

**Office of Education and Data Management**

**Spring 2018 Career Development**

**June 2018**

**Significant Changes in the 2015 International Energy Conservation Code**

**Don Vigneau, AIA, Building Codes Consultant**

Use of Office of Education and Data Management (OEDM) training materials must be approved in writing by the State of Connecticut, Department of Administrative Services' Office of Communications.

### The Two Faces of IECC 2015

#### Commercial Chapters

1. Admin & Enforcement
2. Definitions [CE]
3. General Requirements
4. Energy Efficiency
5. Existing Buildings
6. Referenced Standards
7. Index

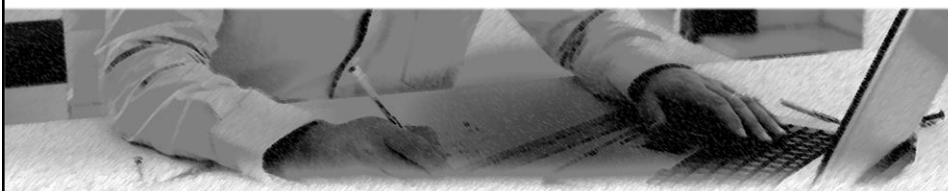
#### Residential Chapters

1. Admin & Enforcement
2. Definitions [RE]
3. General Requirements
4. Energy Efficiency
5. Existing Buildings
6. Referenced Standards
7. Index



## Errata Central

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

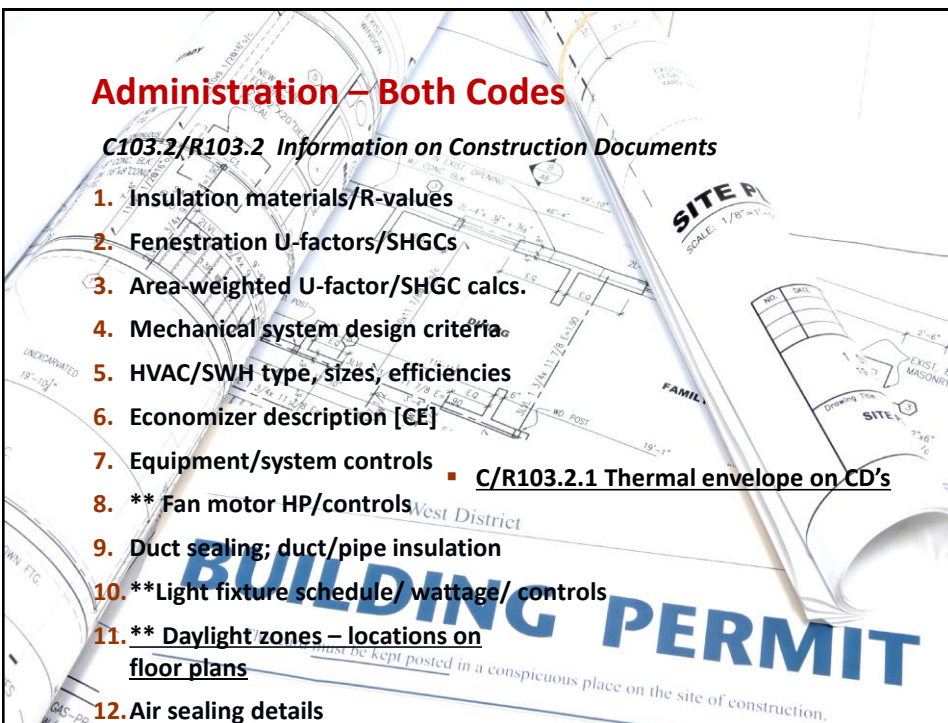


- IECC 2012 had 9 changes between first and third printings
- IECC 2015 has 10 changes already since the first printing

## Administration – Both Codes

### *C103.2/R103.2 Information on Construction Documents*

1. Insulation materials/R-values
2. Fenestration U-factors/SHGCs
3. Area-weighted U-factor/SHGC calcs.
4. Mechanical system design criteria
5. HVAC/SWH type, sizes, efficiencies
6. Economizer description [CE]
7. Equipment/system controls
  - C/R103.2.1 Thermal envelope on CD's
8. \*\* Fan motor HP/controls
9. Duct sealing; duct/pipe insulation
10. \*\*Light fixture schedule/ wattage/ controls
11. \*\* Daylight zones – locations on floor plans
12. Air sealing details



## Scoping and Administration

### *C103.2 / R103.2 Information on Documents*

#### *[CE] [RE] Mechanical Equipment Schedules*

- Equipment efficiencies and load sizing
- Fan and pump nameplate motor and brake horsepower
- Fan efficiency grade (FEG), where applicable
- Economizer descriptions; controls; fault diagnostics (C403.2.4.7)
- Hydronic system supply and return water design temperatures for boilers and terminal devices (baseboards, unit ventilators)
- Steam system design pressure for boilers and all terminal devices (if applicable)

## Administration – OPTIONS

### *C/R 103.2 No Information Required on Construction Documents!*

#### **Both Commercial & Residential**

- IECC vs. ASHRAE for CE Ch.4
- Prescriptive vs. Performance
- Component (R) vs. Assembly (U)
  - ✓ C402.1.5 Component performance
- Delineate thermal boundaries
- COM✓/RES✓ vs. TBP / ECBM
- **Commercial and Mixed Occupancy**
- Daylighting Option (Y/N)
  - ✓ **Mandatory Daylighting Changes**
- ILPA Building or Space-by-Space
- ELPA Tradeable vs. Use or Lose
- Six Efficiency Options – pick 2



## Required Inspections

### *C104.2 Required 'Approvals' Amended: Detail the Information*



- Footings/foundation
- Framing & rough-ins:
  - ✓ Plumbing
  - ✓ Mechanical
  - ✓ Electrical
- Final
  - Systems, Controls
    - ✓ All specified equipment
  - Commissioning
    - ✓ Preliminary Report

## Definitions: New and Amended

### *Section C202 / R202 (Applicable to Climate Zone 5 requirements)*

- *Building Official* (code official)
- *Below-grade walls*
  - ✓ C202 ≥85%;
  - ✓ R202 ≥ 50%
- *Continuous insulation*
- *Insulating siding* (new)
- *Historic Building C/R 202* (amended)
- *Roof recover / re-roof / repair* (new)
- *Vertical glazing* (amended)



- ✓ Hidden Acronyms: pgs.ix & x in Preface

## Definitions

### *C202 & R202 Applicable to Climate Zone 5 requirements*

- **Above-grade walls\***
  - ✓ C202 Walls ≥15% above exterior grade
  - ✓ R202\*Walls ≥50% above grade
- **Opaque Doors\* [CE] – C202.2)**
  - ✓ Doors with less than 50% glass area
- **SHGC C402.4.3\*; R402.3.3**
  - ✓ Solar Heat Gain Coefficients
- **PF - Projection Factor**
  - ✓ Measures ratio (< 1.0) of dimensions for shading devices/fixed overhangs: horizontal over vertical
  - ✓ Table C402.4 sets maximum PF factors



## Chapter 3: General Requirements

*(consistent between the separate divisions)*

- **CE / RE 301.4 Tropical Climate Zone**
- **CE / RE303.1.1 adds insulated siding; term defined in R202**



## Existing Buildings Road Map

*[CE] [RE] Relocations of specific Commercial & Residential sections*

### Existing building requirements move to newly created Chapters 5

501.1 EXISTING BUILDINGS - SCOPE & ADMINISTRATION		
Section Title	2015[CE]	2015[RE]
Scope	C501.1	R501.1
Historic Buildings	C501.6	R501.6
Additions, Alterations, Repairs	C502. 503, 504	R502, 503, 504
Compliance	C501.4	R501.3
Change to Conditioned Space	C503.2	R503.2
Low Energy Building Exemption	C402.1.1	N/A
Roof Solar Reflectance	C402.3	N/A



## COMCheck Version 4.0.8.2

### ***C101.5.1 UA Compliance Alternative***



- Can be used to show compliance with 2015 IECC or ASHRAE 90.1-2013
  - ✓ **Now updated to 2013-2015**
- Completely electronic: user inputs all of the building data
- Will demonstrate whether building meets performance or tradeoff based compliance
- If used, report is submitted with construction documents.

