



# Building Solutions

**Is This Air Space Contributing to  
Energy Code Compliance?**

**Chunlin Cao**  
**3/1/2011**

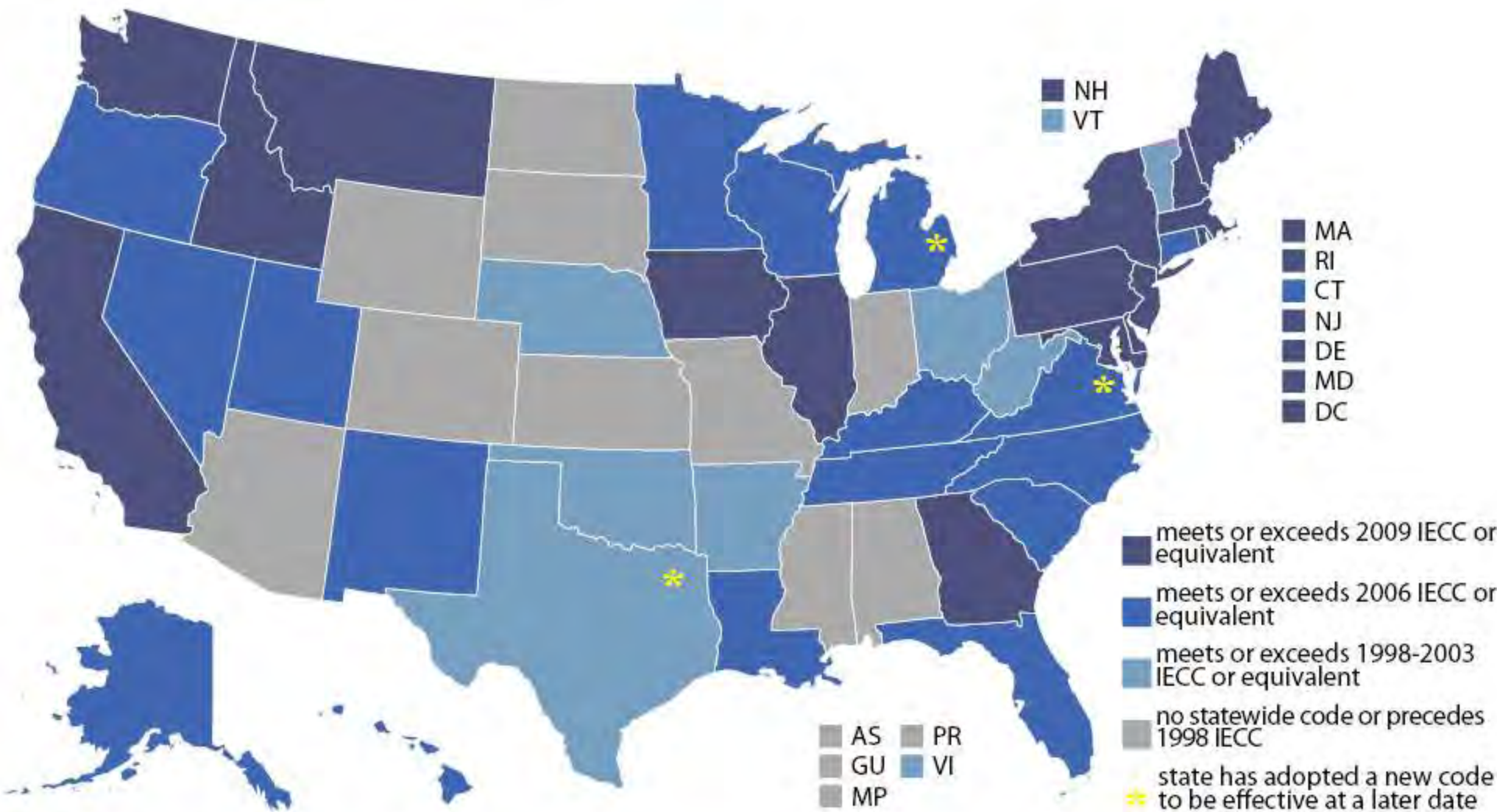
## Reminders/Warnings

- ❑ **My presentation may not be the “hottest” but it is very important**
- ❑ **The content can be somewhat technical**
- ❑ **There may be mistakes in the slides**
  - **Note: these mistakes are unintended “features”**
- ❑ **My presentation is short**
  - **I refuse to be “Between you and the Disney Fun”**
- ❑ **Ask questions as we go along**
- ❑ **Finally- Do you understand my English?**

