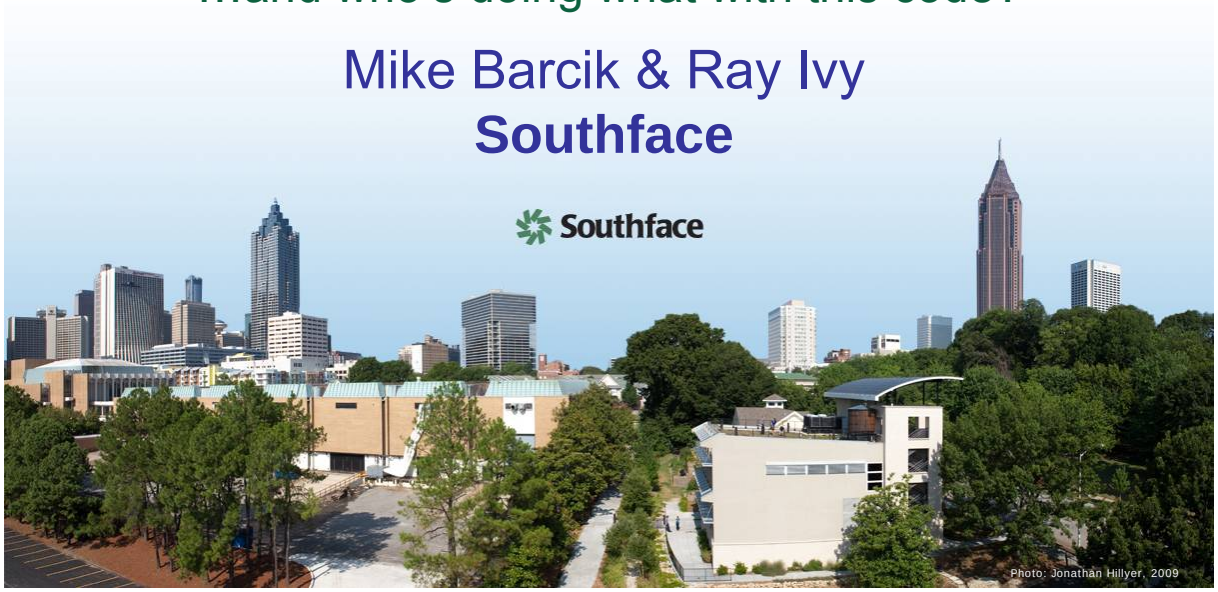
The Latest & Greatest in Energy Codes:

What's in the 2012 IECC that's Not in the Old Code?

…and who's doing what with this code?

Mike Barcik & Ray Ivy
Southface



Nerd Humor

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Einstein, Newton, and Pascal are hanging out one afternoon.
Einstein is bored, so he suggests, "Let's play hide-and-seek. I'll be it!"
The others agree, so Einstein begins counting. "One... Two... Three..."
Pascal runs off right away to find a place to hide.
But Newton merely takes out a piece of chalk and draws a mid-sized square.
He finishes and steps into the square just as Einstein shouts,
"Ready or not -- here I come!"
Einstein looks up and immediately spots Newton standing right in front of him.
He says, "I found you, Newton!"
Newton replies, "No, you found one Newton per square meter -- You found Pascal!"

About Southface

Southface

Southface promotes sustainable homes, workplaces and communities through education, research, advocacy and technical assistance.

Matching Quiz:

- Mike
- Ray
- Both
- Neither

- Drinks lots of water; pees frequently
- Jumped many times out of airplanes
- Dog ate poison and vomited profusely
- Trained many HERS Raters
- Won't eat veggies (drinks them in smoothies)
- Helped Andrew Young change pants
- Built lots of Habitat houses
- Dated Miss Alabama contestant 19xx

Status of Adopted Energy Codes

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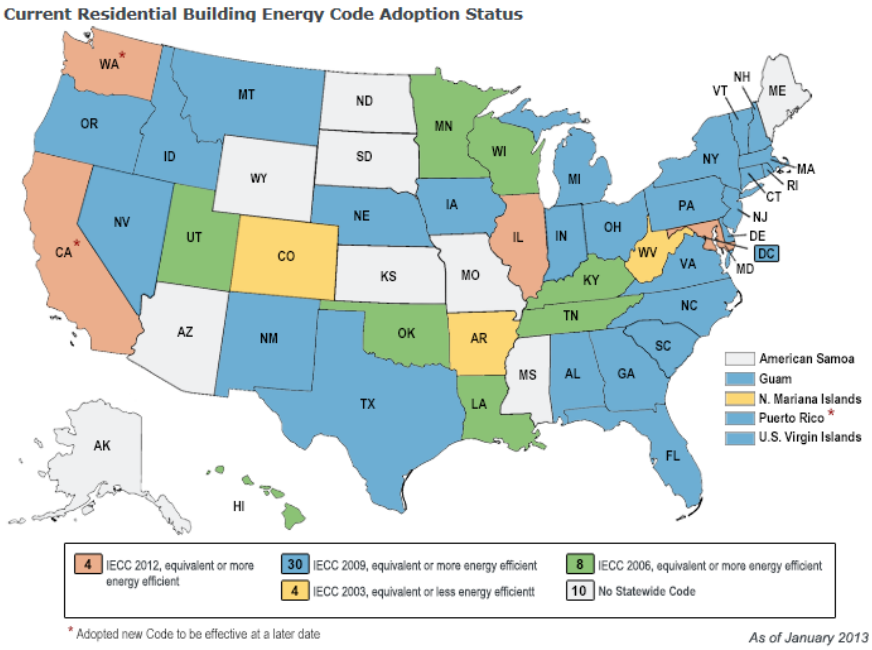

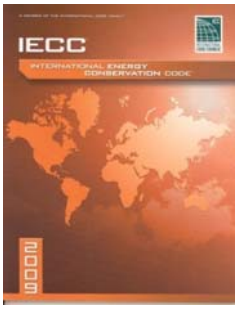

IECC: 2012 vs. 2009

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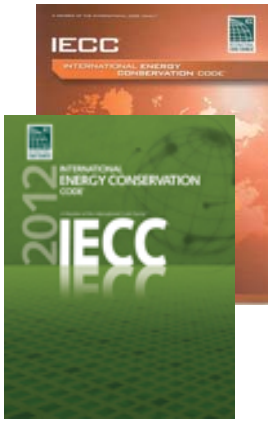
Summary of Changes to IECC 2012



- Major changes
  - Consolidated with IRC energy chapter (actually a change to the IRC, not the IECC)
  - Mandatory whole-house pressure test and thermal envelope checklist
  - More stringent duct leakage test
  - DHW distribution system requirements
  - Will require whole house ventilation system
- Key non-changes
  - Retains prohibition on envelope-equipment trade-offs
  - 75% efficient lighting "mandatory" requirement

Brief History of Energy Codes

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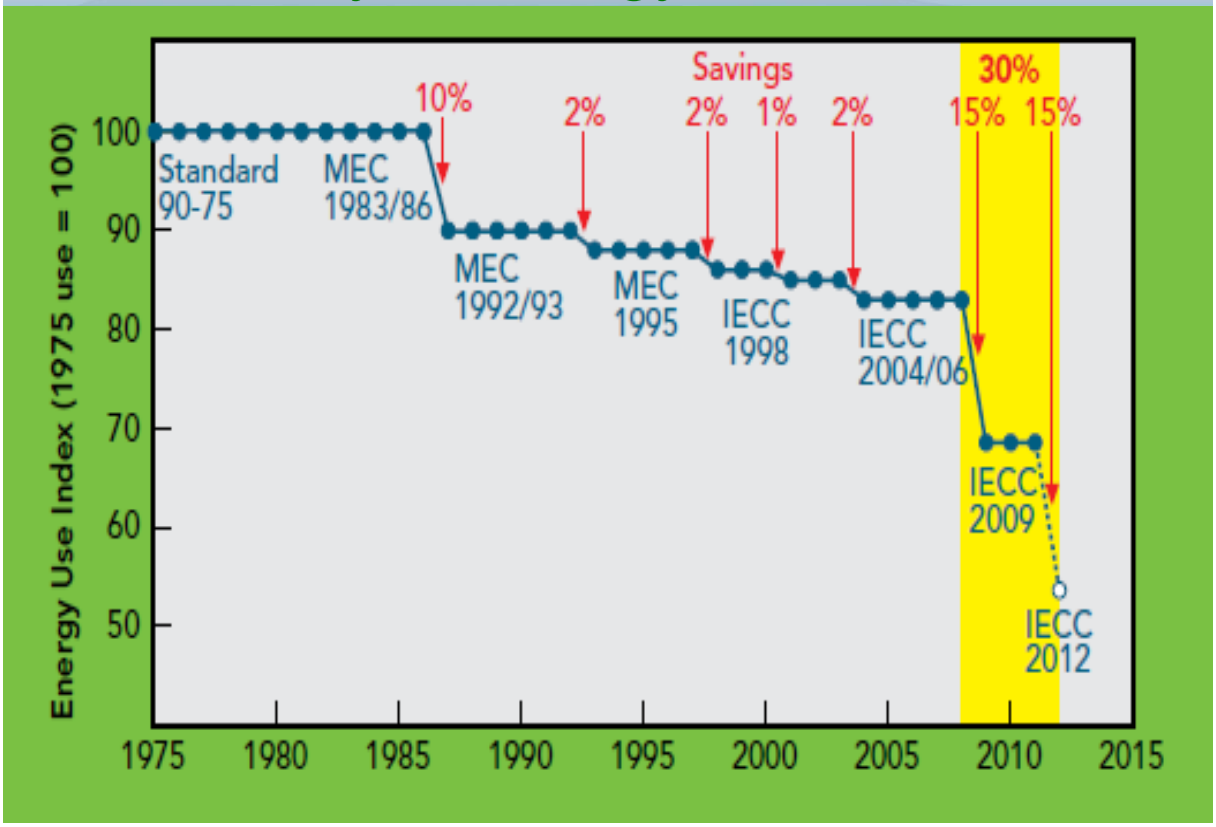

Structure of 2012 IECC

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Commercial Section

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

Residential Section

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

402-Building Thermal Envelope

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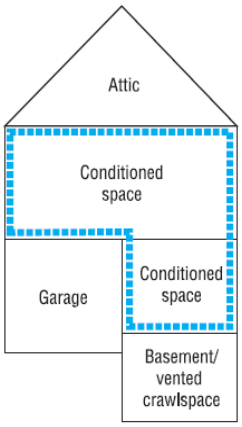
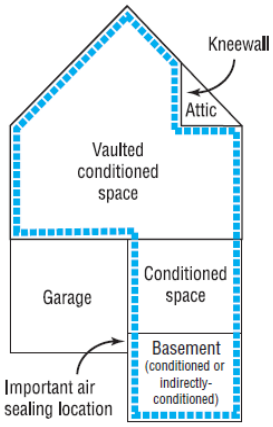
The *building thermal envelope* is the barrier that separates the conditioned space from the outside or unconditioned spaces. The building envelope consists of two parts - an air barrier and a thermal barrier that must be both continuous and contiguous (touching each other). In a typical residence, the building envelope consists of the roof, walls, windows, doors, and foundation. Examples of unconditioned spaces include attics, vented crawlspaces, garages, and basements with ceiling insulation and no HVAC supply registers.