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

## Commercial Compliance Options

### ***C401.2 Application: Commercial Buildings Packages***



Comply with one of the following:

1. **(CT) 90.1; use ASHRAE Appendix 'G,' Tables G3.1.1-1 to G3.1.1-4**
2. **C402-405 + C406\***
3. **Total Building Performance  $\leq$  85%**
  - ✓ **C402.5 Air Barriers**
  - ✓ **C403.2 Mechanical (mandatory)**
  - ✓ **C404 Service Water Heating**
  - ✓ **C405.6 Metered dwelling units**
  - ✓ **C407 Tables C407.5 using Standard v. Proposed Design**



## Envelope Requirements

### C402.1.1 Low Energy Buildings

- Peak energy use < 3.4Btu/h/sf for space conditioning purposes
- Does not contain conditioned space
- Utilizing non-purchased renewables only, and no backup heat sources:
  - ✓ On-site wind, water, solar
  - ✓ Wood-burning heating appliances
- Greenhouses (see Definitions)



## Envelope Requirements

### C402.1.2 "Equipment Buildings"



- < 500 square feet
- Not intended for occupancy
  - ✓ Not habitable or occupied, except for workers
- Housing "electronic equipment"
- Waste heat  $\geq 7 \text{ W/sf}$  (22 Btu/h)
  - ✓ Heating only
  - ✓ Thermostat set  $\leq 50^\circ\text{F}$
- Energy use  $\leq 17\text{kBtu/SF}$
- Envelope UA-factor: < 0.20 in Zone 5

C402.1.2 Envelope Exception



## R-Values / U-Factors

### *Table C402.1.2 Opaque Thermal Envelope*

- ROOFS – Insulation R-value above deck (increases – R25 to R30)



## Prescriptive Envelope

### *C402.1.3/4/5 C402.2.6, C402.4.3.3 Changes*

- C402.1.3&4 Expansion of R-value/U-factor provisions
  - ✓ **Table C402.1.4.1 Effective R-values for Steel Stud Walls**
- C402.1.5 Component Performance Alternative (non-standard): added
  - ✓ **Similar to COMCheck option: user analysis of U/F/C factors**
- C402.2.6 Insulation of radiant heating systems
- C402.4.3.3 Dynamic glazing requirements – when/if used



## Mass Walls

### *C402.5.1; C 202 Materials*



- C402.5.1.2.1 adds clay, shale masonry units as compliance options
- C402.5.1.2.2 amended to include coatings for air barrier materials

## Commercial Glazing

### *C402.4 Prescriptive Fenestration Overview*

#### Overview:



- Vertical fenestration area still 30% since 2012
  - ✓ 40% vertical when daylighting controls used per C402.4.1.1
- U-factors for skylights reduced; allowed % skylight area increases from 3% to 5% of total roof area
  - ✓ 5% skylights when daylighting controls used per C402.4.1.2
- SHGC now varies by orientation: N/S – E/W
- In 16 building types  $\geq 2,500$  SF floor area must be located in a “daylight” zone

## Daylighting

### C402.3.2 Daylighting Prescriptive Requirement



- **Enclosed spaces > 2,500 s.f.** directly under a roof with ceiling heights  $\geq 15'$  for 75% F/A
  - ✓ **Four exceptions**

**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; these uses**

## Glazing: Orientation (2015 prescriptive)

Table C402.4 U-factor / SHGC Requirements by Orientation

Climate Zone	1		2		3		4 except Marine		5 and Marine		6		7/8	
<b>Vertical Fenestration U-factors</b>														
Fixed	0.50		0.50		0.46		0.38		0.38		0.36		0.29	
Operable	0.65		0.65		0.60		0.45		0.45		0.43		0.37	
Doors	1.10		0.83		0.77		0.77		0.77		0.77		0.77	
<b>SHGC</b>	<b>ESW</b>	<b>N</b>	<b>ESW</b>	<b>N</b>	<b>ESW</b>	<b>N</b>	<b>ESW</b>	<b>N</b>	<b>ESW</b>	<b>N</b>	<b>ESW</b>	<b>N</b>	<b>ESW</b>	<b>N</b>
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.40	0.53	0.40	0.53	0.40	0.53	0.45	N/R
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.48	0.58	0.48	0.58	0.48	0.58	N/R	N/R
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.64	0.64	0.64	0.64	0.64	0.64	N/R	N/R
<b>Skylights</b>														
U-factor	0.75		0.65		0.50		0.50		0.50		0.50		0.50	
SHGC	0.35		0.35		0.35		0.40		0.40		0.40		N/R	

## Envelope Requirements

### *C402.5.3 Isolation of Fuel-fired Equipment*



- Separately sealed and insulated rooms
- Isolate appliances from conditioned spaces
- Isolate combustion air & vent openings

## Vestibule Requirements

### *C402.5.7 (6) Exception for Air Curtains*

#### **Air curtain wall technology option for vestibule barriers**

- 6.56 fps minimum air velocity
- Heated; no A/C
- Max. 55°F  $\Delta t$
- Separate control



## Building Mechanical Systems

### *Tables C403.2.3(1) to (9) Minimum Equipment Efficiencies*

Federal NAECA changes (all effective)

- Numerous changes as a result of final determinations by DOE under the National Appliance Energy Conservation Act [NAECA]



## Commercial HVAC

### *C403.2 Mandatory Provisions*

- Load calculations must account for ERV systems
- HVAC Zone Isolation: <25kSF
- Heat Rejection Equipment
- Chiller NPLV required performance
- Auto-start controls
- DCV for all systems w/ >25 occupants/100sf
- Pipe insulation Table C403.2.10



## Exhaust Systems

### *C403.2.4 – C403.2.8 Exhaust Air Requirements*



- Economizers: Fault detection
- Energy recovery: Tables C403.2.7.1 and C403.2.7.2
- Kitchen exhaust systems
  - ✓ ≤ 10% shall be direct outdoor air
  - ✓ ≥ 50% exhaust shall be transfer air from other building exhausts
- Enclosed parking garage ventilation

## Ventilation Fan Controls

### *C403.2.6.2 Enclosed parking garage ventilation controls*



- Contamination sensing automatic fail-safe controls;
- Stage fans to ≤ 50% capacity or operate < 20% of time; failure mode is 100% capacity
- Exceptions: Unconditioned garages
  - ✓ < 22,500 CFM of exhaust capacity
  - ✓ Fan efficiency > 1125 cfm/hp



## HVAC: Economizers

### *C403.3 / C403.2.4.7 Fault Detection (FDD - new)*

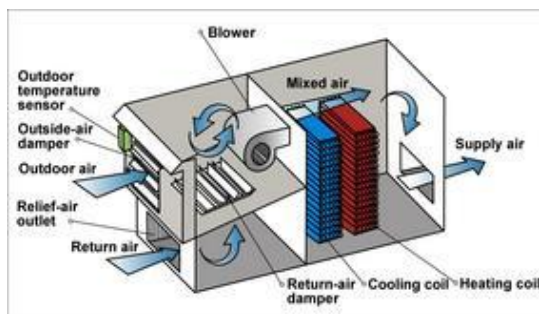
- Fault detection is now required in all systems with economizers
- Units under 54,000 Btu/h cooling capacities – economizer N/R
- Economizers have nine exceptions - tradeoffs possible



## Building Mechanical Systems

### *C403.2.7 Ventilation Systems - Energy Recovery*

- Tables C403.2.7 for systems (1) less than AND (2) greater than 8,000 CFM;
- Minimum 50% enthalpy recovery for makeup ventilation
- C403.3.1 calls for integrated control to ignore false loading



## HVAC Economizer Systems

### *Performance, Fault Detection & Diagnostics [FDD]*

- C403.3 applies to both air and chilled water units > 54,000 Btu/h
- C403.3.1 requires integrated AC operation on partial load; no false loads
- C403.2.7 indicates that most systems will include enthalpy recovery



## Building Mechanical Systems

### *C403.2.8 Kitchen Exhaust hoods*

- C403.2.8:  $\geq 20\%$  total energy recovery on kitchen hoods > 5,000CFM



## Duct Changes

### C403.2.9 Duct Insulation

- Insulate when not completely inside the thermal envelope
- Duct insulation outside of thermal envelope must be R-12 (R-8) Zone 5



**TABLE 1**  
Dew Point Comparison

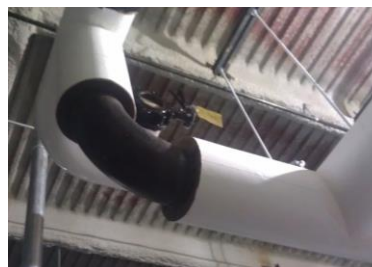
There are many ways to arrive at the same dew point (in this case, 75F):

130F, 20% RH = 75F DP (dew point)
120F, 28% RH = 75F DP
110F, 33% RH = 75F DP
100F, 46% RH = 75F DP
90F, 63% RH = 75F DP
80F, 86% RH = 75F DP
75F, 100% RH = 75F DP

## HVAC: Pipe Sizing and Insulation

### Table C403.2.10 Minimum Pipe Insulation Thickness

- Maximum allowable flow rates for chilled and condensed water
  - ✓ Based on nominal pipe size
- Requirements change for pipe insulation used for heating systems Table C403.2.10
  - ✓ Increases 0.5" - 2" depending on tube size and temp range



FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu · in./(h · ft <sup>2</sup> · °F) <sup>a</sup>	Mean Rating Temperature, °F	< 1	1 to < 1½	1½ to < 4	4 to < 8	≤ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0

## Piping Insulation

### ***C403.2.10.1 Weather Protection - ERRATA***

- Piping insulation exposed to the weather shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.



