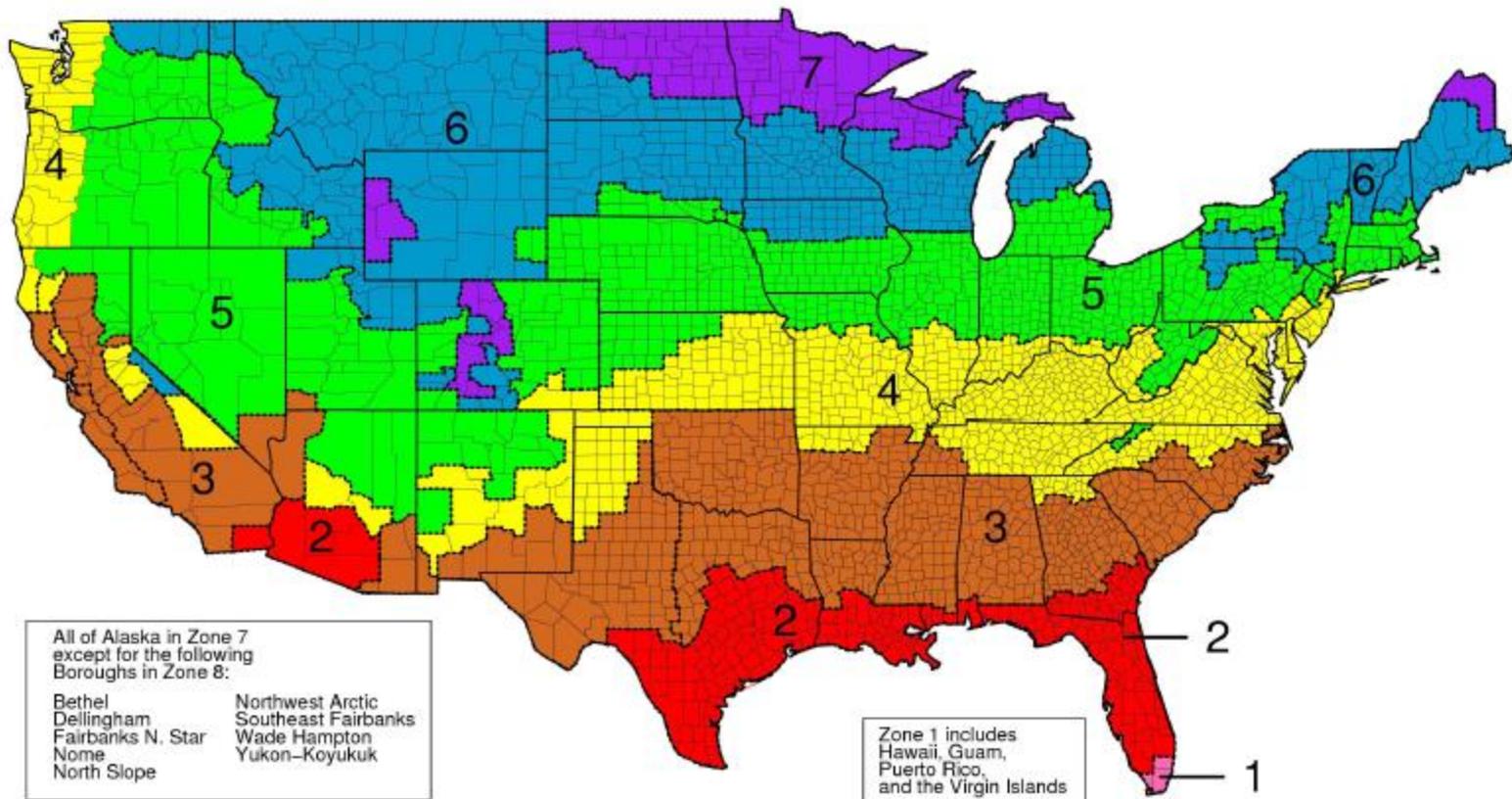# Continuous Insulation for Code-Compliant, High-Performance Walls in Type V and Residential Construction

Module 3: Energy Code Compliance

Revised 10/31/2016

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Energy Code Compliance

U.S. Climate Zones

Why Energy Conservation?

- Even small improvements can have a big impact
  - Significant life-cycle cost savings over a 30-year period
  - Methodology considers energy savings, initial investment financed through increased mortgage costs, tax impacts, and residual values of energy efficiency measures

Table 1. Life-Cycle Cost Savings Compared to the 2006 and 2009 IECC

IECC Climate Zone	30-Year Life-Cycle Savings ($US)		
	IECC 2009 vs. 2006	IECC 2012 vs. 2009	IECC 2012 vs. 2006
1	$2,877	$5,347	$8,256
2	$2,443	$2,280	$4,763
3	$1,944	$3,613	$5,621
4	$2,259	$5,320	$7,625
5	$2,466	$6,717	$9,189
6	$3,094	$8,183	$11,307
7	$3,622	$9,502	$13,166
8	$9,147	$23,900	$33,105

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Understanding the Codes

Three Basic Approaches		
Cavity Insulation only	Cavity + CI	Continuous Insulation Only

Three Paths to Compliance		
Prescriptive	Performance U-factor	Total UA Analysis

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Prescriptive Compliance Path (Walls)

2012 IECC Residential Wall R-value

Installation	Wood Frame R-value	
Climate Zone	2009 IECC	2012 IECC
1	13	13
2	13	13
3	13	20 or 13+5**
4 exc. Marine	13	20 or 13+5
4 Marine & 5	20 or 13+5	20 or 13+5
6	20 or 13+5	20+5 or 13+10
7 & 8	21	20+5 or 13+10

Simplest method— may not be the most cost effective depending on building type

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U-factor Compliance Path

- Use this approach to:
  - Explore alternatives to the prescriptive wall insulation
  - More CI, less CI; More cavity, less cavity; etc.
- Must use code-compliant insulation materials
- Must substantiate U-factor for assembly
- Must check moisture vapor control separately for U-factor analysis
- NOTE: $U = 1/R_{act} \neq 1/R_{nom}$

U-factor Performance Path

TABLE R402.1.3
EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

R402.1.3 *U*-factor alternative. An assembly with a *U*-factor equal to or less than that specified in Table R402.1.3 shall be permitted as an alternative to the *R*-value in Table R402.1.1.

U-factor Building Performance Path

- U-factor is the reciprocal of R-value (lower is better)

- For exterior wall assembly (assuming framing factor 0.25):

$R_{Stud} = 0.25 + 0.59 + 6.5 + 4.38 + 0.45 + 0.68 = 12.85$

$R_{Cavity} = 0.25 + 0.59 + 6.5 + 13 + 0.45 + 0.68 = 21.47$

$U = \dfrac{1}{0.25 R_{stud} + 0.75 R_{cavity}}$

$U = \dfrac{1}{0.25(12.35) + 0.75(20.97)} = 0.052$

$U = 0.053 < 0.057 \rightarrow OK$

- Assembly works for zone 4

Material	2x4 Stud	Cavity
Outside air film	0.25	0.25
Plywood siding	0.59	0.59
Polyiso, 1"	6.0	6.0
Stud (16" oc)	4.38	x
Batt insulation	x	13
Gyp board, 1/2"	0.45	0.45
Inside air film	0.68	0.68
Total R-value	12.35	20.97

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Total UA Performance Path

- Make full use of trade-offs or demonstrate whole-building compliance
  - Requires approved energy modeling (e.g. REScheck, WUFI or other software as allowed by state/local jurisdiction)

R405.3 Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (*proposed design*) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the *code official*, such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations.