

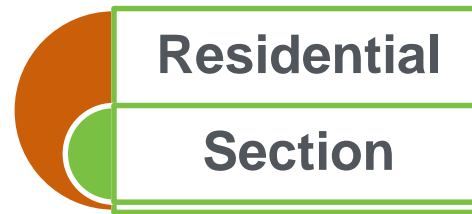


## 2018 IECC Commercial Scope and Envelope Requirements

- Energy codes and standards set minimum efficiency requirements for new and renovated buildings, assuring reductions in energy use and emissions over the life of the building. Energy codes are a subset of building codes, which establish baseline requirements and govern building construction.
- Code buildings are more comfortable and cost-effective to operate, assuring energy, economic and environmental benefits.



- Ch. 1 Scope and Application /  
Administrative and  
Enforcement
- Ch. 2 Definitions
- Ch. 3 General Requirements
- Ch. 4 Commercial Energy Efficiency
- Ch. 5 Existing Buildings
- Ch. 6 Referenced Standards
- Index



- Ch. 1 Scope and Application /  
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# Does My Project Need to Comply with the Commercial Provisions in the IECC?

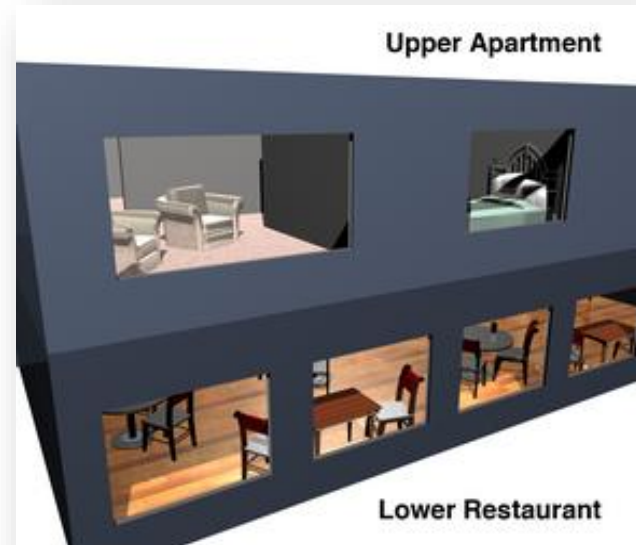


All Buildings Other Than:

- ✓ One- and two-family residential
- ✓ R-2, R-3, R-4 three stories or less in height



- ✓ Treat the residential **building portion** under the applicable residential code
- ✓ Treat the commercial **building portion** under the commercial code
- ✓ Code Official has final authority
  - Compliance materials, Software, worksheets



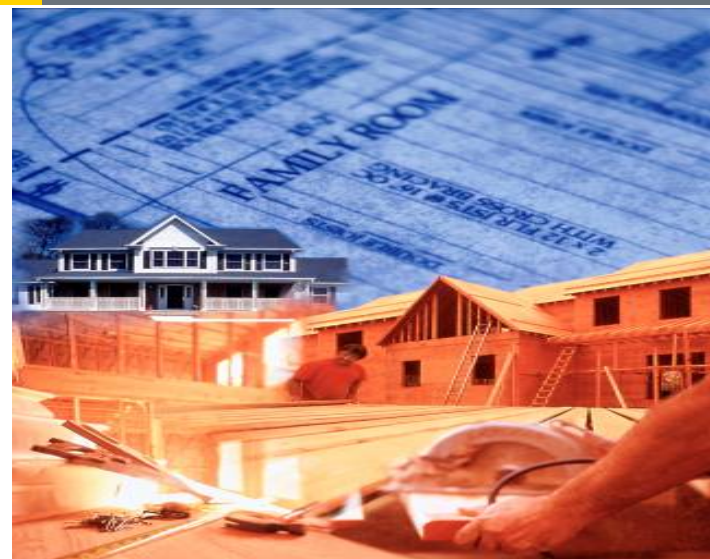


- The code is not intended to prevent installation of any material or prohibit design of construction that is not specifically prescribed in this code if alternative is approved
- **Approved where**
  - Code official finds proposed design is satisfactory and complies with the intent of the provisions and material, method, or work is for the purpose intended, not less than equivalent prescribed in the code in quality, strength, effectiveness, fire resistance, durability and safety
- **Where not approved**
  - Code official to respond in writing stating the reasons why

# Scope/Construction Documents

## Section C103

- ✓ Documentation shall be prepared by a registered design professional
- ✓ Electronic media can be used
- ✓ Information required:
  - ✓ Insulation materials and R-values
  - ✓ Fenestration U-factors, SHGC
  - ✓ Area-weighted U-factor and SHGC calculations
  - ✓ Mechanical system design criteria
  - ✓ Mechanical, SWH, equipment types, sizes, and efficiencies
  - ✓ Economizer description
  - ✓ Equipment and system controls
  - ✓ Duct sealing, duct and pipe insulation and location
  - ✓ Lighting fixture schedule with wattage and control narrative
  - ✓ Location of daylight zones
  - ✓ Air sealing details



**The building thermal envelope shall be represented on the construction drawings.**

- Examination of documents
- Amended construction documents
- Retention of construction documents
- Building documentation and closeout submittal requirements



- ✓ Fees, C104
- ✓ Inspections, C105
  - Work remains visible and accessible for inspection
- ✓ Code Validity, C106
  - Code deemed to be illegal or void shall not affect the remainder of the code
- ✓ Referenced standards, C107
  - Provisions take precedence and considered part of the requirements of the code
- ✓ Stop Work Order, C108
  - ✓ Authority of code official
  - ✓ Failure to comply
- ✓ Board of Appeals, C109

- Construction work for which a permit is required is subject to inspection by code official, his or her designated agent **or an approved agency**
- Required inspections include:
  - Footing and foundation **insulation**
  - **Thermal envelope**
  - **Plumbing system**
  - **Mechanical system**
  - **Electrical system**
  - Final

Codes and standards listed in Chapter 6 are considered part of the requirements of this code to the “prescribed extent of each such reference and as further regulated in Sections C107.1.1 and C107.1.2”

- Conflicts, C107.1.1 – where differences occur between this code and the referenced codes and standards, provisions of this code apply
- Provisions in reference codes and standards, C107.1.2 – “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”

Buildings or portions of buildings that are separated from remainder of building by building thermal envelope assemblies complying with C402 **are exempt** from the Envelope provisions if:

- Peak design rate of energy < 3.4 Btu/h/ft<sup>2</sup> or 1.0 watt/ft<sup>2</sup> of floor area for space conditioning purposes, **OR**
- Those portions or building that do not contain conditioned space, **OR**
- Greenhouses

Buildings that comply with the following are exempt from the building thermal envelope provisions:

- Separate building with floor area  $< 500 \text{ ft}^2$  ( $50 \text{ m}^2$ )
- Intended to house electronic equipment with installed equipment power totaling  $> 7 \text{ watts/ft}^2$  ( $75 \text{ W/m}^2$ )
- Heating system capacity  $< 17,000 \text{ Btu/hr}$  ( $5 \text{ kW}$ ) and a heating thermostat set point that is restricted to  $< 50^\circ\text{F}$
- Average wall and roof U-factor  $< 0.200$  in **Climate Zones 1-5** and  $< 0.120$  in Climate Zones 6-8
- Comply with the roof solar reflectance and thermal emittance provisions for **Climate Zone 1**



# Commercial Compliance Options

1

● ASHRAE  
90.1-2016

OR

2

## 2018 IECC - Prescriptive

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

AND

- Pick At Least One C406:

