Energy Codes: 
IECC 2009 & IECC 2012
What Are The Big Changes?

Mike Barcik
Southface
About Southface

- Training
- Green Building: EarthCraft, LEED
- Building Audits & Assessments
- Charrettes
- Sustainability Planning
- Affordable Housing
- Modeling
- Code Education & Advocacy
Greenprints Conference 2012

Green Building Conference
March 7-8, 2012
Georgia Tech Research Institute
Atlanta, Georgia

Save the Date
March 7-8, 2012
Importance of Energy Codes

• **Saves energy** - Buildings consume 40% of energy in U.S.; energy codes reduce dependence on foreign energy sources

• **Saves money** - energy costs continue to escalate and energy codes help keep money within local economy

• **Additional benefits:**
  - Increases comfort, health and durability of homes
  - Increases value of homes in local community
  - Reduces liability for builder and subcontractors
History of Energy Codes

- **MEC 1992, ’93, 95** – “Early” energy codes, complicated, DP windows required
- **IECC 98, 2000, ‘03** – “Strengthening”, SHGC of 0.4 required where < 3500 HDD
- **IECC 2004, ‘06** – “Simplification”, Fewer CZ’s, eliminate % glazing, certificate required
- **IECC 2009** – Duct + envelope testing, efficient lighting – ARRA “mandated”
- **IECC 2012** – More challenging than ever!

The code keeps raising the bar (typically 1-3%) until more recently!
- ‘09 Code is ~15% more stringent than ‘06 version
- ‘12 Code is ~30% more stringent than ‘06 version
- ‘15 Code target is 50% > than ‘06 version
IECC: 2012 vs. 2009

Summary of Changes to IECC 2012

- ~30% better than IECC 2006
- Major changes
  - Consolidated with IRC energy chapter (actually a change to the IRC, not the IECC)
  - Mandatory whole-house pressure test
  - More stringent duct leakage test
  - DHW distribution system requirements
- Minor changes
- Key non-changes
  - Retains prohibition on envelope-equipment trade-offs
  - Makes lighting requirements “mandatory”
Structure of 2012 IECC

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
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**

- Attic
- Conditioned space
- Garage
- Basement/vented crawlspace

**Example 2**

- Attic
- Vaulted conditioned space
- Garage
- Conditioned space
- basement (conditioned or indirectly-conditioned)
- Important air sealing location

**Example 3**

- Indirectly-conditioned space
- Conditioned space
- Garage
- Indirectly-conditioned crawlspace
IECC Climate Zones

All of Alaska in Zone 7 except for the following Boroughs in Zone 8:
- Bethel
- Dillingham
- Fairbanks North Star
- Nome
- North Slope

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands
Energy Code Compliance Pathways

Scope

Insulation & Window Requirements

- 2009 + 2012 IECC (prescriptive chart)
- RESCheck (free software)
- Section 405 (annual simulation)

Mandatory Requirements
Prescriptive Code: Insulation & Fenestration by Climate Zone

Table 402.1.1
Insulation and Fenestration Requirements by Component

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT WALL R-VALUE</th>
<th>SLAB R-VALUE &amp; DEPTH</th>
<th>CRAWL SPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.20</td>
<td>0.75</td>
<td>0.30</td>
<td>30</td>
<td>13</td>
<td>3 / 4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.65\textsuperscript{j}</td>
<td>0.75</td>
<td>0.30</td>
<td>30</td>
<td>13</td>
<td>4 / 6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>3</td>
<td>0.50\textsuperscript{j}</td>
<td>0.65</td>
<td>0.30</td>
<td>30</td>
<td>13</td>
<td>5 / 8</td>
<td>19</td>
<td>5 / 13\textsuperscript{j}</td>
<td>0</td>
<td>5 / 13</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.35</td>
<td>0.60</td>
<td>NR</td>
<td>38</td>
<td>13</td>
<td>5 / 10</td>
<td>19</td>
<td>10 / 13</td>
<td>10, 2ft</td>
<td>10 / 13</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.35</td>
<td>0.60</td>
<td>NR</td>
<td>38</td>
<td>20 or 13+5\textsuperscript{h}</td>
<td>13 / 17</td>
<td>30\textsuperscript{g}</td>
<td>10 / 13</td>
<td>10, 2 ft</td>
<td>10 / 13</td>
</tr>
<tr>
<td>6</td>
<td>0.35</td>
<td>0.60</td>
<td>NR</td>
<td>49</td>
<td>19 or 13+5\textsuperscript{h}</td>
<td>15 / 19</td>
<td>30\textsuperscript{g}</td>
<td>15 / 19</td>
<td>10, 4 ft</td>
<td>10 / 13</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.35</td>
<td>0.60</td>
<td>NR</td>
<td>49</td>
<td>21</td>
<td>19 / 21</td>
<td>38\textsuperscript{g}</td>
<td>15 / 19</td>
<td>10, 4 ft</td>
<td>10 / 13</td>
</tr>
</tbody>
</table>

\textsuperscript{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.

