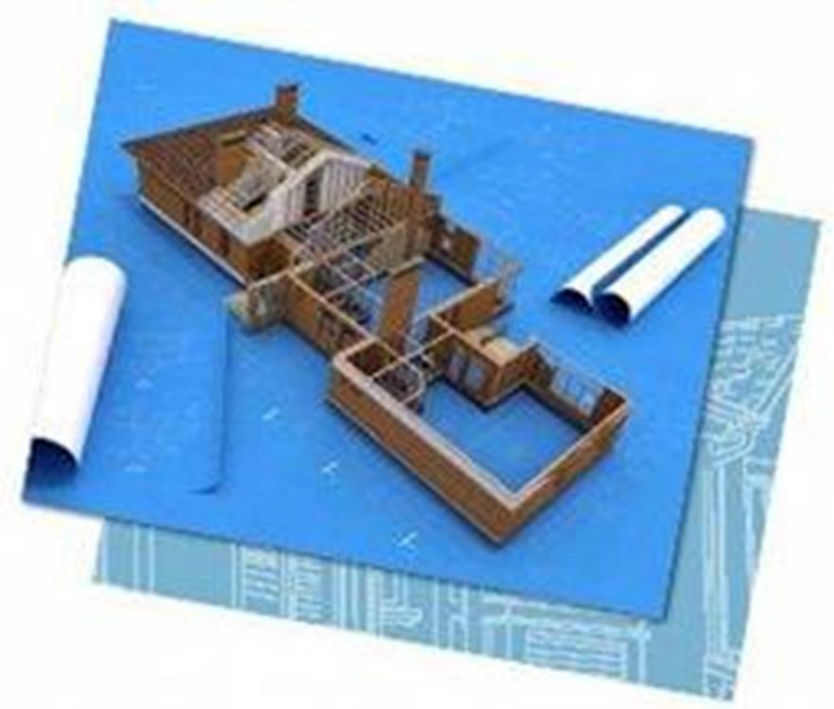
Connecticut

SIGNIFICANT 2012 IECC RESIDENTIAL CHANGES

Today's Presentation



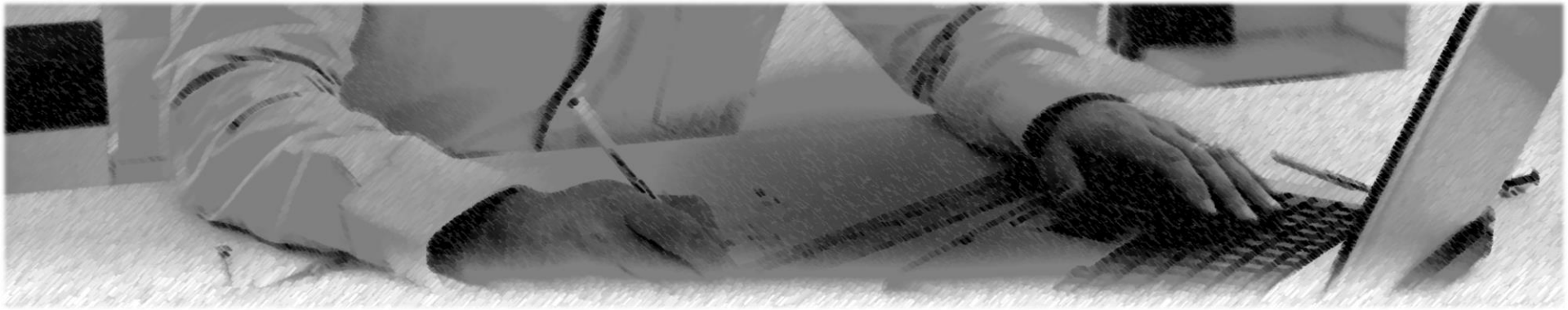
An overview of the significant code change proposals recommended for the 2012 Edition of the ICC Residential Energy Code; published Errata; CT proposed Amendments and deletions; and RES*Check* support

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 membership and considered for inclusion in the 2012 I-Codes.

Errata Central

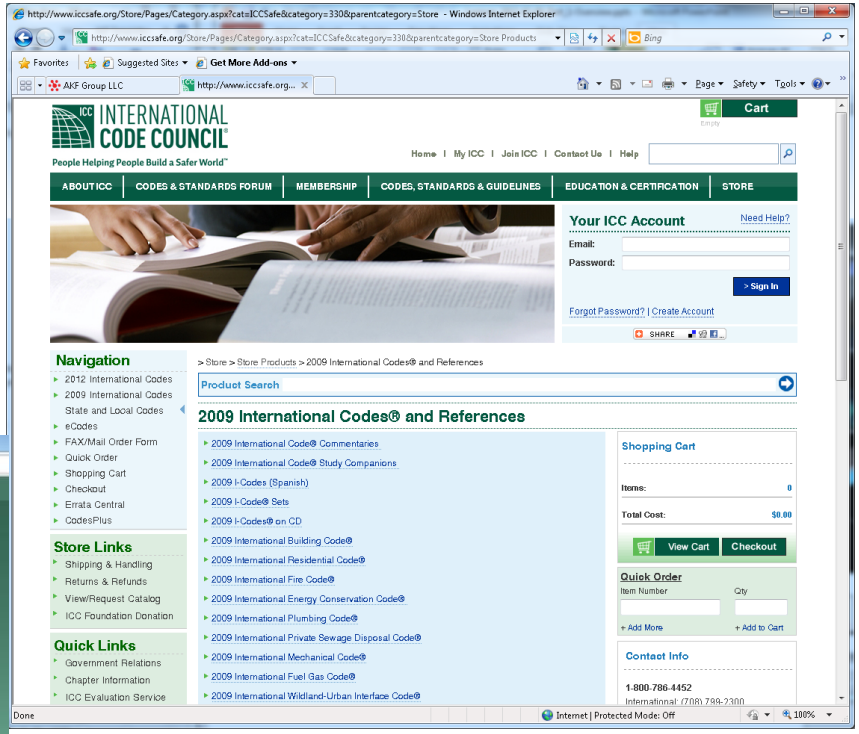
http://www.iccsafe.org/errata-central

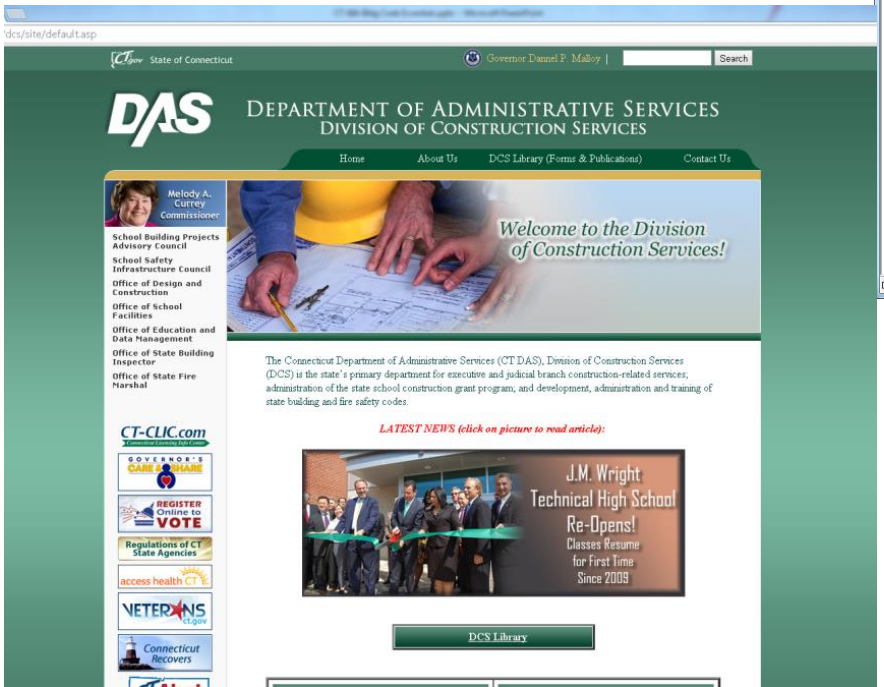


- IECC 2012 had 18 changes between the first printing and third printing
- 6 changes are in Residential