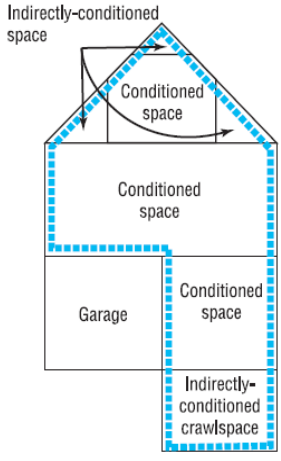
Example 1



Example 2



Example 3



Energy Code Compliance Pathways

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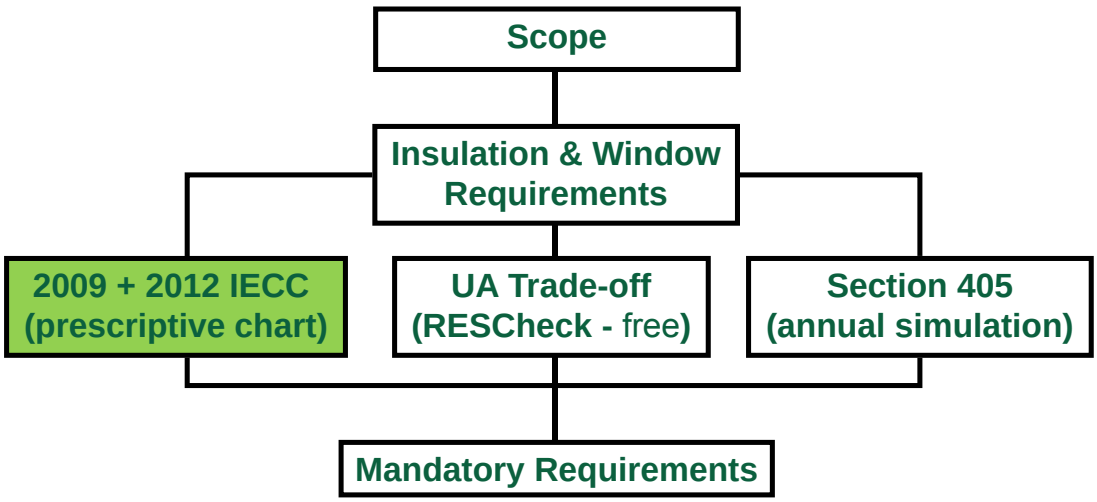

IECC Climate Zones

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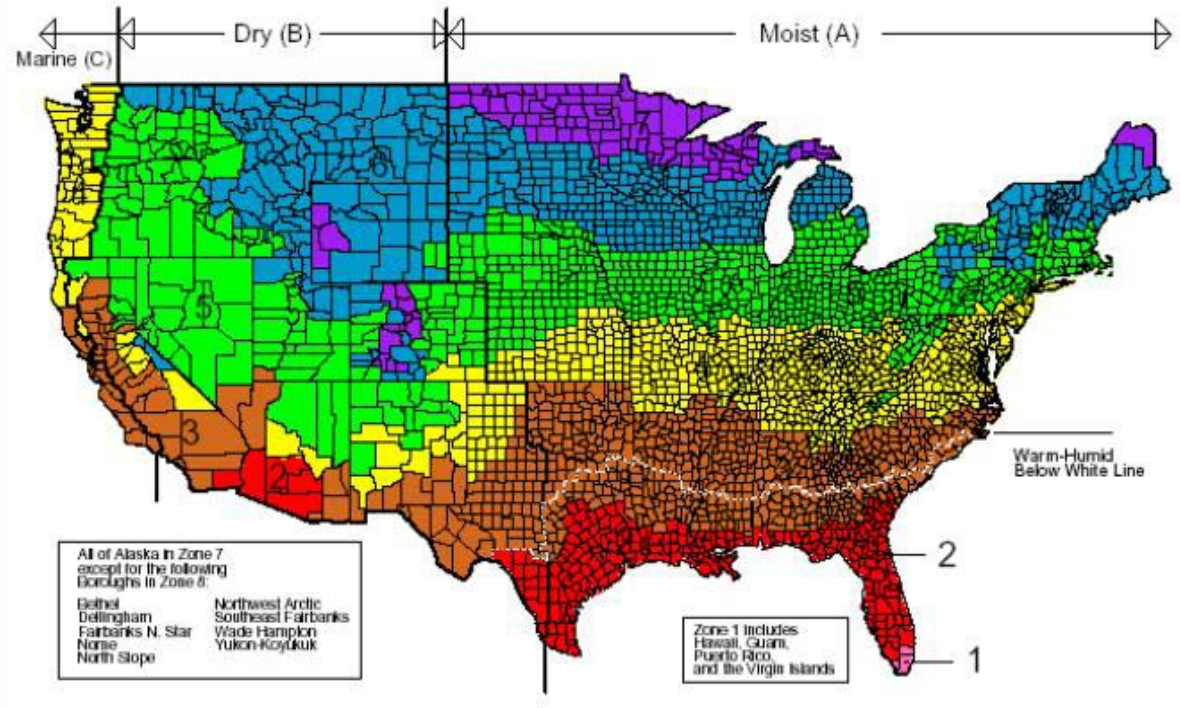

Prescriptive Code:

Insulation & Fenestration by Climate Zone

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Table 402.1.1
Insulation and Fenestration Requirements by Component[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION[b,e] SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	1.20	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, 2ft	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	19 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

[a] *R*-values are minimums, *U*-factors and SHGC are maximums, R-19 batts compressed into a nominal 2 x 6 framing cavity such that the *R*-value is reduced by R-1 or more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.
[b] The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
[c] "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
[d] 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 Zones 1 through 3 for heated slabs.
[e] There are no SHGC requirements in the Marine Zone.
[f] Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.
[g] Or insulation sufficient to fill the framing cavity, R-19 minimum.
[h] "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
[i] The second *R*-value applies when more than half the insulation is on the interior of the mass wall.
[j] For impact rated fenestration complying with Section R301.2.1.2 of the *IRC* or Section 1608.1.2 of the *IBC*, maximum *U*-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

Prescriptive Code:

Insulation & Fenestration by Climate Zone

Southface

TABLE R402.1.1
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[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] 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

For SI: 1 foot = 304.8 mm.

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

Wood Frame Walls – R402

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TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENT

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

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

IECC 2012 Wall Impacts

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- 2x6 construction or foam thermal break now prescriptive "mandate" in most CZ's
  - –Envelope trade-off options limited
  - –Equipment trade-off options prohibited
- 2x4 and R-20
  - –3" closed cell foam
  - –2" closed cell (one pass) + radiant insulation

- Insulating sheathing
  - – Consider Products like Zip System with foam attached or DOW Structural Insulated Sheathing (SIS)
  - – Can reduce sheathing by R-3 up to 40% for bracing
  - – Over-sheathing technique – stagger seams of continuous OSB with continuous foam
- Log walls difficult to comply without large diameter logs or furred-in finish layer (SIP logs!)

Prescriptive Code: Fenestration Changes

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Zone	Fenestration U-Factor	Fenestration SHGC
1	1.2 → 0.50	0.30 → 0.25 (except skylights)
2	0.65 → 0.40 (0.75 → 0.65 skylights)	
3	0.50 → 0.35 (0.65 → 0.55 skylights)	
4 except Marine	(0.60 → 0.55 skylights)	NR → 0.40
5 and Marine 4	0.35 → 0.32 (0.60 → 0.55 skylights)	
6		
7 & 8		

Compliance Paths for Insulation & Windows

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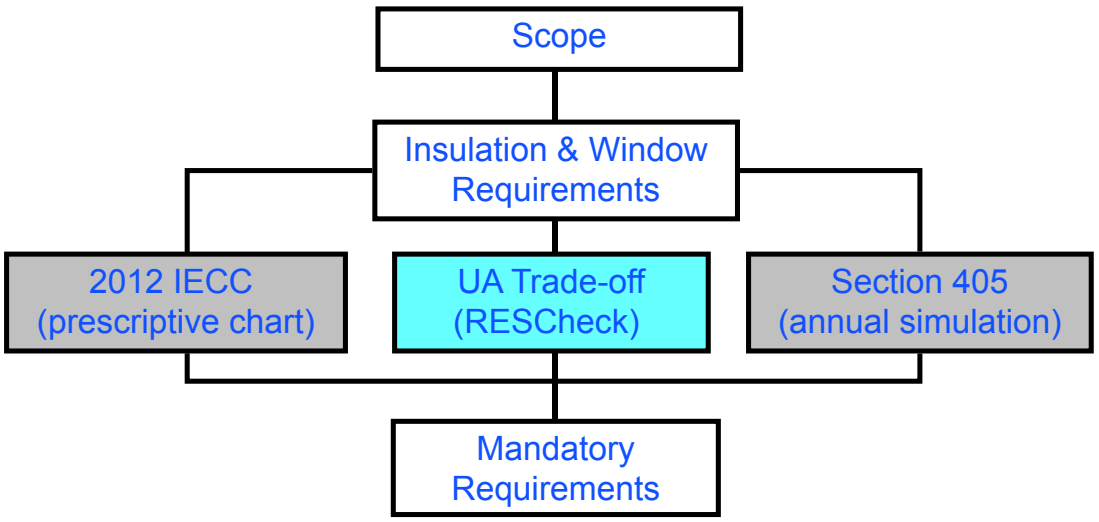

16

RES*check*™ Software

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www.energycodes.gov

- Software evaluates specific designs quickly
- Demonstrates SHGC compliance
- Allows trade-offs
  - Building envelope components
  - Heating and cooling equipment efficiency trade-offs not allowed in '09 or '12 IECC

