BUILDING ENERGY CODES UNIVERSITY

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

2012 IECC Commercial Scope and Envelope Requirements

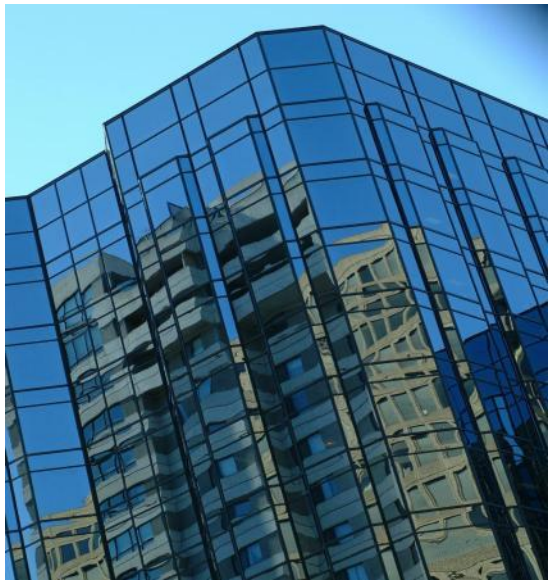
July 2011

PNNL-SA-82105

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



Change in Occupancy
C101.4.4

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- ✓ Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

- ✓ Where the use in a space changes from one to another, the installed lighting wattage shall comply with Section 505.5.

Change in Space Conditioning
C101.4.5

Any non-conditioned space that is altered to become conditioned space shall be required to be brought into full compliance with this code

Image courtesy of Ken Baker, K energy

Mixed Occupancy
C101.4.6

- ✓ Treat the residential occupancy under the applicable residential code
- ✓ Treat the commercial occupancy under the commercial code
- ✓ The residential and commercial occupancies fall under two different scopes. Thus, two compliance submittals must be prepared using the appropriate calculations and forms from the respective codes for each.

Referenced Codes and Standards

C106.1

Codes and standards listed in Chapter are considered part of the requirements of this code to the "prescribed extent of each such reference and as further regulated in Sections C106.1.1 and C106.1.2"

- Conflicts, C106.1.1 – where differences occur between this code and the referenced codes and standards, provisions of this code apply
- Provisions in reference codes and standards, C106.1.2 – "where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard"

What is the Building Thermal Envelope?

- ✓ Roof/Ceiling Assembly
- ✓ Wall Assembly
- ✓ Vertical Fenestration and Skylights
- ✓ Floor Assembly
- ✓ Slab Edge
- ✓ Below Grade Wall Assembly

Commercial Compliance Options

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1

- 90.1-2010

OR

2

2012 IECC

- C402 - Envelope
- C403 - Mechanical
- C404 - SWH
- C405 - Lighting

AND

- Pick One:
  - **C406.2 – Eff. HVAC Performance**

  or
  - **C406.3 – Eff. Lighting Systems**

  or
  - **C406.4 – On-site Renewable Energy**

OR

3

2012 IECC

- C407 – Total Building Performance
- C402.4 – Air Leakage
- C403.2 – Provisions applicable to all mechanical systems
- C404 - SWH
- Lighting Mandatory Sections
  - C405.2
  - C405.3
  - C405.4
  - C405.6
  - C405.7
- Building energy cost **to be ≤ 85% of** standard reference design building

Additional Efficiency Package Options

C406

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- One additional efficiency feature must be selected to comply with the IECC
  - More efficient lighting system (consistent with 90.1-2010), **OR**
  - More efficient HVAC system, **OR**
  - Installation of onsite renewables
    - 3% of the regulated energy

High Efficiency HVAC

More Efficient Lighting System

Onsite Renewables

Additional Efficiency Package Options

C406

- Efficient HVAC performance per C406.2 **OR**
  - Per Tables C406.2(1) thru C406.2(7)
  - Only used when efficiencies in the above tables are greater than those in the efficiency tables in C403
- Efficient lighting system per C406.3 **OR**
  - Whole building LPD complies with C406.3.1
  - Determine total LPD of building using reduced whole building interior lighting power in Table 406.3 x floor area for the building types
- On-site supply of renewable energy per C406.4
  - Total minimum ratings to comply with
    - Provide ≥ 1.75 Btu or ≥ 0.50 watts per ft^2 of conditioned floor area OR
    - Provide ≥ 3% of energy used for mechanical and SWH equipment and lighting

Individual tenant spaces to comply with either C406.2 or C406.3 unless documentation is provided that demonstrates compliance with C406.4 for the entire building

