SOUTHWEST ENERGY CODES CONFERENCE

This is how we do it! Getting to 3ACH50 and other 2012 IECC Requirements
2015 IECC – Intent

- This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building.
2015 IECC – Intent

- This code is intended to **provide flexibility** to permit innovative approaches and techniques to achieve this objective.
2015 IECC – Intent

- The code is **not intended** to **abridge safety, health or environmental requirements** contained in other applicable codes or ordinances.
Simulated Performance Path

- Leverages the applied building science and systems thinking that is built into the code.
- Holistic approach rather than a component approach.
  - Air Flow
  - Thermal Flow
  - Moisture Flow
Simulated Performance Path

- This is where the flexibility in the intent of the code lies
Simulated Performance Path

- **R405.2 Mandatory Requirements**
  - Compliance with this section requires that the mandatory provisions identified in section R401.2 be met.
R405.3 Performance-based compliance

- Energy Analysis
  - A method of performing whole house performance energy trade offs
    - Conduction - Trading off R-values and U-values
    - Convection – Energy moving with air infiltration and exfiltration
    - Radiation – Trade offs created by energy moving form warm to cold
What is a Reference Design

- **Reference Design**
  - A standard set of house specifications that generate a specific level of quantifiable energy performance

- The concept Code uses to show compliance with the UA Trade Off (ResCheck) and the Simulated Performance Path

  The *Actual built* homes performance will be less than or equal to the performance of the code standard reference design

*The Standard reference design for code is the prescriptive path of compliance built in Table 402.1.3*
Twin Houses

2015 IECC reference design house vs. Builder’s desired house

- Geometric Twin
- 2015 IECC prescriptive envelope U-Values in (Table 402.1.3)
- Geometric Twin
- Envelope U-Values based on Builder’s Specification

For the UA trade off path:
The Builder’s house has the same or lower area weighted U-values then it meets the intent of code
This home MEETS the annual energy cost requirements and verifications of Section 405 of the 2012 International Energy Conservation Code based on a climate zone of 5B. In fact, this home surpasses the requirements by 14.4%.
Mandatory Code Requirements
402.4 Air Leakage and Air Barriers (Mandatory)

- The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

- The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer’s instructions and the criteria listed in Table R402.4.1.1.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>CRITERIA*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air barrier and thermal barrier</td>
<td>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.</td>
</tr>
<tr>
<td>Ceiling/attic</td>
<td>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.</td>
</tr>
<tr>
<td>Walls</td>
<td>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.</td>
</tr>
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</table>

**2015 IECC Table**

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>AIR BARRIER CRITERIA</th>
<th>INSULATION INSTALLATION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Requirements</td>
<td>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.</td>
<td>Air-permeable insulation shall not be used as a sealing material.</td>
</tr>
<tr>
<td>Ceiling / attic</td>
<td>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.</td>
<td>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</td>
</tr>
<tr>
<td>Air Barrier Criteria</td>
<td>Insulation Installation Criteria</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------</td>
<td></td>
</tr>
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<td>- A continuous air barrier shall be installed in the building envelope.</td>
<td>- Air-permeable insulation shall not be used as a sealing material.</td>
<td></td>
</tr>
<tr>
<td>- Exterior thermal envelope contains a continuous air barrier.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Breaks or joints in the air barrier shall be sealed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What / Where is the Thermal Envelope?

- Control
  - Air Flow
  - Moisture Flow
  - Thermal Flow
Two Functions of an Air Barrier

- **Interior vs. Exterior air barrier**
- **At its simplest form**
  - Interior drywall
  - Exterior sheathing
    - Drainage Plan
- **Function**
  - Insulation encapsulation
  - Air control
Insulation

Insulation traps pockets of air

Stagnate Air Pockets create the R-value

Air Barrier

Stopping the movement of air from scrubbing away the stagnate air pocket

Now it works
CONTROLLING THERMAL FLOW

Most insulation is NOT an air barrier

- Resists Conduction
  - Does not resist Air Flow:
    - That is the job of the air barrier

* An Air Barrier is any solid material that blocks air flow including sealing at edges and seams

What is the biggest insulation Myth: Insulation Stops the movement of air!
Section R202 General definitions

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

- **Continuous Air Barrier**
  - A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.
5 key Air Barriers Attributes

- **Continuity**: The most important element in 3D structures with so many different components

- **Impermeability**: The ABS must be impermeable to Air

- **Strength**: The ABS must be designed to transfer the full designed wind load and continue to be impermeable

- **Durability**: The ABS must continue to be impermeable throughout its service life

- **Stiffness**: The ABS must be stiff enough so that irregularities do not change its permeance
Air-permeable insulation shall not be used as a sealing material.
Table 402.4.1.1
Component – Ceiling / Attic