C406.2 – Eff. HVAC  
Performance

C406.3 – Reduced Lighting  
Power

C406.4 – Enhanced Lighting  
Controls

C406.5 – On-site Supply of  
Renewable energy

C406.6 – Dedicated Outdoor  
Air System

C406.7 – High Eff. Service  
Water Heating

**C406.8 – Enhanced Envelope  
Performance**

**C406.9 – Reduced Air  
Infiltration**

OR

3

## 2018 IECC - Performance

- C407 – Total Building  
Performance
- C402.5 – Air Leakage
- C403.2 – Provisions  
applicable to all  
mechanical systems
- C404 - SWH
- Lighting Mandatory  
Sections  
C405.2  
C405.3  
C405.4  
C405.6

- Building energy cost  
to be  $\leq 85\%$  of  
standard reference  
design building

# Additional Efficiency Package Options

## Section C406

- One additional efficiency feature must be selected to comply with the IECC
  - More efficient HVAC performance, OR
  - Reduced lighting power density system, OR
  - Enhanced lighting controls, OR
  - On-site supply of renewable energy
  - Dedicated outdoor air system, OR
  - More efficient SWH



High Efficiency HVAC



More Efficient Lighting System



Onsite Renewables

- Efficient HVAC performance per C406.2 **OR**
  - Per Tables C403.2.3(1) thru C403.2.3(7)
  - Only used when efficiencies in the above tables are greater than 10% in addition to the requirements in C403
  - Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10%
  - Variable refrigerant flow systems exceed energy efficiency provisions of 90.1-2013 by 10%
  - Equipment not listed in tables above shall be limited to 10% of total building system capacity
- Reduced lighting power per C406.3 **OR**
  - Whole building LPD determined using 90% of values in Table C405.4.2(1) x floor area for the building types **OR**
  - Using 90% by the space-by-space method in Section C405.4.2
  - Determine total LPD of building using reduced whole building interior lighting power in Table 406.3 x floor area for the building types

- Enhanced digital lighting controls per C406.4, controls located and operated in accordance with C405.2.2:
  - Luminaires capable of continuous dimming
  - Luminaires capable of being addressed individually OR a controlled group of  $\leq 4$  luminaires
  - $\leq 8$  luminaires controlled together in a daylight zone
  - Fixtures controlled through digital control system that includes the following function:
    - Control reconfiguration based on digital addressability
    - Load shedding
    - Individual user control of overhead general illumination in open offices
    - Occupancy sensors capable of being reconfigured through the digital control system
  - Construction documents including submittal of Sequence of Operations including specs outlining each function of the fixture requirements above
  - Functional testing of controls comply with C408

- On-site renewable energy per C406.5 **OR**
  - Total minimum ratings to
    - Provide  $\geq 1.75$  Btu or  $\geq 0.50$  watts per ft<sup>2</sup> of conditioned floor area  
OR
    - Provide  $\geq 3\%$  of energy used for mechanical and SWH equipment and lighting
- Dedicated outdoor air system per C406.6 **OR**
  - Be equipped with an independent ventilation system designed to provide  $\leq 100\%$  outdoor air to each occupied space
  - Ventilation system capable of total energy recovery
  - HVAC system include supply-air temperature controls that automatically reset the supply-air temp. in response to building loads or outdoor air temperatures
  - Controls reset the supply-air temp. at least 25% of the difference between design supply-air temp. and design room-air temp.



- Reduced energy use in SWH per C406.7

Buildings with the following types allowed to use this compliance method:

- Group R-1: Boarding houses, hotels, or motels
- Group I-2: Hospitals, psychiatric hospitals, and nursing homes
- Group A-2: Restaurants and banquet halls or buildings containing food preparation areas
- Group F: Laundries
- Group R-2: Buildings with residential occupancies
- Group A-3: Health clubs and spas
- Buildings showing a service hot water load of  $\geq 10\%$  of total building energy loads as shown with an energy analysis per C407

- Reduced energy use in SWH (cont'd)

### Load fraction:

Building SWH system has  $\geq 1$  of the following sized to provide > 60% of hot water requirements or sized to provide 100% of hot water requirements if building complies with C403.4.7

- Waste heat recovery from service hot water, heat recover chillers, building equipment, process, equipment, or combined heat and power system
- Solar water-heating systems
- **Enhanced Envelope Performance**
  - Total UA of building thermal envelope as designed to be not less than 15% below total UA of building thermal envelope per Section C402.1.5

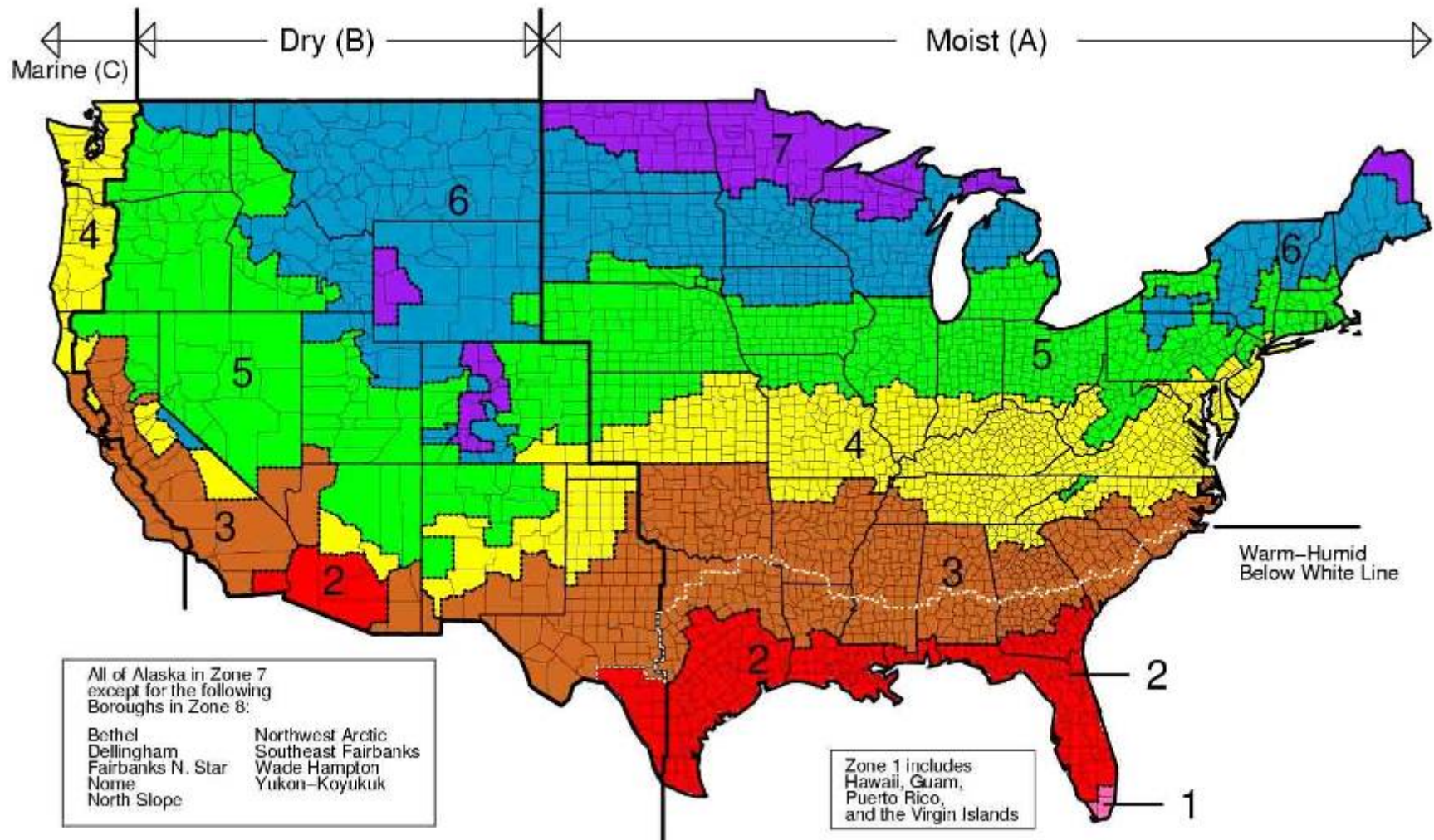
- **Reduced Air Infiltration**

- Air infiltration verified by whole-building pressurization test
  - Per ASTM E779 or ASTM E1827
  - By independent third party
- Measured air-leakage rate not to exceed 0.25 cfm/ft<sup>2</sup> under pressure differential of 0.3 inches w.c. (75 Pa), with calculated surface area the sum of above- and below-grade building envelope
- Submit report to code official and building owner
  - Including: tested surface area, floor area, air by volume, stories above grade, and leakage rates

