

Guide to Georgia Commercial Building Envelope Requirements

ASHRAE 90.1-2013 +
2020 Georgia
State Supplements & Amendments

How to Use the Field Guide

This guide is intended to help explain the commercial envelope portion of the energy code and does not necessarily include all aspects and details. This guide is organized by building component and attempts to compile all relevant information and key practices related to each component. Each entry emphasizes the requirements of ASHRAE 90.1-2013 and (where appropriate) includes references to the 2015 IECC Commercial Provisions and/or 2020 Georgia State Supplements and Amendments. Graphics and illustrations are provided as examples only.

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energycodes@southface.org
404-604-3598

Credits

Principal authors:

Mike Barcik, Southface Senior Technical Principal
Bourke Reeve, Project Manager, Three Points Planning

Graphic design and illustration:

Greg Brough, Southface Senior Technical Principal

Editor: Mike L. Ford, Southface Project Manager

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Roof, Insulation Entirely Above Deck

Inspection Requirements

Verify that R-value of continuous insulation (c.i.) above roof deck meets or exceeds the value required by climate zone. The COMcheck Compliance Certificate (if applicable) should match the installed insulation levels.

Details

Rigid foam board installed above the roof deck is a more effective application of roof insulation than attic insulation, as it provides unbroken thermal resistance from the sun’s radiant energy and reduces heat transfer to the conditioned space.

Ensure that consistent, minimum R-value is met, even at the lowest point on the roof, as insulation thickness is sometimes compromised to provide drainage for roofs. (Pay special attention to areas adjacent to drains and scuppers.)

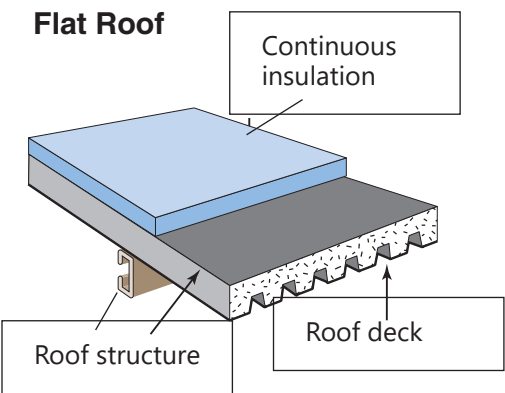
☑ *The 2015 IECC R-values for continuous insulation entirely above roof deck are equivalent to ASHRAE 90.1-2013.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-25.0 c.i.	R-25.0 c.i.	R-5.0 c.i.
3	R-25.0 c.i.	R-25.0 c.i.	R-7.6 c.i.
4	R-30.0 c.i.	R-30.0 c.i.	R-10.0 c.i.

Code reference

ASHRAE 90.1-2013—Section 5.5.1



Roof, Metal Building

Inspection Requirements

Verify that R-value of metal building insulation meets or exceeds the level required and that thermal blocks are installed. Verify that the installed levels match the value in the COMcheck Compliance Certificate (if applicable).

Details

The code requires insulation to be draped perpendicular to the roof purlins with thermal blocks (A2.3.2.1). Better described as “strips” than “blocks,” this minimum R-3 rigid insulation material runs the length of each purlin or girt and acts as a thermal break to reduce conductive energy transfer to/from the roof.

The prescriptive values below contain additional footnotes pertaining to metal building insulation systems. In this context, *fc* stands for “filled cavity” and *ls* stands for “liner system.” The first R-value listed refers to insulation run perpendicular and draped over the purlin. The second R-value listed refers to unfaced insulation installed above the first layer and parallel to the purlin. Some compression will occur.

☑ *The 2015 IECC requires R-19 + 11 ls for metal building roofs in CZ 2–4.*

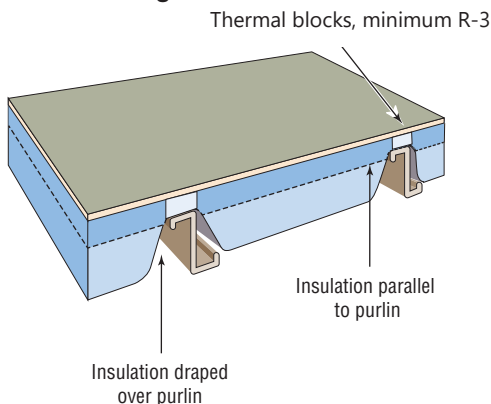
Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-10.0 + R-19.0 fc	R-10.0 + R-19.0 fc	R-16.0
3	R-10.0 + R-19.0 fc	R-10.0 + R-19.0 fc	R-16.0
4	R-19.0 + R-11 ls OR R-25 + R-8 ls	R-19.0 + R-11 ls OR R-25 + R-8 ls	R-19.0

Code reference

ASHRAE 90.1-2013—Section 5.5.1

Metal Building



Roof, Attic and Other

Inspection Requirements

Verify that R-value of insulation meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Any roof insulation that is not entirely above deck or part of a metal building roof falls into this category.

Blown or loose-fill insulation should be applied at a uniform depth or thickness and should extend to the entire thermal boundary, in this case over the top plate to the outermost face of each exterior wall.

Rulers installed every 300 sq. ft. are a good way to verify the blown or loose-fill attic depth.

☑ *The 2015 IECC requires R-38 for attic insulation in CZs 2-4.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-38.0	R-38.0	R-19.0
3	R-38.0	R-38.0	R-19.0
4	R-49.0	R-49.0	R-30.0

Code reference

ASHRAE 90.1-2013—Section 5.5.1



Ruler shows depth of installed blown-in insulation. Typical blown-in insulation has an R-value of around R-3.2 per inch. 12 to 14 inches of blown-in insulation is typical to achieve R-38.

Walls, Above Grade—Mass

Inspection Requirements

Verify that R-value of continuous insulation (c.i.) on mass walls meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Mass walls are thick, heavy walls; typical materials are concrete, CMU, or solid multi-wythe brick.

- ☑ *The 2015 IECC R-values for above-grade mass wall insulation are equivalent to ASHRAE 90.1-2013.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-5.7 c.i. ^b	R-7.6 c.i.	N/A
3	R-7.6 c.i.	R-9.5 c.i.	N/A
4	R-9.5 c.i.	R-11.4 c.i.	N/A

^b For above-grade insulation, an exception for mass walls using approved construction assembly types is permitted. For additional details see ASHRAE 90.1-2013 section 5.5.3.2.

Code reference ASHRAE 90.1-2013—Section 5.5.3.2



Installation of a waterproof coating installed under continuous insulation on a concrete wall.

Walls, Above Grade—Metal Building

Inspection Requirements

Verify that R-value of continuous insulation (c.i.) on metal buildings meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Insulation is draped perpendicular to purlins. Compression at purlins is allowed.

- ☑ *The 2015 IECC requires a minimum R-13 + 6.5 c.i. for metal building walls in CZs 2-4. See IECC Table C402.1.3 for details.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-9.8 c.i.	R- 9.8 c.i.	R-13.0
3	R-9.8 c.i.	R-13.0 c.i.	R-13.0
4	R-15.8 c.i.	R-19.0 c.i.	R-13.0

Code reference ASHRAE 90.1-2013—Section 5.5.3.2



Walls, Above Grade—Steel-Framed

Inspection Requirements

Verify that R-value of continuous insulation (c.i.) at steel-framed walls meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Metal readily conducts energy; continuous insulation (c.i.) across the face of a metal stud wall (ideally on the exterior) minimizes the thermal bridging effect. Therefore, the code often requires both cavity insulation and continuous insulation. Verify that cavity insulation is in permanent continuous contact with the exterior sheathing, with no gaps or voids.

