



State of Connecticut  
Department of Administrative Services  
Division of Construction Services  
Office of Education and Data Management

*Office of Education and Data Management  
Fall 2016 Career Development Series*

# Significant Changes to the IECC

Presented by  
Don Vigneau, Principal, Donald J Vigneau, AIA



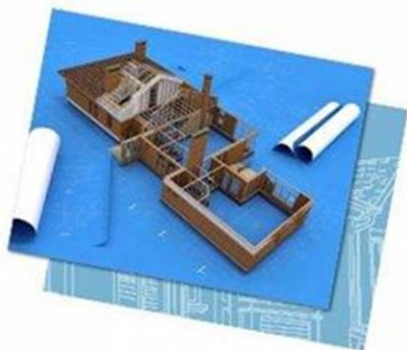
## Connecticut Energy Codes

### **SIGNIFICANT CHANGES TO THE 2012 ICC ENERGY CODES**

Donald J. Vigneau AIA Emeritus

## Today's Presentation

---



An overview of the significant code change proposals adopted as the 2012 Edition of the ICC and IRC Energy Codes; published Errata; CT proposed Amendments and deletions; plus the commercial ASHRAE 90.1 Option

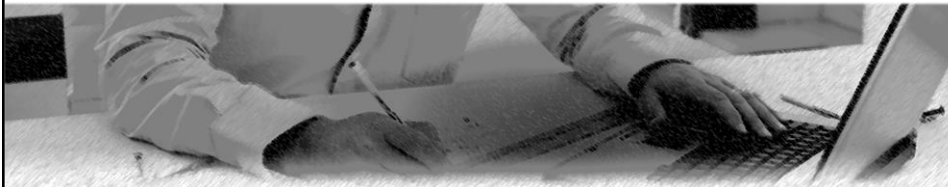
Detailed information is available at:  
<http://www.iccsafe.org/cs/codes/Pages/09-10cycle.aspx>

Original proposals, Committee recommendations, public comments and final approved changes can be found at the website for every specific proposal brought before the ICC and considered for inclusion in the 2012 I-Codes.

## Errata Central

---

<http://www.iccsafe.org/errata-central>



- IECC 2012 had 18 changes between the first printing and third printing
- 6 changes are in Residential
- 12 changes in Commercial

## Adopted Base Codes


*IECC Key Changes and CT Amendments*


Key IECC Changes and CT amendments will be separately identified herein by color-coded bullets:

- ICC changes
- CT Amendments

This format should help assist you in markups of reference documents

**The IECC is NOT part of this package deal for code books and must be ordered separately**

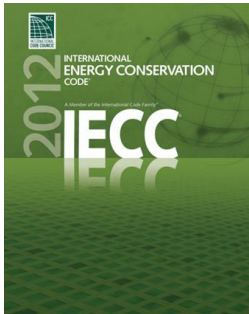





## International Energy Conservation Code

*History; Background*

- The 2009 IECC was effective October 6, 2011
- The 2012 IECC was published in July 2011. Codes & Standards has voted to adopt 2012 IECC October 12, 2016 with a 'modification window ending January 1, 2017
- The Connecticut Energy Code Chapter 4 scoping for commercial buildings allows use of ASHRAE 90.1-2010 for energy conservation compliance
- "CT Building Standard Guidelines Compliance Manual for High Performance Buildings" **CT DEEP 16a-38k** provides energy conservation rules for large building projects that utilize state funding: ≥\$5million (\$2million CT schools); renovations ≥\$2million (21% reduction rule)





## Chapter 1 Administration (both codes)

*Commercial [CE] and Residential [RE] First Chapters*

- Scope; General Requirements (101)
- Alternate Materials, Method of Construction, Design or Insulating Systems (102)
- *Construction Documents (103)*
- Inspections (104)
- Validity (105)
- Referenced Standards (106)
- Fees (107)
- Stop Work Order (108)
- Board of Appeals (109)



## IECC Energy Efficiency

*Re-Organized Requirements in Effect: 2012*

### [CE] Commercial Energy

- 1. Administration
- 2. Definitions
- 3. General Requirements
- 4. Commercial Efficiency
- 5. Reference Standards

### [RE] Residential Energy

- 1. Administration
- 2. Definitions
- 3. General Requirements
- 4. Residential Efficiency
- 5. Reference Standards



## Chapter 1 Administration (both codes)

*Commercial [CE] and Residential [RE] First Chapters*

- Scope; General Requirements (101)
- Alternate Materials, Method of Construction, Design or Insulating Systems (102)
- **Construction Documents** (103\*)
- **Inspections** (104)
- Validity (105)
- Referenced Standards (106)
- Fees (107\*)
- Stop Work Order (108\*)
- Board of Appeals (109\*)



## General Requirements

**C101.4.7 / R101.4.7 Temporary structures - CT Adds**

- Comply with IBC 108.3 for temporary light, heat, power
- Exempt from Energy Code envelope requirements

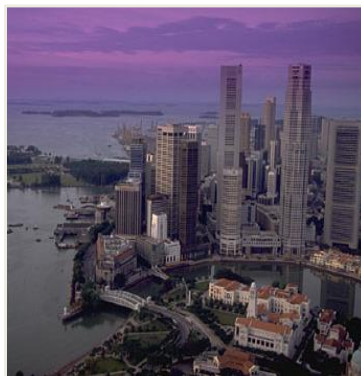


10

## Compliance

### *C101/R101 General*

- Same rules as IECC [RE] Chapter 1:
  - Changes in Occupancy or Use
  - Change to Conditioned Space
  - Mixed Occupancies – both Chapters 4
- C101.4.2 Full Historic\* exemption
- C101.5.2 Thermal envelope exempted:
  - ✓ Low Energy < 1 W/sf (3.4 Btuh/sf)
  - ✓ Without conditioned space
  - ✓ Heat/cooling from renewables: wind, solar, biomass - as primary source
  - ✓ C202 Greenhouses (by definition)



## Administration – Both Codes

### *C101/R101 List scope of work required for existing buildings*



- 101.4.2 Historic buildings are exempt from the energy code
- 101.4.3 Additions, alterations, renovations and repairs
- 101.4.4 Change in use
- 101.4.5 Change in space conditioning
- 101.4.6 Mixed occupancy
- 101.5.1 Allows COM/RESCheck
- 101.5.3 Energy Standards / New products CGS 16a-48



## General Requirements

### ***C101.5.1 / R101.5.1 Compliance Materials - DOE***

- C101.5.1 allows for COMCheck program compliance
- R101.5.1 allows for RESCheck program compliance



13

## General Requirements

### ***C101.5.2 Low energy buildings – CT ADDS Exception 3***

- Exempt from thermal envelope
  - ✓ Peak usage < 3.4Btuh/1.0W/sf
  - ✓ No conditioned space
  - ✓ Utilizes renewable energy from non-purchase sources



14

## General Requirements

### ***C102.1.1 / R102.1.1 Above code programs – CT mod names programs***

- OSBI, and CT State Codes and Standards approve programs
  - ✓ LEED
  - ✓ Green Globes USA
  - ✓ Green Building Standard NAHB
  - ✓ Equivalent system per 20-256a C.G.S.



15

## Construction Documents

### ***C103.1/R103.1 C.G.S. Amendments***

- The building official may waive the submission of construction documents and other supporting data:
  - ✓ *Not required to be prepared by a registered design professional if the work proposed is not required by the provisions of this code, or*
  - ✓ *The building official determines that the nature of the work applied for is such that review of the construction documents is not necessary to obtain compliance with this code*



## Schedule of Permit Fees

### C107.2 / R107.2 C.G.S. Amendments

- "Each municipality shall establish a schedule of fees for each construction document review, building permit, certificate of approval and certificate of occupancy. A schedule of adopted fees shall be posted in the building department for public view."

**CERTIFICATE OF OCCUPANCY 1**  
 DEPARTMENT OF BUILDING CITY OF GARDEN GROVE  
 HARRY R. PEIRCE, Director 11391 ACACIA

JOB ADDRESS 12631 Monarch Street PERMIT NO. 048986 A  
 USE OF BUILDING Office & Storage GROUP F-2 TYPE M-P  
 USE ZONE M-P APPROVED BY Wm. K. Miller DATE 5-16-72  
 ZONING REMARKS CUP-101-62

Floor load sign installed per Section 2308 Yes  No   
 Room capacity sign installed per section 3301 (1) Yes  No

The above described building has been inspected and found to comply with the provisions of the Uniform Building Code.  
 ISSUED TO Southern Cal. Gas Co. ADDRESS 8101 Rosemead, Pico Rivera  
 Authorized By [Signature] DATE May 17, 1972  
**Notice: Post in a Conspicuous Place on the Premises**

## Unlawful Continuance

### C108.4 / R108.4 C.G.S. Amendments

DENVER DEVELOPMENT SERVICES  
 BUILDING INSPECTION DIVISION  
 CITY AND COUNTY OF DENVER  
 200 W. 14th AVENUE  
 DENVER, CO 80204  
 303.733.1611 / FAX 303.733.1612

**STOP WORK**  
 NOTICE

JOB ADDRESS YOUR PROJECT ADDRESS

This building has been inspected and an order to stop work issued for the following reasons:  
 You are in violation of Section 150.1 of the Denver Building Code (commencing work before obtaining a permit) therefore, by authority of Section 103.7 of the Denver Building Code, you are ordered to stop all work at once. No further work will be permitted until permits are obtained. A late fee will be required for this permit. (Section 152.2)

This Order is dated 2/20/17 complaint  
 permit shall be obtained by contract or report  
with permit reports they must obtain  
all required permits

If you wish to speak to an inspector, call 720-865-HOLD  
 between 7:30 a.m. and 5:30 a.m.

