

Village of Northbrook  
Department of Building & Development

Guide to:  
Designing, Documenting & Inspecting  
For

Energy Code Compliance



**SINGLE FAMILY RESIDENCE  
BUILDING PERMITS**

*New Construction  
Additions  
Alterations*

Based on the:  
2009 International Energy Conservation Code

March 5, 2010

# TABLE OF CONTENTS

<u>ENERGY CODE COMPLIANCE FOR SINGLE FAMILY RESIDENCES</u>	<u>3</u>
<u>WHICH BUILDINGS ARE REQUIRED TO MEET CODE?</u>	<u>3-4</u>
NEW BUILDINGS	
ADDITIONS	
ALTERATIONS	
<u>CLIMATE ZONE</u>	<u>5</u>
<u>BUILDING THERMAL ENVELOPE</u>	<u>6</u>
<u>WHICH METHOD TO USE...PRESCRIPTIVE OR PERFORMANCE?</u>	<u>7-9</u>
PRESCRIPTIVE METHOD	
PERFORMANCE METHOD	
MANDATORY REQUIREMENTS	
ALTERNATE MATERIALS-METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS	
<u>SPECIAL CONSTRUCTION REQUIREMENTS</u>	<u>10-11</u>
ACCESS HATCHES & DOORS	
BASEMENT WALLS	
CEILINGS WITH ATTIC SPACE ABOVE	
CEILINGS WITHOUT ATTIC SPACE ABOVE - VAULTED CEILING, FLAT ROOF, ETC.	
CIRCULATING SERVICE HOT WATER PIPING	
CRAWL SPACE WALLS	
DUCTS NOT IN THERMAL ENVELOPE	
DUCT SEALING	
EQUIPMENT	
FIREPLACES	
FLOORS	
LIGHTING	
MASONRY VENEER	
MASS WALLS	
MECHANICAL SYSTEM PIPING	
OPAQUE DOOR EXEMPTION	
SLAB-ON-GRADE FLOORS	
SNOW & ICE MELTING	
STEEL-FRAME CEILINGS, WALLS & FLOORS	
SUNROOMS – THERMALLY ISOLATED	
SWIMMING POOLS	
WATER	
<u>WHAT IS REQUIRED TO SHOW ON THE PERMIT DRAWINGS?</u>	<u>12</u>
GRAPHICALLY IDENTIFY THESE ELEMENTS	
<u>INSPECTING FOR ENERGY CODE COMPLIANCE</u>	<u>13</u>
<u>GLOSSARY</u>	<u>14-15</u>
<u>LINKS TO MORE INFORMATION</u>	<u>16</u>
<u>DRAWING EXAMPLES</u>	<u>(SEE SEPARATE DRAWINGS)</u>
BUILDING THERMAL ENVELOPE	EXAMPLE I
INSULATION DETAILS	EXAMPLE II

# ENERGY CODE COMPLIANCE FOR SINGLE FAMILY RESIDENCES 2009 INTERNATIONAL ENERGY CONSERVATION CODE

All construction, whether residential or commercial, in the Village of Northbrook must meet the requirements of the 2009 International Energy Conservation Code (IECC).

**Residential** is defined by the IECC (see GLOSSARY), but can generally be understood to be one and two family residences. The energy code provides several methods to meet the code requirements: either by the **prescriptive** method or with the flexibility of trading off requirements by the **performance** method.

The goal of the energy code is to reduce the amount of energy that a building uses. Building energy use is mainly for heating and cooling of the structure. Buildings that are well insulated lose less heat in the winter and less cooling in the summer. In addition to well insulated walls/ ceilings, doors and windows help to prevent energy loss by reducing air leakage and improving insulating abilities of the glazed components (double pane glass).

## WHICH BUILDINGS ARE REQUIRED TO MEET CODE?

Buildings with conditioned space (see definition) must comply. This includes:

- New buildings (*see section on NEW BUILDINGS*)
- Additions to existing buildings (*see Additions or Alterations section*)
- Alterations of existing buildings (*see Additions or Alterations section*)
- Any nonconditioned space that is altered to become conditioned must be brought into full compliance.

These buildings are not required to meet the code:

- Buildings, or portions of buildings, that are not conditioned
- Historic buildings, as classified or eligible for listing, by significant governing bodies
- Very low energy use buildings

### NEW BUILDINGS

All new buildings must comply with all requirements of the energy code.

Compliance must meet the following:

- ◆ Prescriptive method; or
- ◆ Performance method; and
- ◆ Mandatory requirements regardless of which method used (*see MANDATORY REQUIREMENTS section*)

## ADDITIONS

All new portions of existing buildings (additions) must comply with all requirements of the energy code. *For alterations of existing buildings in conjunctions with an addition, see ALTERATIONS category that follows.*

Compliance must meet the following:

- ◆ Prescriptive method; or
- ◆ Performance method; and
- ◆ Mandatory requirements regardless of which method used (*see separate section*)

Either the addition alone may comply, by either the prescriptive or performance method; or the entire building (including the addition) may be evaluated for compliance with the performance method.