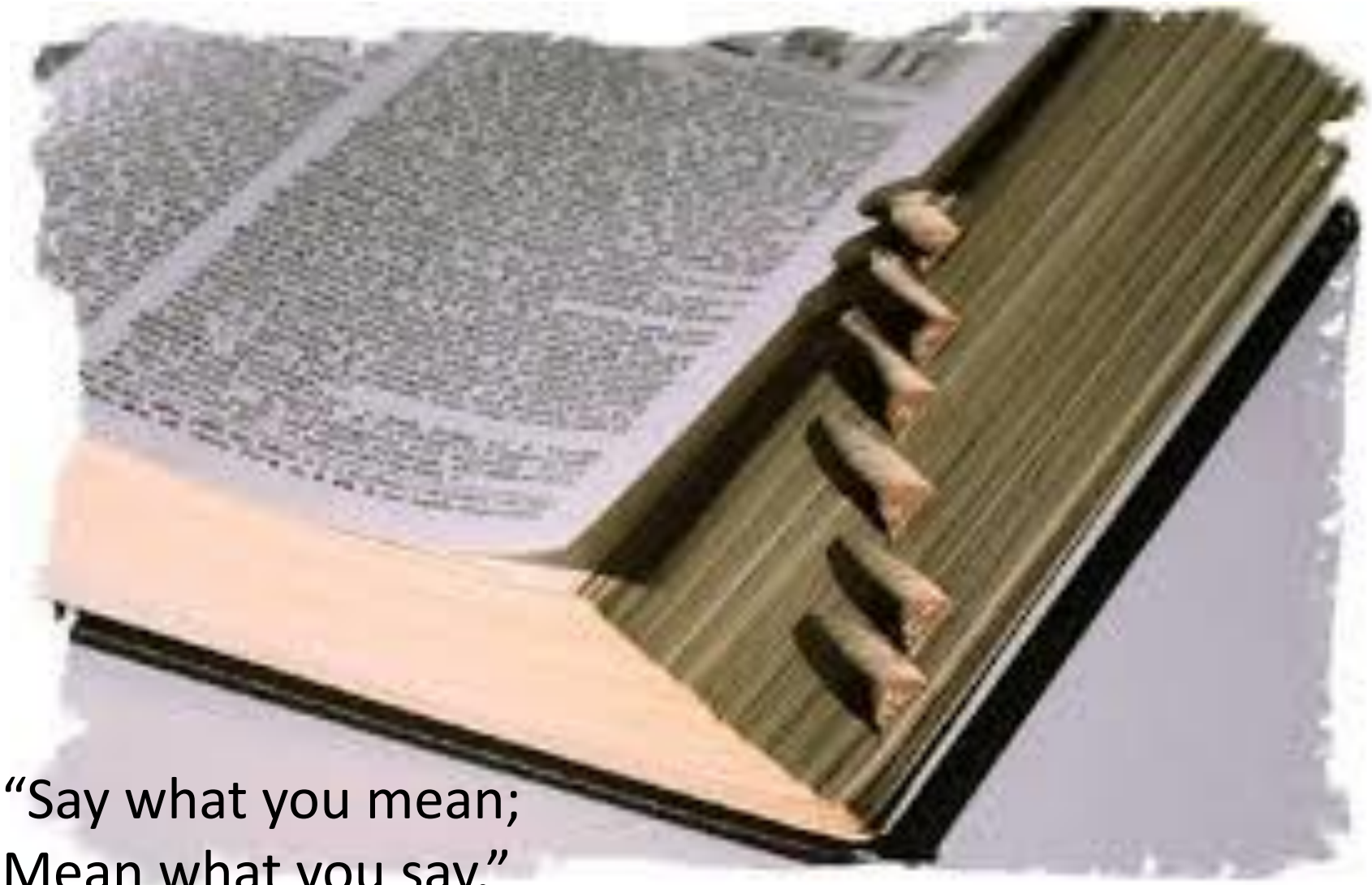
Where to Find, Purchase and Maintain

- 2012 IBC, IFC, IEBC, IMC, IPC, IECC
  - www.iccsafe.org/publications
  - Errata Central
- CT Amendments
  - CT Law Journal
  - www.ct.gov/dcs/





DEFINING THE CODES



"Say what you mean;
Mean what you say."

WORDS/TERMS ARE A PROBLEMS

We're not the only game in town creating *definitions*

- Legal
  - ✓Federal Law (FEMA / ADA)
  - ✓Legislative
  - ✓Courts: BLACK'S Law
- Medical (hazards)
- Scientific (Equations/symbols)
- OTHER CODES
- Construction STANDARDS
- Education, marketing, etc.
- Local Zoning

- ENCARTA dictionary
- OXFORD "
- Roget's Thesaurus
  - ✓Synonyms / antonyms

ABBREVIATIONS, ACRONYMS, SYMBOLS

IECC Definitions has 9; 90.1-3.3 has 74

Where to find them

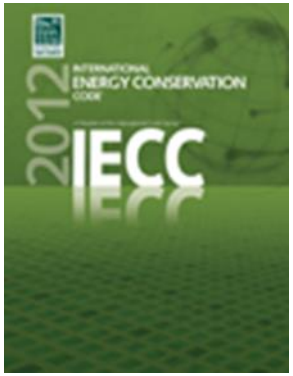
- ICC hardly defines any
  - ✓ Chapter 35 Standards helps
- ASHRAE does
  - ✓ ASHRAE 3.3 & Chapter 12
- Just GOOGLE it (?)

Who's your audience?

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

Relationship Between IRC & IECC

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 *Residential Provisions* with IRC energy Chapter *11* (actually a change to the IRC, not the IECC)

HOW DOES MY PROJECT NEED TO COMPLY?

IECC

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

IRC

One- and two-family dwellings

IECC 2012 CHANGES [RE]

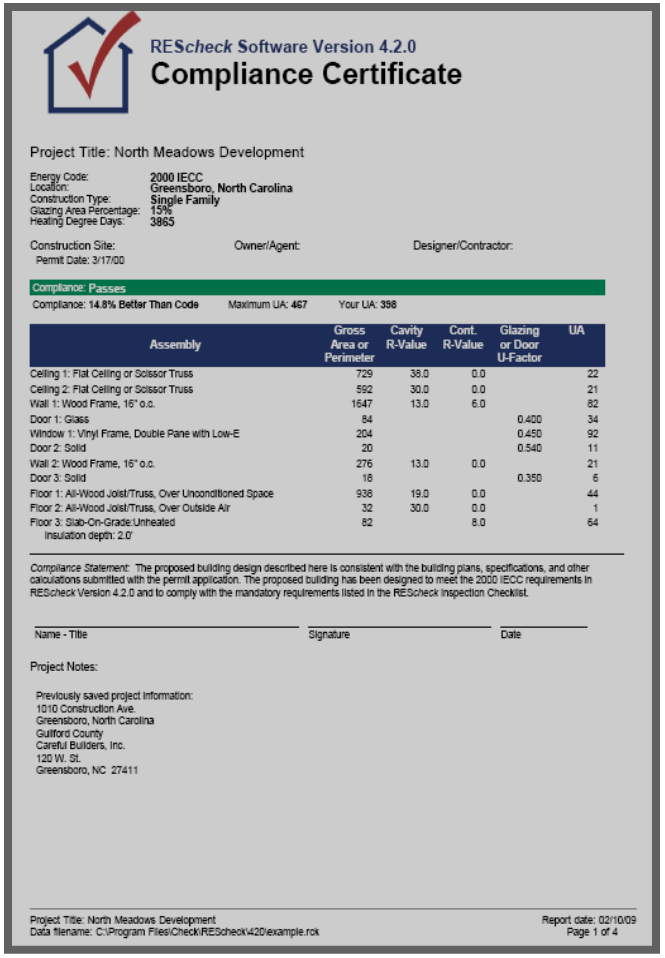
Six Principal Areas

- 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

FINDING THE CERTIFICATE – *R101.3*

- Insulation R-values
- U- & SHGC factors (*)
- Envelope air leakage
- Duct leakage
- Equipment types / efficiencies



RES*check* Software Version 4.2.0

Compliance Certificate

Project Title: North Meadows Development

Energy Code: 2000 IECC
Location: Greensboro, North Carolina
Construction Type: Single Family
Glazing Area Percentage: 15%
Heating Degree Days: 3865

Construction Site: Owner/Agent: Designer/Contractor:
Permit Date: 3/17/00

Compliance: Passes

Compliance: **14.8% Better Than Code** Maximum UA: **467** Your UA: **398**

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Glazing or Door U-Factor	UA
Ceiling 1: Flat Ceiling or Scissor Truss	729	38.0	0.0		22
Ceiling 2: Flat Ceiling or Scissor Truss	592	30.0	0.0		21
Wall 1: Wood Frame, 16" o.c.	1647	13.0	6.0		82
Door 1: Glass	84			0.400	34
Window 1: Vinyl Frame, Double Pane with Low-E	204			0.450	92
Door 2: Solid	20			0.540	11
Wall 2: Wood Frame, 16" o.c.	276	13.0	0.0		21
Door 3: Solid	18			0.350	6
Floor 1: All-Wood Joist/Truss, Over Unconditioned Space	938	19.0	0.0		44
Floor 2: All-Wood Joist/Truss, Over Outside Air	32	30.0	0.0		1
Floor 3: Slab-On-Grade:Unheated Insulation depth: 2.0'	82		8.0		64

Compliance Statement: The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2000 IECC requirements in RES*check* Version 4.2.0 and to comply with the mandatory requirements listed in the RES*check* Inspection Checklist.