INSPECTOR His/Her NAME DATE ALMOST DONE

**DO NOT REMOVE THIS TAG**  
 THE PENALTY FOR VIOLATING A STOP WORK ORDER IS A  
 \$999.00 FINE OR 180 DAYS IN JAIL OR BOTH.

Permitting information for:  
 One & Two Family Dwellings: Call 720-865-2710 between 8 a.m. & 4 p.m.  
 Apartments & Commercial Buildings: Call 720-865-2705 between 8 a.m. & 11:30 p.m.

www.denvergov.org/planning

B1 560 (Rev. 10/05) INSPECTOR'S COPY

- "Any person who shall continue any work in or about the structure after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be liable for penalties in accordance with section 29-254a of the Connecticut General Statutes"

## Means of Appeal

### **C109.1 / R109.1 C.G.S. Amendments**

- (DEL) Board of Appeals Delete 109.1 /.2 /.3 entirely and replace with the following:
- “Means of appeal shall be in accordance with Section 113 of the 2012 International Building Code portion of the State Building Code”



## Words/Terms Are Problems

We are not the only game in town creating *definitions*

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>■ Legal           <ul style="list-style-type: none"> <li>✓ Federal Law (FEMA / ADA)</li> <li>✓ Legislative</li> <li>✓ Courts: BLACK’S Law</li> </ul> </li> <li>■ Medical (hazards)</li> <li>■ Scientific (Equations/symbols)</li> <li>■ OTHER CODES</li> <li>■ Construction STANDARDS</li> <li>■ Education, marketing, etc.</li> <li>■ Local Zoning</li> </ul> | <ul style="list-style-type: none"> <li>■ ENCARTA dictionary</li> <li>■ OXFORD “</li> <li>■ Roget’s Thesaurus           <ul style="list-style-type: none"> <li>✓ Synonyms / antonyms</li> </ul> </li> </ul> |
|---|--|





### Commercial Changes

### Defining the Codes



## Commercial Definitions

*C202 Amended, Revised, Deleted*

- Building
  - ✗ ~~Above-Grade Wall (C402.2.2.1)~~
  - ✓ Commissioning
  - ✗ ~~Basement Wall (C402.2.2.2)~~
  - ✓ Entrance
  - ✓ Site
  - ✓ Thermal Envelope
  - ✓ Greenhouse
- Fenestration
  - ✓ Field fabricated
  - ✓ Site-built
  - ✓ Dynamic glazing
  - ✓ Skylight (15° → 30°)
  - ✓ VT (visible transmittance)
- HVAC
  - ✓ COP Heating/cooling
  - ✓ Furnace Electric Ratio
  - ✓ Demand recirculation
  - ✓ On-site renewable energy\* C406
  - ✓ IPLV / NPLV
  - ✓ Thermal Envelope
- General lighting
  - ✓ Full cutoff luminaire



## Commercial Compliance

*C401.2 Application: OPTIONS*

1. ASHRAE 90.1-2010
  - ✓ No Appendix G modeling energy option
2. C402, C403, C404 & C405 Prescriptive
  - ✓ Must comply w/C406 Add Options
3. C407 TBPM + Mandatory sections
  - ✓ Comply w/ standard reference design



## Commercial Energy Efficiency

### *Compliance Paths C401*

- **Prescriptive-based Design**
  - ✓ 2012 IECC C402 - 406
- **Performance-based Design**
  - ✓ 2012 IECC C407 Total Building Performance
  - ✓ ASHRAE 90.1 – 2007  
(Chapter 4 only)



**AKF**

## Commercial Buildings:

### *C402 Envelope Changes*

- C402.2.1 Roof assembly.  
Exception 2 allows skylights that are part of an NFRC 100 rated assembly to not be insulated
- C402.2.6 Slabs on grade.  
Eliminates exception for slab insulation that may be subject to termite infestation.
- C402.2.8 Radiant heating systems in slabs must have a minimum of R-3.5 continuous insulation underneath



**AKF**

## Envelope Changes

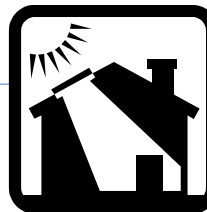
**Table C402.2 Prescriptive Requirements**

Envelope Component	2009 'Other'	2012 'Other'
<b>ROOF - above deck</b>	20	<b>R25</b>
- <b>Metal Buildings</b>	R13+R13	<b>R19+R11 LS</b>
- <b>Attic &amp; Other</b>	R38	<b>R49</b>
<b>Metal Building WALLS</b>	R13+5.6 ci	<b>R13+13 ci</b>
<b>Wood Frame Walls</b>	R13+3.8 ci	<b>R13+7.5 ci*</b>
<b>Floor slabs/heated (C402.2.8)</b>	N/A	<b>R3.5</b>
- <b>Slab Perimeter - unheated</b>	R10/24"	<b>R15/36"</b>
<b>Swinging Doors</b>	U-0.70	<b>U-0.37</b>
<b>Roll-up Doors</b>	U-0.50 (R2)	<b>R4.75</b>



## Commercial Buildings:

### *C402 Envelope Changes*



- Table C402.3 Fenestration. Eliminates differences between framing materials, thermal breaks, and curtain walls/storefronts.
- C402.3.1 Skylight U-factors reduced
- Allowable skylight area increases 3% to 5% of total roof area
  - ✓ Use of automatic daylighting control zones under skylights.
- C402.3.2 ≥ 50% of the floor area in certain building types must be in a "daylight" zone under skylights



## Fenestration Changes

**Table C402.3 Prescriptive Requirements Zone 5**

Fenestration Component	2009	2012
<b>U-Factor - all non-metal</b>	0.35	-
<b>Fixed fenestration</b>	0.45	<b>0.38</b>
<b>Operable fenestration</b>	0.55	<b>0.45</b>
<b>Entrance doors</b>	0.80	<b>0.77</b>
<b>SHGC (&lt;0.25 PF 2009 – 0.40)</b>	0.00-0.40	<b>0.40 (all)</b>
<b>Skylights</b>		
<b>U-factor</b>	0.60	<b>0.50</b>
<b>SHGC</b>	0.40	<b>0.40</b>



## Commercial Buildings

### C402 Fenestration - Significant Changes

- C402.3.1 Maximum fenestration area decreases from 40% to 30%; skylight area remains at 3%
- C402.3.2 Fenestration area increases back to 40%; skylights to 5%: **IF**
  - ✓ ≥ 50% of conditioned floor area within daylight zone,
  - ✓ Automatic daylight-responsive controls are installed
  - ✓ Vertical fenestration VT is ≥1.1 (SHGC)
  - ✓ Space is not otherwise exempted
- C402.3.3 Skylight factors using DRC
  - ✓ C402.3.3.3 SHGC      0.60
  - ✓ C402.3.3.4 U-factor    0.75



## Daylighting

### C402.3.2 Daylighting is a Prescriptive Option - Except



- Enclosed spaces > **10,000 s.f.** directly under a roof with ceiling heights  $\geq 15'$

**Assembly Uses:**

Gym; convention & transportation centers

**Business & Mercantile Uses\*\***

Offices; Retail stores; Automotive services

**Associated spaces**

Lobby; Atrium; Concourse; Corridor

**Factory Uses:**

Manufacturing\*\*, Workshop;

**Storage Uses\*\*:**

Warehouses (non-refrigerated);

*Distribution / Sorting, Storage*

\*\* 90% haze factor



## Daylighting

### C402.3.2 Daylighting Required - Mandatory



- **Skylighting (toplighting)**  
 $\geq 50\%$  of floor area (FA) has **daylight-responsive** controls
  - ✓  $A \geq 3\%$  min. skylight area to daylight zone with VT  $\geq 0.40$ ; or  $\geq 1\%$  effective aperture
  - ✓ Not required where lighting power densities are  $< 0.5W/s.f.$
  - ✓ Not required in areas where daylight obstructed





### Skylight Haze Factor

#### C402.3.2.2 Obscured Glazing\*\*

- Glazing material OR diffuser
  - ✓ > 90% obscuration
  - ✓ ASTM D 1003
- Exception. Achieve diffusion:
  - ✓ Geometry of skylight well
  - ✓ Fixed or automatic baffles