\textsuperscript{b} The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

\textsuperscript{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.

\textsuperscript{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.

\textsuperscript{e} There are no SHGC requirements in the Marine Zone.

\textsuperscript{f} Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.

\textsuperscript{g} Or insulation sufficient to fill the framing cavity, R-19 minimum.

\textsuperscript{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.

\textsuperscript{i} The second R-value applies when more than half the insulation is on the interior of the mass wall.

\textsuperscript{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

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT WALL R-VALUE</th>
<th>SLAB R-VALUE &amp; DEPTH</th>
<th>CRAWL SPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+5h</td>
<td>8/13</td>
<td>19</td>
<td>5/13f</td>
<td>0</td>
<td>5/13</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.35</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5h</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10, 2 ft</td>
<td>10/13</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5h</td>
<td>8/13</td>
<td>19</td>
<td>15/19</td>
<td>10, 2 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10h</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10h</td>
<td>19/21</td>
<td>38</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
</tbody>
</table>

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

#### TABLE R402.1.1

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR&lt;sup&gt;b&lt;/sup&gt;</th>
<th>SKYLIGHT&lt;sup&gt;b&lt;/sup&gt; U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC&lt;sup&gt;b,h&lt;/sup&gt;</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.35</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>b</sup> 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.
# Steel Framing – R402.2.6

## Table R402.2.6

<table>
<thead>
<tr>
<th>Wood Frame R-Value Requirement</th>
<th>Cold-Formed Steel Equivalent R-Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel Truss Ceilings</strong></td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 or R-30 + 3 or R-26 + 5</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 or R-38 + 3</td>
</tr>
<tr>
<td>R-49</td>
<td>R-38 + 5</td>
</tr>
<tr>
<td><strong>Steel Joist Ceilings</strong></td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 in 2 x 4 or 2 x 6 or 2 x 8 R-49</td>
</tr>
<tr>
<td></td>
<td>in any framing</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 in 2 x 4 or 2 x 6 or 2 x 8 or 2 x 10</td>
</tr>
<tr>
<td><strong>Steel-Framed Wall 16” O.C.</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5</td>
</tr>
<tr>
<td>R-20 + 5</td>
<td>R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7</td>
</tr>
<tr>
<td><strong>Steel Framed Wall 24” O.C.</strong></td>
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</tr>
<tr>
<td>R-13</td>
<td>R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9</td>
</tr>
<tr>
<td>R-20 + 5</td>
<td>R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9</td>
</tr>
<tr>
<td><strong>Steel Joist Floor</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-19 in 2 x 6, or R-19 + 6 in 2 x 8 or 2 x 10</td>
</tr>
<tr>
<td>R-19</td>
<td>R-19 + 6 in 2 x 6, or R-19 + 12 in 2 x 8 or 2 x 10</td>
</tr>
</tbody>
</table>

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*a* Cavity insulation R-value is listed first, followed by continuous insulation R-value.

*b* Insulation exceeding the height of the framing shall cover the framing.
Mass Walls – R402.2.5

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR b</th>
<th>SKYLIGHT b U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC b,c</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
</tr>
<tr>
<td>3</td>
<td>0.25</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>13 or 13+5 h</td>
<td>8/13</td>
</tr>
<tr>
<td>4 except Marine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 and 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Second (higher) number applies when more than half the R-value is on the interior of the mass (i.e., when the thermal mass is insulated from the conditioned space)
## Foundation Walls

<table>
<thead>
<tr>
<th>Zone</th>
<th>Basement Wall R-Value</th>
<th>Crawlspace Wall R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 except Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>R10/13 → R15/19</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>R10/13 → R15/19</td>
</tr>
<tr>
<td>7 &amp; 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Prescriptive Code: Major Shell Changes

