



*Providing effective energy strategies for buildings and communities*

# 2018 IECC Commercial Envelope & IBC

1.16.2019



# Who we are

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We assist buildings and communities in achieving energy efficiency, saving money, and becoming more sustainable.

We are an applied research program at University of Illinois, working in collaboration with 360 Energy Group.

**Our goal: Reduce the energy footprint of Illinois.**



# SEDAC is the Illinois Energy Conservation Code Training Provider

This training program  
is sponsored by  
Illinois EPA  
Office of Energy



# Energy Code Assistance



- Technical support
  - 800.214.7954
  - [energycode@sedac.org](mailto:energycode@sedac.org)
- Online resources at [sedac.org/energy-code](http://sedac.org/energy-code)
- Workshops
- Webinars
- Online on-demand training modules





## Energy Code Training

[Illinois Energy Conservation Code](#)[Workshops](#)[Webinars](#)[Online Training](#)[Resources](#)[Frequently Asked Questions](#)[Contact us](#)

## Energy Code Training

### SEDAC is the Illinois Energy Conservation Code training provider

The Smart Energy Design Assistance Center (SEDAC), in partnership with the Illinois EPA Office of Energy, provides training to increase awareness of the Illinois Energy Conservation Code and to improve the energy efficiency of new construction and renovation in Illinois.

Our training program serves community code officials, construction professionals and trades, and design professionals such as architects and engineers in Illinois. SEDAC offers [workshops](#), [webinars](#), [online training](#), [resources](#), and [technical support](#).

Funding provided in whole or in part by the Illinois EPA Office of Energy.

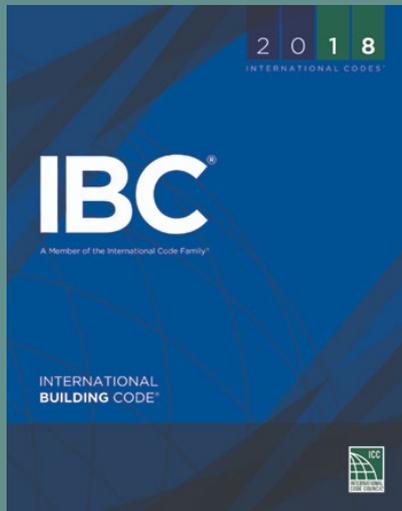


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 Department of  
LANDSCAPE ARCHITECTURE

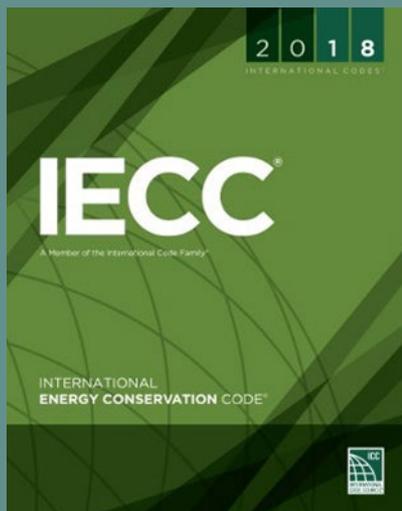
[CONTACT](#)[NEWSLETTER](#)

# What are the different I-Codes?



The International Code Council (ICC) family of codes covers all aspects of construction and includes (but is not limited to):

- International Building Code (IBC): Applies to new and existing buildings, except those residential buildings covered under the International Residential code.
- The IECC contains energy provisions for both commercial and residential buildings (building envelope, mechanical, electrical, and service water heating).
- 2018 IECC to become enforced for Illinois March 2019



# Access to 2018 IECC & IBC



Links to:

- [2018 IECC: https://codes.iccsafe.org/public/document/iecc2018](https://codes.iccsafe.org/public/document/iecc2018)
- [2018 IBC: https://codes.iccsafe.org/content/IBC2018](https://codes.iccsafe.org/content/IBC2018)

The screenshot shows the ICC website interface. At the top, there is a dark green navigation bar with a search box containing "Search product titles", a magnifying glass icon, and the text "Experience the ICC premiumACCESS™ Demo". To the right of the search bar are links for "ICC Home", "cdpACCESS", "Store", "premiumACCESS™", and "publicACCESS™". Below the navigation bar is a white header area with the ICC International Code Council logo on the left, a "Browse" section with "Category" and "Year" dropdown menus, and a "Help | Sign In" link on the right. The main content area has a breadcrumb trail "Home / I-Codes" and a title "2018 International Energy Conservation Code" with an "Enable Premium Features" button. Below the title is a message: "This title is available for premiumACCESS. Click to purchase a premium subscription to this content." A dark green bar contains the text "TABLE OF CONTENTS" and navigation arrows. The "Table Of Contents" section lists the following items: LEGEND, COPYRIGHT, PREFACE, EFFECTIVE USE OF THE INTERNATIONAL ENERGY CONSERVATION CODE, IECC—COMMERCIAL PROVISIONS, and CHAPTER 1 [CE] SCOPE AND ADMINISTRATION.

# IECC Terminology

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## Prescriptive

- Compliance path using a set of specifications, like a shopping list, that all must be met individually.