*Exceptions to meeting the code (only if the energy use of the building is not increased) 2009 IECC 101.4.3:*

- ◆ *Storm windows installed over existing windows*
- ◆ *Glass only replacement in existing windows*
- ◆ *Existing ceiling, wall or floor cavities exposed during construction (provided cavities are filled with insulation)*
- ◆ *Construction where the existing roof, wall or floor cavity is not exposed.*
- ◆ *Reroofing where neither the sheathing nor the insulation is exposed. Roofs without insulation in the cavity where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.*

## ALTERATIONS

For portions of an existing building that are altered, the code requires that exposed cavities in walls/ceilings/floors be filled with insulation. 2009 IECC 101.4.3

Compliance must meet the following:

- ❖ Walls- R-15 (min.) in existing 2 x 4 stud walls; R-20 in existing 2 x 6 stud walls
- ❖ Floors over unconditioned space/exterior- R-30 (min.) or filled with R-19 (min.)
- ❖ Ceilings
  - Flat R-38 (min.) or reduction as code allows 2009 IECC 402.2.1
  - Vaulted R-30 (min.) where/as code allows, with the maximum of 500 sf or 20% of the total insulated ceiling area (whichever is less) 2009 IECC 402.2.2
- ❖ Mandatory requirements (see *MANDATORY REQUIREMENTS* section)

# CLIMATE ZONE

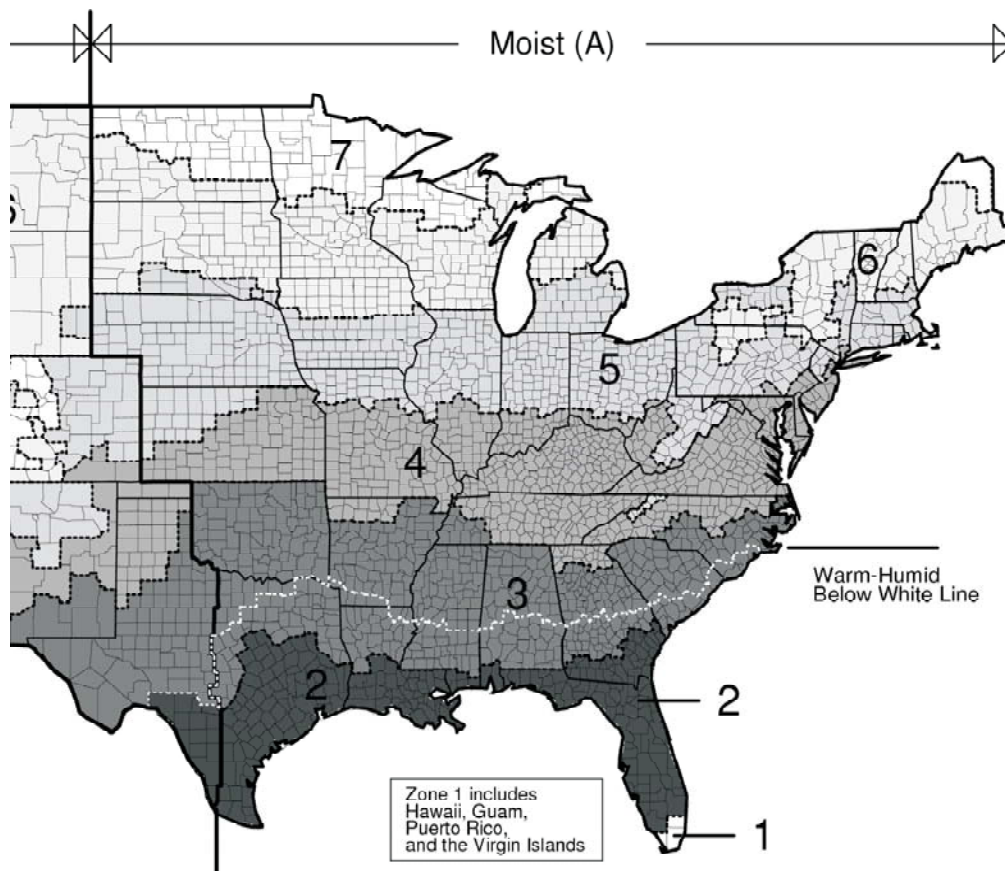
The requirements for energy design are determined by climate zone as shown in the map below.

*Northbrook is located in climate zone 5*

In either method of energy compliance (prescriptive or performance), building components must have a required minimum thermal resistance (R-value for foundation/exterior walls, floors, ceilings/roofs) or a required maximum thermal transmittance (U-factor for windows, skylights, doors) identified on the building drawings.

If using:

- Prescriptive method-climate zone 5 is used to select the appropriate line in Table 402.1.1 (see Zone 5 table example in prescriptive section).
- Performance method-climate zone 5 is used in the software (ResCheck or other software).