- ☑ *The 2015 IECC requires slightly higher levels of continuous insulation for commercial building metal framed walls in CZs 2-4. See IECC Table C402.1.3 for insulation R-values.*

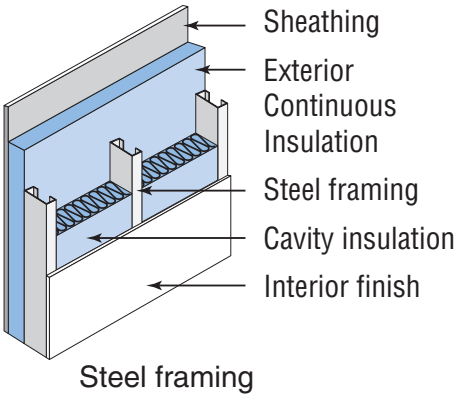
Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-13.0 + R-3.8 c.i.	R-13.0 + R7.5 c.i.	R-13.0
3	R-13.0 + R-5 c.i.	R-13.0 + R7.5 c.i.	R-13.0
4	R-13.0 + R7.5 c.i.	R-13.0 + R7.5 c.i.	R-13.0

Note: two values indicate cavity + continuous insulation

Code reference

ASHRAE 90.1-2013—Section 5.5.3.2



Walls, Above Grade—Wood-Framed

Inspection Requirements

Verify that R-value of insulation on wood-framed walls meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Verify that cavity insulation is in permanent, continuous contact with the exterior sheathing, with no gaps or voids.

- ☑ *The 2015 IECC requires either R-13 + 3.8 c.i. or R-20 for above grade wood-framed walls in CZs 2-4.*

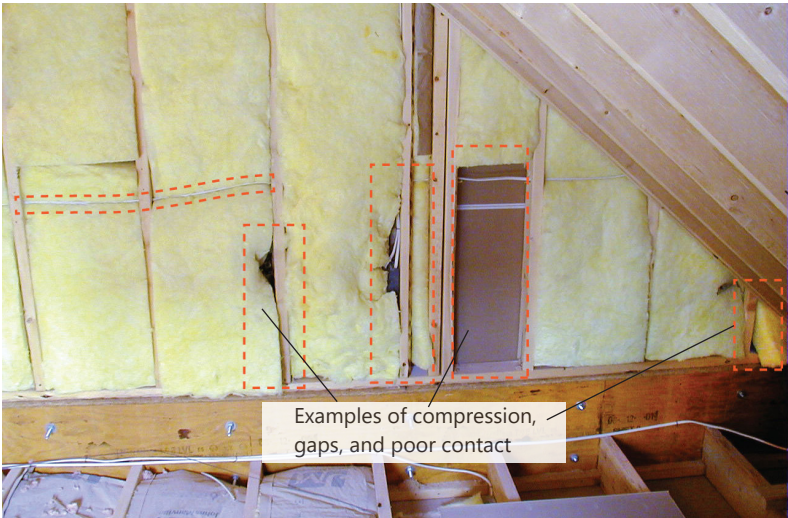
Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-13.0	R-13.0	R-13.0
3	R-13.0	R-13.0	R-13.0
4	R-13.0	R-13.0 + R-3.8 c.i. Or R-20	R-13.0

Note: two values indicate cavity + continuous insulation

Code reference

ASHRAE 90.1-2013—Section 5.5.3.2



R-value of insulation is reduced by gaps, voids, compression, moisture, and lack of contact with air barrier on all sides.

Walls, Below Grade

Inspection Requirements

Verify that R-value of insulation on below-grade walls meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

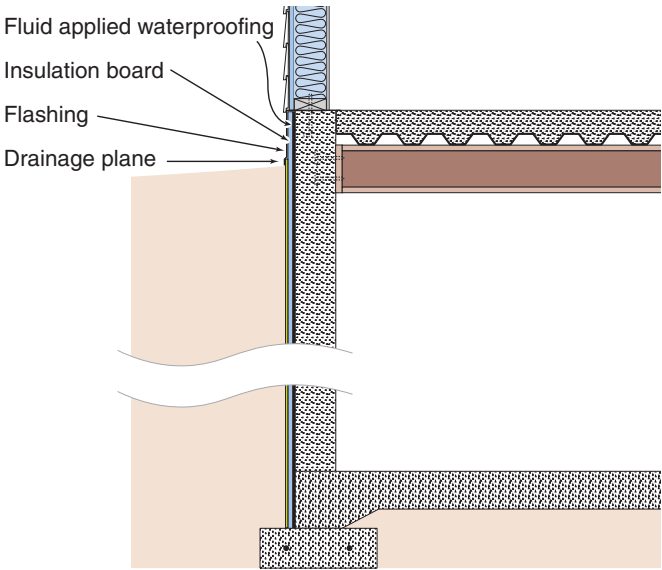
In Georgia, insulation on below-grade walls is only required in CZ4.

- ☑ *The 2015 IECC requires R-7.5 c.i. for all below grade walls in CZ4.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	N/A	N/A	N/A
3	N/A	N/A	N/A
4	R-7.5	R-10.0	N/A

Code reference ASHRAE 90.1-2013—Section 5.5.3.3



Floors, Mass

Inspection Requirements

Verify that R-value of continuous insulation (c.i.) on the mass floors meets or exceeds the values required by climate zone. Verify that the installed insulation value matches COMcheck Compliance Certificate (if applicable).

Details

Insulation installed on mass floors should cover the structure completely, with no gaps or voids visible. Mass-floor insulation is often required for elevated slabs above parking decks in commercial buildings.

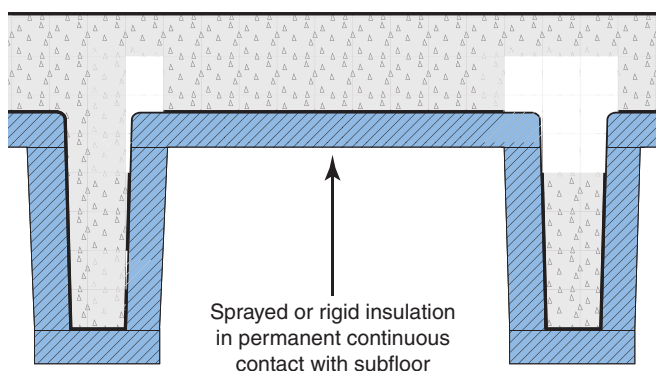
- ☑ *The 2015 IECC R-values for mass floor insulation are equivalent to ASHRAE 90.1-2013 for CZs 2-3. The IECC requires R-10 c.i. for most commercial building mass floors in CZ4. See IECC 2015 Table C402.1.3 for details.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-6.3 c.i.	R-8.3 c.i.	N/A
3	R-10.0 c.i.	R-10.0 c.i.	R-4.2 c.i.
4	R-14.6 c.i.	R-16.7 c.i.	R-6.3 c.i.

Code reference

ASHRAE 90.1-2013—Section 5.5.3.4



Floors, Steel-Joist

Inspection Requirements

Verify that R-Value of floor cavity insulation meets or exceeds the values required by climate zone and insulation is in permanent continuous contact with the underside of the floor deck. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Pay close attention to the installation of insulation in framed floors. Air spaces created by floor insulation that has separated (dropped/sagged) from direct contact with the underside of a floor may allow air to flow through the insulation and negate the thermal benefits.

