2009 IECC

Commercial Envelope Requirements

U.S. Department of Energy
Building Energy Codes Program

Eric Makela
Britt/Makela Group
Major Changes to the Envelope Requirements

- Commercial Provisions Contained in Chapter 5
  - IECC
  - ASHRAE 90.1-2007
- Tables 502.2(1) and Table 502.2(2) Building Envelope Requirements – Opaque Assemblies
Introduction to the Energy Code Compliance Process

**Must the Project Comply with the IECC?**

- Comply with the Envelope Requirements
  - Section 502
  - 90.1 Section 5

- Comply with the Mechanical/SWH Requirements
  - Sections 503 and 504
  - 90.1 Section 6

- Comply with the Power & Lighting Requirements
  - Section 505
  - 90.1 Section 9

Document Compliance with the IECC

- Plan Review
- Inspection
Does My Project Need to Comply with the Commercial Provisions in the IECC?

All Buildings Other Than:

• One- and two-family residential
• R-2, R-3, R-4 three stories or less in height
Introduction to the Commercial Energy Code Compliance Process

Must the Project Comply with the IECC?

Comply with the Envelope Requirements
- Section 502
- 90.1 Section 5

Comply with the Mechanical/SWH Requirements
- Sections 503 and 504
- 90.1 Section 6

Comply with the Lighting Requirements
- Section 505
- 90.1 Section 9

Document Compliance with the IECC

Plan Review

Inspection
What are My Options for Complying with the IECC?

- Chapter 5 of the IECC General Prescriptive Approach
  - Use for $\leq 40\%$ of gross wall area in vertical fenestration
  - Use for $\leq 3\%$ of gross roof area in skylights

- Section 506 Total Building Performance Approach

- ASHRAE/IESNA Standard 90.1-2007
  - Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path
Climate Zones—2009 IECC

Determining Your Climate Zone is the First Step in the Process
Changes to Tables 502.1.2 and 502.2(1)

• Table now separated by occupancy type
  • Group R occupancies use “Group R” column
  • Non-Group R occupancies use “All other” column
### Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

#### TABLE 602.2(1) BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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</thead>
<tbody>
<tr>
<td>All other</td>
<td>R-15ci</td>
<td>R-20ci</td>
<td>R-20ci</td>
<td>R-20ci</td>
<td>R-20ci</td>
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<tr>
<td>above deck</td>
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<tr>
<td>Attic and</td>
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<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
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<td>R-38</td>
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<td>Walls, Above Grade</td>
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<td>Mass</td>
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<td>R-5.7ci</td>
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<td>R-7.6ci</td>
<td>R-9.5ci</td>
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<td></td>
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</tr>
<tr>
<td>Below grade wall</td>
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<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>R-7.5ci</td>
<td>R-7.5ci</td>
<td>R-7.5ci</td>
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<td>Floors</td>
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<td>NR</td>
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<td>R-6.3ci</td>
<td>R-8.3ci</td>
<td>R-6.3ci</td>
<td>R-8.3ci</td>
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<tr>
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<td>NR</td>
<td>R-19</td>
<td>R-19</td>
<td>R-19</td>
<td>R-19</td>
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<td>R-19</td>
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<td>R-19</td>
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<tr>
<td>Slab-on-Grade Floors</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Unheated slabs</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heated slabs</td>
<td>R-7.5 for 12 in. below</td>
<td>R-7.5 for 12 in. below</td>
<td>R-7.5 for 12 in. below</td>
<td>R-7.5 for 12 in. below</td>
<td>R-10 for 24 in. below</td>
<td>R-10 for 24 in. below</td>
<td>R-15 for 24 in. below</td>
<td>R-15 for 24 in. below</td>
</tr>
<tr>
<td>Opaque doors</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swinging</td>
<td>U - 0.70</td>
<td>U - 0.70</td>
<td>U - 0.70</td>
<td>U - 0.70</td>
<td>U - 0.70</td>
<td>U - 0.70</td>
<td>U - 0.70</td>
<td>U - 0.70</td>
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<tr>
<td>Roll-up or sliding</td>
<td>U - 1.45</td>
<td>U - 1.45</td>
<td>U - 1.45</td>
<td>U - 1.45</td>
<td>U - 1.45</td>
<td>U - 1.45</td>
<td>U - 1.45</td>
<td>U - 1.45</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrooved or partially grooved at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrooved cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/hr·F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.
e. Steel floor joint systems shall be R-38.
Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attic and other</td>
<td>R-30</td>
<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
</tr>
</tbody>
</table>