Climate Zones

2012 IECC - Chapter 3

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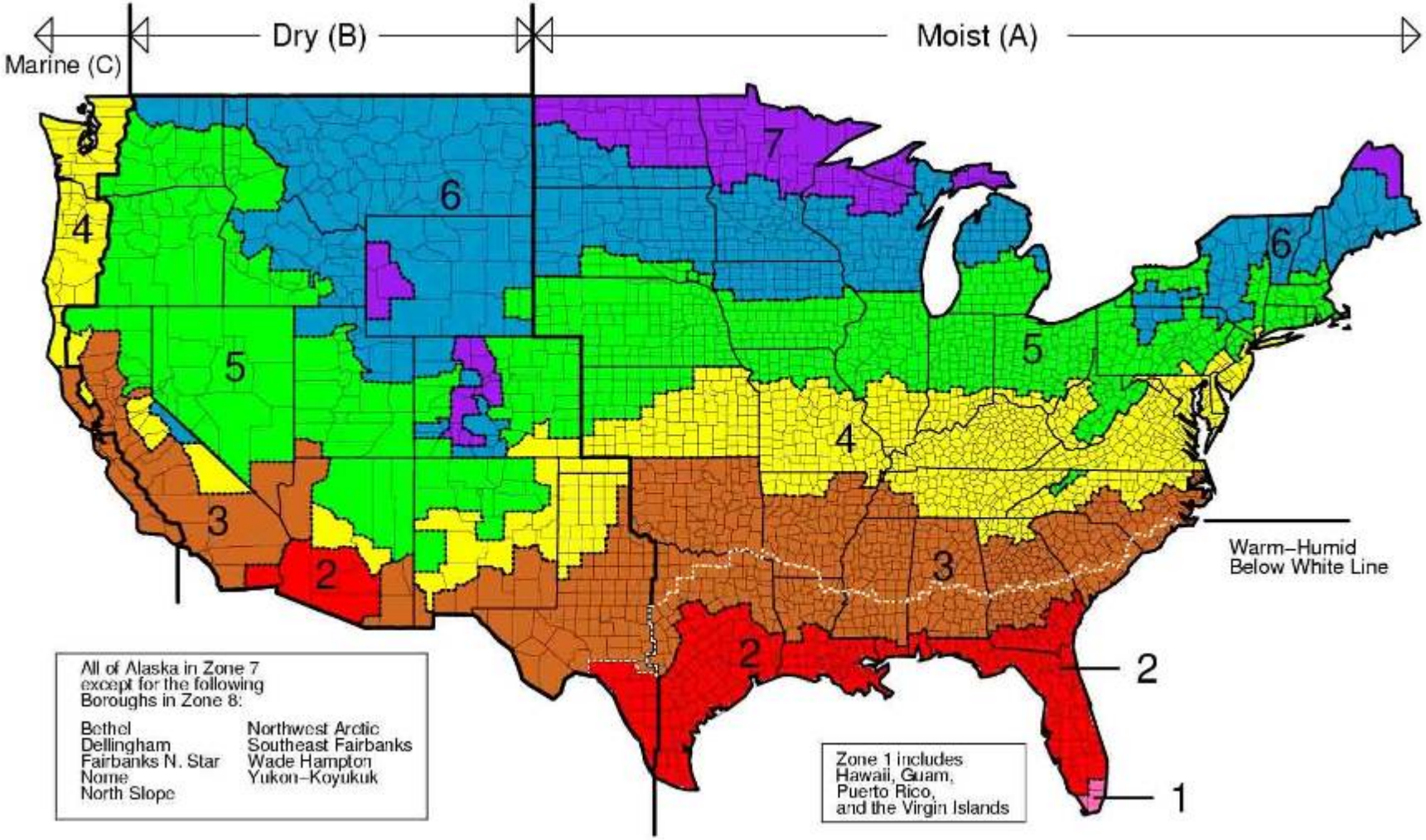

Determining Your Climate Zone is the First Step in the Process

Chapter 5 Prescriptive Approach Compliance

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE C402.2
OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks)[a,b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, Above Grade																
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13+ R-19.5ci	R-13 + R-13ci	R-13+ R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13+ R17.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8cior R-20	R-13 + R-3.8cior R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8cior R-20	R-13 + R-3.8cior R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8cior R-20	R-13 + R-3.8cior R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci	R-13 + R-15.6ci or R-20 + R-10ci
Walls, Below Grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-10ci	R-10ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30[e]	R-30[e]	R-30[e]	R-30[e]	R-30[e]
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs[d]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-15 for 36" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement.

LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft² °F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. Steel floor joist systems shall be insulated to R-38.

Chapter 5 Prescriptive Approach Compliance

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE C402.2
OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks)[c,b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS					
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49
Heated slabs[d]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-15 for 36" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

ROOFS

Climate Zone	1	2	3	4 Except Marine	5 And Marine 4	6	7	8
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-30ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks)	R-19+ R-11 LS	R-19+ R-11 LS	R-19+ R-11 LS	R-19+ R-11 LS	R-19+ R-11 LS	R-25+ R-11 LS	R-30+ R-11 LS	R-30+ R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49

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LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

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	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks[c,b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R					R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38											

WALLS, ABOVE GRADE

Climate Zone	1	2	3	4 Except Marine	5 And Marine 4	6	7	8
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13+6.5ci	R-13+6.5ci	R-13+6.5ci	R-13+R-13 ci	R-13+R-13 ci	R-13+R-13 ci	R-13+R-13 ci	R-13+R-13 ci	R-13+R-13 ci i	R-13+R-13 ci	R-13+R-13 ci	R-13+R-13 ci	R-13+R-13 ci	R-13+R-19.5 ci	R-13+R-13 ci	R-13+R-19.5 ci
Metal Framed	R-13=R-5 ci	R-13=R-5 ci	R-13=R-5 ci	R-13+7.5ci	R-13+7.5ci	R-13+7.5ci	R-13+7.5ci	R-13+7.5ci	R-13+7.5ci	R-13+7.5ci	R-13+7.5ci	R-13+7.;5ci	R-13+7.5cfi	R-13+15.6ci	R-13+7.5ci	R-13+17.5ci
Wood Framed & Other	R-13+R-3.8ci or R-20	R-13+R-3.8ci or R-20	R-13+R-3.8ci or R-20	R-13+R-3.8ci or R-20	R-13+R-3.8ci or R-20	R-13+R-3.8ci or R-20	R-13+R-3.8ci or R-203	R-13+R-3.8ci or R-20	R-13+R-3.8ci or R-20	R-13+R-7.5ci or R-20+R-3.8 ci	R-13+R-7.5ci or R-20+R-3.8 ci	R-13+R-7.5ci or R-20+R-3.8 ci	R-13+R-7.5ci or R-20+R-3.8 ci	R-13+R-7.5ci or R-20+R-3.8 ci	R-13+R-15.6ci or R-20+R-10ci	R-13+R-15.6ci or R-20+R-10 ci

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.
c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft²-°F.
d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
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	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks[d,b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R					R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38											
Walls, Below Grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-10ci	R-10ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs[d]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-15 for 36" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

WALLS, BELOW GRADE

Climate Zone	1	2	3	4 Except Marine	5 And Marine 4	6	7	8
Below grade wall	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-12.5ci

For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement.

LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-inch/h-ft²-°F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

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CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks[b,c])	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-					R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38							R-49	R-49	R-49	R-49	R-49
Walls, Above Grade																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/ Framing Steel/ (Wood)	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30
Walls, Below Grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Floors																
Mass	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs[d]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-15 for 36" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement.

LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft²-°F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. Steel floor joist systems shall be insulated to R-38.

FLOORS

Climate Zone	1		2		3		4 Except Marine		5 And Marine 4		6		7		8	
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/ Framing Steel/ (Wood)	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30

Chapter 5 Prescriptive Approach Compliance

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE C402.2
OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks[b,c])	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R					R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38											
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs[d]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-15 for 36" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement.

LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft²-°F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. Steel floor joist systems shall be insulated to R-38.

SLAB-ON GRADE FLOORS

Climate Zone	1		2		3		4 Except Marine		5 And Marine 4		6		7		8	
Unheated Slabs	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24. in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below
Heated Slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-10 for 24 in below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 36 in. below	R-15 for 36 in. below	R-15 for 48 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below

Chapter 5 Prescriptive Approach Compliance

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE C402.2
OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks[d,b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R						R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38							R-49	R-49	R-49	R-49	R-49

OPAQUE DOORS

Climate Zone	1		2		3		4 Except Marine		5 And Marine 4		6		7		8	
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-Up Or Sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs[d]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-15 for 36" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement.

LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.

b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft²-°F.

d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.

e. Steel floor joist systems shall be insulated to R-38.

Roof R-Value *(C402.2.1)*
U-Factor *(C402.1.2)*

Roof R-values and U-factor requirements are based on assembly type / insulation placement

- ✓ Insulation entirely above deck
- ✓ Metal buildings
- ✓ Attic and other

Skylight curbs to be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less

- ✓ **Exception**: unit skylight curbs included as a component of an NFRC 100 rated assembly

Roof Solar Reflectance

C402.2.1.1

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Required in Climate Zones 1-3 for low-sloped roofs (less than 2 units vertical in 12 horizontal), directly above cooled conditioned spaces

Requirements:

Minimum three-year aged solar reflectance of 0.55 and minimum three-year aged thermal emittance of 0.75

OR

Initial solar reflectance of 0.70 and initial thermal emittance of 0.75

OR

Three-year aged solar reflectance index of 64

OR

Initial solar reflectance index of 82

High Albedo Roofs – Exceptions
C402.2.1.1 (cont'd)

- Portions of roofs that include or are covered by:
  - PV systems or components
  - Solar air or water heating systems or components
  - Roof gardens or landscaped roofs
  - Above-roof decks or walkways
  - Skylights
  - HVAC systems, components, and other opaque objects mounted above the roof
- Portions of roofs shaded during peak sun angle on June 21 by permanent features of the building or adjacent buildings
- Ballasted roofs with minimum stone ballast of 17 lbs/ft^2 or 23 lbs/ft^2 pavers
- Roofs, where a minimum of 75% of the roof area meets one of the above exceptions

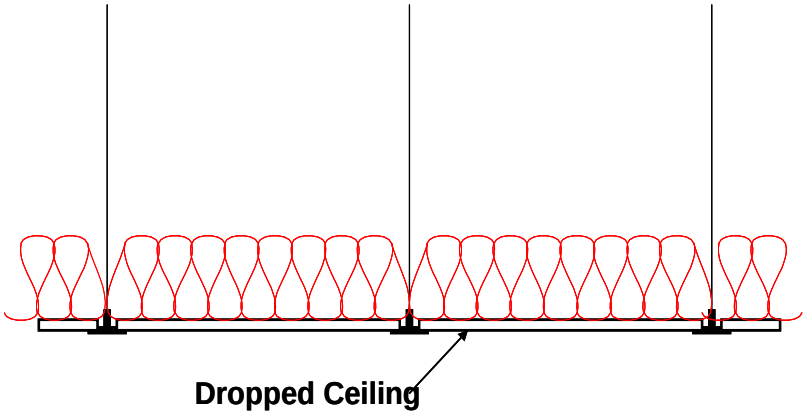
High Albedo Roof - Example

Roof R-Value
Insulation Completely Above Deck

- ✓ Insulation considered continuous (*CI*)
- ✓ Insulation thickness can vary ≤ 1” and area weighted U-factor meets the requirements of Table C402.2

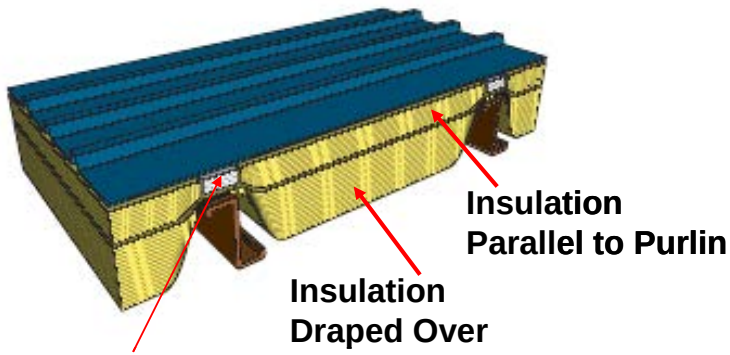
Roof R-Value

Insulation Placed on Suspended Ceiling with Removable Ceiling Tiles



- ✓ Will not count for code compliance
- ✓ Not considered part of the minimum thermal resistance of the roof insulation

Roof R-Value
Metal Buildings



Picture from NAIMA

R-5 thermal blocks required on all metal buildings or must use U-factor Compliance Method

Two layers of insulation required

- ✓ CZ 1-5 and marine 4: R-19+R-11 LS
- ✓ CZ 6: R-25+R-11 LS
- ✓ CZ 7-8: R-30+R-11 LS