Name - Title Signature Date

Project Notes:

Previously saved project information:
1010 Construction Ave.
Greensboro, North Carolina
Guilford County
Careful Builders, Inc.
120 W. St.
Greensboro, NC 27411

Project Title: North Meadows Development
Data filename: C:\Program Files\Check\REScheck\420\example.rck

Report date: 02/10/09
Page 1 of 4

C.G.S. Amendments

R103.1 Construction Documents: General

- *Two sets of construction documents and other supporting data shall be submitted to the building official at the time of application for the building permit. The construction documents and designs submitted shall be prepared by a registered design professional when required by the provisions of Chapters 390 or 391 of the Connecticut General Statutes*

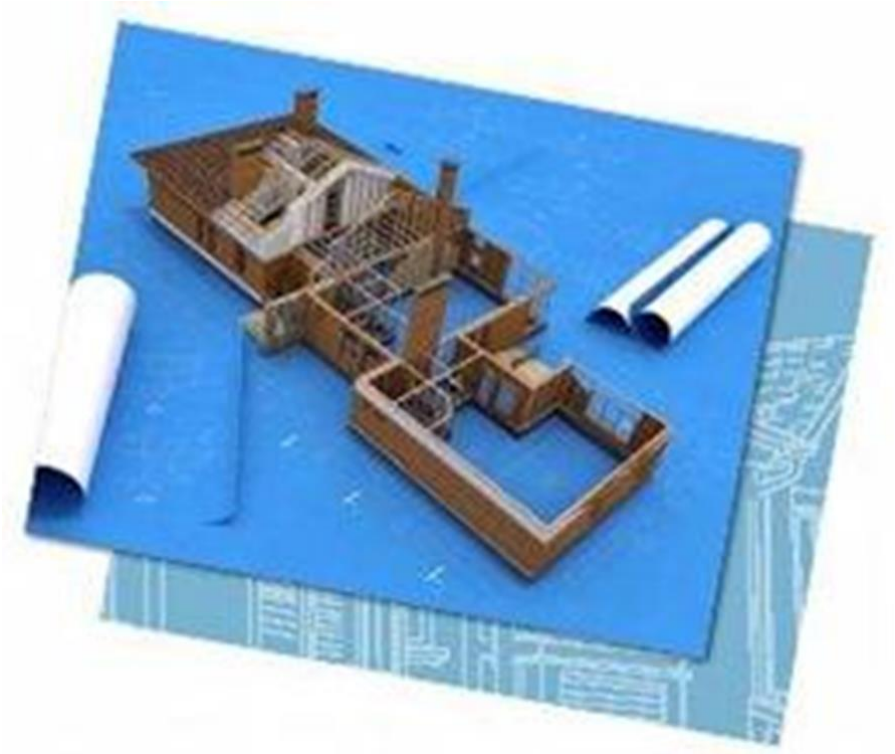
C.G.S. Amendments

R103.1 Construction Documents

- *Exception: 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*

Construction Documents

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



- Insulation materials
- R values, U factors & area weighting
- Mechanical & SWH design criteria: types; sizes; efficiencies; controls
- Duct sealing, insulation & locations
- Duct/pipe insulation; locations
- Lighting fixtures
- Air sealing details

(2015 shows this as a list)

- 2015 R103.2.1 - Thermal Envelope

Construction Documents (cont.)

R103.2 Information on Documents (IRC-R106.1.1)

**** PLUS ****

- Thermal Calculations
- Air sealing details
- Fan motors
- ~~Economizers~~
- ~~Light fixture schedule~~

Construction Documents 2015

R103.2 (AMD) Information on Construction Documents

- **Lists 8 Categories**
  1. **Insulation & R-values**
  2. **Fenestration U- & SHGC factors**
  3. **Area-weighted U- & SHGC**
  4. **HVAC system design criteria**
  5. **HVAC & SWH types, sizes, efficiencies**
  6. **Equipment/system controls**
  7. **Duct sealing; duct/pipe insulation**
  8. **Air sealing details**

R103.2.1 Building thermal envelope shall be shown on construction documents

C.G.S. Amendments

R103.5 Retention of Construction Documents

- *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*

C.G.S. Amendments

R107.2 Schedule of Permit Fees

- *The 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 for public view.*

Click here for the

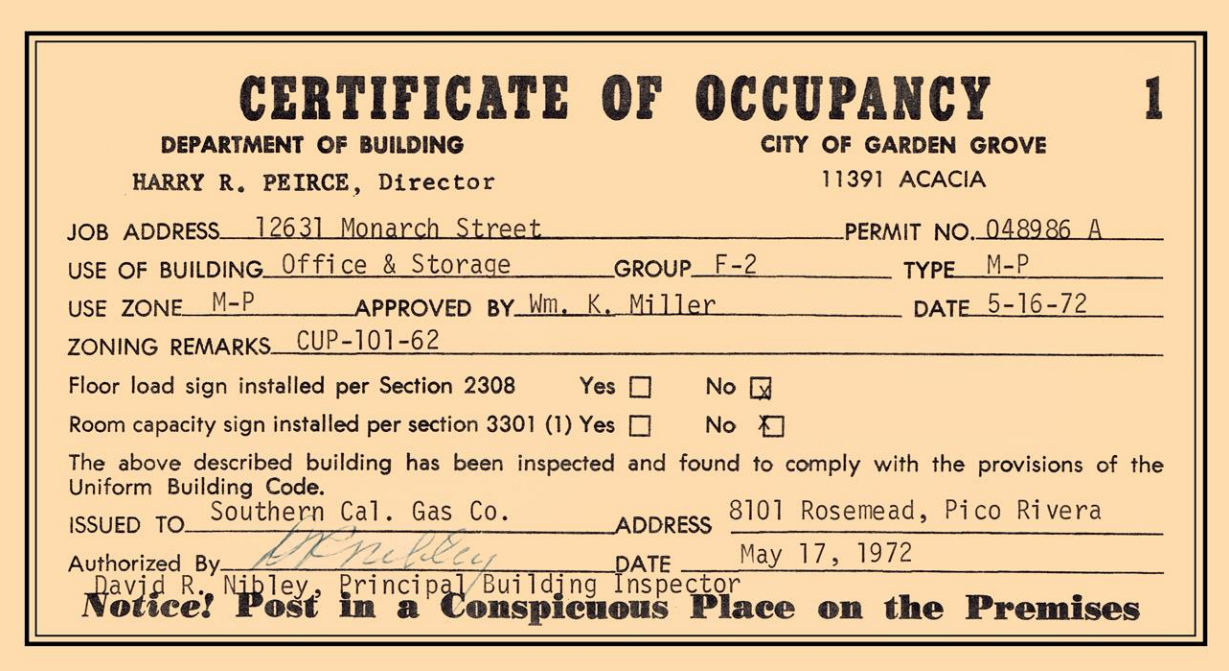
Development and Construction Permit Fee Schedule

Effective 1/1/2016

C.G.S. Amendments

R107.2 Schedule of Permit Fees

- *The 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 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