**Exception:** Buildings over 250,000 ft<sup>2</sup> of conditioned floor area don't need testing on whole building, can test representative above-grade sections. Tested areas to total not less than 25% of conditioned floor area and tested per C406.9

# Climate Zones

## 2015 IECC - Chapter 3



Determining Your Climate Zone is the First Step in the Process

# What is the Building Thermal Envelope?

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



Building thermal envelope to comply with the following:

- Specific insulation requirements of Section C402.2
- Thermal requirements of either:
  - R-value-based method of Section C402.1.3
  - U-, C-, and F-factor-based method of Section C402.1.4 **OR**
  - Component performance alternative of Section C402.1.5
- Roof solar reflectance and thermal emittance
- Fenestration in building envelope assemblies
- Air Leakage of building envelope assemblies

3 Methods for compliance of building components:

- C402.1.3 – Insulation component R-value based method
- C402.1.4 – Assembly U-factor, C-factor or F-factor based method
- C402.1.5 – Component Performance Alternative

# Chapter 5 Prescriptive Approach Compliance

**TABLE C402.1.3**  
**OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD<sup>a,1</sup>**

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
<b>Roofs</b>																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	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-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
<b>Walls, above grade</b>																
Mass <sup>c</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	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	R-13 + R-6.5ci	R-13ci	R-13ci	R-13ci	R-13ci	R-13ci	R-13ci	R-13ci	R-13ci	R-13ci	R-13ci	R-19.5ci	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 + R-17.5ci
Wood framed and 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-20	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-3.8ci	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-10ci	R-13 + R-15.6ci or R-10ci
<b>Walls, below grade</b>																
Below-grade wall <sup>d</sup>	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
<b>Floors</b>																
Mass <sup>e</sup>	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 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>
<b>Slab-on-grade floors</b>																
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 <sup>h</sup>	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab
<b>Opaque doors</b>																
Nonswinging	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, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

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 C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, 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-°F.

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

e. "Mass floors" shall be in accordance with Section C402.2.3.

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

g. "Mass walls" shall be in accordance with Section C402.2.2.

h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

i. Not applicable to garage doors. See Table C402.1.4.

# Chapter 5 Prescriptive Approach Compliance

**TABLE C402.1.3**  
**OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD<sup>a,i</sup>**

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
<b>Roofs</b>																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	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-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
Mass <sup>g</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	R-7.6ci	R-7.6ci	R-9.5ci	<b>ROOFS</b>				R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci

Climate Zone	1	2	3	4	5	6	7	8								
				Except Marine	And Marine 4											
Insulation entirely above deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>a, b</sup>	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-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-38	R-49	R-49	R-49	R-49	R-49	R-49
	Opaque doors															
	Nonswinging	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, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

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 C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, 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-°F.

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

e. "Mass floors" shall be in accordance with Section C402.2.3.

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

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# Chapter 5 Prescriptive Approach Compliance

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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
<b>Roofs</b>																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	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-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
<b>WALLS, ABOVE GRADE</b>																
Mass <sup>g</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	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

Climate Zone	1		2		3		4 Except Marine		5 And Marine 4		6		7		8	
Mass	R-5.7ci	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	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+7.5ci	R-13+7.5ci	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-20 3	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

b. Where using R-value compliance method, a thermal spacer block shall be provided, otherwise use the U-factor compliance method in Table C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, 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-<sup>2</sup> °F.

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

e. "Mass floors" shall be in accordance with Section C402.2.3.

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

g. "Mass walls" shall be in accordance with Section C402.2.2.

h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

i. Not applicable to garage doors. See Table C402.1.4.



# Chapter 5 Prescriptive Approach Compliance

**TABLE C402.1.3**  
**OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD<sup>a,1</sup>**

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
<b>Roofs</b>																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	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-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
<b>WALLS, BELOW GRADE</b>																
Mass <sup>c</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	R-7.6ci	R-7.6ci	R-7.6ci	R-7.6ci	R-7.6ci	R-7.6ci	R-7.6ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci

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

Mass <sup>c</sup>	NR	NR	R-6.3ci	R-8.3ci	R-10ci	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 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>
<b>Slab-on-grade floors</b>																	
Unheated slabs	NR	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 <sup>a</sup>	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab
<b>Opaque doors</b>																	
Nonswinging	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	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

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 C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, 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-°F.

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

e. "Mass floors" shall be in accordance with Section C402.2.3.

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

g. "Mass walls" shall be in accordance with Section C402.2.2.

h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

i. Not applicable to garage doors. See Table C402.1.4.

# Chapter 5 Prescriptive Approach Compliance

**TABLE C402.1.3**  
**OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD<sup>a,1</sup>**

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
<b>Roofs</b>																
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	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-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
<b>FLOORS</b>																
Mass <sup>e</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	R-7.6ci	R-7.6ci	R-7.6ci	R-10.4ci	R-10.4ci	R-10.4ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci

Climate Zone	1		2		3		4 Except Marine		5 And Marine 4		6		7		8	
Mass <sup>e</sup>	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 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>	R-30 <sup>f</sup>

Heated slabs <sup>a</sup>	12" below + R-5 full slab	12" below + R-5 full slab	12" below + R-5 full slab	12" below + R-5 full slab	24" below + R-5 full slab	24" below + R-5 full slab	24" below + R-5 full slab	24" below + R-5 full slab	36" below + R-5 full slab	36" below + R-5 full slab	36" below + R-5 full slab	48" below + R-5 full slab	48" below + R-5 full slab	48" below + R-5 full slab	48" below + R-5 full slab	48" below + R-5 full slab
<b>Opaque doors</b>																
Nonswinging	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, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

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 C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, 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-<sup>2</sup> °F.

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

e. "Mass floors" shall be in accordance with Section C402.2.3.

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

g. "Mass walls" shall be in accordance with Section C402.2.2.

h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

i. Not applicable to garage doors. See Table C402.1.4.