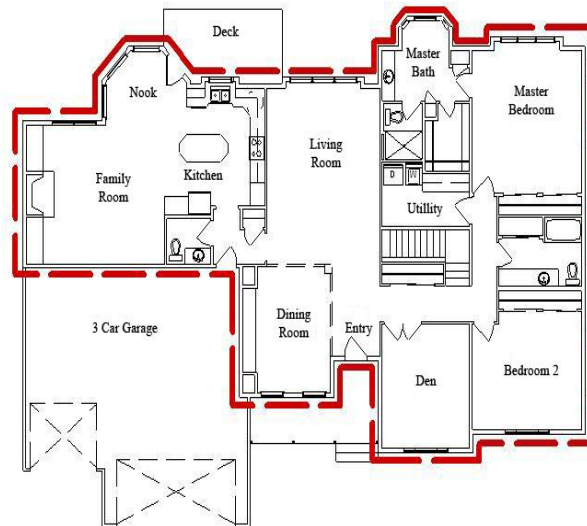
From 2009 IECC  
Figure 301.1  
Climate Zones

# BUILDING THERMAL ENVELOPE

Basic to understanding energy efficiency is identifying the **thermal envelope**. The thermal envelope encloses all conditioned space (see definition of conditioned space and thermal envelope). To help understand the thermal envelope, imagine the building as a 3 dimensional box, the sides, top, and bottom separate heated or cooled (conditioned) space from the outdoors (nonconditioned space). Each face of the box must be provided with insulation to contain conditioned air within (see note below for basement or crawl space floor).

## **Example of Horizontal Plane Separation**

*Vertical elements (walls) separate conditioned space from the outdoors, or nonconditioned space such as the garage.*



## **Example of Vertical Plane Separation**

*Horizontal elements (ceilings/floors) separate conditioned space from the outdoors, or nonconditioned space such as the crawlspace or attic.*



*Images from Building Energy Codes Online Training  
REScheck 101 Training-2006 IECC*

*Note: The bottom of the thermal enclosure (box), if a basement or crawl space floor, is often not required to be insulated if it meets code requirements.*



*See more examples of plans, sections & details in the  
"What is Required to Show on the Permit Drawings?" section.*

# WHICH METHOD TO USE...

## PRESCRIPTIVE OR PERFORMANCE ?

Each method offers the architect choices to achieve energy efficiency. The prescriptive method requires absolute compliance with all components, such as frame wall insulation (R-20 or 13+5). The performance method (by simulated performance alternative software) can allow for a less well insulated component (e.g. wall R-13) if another component compensates.

The code provides a number of alternatives and exceptions, to meet the requirements of the method selected; consult the code or the simulated performance alternative software. The easiest method to verify during building permit review is the prescriptive method where wall, ceiling, foundation, window, etc. R-values or U-factors required in 2009 IECC Table 402.1.1 are met. No additional supporting documentation is required. If not meeting the prescriptive requirements, substantiation is required with the drawings that the entire building, all systems evaluated together, meets the energy code requirements. A 'ResCheck' compliance report is an acceptable (but not the only) method to document compliance.

### PRESCRIPTIVE METHOD

The most common prescriptive method identifies the wall/ceiling/roof insulation R-values and the window/door U-factors required for each component. There are code exceptions to the requirements that can offer a small amount of flexibility, but generally this method requires consistent treatment of building components. Using this compliance method has the benefit of simplifying code review and inspection.

The most common prescriptive method used is:

- **Insulation and fenestration criteria** for building components (*see Table 402.1.1 below*).

Other ways of meeting the prescriptive method are:

- **R-value computation** summation of layers of insulation to compute component R-value
- **U-factor alternative** assembly meeting the criteria for components (*see Table 402.1.3 below*).
- **Total UA alternative** is the total building thermal envelope UA (sum of U-factors x assembly area) is less than or equal to the total UA resulting from using the U-factors in Table 402.1.3 (multiplied by the same assembly area as in the proposed building).

Regardless of which prescriptive method is used, the mandatory requirements in the code must be met (*see separate "Mandatory Requirements" section*).

2009 IECC TABLE 402.1.1										
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT <sup>a</sup>										
CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b e</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>i</sup>	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>c</sup> WALL R-VALUE
5	0.35	0.60	NR	38	20 <sup>or</sup> 13+5 <sup>h</sup>	13/17	30 <sup>g</sup>	10 / 13	10, 2 ft	10 / 13

For SI: 1 foot = 304.8 mm.

- R-values are minimums. U-factors and SHGC are maximums. R-19 compressed into a nominal 2x6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.
- The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.
- There are no SHGC requirements in the Marine zone.
- Basement wall insulation is not required in warm humid locations as defined by Figure 301.1 and Table 301.1.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
- The second R-value applies when more than half the insulation is on the interior of the mass wall.
- For impact rated fenestration complying with Section R301.2.1.2 of the IRC or Section 1608.1.2 of the IBC, the maximum U-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

EQUIVALENT <i>U</i> -FACTORS <sup>a</sup>								
CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR	SKYLIGHT <i>U</i> -FACTOR	CEILING <i>U</i> -FACTOR	FRAME WALL <i>U</i> -VALUE	MASS WALL <i>U</i> -VALUE <sup>b</sup>	FLOOR <i>U</i> -VALUE	BASEMENT WALL <i>U</i> -VALUE	CRAWL SPACE WALL <i>U</i> -VALUE <sup>c</sup>
5	0.35	0.60	0.030	0.057	0.082	0.033	0.059	0.065

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except in marine, and the same as the frame wall *U*-factor in Marine Zone 4 and Zones 5 through 8.

c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure 301.1 and Table 301.2.