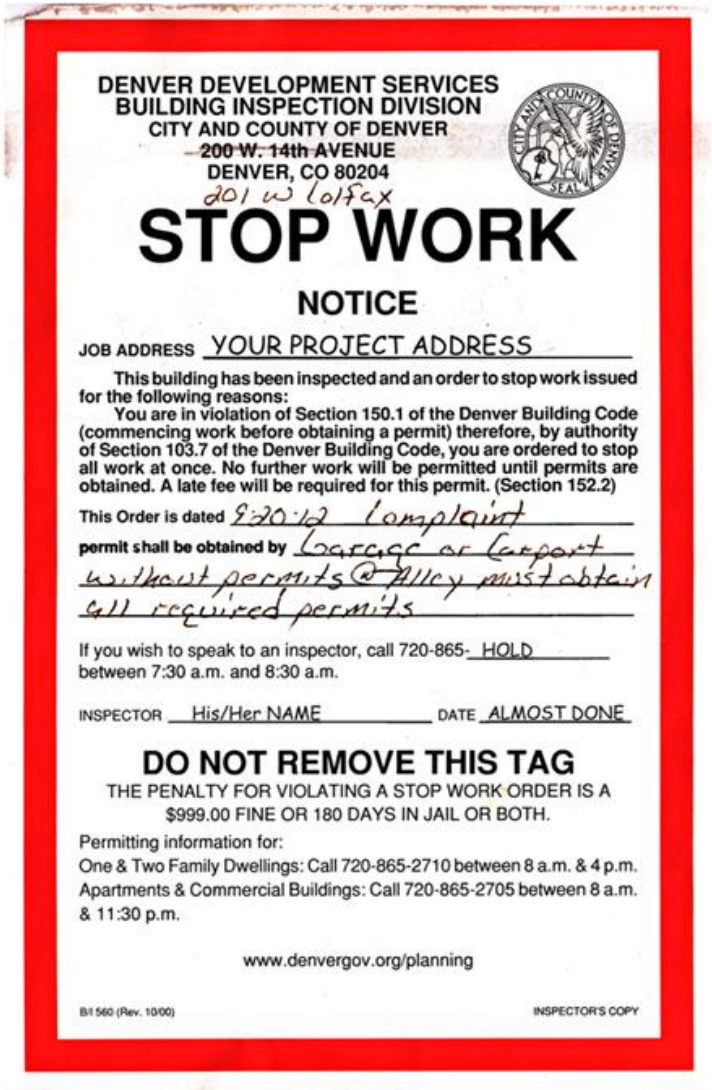
Authorized By [signature] — DATE May 17, 1972

David R. Nibley, Principal Building Inspector

***Notice!* Post in a Conspicuous Place on the Premises**

C.G.S. Amendments

R108.4 Unlawful Continuance



DENVER DEVELOPMENT SERVICES
BUILDING INSPECTION DIVISION
CITY AND COUNTY OF DENVER
~~200 W. 14th AVENUE~~
DENVER, CO 80204
201 W Colfax

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 8-20-12 Complaint

permit shall be obtained by Garage or Carport without permits @ Alley must obtain all required permits

If you wish to speak to an inspector, call 720-865- HOLD between 7:30 a.m. and 8:30 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

BI 560 (Rev. 10/00) 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 Statues*

C.G.S. Amendments

R109.1 Means of Appeal

- *(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 2015 State Building Code*

CG.S. Amendments

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 2015 State Building Code, such terms shall have the meanings ascribed to them as in those codes***

Definitions and Errata

R202 Added / Amended / Not Applicable

ADD

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

AMD

- Residential building
- Skylight (R405.5.2)*

N/A

- Entrance door* (RE12)
- Full Cutoff Luminaire
- Visible Transmittance* (dynamic glazing)

Applicable Definitions

R202; IBC 2404.2*

- Vertical Glazing ≤ 30^0
  - ✓ **Changes to 90.1 definition**
- Sloped Glazing ≤ 15^0
  - ✓ **IBC 2404.2 Safety Glazing**
- Visible transmittance *[VT]*
  - ✓ ***drives SHGC***
- Undefined:
  - ✓ ***Dynamic glazing***
  - ✓ ***Sidelighting***
  - ✓ ***Toplighting***

General Requirements *(info)*

R302.1 Interior Design Conditions

Interior design temperatures used for Load Calculations:

- **Max 72° F for Heating**
- **Min 75° F for Cooling**

OUTDOOR DESIGN CONDITIONS?

http://cdo.ncdc.noaa.gov/climatenormals/clim81_supp/CLIM81_Sup_02.pdf

Vapor Retarder Class *(info)*

(***CT ADDS R402.6.2)*** *– **2007** IECC info - moved in **2012** IRC / IBC*

IRC* / ~~IECC~~

Moisture Control

- **R202 Definitions**
- **R318.1 (*moves from R302.2.10.1*)**
- **R408.3 Crawl spaces**
- **R506.2.3 Slabs**
- **R806.5 Attics**
- **N1102.2.9 Crawl Space**
- **M1601.4.5 Ducts**

(*Was in IECC 402.5/N1102.5)

IBC*

Moisture Control

- **202 Definitions**
- **720 Insulation facings**
- **1203.3.2 Crawl Space.4**
- **1405.3.1 Exterior Walls**
- **1910.1 Floor Slabs**

(*Was in IECC 502.5)

Vapor Retarder

R601.3 Class III Requirements

New 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**;

Use & Occupancy - Residential

IBC 310 – Group R: CT Amendments

New terms added:

- **Bed & Breakfast Establishment**
- **Guest Room**
- **Hotel**

- **310.3 R-1 –hotels, motels; B&B's (transient occupancy)**
- **310.4 R-2 –apartments, dorms (non-transient)**
- **310.5 R-3 – Adult/child day care < 5 people / < 24-hrs**
- **310.6 R-4 – Residential care/ assisted living with 5 to 16 people (excluding staff)**

Prescriptive Residential Changes

Chapter RE 4 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 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[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] 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[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	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 R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

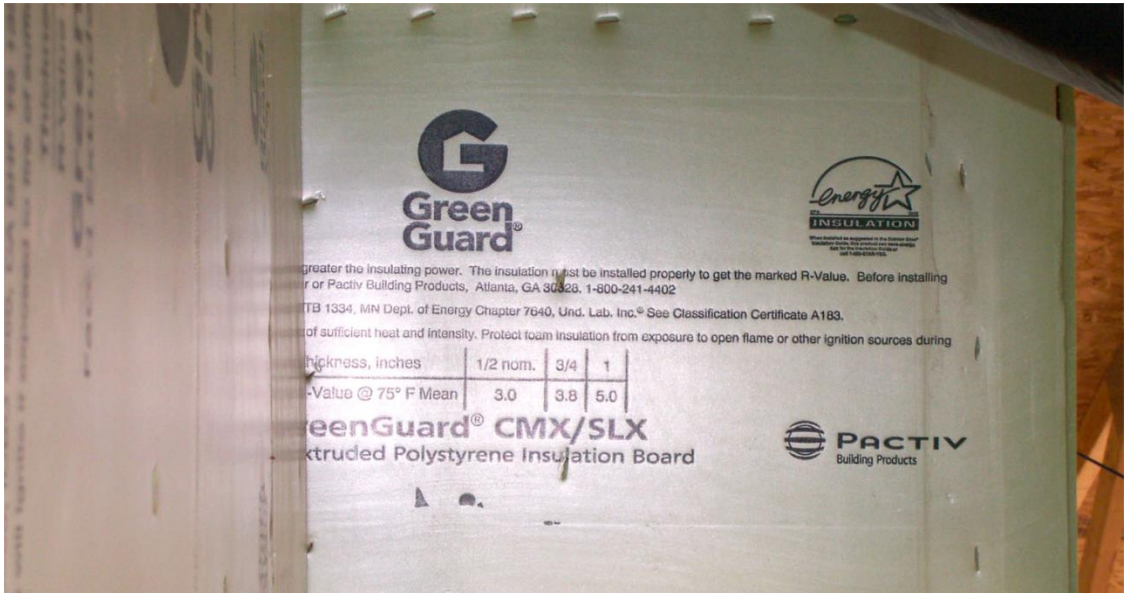
i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

Table Notes !

Insulation and Fenestration

Table R402.1.1 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.