# Chapter 5 Prescriptive Approach Compliance

TABLE C402.1.3  
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD<sup>a,1</sup>

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 roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	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-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
SLAB-ON GRADE FLOORS																
Mass <sup>g</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	R-5.7ci <sup>e</sup>	R-7.6ci	R-7.6ci	R-7.6ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci	R-25ci	R-25ci

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-15 for  
24 in.  
below

R-20 for  
24 in.  
below

Heated  
Slabs

R-7.5 for  
12 in.  
below +  
R-5 full  
slab

R-7.5 for  
12 in.  
below +  
R-5 full  
slab

R-7.5 for  
12 in.  
below +  
R-5 full  
slab

R-7.5 for  
12 in.  
below +  
R-5 full  
slab

R-10 for  
24 in.  
below +  
R-5 full  
slab

R-10 for  
24 in.  
below +  
R-5 full  
slab

R-15 for  
24 in.  
below +  
R-5 full  
slab

R-15 for  
24 in.  
below +  
R-5 full  
slab

R-15 for  
36 in.  
below +  
R-5 full  
slab

R-15 for  
36 in.  
below +  
R-5 full  
slab

R-15 for  
36 in.  
below +  
R-5 full  
slab

R-20 for  
48 in.  
below +  
R-5 full  
slab

R-20 for  
48 in.  
below +  
R-5 full  
slab

R-20 for  
48 in.  
below +  
R-5 full  
slab

R-20 for  
48 in.  
below +  
R-5 full  
slab

R-20 for  
48 in.  
below +  
R-5 full  
slab

R-20 for  
48 in.  
below +  
R-5 full  
slab

Opaque doors

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

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 C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, 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-°F.

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

e. "Mass floors" shall be in accordance with Section C402.2.3.

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

g. "Mass walls" shall be in accordance with Section C402.2.2.

h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

i. Not applicable to garage doors. See Table C402.1.4.

# Chapter 5 Prescriptive Approach Compliance

TABLE C402.1.3  
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD<sup>a,1</sup>

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 roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings <sup>b</sup>	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-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
Mass floors																
Mass <sup>g</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	R-5.7ci <sup>c</sup>	R-7.6ci	R-7.6ci	R-7.6ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci	R-25ci	R-25ci

## OPAQUE DOORS

Climate Zone	1	2	3	4 Except Marine	5 And Marine 4	6	7	8
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75
Joist/traming	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30
Slab-on-grade floors								
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below
Heated slabs <sup>a</sup>	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab
Opaque doors								
Nonswinging	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, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 pound per cubic foot = 16 kg/m<sup>3</sup>.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

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 C402.1.4.

c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, 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-°F.

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

e. "Mass floors" shall be in accordance with Section C402.2.3.

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

g. "Mass walls" shall be in accordance with Section C402.2.2.

h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

i. Not applicable to garage doors. See Table C402.1.4.



# Roof Assembly

## Section C402.2.1

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

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



Insulation on suspended ceiling with removable ceiling tiles not considered for code compliance.

Continuous insulation board to have > 2 layers and the edge joints between each layer should be staggered.

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 a skylight listed and labeled per NRC 100**)

- Continuously insulated roof assemblies where the thickness of insulation varies by  $\leq 1$ " and area-weighted U-factor is equivalent to the same assembly with the R-value specified in Table C402.1.3
- Tapered insulation is used with insulation entirely above deck, the R-value where the insulation thickness varies  $\leq 1$ " from the minimum thickness of tapered insulation must comply with the R-value specified in Table C402.1.3
- Two layers of insulation aren't required where insulation tapers to the roof deck (e.g., at roof drains)

# Roof Solar Reflectance and Thermal Emittance

## Section C402.3

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

### Comply with one or more options:

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

**OR**

2) Three-year aged solar reflectance index of 64

Where aged solar reflectance required by Section C402.3 is not available, it should be determined with Equation 4-3

$$R_{\text{aged}} = [0.2 + 0.7(R_{\text{initial}} - 0.2)]$$



# Roof Solar Reflectance and Thermal Emittance

## Section C402.3 - Exceptions

- 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 permanent features of adjacent buildings
- Ballasted roofs with minimum stone ballast of 17 lbs/ft<sup>2</sup> or 23 lbs/ft<sup>2</sup> pavers
- Roofs, where a minimum of 75% of the roof area meets one or more of the above exceptions

# High Albedo Roof - Example



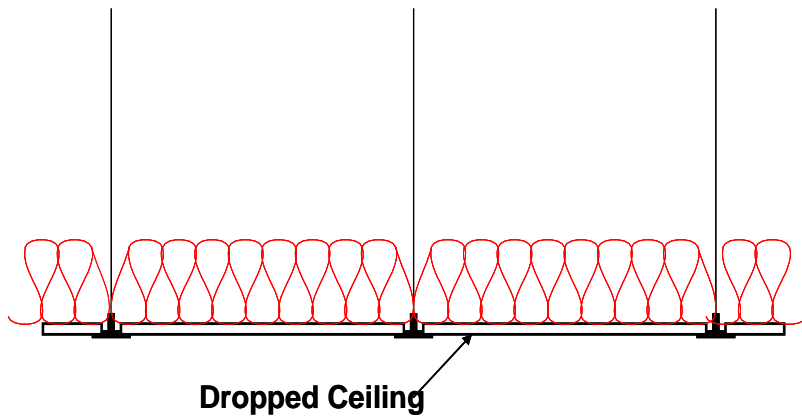
# Roof R-Value Insulation Completely Above Deck



- ✓ Insulation considered continuous (*C/*)
- ✓ Insulation thickness can vary  $\leq 1"$  and area weighted U-factor meets the requirements of Table C402.1.3

# Roof Assembly

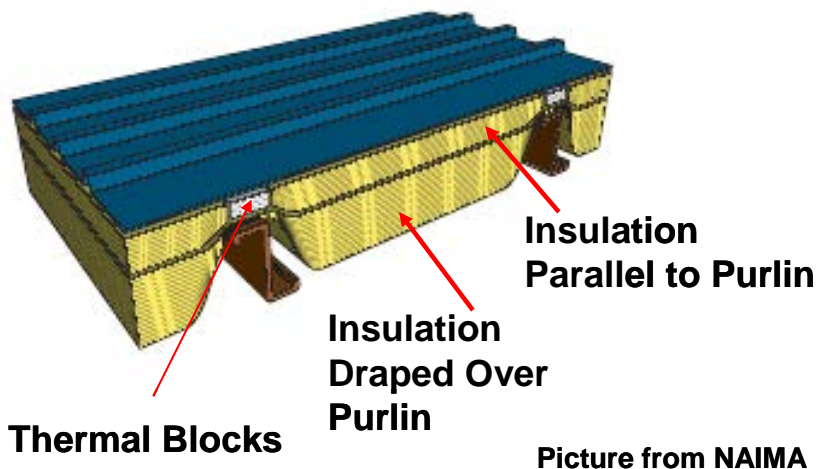
## Insulation Placed on Ceiling with Removable Ceiling Tiles



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



# Roof R-Value Metal Buildings



Thermal spacer block 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

## Liner System includes the following:

- Continuous vapor barrier liner membrane that is installed below the purlins and that is uninterrupted by framing members
- An uncompressed, unfaced insulation resting on top of the liner membrane and located between purlins
- Multilayer installations, the last rated R-value of insulation is for unfaced insulation draped over purlins and compressed when the metal roof panes are attached