## Mandatory

- Provisions required regardless of compliance path



**1** ● ASHRAE  
90.1-2016

**OR**

## 2018 IECC - Prescriptive

- 2** ● 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**

## 2018 IECC - Performance

- 3** ● 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

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

# Section C406 Additional Efficiency Package Options

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C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC
2. Reduced lighting power
3. Enhanced lighting controls
4. On-site renewables
5. Provision for dedicated outdoor air system
6. High-efficiency service water heating

The following two were added to 2018 IECC

7. Enhanced envelope performance
8. Reduced air infiltration

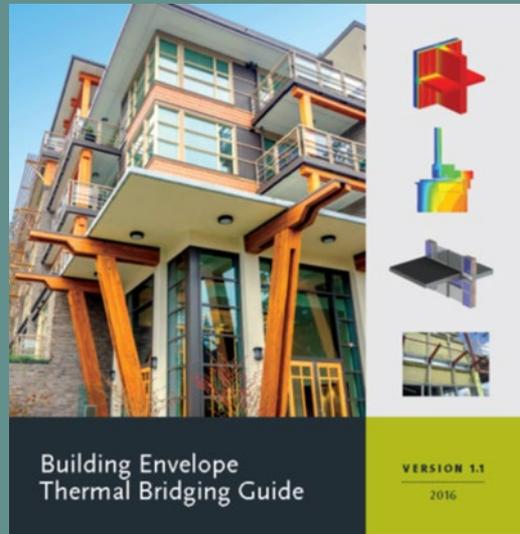


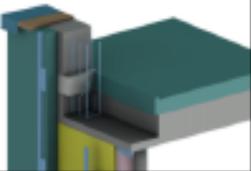
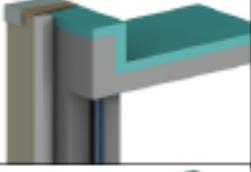
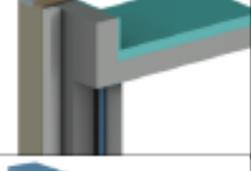
# C406.8 Enhanced Envelope Performance

The total UA of the building thermal envelope as designed shall be not less than 15 percent below the total UA of the building thermal envelope in accordance with Section C402.1.5

## Building Envelope Thermal Bridging Guide

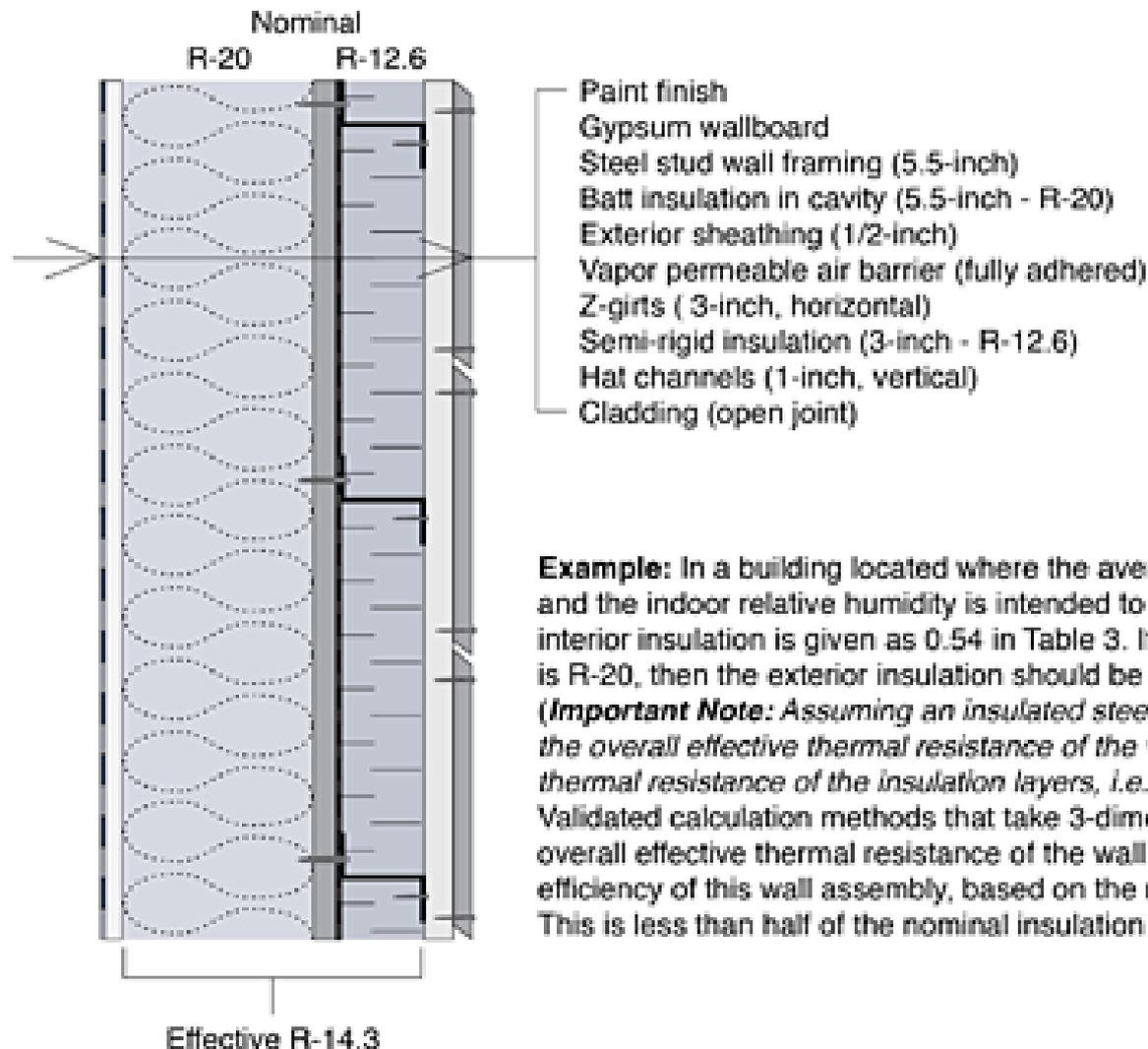
<https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/builders-developers/building-envelope-thermal-bridging-guide-1.1.pdf>