Insulation and Fenestration

Table R402.1.1

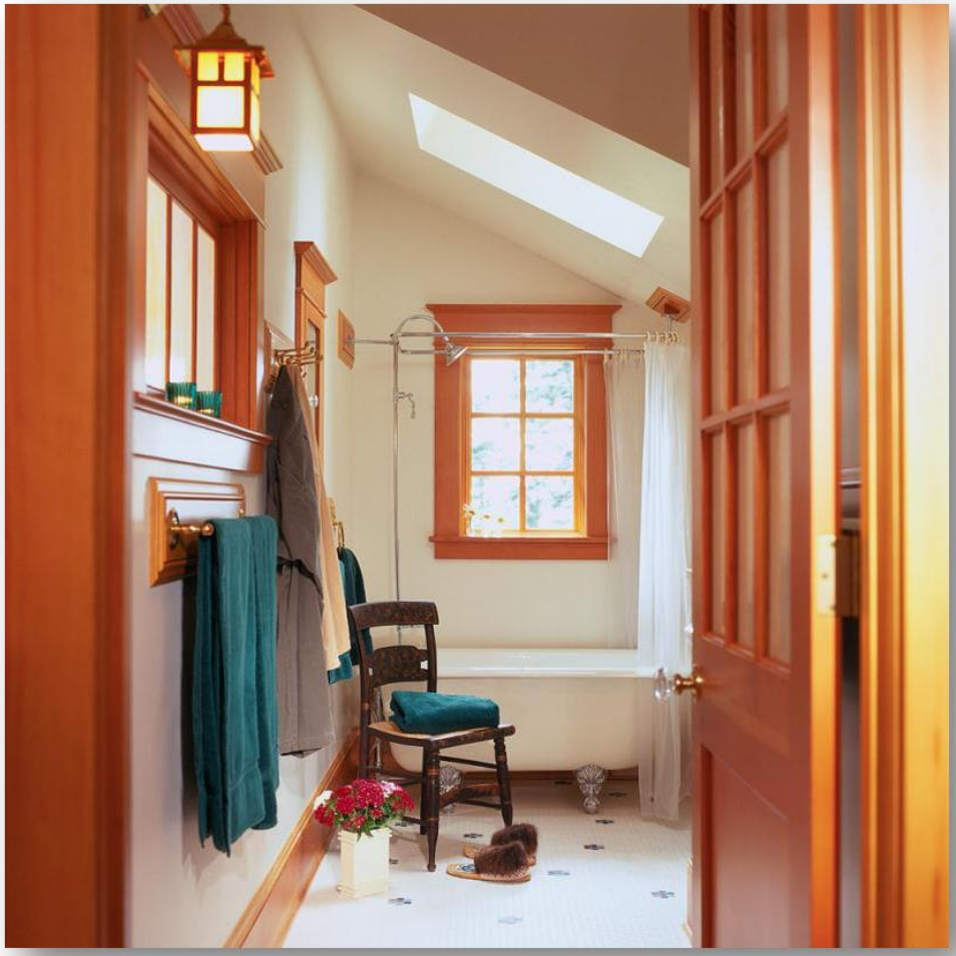
Table R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	…	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE
1		13	0
2		13	0
3		19	5/13f
4 except Marine		19	10/13
5 and Marine 4		**30[g]**	**15/19**
6		30[g]	15/19
7 and 8		38[g]	15/19

Prescriptive Insulation Requirements

R402.2.2 Ceilings w/o Attic Spaces

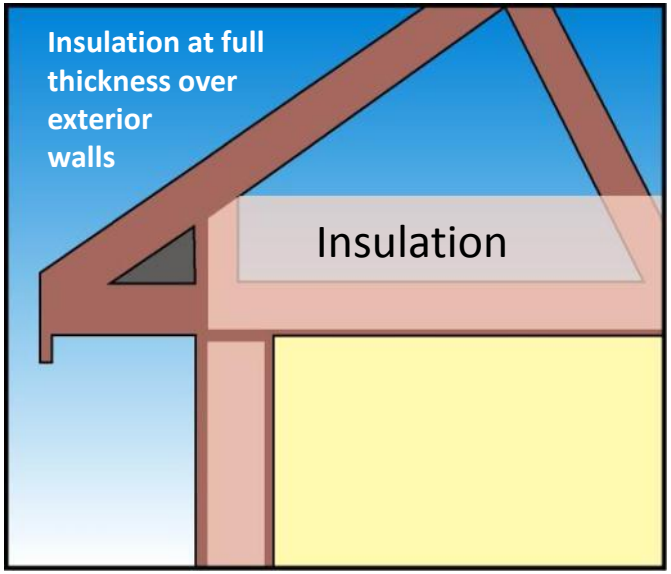
- R-38 allowed for 500 ft^2 or 20% total insulated ceiling area, <u>whichever</u> <u>is less</u>, in 'cathedral' ceilings where:
  - ✓ R-49 Insulation levels would be required
  - ✓ Insufficient framing *cavity* space to meet tabular levels
- ✓ *This does not apply to <u>'cathedral' trusses</u>*



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

Ceilings with Attics

C402.3.3.1 Exception:



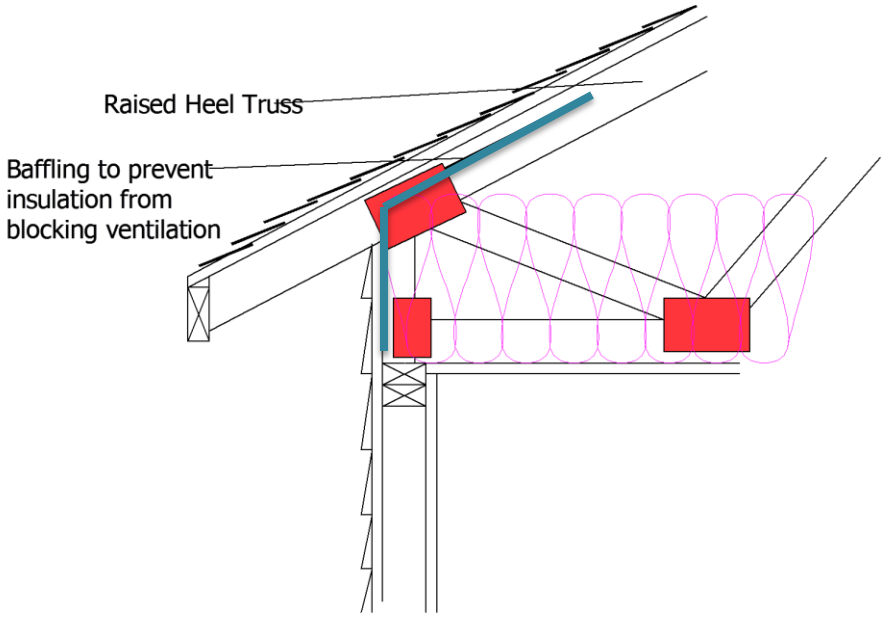
- If insulation is full height over exterior wall top plate:
  - ✓ R-38 complies where R-49 is required

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

Eave Baffles

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

- ✓ Installed adjacent to soffit and eave vents
- ✓ To maintain an opening ≥ size of vent
- ✓ To extend over top *and ends* of attic insulation
- ✓ May be of any solid material



Air Barriers / Insulation - Common Walls

R202; R402.2.12 (ADD)

- 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, unless IRC Appendix 'K' is adopted.

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

Greenhouse

R202; R402.2.12 (ADD)

- *A one-story structure, enclosing a non-habitable space ≤ 400sf, with glazing in excess of 50% of the gross area of the exterior walls and roof*
- *Non-habitable means:*
  - ✓ *Occupiable*
  - ✓ *Thermally separate or free-standing*
  - ✓ *Natural ventilation*
  - ✓ *Can be conditioned*
  - ✓ *GFCI power*

Sunroom

R202; R402.2.12

- ***A one-story structure, enclosing habitable space, with glazing in excess of 40 per cent of the gross area of the exterior walls and roof, and with the area of windows and doors operable to the exterior equal to a minimum of 20 per cent of the area of the sunroom floor***

- ***≤ 500sf***

- ***≤ 350sf when open to interior****

Sunrooms / Greenhouses (New)

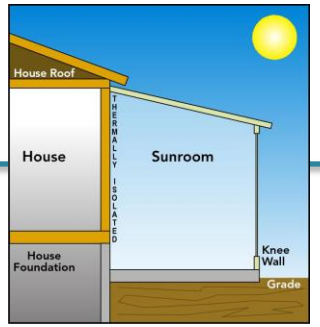


Table R402.2.12. Prescriptive envelope component criteria

BUILDING COMPONENT	MINIMUM R-VALUE – CZ 5	
	IECC	CT Amends
Opaque ceiling	R 24	R 19
Floor over unheated space *[CT]*	R19	R 19
Opaque wall	R 13	R 11
Slab perimeter insulation	R 10	R 5
Sunroom ≤ 500sf - isolated	U 0.60	U 0.50
Sunroom ≤ 350sf – open to home	U 0.32	U 0.45
* Greenhouse fenestration (≥ 50%)	-	U 0.60
Skylights	U 0.70	U 0.70

- ✓ There are no skylight amendments for these CT amendments - cover all glazing
- ✓ Can use REScheck w/negative impacts

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[a]
Steel Truss Ceilings[b]	
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[b]	
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