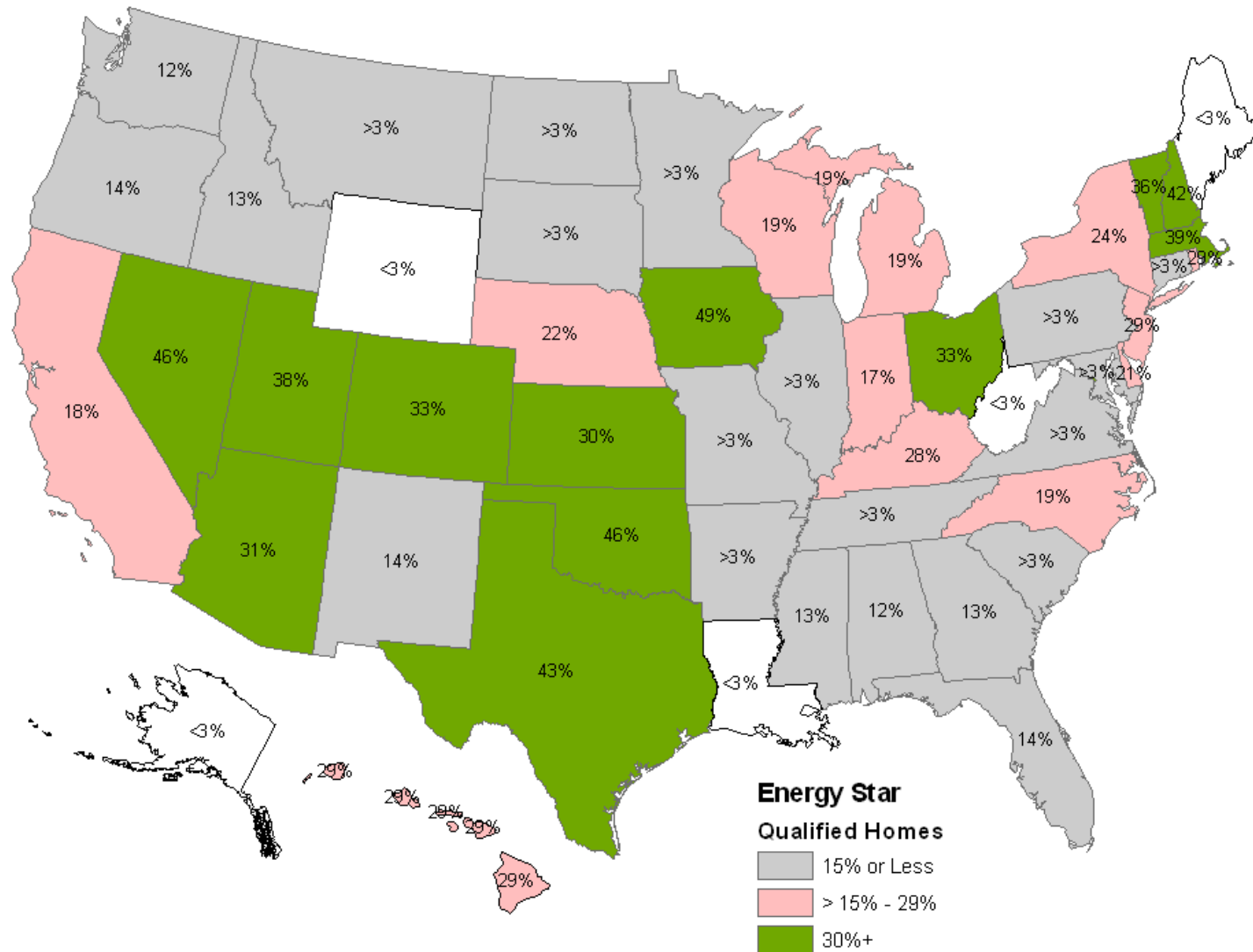
- ❑ **The issue**
- ❑ **Energy Code Compliance Paths**
- ❑ **How/when Air Space R-value should be counted**
- ❑ **Test Results**
- ❑ **Fun Tests**
- ❑ **Conclusions**

# Residential State Energy Code Status

AS OF JANUARY 1, 2011



# Energy Star Qualified Homes Market Share



# Insulation and Fenestration Requirements 2009 IECC by Climate Zone

**Table 402.1.1**  
**Insulation and Fenestration Requirements by Component<sup>a</sup>**  
**Numbers in RED are for 2006 IECC requirements**