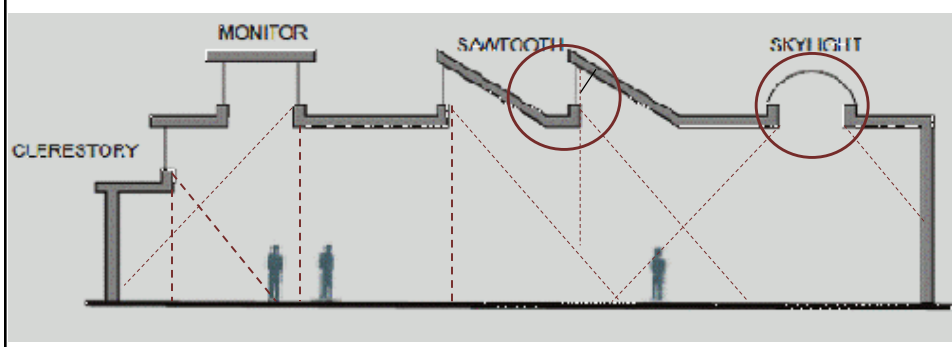


### Glazing: What Counts? As What?

*Basic Daylighting to Illuminate Interiors*

**Windows?**

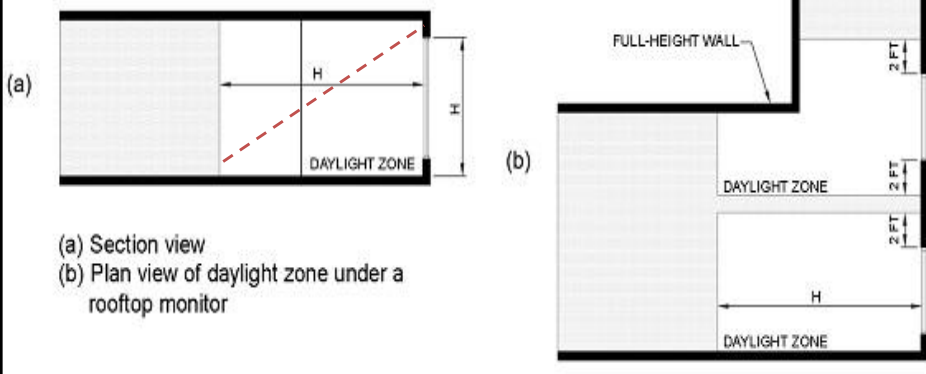
**Skylights?**



## Sidelighting

### C202 Daylight Zone Adjacent to Vertical Fenestration – C402 .3.1.1

- Single zone with DR controls
- **Zone is 15 feet, without regard to window head height**
- Side margins of 2'
- Zone width/depth extends over partitions less than ceiling height

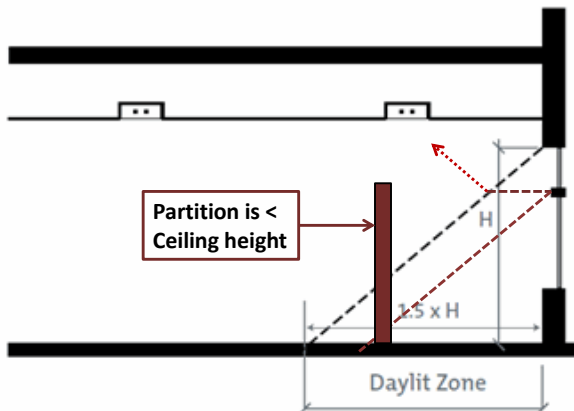


## Sidelighting

### C402.3.1.1 Prescriptive Definition Changes

#### Daylight Zone =

- Full-height opaque wall cutoffs
- **Outside shading is a further limitation**
  - ✓ A light shelf will not change the IECC area measurement
  - ✓ No allowances for technical strategies
  - ✓ No penalties for non-uniformity of lighting

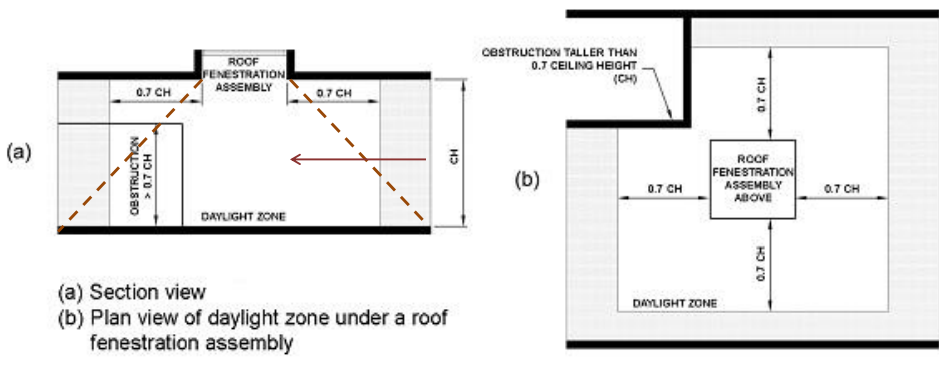


DAYLIT ZONE—SIDELIGHTING

## Skylights

### C202 Daylight Zone Under Skylights –

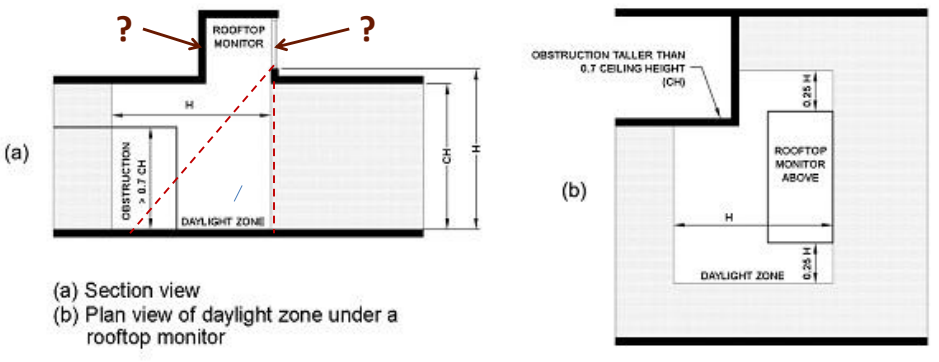
- Floor area dimension equals twice the height of the ceiling plus skylight width
- Only full-height partitions block the light to other portions of the illuminated area
- C405.2.3.3 specifies light control



## Toplighting

### C402.3.2.1 Exception 4 (does not define rooftop monitors)

- Monitor Floor Area Allowance: from sill of glazing to plumb line and out an equal distance with side allowances
- Side illumination allowance: two feet beyond opening plumb line



## Using Projection Factors

### C402.3.3.1 Vertical Fenestration SHGC Adjustment

- SHGC factor by orientation to north
- PF must be  $\geq 0.2$
- $PF < 0.2$ ; no adjustment

Table C402.3.3.1  
SHGC Adjustment Multipliers

Projection Factor	Orientation $\leq 45^\circ$ N	All others
$0.2 \leq PF < 0.5$	x1.1	x1.2
$PF \geq 0.5$	x1.2	x1.6



## SHGC Daylight Control Exception

### C402.3.3 Increased Skylight SHGC

- For daylight zones with automatic daylight-responsive lighting controls
- SHGC increases in Climate Zones 1-6 - 0.40 to  $\leq 0.60$
- SHGC tradeoffs in CZ 7-8 are not allowed



## Envelope Changes

### *Air Barrier Requirements (Mandatory) C402.4*

- C402.4 Air barrier required; Climate Zones 4-8
  - ✓ Construction
  - ✓ Materials
  - ✓ Tested assemblies
  - ✓ Penetrations
  - ✓ Fenestration testing
  - ✓ Other openings
- C402.4.5 Outdoor intakes, exhausts, stairs and shafts
  - ✓ Gravity dampers are OK < 3 stories high



**AKF**

## Commercial HVAC

### *C403.2 Mandatory Provisions*

- Load calculations must account for ERV systems
- Equipment: Sizing per loads
  - ✓ New NAECA regional-based minimums
- Chiller NPLV required performance



**AKF**

## Commercial Buildings

### *Significant Changes C403*

- C403.2.5.1 Demand Control Ventilation. DCV required in spaces > 500 SF with an occupant load  $\geq 25$ /KSF (Table 403.3 IMC)
  - ✓ Having air side economizer
  - ✓ Automated modulating controls
  - ✓ Design outdoor airflow 3,000cfm



**AKF**

## Commercial HVAC

### *C403.2 Mandatory Provisions*

- C403.2.4.3.3 Off-hour controls - automatic start capable
- C403.2.6/Table C403.2.6 Energy recovery required
- C403.2.7 Duct/plenum insulation sealing must be installed values (CT)
  - ✓ R-6 in unconditioned space
  - ✓ R-8 within thermal envelope or outside



**AKF**

## Commercial Buildings

### Significant Changes C403

Table C403.3.1(1)

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B	No requirements
2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	All systems $\geq 33,000\text{Btu/h}$ ; buildings $>300,000\text{Btu/h}$ or $> 20\%$

- Table C403.2.8 Pipe insulation set by diameter, temperature operating range of fluid
- C403.3.1 Economizer threshold decreases to 33,000 Btu/h
  - ✓ Exceptions (6)



## Service Water Heating Changes

### C404.5 Pipe Insulation Confusion

- **C404.5 Pipe insulation. (5<sup>th</sup> line)**  
 The first 8 feet...in non-hot-water-supply temperature maintenance systems served by equipment without integral heat traps...shall be insulated
- **C404.4 (2015) Circulation systems**  
 On both the inlet and outlet piping of a storage HW heater or heated storage tank, the piping to a heat trap, or first 8 feet of piping, shall be insulated