Performance Category	
	Efficient
	Improved
	Regular
	Poor



# Thermal Bridging is a Big Deal



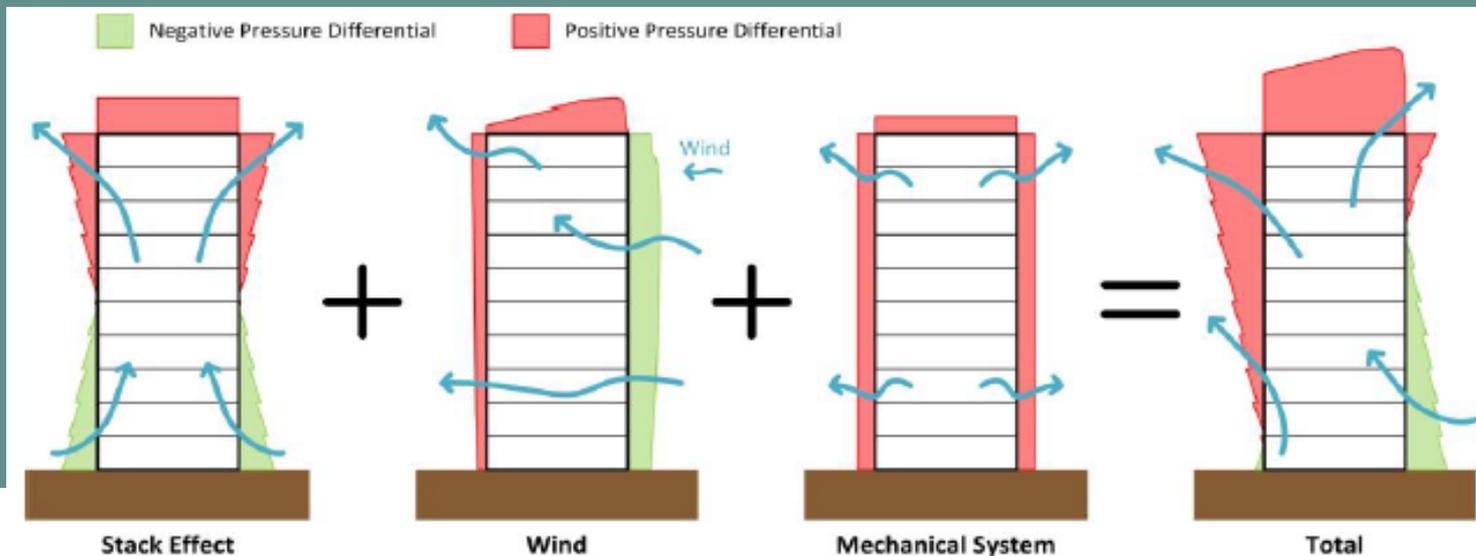
**Example:** In a building located where the average minimum January temperature is 14 °F, and the indoor relative humidity is intended to be maintained at 40%, the ratio of exterior to interior insulation is given as 0.54 in Table 3. If the interior insulation in a 5.5 inch wall cavity is R-20, then the exterior insulation should be at least R-10.8.

**(Important Note:** Assuming an insulated steel stud wall and metal cladding attachments, the overall effective thermal resistance of the wall will be significantly less than the nominal thermal resistance of the insulation layers, i.e.,  $20 + 12.6 = R-32.6$ .)

Validated calculation methods that take 3-dimensional heat flows into account indicate the overall effective thermal resistance of the wall is only R-14.3. This means that the thermal efficiency of this wall assembly, based on the nominal insulation is  $14.3/32.6 = 43.9\%$ . This is less than half of the nominal insulation R-value and may not comply with codes.

# C406.9 Reduced Air Infiltration

- Air Infiltration shall be verified by whole building pressurization testing.
- Measured air leakage rate shall not exceed 0.25 cfm/ft<sup>2</sup> under a pressure differential of 75 Pa.
- Building envelope surface area includes below grade building envelope
- Exception: for buildings having over 250,000 SF of conditioned floor area, air leakage need not be conducted on the whole building. Tested areas shall total not less than 25% of conditioned floor area.