| Climate Zone    | Fenestration U-Factor <sup>b</sup> | Skylight <sup>b</sup> U-Factor | Glazed Fenestration SHGC <sup>b, c</sup> | Ceiling Value | Wood Frame Wall R-Value      | Mass Wall R-Value <sup>i</sup> | Floor R-Value        | Basement <sup>f</sup> Wall R-Value | Slab <sup>d</sup> R-Value & Depth | Crawl Space <sup>e</sup> Wall R-Value |
|-----------------|------------------------------------|--------------------------------|--|---------------|------------------------------|--------------------------------|----------------------|------------------------------------|-----------------------------------|---------------------------------------|
| 1               | 1.2                                | 0.75                           | 0.30 (0.40)                              | 30            | 13                           | 3/4 (3)                        | 13                   | 0                                  | 0                                 | 0                                     |
| 2               | 0.65 <sup>j</sup> (0.75)           | 0.75                           | 0.30 (0.40)                              | 30            | 13                           | 4/6 (4)                        | 13                   | 0                                  | 0                                 | 0                                     |
| 3               | 0.50 <sup>j</sup> (0.65)           | 0.65                           | 0.30 (0.40)                              | 30            | 13                           | 5/8 (5)                        | 19                   | 5/13 <sup>f</sup> (0)              | 0                                 | 5/13                                  |
| 4 except Marine | 0.35 (0.40)                        | 0.60                           | NR                                       | 38            | 13                           | 5/10 (5)                       | 19                   | 10/13                              | 10, 2 ft                          | 10/13                                 |
| 5 & Marine 4    | 0.35                               | 0.60                           | NR                                       | 38            | 20 (19) or 13+5 <sup>h</sup> | 13/17 (13)                     | 30 <sup>g</sup>      | 10/13                              | 10, 2 ft                          | 10/13                                 |
| 6               | .035                               | 0.60                           | NR                                       | 49            | 20 (19) or 13+5 <sup>h</sup> | 15/19 (15)                     | 30 <sup>g</sup>      | 15/19 (10/13)                      | 10, 4 ft                          | 10/13                                 |
| 7 & 8           | 0.35                               | 0.60                           | NR                                       | 49            | 21                           | 19/21 (19)                     | 38 (30) <sup>g</sup> | 15/19 (10/13)                      | 10, 4 ft                          | 10/13                                 |

<sup>a</sup> **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.**

<sup>b</sup> The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

<sup>c</sup> "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.

<sup>d</sup> 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.

<sup>e</sup> There are no SHGC requirements in the Marine Zone.

<sup>f</sup> Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.

<sup>g</sup> Or insulation sufficient to fill the framing cavity, R-19 minimum.

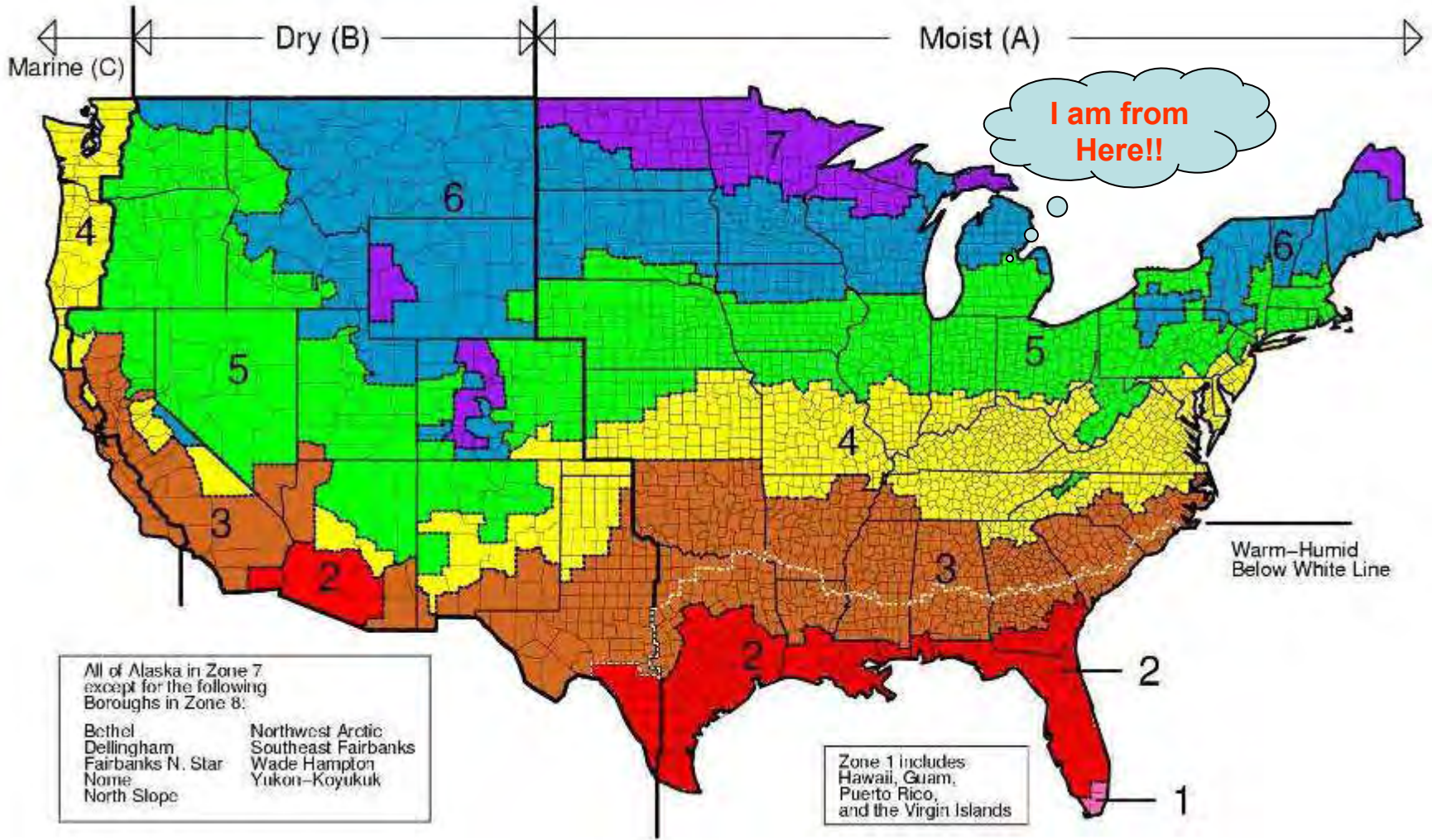
<sup>h</sup> "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

<sup>i</sup> The second R-value applies when more than half the insulation is on the interior of the mass wall.