# Metal Building Roofs



Photos courtesy of MBMA



# Metal Building Roofs



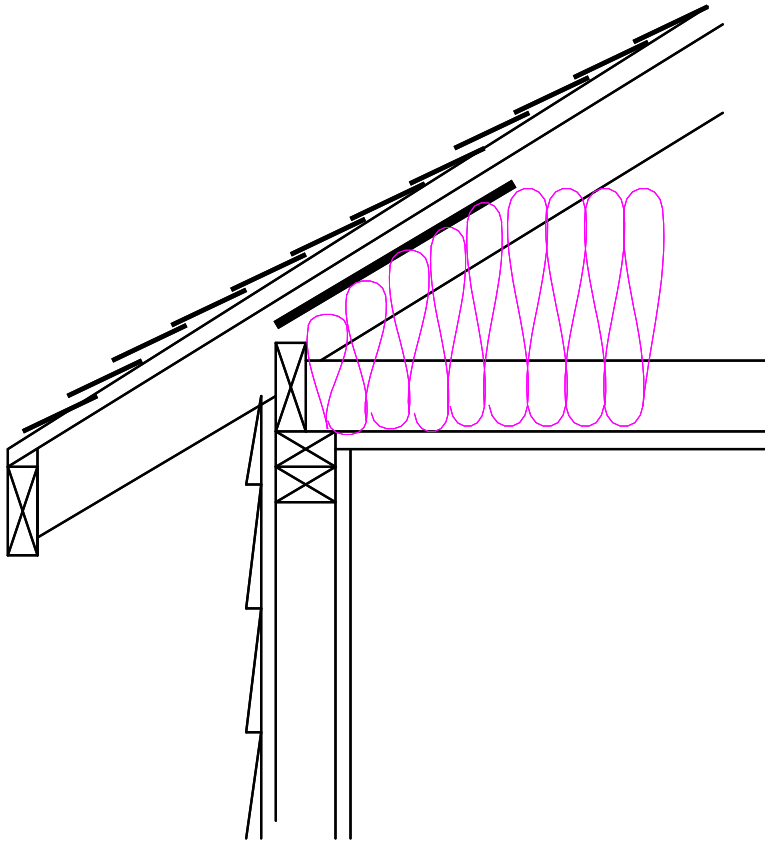
Photos courtesy of MBMA





# 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 5-8 and marine 4 “Group R”

Mass walls must comply with one of the following:



- Walls weigh at least 35 lbs/ft<sup>2</sup> of wall surface area
- 25 lbs/ft<sup>2</sup> of wall surface area if material weight is  $\leq 120 \text{ lb/ft}^3$
- Heat capacity  $> 7 \text{ Btu/ft}^2$
- Heat capacity  $> 5 \text{ Btu/ft}^2$  if the material weight is  $< 120 \text{ pcf}$

Climate Zones 1 and 2 (all other) and Climate Zone 1  
(Group R) – Can use integral insulation instead of R-5.7 ci

- ✓ Concrete block walls must comply with ASTM C 90, and
- ✓ UngROUTED or partially grouted @ 32 inch. o.c. or less vertically or 48 inch. o.c. or less horizontally, and
- ✓ UngROUTED cells must be filled with insulation material  $\leq$  of 0.44 Btu-in./h-ft<sup>2</sup> 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 C402.1.3



Photo courtesy of Ken Baker, K energy

What is a below grade wall?

- ✓ Basement or first-story walls  $\geq 85\%$  below grade

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

Heated slabs installed below grade (*footnoted to Tables C402.1.3 and C402.2.14*)

- ✓ 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

## Section C402.2.3



### Joist/Framing (Steel/Wood)

- ✓ Insulation installed between framing

### Mass Floors

- ✓ Materials weighing (of floor surface area)  
 $35 \text{ lbs/ft}^2$ , **or**
- ✓  $25 \text{ lbs/ft}^2$  if material weight is  $\leq 120 \text{ lbs/ft}^3$
- ✓ Insulation installed continuously

### Steel Floor Joist Systems (footnoted to Table C402.1.3)

- ✓ R-38 in **Climate Zones 6** (Group R) and **7-8** (Group R and All other)

Floor framing cavity insulation or structural slab insulation should be installed to maintain permanent contact with underside of subfloor decking or structural slabs

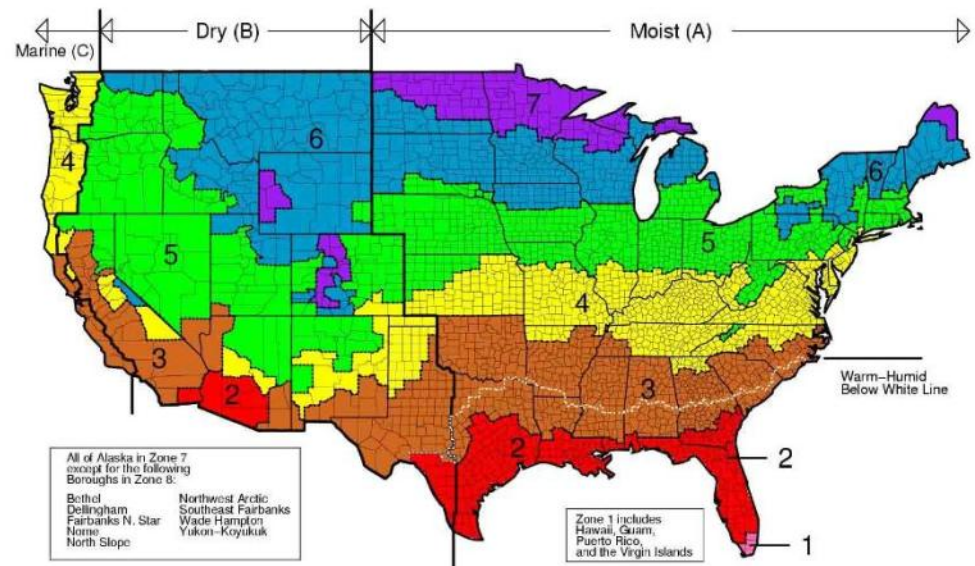
### Exceptions:

- Framing cavity insulation or structural slab insulation is permitted to be in contact with top side of sheathing or ci installed on the bottom side of floor where combined with insulation that meets or exceeds R-value in Table C402.1.3 for “Metal framed” or “Wood framed and other” values for “Walls, Above Grade” and extends from the bottom to the top of all perimeter floor framing or floor assembly members
- Insulation applied to underside of concrete floor slabs is permitted an airspace of  $< 1$ ” where it turns up and is in contact with underside of floor under walls associated with the building thermal envelope

# Slab-on-Grade Floors

## Section C402.2.4

- Unheated slab – insulation required:
  - ✓ Climate Zones 4-8
- Heated slabs – insulation required in all Climate Zones
- **Exception**: where slab-on-grade floor is > 24" below finished exterior grade



- C-factor to be in accordance with Table C402.1.4
- R-value of continuous insulation within or on below-grade exterior walls to be per C402.1.3
- C-factor or R-value required to extend to a depth of not less than 10 feet below outside finished ground level or level of lowest floor in conditioned space enclosed by the below-grade wall, whichever is less

Radiant heating system panels and their associated components:

- Installed in interior or exterior assemblies to be insulated with  $\geq$  R-3.5 on all surfaces not facing the space being heated
- Installed in the building thermal envelope should be separated from the exterior of the building or unconditioned or exempt spaces by not less than the R-value installed in the opaque assembly in which they are installed or assembly comply with Section C402.1.4

**Exception:** heated slabs-on-grade insulated in accordance with Section C402.2.4

# Fenestration

## Chapter 5 Prescriptive Approach

**TABLE C402.4**  
**BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS**

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
<b>Vertical fenestration</b>								
<b>U-factor</b>								
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
<b>SHGC</b>								
Orientation <sup>a</sup>	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.36	0.48
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.43	0.53
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.58	0.58
<b>Skylights</b>								
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

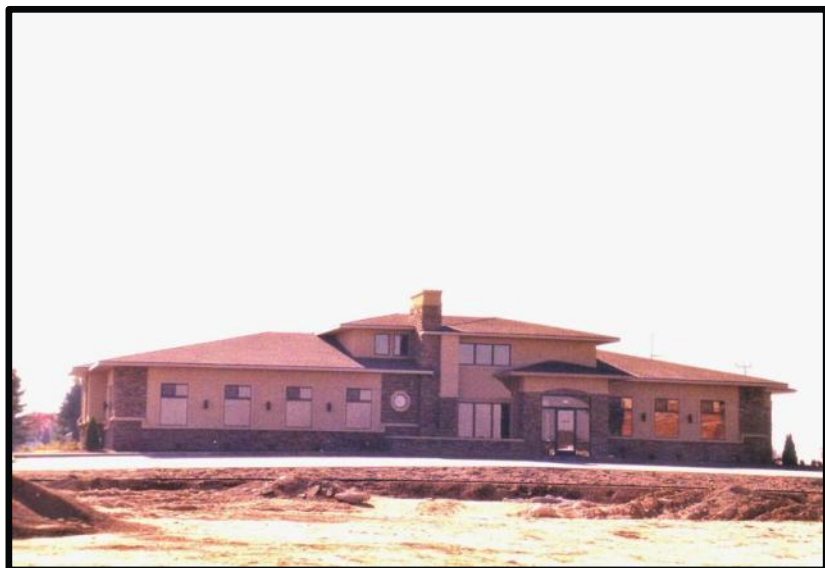
NR = No Requirement, PF = Projection Factor.

a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.