Fenestration U-factors – *Table* R*402.1.1*

Table R402.1.3 Occupancy Sensors

- Doors U-0.32
- Windows U-0.32
- Skylights U-0.55
- SHGC *N/R*
- V/T *[CE]*

Wind-Borne Debris *(Info)*

Section 1609 references Appendix N – CT

MUNICIPALITY - SPECIFIC STRUCTURAL DESIGN PARAMETERS

Municipality	Ground Snow Load (psf)	MCE Spectral Accelerations (%g)		*Wind Design Parameters*								
				Ultimate Design Wind Speeds, *V ult* (mph)			Nominal Design Wind Speeds, *V asd* (mph)			Wind-Borne Debris Regions		Hurricane-Prone Regions
		S_s	S_1	Risk Cat.I	Risk Cat.II	Risk Cat.III-IV	Risk Cat. I	Risk Cat. II	Risk Cat. III-IV	Risk Cat. II & Risk Cat. III except Occupancy I-2	Risk Cat. III Occupancy I-2 & Risk Cat. IV	
Wilton	30	0.231	0.068	110	120	130	85	93	101			X
Winchester	40	0.177	0.065	105	120	125	81	93	97			X
Windham	30	0.173	0.062	120	130	140	93	101	108			X
Windsor	35	0.179	0.064	115	125	135	89	97	105			X
Windsor Locks	35	0.177	0.064	110	125	130	85	97	101			X
Wolcott	35	0.187	0.064	110	125	130	85	97	101			X
Woodbridge	30	0.191	0.063	115	125	135	89	97	105			X
Woodbury	35	0.194	0.065	110	120	130	85	93	101			X
Woodstock	40	0.172	0.063	120	130	140	93	101	108			x

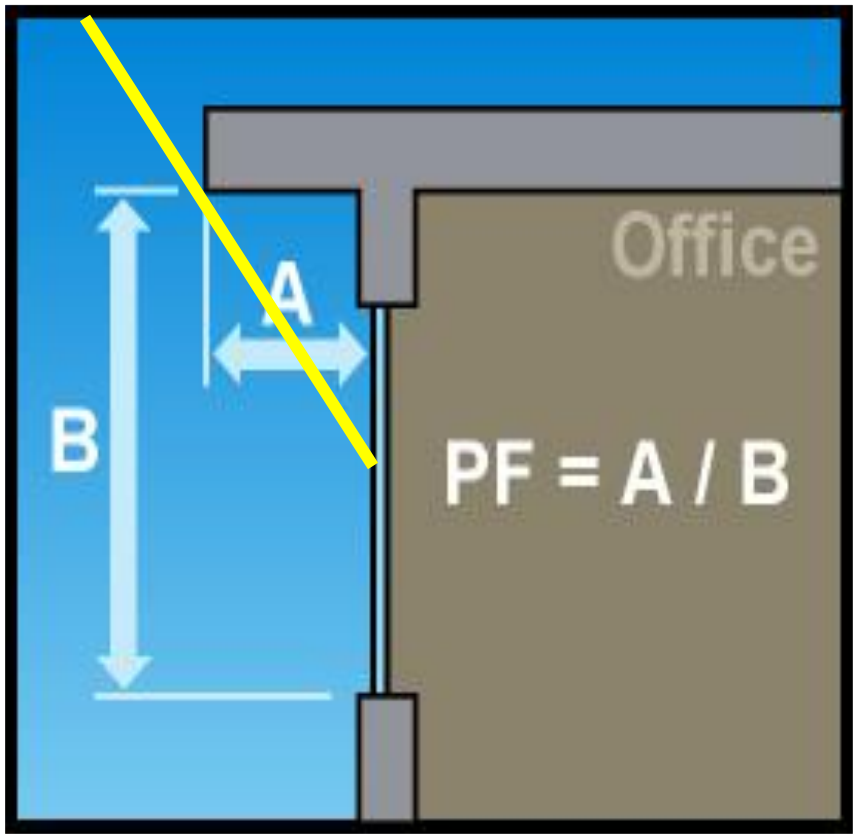
Wind-Borne Debris Regions: Type A: Full Municipality
Type B: Within one mile of coastal mean high-water line (south of I-95 as CT Building Code Basis)
Type C: Within one mile of coastal mean high-water line (Building Code Basis for New Haven – South of Metro North/Amtrak RXR for points west of Quinnipiac River; South of I-95 for points east of Quinnipiac River)

Hurricane-Prone Regions: Municipalities in which Ultimate Wind Speed for Risk Category II Buildings exceeds 115 mph.

Using Projection Factors

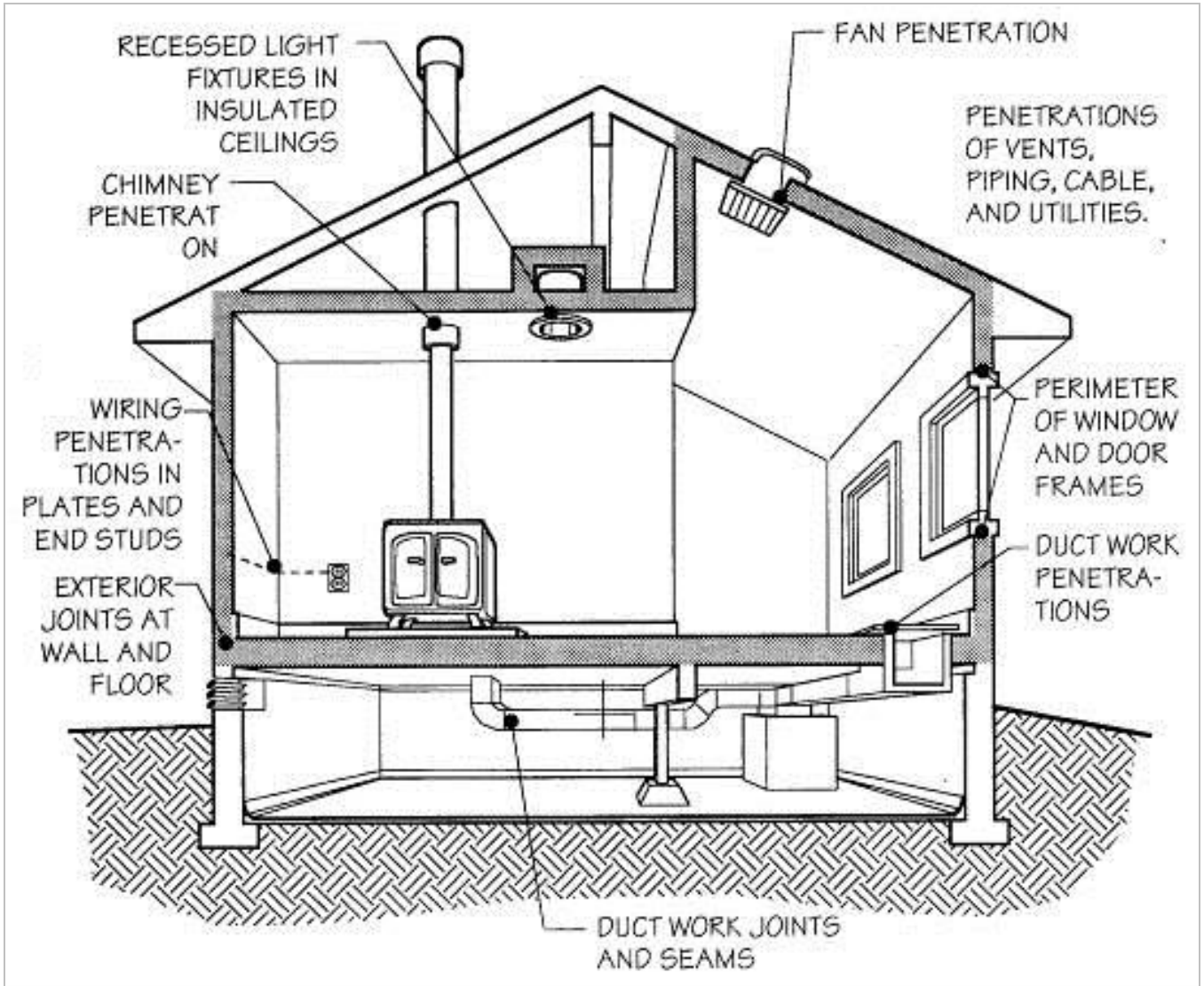
C402.3.3.1 SHGC Adjustment

- Fenestration U-factor constant; can be averaged
- SHGC factor modified by PF
- Modifications of SHGC are permitted by applying the percentages in Table C402.3.3.1



Sealing Air Leakage

Table R402.4.1.1



Air Barrier/Insulation Installation

Table R402.4.1.1 (Mandatory)

Component	Criteria
Air barrier and thermal barrier *	A continuous air barrier shall be installed in the building envelope. 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.
Walls	Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.
Rim joists	Rim joists shall be insulated and include the air barrier.
Floors (including above-garage and cantilevered floors)	Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.