Simple Trade Offs

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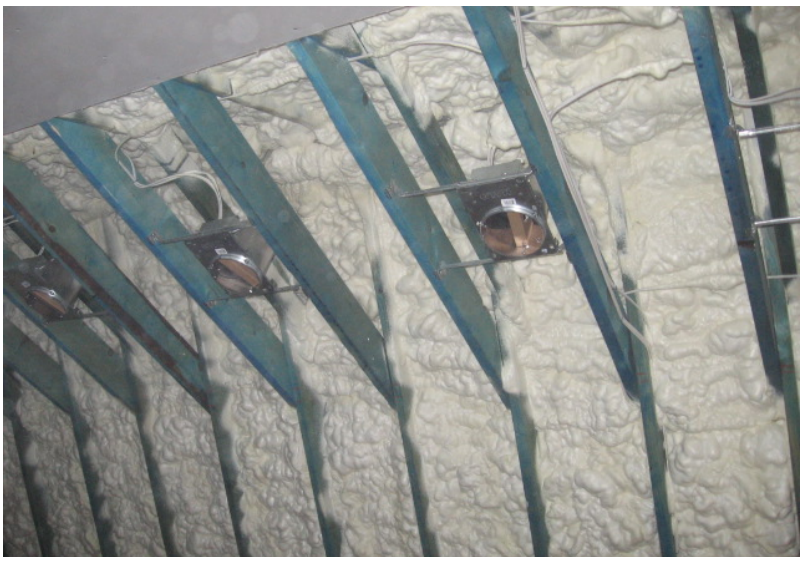

- Vaulted ceilings and foam sprayed rooflines would likely need to perform an R-value (U-factor) trade-off
- RESCheck is historically an excellent free tool for this
- However, much of the trade-off "cushion" is now gone

Section 402.2: Insulation Requirements

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- Details for insulating various aspects of the building envelope
  - Ceilings with Attic – 402.2.1
  - Ceilings w/out Attic – 402.2.2
  - Eave baffle – 402.2.3
  - Access hatches and doors– 402.2.4
  - Mass Walls – 402.2.5
  - Steel Framing – 402.2.6
  - Floors – 402.2.7
  - Basement Walls – 402.2.8
  - Slab-on-grade – 402.2.9
  - Crawlspace Walls – 402.2.10
  - Masonry Veneer – 402.2.11
  - Sunrooms – 402.2.12

402.2.1 - Ceilings with Attics

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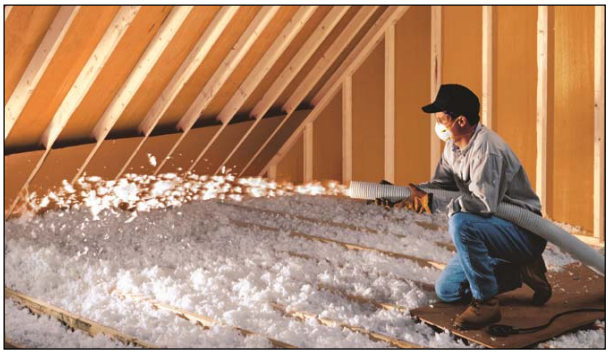
- Use of advanced framing (raised top plate or energy trusses) that permit continuous, consistent R-value is credited:
- R-38->R-30; R-49->R-38
- Rulers required every 300 s.f.



402.2.1 - Ceilings with Attics

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- Tradeoff required unless entire ceiling meets prescriptive R-value (exception for 402.2)

402.2.2 - Ceilings without Attics

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- All Climate Zones require at least R-30
- Up to 500 s.f. can be traded down to R-30 if the assembly does not permit room for full amount

Vaulted ceilings and foam sprayed rooflines will likely need to perform a trade-off

402.2.3 Eave baffle

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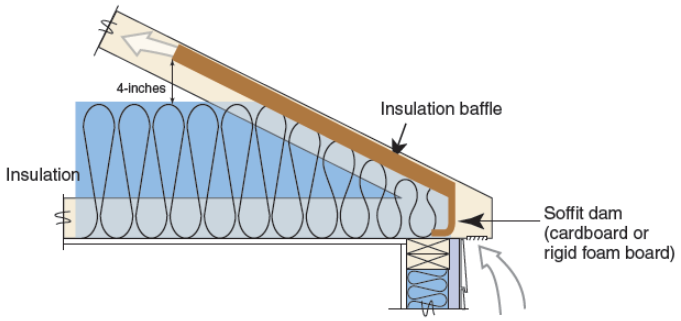
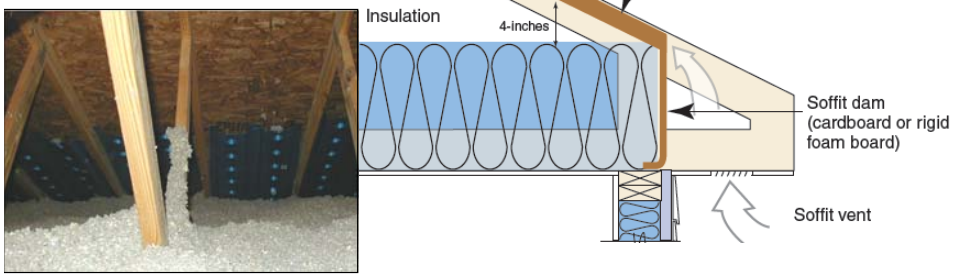
- Details of proper eave baffle – opening ≥ vent opening, solid material that extends over top of insulation

Standard Truss
with tapered
insulation depth



Energy Truss
with full height insulation
(recommended)



Note: Wind wash baffle and air-permeable insulation dam. For air permeable insulation in vented attics, baffles shall be installed adjacent to soffit and eave vents. A minimum of a 1-inch of space shall be provided between the insulation and the roof sheathing and at the location of the vent. The baffle shall extend over the top of the insulation inward until it is at least 4 inches vertically above the top of the insulation. Any solid material such as cardboard or thin insulating sheathing shall be permissible as the baffle.

402.2.4 – Access hatches & doors

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- Weather-strip and insulate access doors to match surrounding R-value
  - Vertical doors (kneewall ~R-20)
  - Hatches/scuttle holes
  - Pull-down stairs – yikes!
  - Insulation dam

402.2.5 – Mass Walls

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Mass walls are above grade walls that are concrete, block, insulated concrete forms, masonry cavity, brick (other than veneer), earth (adobe, compressed block, rammed earth) and solid timber/logs

Exterior or integral insulation

CZ2: R-4, CZ3&4: R-8

Interior insulation

CZ2:R-6, CZ3&4:R-13

402.2.6 Steel Framing & 402.2.7 Floors

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402.2.6 – Steel Framing

- Steel framing – equivalency charts adjust for thermal bridging (see Table)

402.2.7 – Floors

- Floors – insulation must maintain (***continuous)*** **permanent contact** against subfloor

Reality of Underfloor Insulation

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402.2.8 Basement Walls

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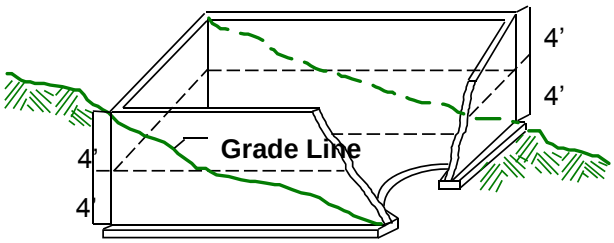

- Basement Wall – Average gross wall must be > 50% below grade and enclose conditioned space
- CZ4: R-10 continuous or R-13 cavity
- CZ3: R-5 continuous or R-13 cavity
- CZ2: No insulation required

402.2.8 Basement Walls

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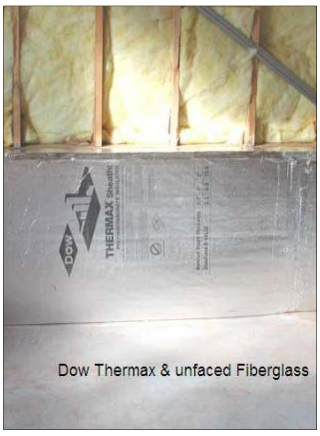
Insulation strategies for non-finished basements:

Cellulose batt

Fiberglass batt w/ vinyl backing

Rigid foam board



402.2.9 Slabs

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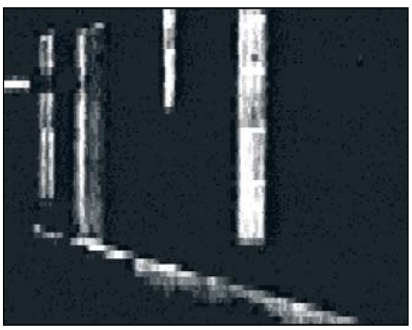
402.2.8 – Slab-on-grade

- Slabs – CZ1-3 no required insulation (termites)
- R-10 for 2' in CZ 4&5
- R-10 for 4' in CZ 6-8
- R-5 added to R-value for heated slab (e.g., radiant floor heating in slab)



402.2.10 Crawlspaces - 3 Options

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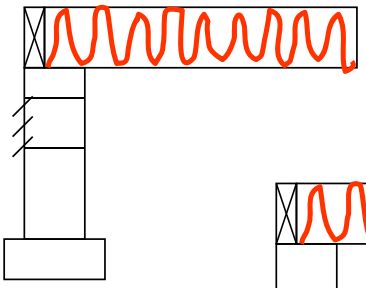
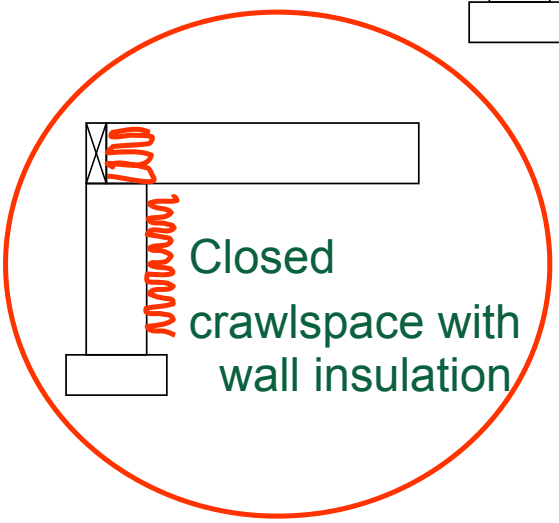
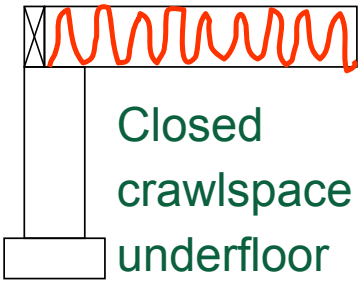
Standard vented crawlspace - underfloor insulation





