Who we are

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
• Online resources at sedac.org/energy-code
• Workshops
• Webinars
• Online on-demand training modules
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.
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 IBC**: https://codes.iccsafe.org/content/IBC2018

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- EFFECTIVE USE OF THE INTERNATIONAL ENERGY CONSERVATION CODE
- IECC—COMMERCIAL PROVISIONS
- CHAPTER 1 [CE] SCOPE AND ADMINISTRATION
IECC Terminology

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
Commercial Compliance Options

1. ASHRAE 90.1-2016

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

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 ≤ 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/ft² or 1.0 watt/ft² 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 ft² (50 m²)
- Intended to house electronic equipment with installed equipment power totaling > 7 watts/ft² (75W/m²)
- Heating system capacity < 17,000 Btu/hr (5 kW) and a heating thermostat set point that is restricted to < 50ºF
- 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

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
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.

From: https://www.wbdg.org/resources/managing-enclosure-heat-flows
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/ft² 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.
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:
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
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)
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 C402.4
Building Envelope Fenestration Maximum U-factor and SHGC Requirements

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vertical fenestration</td>
<td></td>
</tr>
<tr>
<td><strong>U-factor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed fenestration</td>
<td>0.38</td>
<td>0.38</td>
</tr>
<tr>
<td>Operable fenestration</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Entrance doors</td>
<td>0.77</td>
<td>0.77</td>
</tr>
<tr>
<td><strong>SHGC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orientation²</td>
<td>SEW</td>
<td>N</td>
</tr>
<tr>
<td>PF &lt; 0.2</td>
<td>0.36</td>
<td>0.48</td>
</tr>
<tr>
<td>0.2 ≤ PF &lt; 0.5</td>
<td>0.43</td>
<td>0.53</td>
</tr>
<tr>
<td>PF ≥ 0.5</td>
<td>0.58</td>
<td>0.58</td>
</tr>
<tr>
<td><strong>Skylights</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U-factor</strong></td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>SHGC</strong></td>
<td>0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>

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
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

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>All other</td>
<td>Group R</td>
<td>All other</td>
</tr>
<tr>
<td>Floors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>R-10ci</td>
<td>R-10.4ci</td>
</tr>
<tr>
<td>Joist/framing</td>
<td>R-30</td>
<td>R-30</td>
</tr>
<tr>
<td>Slab-on-grade floors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unheated slabs</td>
<td>R-10 for 24’ below</td>
<td>R-10 for 24’ below</td>
</tr>
<tr>
<td>Heated slabs</td>
<td>R-15 for 24’ below + R-5 full slab</td>
<td>R-15 for 24’ below + R-5 full slab</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>All other</td>
<td>Group R</td>
<td>All other</td>
</tr>
<tr>
<td><strong>Roofs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation entirely above roof deck</td>
<td>R-30ci</td>
<td>R-30ci</td>
</tr>
<tr>
<td>Attic and other</td>
<td>R-38</td>
<td>R-38</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>4 EXCEPT MARINE</th>
<th>5 AND MARINE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All other</td>
<td>Group R</td>
</tr>
<tr>
<td>Roofs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation entirely above roof deck</td>
<td>R-30ci</td>
<td>R-30ci</td>
</tr>
<tr>
<td>Metal buildings^{b}</td>
<td>R-19 + R-11 LS</td>
<td>R-19 + R-11 LS</td>
</tr>
<tr>
<td>Attic and other</td>
<td>R-38</td>
<td>R-38</td>
</tr>
</tbody>
</table>

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.
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](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
Masonry Walls with Integrated Insulation

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

C-factor is inverse of R-value
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
Daylight Zones

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

Image courtesy of International Code Council
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 (75 pa) ... Air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft².

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 E 779. 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 ½”
4. Foil-backed polyiso insulation board not less than ½”
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 ½”
8. Cement board not less than ½”
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

<table>
<thead>
<tr>
<th>FENESTRATION ASSEMBLY</th>
<th>MAXIMUM RATE (CFM/SF²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curtain walls</td>
<td>0.06</td>
</tr>
<tr>
<td>Storefront glazing</td>
<td>0.06</td>
</tr>
<tr>
<td>Commercial glazed swinging entrance doors</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Power-operated sliding doors and power-operated folding doors</strong></td>
<td><strong>1.00</strong></td>
</tr>
<tr>
<td>Revolving doors</td>
<td>1.00</td>
</tr>
</tbody>
</table>
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
800-214-7954
IL Energy Code Amendments