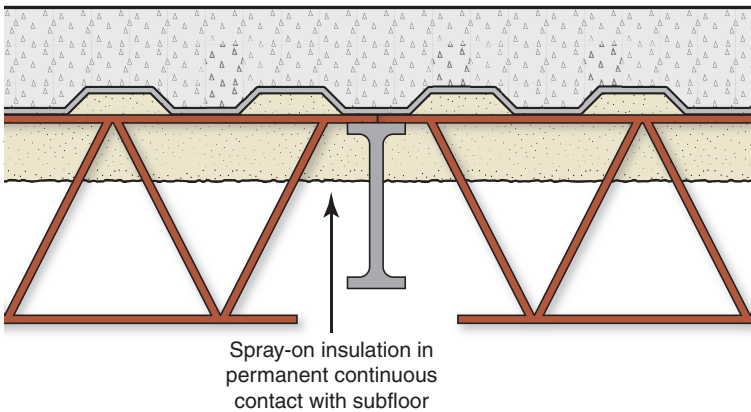
- ☑ *The 2015 IECC R-values for steel-joint framed floors are equivalent to ASHRAE 90.1-2013.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-30	R-30	R-13
3	R-30	R-30	R-19
4	R-30	R-30	R-19

Code reference

ASHRAE 90.1-2013—Section 5.5.3.4



Floors, Wood-Framed

Inspection Requirements

Verify that R-value of floor cavity insulation meets or exceeds the values required by climate zone and insulation is in permanent continuous contact with the underside of the floor deck. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Pay close attention to the installation of insulation in framed floors. Air spaces created by floor insulation that has separated (dropped/sagged) from direct contact with the underside of a floor may allow air to flow through the insulation and negate the thermal benefits. Cantilevered floors must be insulated and the joist cavities blocked above the supporting exterior wall.

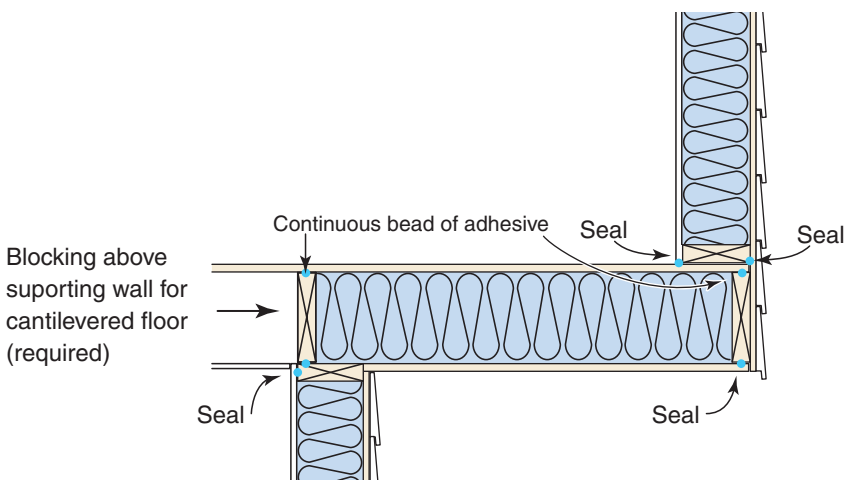
☑ *The 2015 IECC R-values for wood-framed floors are equivalent to ASHRAE 90.1-2013.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-30	R-30	R-13
3	R-30	R-30	R-19
4	R-30	R-30	R-19

Code reference

ASHRAE 90.1-2013—Section 5.5.3.4



Floors, Slab-on-Grade — Heated Floors

Inspection Requirements

Verify that R-value and extent of slab perimeter insulation meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Heat loss at slab edge is minimized by slab perimeter insulation installed per ASHRAE 90.1-2013, Tables 5.5-2 thru 5.5-4.

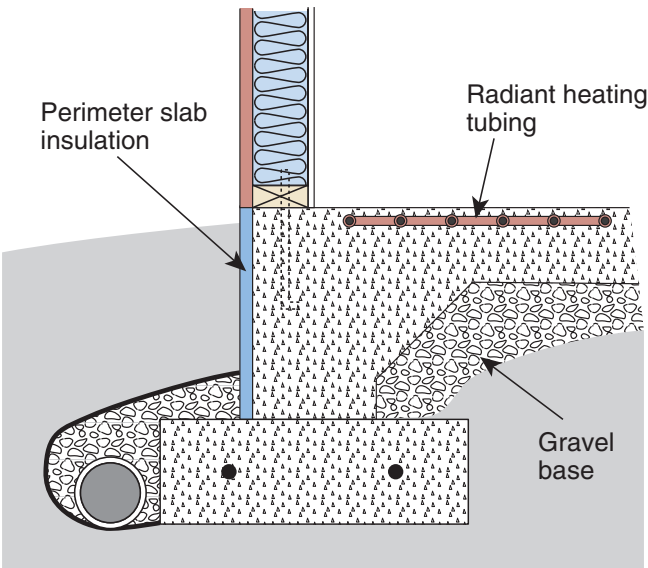
- ☑ *The 2015 IECC R-values for heated, slab-on-grade floors are less stringent than ASHRAE 90.1-2013. The IECC requires R-7.5 to R-15 for commercial buildings depending on climate zone. See IECC Table C402.1.3 for details.*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	R-10.0 for 24 in.	R-15.0 for 24 in.	R-7.5 for 12 in.
3	R-15.0 for 24 in.	R-15.0 for 24 in.	R-7.5 for 12 in.
4	R-20.0 for 24 in.	R-20.0 for 24 in.	R-10.0 for 12 in.

Code reference

ASHRAE 90.1-2013—Section 5.5.3.5



Note: Insulation under slab is not required or useful in CZs 2–4.

Floors, Slab-on-Grade—Unheated Floors

Inspection Requirements

Verify that R-value and extent of slab perimeter insulation meets or exceeds the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

In Georgia, some unheated slabs in CZs 3-4 now require insulation. Heat loss at slab edge is minimized by slab perimeter insulation installed per ASHRAE 90.1-2013, Tables 5.5-2 through 5.5-4.

- ☑ *The 2015 IECC requires R-10 for 24 inches for commercial building unheated slabs in CZ4 (Table C403.1.3); however, a Georgia 2020 Energy Code Amendment reduces this to zero (NR).*

Prescriptive Values (For assembly U-factor and other requirements, see Table 5.5 on pp19-21.)

Climate Zone	Non-Residential	Residential	Semi-Heated
2	NR	NR	NR
3	NR	R-10 for 24in.	NR
4	R-15 for 24in.	R-15 for 24in.	NR

Code reference

ASHRAE 90.1-2013—Section 5.5.3.5

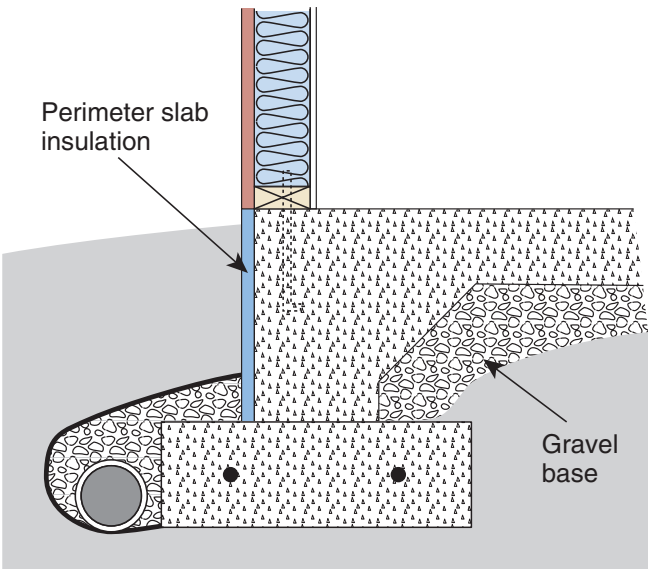


Table 5.5, Building Envelope Requirements CZs 2-4

Tables 5.5-2 to 5.5-4 are included here and on the following two pages as supplements to the Opaque Elements section (pp6-17, above) and show assembly U-factors and other requirements for various components.