Metal Building Roofs

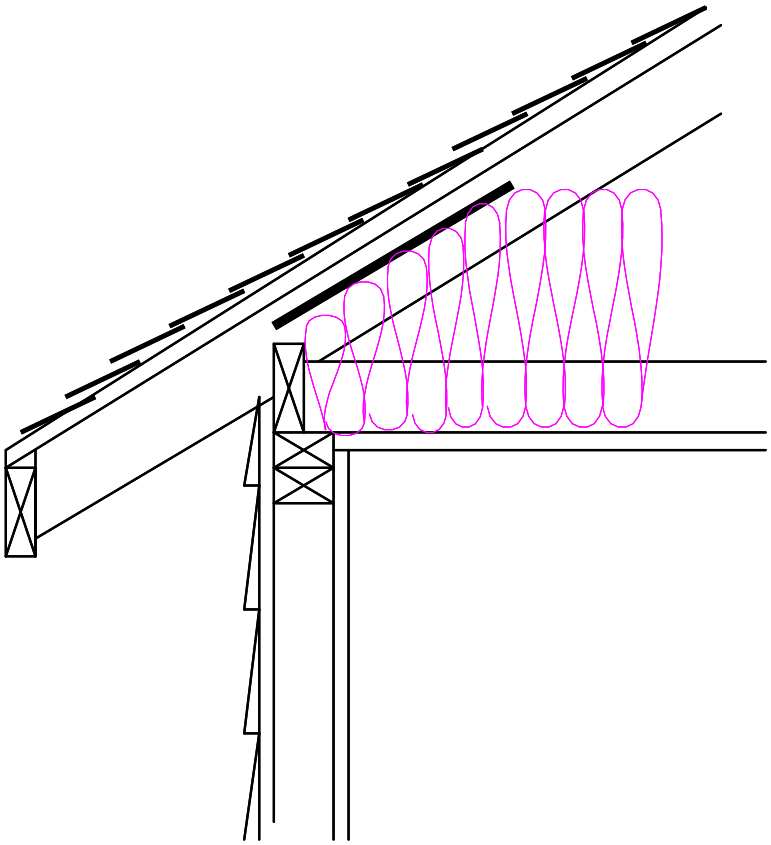
Photos courtesy of MBMA

Metal Building Roofs

Photos courtesy of MBMA

Roof R-Value

Ceilings with Attic Spaces



- ✓ Install insulation between framing
- ✓ R-38 in Climate Zones 1-5 and marine 4 “All Other”
- ✓ R-49 in Climate Zones 5 and marine 4 “Group R”-8

Walls weighing at least 35 lbs/ft^2 of wall surface area

OR

25 lbs/ft^2 of wall surface area if material weight is ≤ 120 lb/ft^3

Climate Zones 1 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 ≤ of 0.44 Btu-in./h-ft^2 F

Wall R-Value

Wood, Metal Frame, and Other

Photo courtesy of Dow Building Solutions

- ✓ Cavity insulation or cavity plus continuous (ci)
- ✓ Continuous insulation not broken up by framing members e.g., rigid board insulation

Metal Building Walls

Table C402.2

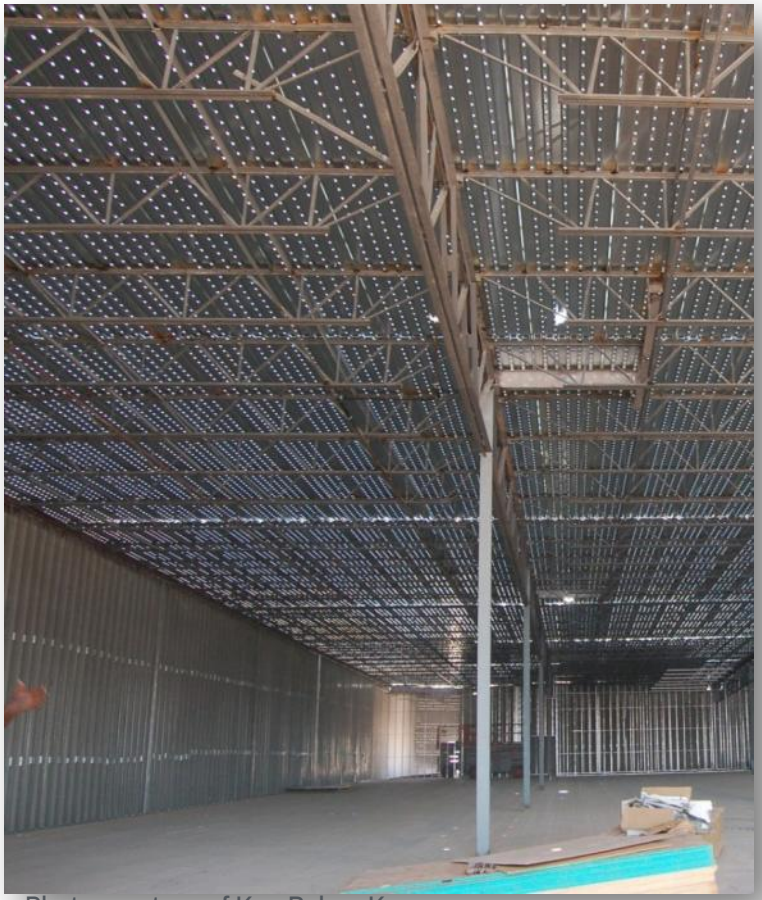


Photo courtesy of Ken Baker, K energy

Below Grade Walls

C402.2.4

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What is a below grade wall?