## Commercial Refrigerators and Freezers

### ***C403.2.14 – NEW; Tables for NAECA Requirements***



- By type and energy use; AHRI #
- Efficiency requirements
- By Class; Family; operating mode
- By operating temperatures
- By energy use limits

## Building Mechanical Services

### ***C403.2.14 Minimum Refrigeration Requirements Expanded***

Coolers and freezers; large and small

- C403.2.14 Kitchen units
- C403.2.16 Walk-Ins
- C403.2.17 Reach-Ins



## Commercial Refrigerators and Freezers

### ***C403.2.14 – NEW; Tables for NAECA Requirements***



- Construction
- Doors
- Fan motors
- Condensers – C403.5
- Anti-sweat heaters
- Controls
- Lighting

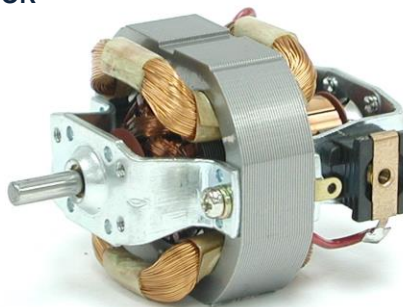
## Mechanical Equipment Motors

### C403.4.4.4 Fractional HP Fan Motors

- *KNOW WHAT YOU'VE GOT; mandated and integral to rated equipment*

■ Fan motors > 1/12hp and < 7.5hp shall be

- ✓ **Electronically commutated OR**
- ✓ **≥ 70% motor efficiency AND**
- ✓ **Be adjustable speed**
- ✓ **Exceptions apply**



## Service Water Performance Efficiency

### C404.2 Equipment and Systems; Insulation

**Table C404.5.1 Sizing by pipe length or pipe volume**





## Service Water Heating

### C404.3 SWH Equipment Performance Efficiency

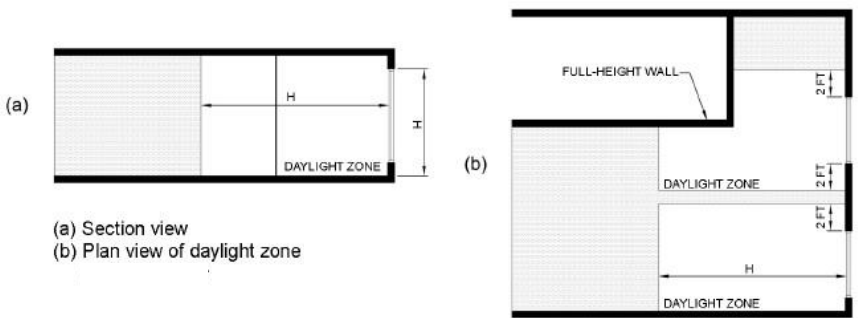
- SWH may also provide building heating per Table C404.2
- SWH pipe insulation may be discontinuous through solid framing members
- Piping insulation: 7 Exceptions listed
- Tables for computing Exceptions:
  - ✓ By length
  - ✓ By volume
- Demand controls for HW circulating systems
- Prohibits gravity or thermo-siphon systems



## Daylighting – Side Light Zones

### Figure C405.2.3.2 Wall Fenestration

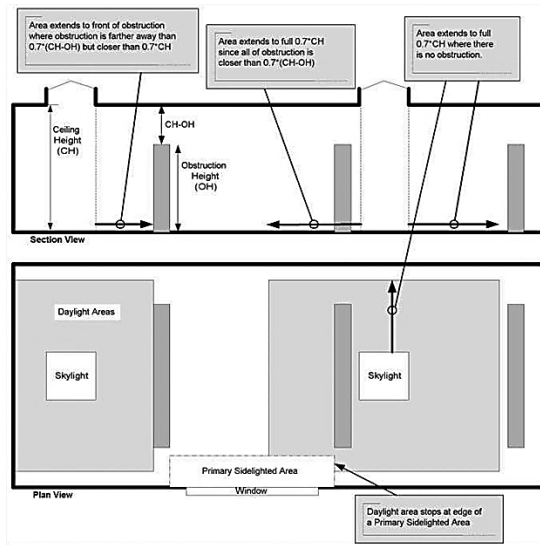
- Zones Adjacent to Wall



## Daylighting - Skylights

C402.4.1.2 / Fig. C405.2.3.3

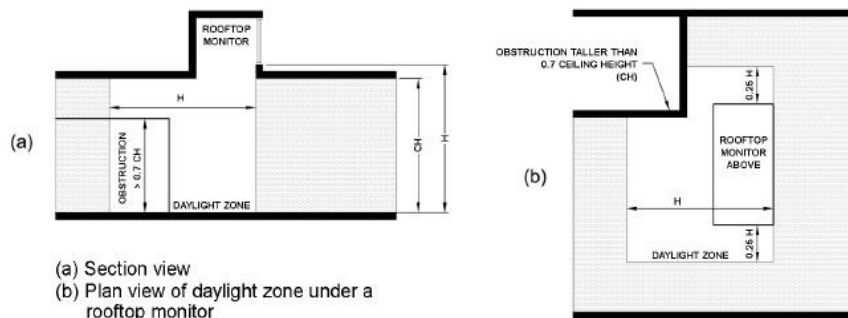
- Twice the ceiling height [CH] times the 0.7 factor, plus the length AND twice the ceiling height times the 0.7 factor, plus the length, equals the control zone area
- $W \times L$  of skylight
- Zone boundary  $A_{fi} =$
- $[2 \times 0.7 CH + L] \times$
- $[2 \times 0.7 CH + W]$



## Daylighting – Top Light Zones

Figure C405.2.3.2 Ceiling (non-skylight) Fenestration

### ■ Under a Rooftop Monitor

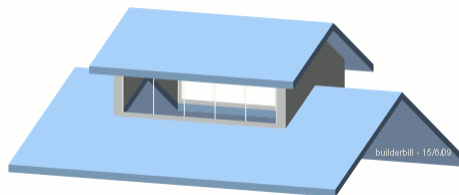


## Daylighting Responsive Controls

**C402.2.3 / Fig.C405.2.3.2**

### Rooftop Monitor Zones Changes

- Zone: top of roof monitor fenestration, not 15'
  - ✓ Accounts for rooftop monitor glazing
  - ✓ Exception: where site shading occurs
- VT in existing buildings determines if a zone
- Figure C405.2.3.2. Partitions at > 70% of ceiling height using roof monitor daylighting have their floor area included



## Power and Lighting Changes

**[CE] [RE] Electrical Power and Lighting**

- CT C 202 Definition: *Full Cutoff Luminaires*
- CT C405.5.2 Light Pollution Controls
  - ✓ Uses C405 for common areas and exterior lighting
  - ✓ Daylighting only for mixed uses
- C405.2.3.2 Sidelight zone
- C405.2.3.3 Toplight zone
- C405.2.4 Specific application control (see diagrams for defined areas)
- R404 Power & Lighting
- R403.8 Systems serving multiple dwelling units

## Lighting Power Densities

### *C405.4.2 Building Area Method*

- Across-the-board reductions in Light Power Density (LPD) W/sf
  - ✓ 21 lower / 5 higher / 5 unchanged
- Introduction of Room Cavity Ratio (RCR) Adjustment, allows 20% increase in LPD for unusually tall or wide spaces using Space-by-Space Method



## Lighting Power Density Changes

### *C405.4.2 Tables C405.4.2; 9.4.1 ASHRAE 90.1 - Addendum 'by'*

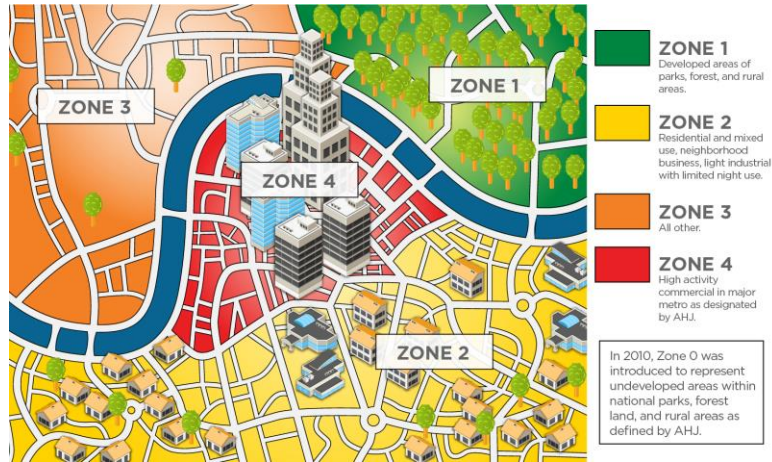
- [https://www.ashrae.org/standards/90\\_1\\_2010\\_2013Addenda.pdf](https://www.ashrae.org/standards/90_1_2010_2013Addenda.pdf)

- Conforms with 90.1-2013 ILPD changes
- Building Type Option:
  - ✓ 5 densities **INCREASED**
  - ✓ 5 densities **UNCHANGED**
  - ✓ 21 densities **DECREASED**
- Space-by-Space densities also change
- Toplighting and Sidelighting
- Combines lighting; new Tables
- Adds occupancy sensor controls
  - ✓ Locker rooms, warehouse aisleways
  - ✓ Control 50% reductions



## Lighting: Exterior LPD Zones

**Table C405.5.2(2) Exterior Building Lighting Power – some tradeoffs**



**CT (ADD) C202.1 / C405.5.2 Full Cutoff Luminaire**

## Lighting: Exterior LPD

**C405.5 and Table C405.5.2**

- Exterior lighting LPD allowances now set by four lighting zones
- Expanded exterior lighting categories
- Divided by tradeable v. non-tradeable
- LIGHTING ZONE 3 definition revised: All other areas not covered by zones 1,2 or 4
- Zone 1 does not allow lighting for lighting applications intended for street frontage or building facades



