Building Enclosure Council (BEC) - Baltimore

November 10, 2015 – Baltimore, MD

2015 I-code R-values and best practices

presented by

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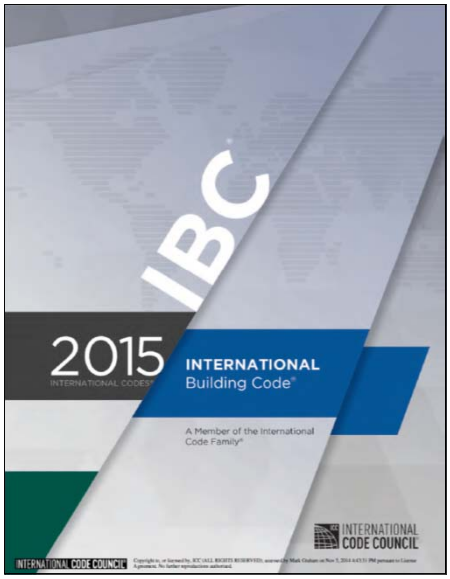

IBC 2015:

Ch. 15: Roofing

- Sec. 1511: Reroofing

Ch. 13: Energy efficiency

- References IECC 2015

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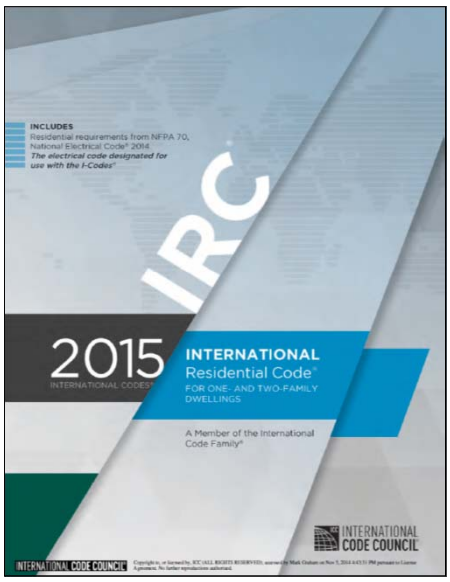

IRC 2015:

Ch. 9-Roof assemblies

- Sec. R908-Reroofing

Ch. 11-Energy efficiency

- References IECC 2015

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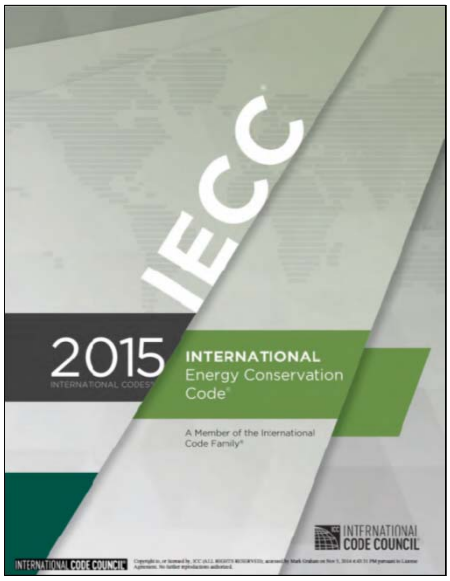

IECC 2015:

Commercial buildings:

- All except "Residential Buildings"

Residential buildings:

- One- and two-family dwellings, multiple single-family dwellings and Group R-2, R-3 and R-4 buildings three stories or less

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Format of IECC 2015

Commercial (CE):

- Ch. 1-Scope
- Ch. 2-Definitions
- Ch. 3-General requirements
- Ch. 4-Commercial energy efficiency
- Ch. 5-Existing buildings
- Ch. 6-Reference standards

Residential (RE):

- Ch. 1-Scope
- Ch. 2-Definitions
- Ch. 3-General requirements
- Ch. 4-Residential energy efficiency
- Ch. 5-Existing buildings
- Ch. 6-Reference standards
- Appendix RA-Atmospheric venting
- Appendix RB-Solar-ready provisions

Residential provisions are not addressed in this presentation

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IECC 2015 – Commercial (CE)