<sup>j</sup> 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.



# Climate Zones—2009 IECC



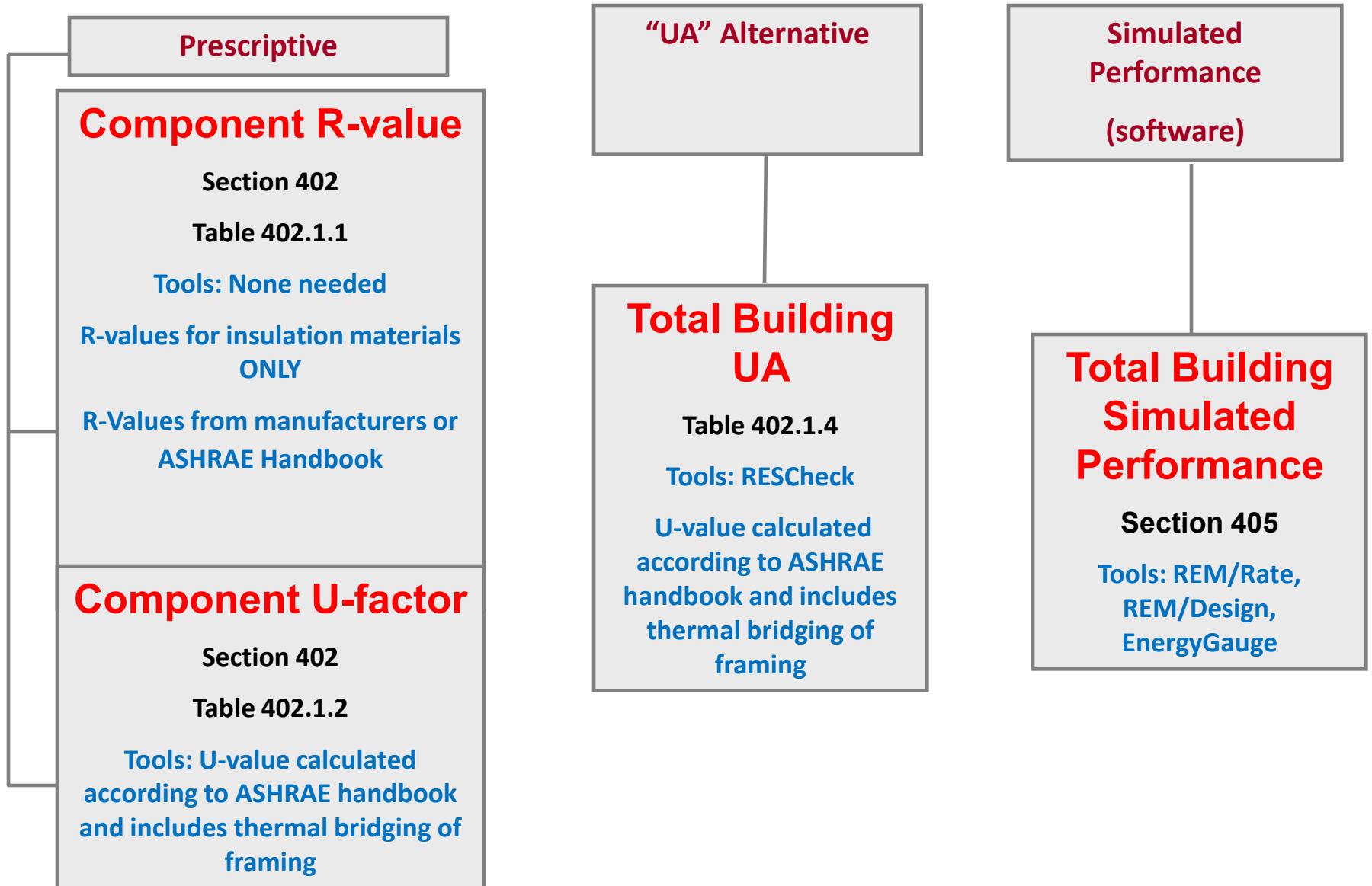
# The Issue

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- ❑ Many states have adopted 2009 IECC
- ❑ Many states will adopt 2009 IECC in 2011 and beyond
- ❑ Builders are looking for creative ways – including air space R value to meet the increased building envelope and overall home energy performance requirements
- ❑ **When does air space R-value qualify as contributing to the 2009 IECC residential requirements for the building thermal envelope?**



