

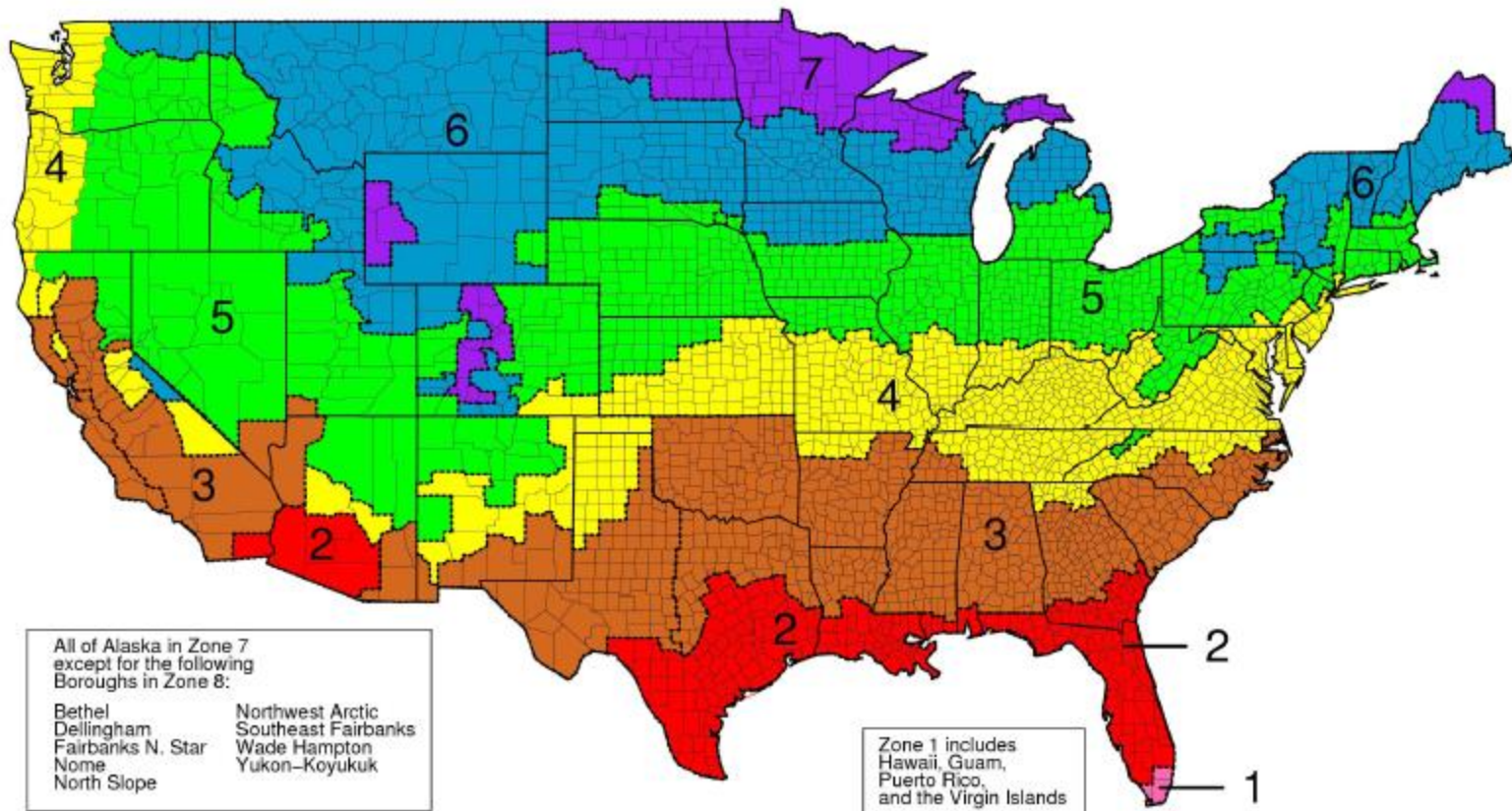
# Continuous Insulation for Code-Compliant, High-Performance Walls in Types I-IV Construction