Table 5.5-2 Building Envelope Requirements for Climate Zone 2 (A,B)*

Opaque Elements	Nonresidential		Residential		Semiheated				
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value			
<i>Roofs</i>									
Insulation Entirely above Deck	U-0.039	R-25 c.i.	U-0.039	R-25 c.i.	U-0.173	R-5 c.i.			
Metal Building ^a	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.096	R-16			
Attic and Other	U-0.027	R-38	U-0.027	R-38	U-0.053	R-19			
<i>Walls, above Grade</i>									
Mass	U-0.151 ^b	R-5.7 c.i. ^b	U-0.123	R-7.6 c.i.	U-0.580	NR			
Metal Building	U-0.094	R-9 + R-9.8 c.i.	U-0.094	R-9 + R-9.8 c.i.	U-0.162	R-13			
Steel Framed	U-0.064	R-13 + R-3.8 c.i.	U-0.064	R-13 + R-7.5 c.i.	U-0.124	R-13			
Wood Framed and Other	U-0.089	R-13	U-0.089	R-13	U-0.089	R-13			
<i>Wall, below Grade</i>									
Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR			
<i>Floors</i>									
Mass	U-0.107	R-6.3 c.i.	U-0.087	R-8.3 c.i.	U-0.322	NR			
Steel Joist	U-0.038	R-30	U-0.038	R-30	U-0.069	R-13			
Wood Framed and Other	U-0.033	R-30	U-0.033	R-30	U-0.066	R-13			
<i>Slab-on-Grade Floors</i>									
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR			
Heated	F-0.980	R-10 for 24 in.	F-0.890	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.			
<i>Opaque Doors</i>									
Swinging	U-0.700		U-0.500		U-0.700				
Nonswinging	U-0.500		U-0.500		U-1.450				
Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0%–40% of Wall</i>		(for all frame types)		(for all frame types)		(for all frame types)			
Nonmetal framing, all	U-0.40			U-0.40			U-0.93		
Metal framing, fixed	U-0.57			U-0.57			U-1.20		
Metal framing, operable	U-0.65	SHGC-0.25	1.10	U-0.65	SHGC-0.25	1.10	U-1.20	NR	NR
Metal framing, entrance door	U-0.83			U-0.77			U-0.83		
<i>Skylight, 0%–3% of Roof</i>									
All types	U-0.65	SHGC-0.35	NR	U-0.65	SHGC-0.35	NR	U-1.80	NR	NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2); FC = fiberglass cavity (see Section A2.3.2.5); L.e. = liner system (see Section A2.3.2.4); NR = no insulation requirement.

a. When using the R-value compliance method for metal building roofs, a thermal spacer block is required (see Section A2.3.2).

b. Exception to Section 5.5.3.2 applies for mass walls above grade.

Table 5.5, Building Envelope Requirements, continued

Table 5.5-3 Building Envelope Requirements for Climate Zone 3 (A,B,C)*

Opaque Elements	Nonresidential		Residential		Semiheated				
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value			
<i>Roofs</i>									
Insulation Entirely above Deck	U-0.039	R-25 c.i.	U-0.039	R-25 c.i.	U-0.119	R-7.6 c.i.			
Metal Building ^a	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.096	R-16			
Attic and Other	U-0.027	R-38	U-0.027	R-38	U-0.053	R-19			
<i>Walls, above Grade</i>									
Mass	U-0.123	R-7.6 c.i.	U-0.104	R-9.5 c.i.	U-0.580	NR			
Metal Building	U-0.094	R-0 + R-9.8 c.i.	U-0.072	R-0 + R-13 c.i.	U-0.162	R-13			
Steel Framed	U-0.077	R-13 + R-5 c.i.	U-0.064	R-13 + R-7.5 c.i.	U-0.124	R-13			
Wood Framed and Other	U-0.089	R-13	U-0.064	R-13 + R-3.8 c.i. or R-20	U-0.089	R-13			
<i>Wall, below Grade</i>									
Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR			
<i>Floors</i>									
Mass	U-0.074	R-10 c.i.	U-0.074	R-10 c.i.	U-0.137	R-4.2 c.i.			
Steel Joist	U-0.038	R-30	U-0.038	R-30	U-0.052	R-19			
Wood Framed and Other	U-0.033	R-30	U-0.033	R-30	U-0.051	R-19			
<i>Slab-on-Grade Floors</i>									
Unheated	F-0.730	NR	F-0.540	R-10 for 24 in.	F-0.730	NR			
Heated	F-0.860	R-15 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.			
<i>Opaque Doors</i>									
Swinging	U-0.700		U-0.500		U-0.700				
Nonswinging	U-0.500		U-0.500		U-1.450				
Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0%-40% of Wall</i>		(for all frame types)		(for all frame types)		(for all frame types)			
Nonmetal framing, all	U-0.35			U-0.35			U-0.87		
Metal framing, fixed	U-0.50			U-0.50			U-1.20		
Metal framing, operable	U-0.60	SHGC-0.25	1.10	U-0.60	SHGC-0.25	1.10	U-1.20	NR	NR
Metal framing, entrance door	U-0.77			U-0.68			U-0.77		
<i>Skylight, 0%-3% of Roof</i>									
All types	U-0.55	SHGC-0.35	NR	U-0.55	SHGC-0.35	NR	U-1.70	NR	NR

* The following definitions apply: c.i. – continuous insulation (see Section 2.2.1), FC – filled cavity (see Section A2.3.2.5), Ls – linear system (see Section A2.3.2.4), NR – no (insulation) requirement.

a. When using the R-value compliance method for metal building roofs, a thermal spacer block is required (see Section A2.3.2).

Table 5.5, Building Envelope Requirements, continued

Table 5.5-4 Building Envelope Requirements for Climate Zone 4 (A,B,C)*

Opaque Elements	Nonresidential		Residential		Semiheated				
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value			
<i>Roofs</i>									
Insulation Entirely above Deck	U-0.032	R-30 c.i.	U-0.032	R-30 c.i.	U-0.093	R-10 c.i.			
Metal Building ^a	U-0.037	R-19 + R-11 Ls or R-25 + R-8 Ls	U-0.037	R-19 + R-11 Ls or R-25 + R-8 Ls	U-0.082	R-19			
Attic and Other	U-0.021	R-49	U-0.021	R-49	U-0.034	R-30			
<i>Walls, above Grade</i>									
Mass	U-0.104	R-9.5 c.i.	U-0.090	R-11.4 c.i.	U-0.580	NR			
Metal Building	U-0.060	R-0 + R-15.8 c.i.	U-0.050	R-0 + R-19 c.i.	U-0.162	R-13			
Steel Framed	U-0.064	R-13 + R-7.5 c.i.	U-0.064	R-13 + R-7.5 c.i.	U-0.124	R-13			
Wood Framed and Other	U-0.064	R-13 + R-3.8 c.i. or R-20	U-0.064	R-13 + R-3.8 c.i. or R-20	U-0.089	R-13			
<i>Wall, below Grade</i>									
Below Grade Wall	C-0.119	R-7.5 c.i.	C-0.092	R-10 c.i.	C-1.140	NR			
<i>Floors</i>									
Mass	U-0.057	R-14.6 c.i.	U-0.051	R-16.7 c.i.	U-0.107	R-6.3 c.i.			
Steel Joist	U-0.038	R-30	U-0.038	R-30	U-0.052	R-19			
Wood Framed and Other	U-0.033	R-30	U-0.033	R-30	U-0.051	R-19			
<i>Slab-on-Grade Floors</i>									
Unheated	F-0.520	R-15 for 24 in.	F-0.520	R-15 for 24 in.	F-0.730	NR			
Heated	F-0.843	R-20 for 24 in.	F-0.688	R-20 for 48 in.	F-0.900	R-10 for 24 in.			
<i>Opaque Doors</i>									
Swinging	U-0.500		U-0.500		U-0.700				
Nonswinging	U-0.500		U-0.500		U-1.450				
Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
Vertical Fenestration, 0%–40% of Wall		(for all frame types)			(for all frame types)		(for all frame types)		
Nonmetal framing, all	U-0.35			U-0.35			U-0.51		
Metal framing, fixed	U-0.42			U-0.42			U-0.73		
Metal framing, operable	U-0.50	SHGC-0.40	1.10	U-0.50	SHGC-0.40	1.10	U-0.81	NR	NR
Metal framing, entrance door	U-0.77			U-0.68			U-0.77		
<i>Skylight, 0%–3% of Roof</i>									
All types	U-0.50	SHGC-0.40	NR	U-0.50	SHGC-0.40	NR	U-1.15	NR	NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2); FC = filled cavity (see Section A2.3.2.5); Ls = linear system (see Section A2.3.2.4); NR = no (insulation) requirement.