# IECC Compliance - Three Options



# Air Space R-values – IECC Compliance

## Prescriptive

### Component R-value

Section 402

Table 402.1.1

Tools: None needed

R-values for insulation  
materials ONLY

R-Values from manufacturers  
or ASHRAE Handbook

2009 IECC Section 402.1.2 R-value computation. Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R-value. The manufacturer's settled R-value shall be used for blown insulation. *Computed R-values shall not include an R-value for other building materials or air films.*

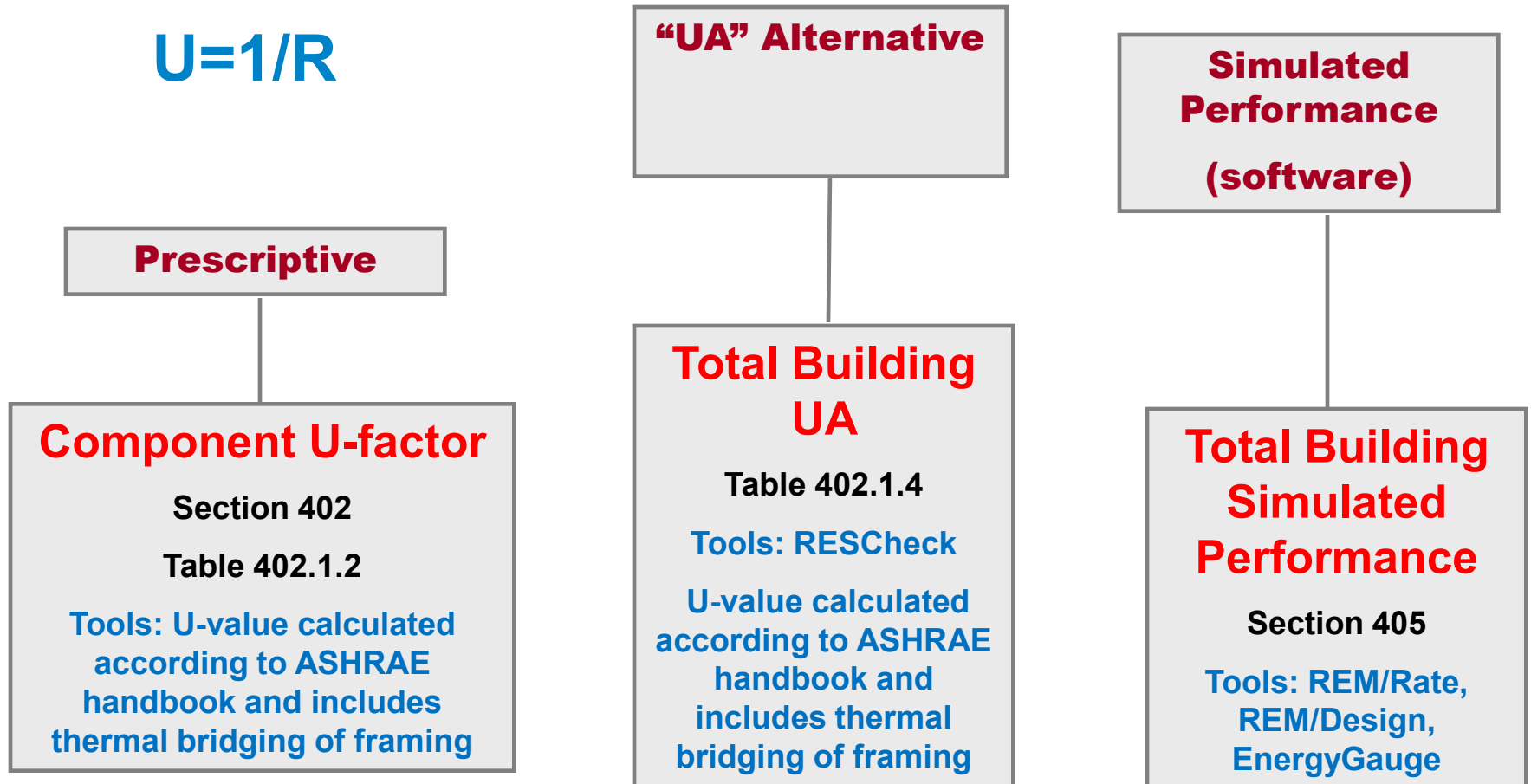
2009 IRC (International Residential Code) N1101.6 Insulation product Rating. The thermal resistance (R-value) of insulation shall be determined in accordance with the **CFR Title 16, part 460**, in units of  $\text{h}\cdot\text{ft}^2\cdot\text{x}^\circ\text{F}/\text{Btu}$  at a mean temperature of 75°F (24°C)