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**Climate Zones 1 through 8**

- **Excerpt marine**
- **Except marine**
- **All other**
- **Group R**

**Roofs**

- **Metal buildings** (with R-5 thermal blocks<sup>a,b</sup>)
- **Attic and other**

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**Floors**

- **Mass**
- **Joint/Frame (Steel/wood)**

**Slab-on-Grade Floors**

- **Unheated slabs**
- **Heated slabs**

**Opaque doors**

- **Swinging**
- **Roll up or sliding**

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*For SI: 1 inch = 25.4 mm.
<sup>ci</sup> = Continuous insulation, NR = No requirement.

<sup>a</sup> When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2.2(b)].

<sup>b</sup> Assembly descriptions can be found in Table 502.3.2(a).

<sup>c</sup> R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrounded or partially grounded at 37 inches or less on center vertically and 48 inches or less on center horizontally, with ungrounded cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/ft²-F.

<sup>d</sup> When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

<sup>e</sup> Steel floor joist systems shall be R-38.
# Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

## Walls, Above Grade

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tbody>
<tr>
<td></td>
<td>All other</td>
<td>Group R</td>
<td>All other</td>
<td>Group R</td>
<td>All other</td>
<td>Group R</td>
<td>All other</td>
<td>Group R</td>
</tr>
<tr>
<td>Metal building</td>
<td>R-16</td>
<td>R-16</td>
<td>R-16</td>
<td>R-19</td>
<td>R-19</td>
<td>R-19</td>
<td>R-13+ 5.6ci</td>
<td>R-13+ 5.6ci</td>
</tr>
</tbody>
</table>

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For SI: 1 inch = 25.4 mm.

cl = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2.2(b)].

b. Assembly descriptions can be found in Table 502.3.2.

c. R-5.7clic is allowed to be substituted with concrete block walls complying with ASTM C90, ungrounded or partially ground at 32 inches or less on center horizontally, with ungrounded cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/ft·°F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Steel floor joist systems shall be R-38.
### Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

#### Walls, Below Grade

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE 4</th>
<th>6</th>
<th>7</th>
<th>8</th>
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</thead>
<tbody>
<tr>
<td>Below grade wall</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>R-7.5ci</td>
<td>R-7.5ci</td>
<td>R-7.5ci</td>
<td>R-7.5ci</td>
<td>R-12.5ci</td>
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</table>

#### Metal Building

- R-16

#### Metal Panel

- R-14

#### Wood Framed and Sheathed

- R-13

#### Slab-on-Grade Flange

- R-10ci

#### Unheated Slabs

- R-7.5ci

#### Heated Slabs

- R-10.4ci

#### Concrete Slab

- R-5ci
# Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>NR</td>
<td>NR</td>
<td>R-6.3ci</td>
<td>R-8.3ci</td>
<td>R-10ci</td>
<td>R-12.5ci</td>
<td>R-14.6ci</td>
<td>R-15ci</td>
</tr>
<tr>
<td>Joist/framing</td>
<td>NR</td>
<td>NR</td>
<td>R-19</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
</tr>
<tr>
<td>Steel/(wood)</td>
<td>NR</td>
<td>NR</td>
<td>R-19</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
<td>R-30</td>
</tr>
</tbody>
</table>

| Mass         | NR  | NR  | R-6.3ci | R-8.3ci | R-10ci | R-12.5ci | R-14.6ci | R-15ci | R-16.7ci |
| Joist/framing| NR  | NR  | R-19 | R-30 | R-30 | R-30 | R-30 | R-30 | R-30 |
| Steel/(wood) | NR  | NR  | R-19 | R-30 | R-30 | R-30 | R-30 | R-30 | R-30 |

| Joist/framing| NR  | NR  | R-19 | R-30 | R-30 | R-30 | R-30 | R-30 | R-30 |
| Steel/(wood) | NR  | NR  | R-19 | R-30 | R-30 | R-30 | R-30 | R-30 | R-30 |

### Joist/framing Steel/(wood)

| Joist/framing| NR  | NR  | R-19 | R-30 | R-30 | R-30 | R-30 | R-30 | R-30 |
| Steel/(wood) | NR  | NR  | R-19 | R-30 | R-30 | R-30 | R-30 | R-30 | R-30 |

For SI: 1 inch = 25.4 mm.