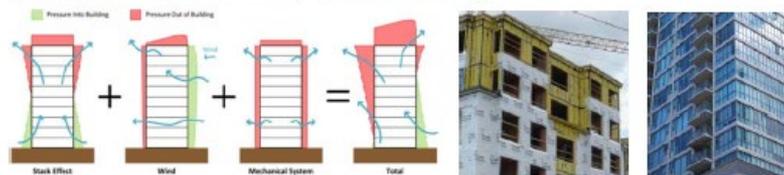
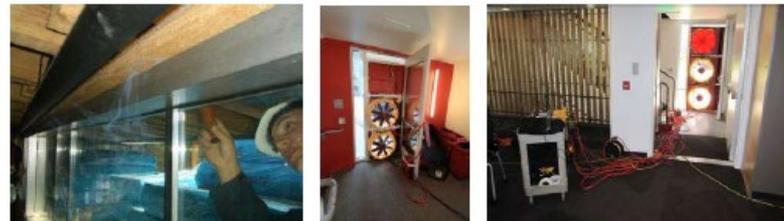
# Air Leakage Control

Canada Mortgage and Housing Corporation has sponsored a lot of building design and performance research.

This publication addresses Air Leakage Control and is a good source of information on how to design, build, and test for air leakage control.

Link:

<https://rdh.com/wp-content/uploads/2014/04/Air-Leakage-Control-in-Multi-Unit-Residential-Buildings.pdf>



CLIENT Silvia Plescia  
Canada Mortgage and Housing Corporation  
700 Montreal Road  
Ottawa ON K1A 0P7

SUBMITTED BY RDH Building Engineering Ltd.  
224 West 8th Avenue  
Vancouver BC V5Y 1N5

**Air Leakage Control in Multi-Unit Residential Buildings**  
Development of Testing and Measurement Strategies to Quantify Air Leakage in MURBS

# Building thermal envelope compliance



Three different methods to determine compliance of the building thermal envelope

1. **C402.1.3** Insulation Component R-value-based method
2. **C402.1.4** Assembly U-factor, C-factor or F-factor-based method
3. **C402.1.5** Component performance alternative

# Method 1: C402.1.3 Insulation component R-value-based method

Building thermal envelope opaque assemblies shall comply with the requirements of Section C402.2 and C402.4.

R-values for insulation shall not be less than that specified in Table C402.1.3.

- C402.2 Specific building thermal envelope insulation requirements (Prescriptive).
- C402.4 Fenestration (Prescriptive)

Table C402.1.3 Excerpt

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4	
	All other	Group R	All other	Group R
<b>Roofs</b>				
Insulation entirely above roof deck	R-30ci	R-30ci	R-30ci	R-30ci
Metal buildings <sup>b</sup>	R-19 + R-11 LS			
Attic and other	R-38	R-38	R-38	R-49
<b>Walls, above grade</b>				
Mass <sup>a</sup>	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci
Metal building	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci
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-7.5ci or R-20 + R-3.8ci
<b>Walls, below grade</b>				
Below-grade wall <sup>d</sup>	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci
<b>Floors</b>				
Mass <sup>e</sup>	R-10ci	R-10.4ci	R-10ci	R-12.5ci
Joist/framing	R-30	R-30	R-30	R-30
<b>Slab-on-grade floors</b>				
Unheated slabs	R-10 for 24' below			
Heated slabs <sup>h</sup>	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
<b>Opaque doors</b>				
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75

## Method 2: C402.1.4 Assembly U-factor, C-factor or F-factor-based method

Building thermal envelope opaque assemblies shall comply with the requirements of Section C402.2 and C402.4.

Building thermal envelope opaque assemblies intended to comply on an assembly U-, C- or F-factor basis shall have a U-, C- or F-factor not greater than specified in Table C402.1.4.

Table C402.1.4 Excerpt

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4	
	All other	Group R	All other	Group R
<b>Roofs</b>				
Insulation entirely above roof deck	U-0.032	U-0.032	U-0.032	U-0.032
Metal buildings	U-0.035	U-0.035	U-0.035	U-0.035
Attic and other	U-0.027	U-0.027	U-0.027	U-0.021
<b>Walls, above grade</b>				
Mass <sup>a</sup>	U-0.104	U-0.090	U-0.090	U-0.080
Metal building	U-0.052	U-0.052	U-0.052	U-0.052
Metal framed	U-0.064	U-0.064	U-0.064	U-0.064
Wood framed and other <sup>c</sup>	U-0.064	U-0.064	U-0.064	U-0.064
<b>Walls, below grade</b>				
Below-grade wall <sup>e</sup>	C-0.119	C-0.119	C-0.119	C-0.119
<b>Floors</b>				
Mass <sup>d</sup>	U-0.076	U-0.074	U-0.074	U-0.064
Joist/framing	U-0.033	U-0.033	U-0.033	U-0.033
<b>Slab-on-grade floors</b>				
Unheated slabs	F-0.54	F-0.54	F-0.54	F-0.54
Heated slabs <sup>f</sup>	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64
<b>Opaque doors</b>				
Swinging door	U-0.61	U-0.61	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31