(partial table)

1998 Airtight Study - Canadian

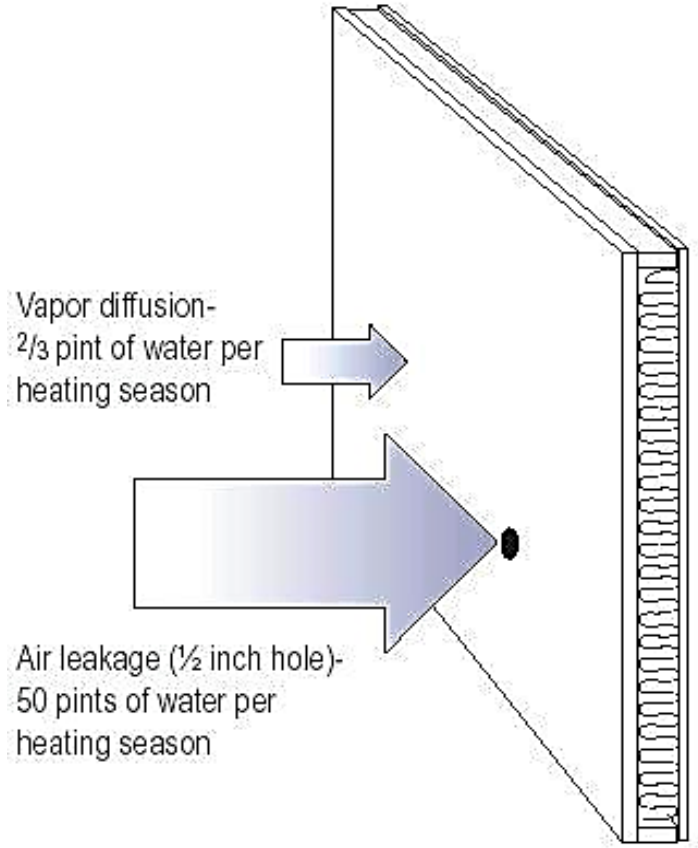
SINGLE FAMILY - ACH

- **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



Air Barrier Materials *(info)*

(C402.4.1.2.1) ASTM E 2178 Tested 'Impermeable'

Material	Thickness (minimum)
Plywood	3/8 in.
Oriented strand board	3/8 in.
Extruded polystyrene insulation board	½ in.
Foil-faced urethane insulation board	½ in.
Closed cell spray foam minimum density of 1.5 pcf	1-1/2 in.
Open cell spray foam density between 0.4 and 1.5 pcf	4.5 in.
Exterior gypsum sheathing or interior gypsum board	½ in.
Cement board	½ in.
Built up roofing membrane	Any
Modified bituminous roof membrane	Any
Fully adhered single-ply roof membrane	Any
A Portland cement/sand parge, stucco, or gypsum plaster	5/8 in.
Cast-in-place and precast concrete	Any
Sheet metal or aluminum	Any

Moisture Diffusion in Materials (*info)*

IBC 1405.3.1 defines V/R Class III Materials

MATERIAL	PERM RATING	VAPOR RETARDER(?)
½" GWB	38 -42	NO
TYVEK	52	NO
Latex Primer	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 + VWC	0.05 – 0.80	YES

Use Group R

R903.2.8 – Residential CT Amendments

- Automatic sprinkler system shall be provided ***throughout all newly constructed buildings*** with a Group R fire area **or in existing buildings with a change of occupancy or addition**
- **Exceptions:**
  - **Group R-1 bed and breakfast**
  - **Existing R-3 renovated buildings > 4 stories with a change of occupancy to ≤ four dwelling units (R2; 3 conditions)**
  - **Existing building conversions: R3 to R2 (before 6/15/94)**
  - **Units added horizontally, provided addition is sprinkled and a 1-hour fire separation is provided**

Building Thermal Envelope (Mandatory)

R402.1.2 R402.4.1 Air Leakage

Show 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

Wood-Burning Fireplaces

Section R402.4.2; Table R402.4.1.1 *(Mandatory)*

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

~~Fireplaces shall have gasketed doors (DEL)~~

HVAC / SWH Changes

Section R403 Mechanical

- R403.2.3 No building cavities used as plenums
- R403.2.2 Tighter duct sealing and duct testing – either rough or final
- R503.5.1 Whole house mechanical ventilation
- R403.6 ACCA equipment sizing /loads requirements
- Table R403.4.2 Insulate piping
- R403.9 Pool heaters/switches /pool covers

NAECA

SINGLE / MULTI-FAMILY RESIDENTIAL MECHANICAL SYSTEMS AND EQUIPMENT

National Appliance
Energy Conservation Act

Equipment efficiency set by Federal law, not the I-Codes

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 standards adopted in 1987; amended by Environmental Protection Acts 1992/2005

- Equipment efficiency tables are being amended starting in 2013 and continuing into 2016 (NOFR 9/12)

- Even if CT were to stay on IECC 2009 the tables still will be amended to more efficient equipment standards

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 ≤ 2% of design air flow rate per ASHRAE 193

Duct Tightness Testing

R403.2.2 Sealing (Mandatory)

Duct tightness shall be verified by:

- Post construction test
  - ✓ Total leakage: **≤4** cfm/per 100 ft^2 ***(<6)***
  - ✓ All register boots taped or sealed
- Rough-in test
  - ✓ Total leakage: **≤4** cfm/per 100 ft^2 ***(<8)***
  - ✓ all register boots taped or sealed
  - ✓ if air handler not installed at time of test, total air leakage ≤3 cfm/ 100 ft^2

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

HVAC and SWH Systems

R403.2 - Multifamily Uses C403 Mechanical & C404 SWH

- Controls
- Heat pump supplementary heat
- Ducts
  - Sealing (Mandatory) – **post-construction test option**
  - Insulation (Prescriptive) - unchanged
- HVAC piping insulation
- Service hot water circulating systems
- Ventilation
  - Dampers
- Loads / Equipment sizing
- Multiple dwelling units systems: Snow melt controls
- Pools and in-ground permanently installed spas

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

Piping Insulation

Table R403.4.2 Maximum Run Length

Largest ∅ 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.

System Controls

R403.1.1 Forced Air Systems Only

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

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 ≤ 2 stories
  - ✓Gravity dampers permitted for outside air intake or exhaust airflows of 300 cfm (0.14m3/s) or less.

Simple Versus Complex Systems

R403.4.1 Manual or automatic pump shutoff

Simple systems

- Unitary/packaged 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

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 ≥ 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 ≥ 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

Mechanical Ventilation

R403.5 Fan Efficacy per Table R403.5.1

Supply and exhaust air

- Range Hoods
- Bath/utility fans
- *HRV? / ERV?*

Whole House Mechanical Ventilation

Table M1507.3.3 Continuous Airflow

CONTINUOUS AIRFLOW RATE REQUIREMENTS

DWELLING UNIT FLOOR AREA	NUMBER OF BEDROOMS				
[square feet]	0 to 1	2 to 3	4 to5	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

Whole House Fan Efficiency

Table R403.5.1 (New)

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: Integral equipment fan motors shall be electronically commutated

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

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**

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)

C404.7.1 **- Pool Heaters**

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

C404.7.2 **- Time switches; other automatic control * Controls operate on preset schedule**

- ✓ **<u>Exceptions</u>**
  - **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^{0}F, vapor-retardant pool cover at least R-12
  - ✓ **Exception**: Over 60 % of energy from site-recovered or solar energy source
- **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