- cl = Continuous insulation. NR = No requirement.
- a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].
- b. Assembly descriptions can be found in Table 502.3(2).
- c. R-5.7; cl is allowed to be substituted with concrete block walls complying with ASTM C90, ungrounded or partially ground at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrounded cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/hr°F.
- d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.
- e. Steel floor joist systems shall be R-38.
### Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unheated slabs</strong></td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>R-10 for 24 in. below</td>
<td>R-10 for 24 in. below</td>
</tr>
<tr>
<td><strong>Heated slabs</strong></td>
<td>R-7.5 for 12 in. below</td>
<td>R-7.5 for 12 in. below</td>
<td>R-7.5 for 12 in. below</td>
<td>R-10 for 24 in. below</td>
<td>R-15 for 24 in. below</td>
<td>R-15 for 24 in. below</td>
<td>R-20 for 48 in. below</td>
<td>R-20 for 48 in. below</td>
</tr>
</tbody>
</table>

**Slab-on-Grade Floors**

- For SI: 1 inch = 25.4 mm.
- R-7.5 is allowed to be substituted where continuous insulation is not used above the top edge of the slab.
# Compliance with Chapter 5 Prescriptive Approach - Insulation R-values

## TABLE 502.2(1)

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</tr>
</thead>
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<td></td>
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<td>Group R</td>
<td>All other</td>
<td>Group R</td>
<td>All other</td>
<td>Group R</td>
<td>All other</td>
<td>Group R</td>
</tr>
<tr>
<td>Attic and other</td>
<td>R-30</td>
<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
<td>R-38</td>
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<tr>
<td>Opaque Doors</td>
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</table>

For SI: 1 inch = 25.4 mm.

- ci = Continuous insulation. NR = No requirement.
- a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].
- b. Assembly descriptions can be found in Table 502.3(2).
- c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrounded or partially grounded at 37 inches or less on center vertically and 48 inches or less on center horizontally, with ungrounded cores filled with material having a maximum thermal conductivity of 0.44 Btu-in/ft·°F.
- d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.
- e. Sheet floor joint systems shall be R-38.
Compliance with Chapter 5 Prescriptive Approach - Assembly U-factors

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>5 AND MARINE 4</th>
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<td>U-0.039</td>
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<td><strong>Roofs</strong></td>
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<td>U-0.124</td>
<td>U-0.064</td>
<td>U-0.064</td>
<td>U-0.064</td>
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<td>U-0.084</td>
<td>U-0.089</td>
<td>U-0.089</td>
<td>U-0.089</td>
<td>U-0.089</td>
<td>U-0.089</td>
<td>U-0.064</td>
<td>U-0.051</td>
</tr>
<tr>
<td><strong>Walls, Below Grade</strong></td>
<td>Below-grade wall</td>
<td>C-1.140</td>
<td>C-1.140</td>
<td>C-1.140</td>
<td>C-1.140</td>
<td>C-1.140</td>
<td>C-1.140</td>
<td>C-1.140</td>
</tr>
<tr>
<td><strong>Floors</strong></td>
<td>Mass</td>
<td>U-0.322</td>
<td>U-0.322</td>
<td>U-0.107</td>
<td>U-0.087</td>
<td>U-0.107</td>
<td>U-0.087</td>
<td>U-0.087</td>
</tr>
<tr>
<td><strong>Joist/Framing</strong></td>
<td>U-0.282</td>
<td>U-0.282</td>
<td>U-0.052</td>
<td>U-0.052</td>
<td>U-0.052</td>
<td>U-0.033</td>
<td>U-0.033</td>
<td>U-0.033</td>
</tr>
<tr>
<td><strong>Slab-on-Grade Floors</strong></td>
<td>Unheated slabs</td>
<td>F-0.730</td>
<td>F-0.730</td>
<td>F-0.730</td>
<td>F-0.730</td>
<td>F-0.730</td>
<td>F-0.730</td>
<td>F-0.730</td>
</tr>
<tr>
<td><strong>Heated slabs</strong></td>
<td>F-1.020</td>
<td>F-1.020</td>
<td>F-1.020</td>
<td>F-1.020</td>
<td>F-1.020</td>
<td>F-1.020</td>
<td>F-1.020</td>
<td>F-1.020</td>
</tr>
</tbody>
</table>