**Table C402.4**  
**Building Envelope Fenestration Maximum**  
**U-factor and SHGC Requirements**

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4	
<b>Vertical fenestration</b>				
<i>U-factor</i>				
Fixed fenestration	0.38		0.38	
Operable fenestration	0.45		0.45	
Entrance doors	0.77		0.77	
<b>SHGC</b>				
Orientation <sup>a</sup>	SEW	N	SEW	N
PF < 0.2	0.36	0.48	0.38	0.51
0.2 ≤ PF < 0.5	0.43	0.53	0.46	0.56
PF ≥ 0.5	0.58	0.58	0.61	0.61
<b>Skylights</b>				
<i>U-factor</i>	0.50		0.50	
SHGC	0.40		0.40	

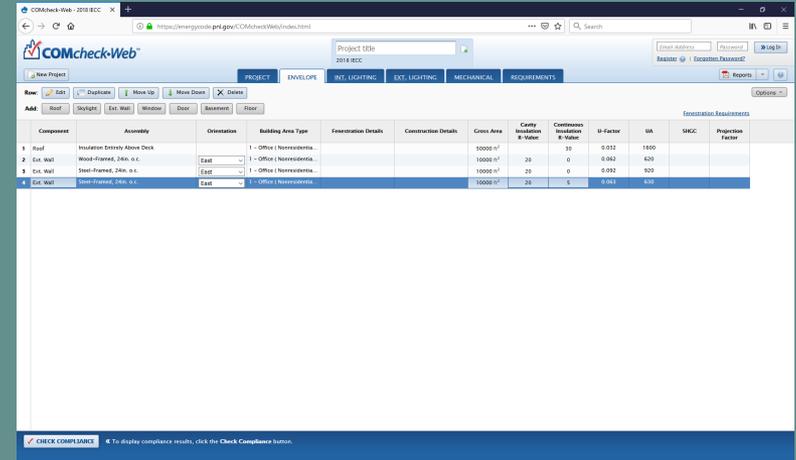
PF = Projection Factor

a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N".



# Method 3: C402.1.5 Component performance alternative

Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be an alternative to compliance with the U-, F- and C-factors in Tables C402.1.4 and C402.4 and the maximum allowable fenestration areas in Section 402.4.1. Fenestration shall meet the applicable SHGC requirements of Section C402.4.3



The screenshot displays the COMcheck-Web software interface. The main window shows a table with the following columns: Component, Assembly, Orientation, Building Area Type, Fenestration Details, Construction Details, Gross Area, Center Insulation R-Value, Corner Insulation R-Value, U-Factor, UA, SHGC, and Projection Factor. The table contains three rows of data:

Component	Assembly	Orientation	Building Area Type	Fenestration Details	Construction Details	Gross Area	Center Insulation R-Value	Corner Insulation R-Value	U-Factor	UA	SHGC	Projection Factor
1 Roof	Insulation Entirely Above Deck		1 - Office (Nonresidential)			50000 ft <sup>2</sup>	10	0.012	1800			
2 Ext. Wall	Wood-Frame, 2-in. G.I.	East	1 - Office (Nonresidential)			10000 ft <sup>2</sup>	20	0.062	600			
3 Ext. Wall	Steel-Frame, 2-in. G.I.	East	1 - Office (Nonresidential)			10000 ft <sup>2</sup>	20	0.092	900			
4 Ext. Wall	Steel-Frame, 2-in. G.I.	East	1 - Office (Nonresidential)			10000 ft <sup>2</sup>	20	0.061	600			



# Heated Slab Insulation

**Added to the 2018 IECC:** R-5 continuous insulation required under heated slabs for both commercial and residential

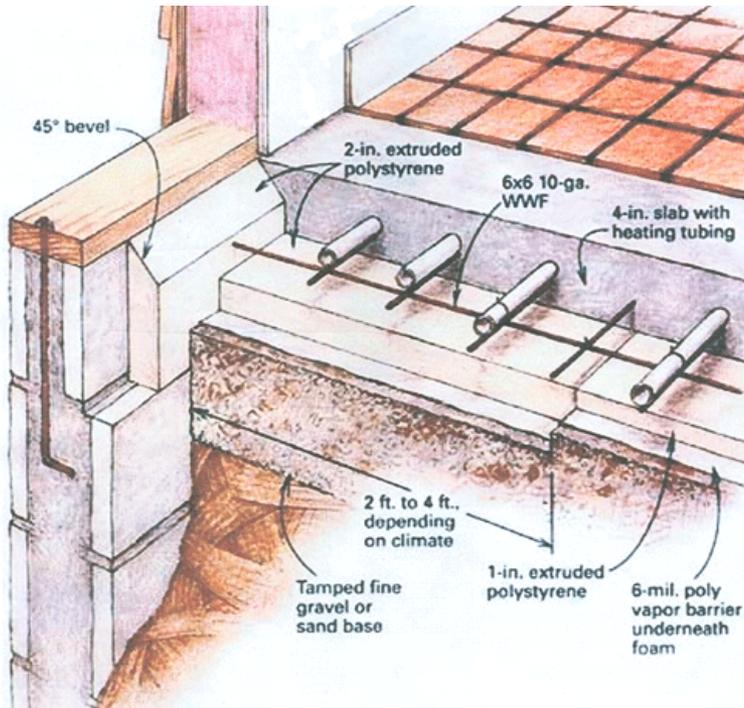


Table C402.1.3  
Opaque Thermal Envelope Insulation Component  
Minimum Requirements, R-Value Method