- ✓ Basement or first-story walls ≥ 85% below grade

Insulation must extend down 10 ft from the outside finished grade level or to the level of the floor, whichever is less

Heated slabs installed below grade *(footnoted to Tables C401.2.2 and C402.2)*

- ✓ Below grade walls must meet exterior insulation requirements for heated slabs

Below-Grade Wall Insulation

Photo courtesy of Dow Building Solutions

Floors Over Outdoor Air or Unconditioned Space
C402.2.5

Joist/Framing (Steel/Wood)

- ✓ Insulation installed between framing

Mass Floors

- ✓ Materials weighing (of floor surface area) 35 lbs/ft^2, **or**
- ✓ 25 lbs/ft^2 if material weight is ≤ 12 lbs/ft^3
- ✓ Insulation installed continuously

Steel Floor Joist Systems
(footnoted to Table C402.2)

- ✓ R-38 in Climate Zones 6-8

Slab-on-Grade Floors

C402.2.6

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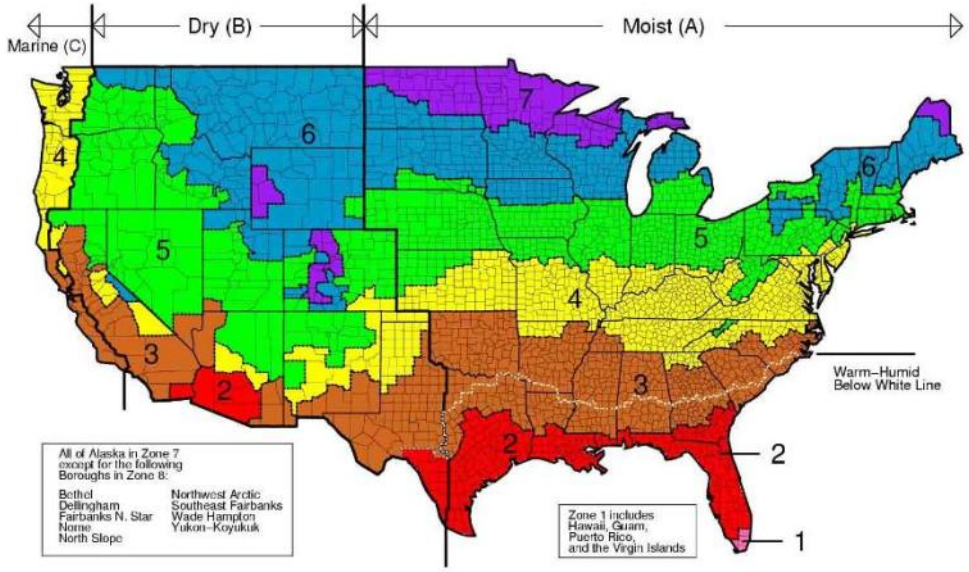
Unheated slab – insulation required:

- ✓ Climate Zones 4-8

Heated slabs – insulation required in all Climate Zones



Opaque Doors
C402.2.7

Doors having < 50% glass area

Swinging doors

- ✓ Meet U-factor requirement

Roll-up or sliding doors

- ✓ R-4.75 in all climate zones

Insulation of Radiant Heating Systems

C402.2.8

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

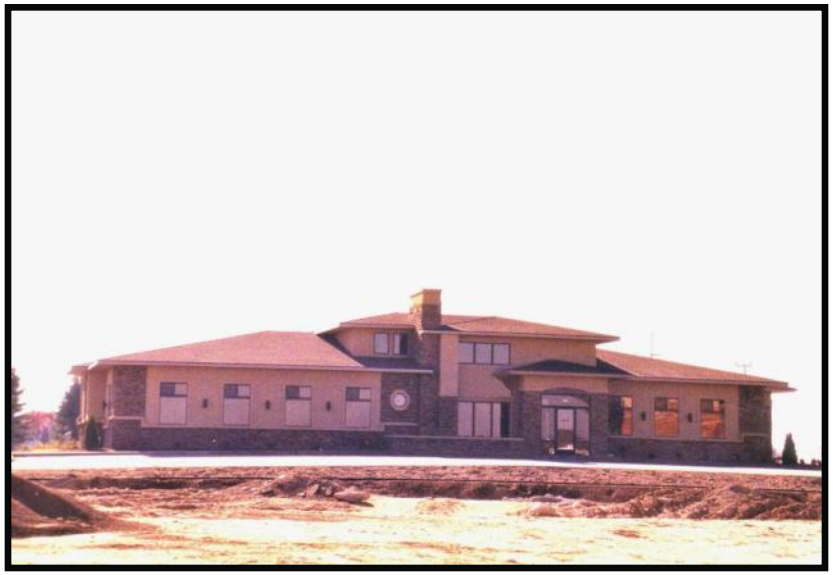
- ✓ Radiant panels and associated U-bends and headers to be insulated with a minimum of R-3.5

TABLE C402.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
***U*-factor**								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
SHGC	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
Skylights								
***U*-factor**	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

Vertical Fenestration Requirement
C402.3.1 – Prescriptive (Max area)



Percentage of Vertical Fenestration Area to Gross Wall Area

- ✓ Allowed up to 30% maximum of above grade wall
  - ✓ In Climate Zones 1-6, up to 40% maximum of above grade wall with daylighting controls

Vertical Fenestration Requirement
C402.3.1

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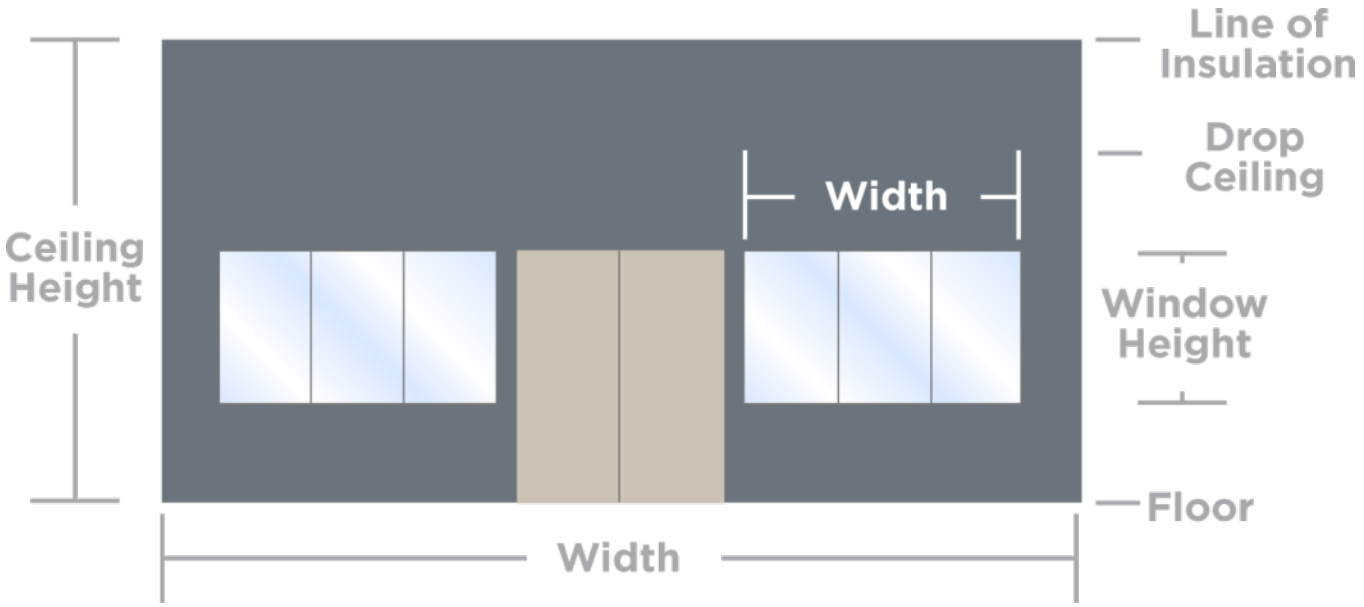
Based on above-grade wall area *(gross)*