## PERFORMANCE METHOD

If the prescriptive requirements cannot be met, the **simulated performance alternative (performance)** method of compliance is required to be used. This method requires that a proposed residence be shown to have an annual energy cost that is less than or equal to the annual energy cost of the "standard reference design" (see code for Table 405.5.2(1) for specific element criteria). This evaluation includes: heating; cooling; and service water heating energy only.

- **ResCheck** is the most commonly used method of **performance** compliance verification. This free downloadable program is available from the US Department of Energy (DOE) at: [www.energycodes.gov/rescheck](http://www.energycodes.gov/rescheck) (In addition to this program, there are many helpful resources available for design and construction professionals at the DOE website)
- **Other simulated energy performance software tools** may be used in lieu of ResCheck as long as they demonstrate compliance with Section 405 of the 2009 IECC.

Regardless of which performance method is used, a compliance report and supporting documentation produced by the software program must be submitted (see "minimum capabilities of the calculation software tools" in 405.6 2009 IECC).

Also, the mandatory requirements in the code must be met (see *MANDATORY REQUIREMENTS section*).

## MANDATORY REQUIREMENTS

In addition to the prescriptive or performance compliance requirements, there are mandatory requirements that apply to all permits.

See the code for specific requirements in each of the following mandatory compliance categories:

- Air leakage control required for (402.4 2009 IECC):
  - ◆ Building thermal envelope to limit infiltration (402.4.1 2009 IECC)
    - Seal with caulk, gasketing, weather-stripping or other barrier material:
      - All joints seams and penetrations
      - Site-built windows, doors and skylights
      - Openings between window and door assemblies and their jambs/framing
      - Utility penetrations
      - Dropped ceilings or chases adjacent to the thermal envelope
      - Knee walls
      - Walls and ceilings separating a garage from conditioned spaces
      - Behind tubs and showers on exterior walls
      - Attic access openings
      - Rim joist junction
      - Other sources of infiltration
    - Air Barrier
    - Vapor Retarder
    - Testing of building thermal envelope tightness and insulation installation is required by either:
      - Air leakage test method (blower door test @ rough-in and after installation of penetrations of the envelope) (402.4.2.1 2009 IECC)
      - Visual inspection when there is field verification of all items (see 402.4.2.2 2009 IECC for air barrier and insulation inspection component criteria)
  - ◆ Fireplaces that are new and wood burning are required to have gasketed doors and outdoor combustion air (402.4.3 2009 IECC)
  - ◆ Fenestration air leakage for windows, skylights and sliding glass doors is limited to 0.3 cfm /sf and for swinging doors to 0.5 cfm/sf (402.4.4 2009 IECC)
  - ◆ Fenestration maximum *U*-factor and SHGC (402.4.4 2009 IECC)



- ◆ Recessed lighting installed in the building thermal envelope must be sealed to limit leakage between conditioned and unconditioned spaces by means of gasket or caulk between the housing and the interior wall or ceiling. All recessed lighted shall be IC-rated and ASTM E 283 (402.4.5 2009 IECC)
- Heating and cooling controls are required (403.1 2009 IECC)
  - ◆ Programmable thermostat (403.1.1 2009 IECC) Required for forced air systems
  - ◆ Heat pump supplementary heat (403.1.2 2009 IECC)
- Ducts (*exempt: ducts or portions thereof located completely inside the thermal envelope*)
  - ◆ Insulation required:
    - Prescriptive method (403.2.1 2009 IECC)
      - Supply ducts in attics R-8
      - All others R-6
    - Performance method (405.2 2009 IECC):
      - Supply and return ducts R-6
  - ◆ Sealing required (403.2.2 2009 IECC):
    - All ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601 2006 IRC. Verification of duct tightness is required by either:
      - Postconstruction testing of leakage to outdoors (403.2.2(1) 2009 IECC)
      - Rough-in test

*Exception: Duct tightness test is **not** required if the air handler and all the ducts are located within the conditioned space.*
  - ◆ Mechanical system piping insulation (R-3 min.) required for piping capable of carrying fluids above 105° (403.3 2009 IECC)
- Circulating service hot water systems are required to be insulated (R-2 min.) and have a manual switch to turn off circulating pump when not in use. (403.4 2009 IECC)
- Mechanical ventilation outdoor air intakes and exhausts must have automatic or gravity dampers. (403.5 2009 IECC)
- Equipment sizing for heating and cooling must be in accordance with Section M1401 2006 IRC (403.6 2009 IECC)
- Snow melting - See SNOW & ICE MELTING section below. (403.8 2009 IECC)
- Fireplace – See FIREPLACE section below. (402.4.3 2009 IECC)

## ALTERNATE MATERIALS – METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

### Section 102

The energy code allows the use of any alternate material, method of construction or design or insulation system as long as it has been approved by the code official as meeting the intent of the code.