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4	
	All other	Group R	All other	Group R
<b>Floors</b>				
Mass <sup>e</sup>	R-10ci	R-10.4ci	R-10ci	R-12.5ci
Joist/framing	R-30	R-30	R-30	R-30
<b>Slab-on-grade floors</b>				
Unheated slabs	R-10 for 24' below			
Heated slabs <sup>h</sup>	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

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





# Garage Door Glazing

**Added to the 2018 IECC:** A U-factor of .31 has been added to table C402.1.4 as a minimum requirement for garage doors with glazing <14%



# Roof Insulation

Requires a minimum of 2 layers of insulation for continuous roof insulation.

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4	
	All other	Group R	All other	Group R
Roofs				
Insulation entirely above roof deck	R-30ci	R-30ci	R-30ci	R-30ci
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
Attic and other	R-38	R-38	R-38	R-49



Image courtesy of Pacific Northwest National Labs



# Tapered Roof Insulation

Where tapered insulation is used with insulation entirely above deck, insulation may not vary more than 1" from the R-value specified in C402.1.3 (excerpt below)

CLIMATE ZONE	4 EXCEPT MARINE		5 AND MARINE 4	
	All other	Group R	All other	Group R
Roofs				
Insulation entirely above roof deck	R-30ci	R-30ci	R-30ci	R-30ci
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
Attic and other	R-38	R-38	R-38	R-49

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.

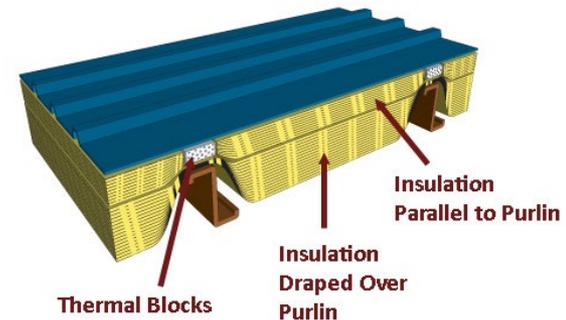
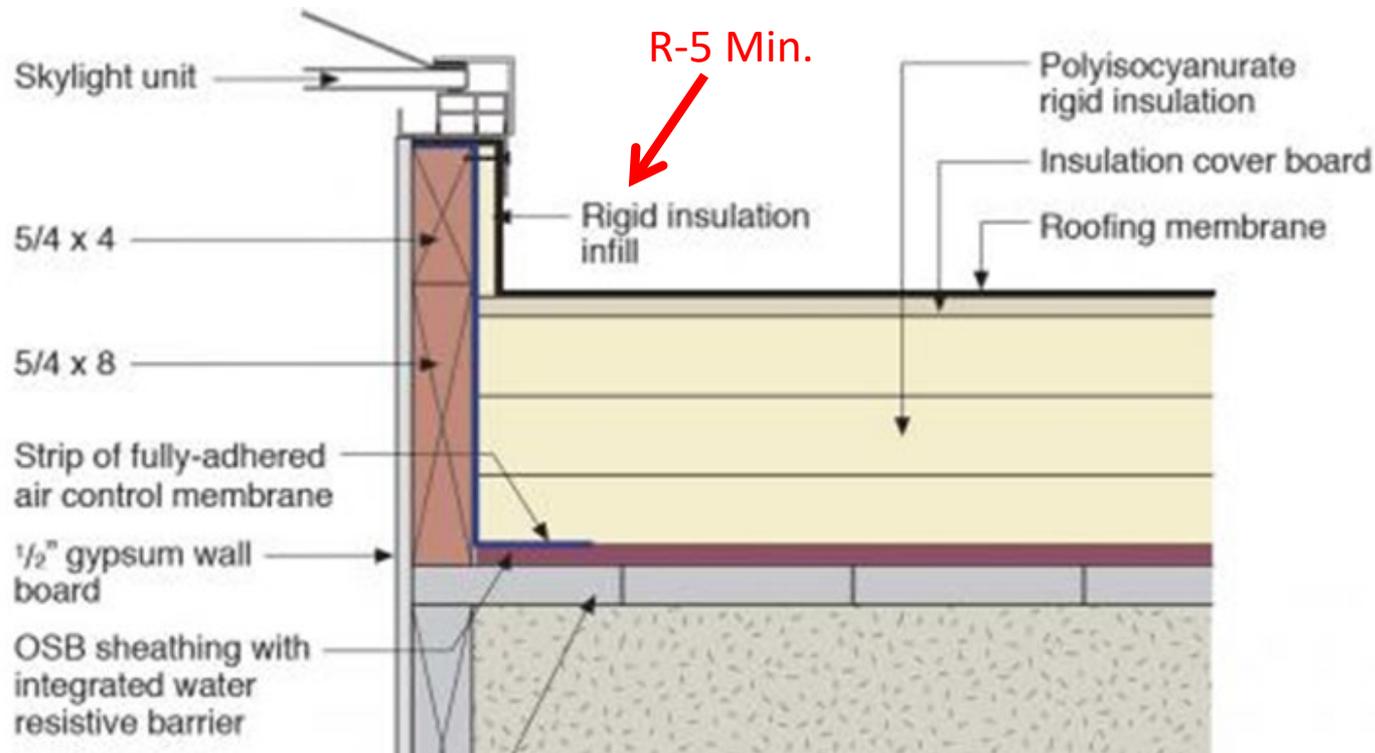