# Vertical Fenestration Requirement

## Section C402.4.1 – 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

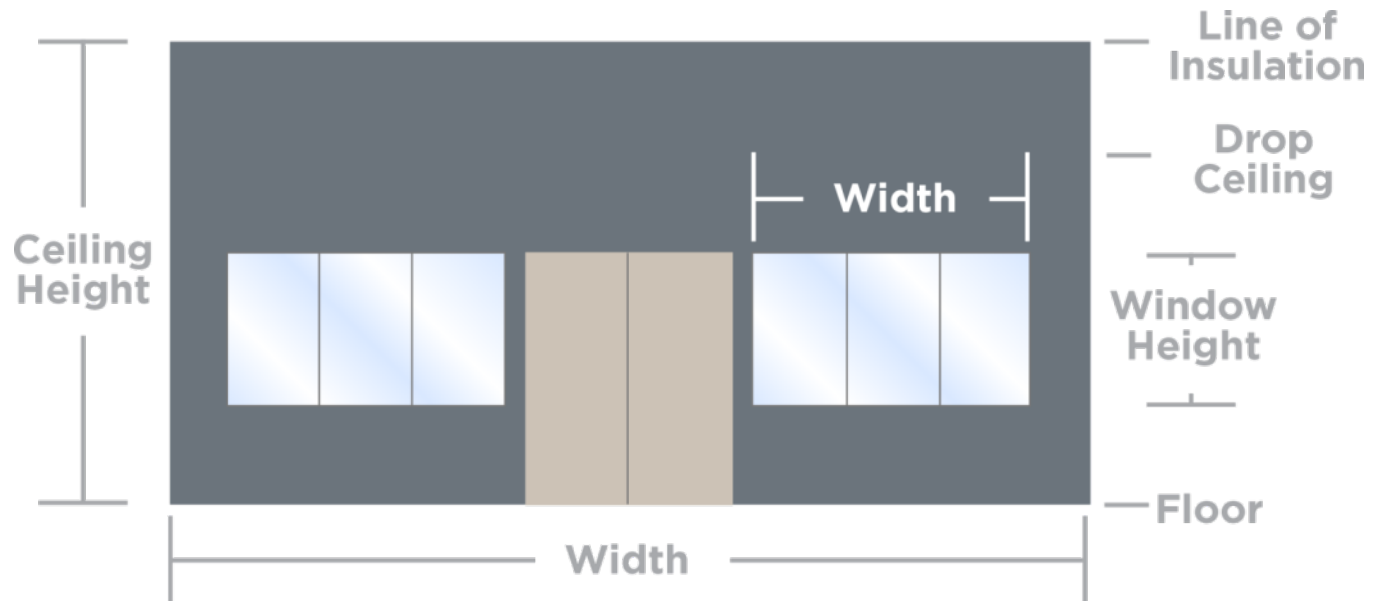
## Section C402.4.1

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

- ✓ Includes walls between conditioned space and unconditioned space or the great outdoors
  - Includes walls that are > 15% above grade

Total fenestration area (*includes frame and glazing*)

- ✓ Does not include opaque door area



# Skylight Minimum Fenestration Area

## Section C402.4.1 Prescriptive

- ✓ Limited to  $\leq 3\%$  of Roof Area
- ✓ Up to **6%** allowed if automatic daylighting controls installed in **toplit zones**



# Increased Vertical Fenestration with Daylight Responsive Controls

## Section C402.4.1.1

- ✓ 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 in buildings < 2 stories above grade
  - No less than 25% of the net floor area is within a daylight zone in building  $\geq$  3 stories above grade
  - Daylight responsive controls complying with C405.2.3.1 are installed in daylight zones
  - VT of vertical fenestration is  $\geq$  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

## Section C402.4.1.2

- ✓ Up to 6% of the roof area provided daylight responsive controls are installed in toplit zones

- In certain types of enclosed spaces  $> 2,500 \text{ ft}^2$  in floor area directly under a roof with  $> 75\%$  of ceiling area with ceiling height  $> 15 \text{ ft}$ .
  - total **toplit** daylight zone to not be  $< \frac{1}{2}$  the floor area and provide one of the following
    - Minimum of 3% of skylight area to **toplit** daylight zone where all skylights have a VT **not less than** 0.40 **OR**
    - Provide a minimum skylight effective aperture of **not less than** 1%

### Exceptions:

- **Climate Zones 6-8**
- Spaces with LPDs  $< 0.5 \text{ W/ft}^2$
- Documented shaded spaces
- Daylight area under rooftop monitors is  $> 50\%$  of floor area
- Spaces where total area minus area of daylight zones adjacent to vertical fenestration is  $< 2,500 \text{ ft}^2$  and lighting is controlled per C405.2.5 (Exterior Lighting Controls)



# Lighting Controls in **Toplit** Daylight Zones

## **Section C402.4.2.1**

Daylight responsive controls complying with C405.2.3.1 should be provided to control all lights with **toplit** zones

- 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 and installed 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

## Section C402.4.3

Table C402.4 requirements by these categories:

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




- ✓ U-factor and SHGC Based
- ✓ NFRC 100 Rating or ANSI/DASMA 105 for U-factor or Default Table
- ✓ NFRC 200 Rating for SHGC and VT or Default Table

# Fenestration Product Rating

## Section C303.1.3

### How Do You Meet the Requirement?

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

 National Fenestration Rating Council CERTIFIED	<b>World's Best Window Co.</b>  Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider
<b>ENERGY PERFORMANCE RATINGS</b>	
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
<b>0.35</b>	<b>0.32</b>
<b>ADDITIONAL PERFORMANCE RATINGS</b>	
Visible Transmittance	Air Leakage (U.S./I-P)
<b>0.51</b>	<b>0.2</b>
Condensation Resistance	
<b>51</b>	
<small>Manufacturer attests that these ratings conform to applicable NFRC procedures for determining window product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>	

<b>NFRC PRODUCT CERTIFICATION PROGRAM</b>		 World's Best Window Co. Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider	
<b>NFRC Label Certificate for Site-Built Products</b>		<b>ENERGY PERFORMANCE RATINGS</b>	
		U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
		<b>0.35</b>	<b>0.32</b>
		<b>ADDITIONAL PERFORMANCE RATINGS</b>	
		Visible Transmittance	Air Leakage (U.S./I-P)
		<b>0.51</b>	<b>0.2</b>
<small>Manufacturer attests that these ratings conform to applicable NFRC procedures for determining window product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>			
<b>Project Location</b>			
Street Address: _____			
City: _____	State: _____	Zip Code: _____	
Project Name (Optional): _____	Designer (Optional): _____		
<b>Product Line Information</b>			
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 _____		
<b>Frame Material Supplier</b> Company name: _____			
City: _____ State: _____ Zip Code: _____			
Street Address: _____			
Contact: _____ Phone: _____ Fax: _____			
<b>Glazing Material Supplier</b> Company name: _____			
City: _____ State: _____ Zip Code: _____			
Street Address: _____			
Contact: _____ Phone: _____ Fax: _____			
<b>Glazing Contractor/Installer</b> Comp. name: _____			
City: _____ State: _____ Zip Code: _____			
Street Address: _____			
Contact: _____ Phone: _____ Fax: _____			
<b>Certification Authorization</b>			
Independent Certification & Inspection Agency (IA): _____			
Date Certification Authorization Issued: _____			