## Service Water Heating Changes

*C404.7 Insulated Pool Covers*

**Pool covers no longer required to be insulated**



**AKF**

## Lighting Changes

*C405*

- C405. 2.2.2 Occupancy sensors:
  - ✓ ≥ 300sf, plus
  - ✓ 8 specific areas
  
- C405.2.2.3 Daylight zone control limitations/exceptions
  
- C405.5.2 Space-by-space method for Interior Lighting Power Allowance (ILPA) returns

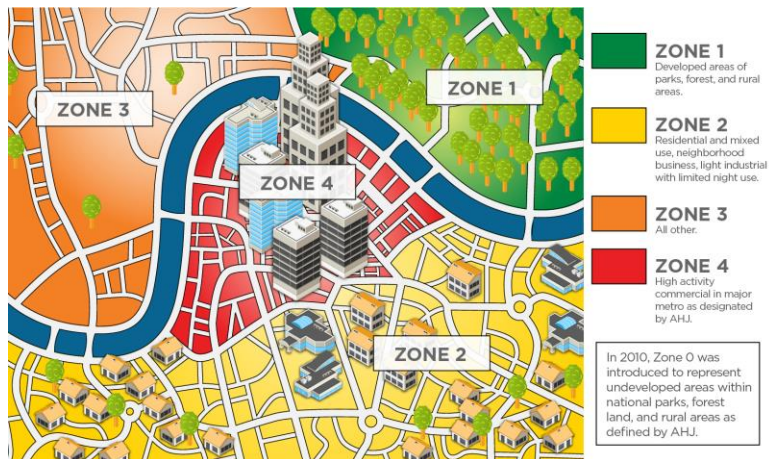


**AKF**



## Exterior Lighting Power Zones\*

Table C405.6.2



## Lighting Changes

C405.6.3 Light Pollution Controls - CT

- Full cutoff luminaires
  - ✓ Powered by building service
- Exceptions:
  - ✓ ≤ 150W equivalent
  - ✓ Building facades/features
  - ✓ Historic site lighting
  - ✓ Outdoor sports playing field
  - ✓ MOE discharge lighting
  - ✓ Low-voltage landscape lights
  - ✓ Sign illumination
  - ✓ Festoon lighting
  - ✓ Temporary lighting



## Additional Efficiency Package Options

### *C406 (Three Options)*

- C406.2 HVAC Performance – all systems; only when all applicable equipment meet/exceed Table C406.2(1-7) values
- C406.3 Efficient lighting system – Table C406.3 reduced values
- C406.4 On-Site Renewables -  $\geq 1.75$  Btu **OR** 0.50w per S.F. **OR**  $\geq 3\%$  of building energy use



**AKF**

## Added Efficiency Packages

### *C406.2 HVAC Reductions - Tables 1-7*

- Increased efficiency beyond NAECA minimum requirements
  - ✓ Air Conditioning
  - ✓ Heat pumps
  - ✓ Warm air furnaces
  - ✓ Boilers
  - ✓ Chillers, absorption



**AKF**

## Added Efficiency Packages

### C406.3 ILPA / ELPA Reductions

- Reduced Lighting Power Density
  - ✓ Whole building lighting power density must be reduced 10% below Table C405.5.2 values or follow C406.3 prescriptive table
  - ✓ Reduced Interior Lighting Power Table C406.3 (b) requires offices and retail to provide  $\geq 30\%$  F/A daylight zones, (c) warehouses 70% F/A zones



**AKF**

## Added Efficiency Packages

### C406.4 On-Site Supply of Renewable Energy

- Renewable systems not located on adjacent or remote land
- $\geq 1.75$  Btu/SF or
- $\geq 3\%$  energy use of regulated energy

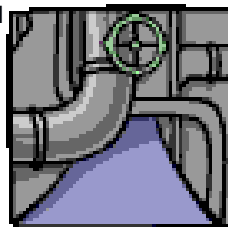


**AKF**

## Commercial Buildings

### *C408 Commissioning (New Section added)*

- Threshold: < 600k Btu/h Heating; 480k Btu/h cooling; all systems and their controls
- Building commissioning: Develop a plan for mechanical system commissioning; provide evidence of commissioning.
- HVAC air and water flow rates must be balanced; equipment, controls, and lighting must be performance tested.
- Preliminary report: submitted to the building owner, and acknowledge report receipt to the code official.



## Systems Commissioning

### *C408.2 Mechanical Systems Commissioning*

#### **Commissioning Plan**

- Adjusting/balancing
  - ✓ Air systems
  - ✓ Hydronic systems
- Equipment
- Controls
- Economizers

#### **Functional Testing**

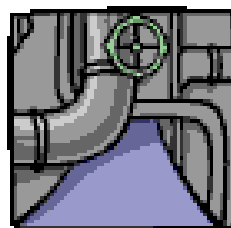
- HVAC Systems/Controls
- ILP/ELP Systems/Controls
- Preliminary Report
  - ✓ Uncorrected Deficiencies
  - ✓ Deferred testing
- Documentation requirements



## HVAC Commissioning

### C408 Systems balancing

- Systems must be adjusted to deliver final air and water flow rates within 10% of design
  - ✓ Each supply air outlet and zone terminal device
  - ✓ Heating and cooling coils
- Systems and equipment must be installed with ability to be adjusted and have performance measured



## Systems Commissioning

### C408 Commissioning Changes - Documentation

#### Within 90 days of C of O:

- Construction documents which must include location and performance data on each piece of equipment
- Manual for operation and maintenance
- System balancing report
- Final Commissioning Report

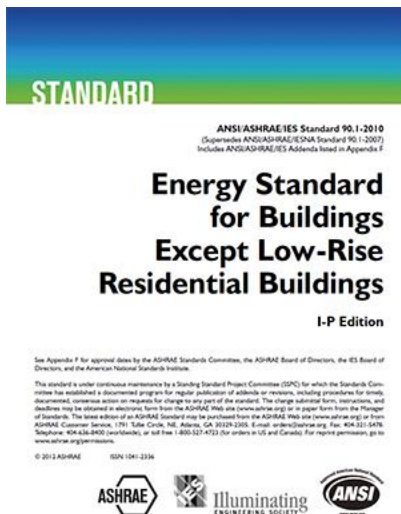
#### Report Contains:

- Results of all Functional Performance Tests
- Deficiencies found during testing and corrective measures proposed
- All Functional Performance Test procedures used during commissioning process



## Commercial Compliance

### C401.2 Compliance Options – ASHRAE 90.1-2010



- DOE - the *de facto* standard
  - ✓ Commercial yardstick
- Applies to [CE] Chapter 4
  - ✓ IECC Ch. 1, 2, 3 apply
- Energy requirements
  - ✓ Efficiency and conservation

**AKF**

## Abbreviations, Acronyms, Symbols

### 90.1- Section 3.3 has 74; IECC Definitions has 9

#### Where to find them

- IECC defines some
  - ✓ Chapter 2 (9)
  - ✓ Figures in various Chapters
- ASHRAE does
  - ✓ ASHRAE 3.3
  - ✓ Chapter 12

#### Who's your audience?

- Construction Industry
- Clients / Developers
- Administrators
- General Public

## ASHRAE Definitions: Sidelighting

### 90.1 Section 3.2

- Primary sidelighted area
- Secondary sidelighted area
- Side extension [2']
- Head height
- Daylight area
- Clerestory, dormer



## ASHRAE Definitions: Toplighting

### 90.1 Section 3.2

- Skylight [ $< 60^{\circ}$  horizontal]
- Daylight area
- Skylight well
- Skylight aperture
- Rooftop monitor



## Fenestration Limitations

### 5.5.4.2 Vertical Fenestration Area – (prescriptive option)



#### Vertical fenestration limits

- 40% without auto controls
  - ✓ Exception (c): < 75% front facade
- 40% with daylight zone F.A. ≥ 50%
  - ✓ Limited to CZ 1-6
  - ✓ ≥3 stories ≥ 25% (2015)

#### Visible transmittance [VT]

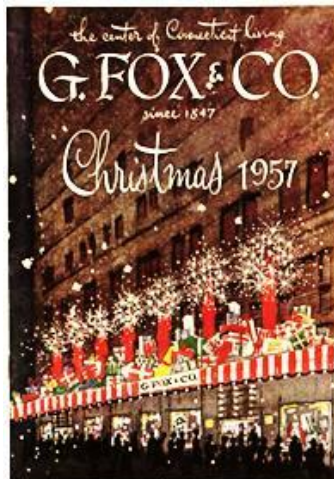
- VT ≥ 1.1 x SHGC

## Fenestration

### 5.5.4.2 Fenestration Area Increase – (prescriptive option only)

#### 5.5.4.2.1 Vertical Fenestration: Street Side Exception in 5.5.4.4.1

- Height of street story ≤ 20ft
- Continuous overhang PF > 0.5
- ≤ 75% gross wall area of story
- Separate SHGC computation for SHGC and glazing – no averaging