Image courtesy of MBCI article Dec. 16, 2015



# Skylight curb

Specifies insulation for skylight curbs of minimum R-5 unless NFRC 100 listed and labeled



From DOE Build America Solutions Center: <https://basc.pnnl.gov/images>



# Skylight Area

Increases maximum skylight area limit from 5% to 6%



Image courtesy of DOE





# Skylight Area

Minimum skylight area in spaces over 2,500 square feet with at least 75% of the ceiling over 15' and used for one of the space types listed



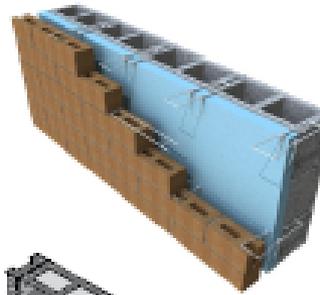
Image courtesy of DOE



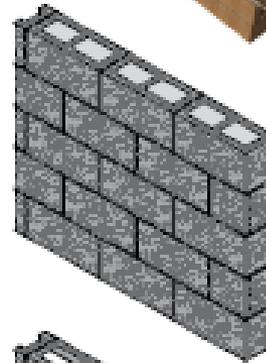
Allows for using u-value table (C402.1.4) for concrete masonry units with integrated insulation

May NOT use r-value table (C402.1.3), but previously, neither path was available

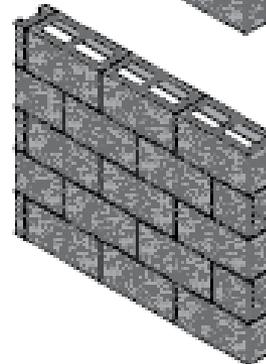
## Integrated Insulation Examples



Concrete masonry backup, continuous insulation, minimum 1 in. (25 mm) cavity and masonry veneer



Foamed-in-place or loose fill insulation



Molded polystyrene inserts





# Mass Floors

Created definition and specification of mass floors where used as part of the thermal envelope

35 pounds per square foot or  
25 pounds per square foot for light weight material



Image courtesy of DOE





# Below-grade walls

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New section on below grade walls includes C-factor and R-value

C-factor is inverse of R-value



# Airspaces

New section provides guidance on treatment of airspaces:

When the thermal properties of airspaces are calculated as part of the thermal wall assembly, these airspaces must be enclosed in an unvented cavity designed to minimize airflow into and out of the cavity.

Cavity shall be enclosed, unventilated, and sealed





# Fenestration Area

Maximum fenestration area is 30% unless the requirements of additional daylight responsive controls are implemented and then not more than 40%.



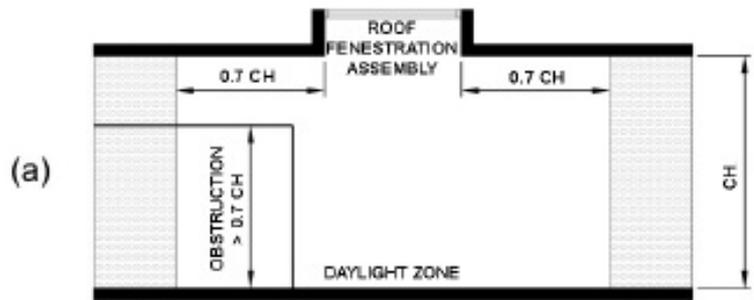
Decreases SHGC for fenestration from 0.4-0.64 to 0.36-0.61

 National Fenestration Rating Council® <b>CERTIFIED</b>	<b>World's Best Window Co.</b> Series "2000" Casement Vinyl Clad Wood Frame Double Glazing•Argon Fill•Low E ABC-X-1-00001-00001
<b>ENERGY PERFORMANCE RATINGS</b>	
U-Factor (U.S. / I-P) <b>0.35</b>	Solar Heat Gain Coefficient <b>0.32</b>
<b>ADDITIONAL PERFORMANCE RATINGS</b>	
Visible Transmittance <b>0.51</b>	Air Leakage (U.S. / I-P) <b>≤ 0.3</b>
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. <a href="http://www.nfrc.org">www.nfrc.org</a></small>	



# Daylight Zones

New section on Daylight zones, includes both top lit and side lit daylight zones



(a) Section view  
(b) Plan view of daylight zone under a roof fenestration assembly

