestration criteria. The *building thermal envelope* shall meet the requirements of Table R402.1.2, based on the *climate zone* specified in Chapter 3.

R402.1.3 R-value computation. Insulation material 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-in 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-0.5.

R402.1.4 U-factor alternative. An assembly with a *U-factor* equal to or less than that specified in Table R402.1.4 shall be an alternative to the *R-value* in Table R402.1.2.

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† WALL R-VALUE	SLAB R-VALUE & DEPTH	CHIMNEY SPACE† WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	7	—	—
2	0.40	0.65	0.25	38	13	4/6	13	7	—	—
3	0.32	0.55	0.25	38	20 or 13+5 [§]	8/13	19	5 [¶]	—	—
4 except Marine	0.32	0.55	0.40	49	20 or 13+5 [§]	8/13	19	10	—	—
5 and Marine 4	0.30	0.55	NR	49	20 or 13+5 [§]	13/17	30 [¶]	15	—	—
6	0.30	0.55	NR	49	20+5 [§] or 13+10 [¶]	15/20	30 [¶]	15	—	—
7 and 8	0.30	0.55	NR	49	20+5 [§] or 13+10 [¶]	19/21	30 [¶]	15	—	—

R402.1.5 Total UA alternative. Where the total *building thermal envelope UA*, the sum of *U-factor* times assembly area, is less than or equal to the total UA resulting from multiplying the *U-factors* in Table R402.1.4 by the same assembly area as in the proposed *building*, the *building* shall be considered to be in compliance with Table R402.1.2. The UA calculation shall be performed using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements shall be met.

R402.2 Specific insulation requirements (Prescriptive). In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.13.

SECTION R404 ELECTRICAL POWER AND LIGHTING SYSTEMS

SECTION R403 SYSTEMS R403.1 Control: (Mandatory). Not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

R403.1.1 Programmable thermostat. The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature setpoints at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

R403.1.2 Heat pump supplementary heat (Mandatory). Heat pumps having supplemental shall have controls that, except supplemental heat operation when

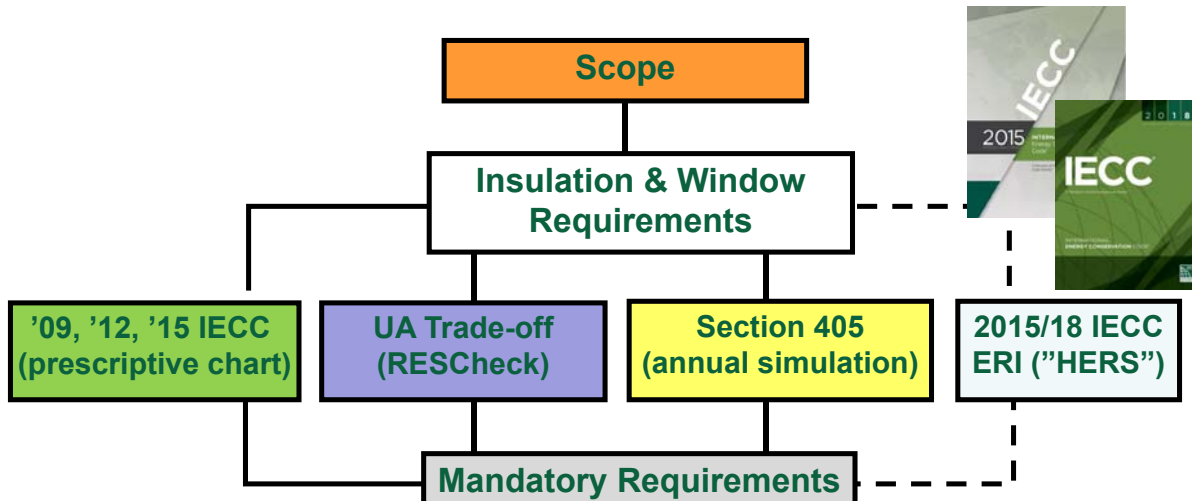
SECTION R406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

R406.1 Scope. This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

R406.2 Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as "Mandatory" and Section R405.3 be met. The *building thermal envelope* shall be greater than or equal to levels of efficiency and *Solar Heat Gain Coefficients* in Table 402.1.1 or 402.1.3 of the 2009