# SPECIAL CONSTRUCTION REQUIREMENTS

These categories have specific requirements as listed.

## **ACCESS HATCHES & DOORS** (Prescriptive requirement 402.2.3 2009 IECC)

Access between unconditioned and conditioned space must be weatherstripped and insulated to the level of the surrounding surfaces

## **BASEMENT WALLS** (Prescriptive requirement 402.2.7 2009 IECC)

Conditioned basement walls must be insulated from the top of the basement wall down to 10 feet below grade or to the basement floor. Walls of unconditioned basement space must meet this requirement unless the floor above is insulated to R-30.

## **CEILINGS WITH ATTIC SPACE ABOVE** (Prescriptive requirement 402.2.1 2009 IECC)

Where ceiling insulation is required to be R-38, R-30 is acceptable wherever the full have of uncompressed R-30 insulation extends over the wall top plate at the eaves.

## **CEILINGS WITHOUT ATTIC SPACE ABOVE - VAULTED CEILING, FLAT ROOF, ETC.**

(Prescriptive requirement 402.2.2 2009 IECC)

Where ceiling insulation is required to be higher than R-30, and there is not sufficient space to allow for its placement in the framing, R-30 is acceptable but it is limited to 500 sf or 20% of the total insulated ceiling area, whichever is less.

## **CIRCULATING SERVICE HOT WATER PIPING** (Mandatory requirement 403.4 2009 IECC)

All circulating service hot water piping to be insulated with at least R-2 and have an automatic manual switch that can turn off the hot water circulating pump when the system is not in use.

## **CRAWL SPACE WALLS** (Prescriptive requirement 402.2.9 2009 IECC)

Crawl spaces may be either conditioned or unconditioned.

- If the crawl space is not vented to the outside (conditioned), the wall insulation must be permanently fastened to the wall and extend downward from the floor to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches. Exposed earth must be covered with a Class I vapor retarder. All joints of the vapor retarder must overlap by 6" (min.) and be sealed or taped and the vapor retarder must extend 6" (min.) up and be attached to the stem wall/
- If the crawl space is vented to the exterior, the floor above must be insulated to R-30 and the separating wall from the basement must meet the basement wall requirements for insulation.

## **DUCTS NOT IN THERMAL ENVELOPE** (Prescriptive requirement 403.2.1 2009 IECC)

Supply ducts in attics to be insulated with R-8 (min.). All other ducts to be insulated with a minimum of R-6.

## **DUCT SEALING** (Mandatory requirement 403.2 2009 IECC)

Sealing of ducts and all mechanical components is required. Testing of duct tightness is required (exception: if all ducts are located within the conditioned space).

## **EQUIPMENT** (Prescriptive requirements XXX 2009 IECC)

- Service water heating (heating/cooling)
- Furnace

## **FIREPLACES** (Mandatory requirement 402.4.3 2009 IECC)

New wood-burning fireplaces must have gasketed doors and outdoor combustion air.

## **FLOORS** (Prescriptive requirement 402.2.6 2009 IECC)

Floor insulation must be installed to maintain permanent contact with the underside of the subfloor decking above.

## **LIGHTING** (Prescriptive requirement 404 2009 IECC)

At least 50% of the lamps (bulbs) in permanently installed light fixtures must be high-efficacy lamps.

### **MASONRY VENEER** (Prescriptive requirement 402.2.10 2009 IECC)

Insulation is not required on the horizontal portion of the foundation that supports masonry veneer.

### **MASS WALLS** (Prescriptive requirement 402.2.4 2009 IECC)

Mass wall are considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth and solid timber/logs.

### **MECHANICAL SYSTEM PIPING** (Mandatory requirement 403.3 2009 IECC)

Piping carrying fluids above 105° F or below 55° F to be insulated with a minimum of R-3.

### **OPAQUE DOOR EXEMPTION** (Prescriptive requirement 402.3.4 2009 IECC)

One side-hinged door up to 24 sf is exempted from the U-factor requirement in Section 402.1.1. This exemption does not apply to the U-factor alternative approach in Section 402.1.3 and total UA alternative in Section 402.1.4.

### **SLAB-ON-GRADE FLOORS** (Prescriptive requirement 402.2.8 2009 IECC)

Slab-on-grade concrete floors less than 12 inches below grade must be insulated from the top of the slab on the inside or outside of the foundation. Insulation must be R-10 (min.) and be extended 2 feet in any combination of vertical and horizontal insulation as allowed in this section.

### **SNOW & ICE MELTING** (Prescriptive requirement 403.8 2009 IECC)

Snow and ice melting systems, supplied through energy service to the building, must have automatic controls capable of shutting off the system when the pavement temperature is above 50° F and no precipitation is falling and an automatic or manual control to allow shutoff when the outdoor temperature is above 40°F.

### **STEEL-FRAME CEILING, WALL & FLOOR** (Prescriptive requirement 402.2.5 2009 IECC)

Steel framed ceilings, walls and floors must be insulated according to Table 402.2.5 in the 2009 IECC.