---

a. When heated slabs are placed below-grade, below-grade walls must meet the U-factor requirements for perimeter insulation according to the heated slab-on-grade construction.
Compliance with Chapter 5 Prescriptive Approach

| TABLE 502.2(2) |
|-----------------|-----------------|-----------------|
| **BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES** | **DESCRIPTION** | **REFERENCE** |
| **ROOFS** | | |
| R-19 | Standing seam roof with single fiberglass insulation layer. | ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G” |
| R-13 + R-13  
R-13 + R-19 | The first R-value is for faced fiberglass insulation batts draped over the purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins. | ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G” |
| R-11 + R-19 FC | Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins. | ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G” |
| **WALLS** | | |
| R-16, R-19 | Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing. | ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G” |
| R-13 + R-5.6 ci  
R-19 + R-5.6 ci | The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing. | ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G” |
### Compliance with Chapter 5 Prescriptive Approach

**TABLE 502.2(2)**

**BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES**

<table>
<thead>
<tr>
<th>ROOFS</th>
<th>DESCRIPTION</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-19</td>
<td>Standing seam roof with single fiberglass insulation layer.</td>
<td>ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”</td>
</tr>
<tr>
<td></td>
<td>This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</td>
<td></td>
</tr>
</tbody>
</table>

**R-13 + R-13** The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.

**R-13 + R-19**

<table>
<thead>
<tr>
<th>ROOFS</th>
<th>DESCRIPTION</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-11 + R-19 FC</td>
<td>Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</td>
<td>ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”</td>
</tr>
</tbody>
</table>

**WALLS**

<table>
<thead>
<tr>
<th>ROOFS</th>
<th>DESCRIPTION</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-16, R-19</td>
<td>Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.</td>
<td>ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ROOFS</th>
<th>DESCRIPTION</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-13 + R-5.6 ci R-19 + R-5.6 ci</td>
<td>The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.</td>
<td>ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”</td>
</tr>
</tbody>
</table>
## Compliance with Chapter 5 Prescriptive Approach

### TABLE 502.2(2)

<table>
<thead>
<tr>
<th>ROOFS</th>
<th>DESCRIPTION</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-19</td>
<td>Standing seam roof with single fiberglass insulation layer. This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</td>
<td>ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”</td>
</tr>
<tr>
<td>R-11 + R-19 FC</td>
<td>Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</td>
<td>ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”</td>
</tr>
</tbody>
</table>

### WALLS

| R-16, R-19 | Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing. | ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”                                           |
| R-13 + R-5.6 ci  | The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing. | ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”                                           |
Roof R-Value – Insulation Placed on Suspended Ceiling with Removable Ceiling Tiles

- Will not count for code compliance
- Will not comply with Section 502.4.3 – “Sealing of the building envelope”
Roof R-Value – Metal Buildings

• R-5 thermal blocks required on all metal buildings or must use U-factor Compliance Method
• Climate Zones 2-8 require two layers of insulation for “all other”
  • CZ 2-5 and marine 4: R-13+R-13
  • CZ 6-7: R-13+R-19
  • CZ 8: R-11+R-19
• Example (R-13+R-19):
  • R-13 draped perpendicularly to the purlins
  • R-19 running parallel to the purlins supported by the R-13
Wall R-Value – Mass Walls

- Walls weighing at least 35 lbs/ft² of wall surface area, or
- 25 lbs/ft² of wall surface area if material weight is ≤ 120 lb/ft³
Mass Walls – Concrete Masonry Units

• Climate Zones 1 (group R) and 2 (all other)— Can use integral insulation instead of R-5.7 ci
  • Concrete block walls must comply with ASTM C 90, and
  • Ungrouted or partially grouted @ 32 inch. o.c. or less vertically or 48 inch. o.c. or less horizontally, and
  • Ungrouted cells must be filled with insulation material \( \leq \) of 0.44 Btu-in./h-ft\(^2\) F

• Climate Zone 1 “all other”
  • No insulation required for mass walls
Wall R-Value – Wood, Metal Frame, and Other

• Cavity insulation or cavity plus continuous (ci)
• Continuous insulation not broken up by framing members e.g. rigid board insulation
### Metal Building Walls [Table 502.2(2)]

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>R-16</td>
</tr>
<tr>
<td>3-4 except Marine</td>
<td>R-19</td>
</tr>
<tr>
<td>Marine 4-6</td>
<td>R-13+R-5.6ci</td>
</tr>
<tr>
<td>7-8</td>
<td>R-19+R-5.6ci</td>
</tr>
</tbody>
</table>