# Default U-Factors

## Tables C303.1.3(1) and (2)

TABLE C303.1.3(1)  
DEFAULT GLAZED WINDOW,  
GLASS DOOR AND SKYLIGHT *U*-FACTORS

FRAME TYPE	WINDOW AND GLASS DOOR		SKYLIGHT	
	Single	Double	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 OPAQUE DOOR *U*-FACTORS

DOOR TYPE	OPAQUE <i>U</i> -FACTOR
Uninsulated Metal	1.20
Insulated Metal (Rolling)	0.90
Insulated Metal (Other)	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35





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)

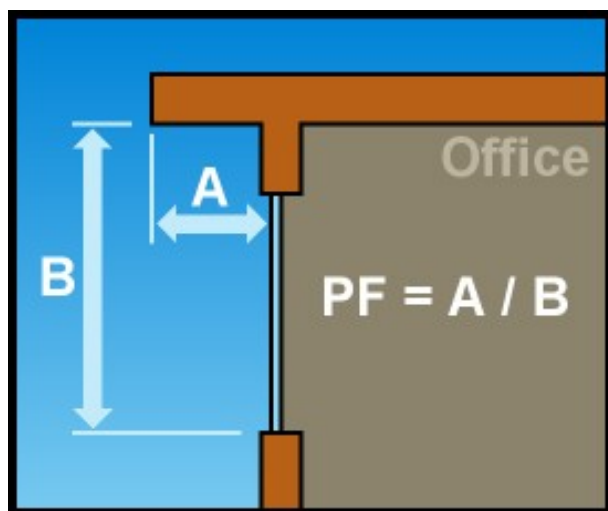
### Two Options for Meeting the SHGC and VT Requirements

- ✓ 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

# Increased Skylight SHGC and U-factor

## *Sections C402.4.3.1, C402.4.3.2*

Skylights installed above daylight zones with daylight responsive controls:

- Climate Zones 1-6, permitted maximum SHGC 0.60
- Climate Zones 1-3, permitted maximum U-factor 0.90
- Climate Zones 4-8, permitted maximum U-factor 0.75

- ✓ SHGC determined using manufacturer's ratio of the higher to lower labeled SHGC
- ✓ SHGC ratio  $\geq 2.4$
- ✓ Automatically controlled to modulate amount of solar gain into the space in multiple steps
- ✓ Considered separately from other fenestration
- ✓ Area-weighted averaging isn't allowed
  
- ✓ **Exception**: not required to comply where both the lower and higher labeled SHGC already comply with Table C402.3

# Area-Weighted U-Factor

## Section C402.4.3.4

- ✓ Allowed to meet requirements in Table C402.4
- ✓ Can't combine products from different categories when calculating the area-weighted average U-factor





Opaque **swinging** doors having  
< 50% glass area

Comply with Table C402.1.4

**Opaque nonswinging doors**

✓ Comply with Table C402.1.3



All other doors to comply with  
vertical fenestration  
requirements (Section C402.4.3)

- ✓ Air Leakage
- ✓ Air barriers
- ✓ Fenestration air leakage
- ✓ Rooms Containing Fuel-burning Appliances
- ✓ Air intakes, exhaust openings, stairways and shafts
- ✓ Loading dock weatherseals
- ✓ Vestibules
- ✓ Recessed lighting

Tested in accordance with ASTM E 779 at pressure differential of 0.3 inch water gauge or an equivalent method approved by code official when tested air leakage rate  $< 0.40 \text{ cfm/ft}^2$

# Air Barrier Construction

## Section C402.5.1.1

- Continuous air barrier required except in:  
**Climate Zone 2B**
- Air barrier 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 sealed including sealing transitions in places and changes in materials, securely installed in or on the joint for its entire length to not dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation



- Penetrations of air barrier and air leakage paths to be caulked, gasketed or otherwise sealed in a manner compatible with construction materials and location (sealing to allow for expansion, contraction and mechanical vibration)
- Joints and seals
  - Sealed in same manner or taped
- Sealing of concealed fire sprinklers where required in a manner recommended by manufacturer
  - Caulking or other adhesive sealants should not be used to fill voids between fire sprinkler cover plates and walls, or ceilings
- Recessed lighting to comply with C402.5.8
- Where similar objects are installed that penetrate the air barrier, make provisions to maintain the air barrier's integrity

# Air Barrier Compliance Options

## Section C402.5.1.2

Two ways to comply with air barrier requirements:

- ✓ Materials – C402.5.1.2.1 OR
- ✓ Assemblies – C402.5.1.2.2



# Air Barrier Materials (Compliance)

## Section C402.5.1.2.1

Materials with air permeance  $\leq 0.004$  cfm/ft<sup>2</sup> 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	1/2 in.
Foil-faced urethane insulation board	1/2 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	1/2 in.
Cement board	1/2 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	
Solid or hollow masonry constructed of clay or shale masonry units	

OR

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

The following assemblies are deemed to comply provided that joints are sealed and Section C402.5.1.1 (Air Barrier Construction) is met:

- Concrete masonry walls coated with either one application either of block filler or two applications of a paint or sealer coating OR
- Masonry walls constructed of clay or shale masonry units with a nominal width of  $\geq 4$ " OR
- Portland cement/sand parge, stucco or plaster  $> \frac{1}{2}$ " thick

# Air Leakage of Fenestration

## Section C402.5.2

Fenestration Assembly	cfm/ft <sup>2</sup>	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 E 283 at 1.57 psf
Commercial glazed swinging entrance doors	1.00	
Power-operated sliding doors and power operated folding doors	1.00	
Revolving doors	1.00	
Garage doors	0.4	ANSI/DASMA 105, NFRC 400, or ASTM E 283 at 1.57 psf
Rolling doors	1.00	
High-speed doors	1.30	

### ✓ Exceptions:

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

# Rooms Containing Fuel-burning Appliances

## Section C402.5.3

- Appliances and combustion air openings to be located outside the building thermal envelope or enclosed in a room isolated from inside the thermal envelope in **Climate Zones 3-8**, one of the following to comply:
  - Rooms to be sealed and insulated per envelope requirements
  - Doors into the rooms fully gasketed
  - Water lines and ducts insulated
  - Combustion air ducts that pass through conditioned space, insulated to  $\geq R-8$

# Rooms Containing Fuel-burning Appliances

## Section C402.5.3 – Cont'd.

### Exceptions:

- Fireplaces and stoves complying with 901-905 IMC and Section 2111.14 IBC

Doors and access openings from conditioned space to shafts, chutes, stairways, and elevator lobbies not within the scope of the fenestration assemblies in Section C402.5.2 to be gasketed, weatherstripped, or sealed

## **Exceptions:**

- Door openings required to comply with 716 IBC
- Doors or door openings required to comply with UL 1784 IBC



# Air Intakes, Exhaust Openings, Stairways, and Shafts

## Section C402.5.5

Openings integral to the building envelope to have dampers per Section **C403.7.7** (Shutoff Dampers)