Closed crawlspace with wall insulation



Closed crawlspace underfloor insulation

- **Note**: all crawspaces must meet Class I vapor retarder requirements, as per IRC

Closed Crawlspaces

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- Seal ground with plastic (6” up walls, 6” overlaps)
- Continuous insulation on interior of walls to satisfy code (R-10 in CZ4, R-5 in CZ3, R-0 in CZ2)
- Eliminate all vents and leaks (access doors)
- Satisfy IRC exception to vent requirement (2006 IRC section R408.3)

Venting Exceptions:

- Continuous exhaust (radon)
- Direct condition crawlspace (supply)
- Direct condition (dehumidifier)

Critical Details:

- No drainage problems
- Use a sealed combustion / direct vent furnace or install a Heat Pump
- Pest Control and Code Official awareness

402.2.10 – Crawlspace Walls

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402.2.10 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least 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*. All 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 at least 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

402.2.11 Veneer & 402.2.12 Sunrooms

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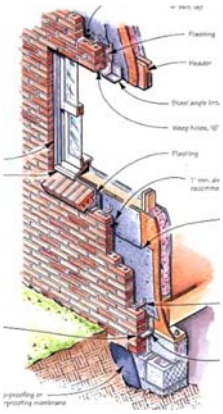
Section 402.2.11

- Masonry veneer – horizontal insulation not required (insulation exception for brick ledge)



Section 402.2.12

- Thermally Isolated Sunroom (CZ1-4: R-19 ceiling, CZ 5-8: R-24 ceiling; R-13 separation walls, fenestration meets code)

SUNROOM. A one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of the structure's exterior walls and roof.

THERMAL ISOLATION. Physical and space conditioning separation from conditioned space(s). The conditioned space(s) shall be controlled as separate zones for heating and cooling or conditioned by separate equipment.

Fenestration Performance

Southface

U-factor

- Lower U-factor means better insulated (U = 1/R)
- U-factor applies to
  - windows,
  - skylights,
  - doors

Single Pane U = 1.05

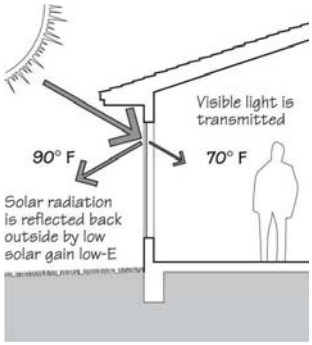
Double Pane U = 0.55

Triple Pane U = 0.35

Double Pane w/ low-e U = 0.35

Solar Heat Gain Coefficient

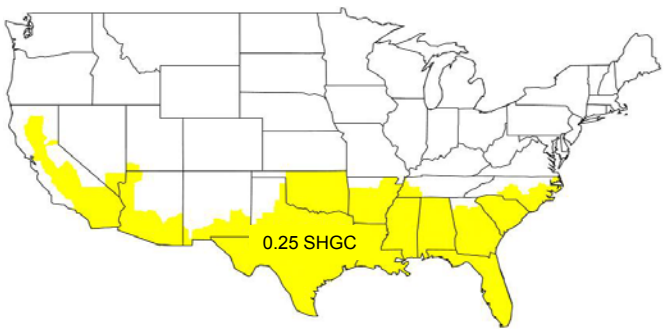
- The SHGC is the fraction of the solar heat from the sun that enters through a window
  - SP clear glass
    SHGC: ~ 0.8
  - DP clear glass
    SHGC: ~ 0.6-0.7
  - DP low-e
    (low solar gain)
    SHGC: ~ 0.25



402.3 Fenestration Requirements

Southface

- **Low-e** effectively required for all CZ's!
- Maximum fenestration **U-factor** = **0.40** in CZ2, **0.35** in CZ3-4 or **0.32** in CZ 5-8
  - Area weighted average of fenestration
- Maximum **SHGC = 0.25** for CZ1-3 and Maximum **SHGC =0.4** for CZ4
  - Area weighted average of fenestration
    1. Show compliance by having all glazing be ≤ 0.25 (or 0.4 for CZ4)
    2. Perform REScheck weighted average trade-off
    3. Use free Weighted Average tool from Southface



402.3 Fenestration Requirements

Southface

- Download free from www.southface.org

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Weighted Average Calculator: U Factor and Solar Heat Gain Coefficient (SHGC)
Directions: For each window type, enter the **U-Factor**, the **SHGC**, the **area of a *single* window**, and the **total number** of windows in the bulding (fill in blue shaded cells only)

Window Type	U Factor	SHGC	Single window area (sq. ft.)	Number of windows of this type
A	0.38	0.23	10	4
B	0.32	0.24	15	8
C	0.36	0.28	16	6
D	0.65	0.5	12	0
E				0
F				0
G				0
H				0
I				0
J				0
K				0
L				0

U-Factor Weighted Average
0.34

SHGC Weighted Average
0.25

Total Window Area (square feet)
256

402.3 Fenestration Requirements

Southface

- 15 square feet exemption for decorative glazing
  - Permits modest amount of stained glass, transom windows, etc.
- Opaque door exemption
  - One opaque door is exempt from U-factor requirements
- Replacement fenestration – must meet code

303.1.3 Fenestration

Southface

If not NFRC labeled, must use tables 303.1.3(1&2) to assign a default SHGC and U-Factor

Example: vinyl-clad wood window

TABLE 303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE 303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		
Clear	Tinted	Clear	Tinted	GLAZED BLOCK
0.8	0.7	0.7	0.6	0.6

If no NFRC label present:
Default U-factor: 0.55
Default SHGC: 0.70

Window Label "Catch-22"
NFRC label effectively required

If NFRC label present:
Values on label apply.
(in this example: U-factor 0.30 SHGC 0.25)

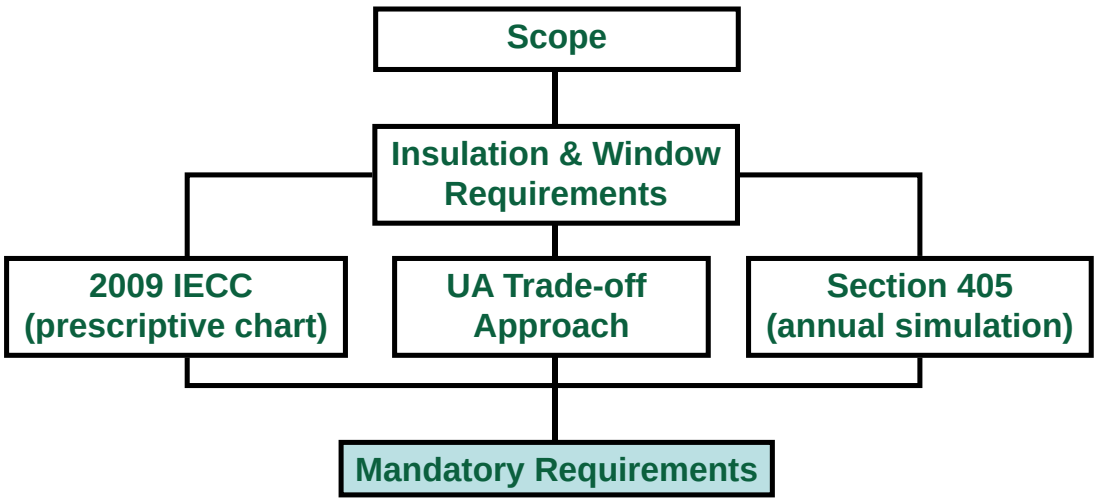
402.5 Fenestration Requirements

Southface

- If the simulated performance path (section 405) trade-offs are used, SHGC cannot exceed 0.50 (CZ 2&3) and U-factor cannot exceed 0.48 (CZ4)
- If REScheck is used, U-factor cannot exceed 0.50 and SHGC cannot exceed 0.30
- Air Leakage < 0.3 cfm / s.f. & labeled (exception for site built)

Energy Code Compliance Pathways

Southface



2012 IECC- Section 401.3

Southface

Mandatory Requirement:

Certificate on panel box with:

- Major Component R-values
- U-factor, SHGC of Windows
- Equipment Efficiencies
- **Duct & Envelope Testing Results**
- GA Specific: **Load Calculation Summary**

Go to southface.org to download fillable pdf of this form!

Blower Door Results go here:

Load Calc Results go here:

Duct testing Results go here:

Georgia Residential Energy Code Compliance Certificate*

Builder/Design Professional: ABC Builder Phone: 404-123-4567

Envelope Summary:

- List the R-Value for the following components:

Flat ceiling/roof:	R-30	Sloped/vault ceiling:	n/a
Exterior wall:	R-13	Above grade mass wall:	n/a
Attic kneewall:	n/a	Attic kneewall sheathing:	R18
Basement stud wall:	n/a	Basement continuous:	n/a
Crawlspace stud wall:	n/a	Crawlspace continuous:	n/a
Foundation slab:	R-0	Floors over unconditioned space:	R19
Cantilevered Floor:	n/a	Other insulation:	n/a

- Fenestration Components:

Window U-factor:	0.32	Window SHGC:	0.29
Skylight U-factor:	n/a	Skylight SHGC:	n/a
Glazed Door U-factor:	n/a	Opaque Door U-factor: (<50% glazed)	0.35

- Building Envelope Tightness (BET):

BET test conducted by: Home Performance Smith Phone: 404-123-6547
Fan Flow at 50 Pascals= 2,000 CFM_{50} Total Conditioned Volume = 20,000 ft^3
ACH_{50} = CFM_{50} x 60 / Volume= 6 ACH_{50} (must be less than 7 ACH_{50})
Low Rise Multifamily Visual Inspection Option
(The visual inspection option may be conducted by a third-party instead of the BET test for R-2 buildings only.)
Visual inspection conducted by: n/a Phone: n/a

Mechanical Summary:

Water Heater Energy Factor: 0.61 EF Fuel type: ☑ Gas ☐ Electric ☐ Other
Number of Heating and Cooling Systems: 1
Heating System Type (choose one):
☑ Gas: 90% AFUE ☐ Air-Source Heat Pump: _____ HSPF
☐ Other: _____ Efficiency: _____
Cooling System Type (Standard DX, Heat Pump, Geothermal, etc.): Standard DX
Cooling System Efficiency: 13 ☑ SEER ☐ EER ☐ Other
Heating/Cooling Load Calculations Performed by: HVAC Smith Phone: 770-123-4567
Total Heating Load (Based on ACCA Man. J or other approved methodology): 39,800 Btu/h
Total Cooling Load (Based on ACCA Man. J or other approved methodology): 28,800 Btu/h
Cooling Sensible Load: 20,800 Btu/h Cooling Latent Load : 8,000 Btu/h
Total Air Handler CFM (based on design calculations): 1600 CFM
Duct Tightness Test Conducted by: HVAC Smith Phone: 404-123-4567
CFM_{25} per 100 ft^2 of conditioned floor area = CFM_{25} x 100 / Conditioned floor area served
If all ducts are not located within conditioned space, builder must verify that either the postconstruction duct leakage to outdoors (**PCO**) is ≤ 8 cfm/100 ft^2, the post construction total duct leakage (**PCT**) is ≤ 12 cfm/100 ft^2, or the rough-in test (**RIT**) with air handler installed is ≤ 6 cfm/100 ft^2. State which method was used to conduct the duct tightness test: duct blower (**DB**), modified blower door subtraction method (**MBDS**), or automated multipoint blower door (**AMBD**).