**Conclusion = Air space R-value cannot be used to comply with prescriptive R-value Table 402.1.1**

# Air Space R-values – IECC Compliance

Air space R-values may be used in U-value calculations when **Federal Trade Commission rules** and **ASHRAE requirements** are met

$$U=1/R$$



# Air Space – Federal Trade Commission rules

2009 IRC (International Residential Code) N1101.6 Insulation product Rating. The thermal resistance (R-value) of insulation shall be determined in accordance with **the CFR Title 16, part 460**, in units of  $\text{h}\cdot\text{ft}^2\cdot\text{x}^\circ\text{F}/\text{Btu}$  at a mean temperature of  $75^\circ\text{F}$  ( $24^\circ\text{C}$ )

## **CFR Title 16 Part 460.5 R value tests:**

- (a) *All types of insulation other than aluminum foil must be tested with ASTM C177, ASTM C518, ASTM C1363... on the insulation material alone excluding any air spaces...*
- (b) *Single sheet systems of aluminum foil... To get the R-value for a specific emissivity level, air space and direction of heat flow, use tables in ASHRAE Fundamentals Handbook if the product is intended for **applications that meet the conditions in the tables... must be tested with ASTM C 1363***
- (c) *Aluminum foil system with more than one sheet or single sheet systems that **do not meet ASHRAE conditions ... must be tested with ASTM C1363...***
- (d) *For insulation material with foil facing, 1) test the system, with its air space under ASTM C1363; 2) Add up the R value of materials and R value of air space **when the air space meets ASHRAE conditions***

# Air Space – Federal Trade Commission Rules

- ❑ Compliance to FTC R Value Rule for air space
  - Meet ASHRAE ideal space requirements or
  - Perform ASTM C1363 test

# ASHRAE Air Space Conditions

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**2009 ASHRAE Handbook  
Fundamentals 26.3 Table 3  
(P26.3 ) Footnote b Air Space  
definition:**

***“Values...apply for ideal conditions (i.e. air space of uniform thickness bound by plane, smooth, parallel surfaces with no air leakage to or from the space.”***

## ***Air Cavities behind vinyl siding and brick veneer:***

***(a) 2009 IRC Section R601.3.3 defines vinyl siding and brick veneer as vented claddings***

***(b) Air spaces behind vinyl siding and brick veneer are **not** smooth, plane, parallel, air tight***

**Conclusion = ASHRAE Handbook cannot be used to determine the R-value of air spaces behind vinyl siding, brick veneers and most other claddings in residential construction**



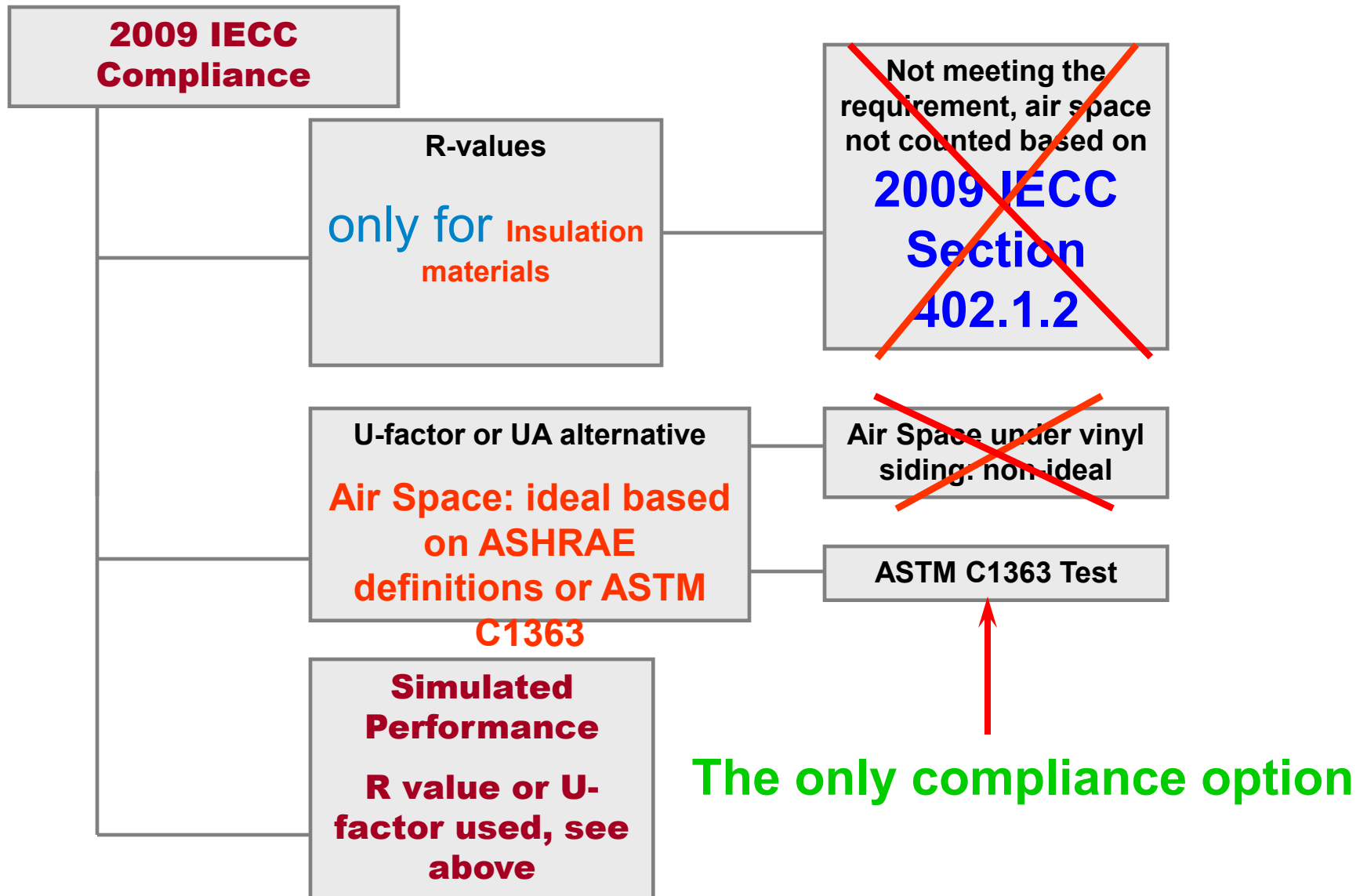
**How to determine the R-value of air spaces behind vinyl siding and brick veneer in residential construction??**