- ✓ 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



Skylight Minimum Fenestration Area

C402.3.1 Prescriptive

- ✓ Limited to ≤ 3% of Roof Area
- ✓ Up to 5% allowed if automatic daylighting controls installed in daylight zones under skylights

Increased Vertical Fenestration with Daylighting Controls

C402.3.1.1

- ✓ Up to 40% vertical fenestration area allowed in Climate Zones 1-6, provided
  - No less than 50% of the conditioned floor area is within a daylight zone
  - Automatic daylighting controls are installed in daylight zones; and
  - VT of vertical fenestration is ≥ 1.1 times SHGC

Exception:

Fenestration that is outside the scope of NFRC 200 isn't required to comply with VT

Increased Skylight Area with Daylighting Controls

C402.3.1.2

- ✓ Up to 5% provided automatic daylighting controls are installed in daylight zones under skylights

Minimum Skylight Fenestration Area
C402.3.2

- In certain types of enclosed spaces > 10,000 ft^2 directly under a roof with ceiling heights > 15 ft
  - total daylight zone under skylights to not be < ½ the floor area and to provide a minimum skylight area to daylight zone of either
    - Minimum of 3% of roof area with a skylight VLT at least 0.40 **OR**
    - Provide a minimum skylight effective aperture of at least 1%

Exceptions

- Climate Zones 6-8
- Spaces with LPDs < 0.5 W/ft^2
- Documented shaded spaces
- Daylight area under rooftop monitors is > 50% of floor area

Lighting Controls in Daylight Zones Under Skylights
C402.3.2.1

- All lighting in daylight zones to have multilevel lighting controls and meet C405.2.2.3.3

Exceptions

- Climate Zones 6-8
- Spaces with LPDs < 0.5 W/ft^2
- Documented shaded spaces
- Daylight area under rooftop monitors is > 50% of floor area

Haze Factor
C402.3.2.2

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- Skylights in certain space types to have a glazing material or diffuser with a measured haze factor > 90% per ASTM D 1003
  - Office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store, and distribution/sorting area
- **Exception**
  - Skylights designed to exclude direct sunlight entering the occupied space by use of fixed or automated baffles, or the geometry of skylight and light well

Fenestration U-Factor

C402.3.3

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Table C402.3 requirements by these categories:

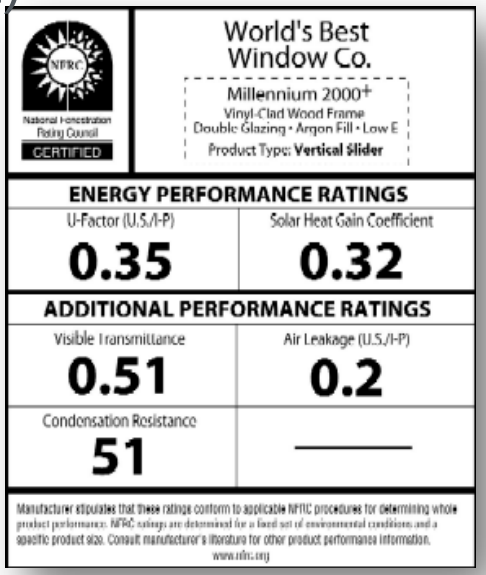
- ✓ Fixed fenestration
- ✓ Operable fenestration
- ✓ Entrance doors

Skylight U-Factor / SHGC

- ✓ U-factor and SHGC Based
- ✓ NFRC 100 Rating for U-factor or Default Table
- ✓ NFRC 200 Rating for SHGC and VT or Default Table
- ✓ No SHGC requirements in Climate Zones 7-8

How Do You Meet the Requirement?

- ✓ Fenestration product rating in accordance to NFRC 100
- ✓ Labeled and certified by the manufacturer
- ✓ Non-NFRC 100 rated fenestration
  - ✓ Default Glazed Fenestration U-factor Table C303.1.3(1)




NFRC PRODUCT CERTIFICATION PROGRAM

NFRC Label Certificate for Site-Built Products

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) 0.35 | Solar Heat Gain Coefficient 0.32
ADDITIONAL PERFORMANCE RATINGS
Visible Transmittance 0.51 | Air Leakage (U.S./I-P) 0.2

Project Location
Street Address:
City: State: Zip Code:
Project Name (Optional): Designer (Optional):

Product Line Information
Operator Type (per Table 4-3 of NFRC 100)
Product Line ID No. Individual Product ID No.
How many of this individual product Location in building
Elevation drawing page Fenestration (window & door) schedule page

Frame Material Supplier Company name:
City: State: Zip Code:
Street Address:
Contact: Phone: Fax:

Glazing Material Supplier Company name:
City: State: Zip Code:
Street Address:
Contact: Phone: Fax:

Glazing Contractor/Installer Comp. name:
City: State: Zip Code:
Street Address:
Contact: Phone: Fax:

Certification Authorization
Independent Certification & Inspection Agency (IA):
Date Certification Authorization Issued:

Default U-Factors
Tables C303.1.3(1) and (2)

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE C303.1.3(1)
DEFAULT GLAZED FENESTRATION U-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE C303.1.3(2)
DEFAULT DOOR U-FACTORS

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

Glazed Fenestration SHGC

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 and VT Product Rating Requirements

Table C303.1.3(3)

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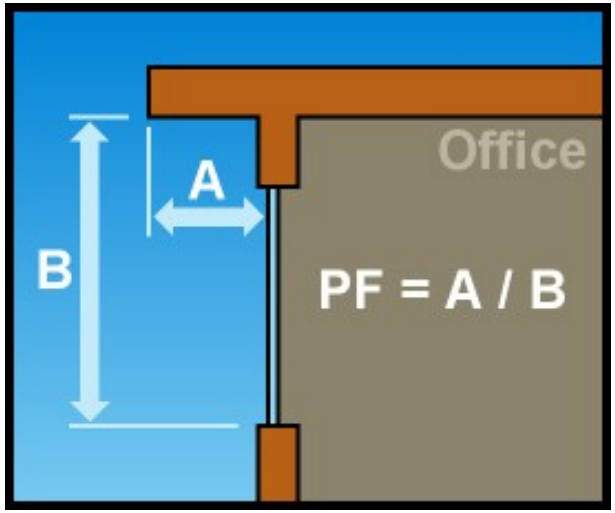
Two Options for Meeting the SHGC and VT Requirements

- ✓ Fenestration product rated and labeled to NFRC 200, or
- ✓ Select default from Table C303.1.3(3)

TABLE C303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

The Effect of Overhangs on Fenestration SHGC



- ✓ Overhangs allow a higher SHGC product to be installed
- ✓ Projection factor must be calculated
- ✓ When different windows or glass doors have different PFs
  - ✓ Evaluate separately

SHGC Adjustment
C402.3.3.1

- ✓ When PF ≥ 0.2, the required maximum SHGC in Table C402.3 must be adjusted by multiplying the required maximum SHGC by the multiplier in Table C402.3.3.1

TABLE C402.3.3.1
SHGC ADJUSTMENT MULTIPLIERS

PROJECTION FACTOR	ORIENTED WITHIN 45 DEGREES OF TRUE NORTH	ALL OTHER ORIENTATION
$0.2 \leq PF < 0.5$	1.1	1.2
$PF \leq 0.5$	1.2	1.6

Increased Vertical Fenestration SHGC

C402.3.3.2

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- ✓ In Climate Zones 1-3, vertical fenestration entirely located not less than 6 ft above the finished floor is permitted a maximum SHGC of 0.40

Increased Skylight SHGC

C402.3.3.3

- ✓ In Climate Zones 1-6, skylights above daylight zones with automated daylight controls are permitted a maximum SHGC of 0.60

Increased Skylight U-Factor

C402.3.3.4

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- ✓ Skylights above daylight zones with automated daylight controls are permitted a maximum U-factor of
  - 0.9 in Climate Zones 1-3
  - 0.75 in Climate Zones 4-8

Dynamic Glazing

C402.3.3.5

- ✓ SHGC determined using manufacturer's lowest-rated SHGC
- ✓ VT/SHGC ratio determined using maximum VT and maximum SHGC
- ✓ Considered separately from other fenestration
- ✓ Area-weighted averaging isn't allowed

Area-Weighted U-Factor

C402.3.4

- ✓ Allowed to meet requirements in Table C402.3
- ✓ Can’t combine products from different categories when calculating the area-weighted average U-factor

Mandatory Requirements

- ✓ Air barriers
- ✓ Fenestration air leakage
- ✓ Air intakes, exhaust openings, stairways and shafts
- ✓ Loading dock weatherseals
- ✓ Vestibules
- ✓ Recessed lighting

Air Barriers and Construction
C402.4.1 and C402.4.1.1

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Continuous air barrier required except in:

- Climate Zones 1-3

Air barrier requirements:

- Placement allowed
  - Inside of building envelope
  - Outside of building envelope
  - Located within assemblies composing envelope **OR**
  - Any combination thereof
- Continuous for all assemblies part of the thermal envelope and across joints and assemblies
- Joints and seams to be sealed per C402.4.2
- Recessed lighting to comply with C404.2.8
- Where similar objects are installed that penetrate the air barrier, make provisions to maintain the air barrier's integrity

Air Barrier Compliance Options
C402.4.1.2

Three ways to comply with air barrier requirements

- ✓ Materials
- ✓ Assemblies
- ✓ Building

Air Barrier Materials (Compliance)
C402.4.1.2.1

Materials with air permeance ≤ 0.004 cfm/ft^2 under pressure differential of 0.3 in. w.g. tested in accordance with ASTM E 2178

These materials meet this requirement:

Material	Thickness (minimum)
Plywood	3/8 in.
Oriented strand board	3/8 in.
Extruded polystyrene insulation board	½ in.
Foil-faced urethane insulation board	½ in.
Closed cell spray foam minimum density of 1.5 pcf	1-1/2 in.
Open cell spray foam density between 0.4 and 1.5 pcf	4.5 in.
Exterior gypsum sheathing or interior gypsum board	½ in.
Cement board	½ in.
Built up roofing membrane	
Modified bituminous roof membrane	
Fully adhered single-ply roof membrane	
A Portland cement/sand parge, stucco, or gypsum plaster	5/8 in.
Cast-in-place and precast concrete	
Sheet metal or aluminum	

Air Barrier Assemblies (Compliance)
C402.4.1.2.2

OR

Assemblies of materials and components (sealants, tapes, etc.) with average air leakage ≤ 0.04 cfm/ft^2 under pressure differential of 0.3 in. w.g. tested in accordance with ASTM E 2357, 1677 or 283

These assemblies meet this requirement:

- Concrete masonry walls coated with one application either of block filler and two applications of a paint or sealer coating OR
- Portland cement/sand parge, stucco or plaster minimum ½ thick