System	Method (DB, MBDS, AMBD)	Test (PCO, PCT, RIT)	CFM_{25}	Area served (ft^2)	Test Result
1	DB	PCT	100	2,000	5
2					
3					

*Note: This permanent certificate shall be posted on or in the electrical distribution panel. Certificate shall be completed by the builder or registered design professional. Where there is more than one value for each component, certificate shall list the value covering the largest area.

402.4 Air Leakage

Southface

- Mandatory Requirement: Air Sealing
  - Detailed list
  - Testing
  - Fireplaces
  - Fenestration
  - Recessed light fixtures: airtight, IC-rated
- Details on techniques for air sealing – in flip book format (www.southface.org)

402.4.3 Wood Burning Fireplaces

Southface

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

*”masonry site-built” – unofficial letter

402.4.1.1 Air Barrier and Insulation Inspection

Southface

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

	COMPONENT	CRITERIA[a]
1.	Air barrier and thermal barrier	A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.
2.	Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.
3.	Walls	Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
4.	Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.
5.	Rim joists	Rim joists shall be insulated and include the air barrier.
6.	Floors (including above-garage and cantilevered floors)	Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.
7.	Crawl space walls	Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawlspace walls. Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
8.	Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.
9.	Narrow cavities	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
10.	Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
11.	Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and sealed to the drywall.
12.	Plumbing and wiring	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
13.	Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.
14.	Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.
16.	HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the sub-floor or drywall.
17.	Fireplace	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Air Sealing General (p. 2)

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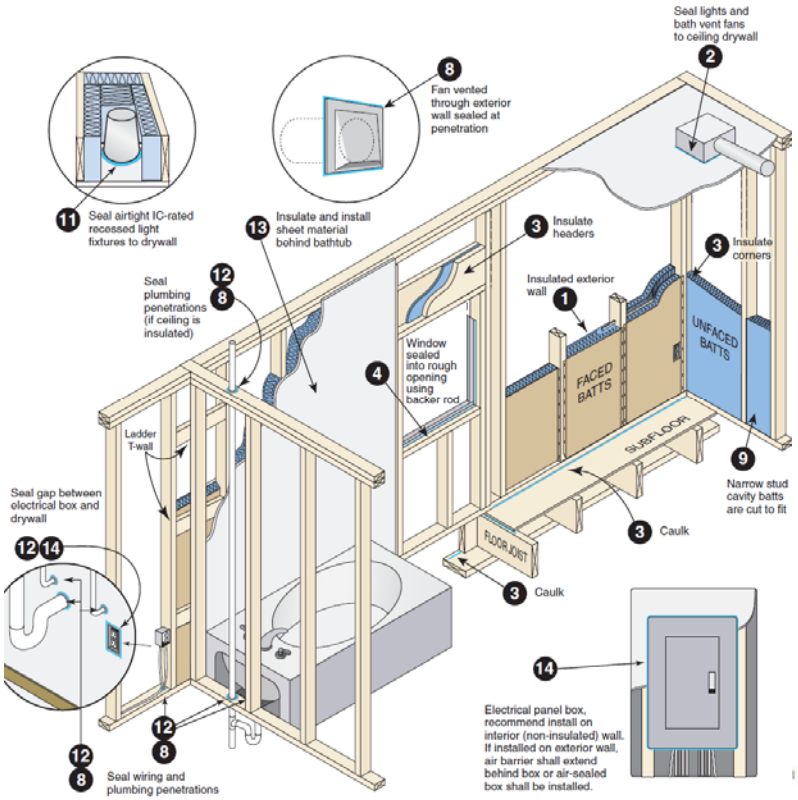
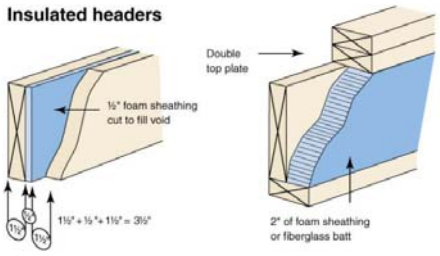
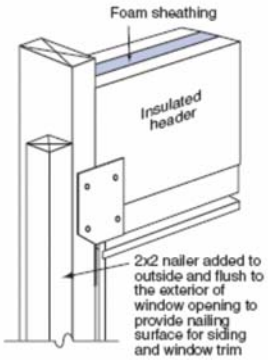
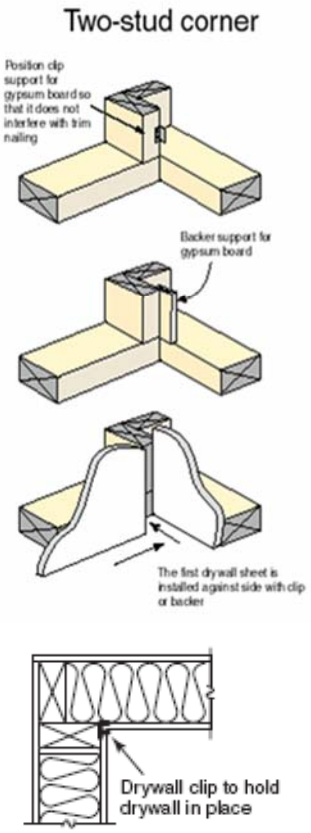
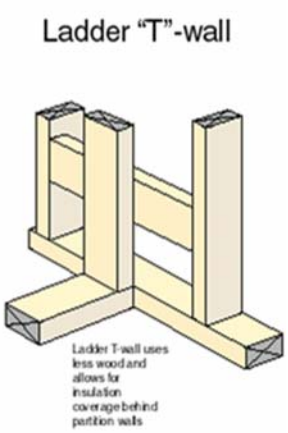


Advanced Framing



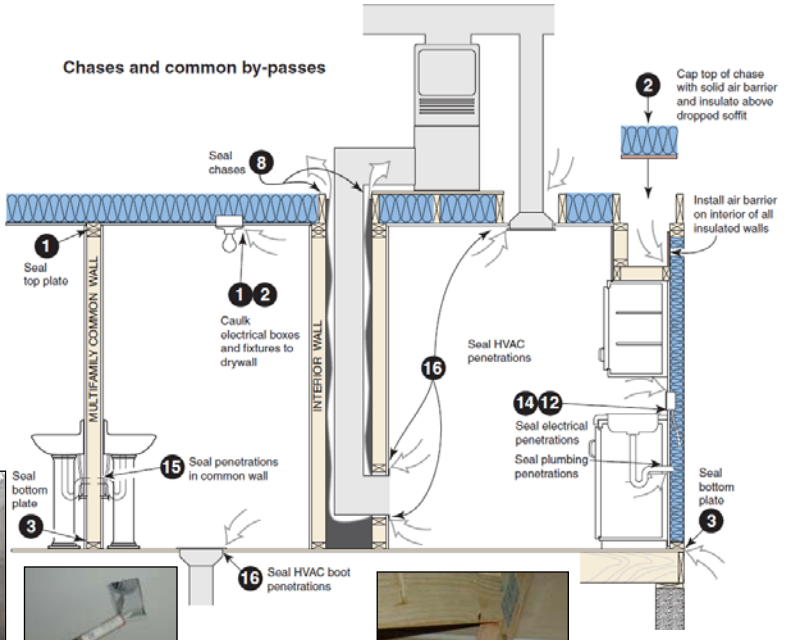






Air Sealing Chases (p. 3)

Southface



Air Sealing Blocking & Sheathing (p. 3)

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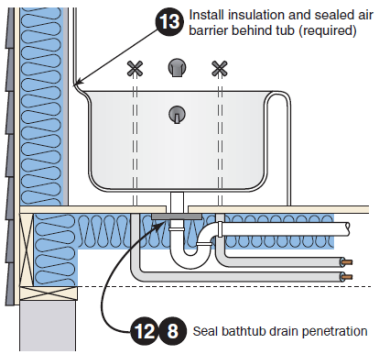
Solid sheet behind tubs & showers on insulated walls

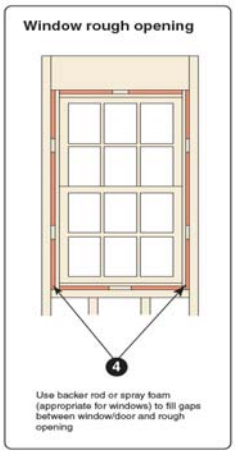


Call back waiting to occur

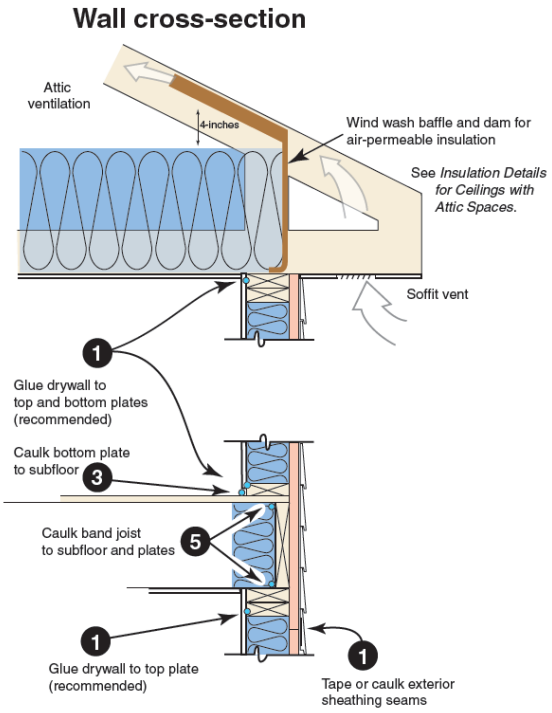
Call back prevention

Air Sealing Windows (p. 4)