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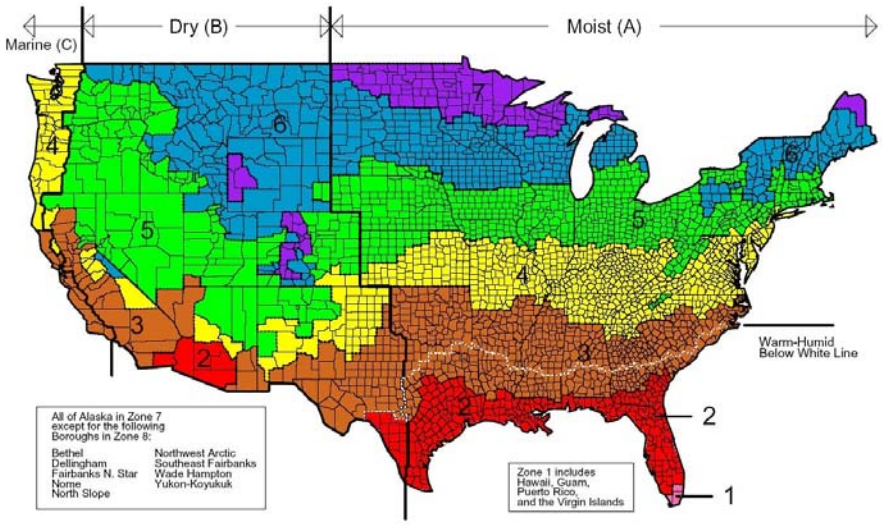
IECC 2015, Fig. C301.1-Climate zones

Fig. R301.1 (residential climate zones) is similar



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Ch. 4[CE]-Commercial energy efficiency

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C404, C405.2, C405.3, C405.4, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

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Ch. 4[CE]-Commercial energy efficiency

C402.1.1 Low-energy buildings. The following low energy buildings, or portions thereof separated from the remainder of the building by building thermal envelope assemblies complying with this section, shall be exempt from the building thermal envelope provisions of Section C402.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h · ft^2 (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.
3. Greenhouses.

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Ch. 4[CE]-Commercial energy efficiency

C402.2.2 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exceptions: [next slide]

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

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Ch. 4[CE]-Commercial energy efficiency

Exceptions:

1. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted U-factor is equivalent to the same assembly with the R-value specified in Table C402.1.3.
2. Where tapered insulation is used with insulation entirely above deck, the R-value where the insulation thickness varies 1 inch (25 mm) or less from the minimum thickness of tapered insulation shall comply with the R-value specified in Table C402.1.3.
3. Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

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Roofing-specific adaptation of Table C402.1.3

Commercial Buildings (Insulation component R-value-based method)

<table>
<tr><th rowspan="2">Climate zone</th><th colspan="3">Assembly description</th></tr>
<tr><th>Insulation entirely above deck</th><th>Metal buildings</th><th>Attic and other</th></tr>
<tr><td>1</td><td>R-20ci (all other)
R-25ci (Group R)</td><td rowspan="5">R-19 + R-11 LS</td><td rowspan="3">R-38</td></tr>
<tr><td>2</td><td rowspan="2">R-25ci</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="3">R-30ci</td><td>R-38
(except Marine 4)</td></tr>
<tr><td>5</td><td>R-38 (all other)
R-49 (Group R, Marine 4)</td></tr>
<tr><td>6</td><td>R-25 + R-11 LS</td><td rowspan="3">R-49</td></tr>
<tr><td>7</td><td rowspan="2">R-35ci</td><td rowspan="2">R-30 + R-11 LS</td></tr>
<tr><td>8</td></tr>
</table>

ci = Continuous insulation; LS = Liner system

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Ch. 4[CE]-Commercial energy efficiency

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

Exceptions: [next slide]

TABLE C402.2
MINIMUM ROOF REFLECTANCE AND EMITTNCE OPTIONS

Three-year solar reflectance of 0.55 and 3-year aged thermal emittance of 0.75
Three-year-aged solar reflectance index of 64

[Footnotes omitted for clarity]

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Ch. 4[CE]-Commercial energy efficiency

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that include or are covered by the following:
   - 1.1. Photovoltaic systems or components.
   - 1.2. Solar air or water-heating systems or components.
   - 1.3. Roof gardens or landscaped roofs.
   - 1.4. Above-roof decks or walkways.
   - 1.5. Skylights.
   - 1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings. [Continued…]

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Ch. 4[CE]-Commercial energy efficiency

3. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot [74 kg/m^2] or 23 psf [117 kg/m^2] pavers.
4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

C402.3.1 Aged roof solar reflectance. Where an aged solar reflectance required by Section C402.3 is not available, it shall be determined in accordance with Equation 4-3.