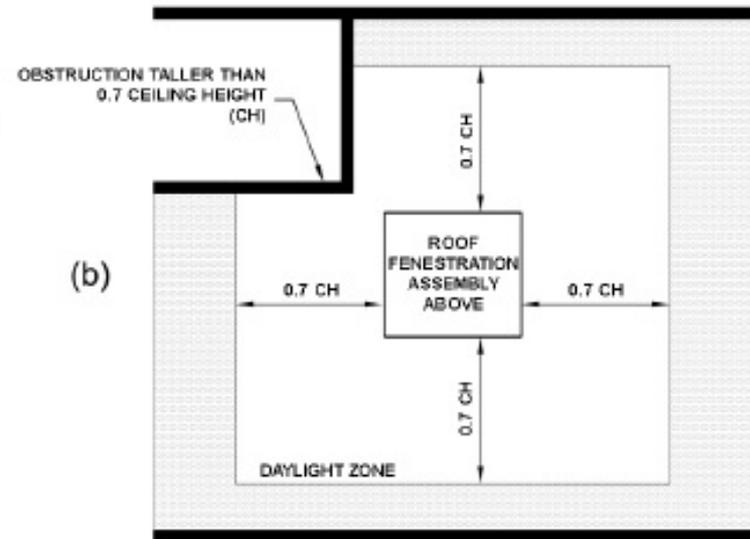


Image courtesy of International Code Council



## C402.5 Air Leakage Requirements (Mandatory)

The thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8 or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure of 0.3 inch water gauge (75pa) ... Air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft<sup>2</sup>

Two main options for to establish that there is limited air leakage in the buildings thermal envelope

1. design and construct the building in compliance with the detailed requirements of Sections C402.5.1 through C402.5.8
2. test the 'tightness' of the envelope in accordance with ASTM E779. Must also comply with C402.5.5, C402.5.6 and C402.5.7.



# Air sealing

Requires sealing to allow for expansion, contraction, vibration, etc.



Photo Courtesy of Matt Risinger



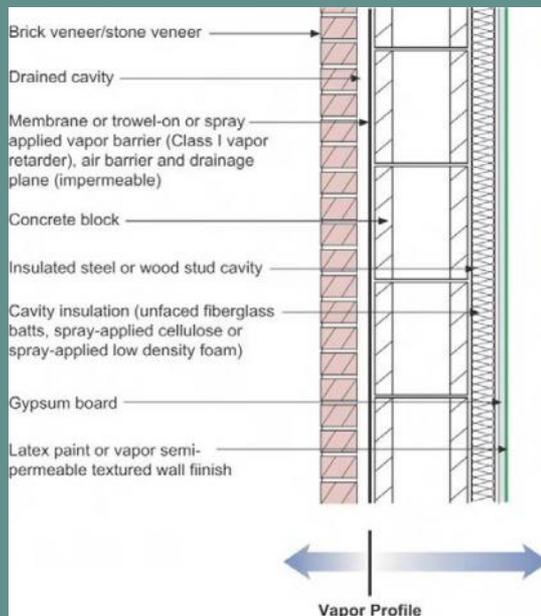
# Air Barrier Materials (C402.5.1.2.1)

1. Plywood not less than 3/8"
2. OSB not less than 3/8"
3. Extruded polystyrene insulation board not less than 1/2"
4. Foil-backed polyiso insulation board not less than 1/2"
5. Closed-cell spray foam with a minimum density of 1.5 pcf not less than 1.5" thickness
6. Open-cell spray foam with a density of between 0.4 and 1.5 pcf not less than 4.5" thickness
7. Gypsum board not less than 1/2"
8. Cement board not less than 1/2"
9. Built-up roofing membrane
10. Modified bituminous membrane
11. Fully adhered single-ply membrane
12. A cement/sand parge or gypsum plaster not less than 5/8"
13. Cast-in-place and precast concrete
14. Fully grouted concrete block masonry
15. Sheet steel or aluminum
16. Solid or hollow masonry constructed of clay or shale masonry units





## 1404.3 Material vapor retarder class



1. Class I: perm rating of less than or equal to 0.1 (Polyethylene sheeting (4 mil min))  
(Vapor impermeable)
2. Class II: perm rating greater than 0.1 and less than or equal to 1.0 (Kraft-faced fiberglass batts)  
(Vapor semi-impermeable)
3. Class III: perm rating of greater than 1.0 and less than or equal to 10.0 (latex or enamel paint)  
(Vapor semi-permeable)

# Door Types

Adds power operating sliding or folding doors to the Maximum Air Leakage Rate for Fenestration Table

Table C402.5.2 (excerpt)

## MAXIMUM AIR LEAKAGE RATE FOR FENESTRATION ASSEMBLIES

FENESTRATION ASSEMBLY	MAXIMUM RATE (CFM/SF <sup>2</sup> )
Curtain walls	0.06
Storefront glazing	0.06
Commercial glazed swinging entrance doors	1.00
<b><u>Power-operated sliding doors and power-operated folding doors</u></b>	<b><u>1.00</u></b>
Revolving doors	1.00



# Loading Dock Weatherseals

Cargo door openings and loading door openings shall be equipped with weatherseals that restrict infiltration and provide direct contact along the top and sides of vehicles that are parked in the doorway



Photo Courtesy of US DOE



# Questions?

[energycode@sedac.org](mailto:energycode@sedac.org)  
800-214-7954



# IL Energy Code Amendments

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- [http://www.cyberdriveillinois.com/departments/index/register/volume42/register\\_volume42\\_issue49.pdf](http://www.cyberdriveillinois.com/departments/index/register/volume42/register_volume42_issue49.pdf)