Southface

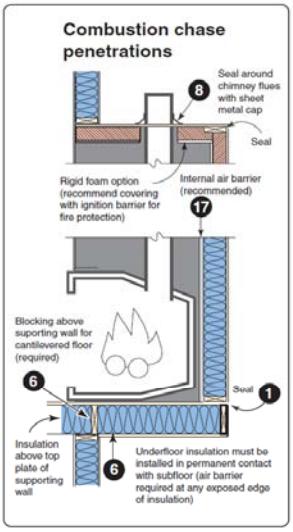


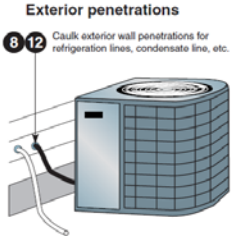
N1102.4.4- Windows, skylights and doors ≤ 0.3 cfm/s.f., Swinging doors ≤ 0.5 cfm/s.f. Exception: site built

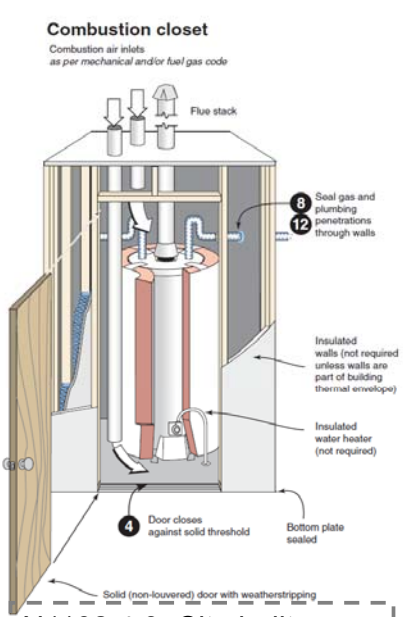


Air Sealing Combustion (p. 5)

Southface



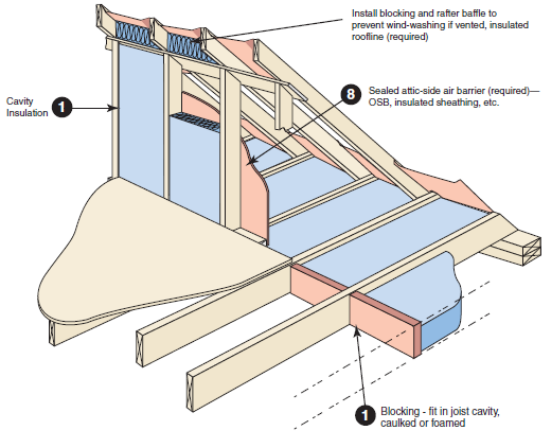




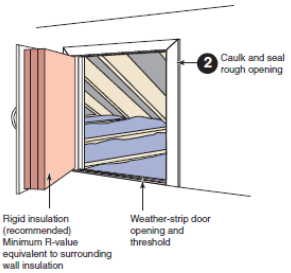
N1102.4.3- Site built masonry wood-burning fireplaces must have gasketed doors and outdoor combustion air

Air Sealing Kneewalls (p. 6)

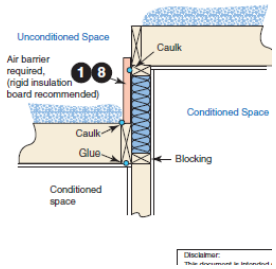
Southface



Attic knee-walls



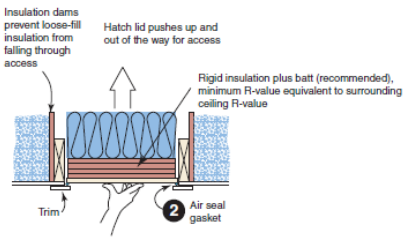
Two-level attic



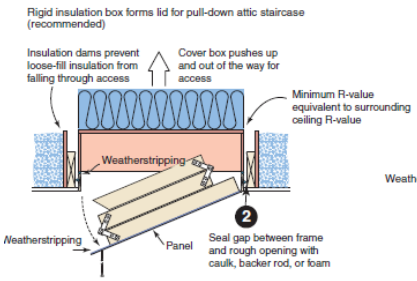
Air Sealing Attic Access (p. 7)

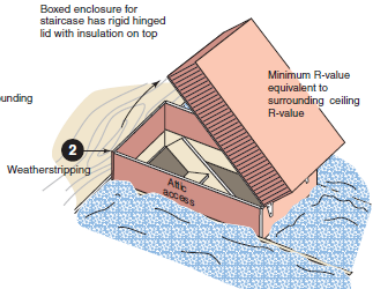
Southface

Attic scuttle



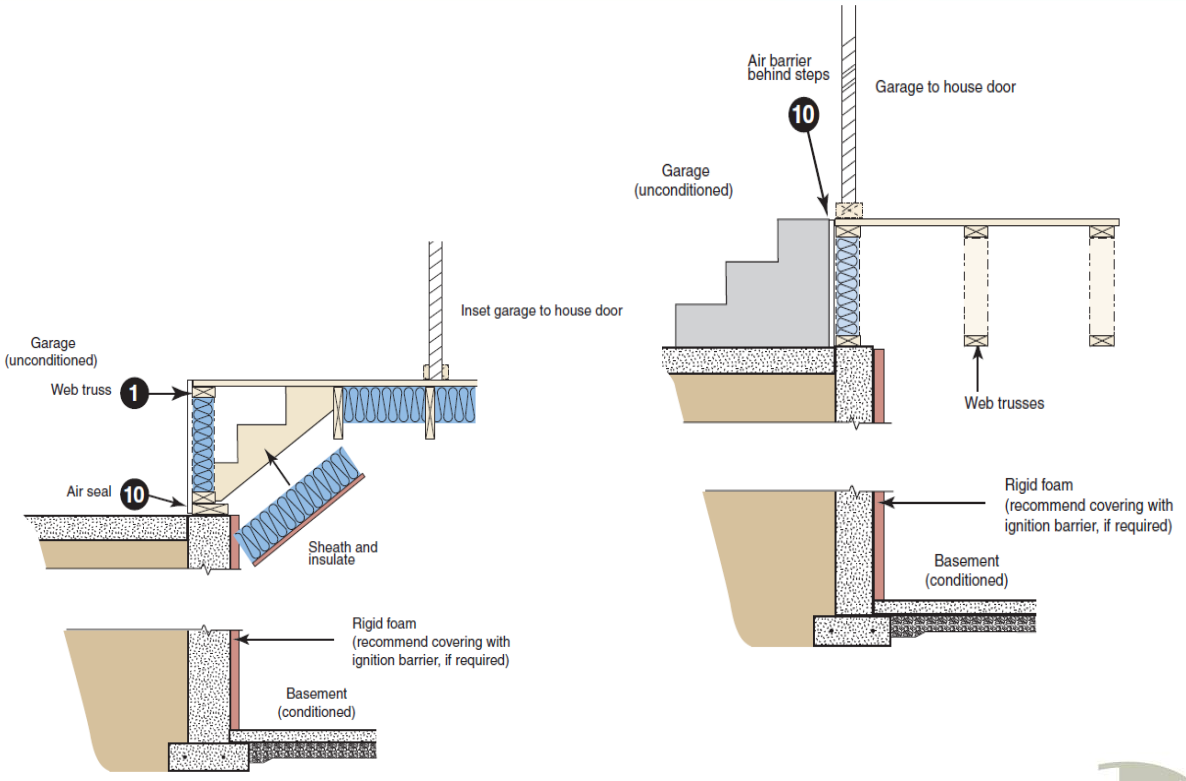
Attic pull-down stairs





Air Sealing Adjacent Garage

Southface



402.4.2.1 Envelope Tightness

Southface

- REQUIRED Blower Door test
  - CZ 1-2 Test out at less than **5 ACH_{50}**
  - CZ 3-8 Test out at less than **3 ACH_{50}**

$$ACH_{50} = \frac{CFM50 \times 60}{Volume}$$

403.5 Mechanical Ventilation

Southface

- Ventilation is REQUIRED
  - Any home tighter than **5 ACH_{50}**

- [Negative] Exhaust
  - (whole house exhaust systems)
- [Balanced] Air-in / Air-out
  - (HRV, ERV, multiple fans)
- [Positive] Pull/pump air into home
  - (ducted supply, return intake)

IRC Ventilation (based on ASHRAE 62.2 table)

Southface

TABLE M1507.3.3(1) CONTINUOUS WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM AIRFLOW RATE REQUIREMENTS

DWELLING UNIT FLOOR AREA (square feet)	NUMBER OF BEDROOMS				
	0 – 1	2 – 3	4 – 5	6 – 7	> 7
	Airflow in CFM				
< 1,500	30	45	60	75	90
1,501 – 3,000	45	60	75	90	105
3,001 – 4,500	60	75	90	105	120
4,501 – 6,000	75	90	105	120	135
6,001 – 7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

Note:
IECC 2012 does ***not*** include ASHRAE 62.2 details & formula:

(#BR+1) x 7.5 cfm
+ 1 cfm / 100 s.f.

(Suggest state amendment with 62.2 as alternative approach)

For SI: 1 square foot = 0.0929 m^2, 1 cubic foot per minute = 0.0004719 m^3/s.