SECTION R405 SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)

R405.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such



Residential Energy Code Field Guides

- Contextual description of code item
- Diagrams & photos to illustrate details

2009 IECC + 2011 GEORGIA AMENDMENTS
RESIDENTIAL ENERGY CODE FIELD GUIDE

Attic Knee Wall

Code Section: 402.1.1.402.1.4
Checklist Item: R-10
Code Value: R-10
Description: An attic knee wall is defined as any vertical or near vertical wall in the building envelope that has conditioned space on one side and attic space on the other side. All attic knee walls must be insulated and air-sealed. Attic knee walls may be insulated using R-13-R-6 insulated sheathing, R-10-R-3 insulated sheathing, or R-10 compressed (i.e. 2-in.) studs. The attic side of the knee wall must have a sealed air barrier (rigid is preferred). The top and bottom of the knee wall stud cavity must be blocked and sealed to impenetrable insulation. Note: If IECC code is used, minimum insulation value for attic knee walls is R-10 with attic-side air barrier.

Knee Wall Air Sealing and Insulation Diagram

CORRECT: Blocked Joint Cavity/Sealed Attic-side Air Barrier

INCORRECT: Unblocked Joint Cavity

Southface Residential Energy Code Field Guide | 38

Success with Energy Code Series

- Code items broken out by discipline
- “Good” & “Bad” photos show comparative details

Success with 2009 IECC in Georgia:
Tech Tips for Builders
HVAC INSTALLATION

advanced energy SEEA

5. Do not compress insulated flexible ducts more than the thickness of the insulation.

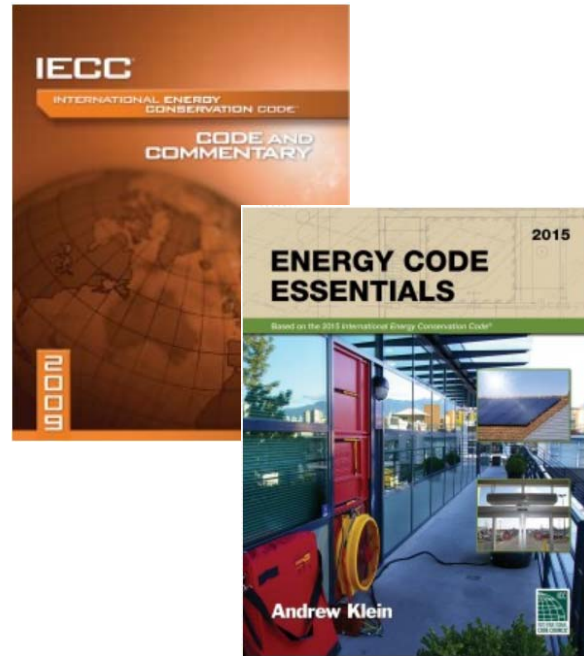
UNINSULATED BOOT **INSULATED BOOT** **COMPRESSION** **NO COMPRESSION**

6. Support flexible duct (including spot ventilation) at least every 4 feet and do not bend greater than 90°.

NO SUPPORT **SUPPORT** **GREATER THAN 90°** **LESS THAN 90°**

Residential Energy Code – IECC Code Commentary

- Code with descriptive language and some background and context
- Some crude photos and diagrams
- 2015 has “Companion Guide”



2009 IECC Prescriptive Code



Prescriptive envelope requirements of the 2009 IECC mostly represent common industry practice!