Picture from NAIMA
Floors Over Outdoor Air or Unconditioned Space (502.2.5)

- Joist/Framing (Steel/Wood)
  - Insulation installed between framing
- Mass Floors
  - Materials weighing 35 lbs/ft$^2$, or
  - 25 lbs/ft$^2$ if material weight is $\leq 120$ lbs/ft$^3$
  - Insulation installed continuously
- Steel Floor Joist Systems [Footnote e to Table 502.2(1)]
  - R-38 in Climate Zones 6-8
Slab-on-Grade Floors (502.2.6)

- Unheated slab – insulation required:
  - All Other in Climate Zones 6 - 8
  - Group R in Climate Zones 4 - 8
- Heated slabs – insulation required in all Climate Zones
Compliance with Chapter 5 Prescriptive Approach

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>EXCEPT MARINE</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical fenestration (40% maximum of above-grade wall)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U-factor</td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.40</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>Framing materials other than metal with or without metal reinforcement or cladding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U-factor</td>
<td>1.20</td>
<td>1.10</td>
<td>0.90</td>
<td>0.85</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Metal framing with or without thermal break</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curtain wall/storefront U-factor</td>
<td>1.0</td>
<td>0.70</td>
<td>0.60</td>
<td>0.50</td>
<td>0.45</td>
<td>0.45</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Entrance door U-factor</td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>All other U-factora</td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>0.45</td>
<td>0.45</td>
</tr>
</tbody>
</table>

SHGC: all frame types

| SHGC: PF < 0.25 | 0.25 | 0.25 | 0.25 | 0.40 | 0.40 | 0.40 | 0.45 | 0.45 |
| SHGC: 0.25 ≤ PF < 0.5 | 0.33 | 0.33 | 0.33 | NR  | NR  | NR  | NR  | NR  |
| SHGC: PF ≥ 0.5 | 0.40 | 0.40 | 0.40 | NR  | NR  | NR  | NR  | NR  |

Skylights (3% maximum)

| U-factor | 0.75 | 0.75 | 0.65 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| SHGC     | 0.35 | 0.35 | 0.35 | 0.40 | 0.40 | 0.40 | NR  | NR  |

NR = No requirement.
PF = Projection factor (see Section 502.3.2).
a. All others includes operable windows, fixed windows and nonentrance doors.
## Compliance with Chapter 5 Prescriptive Approach

Framing materials other than metal with or without metal reinforcement or cladding

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-factor</td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.40</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
</tbody>
</table>

- **SHGC: **
  - **PF < 0.25**: 0.25, 0.25, 0.25, 0.40, 0.40, 0.40, 0.45, 0.45
  - **0.25 ≤ PF < 0.5**: 0.33, 0.33, 0.33, NR, NR, NR, NR, NR
  - **PF ≥ 0.5**: 0.40, 0.40, 0.40, NR, NR, NR, NR, NR

- **Skylights (3% maximum)**
  - **U-factor**: 0.75, 0.75, 0.65, 0.60, 0.60, 0.60, 0.60, 0.60
  - **SHGC**: 0.35, 0.35, 0.35, 0.40, 0.40, 0.40, NR, NR

*NR = No requirement.
*PF = Projection factor (see Section 502.3.2).
*a. All others includes operable windows, fixed windows and nonentrance doors.
Compliance with Chapter 5 Prescriptive Approach

### Curtain wall/storefront U-Factor

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EXCEPT MARINE</td>
<td>AND MARINE 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curtain wall/</td>
<td>1.0</td>
<td>0.7</td>
<td>0.60</td>
<td>0.50</td>
<td>0.45</td>
<td>0.45</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>storefront U-Factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Entrance door U-factor

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EXCEPT MARINE</td>
<td>AND MARINE 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrance door</td>
<td>1.20</td>
<td>1.10</td>
<td>0.90</td>
<td>0.85</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>U-factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### All other U-factor

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>All other U-factor</td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>0.45</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**Metal framing with or without thermal break**

**TABLE 502.3 BUILDING ENVELOPE REQUIREMENTS: FENESTRATION**

<table>
<thead>
<tr>
<th>Vertical fenestration (40% maximum of above-grade wall)</th>
<th>U-factor</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal framing with or without thermal break</td>
<td>0.75</td>
<td>0.35</td>
</tr>
<tr>
<td>Metal framing without thermal break</td>
<td>0.65</td>
<td>0.35</td>
</tr>
<tr>
<td>Metal framing with thermal break</td>
<td>0.60</td>
<td>0.40</td>
</tr>
</tbody>
</table>