### **SUNROOMS - THERMALLY ISOLATED** (Prescriptive requirement 402.2.11 2009 IECC)

Insulation values for thermally isolated sunrooms are:

- ◆ Ceiling R-24
- ◆ Walls R-13
- ◆ Walls separating the sunroom from conditioned space must meet the thermal envelope requirements

### **SWIMMING POOLS** (Mandatory requirement 403.9 2009 IECC)

Swimming pools must be provided with energy conserving measures as they can be large consumers of energy, mainly for water heating.

- Pool heaters must have an on-off switch that is readily accessible to allow shutting off the heater without adjusting the thermostat setting. Pool heaters with continuously burning pilot lights are not allowed.
- Time switches that can automatically turn off and on heaters and pumps according to a preset schedule must be installed on swimming pool heaters and pumps.
  - Exceptions:
    1. Where public health standards require 24-hour pump operation.
    2. Where pumps are required to operate solar-and waste-heat-recovery pool heating systems.
- Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F shall have a pool cover with a minimum insulation value of R-12.
  - Exception:
    1. Pools deriving over 60% of the energy for heating from site-recovered energy or solar energy source.

**WATER** - See Circulating Service Hot Water Piping

# WHAT IS REQUIRED TO SHOW ON THE PERMIT DRAWINGS?

*Show for all methods of compliance*  
(Section 103, 2009 IECC)

The building thermal envelope (separation between conditioned and unconditioned space) must be graphically identified on the documents submitted for building permit review, either contained on the construction drawings or on a separate **.Energy Plan**

If meeting the energy requirements by the performance method, a ResCheck printout or similar simulated energy alternative documentation is required to be submitted as supplementary information.

## GRAPHICALLY IDENTIFY THESE ELEMENTS (See Drawing Examples I & II)

- ❖ **Building Thermal Envelope** (these are to be shown on the floor plans):
  - ◆ **Vertical elements (walls) that enclose** conditioned space (horizontally).
    - Exterior walls (at every level)
    - Interior walls between conditioned and unconditioned space such as:
      - Walls between the house and the garage (if the garage is not in the thermal envelope)
      - Walls between 2<sup>nd</sup> floor living space and any unfinished attic on the same floor
      - Walls between finished basement space and unconditioned crawl space
  - ◆ **Horizontal elements (ceiling or floors) that separate** (vertically) conditioned from unconditioned space:
    - Floor over outside space below (e.g. projecting bay, floor extending beyond walls below, over a exterior porch)
    - Floor above unconditioned basement, crawlspace, garage
      - Note: If there are uninsulated heating ducts/piping through an unconditioned space, that space is no longer considered unconditioned and must therefore meet all requirements for wall/ceiling/floor insulation as required by the method used for compliance.)*
    - Ceiling (flat) between living space and unconditioned attic above
    - Ceiling above an unconditioned crawl space
    - Ceiling/roof above a projecting bay
    - Ceiling/roof at location of vaulted ceiling
    - Roof with no attic above (e.g. flat roof)
- ❖ **Insulation R-values** (these are to be shown with the thermal envelope and on any sections/details)
- ❖ **Window U-factors** (these are to be indicated in an appropriate location)
- ❖ **Window solar heat gain coefficient (SHGC)** values, if applicable (these are to be indicated in an appropriate location)
- ❖ **Duct insulation R-values** (these are to be indicated in an appropriate location)
- ❖ **Duct sealing** (these are to be indicated in an appropriate location)
- ❖ **Air sealing** for the building envelope (these are to be indicated in an appropriate location)
- ❖ **Circulation loop pipe insulation** for water heating (these are to be indicated in an appropriate location)
- ❖ **IC rated / air-tight recessed can lights** (these are to be indicated in an appropriate location)

### Be aware that...

- If using the **prescriptive method**, the items listed above, and shown on the drawings, must match the requirement in Table 402.1.1.
- If using the **performance method**, the items listed above, and shown on the drawings, must match the values used in the software documentation submitted.
- **Mandatory requirements** apply to both prescriptive and performance methods of compliance.

# INSPECTING FOR ENERGY CODE COMPLIANCE

(Section 104, 2009 IECC except as noted)

During construction, and before walls and ceilings are enclosed, an insulation inspection is required to determine compliance with either the prescriptive or performance method. The items indicated in the "What Is Required to Show on the Permit Drawings?" section above will be inspected for conformance with the approved building permit drawings (either contained on the construction floor plans, or on a separate energy plan).

An insulation inspection must be performed before any wall and/or ceiling finish material (such as drywall) can be allowed to be installed.