a. When using the R-value compliance method for metal building roofs, a thermal spacer block is required (see Section A2.3.2).

Opaque Doors, Swinging

Inspection Requirements

Verify that assembly U-value as stamped on product is no higher than the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Labeling of U-values on doors is not standard industry practice. It is often necessary to request documentation demonstrating compliance when no label is present on the installed product.


- ☒ *The 2015 IECC requires U-0.61 for all swinging doors in commercial buildings in CZs 2-4, equivalent to ASHRAE 90.1-2013.*

Prescriptive Values

Climate Zone	Non-Residential	Residential	Semi-Heated
2	U-0.70	U-0.50	U-0.70
3	U-0.70	U-0.50	U-0.70
4	U-0.50	U-0.50	U-0.70

Code reference

ASHRAE 90.1-2013—Section 5.5.3.6



National Fenestration
Rating Council®

CERTIFIED

World's Best Door Co.

Entrance Door
CPD#000-x-000

Insulated Steel Wood Edge Door

ENERGY PERFORMANCE RATINGS					
Product Description* Default Frame** Wood	U-Factor/Solar Heat Gain Coefficient (SHGC)				
	1/4 Lite ≤410†	1/2 Lite ≤900†	3/4 Lite ≤1100†	Full Lite >1100†	
2/A1/na/AIR/0.250	0.23	0.30	—	0.40	0.40
2/A1/.020(3)/ARG/0.750	0.21	0.24	—	0.28	0.36
2/A1/na/AIR/0.675	—	0.28	0.33	0.34	0.40
3/SS/na/AIR/0.250	0.21	0.25	—	0.29	0.40
Flush/Embossed	U-Factor 0.19		SHGC 0.04		

Manufacturer stipulates that these ratings conform to applicable NFRCC procedures for determining whole product performance. NFRCC ratings are determined for a fixed set of environmental conditions and a specific product size.

* #glazing layers / spacer type / low-e emissivity (surface) / gap fill / gap width (na-not applicable)
** per NFRCC 100 Section B3.24 † square inches

www.nfrcc.org

Opaque Doors, Non-Swinging

Inspection Requirements

Verify that assembly U-value as stamped on product is no higher than the values required by climate zone. Verify that the installed insulation value matches the COMcheck Compliance Certificate (if applicable).

Details

Labeling of U-values on doors is not standard industry practice. It is often necessary to request documentation demonstrating compliance when no label is present on the installed product.

- ☑ *The 2015 IECC requires R-4.75 for all non-swinging doors in commercial buildings in CZs 2-4.*

Prescriptive Values

Climate Zone	Non-Residential	Residential	Semi-Heated
2	U-0.50	U-0.50	U-1.45
3	U-0.50	U-0.50	U-1.45
4	U-0.50	U-0.50	U-1.45

Code reference

ASHRAE 90.1-2013—Section 5.5.3.6



Vertical Glazing, 0%–40% of Wall Area

Inspection Requirements

Verify that the assembly U-value, SHGC, and VT/SHGC as listed on product or certificate comply with the values required by climate zone. Verify that the installed product values match the COMcheck Compliance Certificate (if applicable).

Details

The prescriptive building envelope option is applicable only if the vertical fenestration area does not exceed 40% of the gross wall area for each space-conditioning category. Buildings with greater than 40% glazing must use the Section 11 Energy Cost Budget performance pathway to show compliance.

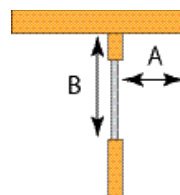
Assembly U-value and SHGC can be verified either with a factory installed label or by a certificate from the manufacturer.

The SHGC target value of 0.25 in CZs 2–3 can be difficult to achieve with glazing performance alone. An overhang or shading device may improve the performance of the glazing.

The “projection factor” credit for an overhang can be calculated using values from the Table 5.5.4.4.1. This table value times the actual glass SHGC will yield a lower effective SHGC. COMcheck is generally the easiest way to receive credit for this external shading benefit of the 90.1 code. *See example problem p. 91*

	World's Best Window Co. Millennium 2000® Vinyl-Clad Wood Frame Double Glazing - Argon Fill - Low E Product Type: Vertical Slider	
	ENERGY PERFORMANCE RATINGS	
	U-Factor (U.S./I-P) 0.30	Solar Heat Gain Coefficient 0.30
	ADDITIONAL PERFORMANCE RATINGS	
	Visible Transmittance 0.51	Air Leakage (U.S./I-P) 0.2

Manufacturer requires that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not measure any product and does not warrant the validity of any product for any specific use. Consult manufacturer's literature for other product performance information.



$$PF = A/B$$

Projection Factor (PF) and SHGC
 PF = Ration of overhang projection divided by height from window sill to bottom of overhang (must be permanent)

Table 5.5.4.4.1 SHGC Multipliers for Permanent Projections

Projection Factor	SHGC Multiplier (non-North Orientations)	SHGC Multiplier (North Oriented)
0-0.10	1.0	1.0
>0.10-0.20	0.91	0.95
>0.20-0.30	0.82	0.91
>0.30-0.40	0.74	0.87
>0.40-0.50	0.67	0.84
>0.50-0.60	0.61	0.81
>0.60-0.70	0.56	0.78
>0.70-0.80	0.51	0.76
>0.80-0.90	0.47	0.75
>0.90-1.00	0.44	0.73

ASHRAE 2013 also requires compliance with the Visible Transmittance to Solar Heat Gain Coefficient Ratio (VT/SHGU). The ratio must not be less than the requirement specified in the following table.

- ☑ *The 2015 IECC limits fenestration to 30% of the gross wall area when using the prescriptive pathway. (Continued on next page.)*
- ☑ *The 2015 IECC requires U-0.50 in CZ2, U-0.46 in CZ3, and U-0.38 in CZ4 for commercial building fenestration. SHGC requirements are the same as ASHRAE (0.25) for glazing that faces south, east, and west. North-facing glazing has a separate SHGC requirement in the IECC. Projection factor is also calculated differently by the IECC. See IECC Table C402.4 for details.*
- ☑ *The 2015 IECC does not require VT/SHGC ratio compliance.*

Climate Zone	Non-Residential	Residential	Semi-Heated
2	U-0.57, SHGC-0.25, VT/SHCG-1.10	U-0.57, SHGC-0.25, VT/SHGC-1.10	U-1.20, SHGC – NA, VT/SHGC - NA
3	U-0.50, SHGC-0.25, VT/SHCG-1.10	U-0.50, SHGC-0.25, VT/SHCG-1.10	U-1.20, SHGC – NA, VT/SHGC - NA
4	U-0.50, SHGC-0.40, VT/SHCG-1.10	U-0.50, SHGC-0.40, VT/SHCG-1.10	U-1.20, SHGC – NA, VT/SHGC - NA

Code reference ASHRAE 90.1-2013—Section 5.5.4 & 5.8.2

[illegible]

Example Compliance Certificate

Skylights, U-Factor and SHGC

Inspection Requirements

Verify that the assembly U-value as listed on product is no higher than the values required by climate zone. Verify that the installed product U-factor and SHGC values match the COMcheck Compliance Certificate (if applicable).