<table>
<thead>
<tr>
<th>Air Barrier Criteria</th>
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<tbody>
<tr>
<td>▪ The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed</td>
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<td>▪ Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed</td>
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<table>
<thead>
<tr>
<th>Insulation Installation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ The insulation in any dropped ceiling/soffit shall be aligned with the air barrier</td>
</tr>
</tbody>
</table>


Dropped Ceiling / Soffit
Full Air Barrier Aligned with Insulation
Table 402.4.1.1
Component – Walls

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<thead>
<tr>
<th>Air Barrier Criteria</th>
<th>Insulation Installation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ The junction of the foundation and sill plate shall be sealed</td>
<td>▪ Cavities within <strong>corners and headers of frame walls</strong> shall be insulated by completely filling the cavity with a material having a thermal resistance of R3 per inch minimum</td>
</tr>
<tr>
<td>▪ The junction of the top plate and top of exterior walls shall be sealed</td>
<td>▪ Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier</td>
</tr>
<tr>
<td>▪ Knee walls shall be sealed</td>
<td></td>
</tr>
</tbody>
</table>
Junction of foundation and sill plate is sealed
The junction of the top plate and top of exterior walls shall be sealed.
Attic Knee Walls
Doing it Right

1. Top plate
2. Bottom plate
3. Side Studs
4. Attic side sheathing
5. Interior drywall is the sixth side
Corners and Headers shall be Insulated

Wood backer

Drywall clip
Other wall assemblies

- Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
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<tr>
<th>Air Barrier Criteria</th>
<th>Insulation Installation Criteria</th>
</tr>
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<tbody>
<tr>
<td>Duct shafts, utility penetrations, fireplace chases and flue shafts opening to exterior or unconditioned space shall be sealed</td>
<td>In the 2015 IECC the Fireplace section was consolidated into this section</td>
</tr>
</tbody>
</table>
Shafts / Penetrations

Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.
Other Potential Problem Areas
Traps: Seal them!
Table 402.4.1.1
Component – Plumbing and Wiring

Air Barrier Criteria

Insulation Installation Criteria

- 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.
Plumbing and Wiring
Ducts in Garage Ceiling

**Code requirements**

- Insulation in complete contact with subfloor
- Insulation encapsulates duct
- IECC Table 402.1.1, footnote G
- **Minimum R-19 below duct**
### Table 402.4.1.1
Component – Shower/tub on exterior wall

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<thead>
<tr>
<th>Air Barrier Criteria</th>
<th>Insulation Installation Criteria</th>
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</thead>
<tbody>
<tr>
<td>The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs</td>
<td>Exterior walls adjacent to showers and tubs shall be insulated</td>
</tr>
</tbody>
</table>
Tubs and Showers
### Table 402.4.1.1
Component – Electrical/phone box on exterior walls

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<th>Air Barrier Criteria</th>
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<tbody>
<tr>
<td>▪ The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed</td>
<td></td>
</tr>
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</table>

- The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.
Electrical/phone box on exterior walls
Table 402.4.1.1
Component – HVAC Register boots

- HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.
### Table 402.4.1.1
Component – Fireplace

<table>
<thead>
<tr>
<th>Insulation Installation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>This section was moved in the 2015 IECC</td>
</tr>
<tr>
<td>An air barrier shall be installed on fireplace walls</td>
</tr>
<tr>
<td>Fireplaces shall have gasketed doors</td>
</tr>
</tbody>
</table>

- **Air Barrier Criteria**

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[Image of a fireplace installation in a building under construction]
Table 402.4.1.1
Component – Concealed Sprinklers

- When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.
Fire Sprinklers and air leakage?
Fire Sprinklers and Insulation
Fire Code and Energy Code

Not on the same page

- **2009 IECC**
  - Common wall: Air barrier is installed in common wall between dwelling units

- **2012 and 2015 IECC**
  - Not mentioned in the table
The Problem
Common wall between Dwelling Units taken out of the code table

- Energy Code and Fire Code are not in alignment
- Potential swapping of like materials
  - Fire rated foam for rock wool fire stop
  - Blown fiberglass for fiberglass batt
- Treat Common / Party Walls Like Exterior Walls and require all air sealing and air barriers adjacent to the assembly.
R402.4.1.2 Testing (Mandatory)

- The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding:
  - 5 ACH@50 in Climate Zones 1 and 2
  - 3 ACH@50 in Climate Zones 3 through 8

- Testing shall be conducted by an approved third party

- Reporting
Air leakage Testing

Air out = Air in

The principle behind the blower door
What is the Thermal Envelope?

- Air barrier and thermal barrier alignment
  - Throughout the house to define the conditioned space

- Code Says:
  - Continuous Air barrier
  - Air-permeable insulation is not used as a sealing material
  - Interior or exterior air barrier?
    - Code vs. best practice

- Control
  - Air Flow
  - Moisture Flow
  - Thermal Flow
Don’t Forget Ventilation
Thank you!

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