The following items will be inspected for conformance with the permit drawings:

- ◆ Wall insulation R-value
  - Exterior - Above / below grade
  - Interior
- ◆ Ceiling insulation R-value
  - Flat
  - Vaulted
- ◆ Floor insulation R-value
  - Over interior unconditioned space
  - Over outside spaces
- ◆ Vapor retarder
  - Exterior wall
  - Ceiling/roof assembly
- ◆ Lighting See "Special Construction-Lighting"
- ◆ Mechanical
  - Furnace AFUE
  - Air conditioner SEER
  - HVAC fluid piping insulated with R-3 (min.)
  - Circulating service hot water system meets requirements
    - Pipes insulated with R-2 (min.)
    - Automatic or accessible manual switch to turn off circulating pump
  - Temperature controls meet requirements
  - Equipment sizing meets requirements
  - Duct construction meets requirements
    - Sealing
    - Damper, gravity or automatic present
- ◆ Air Leakage
  - Joint and penetrations in the building envelope sealed
  - Recessed light sealed in an approved manner
  - Sealing
- ◆ Window/door glazing U-factors
- ◆ Swimming pool
  - Heater
  - Cover
- ◆ Energy certificate included with the building permit affixed to the electrical distribution panel.
  - ResCheck Certificate, or
  - IECC generic certificate

**Additions** *2009 IECC*

An extension or increase in the conditioned space floor area or height of a building or structure.

**Above-Grade Wall** *2009 IECC*

A wall more than 50 percent above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

**Air Barrier** *2009 IECC*

Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials.

**Alteration** *2009 IECC*

Any construction or renovation to an existing structure other than repair or addition that requires a permit. Also, a change in a mechanical system that involves an extension, addition or change to the arrangement, type or purpose of the original installation that requires a permit.

**Approved** *2009 IECC*

Approval by the code official as a result of investigation and tests conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

**Basement Wall** *2009 IECC*

A wall 50% or more below grade and enclosing conditioned space.

**Building** *2009 IECC*

Any structure used or intended for supporting or sheltering any use or occupancy.

**Building Thermal Envelope** *2009 IECC*

The basement walls, exterior walls, floor, roof, and any other building element that enclose conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space.

**C-Factor (Thermal Conductance)** *2009 IECC*

The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (Btu/h ft<sup>2</sup> x ° F)[W/(m<sup>2</sup> x K)].

**Conditioned Space** *2009 IECC*

An area or room within a building being heated or cooled, containing uninsulated ducts, or with a fixed opening directly into an adjacent conditioned space.

**Crawl Space Wall** *2009 IECC*

The opaque portion of a wall that encloses a crawl space and is partially or totally below grade.

**Daylight Zone** *2009 IECC*

1. Under skylights. The area under skylights whose horizontal dimension, in each direction, is equal to the skylight dimension in that direction plus either the floor-to-ceiling height or the dimension to a ceiling height opaque partition, or one-half the distance to adjacent skylights or vertical fenestration, whichever is least.
2. Adjacent to vertical fenestration. The area adjacent to vertical fenestration which receives daylight through the fenestration. For purposes of this definition and unless more detailed analysis is provided, the daylight zone depth is assumed to extend into the space a distance of 15 feet or to the nearest ceiling height opaque partition, whichever is less. The daylight zone width is assumed to be the width of the window plus 2 feet on each side, or the window width plus the distance to an opaque partition, or the window width plus one-half the distance to adjacent skylight or vertical fenestration, whichever is least.

**Fenestration** *2009 IECC*

Skylights, roof windows, vertical windows (fixed or moveable), opaque doors, glazed doors, glazed block, and combination opaque/glazed doors. Fenestration includes products with glass and non-glass glazing materials.

**Heated Slab** *2009 IECC*

Slab-on-grade construction in which the heating elements, hydronic tubing, or hot air distribution system is in contact with, or placed within or under, the slab.

**Heating Degree Day (HDD)** *ResCheck 101*

An example of a typical heating degree-day is HDD65 which means for any one day, when the temperature is < 65°F, there are as many degree-days as degrees F temperature difference between mean temperature and 65. Annual heating degree-days are the sum of the degree-days over a calendar year.

**High Efficacy Lamps** *2009 IECC*

Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts,
2. 50 lumens per watt for lamps over 15 watts to 40 watts, and
3. 40 lumens per watt for lamps 15 watts or less.

**HVAC Equipment Efficiency** *ResCheck 101***AFUE**

Annual fuel utilization efficiency; combustion heating equipment efficiency is expressed in terms of AFUE. New equipment typically ranges from about 78- to 96-percent AFUE. Higher AFUE ratings indicate more efficient equipment.

**HSPF**

Heating seasonal performance factor; heat pump heating is expressed in terms of HSPF. New equipment ranges from about 6.8 to 10.0 HSPF. Higher HSPF ratings indicate more efficient equipment.

**SEER**

Seasonal energy efficiency ratio; cooling efficiency for electric air conditioners and heat pumps is expressed in terms of SEER. Higher SEER ratings indicate more efficient equipment.

### Labeled *2009 IECC*

Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

### Listed *2009 IECC*

Equipment, materials, products or services included in a list published by an organization acceptable to the code official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or have been tested and found suitable for a specified purpose.

### R-Value (Thermal Resistance) *2009 IECC*

The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ( $h \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$ ) [ $(\text{m}^2 \cdot \text{K})/\text{W}$ ].