Details

Assembly U-value and SHGC can be verified either with a factory installed label or by a certificate from the manufacturer.

- ☒ *Prescriptive values for skylight U-factor and SHGC are the same for 2015 IECC (Table C402.4).*

Prescriptive Values

Climate Zone	Non-Residential	Residential	Semi-Heated
2	U-0.65, SHGC-0.35	U-0.65, SHGC-0.35	U-1.80
3	U-0.55, SHGC-0.35	U-0.55, SHGC-0.35	U-1.7
4	U-0.50, SHGC-0.40	U-0.50, SHGC-0.40	U-1.15

Prescriptive values above are for skylights comprising less than 3% of roof area per space category.

Code reference ASHRAE 90.1-2013—Section 5.5.4 & 5.8.2



Skylights, Maximum and Minimum Fenestration Area

Inspection Requirements

Verify that skylight maximum and minimum area is compliant.

Details

ASHRAE 90.1-2013 generally limits total skylight maximum area to 0–3% of the total roof area for each space-conditioning category. Buildings may be allowed up to 6% skylight area provided they meet all requirements of section 5.5.4.4.2, Exception 1.

Additionally, ASHRAE 90.1-2013 requires some buildings to have a minimum skylight area. This minimum area is described in Section 5.5.4.2.3 and applies to buildings which:

1. Are 2,500 sq. ft. or larger
2. Have ceilings with a height greater than 15 feet

Applicable space types include office, lobby, atrium, concourse, corridor, storage (including nonrefrigerated warehouse), gymnasium and gymnasium seating area, fitness/exercise area, playing area, convention exhibit/event space, courtroom, automotive service, fire station engine room, manufacturing corridor/transition and bay areas, retail, library reading and stack areas, distribution/sorting area, transportation baggage and seating areas, and workshops.

- ☑ *The 2015 IECC limits skylights to 3% gross roof area. See section C402.4 for details.*
- ☑ *The 2015 IECC also has a minimum skylight area of 3% for spaces greater than 2,500 sq. ft. with ceilings higher than 15 feet. See IECC section 402.4.2 for details.*

Code reference

ASHRAE 90.1-2013—Section 5.5.4 & 5.8.2

Labeled Fenestration

Inspection Requirements

Verify that windows and skylights are labeled and certified by the manufacturer for U-factor, SHGC, air leakage rate, and visual transmittance.

Details

A compliance certificate from the manufacturer is also acceptable documentation.

Code reference

ASHRAE 90.1-2013—Sections 5.8.2.3–5.8.2.5

10.0 – Certificate of Compliance

CERTIFICATE of COMPLIANCE

Certificate Authorization

Name: _____

Signature: _____ Date: _____

Company: _____

OVERALL RATING

U-Factor:
($Btu/h \cdot ft^2 \cdot F$)

SHGC:

Directions: Fill out form completely. Determine the Overall Rating for this project by using the C.O.G. U-Factor and C.O.G. SHGC from Table 1 and looking up the overall rating from Table 2. Indicate the Overall Rating in the space above. Linear interpolation is permitted.

CERTIFIES THAT THE MATERIALS LISTED ON THIS CERTIFICATE WERE INSTALLED ON THE PROJECT IDENTIFIED BELOW.

PROJECT INFORMATION:

Street Address: _____

City: _____ State: _____ Zip: _____

GLAZING CONTRACTOR / INSTALLER:

Street Address: _____ Contact Person: _____

City: _____ Phone Number: _____

State: _____ Zip: _____

GLAZING MATERIAL SUPPLIER:

Street Address: _____ Contact Person: _____

City: _____ Phone Number: _____

State: _____ Zip: _____

Glass and Spacer Type: _____

Center-of-glass (C.O.G.) U-Factor: _____ Center-of-glass (C.O.G.) SHGC: _____

$Btu/h \cdot ft^2 \cdot F$

FRAMING MATERIAL SUPPLIER:

Street Address: _____ Contact Person: _____

City: _____ Phone Number: _____

State: _____ Zip: _____

Product Line:

YES 45 TU

The overall ratings for U-factor and SHGC are based on a size of 2000 mm x 2000 mm (79 3/4 in x 79 3/4 in) as required in NFRC 100.

Overall U-factors and Solar Heat Gain Coefficients (SHGC) listed in the matrix were determined in accordance with NFRC 100 and NFRC 200 respectively by a NFRC accredited laboratory.

ACCREDITED LABORATORY:

Architectural Testing
Reference Test Report #: 76081.01-116-45

TABLE 1 – GLAZING

U-Factor Matrix ($Btu/h \cdot ft^2 \cdot F$)

C.O.G. U-Factor	OVERALL U-Factor	C.O.G. SHGC	OVERALL SHGC
0.48	0.69	0.75	0.67
0.46	0.67	0.70	0.63
0.44	0.65	0.65	0.59
0.42	0.64	0.60	0.54
0.40	0.62	0.55	0.50
0.38	0.61	0.50	0.46
0.36	0.59	0.45	0.41
0.34	0.58	0.40	0.38
0.32	0.56	0.35	0.32
0.30	0.54	0.30	0.29
0.28	0.53	0.25	0.23
0.26	0.51	0.20	0.19
0.24	0.49	0.15	0.14
0.22	0.58	0.10	0.10
0.20	0.58	0.05	0.06

TABLE 2 – FRAMING

Unlabeled Fenestration Products

Inspection Requirements

Verify that fixed windows and skylights and other vertical fenestration (operable and fixed) that are unlabeled by the manufacturer have been site-labeled using the default U-factor and SHGC. Verify that no credit has been given for metal frames with thermal breaks, low-emissivity coatings, gas fillings, or insulating spacers.

Details

Unlabeled fenestration is required to use the default U-factor and SHGC. These default values are poor and will not comply with the Prescriptive Path values.

Code reference

ASHRAE 90.1-2013—A8.1, A8.2, & 5.8.2.5

TABLE A8.2 Assembly U-Factors, Assembly SHGCs, and Assembly Visible Light Transmittances (VLTs) for Unlabeled Vertical Fenestration

Frame Type	Glazing Type	Unlabeled Vertical Fenestration					
		Clear Glass			Tinted Glass		
		U-Factor	SHGC	VLT	U-Factor	SHGC	VLT
All frame types	Single glazing	1.25	0.82	0.76	1.25	0.70	0.58
	Glass block	0.60	0.56	0.56	n.a.	n.a.	n.a.
Wood, vinyl, or fiberglass frames	Double glazing	0.60	0.59	0.64	0.60	0.42	0.39
	Triple glazing	0.45	0.52	0.57	0.45	0.34	0.21
Metal and other frame types	Double glazing	0.90	0.68	0.66	0.90	0.50	0.40
	Triple glazing	0.70	0.60	0.59	0.70	0.42	0.22