## Exterior Lighting LPD – By Zone

**Table C405.5.2(2) Exterior Lighting Power Allowances**

		<u>Zone 1</u>	<u>Zone 2</u>	<u>Zone 3</u>	<u>Zone 4</u>
<b>Base Site Allowance</b>		500 W	600 W	750 W	1300 W
<b>Tradable Surfaces</b>	<b>Uncovered Parking Areas</b>				
	Parking areas and drives	0.04 W/ft <sup>2</sup>	0.06 W/ft <sup>2</sup>	0.10 W/ft <sup>2</sup>	0.13 W/ft <sup>2</sup>
	<b>Building Grounds</b>				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater Plaza areas Special Feature Areas	0.14 W/ft <sup>2</sup>	0.14 W/ft <sup>2</sup>	0.16 W/ft <sup>2</sup>	0.2 W/ft <sup>2</sup>
	Stairways Pedestrian Tunnels	0.75 W/ft <sup>2</sup> 0.15 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup> 0.15 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup> 0.2 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup> 0.3 W/ft <sup>2</sup>

*Partial Table*

## Electrical Power Changes

### C405.9 Equipment Efficiencies Added

- A17.1 safety rules limit to automatic sensing for slowdown / resume speed



- Transformer efficiency
- Motor drives; controls
- Elevators:
  - ✓ power reduction controls
- Escalators:
  - ✓ Regenerative drives
- Moving Walkways:
  - ✓ energy demand reductions



## Additional Efficiency Package Options

### *C406.1: Six Choices; Choose Two*

- High efficiency HVAC performance
- Reduced LPD demands
- Enhanced digital lighting controls
- On-site renewable energy
- Dedicated energy recovery air system
- SWH energy reductions



## Additional Efficiency Package Options

### *Service Connections*



- This energy efficiency code change option was not accepted

## Commissioning Building Systems

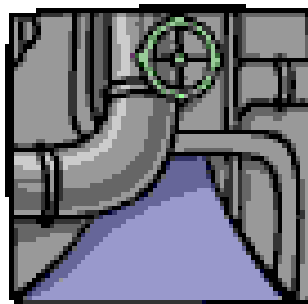
### *C408 Commissioning (New Section added)*

#### **Building commissioning:**

- Develop a plan for mechanical system commissioning; provide evidence of commissioning by a registered design professional (or agency) to building department prior to the final mechanical inspection.

#### **Exemptions:**

- ✓ < 480k Btuh – cooling and
- ✓ < 600k Btuh – combined heating + SWH
- ✓ Systems serving individual dwelling units



## Mechanical / Electrical Commissioning

### *C408.2 Mechanical and SWH Systems Commissioning and Completion*

- Mechanical / SWH systems and controls function and performance evaluations

### *C408.3 Functional Testing: Lighting & Controls*

- Testing of lighting systems / controls expanded



## Systems Commissioning

### **C408**

#### **Commissioning Plan**

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

#### **Functional Testing**

- HVAC Systems/Controls
  - ✓ Fault detection
  - ✓ Fail-safe modes
- SWH Systems/Controls
  - ✓ Accessibility requirements
- ILP/ELP Systems/Controls

## Systems Commissioning

### **C408.2.4 Procedures**

#### **Functional Testing**

- HVAC air and water flow rates must be balanced;
- Equipment, controls, lighting must be performance tested.

#### **Preliminary Report**

- Test Procedures
- Results
  - ✓ HVAC separate from SWH
  - ✓ Design Professional or
  - ✓ Third party agency
- Identify, itemize
  - ✓ Deficiencies still uncorrected
  - ✓ Deferred testing and climatic conditions necessary to complete
- Submitted to the building owner; acknowledge report receipt to the code official.

## Systems Commissioning

### *C408.2.5.4 Final Report*

#### **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
- Preliminary Report before C.O.
- 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

## Lighting: Commissioning

### *C408.3.1 Functional testing (90.1-2013 'bd')*

- Any project/retrofit which alters 10% of the connected lighting load **must comply with 90.1 ASHRAE.**
- All lighting controls must be tested and documented by a 3<sup>rd</sup> party that equipment is installed to manufacturer's specifications and meets performance criteria.




# COMCheck Requirements Checklist

## C101.5.1 Compliance Materials

### Compliance Report Information

- Project
- General Building/Systems
- Systems List
- Checklist



**COMcheck Software Version 3.6.0**  
**Mechanical Compliance Certificate**

**2006 IECC**

**Section 1: Project Information**  
 Project Type: New Construction  
 Project Title:  
 Construction Site:                      Owner/Agent:                      Designer/Contractor:

**Section 2: General Information**  
 Building Location (for weather data): Bozeman, Montana  
 Climate Zone: 6b  
 Heating Degree Days (base 65 degrees F): 1705  
 Cooling Degree Days (base 50 degrees F): 1763

**Section 3: Mechanical Systems List**

Quantity	System Type & Description
2	RT-2 & RT-3 - Pkg. gas/elec.: RT-2 & RT-3 - Pkg. gas/elec.
1	CU-1 - Condensing unit: Cooling: Field-Assembled DX System, Capacity >=90 - <135 kBtu/h, Air-Cooled Condenser / Single Zone
1	UH-1 - Gas unit heater: Heating: Unit Heater, Gas
1	F-1 - Gas furnace: Heating: Central Furnace, Gas / Single Zone

**Section 4: Requirements Checklist**

**Requirements Specific To: RT-2 & RT-3 - Pkg. gas/elec.:**

- 1. Newly purchased heating equipment meets the heating efficiency requirements
- 2. Specified equipment consists of field-assembled components - efficiency documentation provided
- 3. Cooling system provides a means to relieve excess outdoor air during economizer operation.
- 4. Integrated air economizer required

**Requirements Specific To: CU-1 - Condensing unit:**

- 1. Specified equipment consists of field-assembled components - efficiency documentation provided
- 2. Cooling system provides a means to relieve excess outdoor air during economizer operation.
- 3. Integrated air economizer required

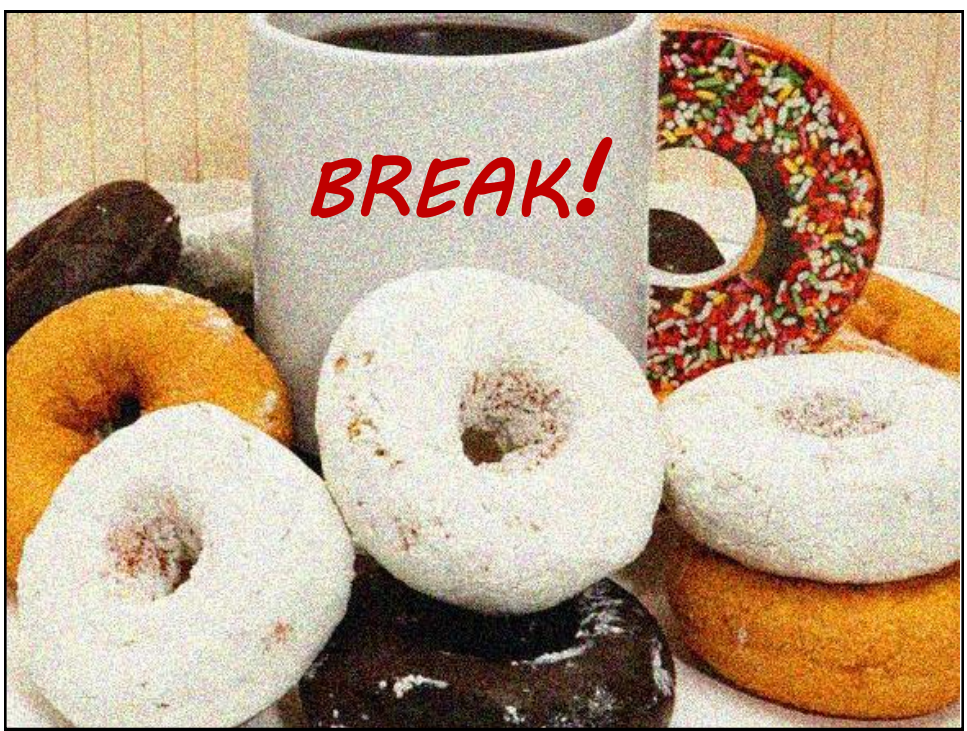
**Requirements Specific To: UH-1 - Gas unit heater:**

- 1. Equipment minimum efficiency: Unit Heater (Gas): 80% @

**Requirements Specific To: F-1 - Gas furnace:**

- 1. Newly purchased heating equipment meets the heating efficiency requirements

**Generic Requirements: Must be met by all systems to which the requirement is applicable:**



**ASHRAE 90.1 - 2013 CHANGES**

<http://shop.iccsafe.org/2015-international-energy-conservation-code-and-ansi-ashrae-ies-standard-90.1-2010-42102.html>