R_{aged} = [0.2+0.7($R_{initial}$ - 0.2)] **(Equation 4-3)**

where:

R_{aged} = The aged solar reflectance.

$R_{initial}$ = The initial solar reflectance determined in accordance with CRRC-1.

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Ch. 4[CE]-Commercial energy efficiency

C402.5 Air leakage—thermal envelope (Mandatory). The thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft^2 (0.2 L/s · m^2). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

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Ch. 4[CE]-Commercial energy efficiency

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1 and C402.5.1.2.

Exception: Air barriers are not required in buildings located in Climate Zone 2B.

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Ch. 4[CE]-Commercial energy efficiency

C402.5.1.2 Air barrier compliance options. A continuous air barrier for the opaque building envelope shall comply with Section C402.5.1.2.1 or C402.5.1.2.2.

C402.5.1.2.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft^2 (0.02 L/s · m^2) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E 2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

[Continued…]

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Ch. 4[CE]-Commercial energy efficiency

1.-4. …

5. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) having a thickness of not less than 1½ inches (38 mm)

6.-8. …

9. Built-up roofing membrane.

10. Modified bituminous roof membrane.

11. Fully adhered single-ply roof membrane.

12.-16. …

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Ch. 4[CE]-Commercial energy efficiency

C402.5.1.2.2 Assemblies. Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft^2 (0.2 L/s · m^2) under a pressure differential of 0.3 inch of water gauge (w.g.)(75 Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided joints are sealed and the requirements of Section C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.
2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches (102 mm) or more.
3. A Portland cement/sand parge, stucco or plaster not less than 1/2 inch (12.7 mm) in thickness.

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Ch. 5[CE]-Commercial energy efficiency

Sec. C503-Alterations:

C503.3 Building envelope. New building envelope assemblies that are part of the alteration shall comply with Sections C402.1 through C402.5.

C503.3.1 Roof replacement. Roof replacements shall comply with Table C402.1.3 or C402.1.4 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck.

Roof replacements shall comply to the same IECC 2015 requirements as new construction

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Ch. 5[CE]-Commercial energy efficiency

SECTION C504

REPAIRS

C504.1 General. Buildings and structures, and parts thereof, shall be repaired in compliance with Section C501.3 and this section. Work on nondamaged components that is necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this chapter. Routine maintenance required by Section C501.3, ordinary repairs exempt from permit and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section.

Where a building was constructed to comply with ANSI/ASHRAE/IESNA 90.1, repairs shall comply with the standard and need not comply with Sections C402, C403, C404 and C405.

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Ch. 5[CE]-Commercial energy efficiency

C504.2 Application. For the purposes of this code, the following shall be considered repairs:

1. ...
2. *Roof repairs*.
3. Air barriers shall not be required for *roof repair* where the repairs to the building do not include *alterations*, renovations or *repairs* to the remainder of the building envelope.
4. …
5. …

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In summary: IECC 2015 – Commercial (CE)

- R-value
- Roof reflectivity (Climate Zones 1-3 only)
- Air retarders (All Climates Zones except 2B)
- Roof replacement:
  - R-value requirements to IECC 2015 levels
  - Roof reflectivity per IECC 2015
  - Air retarder per IECC 2105 (whole building envelope replacement only)

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Insulation R-values

International Energy Conservation Code, 2015 Edition

C303.1.4 Insulation product rating. The thermal resistance (R-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission R-value rule (CFR Title 16, Part 460) in units of h · ft^2 · °F/Btu at a mean temperature of 75°F (24°C).

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Long-term thermal resistance (LTTR)

- ASTM C1303
- ULC-S 770

LTTR is intended to represent the R-values of specimens tested after five years of aging when stored in a controlled laboratory environment. This five-year figure corresponds closely to a predicted 15-year, time weighted average of R-values.