Insulation in Attics

Inspection Requirements

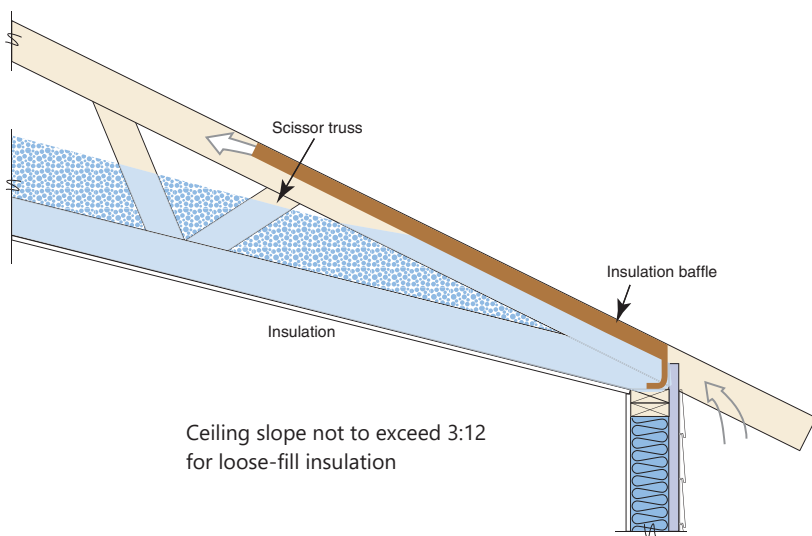
Verify that open-blown or poured loose-fill insulation is not used in attic roof spaces over ceilings with slope greater than 3:12. Insulation must be left exposed for inspection.

Details

Loose-fill insulation (open-blown or poured) can only be used on a ceiling slope of 3:12 or less. When the slope exceeds 3:12, loose-fill insulation is not acceptable.

Code reference

ASHRAE 90.1-2013—Section 4.2.4 & Section 5.8.1.3



Vent Baffles in Attics

Inspection Requirements

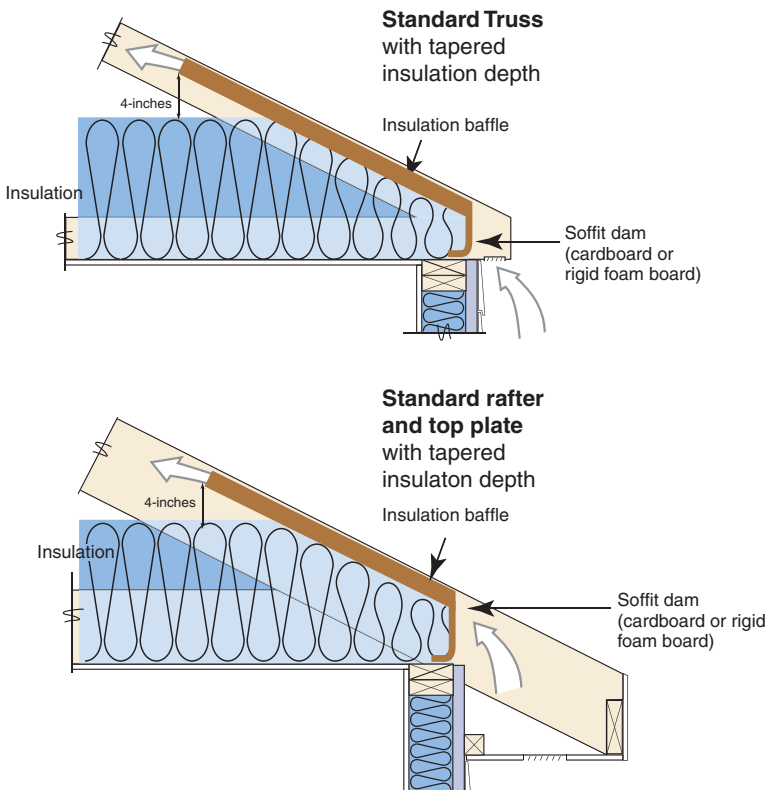
Verify that baffles are installed to deflect incoming air above insulation wherever vents are located.

Details

ASHRAE 90.1-2013 requires that vent baffles be installed to direct wind/air over the insulation (because batt and loose insulation can be blown out of place by wind passing through vents). Also, the resistance to energy transfer by batt and loose insulation is greatly diminished by convective air flow (often referred to as “wind-washing”).

Code reference

ASHRAE 90.1-2013—Section 5.8.1.4 & 5.8.2.5



Insulation, Substantial Contact

Inspection Requirements

Verify that insulation is installed in direct contact with an air barrier (solid surface or sheet material).

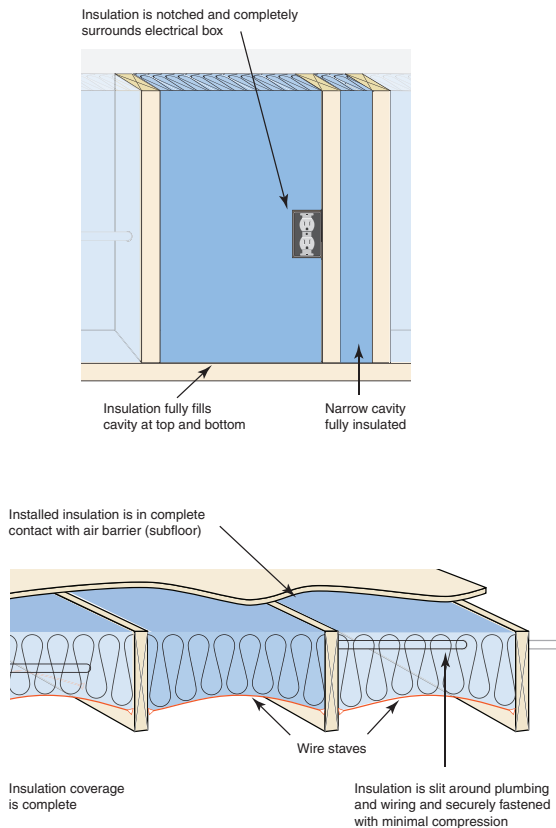
Details

Insulation must be installed in a permanent contact with the inside surface in accordance with manufacturer's recommendations for the type of framing system used.

Batt insulation installed in floor cavities must be supported in a permanent manner. Support spacing can be no greater than 24 inches on center.

Code reference

ASHRAE 90.1-2013—Section 5.8.1.5



Insulation Thickness

Inspection Requirements

Verify that recessed lights, equipment, and ducts do not affect insulation thickness.

Details

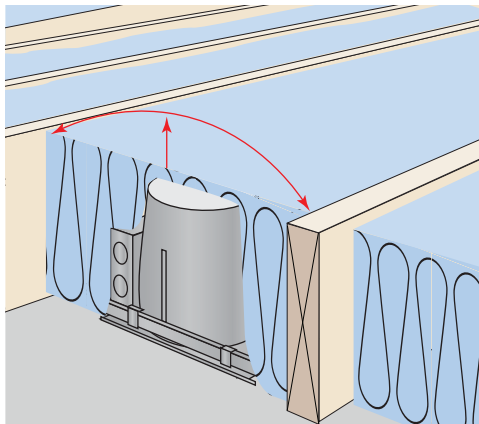
The installed insulation must maintain the proper thickness above can lights, below ducts, and wherever equipment is placed in an attic.

Insulation must not be compressed or reduced because of equipment. Batt and loose insulation will not meet prescribed R-values when compressed. Recessed lighting in an insulated ceiling should be airtight and insulation contact (IC) rated.

☑ *The 2015 IECC also requires airtight, IC-rated can lights to be installed in insulated ceilings.*

Code reference

ASHRAE 90.1-2013—Section 5.8.1.6



Suspended Ceilings

Inspection Requirements

Verify that roof insulation is not installed on a suspended ceiling with removable ceiling panels.

Details

The ASHRAE 90.1 standard does not allow insulation on suspended ceilings as part of the building's thermal envelope. Suspended ceilings are not an effective air barrier. Additionally, insulation supported by a suspended ceiling will often be disturbed by maintenance activities, which decreases effectiveness.