Air Barrier Building Test (Compliance)
C402.4.1.2.3

OR

Air leakage rate of completed building tested and confirmed to not exceed 0.40 cfm/ft^2 at a pressure differential of 0.3 inches water gauge per ASTM E779 or equivalent method approved by code official

Air Barrier Penetrations
C402.4.2

- Penetrations of air barrier and air leakage paths to be caulked, gasketed, or otherwise sealed
- Joints and seals
  - Sealed in same manner or taped or covered with a moisture vapor-permeable wrapping material
  - Securely installed in or on the joint for the entire length
    - To resist positive and negative pressure from wind, stack effect and mechanical ventilation
  - Sealing materials appropriate to construction materials

Air Leakage of Fenestration
C402.4.3

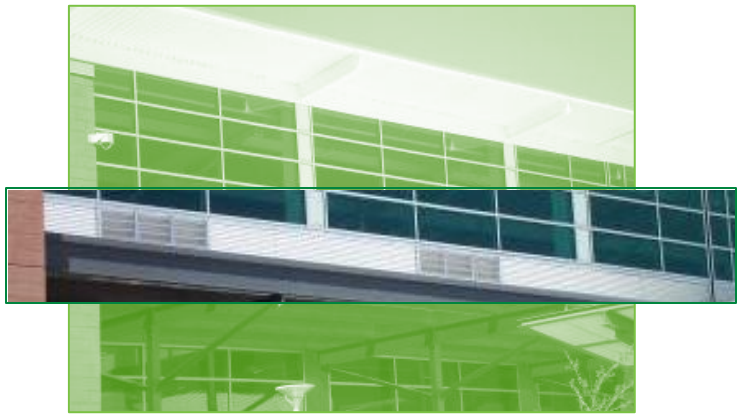
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Fenestration Assembly	cfm/ft^2	Test Procedure
Windows, sliding glass doors, and swinging doors	0.20	AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400
Skylights - with condensation weepage openings	0.30	
Skylights – all other	0.20	
Curtain walls and storefront glazing	0.06	NFRC 400 or ASTM E283 at 1.57 psf
Commercial glazed swinging entrance doors	1.00	
Revolving doors	1.00	
Garage doors	0.4	ANSI/DASMA 105, NFRC 400, or ASTM E283 at 1.57 psf
Rolling doors	1.00	

- ✓ **Exceptions**
  - Field-fabricated fenestration assemblies
  - Fenestration in buildings that meet the building test for air barrier compliance option

- To have Class I motorized dampers with maximum leakage rate of 4 cfm/ft^2 at 1.0 inch water gauge
- Dampers to be installed with controls to be able to open automatically upon
  - Activation of any fire alarm initiating device of building's fire alarm system or
  - Interruption of power to the damper

Mandatory Requirements
C402.4.5.2 Outdoor Air Intakes and Exhausts



Buildings ≥ 3 stories in height above grade

- ✓ Class IA motorized leakage-rated damper
  - – Maximum leakage rate ≤ 4cfm /ft^2 @ 1.0 inch w.g.

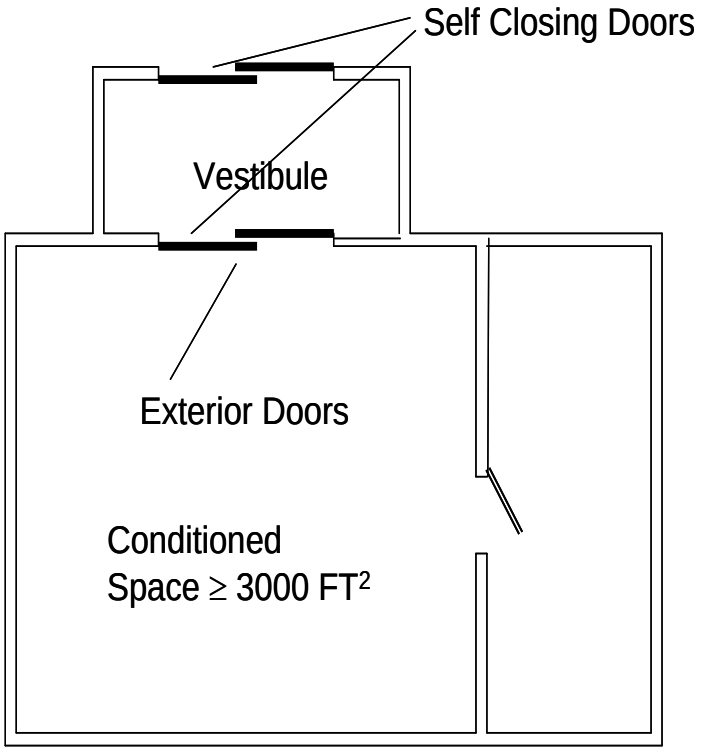
Buildings < 3 stories in height

- ✓ Gravity (nonmotorized) with maximum leakage rate of 20 cfm/ft^2 at 1.0 inch water gauge allowed
  - ✓ For exhaust and relief dampers
  - ✓ For ventilation air intakes and exhaust and relief dampers in buildings of any height in CZ 1-3
  - ✓ Where design outdoor air intake or exhaust capacity is < 300 cfm
- ✓ Dampers < 24 inches in either dimension may have a leakage of 40 cfm/ft^2 at 1.0 inch water gauge

- ✓ Equip cargo doors and loading dock doors with weatherseals
- ✓ Goal is to restrict infiltration

Mandatory Requirements
C402.4.7 Vestibules

- ✓ Required to reduce infiltration into spaces
- ✓ Required on entrance doors leading into spaces ≥ 3,000 ft^2
- ✓ Doors must have self-closing devices
- ✓ Exceptions
  - Buildings in Climate Zones 1 and 2
  - Doors from a sleeping unit or dwelling unit
  - Revolving doors
  - Doors not intended for public use or intended solely for employee use



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 ≤ 2.0 cfm of air movement between conditioned and unconditioned spaces