## Energy Conservation Code - 90.1 Option

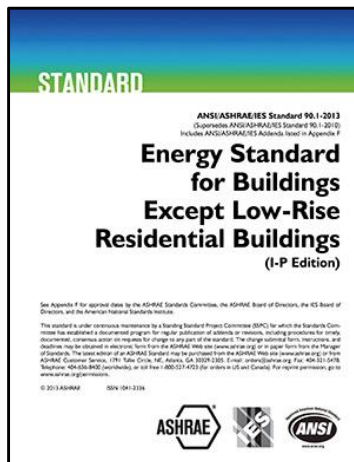
### Amendments to ASHRAE 90.1-2013 Definitions

#### ■ 3.2 DEFINITIONS

- ✓ Computer room
- ✓ Data center 90.1-2016
- ✓ Roof monitor (clerestory)
- ✓ Sectional garage door
- ✓ Fan Efficiency Grade
- ✓ Wet bulb temperatures
- ✓ Dry bulb temperatures
- ✓ NAECA refrigeration units

#### ■ 3.2

- ✓ Zones





## Definitions

### 90.1 Section 3.2 Definitions: Climate Zone 5 requirements

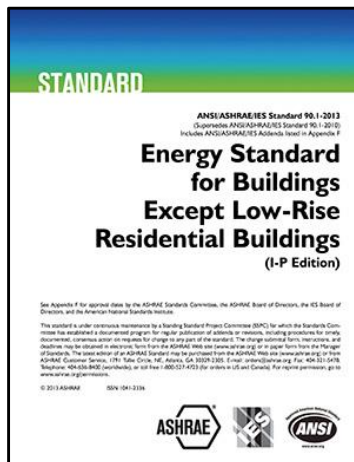
- *Historic Building (new)*
- **3.2 Fig.1-4 Daylighting areas**
  - ✓ Zones – primary / secondary
  - ✓ Sidelight areas
  - ✓ Toplight areas
  - ✓ Head & sill measurements
  - ✓ Intervening partitions



## Energy Conservation Code - 90.1 Option

### Key Changes to ASHRAE 90.1-2013 Commercial Requirements

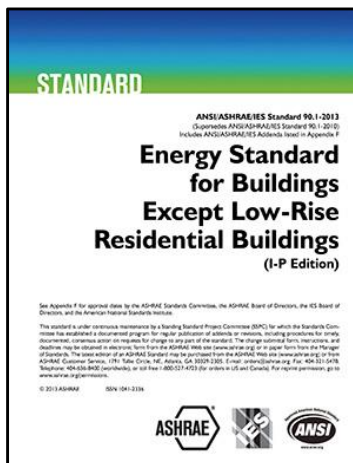
- 5.1.3 Low-E storm windows and roof recover vs. replacement
- 5.4.3.2 High-speed door leakage
- 5.4.3.4 Vestibules for larger spaces
- 5.5.4.2 skylights up to 6% w/DRC
- 5.5.4.4 Fenestration orientation < 25% on E & W facades
- 5.7.4 Daylight zones shown on CD's



## Energy Conservation Code - 90.1 Option

### Key Changes to ASHRAE 90.1-2013 Commercial Requirements

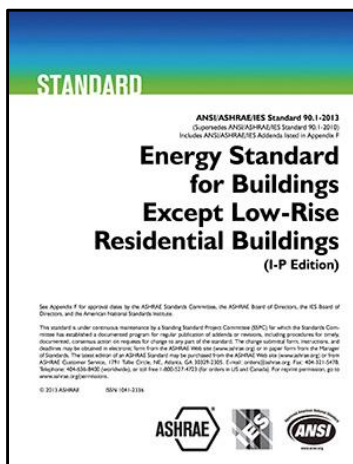
- 6.4.5 Adds NAECA commercial refrigeration equipment
- 6.4.3.3.3 Optimum start required for any DDC system
- 6.5.6.1 ERV systems required
- 6.6 Escalator/walkway speed reduction controls
- 6.8.1 Equipment efficiencies
- 6.4.3.8 DCV threshold occupancy now 25 per 1,000 SF



## Energy Conservation Code - 90.1 Option

### Key Changes to ASHRAE 90.1-2013 Commercial Requirements

- 8.4.2 Plug Loads 50% receptacles; 25% of branch circuit feeders
- 9.4.1.1 Sidelighting ADR controls
- 9.4.1.3 Controls/ guest bathrooms
- 9.4.1.4 Exterior light shutoff
- Table 9.6.1 Use of controls
- Table 9.6.2 Added LPD w/control
- 9.7 Submittals: Identify ADC luminaires; top- and sidelighting



## Building Thermal Envelope Changes

### 5.5.5 Prescriptive Envelope Option – Addendum ‘bb’

Major improvements: Non-Residential, Residential R-values / U-factors



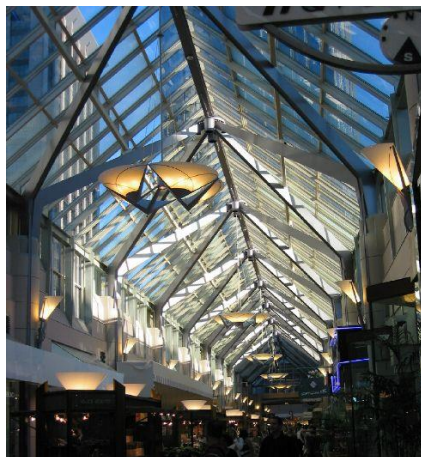
- Thermal envelope opaque components improved; Semi-heated has only minor changes
- Fenestration remains capped at 40%; distribution by orientation.
- SHGC set by VT/SHGC dependent on glazing percentages

## Envelope: Skylight Minimums

### 5.5.4.2.3 Minimum Skylight Fenestration Area

For many spaces, < 4 floors, >15ft top-level ceiling and > 2500sf, minimum skylight areas apply:

- Minimum 3% F/A-skylight A w/ minimum 0.40 transmittance, or
- Minimum 50% of daylight floor area with minimum effective skylight aperture of 1%
- 5.5.4.2 allows up to 6% skylights for daylight areas w/DR controls

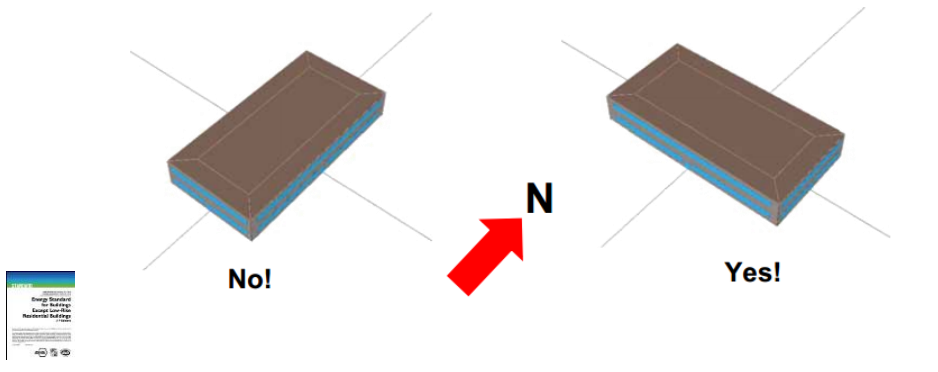


## Building Orientation: Fenestration

### 5.5.4.5 Glazing Locations – Addendum ‘bw’

South facing vertical fenestration area  $\leq$  East or West face areas

**Storefront/ urban infill sites are exempt.**

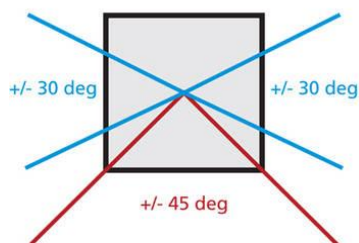


## Building Orientation: Fenestration

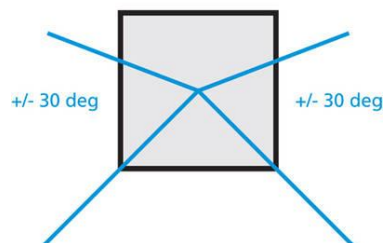
### 5.5.4.5 Orientation of fenestration Option

- Revises the fenestration orientation rules and adds a compliance option. Either:
  - East- and west-oriented glazing must each be less than 25% of the total glazing, OR
  - East- and west-oriented glazing, multiplied by their solar heat gain coefficients (SHGC), must each be less than the total building sum of glazed area multiplied by each area's SHGC.