## **ASTM C 1363**

**Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus**

**This test method is used for large homogeneous or non-homogeneous specimens. This test method applies to building structures or composite assemblies of building materials for which it is possible to build a representative specimen that fits the test apparatus.**

# Summary: Compliance Paths for Air Space



# IECC Compliance – ASTM C1363

- ❑ ASTM C1363 by an accredited third-party testing lab
- ❑ R values tested for 4 different 8'x8' wall configurations, 6 different test conditions were tested

| <b>Test #</b> | <b>Wall Assembly Description</b>   |
|---------------|--|
| 1             | 2x4 OSB basewall, R15 batt, exterior air velocity 2.75 m/s                                     |
| 2             | 2x4 OSB basewall, R15 batt, reflective housewrap, exterior air velocity 2.75 m/s               |
| 3             | 2x4 OSB basewall, R15 batt, reflective housewrap, vinyl siding, exterior air velocity 2.75 m/s |
| 4             | 2x4 OSB basewall, R15 batt, reflective housewrap, vinyl siding, exterior air velocity 0.5 m/s  |
| 5             | 2x4 OSB basewall, R15 batt, reflective housewrap, vinyl siding, exterior air velocity 5.5 m/s  |
| 6             | 2x4 OSB basewall, R15 batt, vinyl siding, exterior air velocity 2.75 m/s                       |

# IECC Compliance – ASTM C1363 Test Results

Exterior wind velocity does not affect R value of these wall assemblies

| Test # | R Value Tested | Wall Assembly Description   |
|--------|----------------|---|
| 3      | 13.12          | 2x4 OSB basewall, R15 batt, reflective housewrap, vinyl siding, exterior air velocity <b>2.75 m/s</b> |
| 4      | 13.15          | 2x4 OSB basewall, R15 batt, reflective housewrap, vinyl siding, exterior air velocity <b>0.5 m/s</b>  |
| 5      | 13.18          | 2x4 OSB basewall, R15 batt, reflective housewrap, vinyl siding, exterior air velocity <b>5.5 m/s</b>  |