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NRCA R-values testing

- Polyisocyanurate (2009 and previous)
- Expanded polystyrene (2010)
- Extruded polystyrene (2010)
- Polyisocyanurate (2015)

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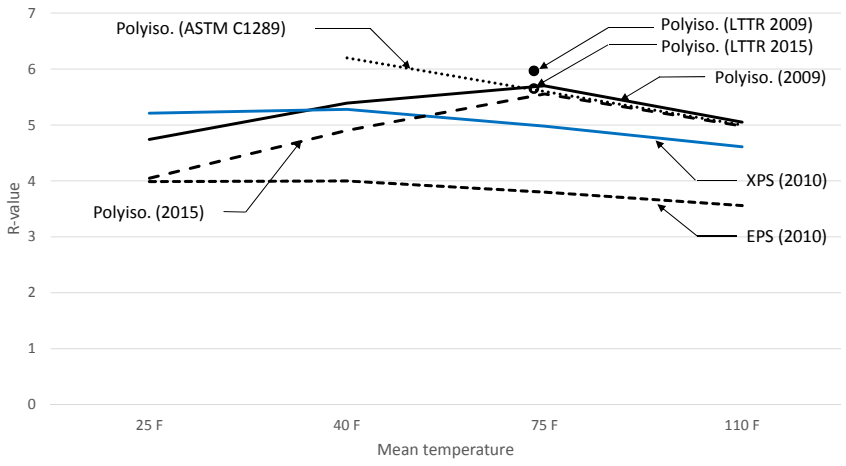
NRCA R-value testing



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Design R-value recommendation

Polyisocyanurate insulation

1986-2011:

- R = 5.6 per inch thickness

2012-2015:

- R = 5.6 per inch thickness (cooling climates)
- R = 5.0 per inch thickness (heating climates)

Beginning in 2016:

- R = 5.0 per inch thickness

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NRCA recommendation

In purchase orders and contracts, identify insulation by its thickness, not its R-value.

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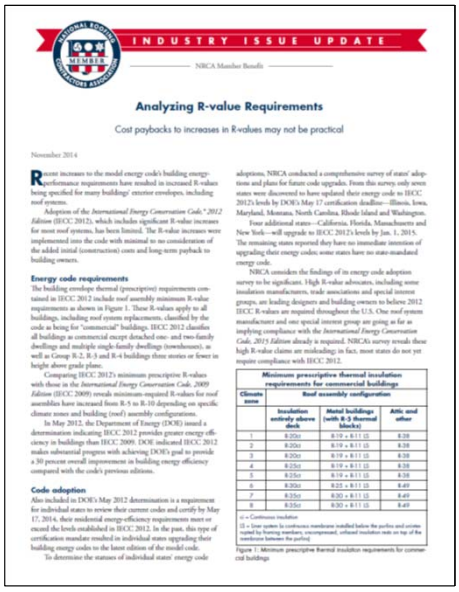

INDUSTRY ISSUE UPDATE

NRCA Member Benefit

Analyzing R-value Requirements

Cost paybacks to increases in R-values may not be practical

November 2014

Recent increases to the model energy code's building energy-performance requirements have resulted in increased R-values being specified for many buildings' exterior envelopes, including roof systems.

Adoption of the *International Energy Conservation Code,® 2012 Edition* (IECC 2012), which includes significant R-value increases for most roof systems, has been limited. The R-value increases were implemented into the code with minimal to no consideration of the added initial (construction) costs and long-term payback to building owners.

Energy code requirements

The building envelope thermal (prescriptive) requirements contained in IECC 2012 include roof assembly minimum R-value requirements as shown in Figure 1. These R-values apply to all buildings, including roof system replacements, classified by the code as being for "commercial" buildings. IECC 2012 classifies all buildings as commercial except detached one- and two-family dwellings and multiple single-family dwellings (townhouses), as well as Group R-2, R-3 and R-4 buildings three stories or fewer in height above grade plane.

Comparing IECC 2012's minimum prescriptive R-values with those in the *International Energy Conservation Code, 2009 Edition* (IECC 2009) reveals minimum-required R-values for roof assemblies have increased from R-5 to R-10 depending on specific climate zones and building (roof) assembly configurations.

In May 2012, the Department of Energy (DOE) issued a determination indicating IECC 2012 provides greater energy efficiency in buildings than IECC 2009. DOE indicated IECC 2012 makes substantial progress with achieving DOE's goal to provide a 30 percent overall improvement in building energy efficiency compared with the code's previous editions.