# Loading Dock Weatherseals

## Section C402.5.6

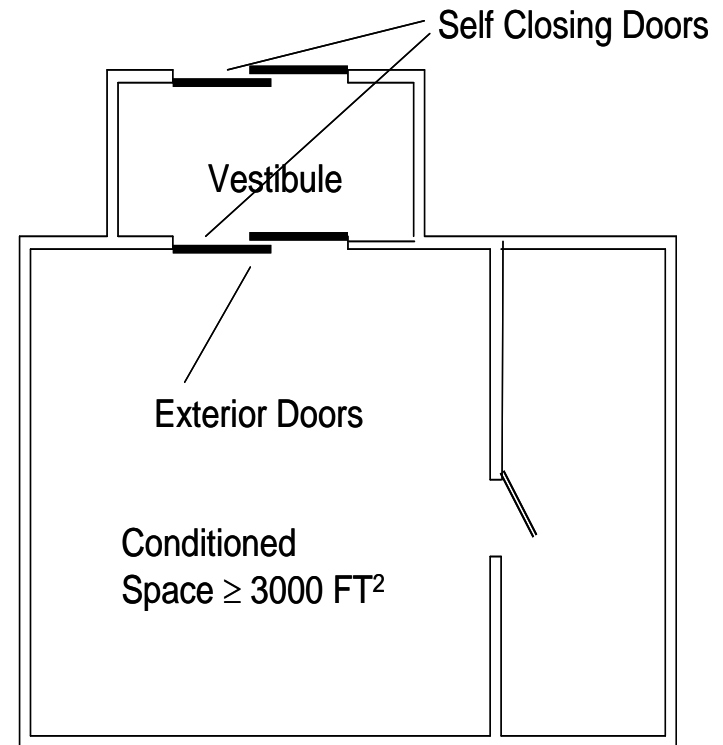


- ✓ Equip cargo door **openings** and loading door **openings** with weatherseals
- ✓ Goal is to restrict infiltration and provide direct contact with vehicles **along top and sides**

# Vestibules

## Section C402.5.7

- ✓ Required to reduce infiltration into spaces
- ✓ Required on entrance doors leading into spaces  $\geq 3,000 \text{ ft}^2$
- ✓ 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 that have an air curtain with velocity  $> 6.56 \text{ ft/second}$  at the floor tested in accordance with ANSI/AMCA 220 installed in accordance with manufacturer's instructions. Manual or automatic controls provided that will operate the air curtain with opening and closing. Air curtain and their controls to comply with Section C408.2.3.



All recessed luminaires installed in the building thermal envelope Type IC rated to have all of the following:

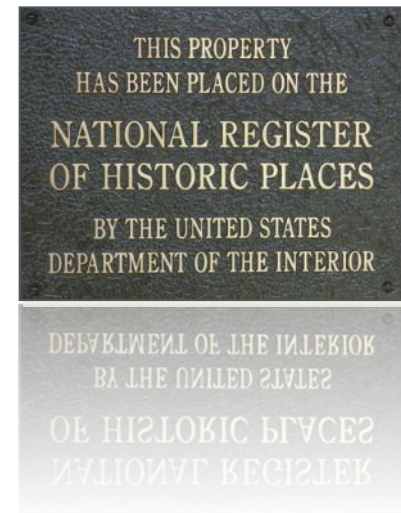
- ✓ Sealed with gasket or caulk between housing and interior wall or ceiling covering **AND**
- ✓ Labeled in accordance with ASTM E 283 to allow  $\leq 2.0$  cfm of air movement between conditioned and unconditioned spaces



# Existing Buildings Chapter 5

## Section C501 - General

- ✓ Additions, alterations, or repairs
- ✓ Existing buildings
- ✓ Maintenance
- ✓ Compliance
- ✓ New and replacement materials
- ✓ Buildings designated as historic



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

### **Examples:**

- ✓ Converting part of an unconditioned warehouse to office space
- ✓ Shell building tenant build-out

Vertical fenestration: new fenestration that results in a total building fenestration area  $\leq 30\%$  must comply with **C402.4.1.5, C402.4.3 or C407**

- If  $> 30\%$  for total building or addition alone, must comply with C402.4.1.1 Increased Vertical Fenestration Area with Daylight Responsive Controls for the addition only
- Additions that result in total building vertical **fenestration**  $> 40\%$  must comply with **C402.1.5 Component Performance Alternative** or C407 Total Building Performance

Skylight Area: new skylight area that is  $\leq 3\%$  complies with C402.4.1

- If  $> 3\%$  for total building or addition alone, must comply with C402.4.1.2 Increased Skylight Area with Daylight Responsive Controls for addition only
- Additions that result in total building skylight area  $> 6\%$  must comply with **C402.1.5 Component Performance Alternative** or C407 Total Building Performance



- Mechanical Systems comply with C403
- SWH – C404
- Pools and inground permanently installed spas – C404.10
- Lighting power and systems – C405
  - Interior comply with addition alone or addition plus existing building
  - Exterior comply with addition alone or addition plus existing

# Existing Buildings

## Section C503 - Alterations



Code applies to any new construction

Unaltered portion(s) do not need to comply

Alterations complying with ASHRAE 90.1-2016 do not need to comply with C402-C405

Vertical Fenestration and Skylight Area similar to requirements for additions

Envelope – where existing building exceeds fenestration area limitations of Section C402.4.1 prior to alteration, building is exempt from C402.4.1 provided there is no increase in fenestration area

### Exceptions:

- ✓ Storm windows over existing fenestration
- ✓ Surface-applied window film installed on existing single pane
- ✓ Exposed, existing ceiling, wall or floor cavities if already filled with insulation
- ✓ Where existing roof, wall or floor cavity isn't exposed
- ✓ Roof recover
- ✓ Reroofing for roofs where neither sheathing nor insulation exposed
  - Insulate above or below the sheathing
    - Roofs without insulation in the cavity
    - Sheathing or insulation is exposed

Any non-conditioned or low energy 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

### **Exceptions:**

- Where component performance alternative in Section C402.1.5 is used, proposed UA to be not greater than 110% of the target UA
- Where total building performance option in Section C407 is used to comply, annual energy cost of proposed design to be not greater than 110% of annual energy cost otherwise permitted by Section C407.3

- Heating and Cooling
  - New HVAC systems and duct systems that are part of the alteration to comply with Section C403
    - Economizers – new cooling systems that are part of the alteration to comply with Section C403.5
- Service hot water systems
  - New SWH systems that are part of the alteration to comply with C404
- Lighting Systems
  - New Lighting systems that are part of the alteration to comply with C404
    - **Exception** – alteration that replace <10% of the luminaires in a space provided such alteration does not increase the installed interior lighting power

- Work on nondamaged components necessary for the required repair or damaged components shall be considered to be part of the report and subject to the alterations requirements
- Repairs considered part of the code
  - Glass-only replacements in an existing sash and frame
  - Roof repairs
  - Replacement of existing doors that separate conditioned space from the exterior do not require the installation of a vestibule or revolving door, provided that an existing vestibule that separate a conditioned space from the exterior shall not be removed
  - Repairs where only the bulb and/or ballast within the existing luminaires in a space are replaced provided the replacement does not increase the installed interior lighting power

- ✓ 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 in Tables C405.3.2(1) or C405.3.2(2), the installed lighting wattage shall comply with Section 405
- ✓ Where in a building with a fenestration area exceeding C402.4.1, space is exempt from C402.4.1 provided there is no increase in fenestration area



### ✓ Exceptions

- ✓ Where Section 402.1.5 is used for compliance, proposed UA not to be  $> 10\%$  of target UA
- ✓ Where Section C407 is used for compliance, annual energy cost of proposed design not to be  $> 110\%$  of that permitted by Section C407.3