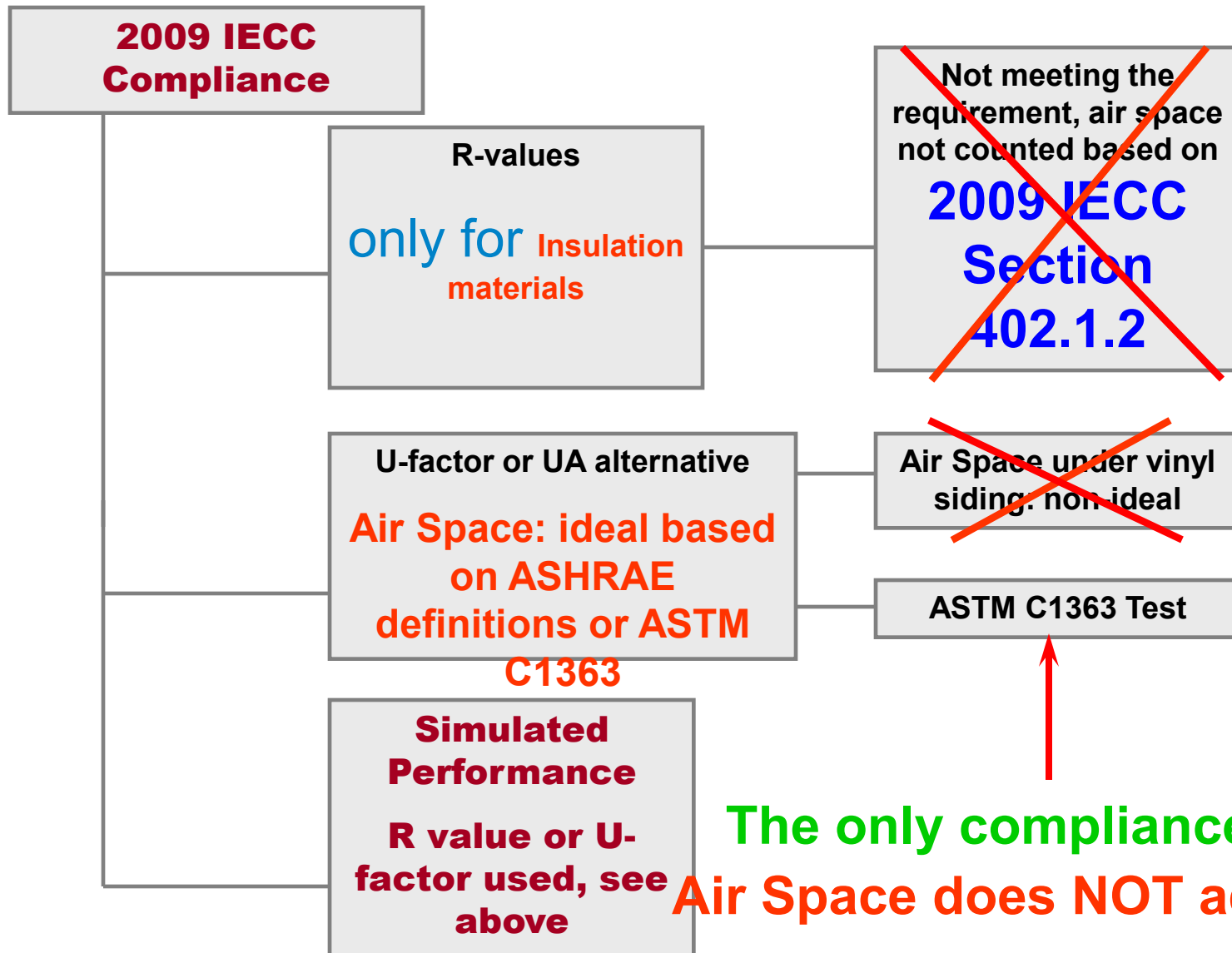
# IECC Compliance – Summary ASTM C1363 Test Results

| Test # | R Value Tested | Wall Assembly Description  |
|--------|----------------|--|
| 1      | 11.82          | 2x4 OSB basewall, R15 batt, exterior air velocity 2.75 m/s                                     |
| 2      | 12.78          | 2x4 OSB basewall, R15 batt, reflective housewrap, exterior air velocity 2.75 m/s               |
| 3      | 13.12          | 2x4 OSB basewall, R15 batt, reflective housewrap, vinyl siding, exterior air velocity 2.75 m/s |
| 6      | 12.46          | 2x4 OSB basewall, R15 batt, vinyl siding, exterior air velocity 2.75 m/s                       |

- 2 vs 3, the R-value of vinyl siding + air space over reflective housewrap = 0.34
- 1 vs. 6, the R value of vinyl siding+ air space over OSB = 0.64
- Note: ASHRAE R-value for vinyl siding = 0.62

**Conclusion = C 1363 testing shows that air space behind vinyl siding does not add R-value to the wall assembly**

# Summary: C1363 Test value vs. Claimed Value





**❑ Can Air space R-value be used to comply with prescriptive R-value Table 402.1.1?**

- Can ASHRAE Handbook be used to determine the R-value of air spaces behind vinyl siding, brick veneers and most other claddings in residential construction?**

**□ What is ASTM C1363 test? And why is needed?**

**❑ What is the outcome of the third-party ASTM C1363 test?**

# Conclusions

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- ❑ Air space R-value can not be used to comply with prescriptive R-value Table 402.1.1**
- ❑ ASHRAE Handbook cannot be used to determine the R-value of air spaces behind vinyl siding, brick veneers and most other claddings in residential construction**
- ❑ ASTM C1363 test results prove that air space under vinyl siding does not contribute wall assembly R value**

# Keep This in Mind...

- ❑ When R-value for non-ideal air space is treated as ideal air space R-value, it may be
  - Non-compliant with 2009 IECC or 2009 IRC
  - Non-compliant with FTC R-value rule
  - The potential business risks of civil penalties by FTC (Fines can be \$11,000 per incident)
  - Inappropriate design or misrepresentation of actual energy savings to consumers
  - Erosion of the purpose of energy codes and related regulatory policy
  - Unfair competition between alternative insulation materials and methods



# What You Can Do...

- ❑ There are many proven ways to meet energy code compliance
  - Rigid foam continuous insulation
  - Spray PU foam cavity insulation
  - Other cavity insulation such as fiberglass, blown-in, etc.
  - Air spaces that meet ASHRAE conditions for ideal air spaces (rare)
  
- ❑ **Stick with the products with proven performance and deliver a true energy saving home to consumers**

# Disclaimer

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Questions?

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