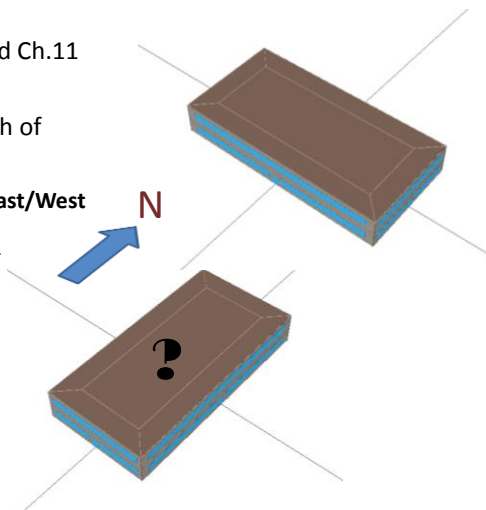




## Fenestration Orientation - 2010

### 5.5.4.5 Fenestration

- Changes to section 5.5.4.5 and Ch.11 for locations of fenestration
- E & W orientations < 25% each of total vertical fenestration
  - ✓ Must be within 30° of true East/West
- Physical dimensions of design solution may be affected



## Building Thermal Glazing Changes

### 5.5.4 Prescriptive Envelope Fenestration Limits

- Fenestration remains capped at 40%; SHGC by VT/SHGC; dependent on percentages of glazing
  - ✓ Vertical glazing orientation limitations covered by Section 5.5.4.5
  - ✓ Dynamic glazing SHGC 5.5.4.4.2
  - ✓ Must be separately analyzed from remainder of conventional glazing



## Building Thermal Glazing Changes

### 5.5.4 Skylight Area Limits

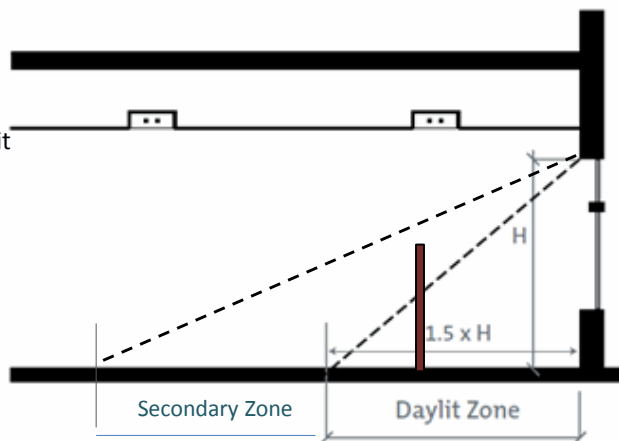


- Skylights remain at two niches: 0-2% and 2.1-5%
- Different U- and SHGC factors
- Table has 3 classes for skylight glazing materials, curb heights
  - ✓ Exception: Skylights outside of scope NFRC 200, VT determined by ASTM E972

## Sidelighting

### Prescriptive Figures in 3.2: Daylight Zones

- Equals head height
- 2x for secondary limit
- Side margins of 2'
- Opaque wall cutoffs
- Obstruction < 5 ft
- No allowances yet - technical strategies



DAYLIT ZONE—SIDELIGHTING

### Increased Skylighting – (Prescriptive mandate)

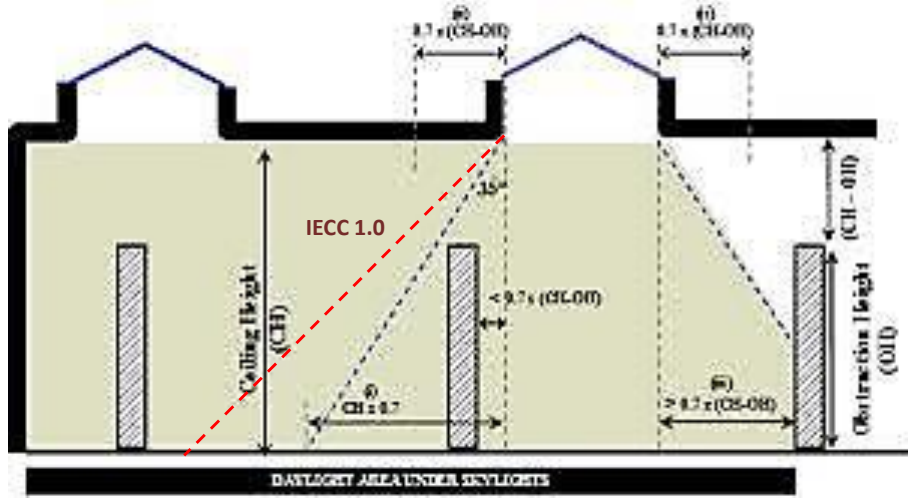
#### 5.5.4.2.3(a) Minimum Skylight Areas; 15 Types



- Assembly Uses:**
    - Gym/exercise center; convention and transportation centers
  - Business & Mercantile Uses\*\*:**
    - Offices\*\*; Retail stores\*\*
    - Automotive services\*\*
  - Associated spaces**
    - Atrium; Concourse; Corridor; Lobby
  - Factory Uses:**
    - Manufacturing\*\*; Workshop;
  - Storage Uses\*\*:**
    - Warehouses (non-refrigerated); Distribution/Sorting, Storage
- \*\* 90% haze factor; these uses

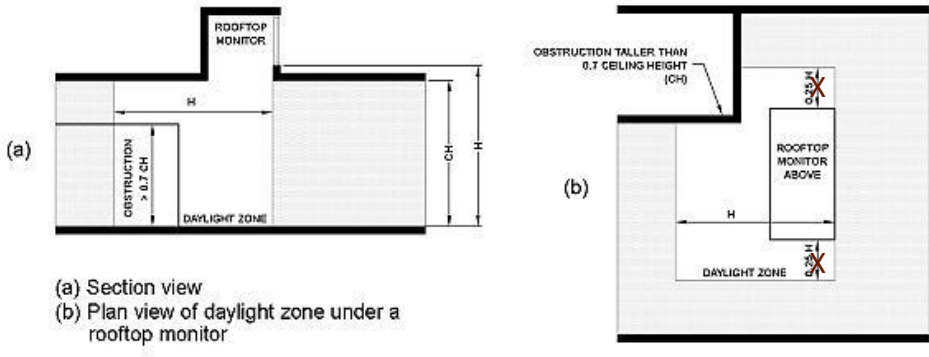
### Skylighting

#### 90.1 3.2 Illuminated Area better defined



### Rooftop Monitor In 90.1

90.1 3.2 Illuminated Area better defined



### Combining Sloped Glazing, Skylights

5.5.4.2 Using Both Percentages to Best Effect



## Lighting Control Compared

*Sections ICC C405 and 90.1-9.4.1*

### IECC [CE]

- C405.2.1.2
- C405.2
- C405.2.2
- C405.2.2.3
- C405.2.2.3.3
- C405.2.2.3
- C405.2.3

### Controls

- Lighting reduction controls in spaces that use < 6w/sf
- Space Control -50% on
- Auto shutoff
- Primary Sidelighting
- Secondary Sidelighting
- Toplighting\*
- Additional controls

### ASHRAE 90.1

- 9.4.2.1a
- 9.4.1
- 9.4.1.1
- 9.4.1.4
- (9.4.1.4 separate)
- 9.4.1.5
- 9.4.1.6



## Commissioning

*9.4.4 Functional Testing – Lighting Controls*

Devices and Control Systems Tests

- Occupant sensors performance
- Programmable/T.O.D. controls can turn lights off
- Photosensors will reduce lighting levels based on usable daylight
- Safety/security exceptions
  - ✓ 4.2.4 Inspections. Electrical equipment and systems; after installation; before concealment



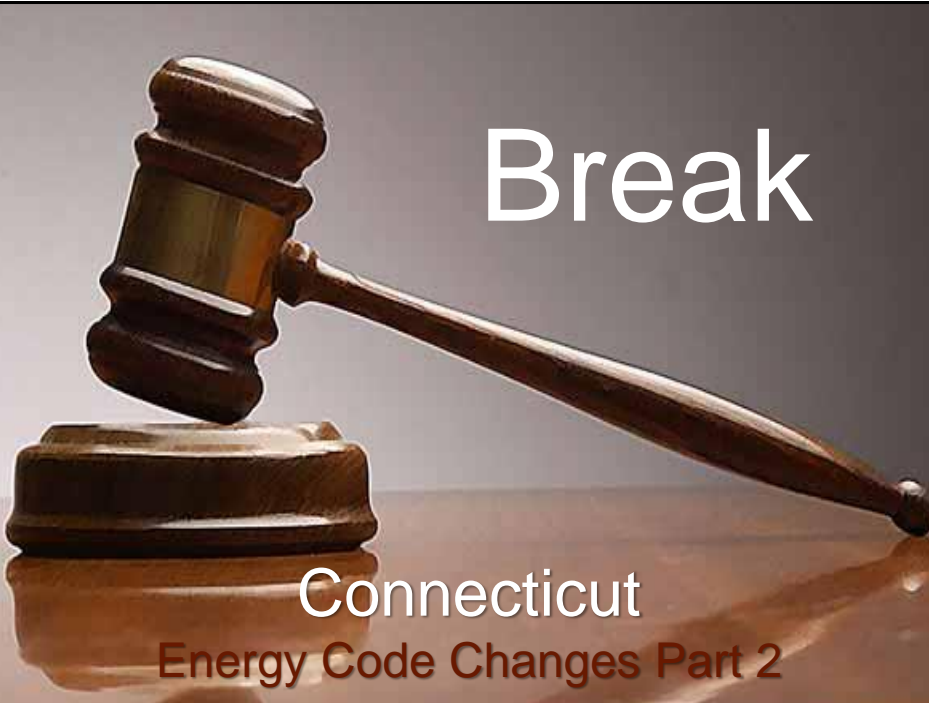
## DEEP 16a-38k High Performance Buildings

*An OVERLAY - Not governed by the CT Codes Adoption*

- Applies to State and State-funded construction
  - ✓ > \$5 million new
  - ✓ > \$2 million addition
- **21% less energy use**
- Demonstrate whether building meets performance or tradeoff compliance
- If applicable, a report is submitted with CDs.