**Notes:**
- **NR** = No requirement.
- **PF** = Projection factor (see Section 502.3.2).
- **a.** All others includes operable windows, fixed windows and nonentrance doors.
### Compliance with Chapter 5 Prescriptive Approach

**TABLE 502.3**

**BUILDING ENVELOPE REQUIREMENTS: FENESTRATION**

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 (\text{EXCEPT MARINE})</th>
<th>5 (\text{AND MARINE 4})</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHGC: PF &lt; 0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>SHGC: 0.25 ≤ PF &lt; 0.5</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>SHGC: PF ≥ 0.5</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

| U-factor | 0.75 | 0.75 | 0.65 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| SHGC | 0.35 | 0.35 | 0.35 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |

**NR** = No requirement.

PF = Projection factor (see Section 502.3.2).

(a) All others includes operable windows, fixed windows and nonentrance doors.

**SHGC – all frame types**
## Compliance with Chapter 5 Prescriptive Approach

### Building Envelope Requirements: Fenestration

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE 4</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-factor</td>
<td>0.75</td>
<td>0.75</td>
<td>0.65</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>SHGC</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

- **Skylights (3% maximum)**

**TABLE 502.3**

**Vertical fenestration (40% maximum of above-grade wall)**

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE 4</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-factor</td>
<td>0.75</td>
<td>0.75</td>
<td>0.65</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>SHGC</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

**NR** = No requirement.

**PF** = Projection factor (see Section 502.3.2).

a. All others includes operable windows, fixed windows and non-entrance doors.
Vertical Fenestration Requirement (502.3.1)

- Based on above-grade wall area (gross)
  - Includes walls between conditioned space and unconditioned space or the great outdoors
    - Includes walls that are > 15% above grade
- Total fenestration area (includes frame and glazing)
  - Does not include opaque door area
Fenestration U-Factor (502.3.2)

Framing Materials Other Than Metal w/ or w/o metal reinforcement or cladding

Curtain Wall
Fenestration U-Factor – Storefront

Storefront

Entrance Door
Fenestration U-Factor – All Other

- Includes operable windows, fixed windows and non-entrance doors
What is Solar Heat Gain Coefficient?

“The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation.”
### Fenestration SHGC Requirements

The Effect of Overhangs on Fenestration SHGC

- Overhangs allow a higher SHGC product to be installed
- Projection factor must be calculated

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHGC: PF &lt; 0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
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<tr>
<td>SHGC: 0.25 ≤ PF &lt; 0.5</td>
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<td>0.33</td>
<td>0.33</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
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</tr>
<tr>
<td>SHGC: PF ≥ 0.5</td>
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<td>0.40</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>
Mandatory Requirements – Sealing of the Building Envelope (502.4.3)

• All penetrations, openings, joints and seams in the building envelope must be sealed. Materials that can be used include:
  • Caulking
  • Gasketing
  • Tapes
  • Moisture vapor-permeable wrapping material
• Sealing materials spanning joints between dissimilar materials must allow for expansion and contraction
Mandatory Requirements – Outdoor Air Intakes and Exhaust Openings (502.4.5)

- Buildings $\geq 3$ stories in height above grade
  - Class 1 motorized leakage-rated damper
    - Maximum leakage rate $\leq 4\text{cfm} / \text{ft}^2 @ 1.0 \text{ inch w.g.}$

- Buildings $< 3$ stories in height
  - Gravity (nonmotorized) allowed
Mandatory Requirements – Loading Dock Weatherseals (502.4.6)

- Equip cargo doors and loading dock doors with weatherseals
- Goal is to restrict infiltration
Mandatory Requirements – Vestibules (502.4.7)

• Required to reduce infiltration into spaces
• Required on entrance doors leading into spaces ≥ 3,000 ft²
• Doors must have self-closing devices
• Exceptions
  • Buildings in Climate Zones 1 and 2
  • Doors from a guest room or dwelling unit
  • Doors used primarily for vehicular movement, material handling and adjacent personnel doors
Mandatory Requirements – Recessed Lighting (502.4.8)

All recessed luminaires installed in the building envelope

- Type IC rated and sealed with gasket or caulk between housing and interior wall or ceiling covering
- Type IC rated and labeled in accordance with ASTM E 283 to allow $\leq 2.0$ cfm of air movement from conditioned space to ceiling cavity