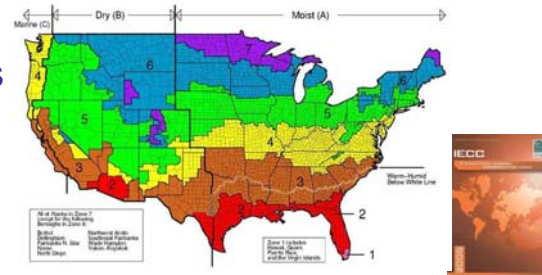
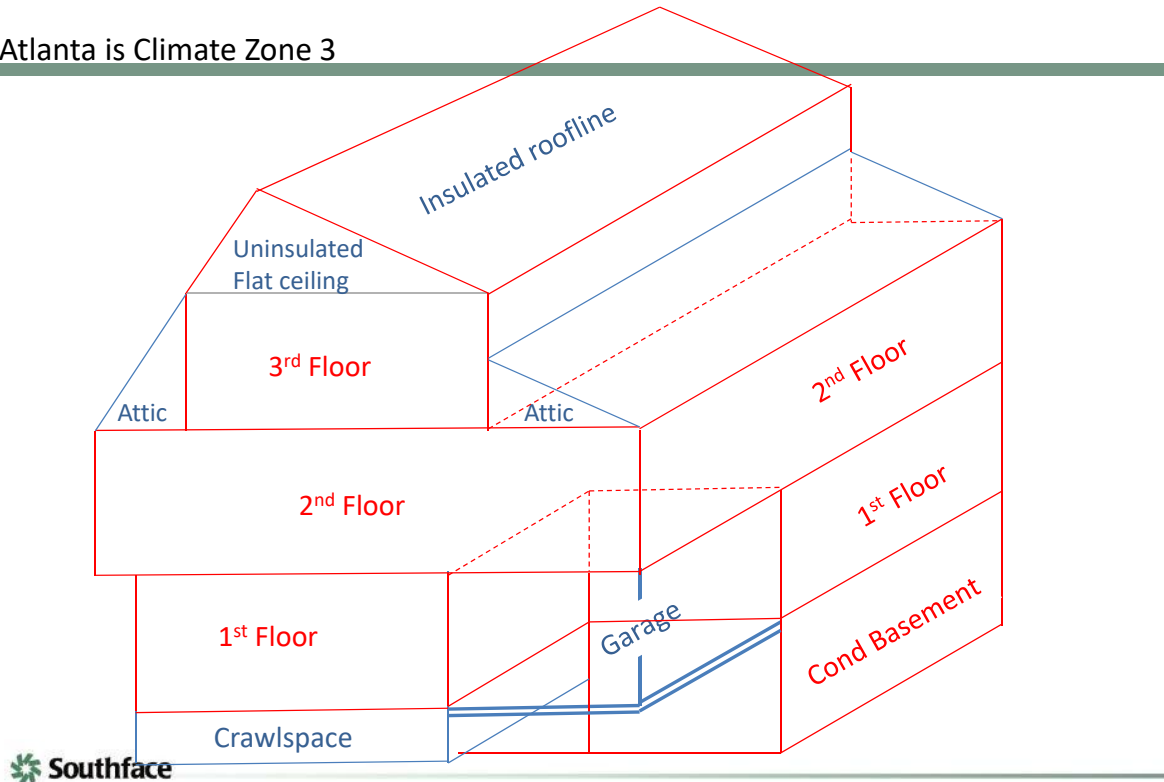


TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ¹	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^c WALL R-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65 ^j	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50 ^j	0.65	0.30	30	13	5/8	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5 ^h	13/17	30 ^g	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5 ^h	15/19	30 ^g	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38 ^g	15/19	10, 4 ft	10/13

FILL IN THE PRESCRIPTIVE CODE R-VALUES

Atlanta is Climate Zone 3



IECC 2009 - Proving Air Sealing & Insulation

- **Performance Testing Option for house leakage**

- Blower door result must be less than 7 ACH₅₀

- **Visual Inspection Option**

- Use Code Checklist (thermal bypass)
- Requires multiple inspections
 - Framing stage / pre-drywall
 - Final



NUMBER	COMPONENT	CRITERIA
1	Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
2	Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
3	Walls	Corners and headers Junction of foundation
4	Windows and doors	Space between window
5	Rim joists	Rim joists are insulated
6	Floors (including above-garage and cantilevered floors)	Insulation is installed subfloor decking. Air insulation.
7	Crawl space walls	Insulation is permanent Exposed earth in unventilated crawl space is covered with a vapor retarder with overlap
8	Shafts, penetrations	Duct shafts, utility penetrations are sealed exterior or unconditioned space
9	Narrow cavities	Batts in narrow cavities are sealed sprayed/blown insulation
10	Garage separation	Air sealing is provided
11	Recessed lighting	Recessed light fixtures are sealed Exception—fixtures in conditioned space
12	Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
13	Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
14	Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
15	Common wall	Air barrier is installed in common wall between dwelling units.
16	HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
17	Fireplace	Fireplace walls include an air barrier.