AKF



# Break

## Connecticut

### Energy Code Changes Part 2

## Relationship Between IECC & IRC

### R103.2 Construction Documents



VS



- IECC addresses only energy
- IECC addresses residential and commercial;
- IRC addresses all R-3 Residential topics (*structural, plumbing, etc.*),
  - ✓ Allows builder to carry only one code book
  - ✓ Chapter 11 covers energy efficiency
- IRC addresses subsets of residential;
  - detached one- and two-family dwellings
  - townhouses 3 stories or fewer
- 2012 consolidates IECC *Residential Provisions* with IRC energy Chapter 11 (actually a change to the IRC, not the IECC)

## How Does My Residential Project Need to Comply?

**IECC**

R-2/R-3/R-4 - three stories or less in height

**IRC**

One- and two-family dwellings; townhouses



## Residential Changes [RE]

### Six Principal Areas

- R101 Administration
- R202 Definitions
- R402 Thermal Envelope
- R403 Mechanical/SWH
- R404 Power & Lighting
- R405 Performance Alternative



[http://www.energycodes.gov/events/energycodes/documents/ecodes11/EC2011\\_2012iecc\\_residential\\_update.pfd](http://www.energycodes.gov/events/energycodes/documents/ecodes11/EC2011_2012iecc_residential_update.pfd)

## Compliance

### R101.5.2 Low Energy Buildings *CT Amends*



*“Buildings and structures for which heating and cooling is supplied solely by non-purchased renewable energy sources...that do not rely on backup heat from other purchased, non-renewable sources.”*

- On-site wind
- On-site water
- ✓ Geothermal, water power
- On-site PV solar power
- Wood-burning heating appliances



**Construction Documents**

**R103.2/N1101.8 Information on Construction Documents**

- **Describes Categories**
  1. Insulation; R-values
  2. U- & SHGC factors
  3. Area-weighted U- & SHGC
  4. HVAC system design criteria
  5. HVAC & SWH types, sizes, efficiencies
  6. Equipment/systems controls
  7. Fan motor HP; controls
  8. Duct sealing; duct & pipe insulation
  9. Air sealing details
  10. Light Fixture Schedule; controls

**Construction Documents**

**R103.5– Document Retention - C.G.S. Amendments**

- **Chapter 188, C.G.S. - Records**
- *“One set of approved construction documents shall be retained by the building official for a period as set forth in the records/disposition schedule adopted pursuant to Chapter 188 of the Connecticut General Statutes”*

## Definitions and Errata

### *R202 Added / Amended / Not Applicable*

#### **ADD**

- Continuous air barrier
- Demand recirculation water system
- Fenestration product – site built
- Whole-house ventilation

#### **AMD**

- Residential building
- Skylight (2405.2)\*

#### **N/A**

- Entrance door\* (RE12)
- Visible Transmittance\* (dynamic glazing)



## Definitions

### *R201.3 Terms Defined in Other Codes*

- ***“Where terms are not defined in this code and are defined in other codes adopted as portions of the 2012 State Building Code, such terms shall have the meanings ascribed to them as in those codes “***



## Definitions - Glazing

**R202; IBC 2404.2\***



- Vertical Glazing  $\leq 30^\circ$ 
  - ✓ Changes to 90.1 definition
- Sloped Glazing  $\leq 15^\circ$ 
  - ✓ IBC 2405.2 Safety Glazing
- Visible transmittance [VT]
  - ✓ *drives SHGC*
- Undefined:
  - ✓ *Dynamic glazing*
  - ✓ *Sidelighting*
  - ✓ *Toplighting*

## Prescriptive Residential Changes

### Chapter 4 [RE] Summary

- Increased performance : *envelope, windows, skylights*
- Reduced allowable air leakage: *envelope & duct systems*
- Increased duct tightness *(reduced allowed leakage)*
- Requires supply & exhaust ventilation *(IRC R702.7; IBC 1405.3)*
- Greater HVAC/SHW efficiencies \* *(commercial equipment tables)*
- Mandatory Equipment Sizing based on loads *ACCA Manuals S & J*
- Increased H/E lighting *by fixture count or by socket*

## Insulation and Fenestration Performance

**Table R402.1.1 - by Climate Zone**

TABLE R402.1.1 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT*										
CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>a</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b, c, d</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB <sup>e</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>f</sup> WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 <sup>h</sup>	8/13	19	5/13 <sup>i</sup>	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 <sup>h</sup>	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 <sup>h</sup>	13/17	30 <sup>g</sup>	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>	15/20	30 <sup>g</sup>	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 <sup>h</sup>	19/21	38 <sup>g</sup>	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

- a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.
- b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.
- c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 continuous 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 and R-10 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- d. 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 Climate Zones 1 through 3 for heated slabs.
- e. There are no SHGC requirements in the Marine Zone.
- f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- g. Or insulation sufficient to fill the framing cavity, R-19 minimum.
- h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.
- i. The second R-value applies when more than half the insulation is on the interior of the mass wall.

Table Notes!

## Insulation and Fenestration

**Table R402.1.3 Equivalent U-Factors History: Climate Zone 5**

U-Factors	2009	2012	CT
Fenestration	0.35	0.32	0.32
Skylight	0.60	0.55	0.55
Ceiling	0.030	0.026	0.026
Frame Wall	0.057	0.057	0.060
Mass Wall	0.082	0.082	0.082
Floor	0.033	0.033	0.033
Basement	0.059	0.050	0.050
Crawl Space	0.065	0.055	0.055
*Sunroom	0.50	0.45	0.45
*Skylight	0.75	0.70	0.70

## Insulation and Fenestration

**Table R402.1.1 Requirements by Component – Table Note “h”**

- Allows for an R-value for the continuous insulation to be **reduced** not more than **R-3**, over not more than **40%** of wall structural sheathing, to maintain a uniform total “insulated sheathing plus c.i. thickness.”
- The minimum R-value continuous insulation must be installed over the remainder of the entire wall.



## Fenestration U-factors

**Table R402.1.3 Equivalencies**



- Doors **U-0.32**
- Windows **U-0.32**
- Skylights **U-0.55**
- SHGC N/R

## Prescriptive Insulation Requirements

### R402.2.2 Ceilings w/o Attic Spaces

- **R38** allowed for 500 ft<sup>2</sup> or 20% total insulated ceiling area, whichever is less, in 'cathedral' ceilings where:
  - ✓ **R-49** Insulation levels would be required
  - ✓ Insufficient framing cavity space to meet tabular levels
- ✓ *This does not apply to 'cathedral' trusses*



*Note: Reduction ONLY applies to the R-value prescriptive path, not the U-factor or Total UA alternatives*

95

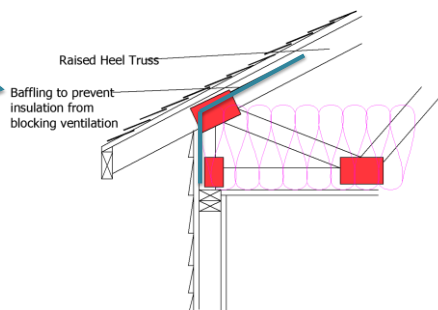
## Eave Baffles

### R402.2.3 Baffles for air permeable insulations in vented attics

- ✓ Installed adjacent to soffit and eave vents
- ✓ Maintains air openings  $\geq$  size of vent
- ✓ Extends over top and ends of attic insulation
- ✓ May be of any solid material



**Baffle**

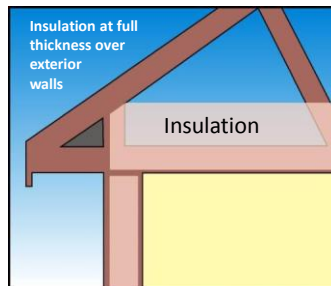


96

## Ceilings with Attics



### C402.2.3.1 Exception:



- If insulation is full height over exterior wall top plate:
  - ✓ R-38 complies where R-49 is required

**Note:** Reductions *ONLY* apply to the R-value prescriptive path, not the U-factor or Total UA alternatives

## Steel-Frame Ceilings / Walls

Section R402.2.6; Table R402.2.6 Expanded Requirements

### Steel-Frame Ceiling, Wall and Floor Insulation (R-Value)

Wood Frame R-value Requirement	Cold-Formed Steel Equivalent R-value <sup>a</sup>
Steel Truss Ceilings <sup>b</sup>	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings <sup>b</sup>	
R-30	R-38 in 2x4, or 2x6, or 2x8 R-49 any framing
R-38	R-49 2x4, or 2x6, or 2x8, or 2x10
Steel Framed Wall	
R-13	R-13 + 4.2 or R-19 + 2.1, or R-21 + 2.8 or R-0+9.3 or R-15+R-3.8 or R-21 + 3.1
R-13+R-3	R-0 + 11.2 or R-13 + 6.1, or R-15 + 5.7 or R-19+5.0 or R-21+4.7

## Sunrooms

R202; R402.2.12; R402.3.5

- **“A one-story structure attached to a dwelling with glazing in excess of 40 per cent of the gross area of the exterior walls and roof.”**

- **Roof - R24**

- **Walls - R13**

- **Glazing - 0.45**

- ✓ **SHGC -0.48**

- **Skylight -0.70**

- ✓ **SHGC - NR**



## Air Barriers / Insulation - Common Walls

Table R402.4.1.1 Common Walls – (see Appendix K)

- There is no requirement for an air barrier or insulation in common walls between conditioned living spaces of adjacent dwelling units in townhouses or two-families. However, IRC Appendix ‘K’ is adopted.