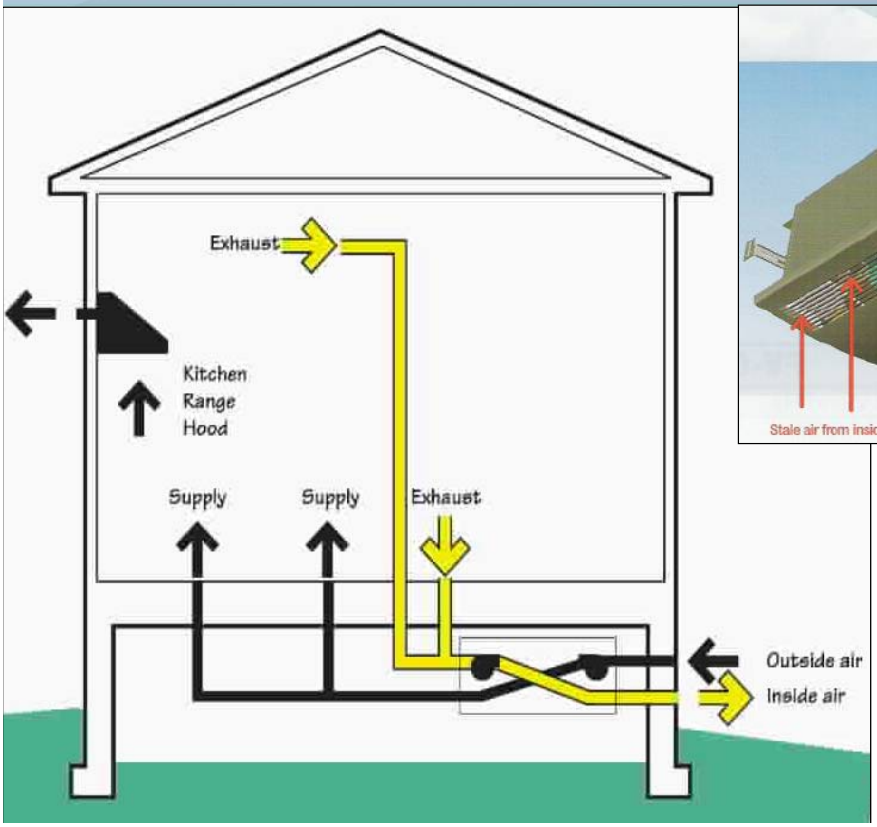
TABLE M1507.3.3(2) INTERMITTENT WHOLE-HOUSE MECHANICAL VENTILATION RATE FACTORS[a, b]

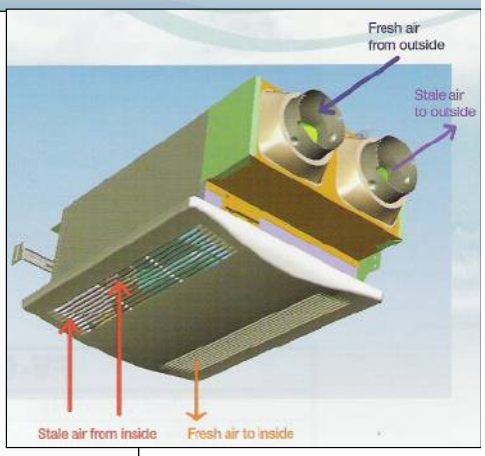
RUN-TIME PERCENTAGE IN EACH 4-HOUR SEGMENT	25%	33%	50%	66%	75%	100%
Factor[a]	4	3	2	1.5	1.3	1.0

a. For ventilation system run time values between those given, the factors are permitted to be determined by interpolation.
b. Extrapolation beyond the table is prohibited.

Balanced Ventilation

Southface

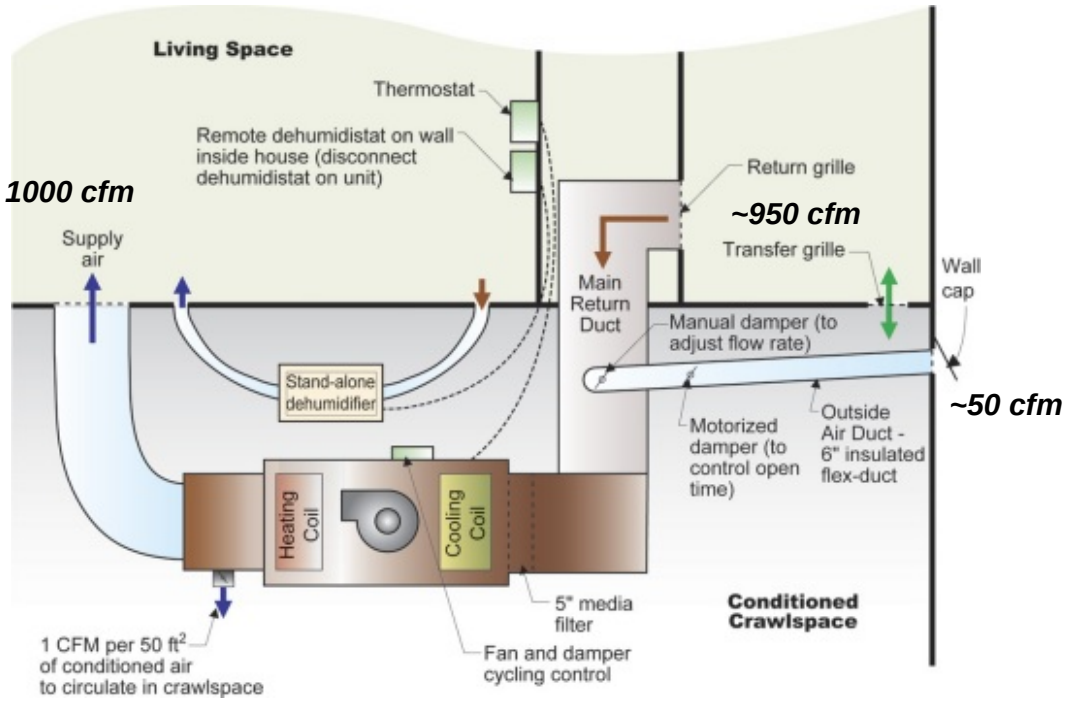




ERV - energy recovery ventilator

Positive Ventilation

Southface



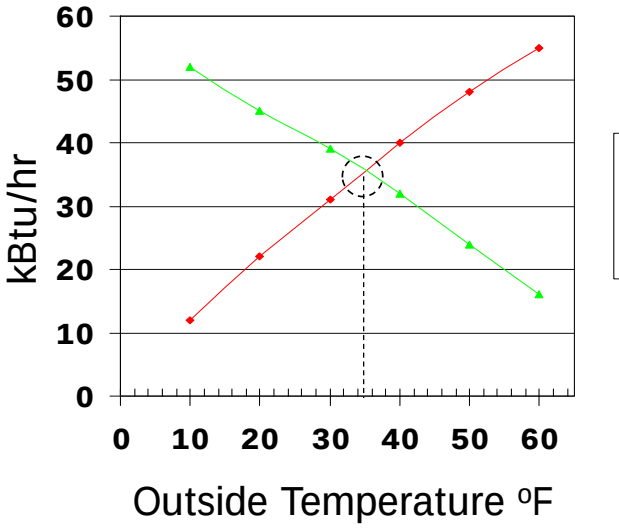
Positive Ventilation Supplied via O.A. Ducted to Return

Section 403.1 - HVAC Controls

Southface

Mandatory Requirement:

- **Programmable** thermostat required for furnace
- Heat Pump requires smart thermostat / lockout feature to prevent unnecessary strip heat



403.2.2. Duct Tightness Testing

Southface

- Duct Tightness Testing REQUIRED (by **DET Verifier?)**
  - When tested at rough-in
    - Maximum 4% Total Leakage with AHU installed (RIT)
    - Maximum 3% Total Leakage without AHU installed (RITnah)
  - When tested at final
    - Maximum 4% Total Leakage (PCT)

Note: Blower Door and Duct Leakage test results **MUST be displayed on Certificate!** (but code provides no other detail on this)

403.2 - Ducts

Southface

Mandatory Requirement:

- Insulation:
  - R-8 Insulation in Attic
  - R-6 Insulation other unconditioned space
  - No Insulation required when inside envelope
- May not use building cavities as supply or return
- **Sealing with Mastic required – "thick as a nickel" (GA specific)**

403.3&4 Piping Insulation & SWH

Southface

- Pipe Insulation
  - R-3: long list of new applications, must be weather proof
  - mechanical systems – fluids > 105 F or < 55 F
- Controls for plumbing circulating systems

403.5 Ventilation

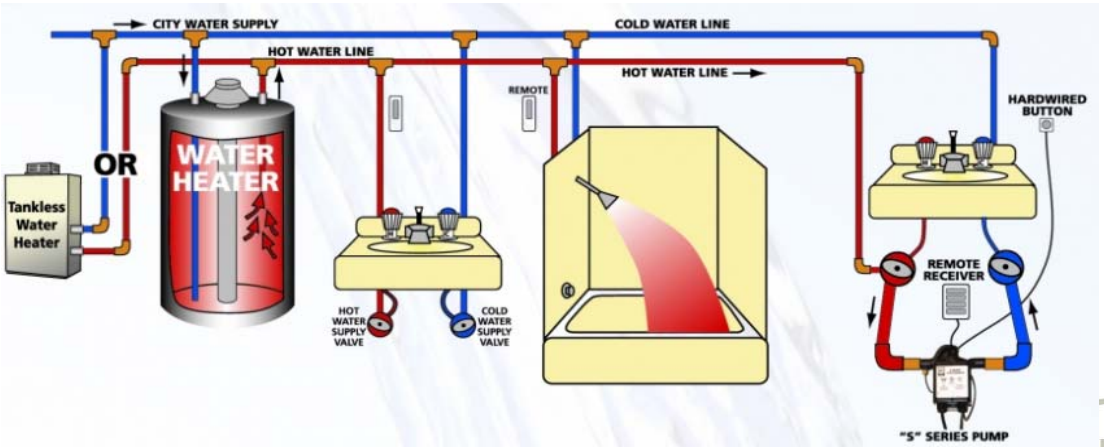
Southface

- Whole house ventilation system required
  - meet IMC or IRC
  - minimum efficacy
- Mechanical Vents
  - require dampers

403.4 Hot Water Distribution

Southface

- Circulating system controls (prefer *on-demand* with button or motion activated)-(Mandatory)
- Pipe insulation -(Prescriptive)



403.6 Equipment Sizing

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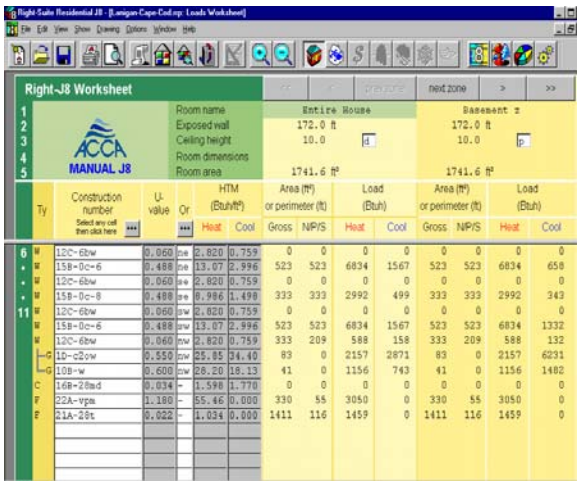
- Load Calcs & Sizing
  - –Per Mechanical section of IRC
  - –ACCA Manual J or approved equivalent, i.e., ASHRAE Fundamentals
  - –MUST BE ACCURATE
  - –Permits 72 and 75 as indoor design temps



M1401.3 Sizing. Heating and cooling *equipment* shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies.