- ☑ *The 2015 IECC also does not allow insulation on suspended ceilings as part of the building's thermal envelope.*

Code reference

ASHRAE 90.1-2013—Section 5.8.1.8



Envelope insulation may not be installed on top of suspended ceiling panels. Drop/suspended ceilings may be insulated for sound, but that insulation cannot be counted as part of the roof insulation R-value.

Exterior Insulation Protection

Inspection Requirements

Verify that all exterior insulation is covered with protective material.

Details

Exterior insulation must be protective with a material that will prevent damage from sunlight, moisture, landscaping, maintenance, and wind.

Attics and mechanical rooms must provide easy access to equipment and prevent damage or compression of the insulation when accessing the space.

Foundation vents must not interrupt the insulation. Insulation materials in ground contact shall have a water absorption rate no greater than 0.3%.

Code reference

ASHRAE 90.1-2013—Section 5.8.1.7



Exterior insulation must be protected by a cladding system. Some examples are EIFS, stucco, brick veneer, lap siding, and metal or cementitious panels.

Loading Dock Weather Seals

Inspection Requirements

In CZ4, verify that cargo and loading dock doors are equipped with weather seals to restrict infiltration when vehicles are parked in the doorway.

Details

Weather seals reduce air infiltration that occurs when a trailer pulls up to unload or load at an open loading dock door.

Code reference

ASHRAE 90.1-2013—Section 5.4.3.3



Air Sealing

Inspection Requirements

Verify that all joints and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.

Details

Openings in the building thermal envelope (penetrations of the air barrier) can be sources of considerable air leakage, resulting in major loss of conditioned air and introduction of unfiltered outside air.

The following areas of the building envelope must be sealed, caulked, gasketed, or weather-stripped to minimize air leakage:

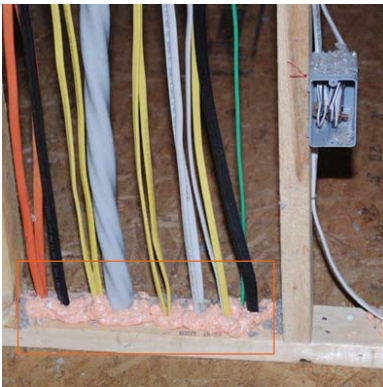
- Joints around fenestration and door frames
- Junctions between walls and foundations, between walls at building corners, between walls and structural floors or roofs, and between walls and roof or wall panels
- Openings at penetrations of utility services through roofs, walls, and floors
- Site-built fenestration and doors
- Building assemblies used as ducts or plenums
- Joints, seams, and penetrations of vapor retarders
- All other openings in the building envelope

Pay special attention to roof wall connections and any junctions hidden by suspended ceilings or chases.

☑ *The 2015 IECC (Section C402.5) requires commercial buildings to create an air-sealed thermal envelope. Like ASHRAE, the IECC has requirements for acceptable air barrier materials and construction methods.*

Code reference

ASHRAE 90.1-2013—Section 5.4.3.1.2



Fenestration Air Leakage Certification

Inspection Requirements

Verify that windows, doors, and skylights are certified as meeting air-leakage requirements.

Details

Fenestration air leakage must be labeled on the product. If air leakage information is not labeled on product, it must be provided by the manufacturer.

- ☑ *The 2015 IECC (Section C402.5) also requires labeling of fenestration for air leakage.*

Code reference ASHRAE 90.1-2013—Section 5.4.3.2

	<p>World's Best Window Co.</p> <p>Millennium 2000⁺</p> <p>Vinyl-Clad Wood Frame</p> <p>Double Glazing • Argon Fill • Low E</p> <p>Product Type: Vertical Slider</p>	
<p>ENERGY PERFORMANCE RATINGS</p>		
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient	
0.30	0.30	
<p>ADDITIONAL PERFORMANCE RATINGS</p>		
Visible Transmittance	Air Leakage (U.S./I-P)	
0.51	0.2	
<p>Manufacturer stipulates that these ratings conform to applicable NFRCC procedures for determining whole product performance. NFRCC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRCC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.</p> <p>www.nfrcc.org</p>		

Component Labels and Supporting Documentation

Inspection Requirements

Verify that all envelope component R-values and U-factors are labeled as certified or that 'other' components have supporting documentation for proposed U-factors.

Details

For certain assemblies—including built-up wall, roof, or floor—make sure each component (such as plywood sheathing or brick) is labeled or that some documentation is provided to demonstrate compliance.

Code reference

ASHRAE 90.1-2013—Section A1.1

TABLE A3.1A Assembly U-Factors for Above-Grade Concrete Walls and Masonry Walls

Framing Type and Depth	Rated R-Value of Insulation Alone	Assembly U-Factors for 8 in. Normal Weight 145 lb/ft ³ Solid Concrete Walls	Assembly U-Factors for 8 in. Medium Weight 115 lb/ft ³ Concrete Block Walls: Solid Grouted	Assembly U-Factors for 8 in. Medium Weight 115 lb/ft ³ Concrete Block Walls: Partially Grouted (Cores Uninsulated Except Where Specified)
No Framing	R-0	U-0.740	U-0.580	U-0.480
	UngROUTED Cores Filled with Loose-Fill Insulation	N/A	N/A	U-0.350
Continuous Metal Framing at 24 in. on Center Horizontally				
3.5 in.	R-11.0	U-0.168	U-0.158	U-0.149
3.5 in.	R-13.0	U-0.161	U-0.152	U-0.144
3.5 in.	R-15.0	U-0.155	U-0.147	U-0.140
4.5 in.	R-17.1	U-0.133	U-0.126	U-0.121
4.5 in.	R-22.5	U-0.124	U-0.119	U-0.114
4.5 in.	R-25.2	U-0.122	U-0.116	U-0.112
5.0 in.	R-19.0	U-0.122	U-0.117	U-0.112
5.0 in.	R-25.0	U-0.115	U-0.110	U-0.106
5.0 in.	R-28.0	U-0.112	U-0.107	U-0.103

Vestibules

Inspection Requirements

Verify that building entrances are constructed as required. Note that buildings in CZ2 are exempt from vestibule requirements.

Details

Vestibules reduce the loss of conditioned air when exterior doors are open. Building entrances are defined in ASHRAE Section 3.2 as “the means ordinarily used to gain access to the building.” Therefore, exits from fire stairwells, handicapped access doors, and access to mechanical/electrical rooms are not considered building entrances.

Building entrances separating conditioned space from the exterior must be protected with an enclosed vestibule. All doors opening into and out of the vestibule must be equipped with self-closing devices. Vestibules must be designed so that—when a person passes through the vestibule—the interior and exterior doors do not open at the same time. Interior and exterior doors in the closed position shall be no less than 7 feet apart.



The exterior envelope (glazing) of conditioned vestibules must meet the requirements for thermal performance of fenestration required by climate zone. The interior and exterior envelope of unconditioned vestibules must comply with the requirements of a semi-heated space.

There are some exceptions to these requirements:

- Building entrances with revolving doors
- Doors not intended to be used as a building entrance
- Doors opening directly from a dwelling unit
- Building entrances in buildings located in CZ2
- Building entrances in buildings located in CZ3 or 4 that are less than four stories above grade and < 10,000 sq. ft. in area
- Doors that open directly from a space that is < 3000 sq. ft. in area and is separate from the building entrance

☑ *The 2015 IECC (C402.5.7) requires all commercial buildings to have vestibules on primary entrances unless the building or space qualifies for one of the following exceptions: buildings in CZs 1-2; doors not for use by the public; doors opening from a dwelling unit; revolving doors; and use of air curtains.*

Code reference

ASHRAE 90.1-2013—Section 5.4.3.4