MAKING SENSE OF ENVELOPE CHECKLIST

Appendix RA
2015 ICC-2019 Georgia Energy Code

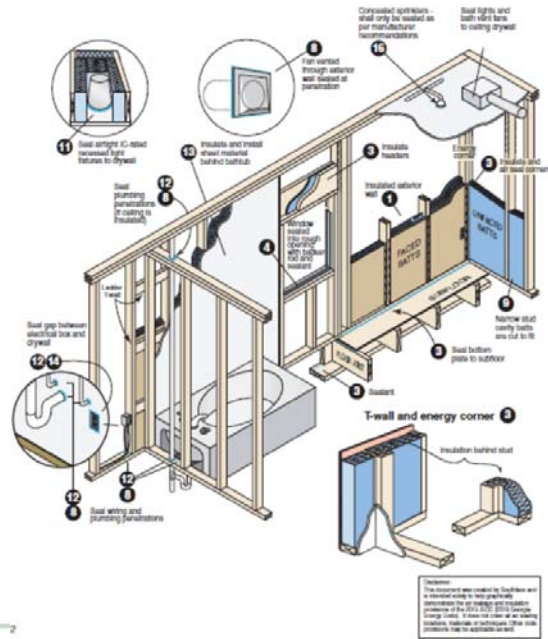
Air Barrier and Insulation Installation Component Guide

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
1 General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. <i>(Seams or joints in the air barrier shall be sealed.)</i>	Air permeable insulation shall not be used as a sealing material.
2 Ceiling/joints	The air barrier in any dropped ceiling/joints shall be aligned with the insulation and any gaps in the air barrier shall be sealed. <i>(Seams openings, drop-down studs or joists and wall studs in unconditioned attic spaces shall be sealed.)</i>	The insulation in any dropped ceiling/joints shall be aligned with the air barrier.
3 Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. The space between window/door/joints and framing, and splayouts and framing shall be sealed. The joints shall include the air barrier.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of minimum R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
4 Windows, splayouts and doors	The space between window/door/joints and framing, and splayouts and framing shall be sealed. The joints shall include the air barrier.	The joints shall be insulated.
5 Floor joists	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of exterior decking, or floor framing cavity insulation shall be provided to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.
6 Floors (including above garage and conditioned floor)	Exposed walls in unconditioned crawl spaces shall be covered with a Class I vapor retarder with permeability equal to or less than 0.05 perm.	When provided instead of floor insulation (permitted crawl spaces), insulation shall be permanently attached to the concrete walls.
7 Crawl space walls	Exposed walls in unconditioned crawl spaces shall be covered with a Class I vapor retarder with permeability equal to or less than 0.05 perm.	Capped chases shall be insulated to surrounding ceiling if value (maintain clearance from ventilation flows).
8 Shafts, penetrations	Shaft, utility penetrations, and flow shafts opening to exterior or unconditioned spaces shall be sealed.	Seals in recessed shafts shall be cut to fit, or recessed shafts shall be filled by insulation that is installation ready, conforms to the shaft's cavity space.
9 Narrow cavities	Air sealing shall be provided between the garage and conditioned spaces.	Seals in recessed shafts shall be cut to fit, or recessed shafts shall be filled by insulation that is installation ready, conforms to the shaft's cavity space.
10 Garage separation	Recessed light fixtures installed in the building thermal envelope shall be sealed to the shaft and IC-BOB.	Seals in recessed shafts shall be cut to fit, or recessed shafts shall be filled by insulation that is installation ready, conforms to the shaft's cavity space.
11 Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the shaft and IC-BOB.	Recessed light fixtures installed in the building thermal envelope shall be sealed to the shaft and IC-BOB.
12 Plumbing and wiring	Wiring and plumbing penetrations shall be sealed.	Seal insulation shall be cut ready to fit around wiring and plumbing in exterior walls, or insulation that is installation ready conforms to shaft's cavity (shall extend beyond joints and wires).
13 Shower/tub in exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the exterior and fully.	Exterior walls adjacent to showers and tubs shall be insulated.
14 Electrical/phone lines in exterior walls	The air barrier shall be installed around electrical or communication conduits or separated from them shall be sealed.	Exterior walls adjacent to showers and tubs shall be insulated.
15 HVAC register boots	HVAC register boots shall be sealed to the shaft and IC-BOB.	Seals in unconditioned spaces shall be installed. Enclosure meeting seals in conditioned spaces for ventilation control.
16 Ceilings/splitters	When required to be sealed, ceilings/splitters shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealers shall not be used to fill walls between the partition, other studs and walls or ceiling.	
17 Blocking between framing (e.g. between knee walls, conditioned floors, garage separation walls)	Blocking shall be sealed to framing.	Insulation shall be in contact with blocking.
18 Chimney walls	An barrier is installed in exterior wall between chimney walls.	
19 Finishes	Finish air barriering elements shall have light-filling flux dispersers or doors, and exterior construction air.	Finish air barriering elements shall be maintained in place.