#### ASHRAE 90.1-2010



#### ASHRAE 90.1-2013



## HVAC: Equipment Efficiencies

### Tables 6.8.1 (A-K) for Direct Digital Controls

Significant Efficiency Rating Increases:

- Packaged Heat Pumps/Air Conditioners
- Air-cooled and water-cooled chillers
  - ✓ Changes for part-load chillers
- Air-cooled Air Conditioners and Heat Pumps – Addendum ‘aq’
- Water-cooled Air Conditioners and Heat Pumps
- Turndown ratios for boilers Direct Digital Control (DDC – ‘Addendum ‘aa’)



## HVAC: ERVs

### 6.5.6.1; Tables 6.5.6.1(1)&(2) Energy Recovery Ventilation (ERV – Mandatory)

- Energy Recovery (ERV) systems now required for all systems CZ5 with any % of outside air
  - ✓ Required when system airflow exceeds Table values
  - ✓ Enthalpy recovery  $\geq 50\%$
  - ✓ System size varies if used  $< 8,000$  hours/year
  - ✓ Ten exceptions



## Lighting Power Densities

### Tables 9.5.1 & 9.6.1 – Several Addenda

- LPD allowances have been reduced again, by technology and new products

#### Addendum 'co'

- Building Use Groups
- 32 Building Types

#### Addenda 'bh' and 'cr'

- Space Utilizations
- 97 Room Occupancy Types
- LPD Additions: Addendum 'm'



## Lighting: Controls

### 9.4.1.1 Interior Lighting Controls



- Automatic shutoff controls required in **nearly all spaces**.
- All lighting controls must be “manual-on” or “automatic-on” to only 50% power.
- Multi-level automatic daylighting controls required when
  - **primary sidelighted area exceeds 2500 sf**
  - **primary toplighted area exceeds 900sf**
- 8.4. 2 adds requirements for “auto-off” plug load receptacles





## Lighting: Space by Space Method

### Section 9.6.2 – Additional ILP Allowances – Addendum ‘m’

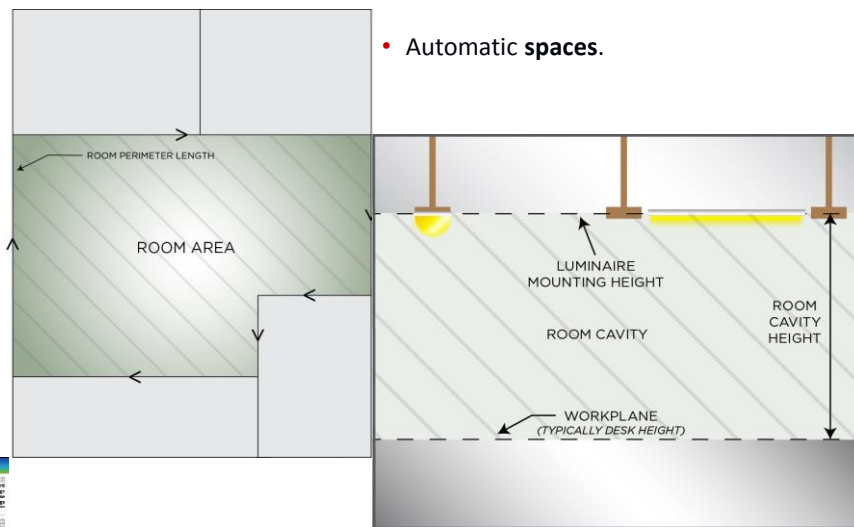
- Many LPD reductions in Table 9.6.1; too numerous to show in detail
- Addendum “m” reduces the allowance for specific lighting to highlight merchandise
- This shows proposed reductions for the additional interior Lighting Power Allowance (LPA):
- LPA = 1000 watts



## Lighting: Room Cavity Ratio

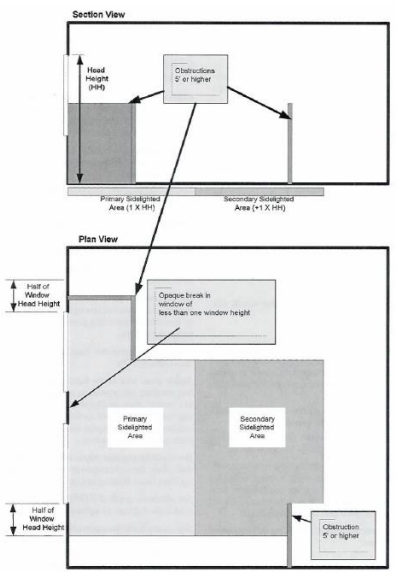
### Lighting Controls ‘by’ and Alterations ‘m’

- Automatic spaces.



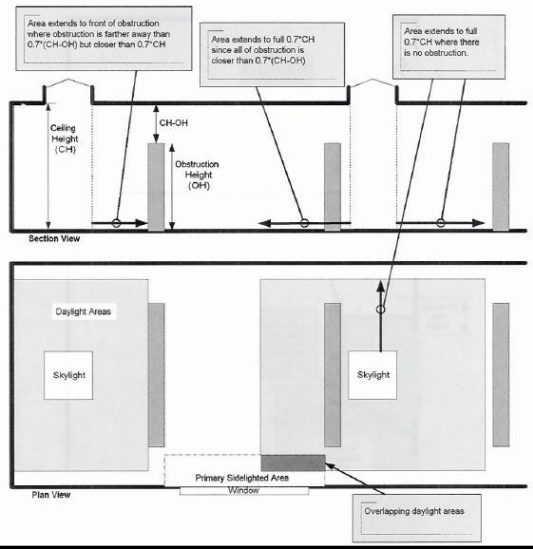
# SideLighting: Primary & Secondary Zones

## 9.4.1.4 Lighting Controls



# Toplighting: Skylights

## Lighting Controls 'by' and Alterations 'm'

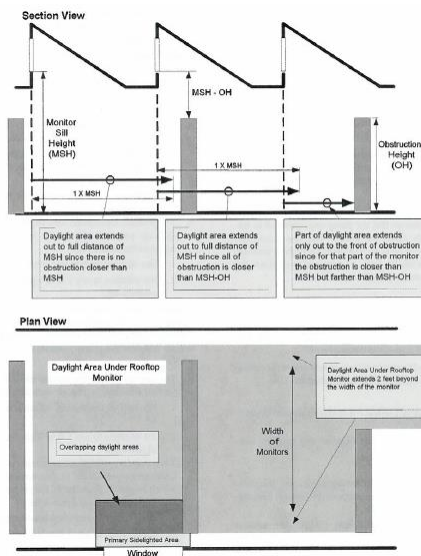


Energy Standards for Buildings  
Energy Use and  
Resource Allocation

## TopLighting: Roof Monitors

### 90.1 Lighting Controls and Alterations

- 3.2-1 Diagrams daylight area under roof monitors
- Three parts of the illustrated plan and section define how zone is measured depending on partitions
  - ✓ Depth is determined by the height of glazing above floor surface lit
  - ✓ Width extends two feet beyond monitor ends, each side
  - ✓ Obstruction counts when distance is greater than dimension from the partition top to the window sill



## Lighting Control Outside the Envelope

### 9.4.1.3 Parking Garage Lighting Control

- Automatic lighting shutoff
- LPD reduction  $\geq 30\%$  in lighting zones unoccupied for  $> 30$  min.
  - ✓ Except where HID  $< 150w$  used
- Daylight transition zone separately controlled using daylight sensors
- Daylight-responsive control of perimeter sidelighting areas\*
  - ✓ Except transition zones and ramps without parking



Download from Dreamstime.com



## Lighting Power Densities

**Table 9.5.1 Interior Lighting Power – Building Area**

- For most building types, LPDs are reduced.
- Table shows samples.
- Average LPDs:
  - ✓ • 90.1-2007..... avg.= 1.09
  - ✓ • 90.1-2010..... avg.= 0.906
  - ✓ • Difference ..... -16.9%

Building Area Type <sup>a</sup>	LPD (W/ft <sup>2</sup> )	
	90.1-2007	90.1-2010
Automotive facility	0.9	0.82
Convention center	1.2	1.08
Courthouse	1.2	1.05
Dining: bar lounge/leisure	1.3	0.99
Dining: cafeteria/fast food	1.4	0.90
Dining: family	1.6	0.89
Dormitory	1.0	0.61
Exercise center	1.0	0.88
Gymnasium	1.1	1.00
Health-care clinic	1.0	0.87
Hospital	1.2	1.21
Hotel	1.0	1.00
Library	1.3	1.18
Manufacturing facility	1.3	1.11
Motel	1.0	0.88
Motion picture theater	1.2	0.83
Multifamily	0.7	0.60
Museum	1.1	1.06
Office	1.0	0.90
Parking garage	0.3	0.25

## Lighting Power Densities

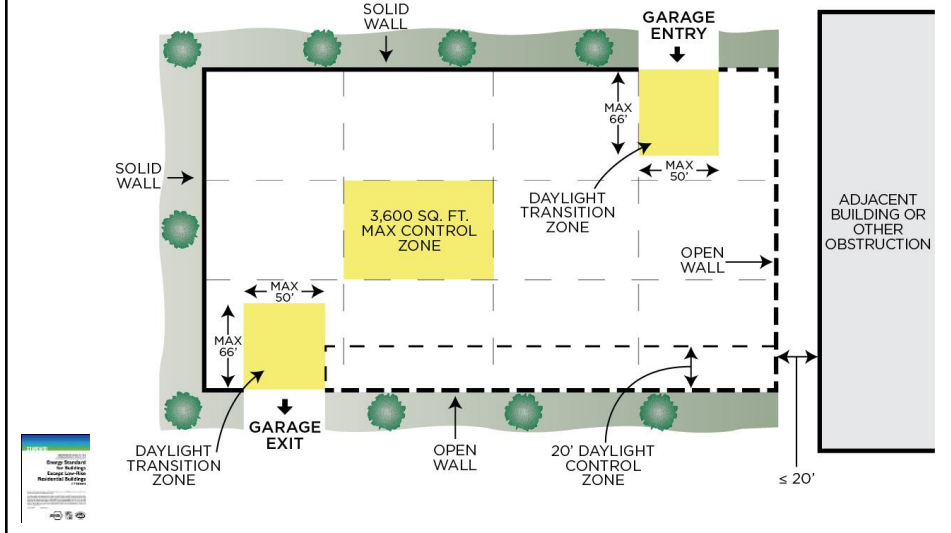
**Table 9.6.1 Interior Lighting Power – Space by Space**