<table>
<thead>
<tr>
<th>Zone</th>
<th>Ceiling R-Value</th>
<th>Wood-Frame Wall R-Value</th>
<th>Mass Wall R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>R30 → R38</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>R30 → R38</td>
<td>R13 → R20/R13+5</td>
<td>R5/8 → R8/13</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>R38 → R49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>R20/R13+5 → R20+5/R13+10</td>
<td>R15/19 → R15/20</td>
</tr>
<tr>
<td>7 &amp; 8</td>
<td></td>
<td>R21 → R20+5/R13+10</td>
<td></td>
</tr>
</tbody>
</table>
IECC 2012 Wall Impacts

• 2x6 construction now “required” in some zones
  – Envelope trade-off options limited
  – Equipment trade-off options prohibited

• Log walls difficult to comply without large diameter logs or furred-in finish layer

• Insulating sheathing now “required” in some zones
  – Bracing options limited, especially with recent IRC changes
### Prescriptive Code: Fenestration Changes

<table>
<thead>
<tr>
<th>Zone</th>
<th>Fenestration U-Factor</th>
<th>Fenestration SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1.2 \rightarrow 0.50$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$0.65 \rightarrow 0.40$ (0.75 → 0.65 skylights)</td>
<td>$0.30 \rightarrow 0.25$ (except skylights)</td>
</tr>
<tr>
<td>3</td>
<td>$0.50 \rightarrow 0.35$ (0.65 → 0.55 skylights)</td>
<td></td>
</tr>
<tr>
<td>4 except Marine</td>
<td>(0.60 → 0.55 skylights)</td>
<td>$NR \rightarrow 0.40$</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$0.35 \rightarrow 0.32$ (0.60 → 0.55 skylights)</td>
<td></td>
</tr>
<tr>
<td>7 &amp; 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Compliance Paths for Insulation & Windows

Scope

Insulation & Window Requirements

- 2012 IECC (prescriptive chart)
- UA Trade-off (RESCheck)
- Section 405 (annual simulation)

Mandatory Requirements
REScheck™ Software
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

- Vaulted ceilings and foam sprayed rooflines would likely need to perform an R-value (U-factor) trade-off
- RESCheck is an excellent free tool for this
- Still must satisfy all mandatory requirements
Section 402.2: Insulation Requirements

- 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

- 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.
  - GA: R-19 acceptable under HVAC attic platforms (32 s.f./platform + 32” walkway)
402.2.1 - Ceilings with Attics

- Tradeoff required unless entire ceiling meets prescriptive R-value (exception for 402.2)
402.2.2 - Ceilings without Attics

- 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

• 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.
402.2.3 Eave baffle details

Standard rafter and top plate with tapered insulation depth

Rafter on raised top plate with full height insulation (recommended)
402.2.4 – Access hatches & doors

- Weather-strip and insulate access doors to match surrounding R-value
  - Vertical doors
  - Pull-down stairs
  - Hatches/scuttle holes
  - Insulation dam
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

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

402.2.7 – Floors

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

- 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

Insulation strategies for non-finished basements:

- Cellulose batt
- Fiberglass batt w/ vinyl backing
- Rigid foam board

Images of installation methods:

- Hand applying cellulose batt
- View of basement with insulated walls
- Close-up of rigid foam board installation
402.2.9 Slabs

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

Standard vented crawlspace - underfloor insulation

Closed crawlspace with wall insulation

Closed crawlspace underfloor insulation

• **Note**: all crawspaces must meet vapor retarder requirements, as per IRC
Closed Crawlspaces

- 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. As an alternative to insulating floors over crawls spaces, crawls space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawlspace 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 crawlspace 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.
Reality of Underfloor Insulation
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

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

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

- **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 $\leq 0.25$ (or 0.4 for CZ4)
  2. Perform RESCheck weighted average trade-off
402.3 Fenestration Requirements

• 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

If not NFRC labeled, must use tables 302.1.3 to assign a default SHGC and U-Factor.

**Example:** vinyl-clad wood window

<table>
<thead>
<tr>
<th>Frame Type</th>
<th>Single Pane</th>
<th>Double Pane</th>
<th>Skylight Single</th>
<th>Skylight Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>1.20</td>
<td>0.80</td>
<td>2.00</td>
<td>1.30</td>
</tr>
<tr>
<td>Metal with Thermal Break</td>
<td>1.10</td>
<td>0.65</td>
<td>1.90</td>
<td>1.10</td>
</tr>
<tr>
<td>Nonmetal or Metal Clad</td>
<td>0.95</td>
<td>0.55</td>
<td>1.75</td>
<td>1.05</td>
</tr>
<tr>
<td>Glazed Block</td>
<td></td>
<td></td>
<td>0.60</td>
<td></td>
</tr>
</tbody>
</table>