Code adoption

Also included in DOE's May 2012 determination is a requirement for individual states to review their current codes and certify by May 17, 2014, their residential energy-efficiency requirements meet or exceed the levels established in IECC 2012. In the past, this type of certification mandate resulted in individual states upgrading their building energy codes to the latest edition of the model code.

To determine the statuses of individual states' energy code adoptions, NRCA conducted a comprehensive survey of states' adoptions and plans for future code upgrades. From this survey, only seven states were discovered to have updated their energy code to IECC 2012's levels by DOE's May 17 certification deadline—Illinois, Iowa, Maryland, Montana, North Carolina, Rhode Island and Washington.

Four additional states—California, Florida, Massachusetts and New York—will upgrade to IECC 2012's levels by Jan. 1, 2015. The remaining states reported they have no immediate intention of upgrading their energy codes; some states have no state-mandated energy code.

NRCA considers the findings of its energy code adoption survey to be significant. High R-value advocates, including some insulation manufacturers, trade associations and special interest groups, are leading designers and building owners to believe 2012 IECC R-values are required throughout the U.S. One roof system manufacturer and one special interest group are going as far as implying compliance with the *International Energy Conservation Code, 2015 Edition* already is required. NRCA's survey reveals these high R-value claims are misleading; in fact, most states do not yet require compliance with IECC 2012.

Minimum prescriptive thermal insulation requirements for commercial buildings

Climate zone	Roof assembly configuration		
	Insulation entirely above deck	Metal buildings (with R-5 thermal blocks)	Attic and other
1	R-20ci	R-19 + R-11 LS	R-30
2	R-20ci	R-19 + R-11 LS	R-30
3	R-20ci	R-19 + R-11 LS	R-30
4	R-25ci	R-19 + R-11 LS	R-30
5	R-25ci	R-19 + R-11 LS	R-30
6	R-30ci	R-25 + R-11 LS	R-49
7	R-35ci	R-30 + R-11 LS	R-49
8	R-35ci	R-30 + R-11 LS	R-49

ci = Continuous insulation

LS = Liner system (a continuous membrane installed below the purlins and across supported by framing members, uncompressed, unfaced insulation mats on top of the membrane between the purlins)

Figure 1: Minimum prescriptive thermal insulation requirements for commercial buildings

NRCA "Industry Issue Update," November 2014

Payback analysis:

- 100 sq. single story building
- Costs per R+5 increases
- Energy savings per R+5 increases
- Local energy costs
- Cost ÷ Savings = Payback
- 16 cities in 8 climate zones

Payback results (Philadelphia, PA):

- R-10 to R-15: 7.5 yrs.
- R-15 to R-20: 15.5 yrs.
- R-20 to R-25: 24.9 yrs.
- R-25 to R-30: 54.3 yrs.

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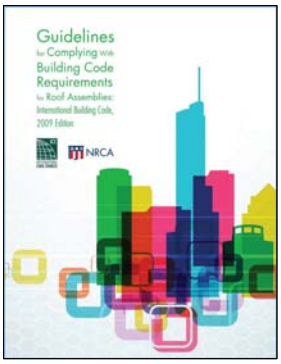
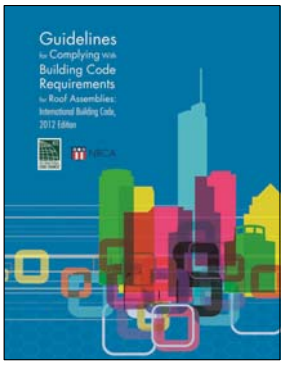
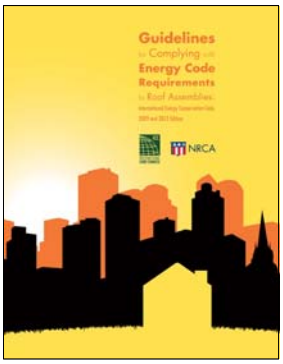
NRCA code manuals

shop.nrca.net or (866) ASK-NRCA







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Consider joining ICC

Membership categories:

- Corporate member: $400 (complete collection)
- Building safety professional member: $150 (1 code)

http://www.iccsafe.org/Membership/Pages/join.aspx

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