- Multi-family dwellings must comply with IBC 1207.2 for sound attenuation

- Appendix K requiring sound attenuation between dwelling units is not adopted





## Building Thermal Envelope (Mandatory)

### R402.4.1 Air Leakage



Show envelope compliance - R402.1.2

- Air barrier installation
- Whole-house pressure test
- Procedures for testing outlined
- Testing may occur any time after creation of all building envelope penetrations\*
- Signed report shall be provided

Air Leakage Rate	Climate Zone	Test Pressure
ACH ≤ 5	1-2	50 Pascals
ACH ≤ 3	3-8	50 Pascals

## Building Thermal Envelope (Mandatory)

### R402.4.1.2 Exceptions



- **CT Table R402.4.1.1 Exceptions:**  
Relaxed ACH for Townhouses
  - ✓ 5.0 ACH > 850sf
  - ✓ 6.5 ACH ≤ 850sf
  - ✓ Sampling buildings > 7 units
  - ✓ Visual: Additions/alterations
- **CT R402.4.2 AMD Fireplace sealing requirements**



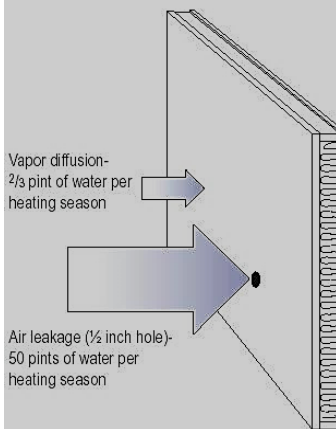
## Canadian Airtight Study - 1998

### SINGLE FAMILY - ACH

- Mean Age: 20-30yr
  - Multiply # by 20 for ACH
  - Tight: 0.19-0.24
  - Good: 0.48-0.59
  - Typical: 0.96-1.18
  - Leaky: 1.93-2.35
- 
- Canada: 0.11+ ACH
  - ASHRAE 62 ≥ 0.35 ACH

### MOISTURE MIGRATION PRIORITIES

Significantly more water vapor travels through a wall by air leakage than by diffusion



## Vapor Retarder – Class III

### R702.7 IRC Class III Requirements

Table R702.7.1 Vapor retarder requirements allow the use of a coat of vinyl paint to satisfy the requirement in Zone 5 when:

- A **vapor-impermeable insulating sheathing** with a minimum value of **R-5** is located **outside** of a 2x4 stud wall with **wall cavities insulated to R-3.4 per inch**;
- A **vapor-impermeable insulating sheathing** with a minimum value of **R-7.5** is located **outside** of a 2x6 stud wall with **wall cavities insulated to R-3.4 per inch**;



## Moisture Diffusion in Materials *(source)*

*IBC 1405.3.1 defines Vapor Retardant Class III Materials*

MATERIAL	PERM RATING	VAPOR RETARDER(?)
½" GWB	38 -42	NO
TYVEK	52	NO
Latex <u>Primer</u>	7.0 – 10.0	NO
7/16" OSB (w/exterior glue)*	0.77* – 3.48	SOMETIMES
1" XPS	0.40 – 1.60	SOMETIMES
7/16" Plywood (exterior glue)	0.70	YES
Kraft Paper Facing	1.0	YES
2 mil polyethylene	0.06 – 0.22	YES
Alkyd-base or V/R paint	< 0.05	YES
1 mil aluminum foil laminate	< 0.05	YES
½" GWB + <u>VWC</u>	0.05 – 0.80	YES

108

## Wood-Burning Fireplaces

*Section R402.4.2; Table R402.4.1.1 (Mandatory) – CT Amends*

New wood-burning fireplaces shall have tight-fitting flue dampers (and outdoor combustion air - 2009).

Fireplaces shall have gasketed doors (DEL)



# NAECA

## SINGLE / MULTI-FAMILY RESIDENTIAL MECHANICAL SYSTEMS AND EQUIPMENT

National Appliance  
Energy Conservation Act  
Equipment efficiency set by Federal law, not the I-Codes

110

## National Appliance Energy Conservation Act

### *C403.2.3 / Tables C403.2.3 (1-6)*

- NAECA says: Code cannot require higher efficiencies than are set by energy standards adopted in 1987; amended by Environmental Protection Acts 1992/2005
- Equipment efficiency tables have been amended starting in 2013 and completing in 2016 (NOFR 9/12)
- Even if CT were to remain on IECC 2009 the tables still will be amended to more efficient equipment standards



## System Controls

### *R403.1.1 Programmable for Forced Air Systems Only*

- Control is required for each system
  - ✓ if zoned for each zone - multifamily



## HVAC Air Systems

### *R403.2.2.1 Sealed Air Handler*

- Air handlers are leak-tested at the factory and have a manufacturer's designation for air leakage of  $\leq 2\%$  of design air flow rate per ASHRAE 193



113

## HVAC / SWH Changes

### Section R403 Mechanical

- R403.2.2 Revised duct sealing and duct testing – either rough or final
- R403.5.1 Whole house mechanical ventilation
  - ✓ Meet Table R403.5.1 fan efficacy
  - ✓ Where leakage is < 5 ACH 50
- R403.6 Equipment sizing
  - ✓ Use ACCA Manual J



## Duct Tightness Testing

### R403.2.2 Sealing (Mandatory)

Duct tightness shall be verified by:

- Post construction test
  - ✓ Total leakage:  $\leq 8$  cfm/per 100 ft<sup>2</sup> ( $\leq 4$ )
  - ✓ All register boots taped or sealed
- Rough-in test
  - ✓ Total leakage:  $\leq 8$  cfm/per 100 ft<sup>2</sup> ( $\leq 4$ )
  - ✓ all register boots taped or sealed
  - ✓ if air handler not installed at time of test, total air leakage  $\leq 4$  cfm/ 100 ft<sup>2</sup> ( $\leq 3$ )



**Exception:** Duct tightness test is not required if the air handler and all ducts are located within the building thermal envelope

## Building Framing Cavities

### R403.2.3 Sealing (Mandatory)

Framing cavities cannot be used as ducts or plenums (or jump ducts)



116

## Whole House Fan Efficiency

**Table R403.5.1 (New) – For Whole House Ventilation Systems**

**MECHANICAL VENTILATION SYSTEM FAN EFFICIENCY**

FAN LOCATION	AIR FLOW MIN CFM	EFFICIENCY	MAX AIRFLOW
Range Hoods	Any	2.8cfm/watt	Any
In-line Fan	Any	2.8cfm/watt	Any
Bathroom/Utility	10	1.4cfm/watt	<90cfm
Bathroom/Utility	90	2.8cfm/watt	Any

Exception: For integral equipment fan motors, that shall be electronically commutated

## Whole House Mechanical Ventilation

**Table M1507.3.3 /403.3 (info) Continuous Airflow**

### CONTINUOUS AIRFLOW RATE REQUIREMENTS

DWELLING UNIT FLOOR AREA [square feet]	NUMBER OF BEDROOMS				
	0 to 1	2 to 3	4 to 5	6 to 7	over 7
	Airflow in CFM				
<1,500	30	45	60	75	90
1,501-3,000	45	60	75	90	105
3,001-4,500	60	75	90	105	120
4,500-6,000	75	90	105	120	135
6,000-7,500	90	105	120	135	150
over 7,500	105	120	135	150	165

## Mechanical Piping Insulation

### R403.3.1 Protection From Damages (Mandatory)

- Protect from weather and damage, including
  - ✓ Sunlight
  - ✓ Moisture
  - ✓ Wind
  - ✓ Maintenance personnel
- Provide shielding from solar radiation that can cause degradation of insulation
- Adhesive tape not allowed



11  
9



## Damper Controls

### *R403.4.1 Manual or automatic shutoff (mandatory)*

- Shutoff Dampers
- Motorized dampers that will automatically shut when the system or spaces are not in use.
- Exceptions
  - ✓ Gravity dampers permitted in buildings  $\leq 2$  stories
  - ✓ Gravity dampers permitted for outside air intake or exhaust airflows of 300 cfm (0.14m<sup>3</sup>/s) or less.