## Module 3: Energy Code Compliance

Revised 10/31/2016



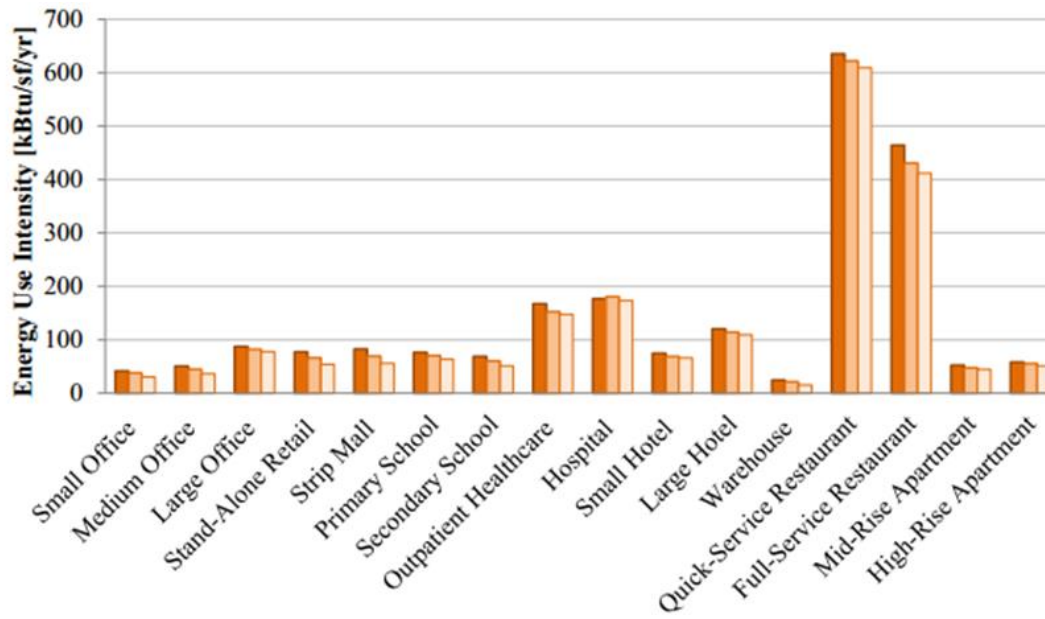
# Topic #3 – Energy Code Compliance



**U.S. Climate Zones**

# Why Energy Conservation?

- Even small improvements can have a big impact
  - 2009 IECC-C = 8.7% energy savings over 2006
    - Cost savings of \$0.15/ft<sup>2</sup>/year
  - 2012 IECC-C = 18.6% energy savings over 2006
    - Cost savings of \$0.33/ft<sup>2</sup>/year



National Average Energy Use Intensity for all IECC Prototypes (with Plug-and-Process Loads)

■ 2006 IECC ■ 2009 IECC ■ 2012 IECC

# Understanding the Codes

<b>Three Basic Approaches</b>		
<b>Cavity Insulation only</b>	<b>Cavity + CI</b>	<b>Continuous Insulation Only</b>

<b>Three Paths to Compliance</b>		
<b>Prescriptive</b>	<b>Performance U-factor</b>	<b>Total UA Analysis</b>

# Prescriptive Compliance Path (Walls)

2012 IECC Commercial Wall R-value

Climate Zone	Metal Frame	Metal Bldg	Mass
1	R13+ R5ci	R13+ R6.5ci	R5.7ci
2	R13+ R5ci	R13+ R6.5ci	R5.7ci
3	R13+ R7.55ci	R13+R6.5ci	R7.6ci
4	R13+ R7.5ci	R13+R13ci	R9.5ci
5/4 Marine	R13+ R7.5ci	R13+R13ci	R11.4ci
6	R13+ R7.5ci	R13+R13ci	R13.3ci
7	R13+ R7.5ci	R13+R13ci	R15.2ci
8	R13+ R7.5ci	R13+R13ci	R25ci

Simplest method – but may not work for all building types

# 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 Building Performance Path (cont'd)

TABLE C402.1.2  
OPAQUE THERMAL ENVELOPE ASSEMBLY REQUIREMENTS\*

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Walls, Above Grade																
Mass	U-0.142	U-0.142	U-0.142	U-0.123	U-0.110	U-0.104	U-0.104	U-0.090	U-0.078	U-0.078	U-0.078	U-0.071	U-0.061	U-0.061	U-0.061	U-0.061
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.057	U-0.064	U-0.052	U-0.045	U-0.045
Wood framed and other	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036

**C402.1.2 U-factor alternative.** An assembly with a  $U$ -factor,  $C$ -factor, or  $F$ -factor equal or less than that specified in Table C402.1.2 shall be permitted as an alternative to the  $R$ -value in Table C402.2. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the  $U$ -factor,  $C$ -factor, or  $F$ -factor from the "Group R" column of Table C402.1.2. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the  $U$ -factor,  $C$ -factor or  $F$ -factor from the "All other" column of Table C402.1.2.

# U-factor Building Performance Path (cont'd)

- U-factor is the reciprocal of R-value (lower is better)
- For exterior wall assembly (assuming framing factor 0.25):

$$R_{Stud} = 0.17 + 0.08 + 0.79 + 0.45 + 6.5 + 0.68 = 8.67$$

$$R_{Cavity} = 0.17 + 0.08 + 10.8 + 0.45 + 6.5 + 0.68 = 18.68$$

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

$$U = \frac{1}{0.25(8.67) + 0.75(18.68)} = 0.062$$

$$U = 0.062 < 0.064 \rightarrow OK$$

- Assembly works for zone 4

Material	Metal framing	Cavity
Outside air film	0.17	0.17
Stucco	0.08	0.08
Stud cavity (16" oc)	0.79	x
SPF open cell 3"	x	10.8
Gyp board, 1/2"	0.45	0.45
Polyiso, 1"	6.5	6.5
Inside air film	0.68	0.68
Total R-value	8.67	18.68



# Total UA Performance Path

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



**C407.3 Performance-based compliance.** Compliance based on total building performance requires that a proposed building (*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. Nondepletable energy collected off site shall be treated and priced the same as purchased energy. Energy from nondepletable energy sources collected on site shall be omitted from the annual energy cost of the *proposed design*.