**Table 303.1.3(3)**

<table>
<thead>
<tr>
<th>Single Glazed</th>
<th>Tinted</th>
<th>Clear</th>
<th>Tinted</th>
<th>Clear</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

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

- 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)
Scope

Insulation & Window Requirements

2009 IECC (prescriptive chart)

UA Trade-off Approach

Section 405 (annual simulation)

Mandatory Requirements
Mandatory Requirement:
Certificate on panel box with:

- Major Component R-values
- U-factor, SHGC of Windows
- Equipment Efficiencies
- GA Specific: Load Calculations and Envelope and Duct Testing Results
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:
402.4 Air Leakage

• Mandatory Requirement: Air Sealing
  – Detailed list
  – Fenestration
  – Fireplaces
  – Recessed light fixtures: airtight, IC-rated

• Details on techniques for air sealing – in flip book format
402.4.3 Wood Burning Fireplaces

• New *wood-burning fireplaces shall have gasketed doors and outdoor combustion air
  *
  *masonry site-built
# 402.4.1.1 Air Barrier and Insulation Inspection

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>COMPONENT</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air barrier and thermal barrier</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>Ceiling/attic</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>Walls</td>
<td>Corners and headers are insulated. Junction of foundation and sill plate is sealed.</td>
</tr>
<tr>
<td>4</td>
<td>Windows and doors</td>
<td>Space between window/door jambs and framing is sealed.</td>
</tr>
<tr>
<td>5</td>
<td>Rim joists</td>
<td>Rim joists are insulated and include an air barrier.</td>
</tr>
<tr>
<td>6</td>
<td>Floors (including above-garage and cantilevered floors)</td>
<td>Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.</td>
</tr>
<tr>
<td>7</td>
<td>Crawl space walls</td>
<td>Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.</td>
</tr>
<tr>
<td>8</td>
<td>Shafts, penetrations</td>
<td>Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.</td>
</tr>
<tr>
<td>9</td>
<td>Narrow cavities</td>
<td>Batt insulation in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.</td>
</tr>
<tr>
<td>10</td>
<td>Garage separation</td>
<td>Air sealing is provided between the garage and conditioned spaces.</td>
</tr>
<tr>
<td>11</td>
<td>Recessed lighting</td>
<td>Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception—fixtures in conditioned space.</td>
</tr>
<tr>
<td>12</td>
<td>Plumbing and wiring</td>
<td>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.</td>
</tr>
<tr>
<td>13</td>
<td>Shower/tub on exterior wall</td>
<td>Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.</td>
</tr>
<tr>
<td>14</td>
<td>Electrical/phone box on exterior walls</td>
<td>Air barrier extends behind boxes or air sealed-type boxes are installed.</td>
</tr>
<tr>
<td>15</td>
<td>Common wall</td>
<td>Air barrier is installed in common wall between dwelling units.</td>
</tr>
<tr>
<td>16</td>
<td>HVAC register boots</td>
<td>HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.</td>
</tr>
<tr>
<td>17</td>
<td>Fireplace</td>
<td>Fireplace walls include an air barrier.</td>
</tr>
</tbody>
</table>
GA Appendix A - Air Sealing General (p.18)

1. Insulate and install headers
2. Caulk
3. Insulate corners
4. Insulate window wall
5. Window sealed into rough opening using backer rod
6. Narrow stud cavity batts are cut to fit
7. Fan vented through exterior wall sealed at penetration
8. Seal plumbing penetrations (if ceiling is insulated)
9. Caulk
10. Insulate exterior wall
11. Seal airlight IC-rated recessed light fixtures to drywall
12. Seal gap between electrical box and drywall
13. Insulate and install sheet material behind bathtub
14. Electrical panel box, recommend install on interior (non-insulated) wall. If installed on exterior wall, air barrier shall extend behind box or air-sealed box shall be installed.
Chases and common by-passes

1. Seal top plate
2. Cap top of chase with solid air barrier and insulate above dropped soffit
3. Seal bottom plate
4. Seal penetrations in common wall
5. Seal chases
6. Seal HVAC penetrations
7. Seal electrical penetrations
8. Seal plumbing penetrations
9. Install air barrier on interior of all insulated walls
10. Seal penetrations
11. Seal HVAC boot penetrations
Solid sheet behind tubs & showers on insulated walls (p. 19)

Call back waiting to occur

Call back prevention
GA Appendix A - Air Sealing Kneewalls (p. 22)

- Install blocking and rafter baffle to prevent wind-washing if vented, insulated roofline (required)
- Sealed attic-side air barrier (required) - OSB, insulated sheathing, etc.
- Blocking - fit in joist cavity, caulked or foamed

Attic knee-walls

1. Caulk and seal rough opening
2. Rigid insulation (recommended)
   Minimum R-5 (Georgia requirement)
3. Weather-strip door opening and threshold

Two-level attic

1. Unconditioned Space
2. Conditioned Space
3. Air barrier required, rigid insulation board recommended
4. Attic kneewall requires R-18 insulation (Georgia requirement)
402.4.2.1 Envelope Tightness

- REQUIRED Blower Door test
  - CZ1-2 Test out at less than 5 $\text{ACH}_{50}$
  - CZ 3-8 Test out at less than 3 $\text{ACH}_{50}$

\[
\text{ACH}_{50} = \frac{\text{CFM50} \times 60}{\text{Volume}}
\]
Mandatory Requirement:

- **Programmable** thermostat required for furnace
- Heat Pump requires smart thermostat or lockout feature to prevent unnecessary strip heat
403.2.2. Duct Tightness Testing

• Duct Tightness Testing REQUIRED by DET Verifier
  – When tested at rough-in
    • Maximum 4% Total Leakage with AHU installed
  – When tested at final
    • Maximum 4% – Total Leakage

GA: Blower Door and Duct Leakage test results MUST be displayed on Certificate!
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)
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

• Whole house ventilation system required
  – meet IMC or IRC
  – minimum efficacy
• Mechanical Vents
  – require dampers
403.6 Equipment Sizing

- **Load Calcs & Sizing**

<table>
<thead>
<tr>
<th>Room name</th>
<th>Exposed wall</th>
<th>Ceiling height</th>
<th>Room dimensions</th>
<th>Room area</th>
<th>Entire House</th>
<th>Basement 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1741.6 ft²</td>
<td>1741.6 ft²</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ty</th>
<th>Construction number</th>
<th>U. value</th>
<th>HTM (Btu/h)</th>
<th>Area (ft²)</th>
<th>Load (Btu)</th>
<th>Area (ft²)</th>
<th>Load (Btu)</th>
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</thead>
<tbody>
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</tr>
<tr>
<td>6</td>
<td>12C-6bw</td>
<td>0.060</td>
<td>2.820</td>
<td>8.759</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>6</td>
<td>15B-6c-6</td>
<td>0.498</td>
<td>13.07</td>
<td>2.996</td>
<td>523</td>
<td>523</td>
<td>684</td>
</tr>
<tr>
<td>6</td>
<td>12C-6bw</td>
<td>0.061</td>
<td>2.820</td>
<td>8.759</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>6</td>
<td>15B-6c-8</td>
<td>0.486</td>
<td>13.06</td>
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<td>2.820</td>
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<td>2.996</td>
<td>523</td>
<td>523</td>
<td>684</td>
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<td>0</td>
<td>0</td>
</tr>
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<tr>
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<td>523</td>
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<tr>
<td>6</td>
<td>12C-6bw</td>
<td>0.060</td>
<td>2.820</td>
<td>8.759</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>15B-6c-8</td>
<td>0.498</td>
<td>13.07</td>
<td>2.996</td>
<td>523</td>
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<td>684</td>
</tr>
<tr>
<td>6</td>
<td>12C-6bw</td>
<td>0.060</td>
<td>2.820</td>
<td>8.759</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>15B-6c-6</td>
<td>0.490</td>
<td>13.07</td>
<td>2.996</td>
<td>523</td>
<td>523</td>
<td>684</td>
</tr>
<tr>
<td>6</td>
<td>12C-6bw</td>
<td>0.060</td>
<td>2.820</td>
<td>8.759</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Notes:**
- Load Calcs & Sizing are crucial for determining the appropriate equipment size for HVAC systems.
- The table above provides a detailed breakdown of load calculations for different construction types and areas.

**Image:**
- An image of an HVAC unit is shown, indicating the practical application of load calculations in real-world scenarios.

---

**ACCA Manual J8**
- This manual is a widely recognized guide for HVAC equipment sizing.
403.9 Pools

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

- 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

• 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
Compliance Paths for Insulation & Windows

Scope

Insulation & Window Requirements

- 2012 IECC (prescriptive chart)
- RESCheck (free software)
- Section 405 (annual simulation)

Mandatory Requirements
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.)

www.resnet.us
Unique to Georgia

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)
Certified DET Verifier can either:

- **Be previously certified**
  - HERS Rater
  - BPI Analyst
  - Home Performance with ENERGY STAR contractor

- **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)
Wrap up and Q&A

Thank you!

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