Disclaimer: This document was created by Southface and is intended solely to help practitioners understand the air barrier and insulation provisions of the 2015 ICC-2019 Georgia Energy Code. It does not cover all air sealing materials, methods or techniques. Other code provisions may be applicable as well.

Appendix RA
2015 ICC-2019 Georgia Energy Code

Air sealing key points



HOW TO FAIL A BLOWER DOOR TEST



CORRECT PRACTICES



Complete
air barrier
behind tub

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GEORGIA RESIDENTIAL ENERGY CODE FIELD STUDY

8 Key Items :

- High-efficiency lighting
- Envelope tightness (ACH₅₀)
- Duct leakage
- Exterior wall insulation
- Ceiling insulation
- Foundation insulation (floor / basement wall / slab)
- Window U-factor
- Window SHGC



63 observations of each key item minimum

 Southface

GEORGIA SAVINGS POTENTIAL



First-year savings if 100% compliance achieved

Electricity savings

- 11,148 MWh
- \$2.41 million

Gas savings

- 547,700 therms
- \$0.78 million

**Total first-year savings:
\$3.1 million**



What did we learn from all this?



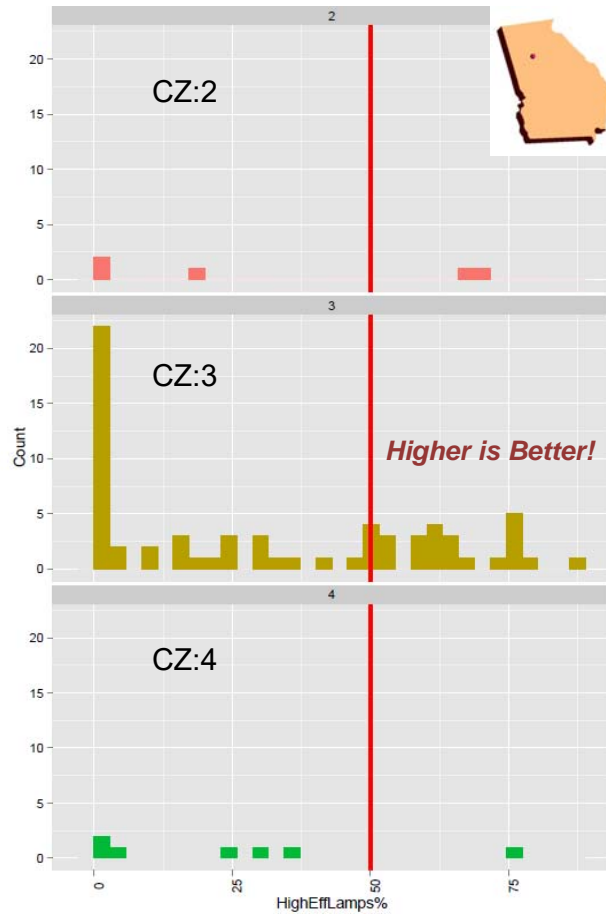
- 1) Study proves where we are – affects adoption
- 2) Point of Sale code enforcement yields very high compliance (e.g., windows)
- 3) Insulation Quality is poor – the cheapest insulation usually had the poorest installation
- 4) Testing matters – ducts inside the envelope were leakier than ducts outside the envelope (which were required to be tested)
- 5) Theories on lighting – brand new in code, not even on the builder's radar (bulbs are installed by electrical sub), not life safety item