Common Space Types <sup>1</sup>	LPD, W/ft <sup>2</sup>	RCR Threshold	Control Functions								
			a	b	c	d	e	f	g	h	i
<b>Atrium</b>											
... that is <20 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... that is ≥20 ft and ≤40 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... that is >40 ft in height	0.40 + 0.02/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
<b>Audience Seating Area</b>											
... in an auditorium	0.63	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a convention center	0.82	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2

- For each space type, apply the lighting control functions listed.
- If using the Space-by-Space method for LPD requirements, use same space type for control requirements. For space types not listed, use a reasonable equivalent
- “REQ” = mandatory
- “ADD1” = at least one of these must be implemented
- “ADD2” = at least one of these must be implemented

## Lighting Control: Open Parking Garage

### Glazing Locations – Addendum ‘bw’



## Lighting: Functional Testing

### 9.4.3 Requirements

**Functional testing (calibrated/adjusted/programmed) of lighting control devices and systems required within 90 days of occupancy**

- Must be performed by individuals NOT involved in design, manufacture, or installation
- For occupant sensors:
  - ✓ Certify location and aiming per manufacturer recommendation
  - ✓ Test all sensors if project has  $\leq 7$
  - ✓ If  $> 7$  sensors, test for each unique combination of sensor type and space geometry. Verify:
    - Operation of Status indicator
    - Lights turn off or down to permitted level at preset times
    - Auto-on – lights turn on to permitted level when occupied
    - Manual on – lights turn on only when manually activated
    - Lights are not incorrectly turned on by movement in nearby areas or by HVAC operation

## Existing Buildings

### A New Chapter 5

- C501 (et al) provides limited alternative to IEBC



- Alterations
  - ✓ Limited in type and scope
- Additions
  - ✓ Can comply with ASHRAE 90.1
- Repairs
- Changes of Occupancy
- Historic buildings
- Maintenance

## IECC – Energy Provisions

### Option 3 - Performance Compliance Method

- Mandatory compliance with 2015 edition for additions, relocations
- Only those systems or portions of the existing building that are altered are required to comply.
- IEBC historic buildings may be modified or exempted only by request approved through SBI
- Option to comply with ASHRAE Energy Standard 90.1 – 2013

**ENERGY EFFICIENCY**

High efficiency light fixtures with low-mercury fluorescent lamping reduce energy use and carbon dioxide production. Save even more energy and lower your utility bill...

**Turn off lights when they are not needed.**



## Functional Testing

### 9.7.2.3 Daylighting Documentation

**For automatic time switches:**

- Confirm programmed schedules
- Document schedules for own
- Verify correct time and date are set
- Verify battery backups are installed and energized
- Verify override time limit set to  $\leq 2$  hours
- Simulate occupied condition/verify and document:
  - Lights turn on and off with respective switches
  - Switch only operates lights in enclosed space where switch is located
- Simulate unoccupied condition and verify and document:
  - All nonexempt lights turn off
  - Manual override only operates lighting where it is located

**For daylighting controls**

- Properly located, field-calibrated, and set to have appropriate setpoints and threshold light levels
- Daylight controlled lighting loads adjust to correct levels with available daylight
- ✓ Location where calibration adjustments are made is readily accessible only to authorized personnel
- ✓ Daylighting documentation
  - Identify all general lighting located within daylight areas under skylights, daylight areas under roof monitors as well as primary sidelighted areas and secondary sidelighted areas

## RESIDENTIAL CHANGES



## Relationship Between IECC & IRC

### R103.2 Construction Documents



VS



- IECC addresses only energy
- IECC addresses residential and commercial;
- IRC addresses all R-3 Residential Use 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
- 2015 consolidates IECC *Residential Provisions* with IRC energy Chapter 11 (actually a change to the IRC, not the IECC)

## REScheck Version 4.6.4.0

### R101.5.1/N1101.3 UA Compliance Alternative



- Can be used to show compliance with both 2015 IECC or IRC
  - ✓ **Now updated to 2015**
- Completely electronic: user inputs all of the building data
- Will demonstrate whether building meets performance or tradeoff based compliance
- If used, report is submitted with construction documents.
- Should include checklists for envelope, mechanical, common spaces in multi-family

## Energy Conservation Code – IRC Ch. 11

### *R102.1.1 / N1101.4 Above-Code Programs*

- A national, state or local energy efficiency program may be deemed to exceed the energy efficiency required by this Chapter.
- May include:
  - ✓ LEED
  - ✓ Green Globes
  - ✓ Green Building Standard
  - ✓ Approved equivalent rating system



## Scoping and Administration

### *R103.2 / N1101.5 Information on Documents*

#### *[RE] Insulation, Fenestration/Daylighting, U-factor/SHGC, Air Sealing*

- Insulation materials / R-values (U-factor/C-factor/F-factor)
- Fenestration: U-factors / SHGC coefficients
- Area-weighted U & SHGC calculations
- Mechanical system design criteria
- HVAC / SWH equipment types, sizes, efficiencies
- Equipment & systems controls
- Duct sealing, duct/pipe insulation & locations
- Air sealing details
- Depict thermal envelope boundaries on overall plans/elevations

## Important [RE] Definition Changes

### *R 202 / 1101.6 Definitions*

#### **ADDED DEFINITIONS**

- Building Site
- Bldg. Thermal Envelope
- Continuous Air Barrier
- Demand Recirculation\*
- Roof Recover v. Replacement
- Visible Transmittance\*
- Whole house ventilation

#### **EXISTING DEFINITIONS**

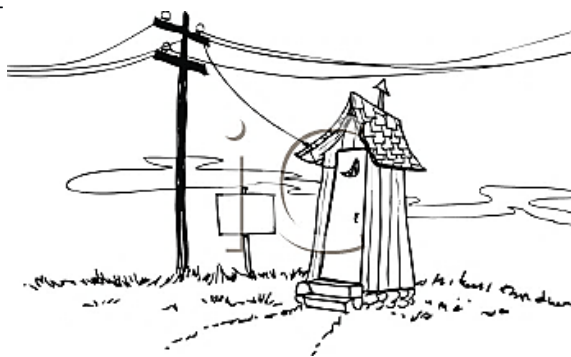
- Residential Building
  - ✓ Non-transient occupancy
  - ✓ # stories < 4



## General Requirements – Low Energy Buildings

### *R402.1 / N1102.1 General Exceptions for Thermal Envelope*

- Those with peak energy usage < 3.4 Btuh/sf for conditioning
- Those without conditioned space
- (CT) Where heating & cooling are supplied by on-site non-renewable sources:
  - ✓ Wind
  - ✓ Water
  - ✓ Wood stoves



## Building Thermal Envelope

### **R402.1 (N1102.1) Compliance Changes**

- R402.1 General
- CT Low-energy buildings Exception 3
- Peak energy use < 3.4Btuh/sf for space conditioning purposes
- Does not contain conditioned space
- Utilizing non-purchased renewables only, without backup heat sources:
  - ✓ On-site wind, water, solar
  - ✓ Wood-burning heating appliances
- R402.1.1 Vapor retarder: Comply with R702.7 or IBC 1405.3R402.1.3
- R-value computations: reduce insulated siding by R-0.06

## Prescriptive Table R402.1.1

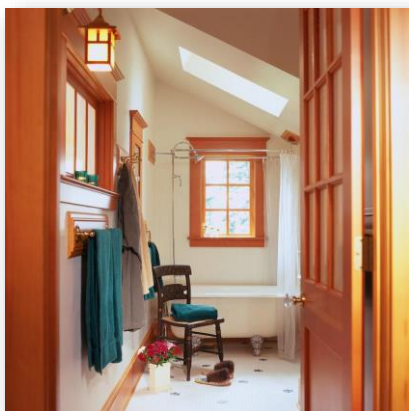
**TABLE R402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT\***

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>a, c</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>e</sup>	FLOOR R-VALUE	BASEMENT <sup>f</sup> WALL R-VALUE	SLAB <sup>g</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>h</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>b</sup>	8/13	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 <sup>b</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>b</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>b</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>b</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 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 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 0.2 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.

## Envelope Changes

### *R 402.2/N1102. Building Thermal Envelope*



- Prescriptive Tables
  - R402.1.1
  - R402.1.3R-Values U-Factors (+ C/F)
  - R402.2.6 Steel Equivalents  
Cavity + c.i. options
- Table Notes “a”, “c”, “h”
- Sunroom R-values
- “Certificate” information
- Fenestration Defaults

## Envelope Changes

### *R402.1.2/N1102.1 and Table Note “h”*

- Thickness reduction facilitates even wall surfaces

- Insulated siding defined
- Partial structural sheathing  
≤ 40% of thermal envelope  
AND
- R402.2.4 Access hatches /  
Exception for doors
- R402.2.7 Wall corners,  
headers
- R402.2.8 Floor cavities over  
unconditioned space
- R402.4.1.2 / N1101.10.1.1.1  
Formaldehyde
- R303.1.3 Default ratings





## Steel Frame Construction

**Table R402.2.6 / N1102.2.6 Equivalent Framing (partial)**

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

## Air Barrier & Insulation Installation

**Table R402.4.1.1 / N1102.4.1.1 (partial)**

Component	Air Barrier Criteria	Insulation Installation Criteria
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.	