#### *ResCheck 101*

R-value is a measurement of a material's resistance to heat flow. Insulation materials have tiny pockets of trapped air that resist the transfer of heat through the material. (The code assumes that insulation is installed properly and is not compressed in any way.) The ability of insulation to slow the transfer of heat is measured in R-values. The higher the R-value, the better the insulation material's ability to resist the flow of heat through it. The picture below represents the relative thickness of insulation material at different R-values. Cavity Insulation - Insulation installed between structural members

Continuous Insulation - Insulation that runs continuously over structural members and is free of significant thermal bridging; such as rigid foam insulation above the ceiling deck.

### Residential Building *2009 IECC*

For energy requirements, residential buildings include one and two family dwelling as well as R-2 and R-4 buildings three stories or less in height and R-3 (from 2006 IBC).

### Service Water Heating *2009 IECC*

Supply of hot water for purposes other than comfort heating.

### Solar Heat Gain Coefficient (SHGC) *2009 IECC*

The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation which is then reradiated, conducted or convected into the space.

### Solar Heat Gain Coefficient (SHGC) *ResCheck 101*

- the glazing's effectiveness in blocking heat caused by sunlight
- expressed as a number between 0 and 1
- part of a system for rating window performance
  - ♦ used by the National Fenestration Rating Council
  - ♦ replacing shading coefficient (SC) in product literature and design standards
    - convert SC to SHGC by multiplying the SC value by 0.87

The lower the glazing's SHGC, the less solar heat it transmits. The REScheck software includes options for inputting SHGC and projection factors (horizontal overhangs) when the home is being built in certain locations (<3500 HDD). The 2003 IECC requires that the combined SHGC of all glazed fenestration (including all windows, glazed doors, and skylights) must be  $\leq 0.4$ . The combined SHGC is the weighted average of all glazed fenestration products (including effects of any permanent exterior solar shading devices). The software enables the required SHGC field when applicable (when the location entered is <3500 HDD) and automatically tracks the area-weighted SHGC average based on the user's entries. Overhangs may also be entered by enabling this field from the software's Options menu.

### Sunroom *2009 IECC*

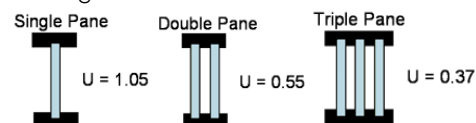
A one-story structure attached to a dwelling with a glazed area in excess of 40 percent of the gross area of the structure's exterior walls and roof.

### U-Factor (Thermal Transmittance) *2009 IECC*

The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films ( $\text{Btu}/\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}$ ) [ $\text{W}/(\text{m}^2 \cdot \text{K})$ ].

#### *ResCheck 101*

U-factor measures how well a product prevents heat from escaping. U-factor ratings generally fall between 0.20 and 1.20. The insulating value is indicated by the R-value, which is the inverse of the U-factor. The lower the U-factor, the greater a product's resistance to heat flow and the better its insulating value.



### Vapor Retarder *2006 IECC [missing in 2009 IECC but referenced in index...]*

A vapor resistant material, membrane or covering such as foil, plastic sheeting, or insulation facing having a permeance rating of 1 perm ( $5.7 \times 10^{-11} \text{ kg}/\text{Pa} \cdot \text{s} \cdot \text{m}^2$ ) or less when tested in accordance with the desiccant method using Procedure A of ASTM E 96. Vapor retarders limit the amount of moisture vapor that passes through a material or wall assembly.

## LINKS TO MORE INFORMATION

1. **Changes between the 2006 & 2009 IECC**  
[www.energycodes.gov/training](http://www.energycodes.gov/training) (see presentation-.ppt by Mark Halverson)
  
2. **Inspecting for the Residential Provisions of the IECC:**  
[http://www.energycodes.gov/training/pdfs/iecc\\_res\\_wb.pdf](http://www.energycodes.gov/training/pdfs/iecc_res_wb.pdf)  
[http://www.energycodes.gov/rescheck/pdfs/iecc\\_00\\_plancheck.pdf](http://www.energycodes.gov/rescheck/pdfs/iecc_00_plancheck.pdf)
  
3. **DOE Compliance Tools:**  
[http://www.energycodes.gov/compliance\\_tools.stm](http://www.energycodes.gov/compliance_tools.stm)
  
4. **DOE Resource Center:**  
<http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter>
  
5. **DOE Training / Education:**  
<http://www.energycodes.gov/training/>
  
6. **DOE EERE Building Energy Codes Program Information:**  
[http://www.energycodes.gov/implement/state\\_codes/reports/residential/Residential\\_Illinois.pdf](http://www.energycodes.gov/implement/state_codes/reports/residential/Residential_Illinois.pdf)
  
7. **ResCheck**  
<http://www.energycodes.gov/rescheck/download.stm>
  
8. **EnergyStar/HERS Index (prevailing minimum federal efficiency)**  
[http://www.energystar.gov/index.cfm?c=bldrs\\_lenders\\_raters.nh\\_HERS](http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_HERS)
  
9. **Village of Northbrook – Building & Development**  
<http://www.northbrook.il.us>