HIGH EFFICACY LAMPS (%)

NO. OF OBSERVATIONS: 79

Vertical red line indicates the 2009 IECC prescriptive code requirement of minimum 50% of all lamps

Of 79 homes observed only 27 complied with the minimum Standard (~35% compliance)



The Economics of Lighting for Builders



Bulb Cost Assumption:		Electricity Rate: 0.12 \$/kwh			
Incandescent = \$0.25					
LED = \$2 each					
	# Incand	# LED's	Price Premium	Bulb Wattage	
				Incand	LED
All Incand House	60	0	\$ -	60	10
50% LED House	30	30	\$ 52.50	60	10
100% LED House	0	60	\$ 105.00	60	10

It takes 24 days to payback LED's if half the lights are left on during construction!
(12 days if all on!!!)

	\$ Cost for 1 month - ON half the time			Simple Payback	
	Incand	LED	Total	\$ Savings	(months) (days)
100% Incand House	\$ 158.11	\$ -	\$ 158.11	0	
50% Incand / 50% LED	\$ 79.06	\$ 13.18	\$ 92.23	\$ 65.88	0.80 24.3
100% LED House	\$ -	\$ 26.35	\$ 26.35	\$ 131.76	0.80 24.3

Component Specific How-to Videos:

- Short/small – easily downloaded or streamed
- Compare / contrast images (go / no-go)
- Include Hotline information
- Templates and links to other tools

Energy Code Hotline – 404-604-3598
energycodes@southface.org

Code Resources

From Lauren:

- www.southface.org
- www.seealliance.org
- www.energycodes.gov
- www.iccsafe.org
- [Success with Energy Code Tech Tips for HVAC](#)
- [Insulation installation resources in Spanish](#)
- [DOE Field Study resource](#)
- Nice ventilation video ~30 minutes long, but they do a good job of talking through the why: <https://www.youtube.com/watch?v=PqW-b5GU03c>

Group Exercise

How well can you illustrate a 2018 IECC concept?

- Group exercise – split into groups of ~1-6 people, Each group receives a slip of paper with code items and code language written on it.
- Each group should choose at least one code concept and should discuss and consider how it could be easier to communicate this concept
- Try to draw or demonstrate graphically on a piece of poster paper.
- Groups get **two minutes to share** with entire audience and judge will offer feedback and choose best ones for prize(s)

“It’s like playing Pictionary with a blind cat”

- Hand out slips and break into ~10 groups – give them choice of up to 4 items - ~10-15 minutes
- MB+LW will display Code Section on screen – ~30 minutes

Illustrating a 2018 IECC concept

A

BUILDING THERMAL ENVELOPE. The *basement walls, exterior walls, floors, ceiling, roofs* and any other *building* element assemblies that enclose *conditioned space* or provide a boundary between *conditioned space* and *exempt* or unconditioned space.

Illustrating a 2018 IECC concept

B

CIRCULATING HOT WATER SYSTEM. A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to fixtures and back to the water-heating equipment.

Illustrating a 2018 IECC concept

C

R303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation that is 12 inches (305 mm) or greater in width. Alternatively, the insulation installers shall provide a certification that indicates the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown-in or sprayed fiberglass and cellulose insulation, the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be indicated on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and the *R*-value of the installed thickness shall be indicated on the certification. For insulated siding, the *R*-value shall be on a label on the product's package and shall be indicated on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

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D

R303.1.1.1 Blown-in or sprayed roof and ceiling insulation. The thickness of blown-in or sprayed fiberglass and cellulose roof and ceiling insulation shall be written in inches (mm) on markers that are installed at not less than one for every 300 square feet (28 m²) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. The thickness and installed R-value of sprayed polyurethane foam insulation shall be indicated on the certification provided by the insulation installer.

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E

R402.2.1 Ceilings with attic spaces. Where Section R402.1.2 requires R-38 insulation in the ceiling, installing R-30 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-49 insulation in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves.