403.8 Snow melt system controls

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Snow melt system controls:

- Automatic controls that can shut system down when pavement temperature is above 50°F and it is not snowing/raining; or
- Automatic or manual control that can shut system down when outdoor temp is above 40°F

403.9 Pools

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403.9.1 Pool heaters

- Readily accessible on-off switch
- Natural gas or LPG fired pool heaters will not have continuously burning pilot lights

403.9.2 Time switches

- Automatic controls required to operate pool heaters and pumps on a preset schedule
- Exceptions
  - Where public health standards require 24 hour operation
  - Where pumps are required to operate solar and waste heat recovery pool heating systems

403.9.3 Pool Covers

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- Heated pools required to have a pool cover
  - Pool cover must be vapor retardant
- Exception
  - Pools deriving > 70% energy for heating from site-recovered energy (heat pump) or solar source

Lighting – Section 404

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- Residential
  - 75% of lamps in permanently installed fixtures shall be high efficacy lamps
    - 60 lumens per watt if over 40 W
    - 50 lumens per watt if between 40 and 15 W
    - 40 lumens per watt if 15 W less

- *Check out smart planet – "nano bulb"*

Compliance Paths for Insulation & Windows

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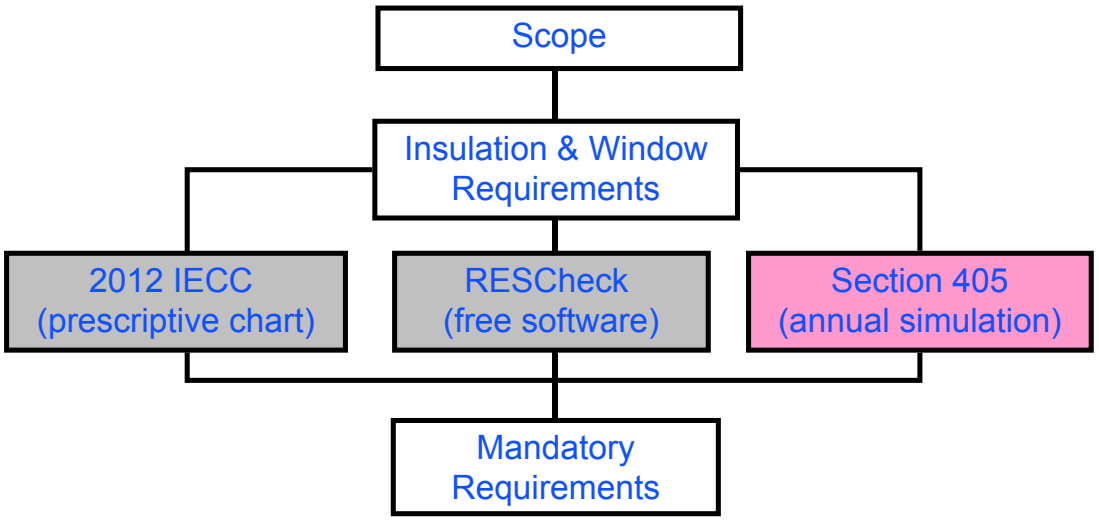

IECC 2009 – Section 406

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Simulated Performance Alternative

- Annual energy usage simulation demonstrates that the proposed building's *energy costs* are ≤ "standard code" building
- Likely to involve a HERS rater
- REMrate, Energy Gauge, etc.
- Allow more flexibility (SHGC, duct R-value, etc.)
- More valuable due to stricter code

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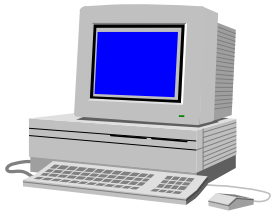

Duct and Envelope Tightness (DET) Verifier

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Certified DET Verifier can either:

- Be previously certified
  - HERS Rater
  - BPI Analyst
- Pass a DET Verifier Course
  - Explain calculations for ACH50 and % duct leakage
  - Discuss testing protocol (setup, safety, and accuracy)
  - Field exam on tools (use blower door and duct tester)
  - Pass Written Exam – 25 Questions (1 hour)

CERTIFIED DUCT AND ENVELOPE TIGHTNESS (DET) VERIFIER. A certified DET verifier shall be a certified Home Energy Rating Systems (HERS) rater, or be a certified Home Performance with ENERGY STAR contractor, or be a Building Performance Institute (BPI) Analyst, or successfully complete a certified DET verifier course that is approved by the Georgia Department of Community Affairs.
(Effective January 1, 2011)

DET Verifier Study

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Draft of white paper for Thermal XII Conference about DET Verifier program

(available from southface.org)

Meeting the Residential Performance Testing Requirements of the 2012 IECC: A Case Study for States to Ensure Code Adoption and Compliance Using Duct and Envelope Tightness (DET) Verifiers

An Overview of Lessons Learned Plus Recommendations

Mike Barcik
ASHRAE Member since 1987

ABSTRACT

The 2012 International Energy Conservation Code (IECC) requires new homes and major renovations to have a pressure test of the building envelope and duct systems that are located outside of the thermal envelope. Testing is vital as leaky homes and ductwork often represent major sources of energy waste in homes. Many states will likely adopt the 2012 IECC over the next few years. However, many states currently lack the capacity to meet the testing requirements mandated by the 2012 IECC. To ensure code adoption and compliance, it is critical that states build lasting infrastructure to offer testing services and that these services be available at a competitive price. If not, there could be a serious threat of a backlash against the testing provisions of the 2012 IECC, or perhaps, the entire code.

In 2011, Georgia implemented a building energy code that requires duct and building envelope leakage testing (DET) and addresses performance testing issues left unresolved by the IECC such as who is qualified to perform the required testing, where should the testing results be recorded, how do the testing requirements apply to upgrades and renovations to existing homes and duct systems, should there be special considerations for multifamily buildings (e.g., sampling), and what is an acceptable and effective duct sealant. This case study addresses key issues such as the appropriate experience and training required for DET professionals, acceptance of existing national testing certifications and effective outreach strategies to recruit and train DET professionals.

INTRODUCTION

The U.S. Department of Energy has identified air leakage in building envelopes and duct systems as major

DET Verifier Study

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Table 1: Duct and Envelope Tightness Requirements

Issue	2009 IECC	2011 GA Energy Code	2012 IECC
Envelope Testing – Single Family	Optional: Blower door (BD) test or Visual Inspection checklist	Mandatory BD test with optional Visual Inspection checklist	Mandatory BD test and Visual Inspection checklist
Envelope Testing – Multifamily	Optional: BD test or Visual Inspection checklist	Optional – Visual Inspection or BD test. Sampling 1 in 4 units per floor permitted or RESNET protocol	Mandatory BD test (no mention of sampling)
Envelope passing criteria	< 7 ACH_{50} all Climate Zones (CZ)	< 7 ACH_{50} all CZ (2-4)	≤ 3 ACH_{50} in CZ 3-8 ≤ 5 ACH_{50} in CZ 1-2
Clarify if envelope test required on alteration or renovation	No guidance	"When construction affects all aspects of building envelope (gut renovation)	No guidance
Duct Testing criteria at Rough-in (RI) (Total)	4% - RI Total no Air Handler 6% - RI Total w/ Air Handler	6% - RI Total w/ Air Handler	3% - RI Total no Air Handler 4% - RI Total w/ Air Handler
Duct Testing criteria at Post Construction—Post Construction Total (PCT) or Post Construction to Outside (PCO)	12% - PCT 8% - PCO	12% - PCT 8% - PCO	4% PC (no incentive for testing at final or To Outside)

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Table 1: Duct and Envelope Tightness Requirements

Issue	2009 IECC	2011 GA Energy Code	2012 IECC
Record /Display Test Results	Not required	On Energy Code certificate – template provided	On Energy Code certificate – no specifics on what to provide
Exempt from Duct Testing	Ducts and Air Handler Unit (AHU) entirely inside building Thermal Envelope	Ducts and AHU entirely inside building Thermal Envelope	Ducts and AHU entirely inside building Thermal Envelope
Duct pressure test required when modifying an existing system	No guidance	When > 50% of existing duct system is modified. When AHU is changed out, test is not required but duct sealing with mastic through plenum connections is required	No guidance
Building cavities allowed as ducts	Only for returns	Not allowed for supply or returns	Not allowed for supply or returns
Duct sealing material	UL tape, mastic, etc.	No UL tape, only mastic and mastic tape	UL tape, mastic, etc.
Qualified testers	No guidance	DET verifiers and RESNET and BPI certified professionals	No guidance

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Four Companies Surveyed around Georgia:

- Company A – metro Atlanta -CZ3A (944 homes)
  - 595 minimum code / 349 beyond code single family
- Company B – southeast -CZ2A & 3A (77 dwellings)
  - 3 multifamily developments – all in beyond code program
- Company C – southern -CZ2A (22 homes)
  - 19 minimum code / 3 beyond code single family
- Company D – northern -CZ4A (55 homes)
  - All minimum code single family

DET Verifier Study

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Some key results and conclusions:

- 2009 energy code requirements can be met
  - Fairly modest effort and should pass
- Beyond Code programs work
  - Results consistently exceeded code minimum
- Companies that performed additional services achieved higher performance
  - Air sealing
- Energy code enforcement matters
  - Homes and ducts that did pass were only barely passing
  - Houses that did not pass were still granted C.O. and thus did not follow up on testing requirements
- Spray foam houses performed well
- Prefer ELR_{50} over ACH_{50}
- Sampling Protocol for MF (test every SF home)

Wrap up and Q&A

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Thank you!

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Photo: Jonathan Hillyer, 2009

Unique to Georgia

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Ways we have made the code better

1. Improved Kneewalls
2. Consistent Windows
3. Air Sealing Graphics
4. Minimum Insulation Thresholds
5. Lighting Vacancy Sensor Credit
6. Better Ducts - Require Mastic
7. No Electric Furnaces
8. No Powered Attic Ventilators (except solar powered)
9. Mandatory Blower Door and Duct Blaster test
10. Qualifications of Verifiers– (who can do testing)