## Envelope Requirements

### *R402.4.4 / N1102.4.4 Isolation of Fuel-fired Equipment*

- Separately sealed and insulated rooms
- Isolate appliances from conditioned spaces
- Isolate combustion air & vent openings



## Hot Water Systems

### *R403.2 Outdoor temperature Setback*



- Boilers with one- or two-pipe heating systems require an outdoor setback control that lowers the boiler water temperature in response to the outdoor temperature.

## Hard-Ducted Return Air

### *R 403.2.3 Building Cavity Returns Not Acceptable*

Return air runs must be hard ducted. Supply or return air can no longer be “panned” through the floor joists.



## Air Barrier Testing

### *CT R402.4.1.2 / N1102.4.1.2 Testing Protocol: Sampling*



- For buildings  $\geq 7$  dwelling units
- $\geq 850$  SF 5.0 ACH 50
- $< 850$  SF 6.5 ACH 50
- Third party blower door testing
- Sampling allowed:
  - First group of 7 units – test all 7
  - Next – test 1 in 7 from each group
  - When a unit fails; test two more successfully to continue sampling. If more than two fail, start again from the beginning.

## HVAC / SWH Changes

### R 403 Systems



- R403.1.1 Programmable t’stats; all systems
- R403.3.2 Tighter duct sealing
- R403.3.3 Duct testing – either rough or final
- R403.4 SHW Insulation
- R403.2 HW boiler outside setback
- R403.7 ACCA loads/equipment sizing
- R403.5 Service HW systems
- R403.8 Systems serving multiple units

## Duct Leakage and Testing

### R403.3.3 (N1103.3.3) CT amends from R502.1.1.2

R403.3.3 Duct testing.

- Rough-In
- Postconstruction

#### Exceptions

- ✓ Duct testing not required where ducts and air handlers are located entirely within the building thermal envelope
- ✓ (CT) Where existing ducts are extended due to an addition or alteration, new portions of ducts < 40LF in unconditioned spaces shall not be required to be tested in accordance with this section



## Hot Water Recirculation

### *R403.5 / N1103.5.1 Service Hot Water Systems*

- R403.5.1.1 Circulation Systems
  - ✓ Demand-controlled Pump with automatic temp/flow sensor
  - ✓ Outlet temperature 104°F
  - ✓ Dedicated or cold pipe return
  - ✓ Gravity or thermosyphon prohibited
- R403.5.1.2 Heat trace system
  - ✓ Comply w/UL 515 or IEEE 515.1
  - ✓ Controls shall sense demands
- R403.5.3 Pipe insulation
  - ✓ ≥ ¾ inch diameter
  - ✓ Serving more than one dwelling unit
  - ✓ Piping from water heater to manifold
  - ✓ Under floor slabs; buried
  - ✓ Piping in non-recirculating systems
- R403.5.4 Drain water heat recovery
  - ✓ Comply with CSA B55.1/B55.2
  - ✓ Connected to one or two showers

## Whole House Mechanical Ventilation

### *Tables R403.6.1 / N1103.6.1 Mechanical Ventilation Fan Efficacy*

IRC Table M1507.3.3

CONTINUOUS AIRFLOW RATE REQUIREMENTS

DWELLING UNIT FLOOR AREA	NUMBER OF BEDROOMS				
	0 to 1	2 to 3	4 to 5	6 to 7	over 7
[square feet]	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

## Lighting Changes

### R404.1, R403.8 / N1104.1 Lighting Equipment



- 75% - Fixture or Socket Count still an Option
- R403.8 Multi-family common areas must use LPD lighting requirements of C405.4/.5
- Fuel gas lighting – no standing pilots

## Lighting Equipment

### R404.1 / N1104.1 – MANDATORY with Option

- A minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps, or 75% of permanently installed lighting fixtures to contain only high efficacy lamps (newly defined):
  - ✓ 60 l/w > 40w
  - ✓ 50 l/w > 15 to 39w
  - ✓ 40 l/w < 15w
- Exception:
  - ✓ Low-voltage lighting
  - ✓ \*Pilot lights are now prohibited on fuel gas lighting.





## ERI: The Energy Rating Index

### **R406.1 / N1106.1 – Performance by Energy Utilization Option**

#### R406.2 Proposed Building

- R-2; R-3; R-4 Uses
- Whole building must be treated as a single zone
- Reference: 2006 = 100  
Zero Net Energy = 0
- Certification by builder of design
- Approved software tools

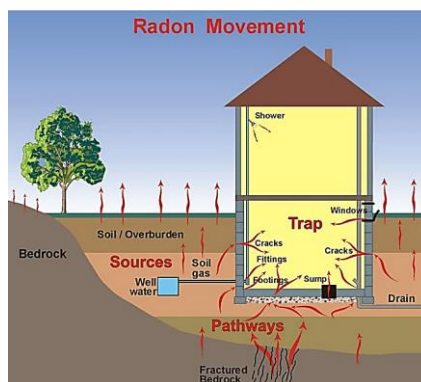
#### Required Target Values

- ~~Tables R406.4/N1106.4 DELETED~~
- R406.4 CT maximum ER Index ≤ 61 with no tradeoffs for renewables
- ~~N1106.4.1/R406.4.1 Tradeoffs DELETED~~
- CT R406.6.1&5 Use ANSI Standard 301 for approved tools; other inputs
- CT Chapter 6 references ANSI/RESNET/ICC 600

## Radon Systems – Appendix AF

### **CT AF104 Mitigation Preparations**

- Soil Gas retarder
- T-fitting; vent pipe
- Floor Openings
  - ✓ Multi-level slab venting
  - ✓ Drain tile & sump depressurization
- Sumps
- Waterproofing/dampproofing
- Ventilation prep: conduit; circuit
- Accessible attic space - future fan



Attribution: radiationsafety.ca

## Performance Alternative

***N1105/R405 / Table N1105.5.2/R405.5.2(1) - ECBM***

- Glazing baseline is 15%
  - ✓ Coordinated w/R402.1.1
- Air exchange rate set for whole-house testing
- HVAC systems matched w/R403.2 changes
- Thermal distribution system effects – Table 405.5.2



## Simulated Performance Alternative

***R405.4.2 Compliance reports – Permit; C.O.***

Compliance Scope Changes:

- Orientation of fenestration EW/NS
  - Fenestration set at 15% Standard
- Air exchange rate set for whole-house testing
  - ✓ Coordinated w/R402.1.1
- HVAC systems matched with R403.1/.2/.3 changes
- Effects of thermal distribution systems; Table R405.5.2(1) amended for standard reference



## Existing Buildings

### *R501 Scope and Application*

R501 (et al) provides limited IRC alternative to adopting IEBC

- R501.1 Scope
- R501.6 Historic Buildings
- R502-4 Additions, Alterations
- R503.1.1.1 Fenestration
- R503.2 Conditioned space
- R505 Compliance
- ✓ R402.1 Low energy exemption



## An Existing Residential Road Map

### *R501 Relocations of specific Residential Administration sections*

Applicability requirements move to newly created Existing Buildings section

EXISTING BUILDINGS - SCOPE & ADMINISTRATION		
Section Title	2012	2015
Scope	R101.4.1	R501
Historic Buildings	R101.4.2	R501.6
Additions, Alterations, Repairs	R101.4.3	R502 thru R504
Compliance	R101.4.4	R505
Change to Conditioned Space	R101.4.5	R503.2
Low energy building exemptions	R101.5.2	R402.1
Replacement fenestration	R402.3.6	R503.1.1.1

## Historic Buildings

### *C202 Definitions (New)*



- **C202 HISTORIC BUILDING.** Any building or structure that is one or more of the following:
  - ✓ **1. Listed, or certified as eligible for listing in the National Register of Historic Places by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places.**
  - ✓ **2. Designated as historic under an applicable state or local law.**
  - ✓ **3. Certified as a contributing resource within a National Register-listed, state-designated or locally designated historic district.**

## Credits

- *Some content and images in this presentation provided by resources from:*

Building Codes Assistance Project



[energycodesocean.org](http://energycodesocean.org)

DOE Building Energy Codes Program



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

National Renewable Energy Laboratory



[nrel.gov/data/pix](http://nrel.gov/data/pix)

## Resources

*Available Over Your Internet Connection*

- [www.iccsafe.org/errata-central](http://www.iccsafe.org/errata-central)
- [www.energycodes.gov/resources](http://www.energycodes.gov/resources)
- [http://www.energycodes.gov/sites/default/files/documents/901-2013-finalCommercialDeterminationQualitativeAnalysis\\_TSD.pdf](http://www.energycodes.gov/sites/default/files/documents/901-2013-finalCommercialDeterminationQualitativeAnalysis_TSD.pdf)
- [www.bcap.org](http://www.bcap.org)
- [www.buildingscience.com](http://www.buildingscience.com)
- [www.neep.org](http://www.neep.org)