120

## HVAC / SWH Changes

### *Section R403.4 Mechanical*

- Table R403.4.2 Insulate piping
- R403.9 Pool heaters/switches /pool covers
  - ✓ Heaters/pumps/motors shall have built-in timers
- Pool cover Exception: where >70% of energy is supplied by renewable sources on site



## SWH Piping Insulation

Table R403.4.2 Maximum Run Length

Largest Ø in Run (inches)	3/8	1/2	3/4	>3/4
Max. Run Length (feet)	30	20	10	5

### Piping:

1. > 3/4 inch diameter
2. > one dwelling unit
3. To kitchen outlets
4. Outside conditioned space
5. To distribution manifold
6. Under floor slab
7. Buried piping
8. Recirc. Supply & returns
9. Runs more than Table max.



122

## Mechanical Ventilation

R403.5 Fan Efficacy per Table R403.5.1

- Supply and exhaust air
- Bath/utility fans
- Range Hoods
- HRV? / ERV?

Table R403.5.1 Mechanical Ventilation System Efficacy

Fan Location	Minimum CFM	Efficacy – CFM/Watt	Maximum CFM
Range Hood	Any	2.8 cfm/w	Any
In-line Fan	Any	2.8 cfm/w	Any
Bath/Utility	10	1.4 cfm/w	< 90
	90	2.8 cfm/w	Any

## Equipment Sizing

*R403.6 Sized in Accordance With Loads (Mandatory)*

ACCA Standards

- J – Load Calculations
- S – Equipment Selections
- D – Duct Design\* (N/R)
- ASHRAE/ACCA 183 [CE] similar



<http://www.acca.org/store/product.php?pid=97>

1241

## Equipment Sizing for HVAC and SWH Systems

*R403.7*

- Systems serving multiple dwelling units shall comply with Commercial Provisions, Sections C403 and C404 in lieu of Section R403



125

**AKF**

## Hot Water System Controls

### *R403.4.1 Multi-family Systems Only*

Ability to turn off circulating hot water pumps and heat trace tape when there is limited demand



- ✓ Automatic or manual
- ✓ Readily accessed

## Motor Nameplate Horsepower

### *R403.4.1 Multi-family motors only (mandatory)*

- Selected fan motor to be no larger than first available motor size greater than bhp
- Fan bhp on design documents
- **Exceptions**
  - ✓ Fans  $\geq 5$  bhp, where first available motor larger than bhp has nameplate rating within 50% of bhp, next larger nameplate motor size may be selected
  - ✓ Fans  $\geq 6$  bhp, where first available motor larger than bhp has nameplate rating within 30% of bhp, next larger nameplate motor size may be selected
  - ✓ Fans less than 5 bhp are exempt

bhp = brake horsepower

## Multifamily HVAC and SWH Systems

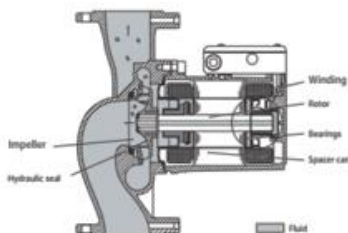
### R403.7 - Multifamily Uses - C403 Mechanical & C404 SWH

- Controls
- Heat pump supplementary heat
- Ducts
  - ✓ Sealing (Mandatory) – **post-construction test option**
  - ✓ Insulation (Prescriptive) - unchanged
- HVAC piping insulation

## Multifamily HVAC and SWH Systems

### R403.7 - Multifamily Uses - C403 Mechanical & C404 SWH

- Service hot water circulating systems
- Ventilation
  - ✓ Dampers
- Loads / Equipment sizing
- Multiple dwelling units systems: Snow melt controls
- Pools and in-ground permanently installed spas



## Multi-Family HVAC Systems

### *R403.7– Use C403 for Simple or Complex Systems*

#### Simple systems

- Unitary/package HVAC equipment
- One zone - single thermostat

#### ■ Complex systems

- All equipment not covered under Section C403.3

#### Section C403.3 Simple Systems

Buildings served by unitary or packaged HVAC each serving 1 zone controlled by 1 thermostat. Two-pipe heating systems serving multiple zones are included if no cooling system is installed

#### Section C403.4 Complex Systems

All buildings served by HVAC systems not covered under 503.3

## Service Water Heating

### *IPC Chapter 5 Multi-family Water Heaters Systems*

#### IPC 404.2 Minimum Performance of Water-Heating Equipment (NAECA)

#### ✓ Water Heater Types Covered

- Electric Storage
- Gas and Oil Storage
- Instantaneous Water Heaters – gas/oil
- Hot water boilers – gas/oil
- Pool heaters
- Unfired storage tanks

Temperature Controls (*IPC 501.8*)

Heat Traps (*IPC 504.1*)



## Pools and Spas

**R403.9 Permanent, In-Ground (mandatory)**

**C404.9.1 - Pool Heaters**

- ✓ **Switch accessible outside**
- ✓ **Natural or LPG fired pool heaters**
  - no continuous pilots

**C404.9.2 - Time switches; other automatic control \***  
**Controls operate on preset schedule**

✓ **Exceptions**

- **Where 24 hour operation required**
- **Where pumps operate using solar/waste heat recovery**

\*Note: heaters, pumps and motors with built-in timers meet this requirement



## Pools and Spas

**R403.9.3 Heated Pool Covers**

- **2009** - If heated to >90°F, vapor-retardant pool cover at least R-12
- **2012** – Heated pools and permanently installed spas shall be provided with a vapor-retardant cover
  - ✓ **Exception:** Over 70 % of the energy for heating from site-recovered energy



## Lighting Allowance - OPTIONS

### R404.1 - 75 percent High Efficacy Lighting

- SOCKETS
- FIXTURES



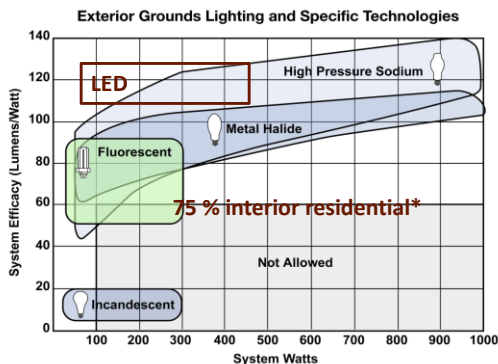
**EXCEPTIONS:** *Low-voltage lighting; no fuel gas pilots*

134

## Lighting Equipment

### R404.1 - 75 percent High Efficacy Lighting

- R404.1 A minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps, OR a minimum of 75 percent of the permanently installed fixtures shall contain only high-efficiency lamps
- C405.1 Exception: (ILPA) + Controls + equipment in multi-family dwelling units: are regulated indirectly by this Section

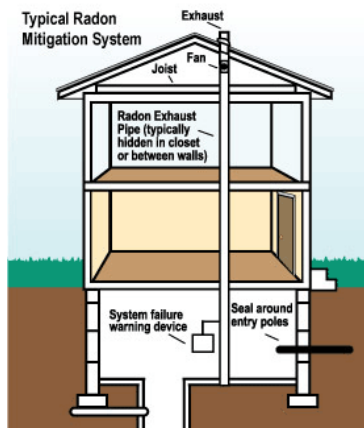




## Radon Passive Systems

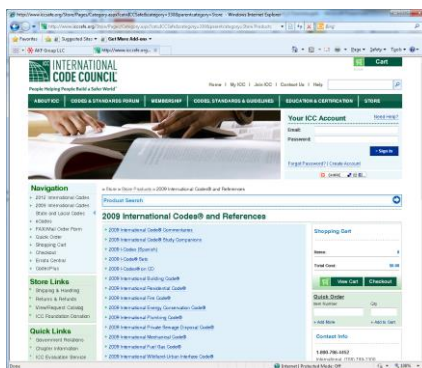
*IRC Appendix AF101.2 Radon Mitigation Construction (CT)*

- Sub-slab preparation/retarder
- Passive venting above roof
- Sealed system
- Termination above roof line
- Provisions for power source to accommodate future fan ventilator



## Where to Find, Purchase and Maintain

- 2012 IBC, IFC, IEBC, IMC, IPC, IECC
  - ✓ [www.iccsafe.org/publications](http://www.iccsafe.org/publications)
  - ✓ Errata Central
- CT Amendments
  - ✓ [www.ct.gov/dcs/osbi](http://www.ct.gov/dcs/osbi)



## Suggested Resources

- ICC 2012 Codes - public ACCESS/ICC Codes 2009-2015
- [www.iccsafe.org](http://www.iccsafe.org)
- ICC 2015 Codes
- <http://codes.iccsafe.org/l-Codes.html#all>
- DOE Resource Guides for air leakage, HVAC
- <https://www.energycodes.gov/resource-center/resource-guides>
- DOE Resources for RESCheck Basics
- <https://www.energycodes.gov/sites/default/files/becu/rescheckbasics.pdf>
- DOE Video on Duct Testing
- <https://www.energycodes.gov/training-courses/duct-testing>
- Energy Star Checklists
- [http://www.energystar.gov/ia/partners/bldrs\\_lenders\\_raters/downloads/InspectionChecklists.pdf](http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/InspectionChecklists.pdf)

## BECP - Your Resources



*Additional resources, including:*

- Code Notes
- Technical Assistance to Users
- Energy Codes 101
- Setting the Standard
- Training Materials
- Resource Center

*Are available through the Building Energy Codes Program*

[www.energycodes.gov](http://www.energycodes.gov)