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F

R402.2.8 Floors. Floor framing-*cavity insulation* shall be installed to maintain permanent contact with the underside of the subfloor decking. **Exception:** As an alternative, the floor framing-*cavity insulation* shall be in contact with the topside of sheathing or continuous insulation installed on the bottom side of floor framing where combined with insulation that meets or exceeds the minimum wood frame wall *R*-value in Table R402.1.2 and that extends from the bottom to the top of all perimeter floor framing members.

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G

R402.2.11 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be insulated provided that the crawl space is not vented to the outdoors. Crawl space wall insulation shall be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code* or *International Residential Code*, as applicable. Joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up stem walls and shall be attached to the stem walls.

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H

R402.4.1.2 Testing. The *building* or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in *Climate Zones* 1 and 2, and three air changes per hour in *Climate Zones* 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

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I

R402.4.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory built fireplaces *listed* and *labeled* in accordance with UL 127, the doors shall be tested and *listed* for the fireplace.

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J

R403.1.1 Programmable thermostat. The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature setpoints at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain *zone* temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

Illustrating a 2018 IECC concept

K

R403.1.2 Heat pump supplementary heat (Mandatory). Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

Illustrating a 2018 IECC concept

L

R403.3.3 Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. **Rough-in test:** Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. **Postconstruction test:** Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the *building thermal envelope*.
2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Illustrating a 2018 IECC concept

M

R403.3.5 Building cavities (Mandatory). *Building* framing cavities shall not be used as ducts or plenums.

Illustrating a 2018 IECC concept

N

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 be not less than R-19, excluding the *R*-value of the duct insulation.
3. In *Climate Zones* 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an *R*-value of not less than R-13 and in compliance with the vapor retarder requirements of Section 604.11 of the *International Mechanical Code* or Section M1601.4.6 of the *International Residential Code*, as applicable.

Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

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O

R403.3.7 Ducts located in conditioned space. For ducts to be considered as inside a conditioned space, such ducts shall comply with either of the following:

1. The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.
2. The ducts shall be buried within ceiling insulation in accordance with Section R403.3.6 and all of the following conditions shall exist:
 - 2.1. The air handler is located completely within the *continuous air barrier* and within the building thermal envelope.
 - 2.2. The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section R403.3.4, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m²) of conditioned floor area served by the duct system.
 - 2.3. The ceiling insulation *R*-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation *R*-value, less the *R*-value of the insulation on the duct.

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P

R403.4 Mechanical system piping insulation (Mandatory).

Mechanical system piping capable of carrying fluids greater than 105°F (41°C) or less than 55°F (13°C) shall be insulated to an R-value of not less than R-3.

R403.4.1 Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind. The protection shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall be prohibited.

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Q

R403.5.1 Heated water circulation and temperature maintenance systems (Mandatory). Heated water circulation systems shall be in accordance with Section R403.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R403.5.1.2. Automatic controls, temperature sensors and pumps shall be accessible. Manual controls shall be readily accessible.

R403.5.1.1 Circulation systems. Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermosyphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

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R

R403.5.2 Demand recirculation water systems. *Demand recirculation water 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 or tempered 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).

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S

R403.5.3 Hot water pipe insulation (Prescriptive). Insulation for hot water piping with a thermal resistance, Rvalue, of not less than R-3 shall be applied to the following:

1. Piping $\frac{3}{4}$ inch (19.1 mm) and larger in nominal diameter.
2. Piping serving more than one dwelling unit.
3. Piping located outside the *conditioned space*.
4. Piping from the water heater to a distribution manifold.
5. Piping located under a floor slab.
6. Buried piping.
7. Supply and return piping in recirculation systems other than demand recirculation systems.

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T

R403.6 Mechanical ventilation (Mandatory). The *building* shall be provided with ventilation that complies with the requirements of the *International Residential Code* or *International Mechanical Code*, as applicable, or with other *approved* means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

R403.6.1 Whole-house mechanical ventilation system fan efficacy. Fans used to provide whole-house mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler that is integral to tested and *listed* HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

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U

R404.1 Lighting equipment (Mandatory). Not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

R404.1.1 Lighting equipment (Mandatory). Fuel gas lighting systems shall not have continuously burning pilot lights.

THANK YOU!



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