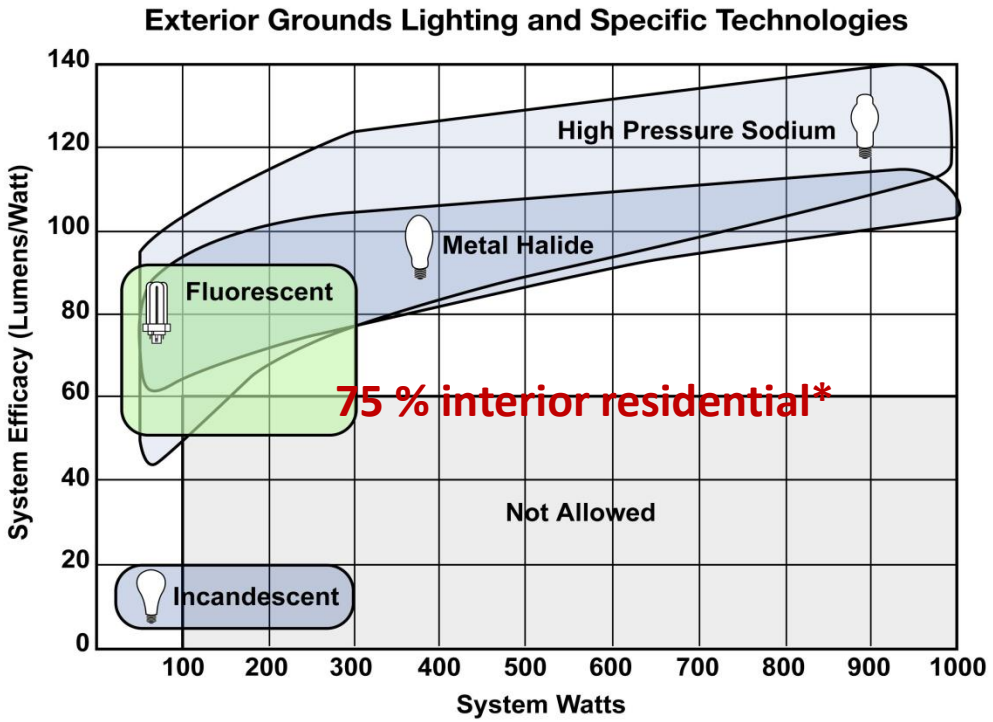
EXCEPTIONS: ***Low-voltage lighting; no fuel gas pilots***

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: regulated indirectly by this Section



RES*Check* 4.6.2.1 *(includes 2015 IECC)*

RES*check* Software Version 4.5.0

Inspection Checklist

Energy Code: 2012 IECC

Requirements: 0.0% were addressed directly in the RES*check* software

Text in the "Comments/Assumptions" column is provided by the user in the REScheck Requirements screen. For each requirement, the user certifies that a code requirement will be met and how that is documented, or that an exception is being claimed. Where compliance is itemized in a separate table, a reference to that table is provided.

Section # & Req.ID	Pre-Inspection/Plan Review	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
103.1, 103.2, 403.7 [PR3][1]	Construction drawings and documentation demonstrate energy code compliance for lighting and mechanical systems. Systems serving multiple dwelling units must demonstrate compliance with the IECC Commercial Provisions.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
302.1, 403.6 [PR2][2]	Heating and cooling equipment is sized per ACCA Manual S based on loads calculated per ACCA Manual J or other methods approved by the code official.	Heating: Btu/hr____ Cooling: Btu/hr____	Heating: Btu/hr____ Cooling: Btu/hr____	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	

Additional Comments/Assumptions:

RES*Check* 4.6.2.1 *(includes 2015 IECC)*

Section # & Req.ID	Framing / Rough-In Inspection	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
403.2.1 [FR12][1]	Supply ducts in attics are insulated to ≥R-8. All other ducts in unconditioned spaces or outside the building envelope are insulated to ≥R-6.	R-____ R-____	R-____ R-____	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
403.2.2 [FR13][1]	All joints and seams of air ducts, air handlers, and filter boxes are sealed.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
403.2.3 [FR15][3]	Building cavities are not used as ducts or plenums.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
403.3 [FR17][2]	HVAC piping conveying fluids above 105 ºF or chilled fluids below 55 ºF are insulated to ≥R-3.	R-____	R-____	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
403.3.1 [FR24][2]	Protection of insulation on HVAC piping.			☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	
403.4.2 [FR18][2]	Hot water pipes are insulated to ≥R-3.	R-____	R-____	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	

ENERGY STAR Qualified Homes, Version 3 (Rev. 03)
Thermal Enclosure System Rater Checklist

Home Address:_____ City:_____ State:_____

Inspection Guidelines	Must Correct	Builder Verified[1]	Rater Verified	N/A
1. High-Performance Fenestration				
1.1 *Prescriptive Path*: Fenestration shall meet or exceed ENERGY STAR requirements[2]	☐	☐	☐	☐
1.2 *Performance Path*: Fenestration shall meet or exceed 2009 IECC requirements[2]	☐	☐	☐	☐
2. Quality-Installed Insulation				
2.1 Ceiling, wall, floor, and slab insulation levels shall meet or exceed 2009 IECC levels[3,4,5]	☐	☐	☐	☐
2.2 All ceiling, wall, floor, and slab insulation shall achieve RESNET-defined Grade I installation or, alternatively, Grade II for surfaces with insulated sheathing (see checklist item 4.4.1 for required insulation levels)	☐	☐	☐	☐
3. Fully-Aligned Air Barriers[6]				
At each insulated location noted below, a complete air barrier shall be provided that is fully aligned with the insulation as follows: • At interior surface of ceilings in all Climate Zones; also, at interior edge of attic eave in all Climate Zones using a wind baffle that extends to the full height of the insulation. Include a baffle in every bay or a tabbed baffle in each bay with a soffit vent that will also prevent wind washing of insulation in adjacent bays • At exterior surface of walls in all Climate Zones; and also at interior surface of walls for Climate Zones 4-8[7, 8] • At interior surface of floors in all Climate Zones, including supports to ensure permanent contact and blocking at exposed edges[9,10]				
3.1 Walls				
3.1.1 Walls behind showers and tubs	☐	☐	☐	☐
3.1.2 Walls behind fireplaces	☐	☐	☐	☐
3.1.3 Attic knee walls / Sloped attics[11]	☐	☐	☐	☐
3.1.4 Skylight shaft walls	☐	☐	☐	☐
3.1.5 Wall adjoining porch roof	☐	☐	☐	☐
3.1.6 Staircase walls	☐	☐	☐	☐
3.1.7 Double walls	☐	☐	☐	☐
3.1.8 Garage rim / band joist adjoining conditioned space	☐	☐	☐	☐
3.1.9 All other exterior walls	☐	☐	☐	☐
3.2 Floors				
3.2.1 Floor above garage	☐	☐	☐	☐
3.2.2 Cantilevered floor	☐	☐	☐	☐
3.2.3 Floor above unconditioned basement or vented crawlspace	☐	☐	☐	☐
3.3 Ceilings				
3.3.1 Dropped ceiling/soffit below unconditioned attic	☐	☐	☐	☐
3.3.2 Sloped ceilings[11]	☐	☐	☐	☐
3.3.3 All other ceilings	☐	☐	☐	☐
4. Reduced Thermal Bridging				
4.1 For insulated ceilings with attic space above (i.e., non-cathedralized ceilings), uncompressed insulation extends to the inside face of the exterior wall below at the following levels: CZ 1 to 5: ≥ R-21; CZ 6 to 8: ≥ R-30[12]	☐	☐	☐	☐
4.2 For slabs on grade in CZ 4 and higher, 100% of slab edge insulated to ≥ R-5 at the depth specified by the 2009 IECC and aligned with thermal boundary of the walls[4,5]	☐	☐	☐	☐
4.3 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) ≥ R-21 in CZ 1 to 5; ≥ R-30 in CZ 6 to 8	☐	☐	☐	☐
4.4 Reduced thermal bridging at walls (rim / band joists are exempted) using one of the following options:				
4.4.1 Continuous rigid insulation, insulated siding, or combination of the two; ≥ R-3 in Climate Zones 1 to 4, ≥ R-5 in Climate Zones 5 to 8[13,14], OR;	☐	☐	☐	☐
4.4.2 Structural Insulated Panels (SIPs), OR;	☐	☐	☐	☐
4.4.3 Insulated Concrete Forms (ICFs), OR;	☐	☐	☐	☐
4.4.4 Double-wall framing[15], OR;	☐	☐	☐	☐
4.4.5 Advanced framing, including all of the items below:				
4.4.5a All corners insulated ≥ R-6 to edge[16], AND;	☐	☐	☐	☐
4.4.5				
4.4.5				
4.4.5 of the exterior wall[19], AND;	☐	☐	☐	☐
4.4.5e Minimum stud spacing of 16" o.c. for 2 x 4 framing in all Climate Zones and, in Climate Zones 5 through 8, 24" o.c. for 2 x 6 framing unless construction documents specify other spacing is structurally required[20]	☐	☐	☐	☐

ENERGY STAR Checklists

http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/InspectionChecklists.pdf

SUGGESTED RESOURCES

- **ICC 2012 Codes**
- www.iccsafe.org/content/historical-free-resources
- **ICC 2015 Codes**
- http://codes.iccsafe.org/I-Codes.html#all
- **DOE Resource Guides for air leakage, HVAC**
- https://www.energycodes.gov/resource-center/resource-guides
- **DOE Resources for RES*Check* 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

BECP – YOUR RESOURCES

Additional resources, including:

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

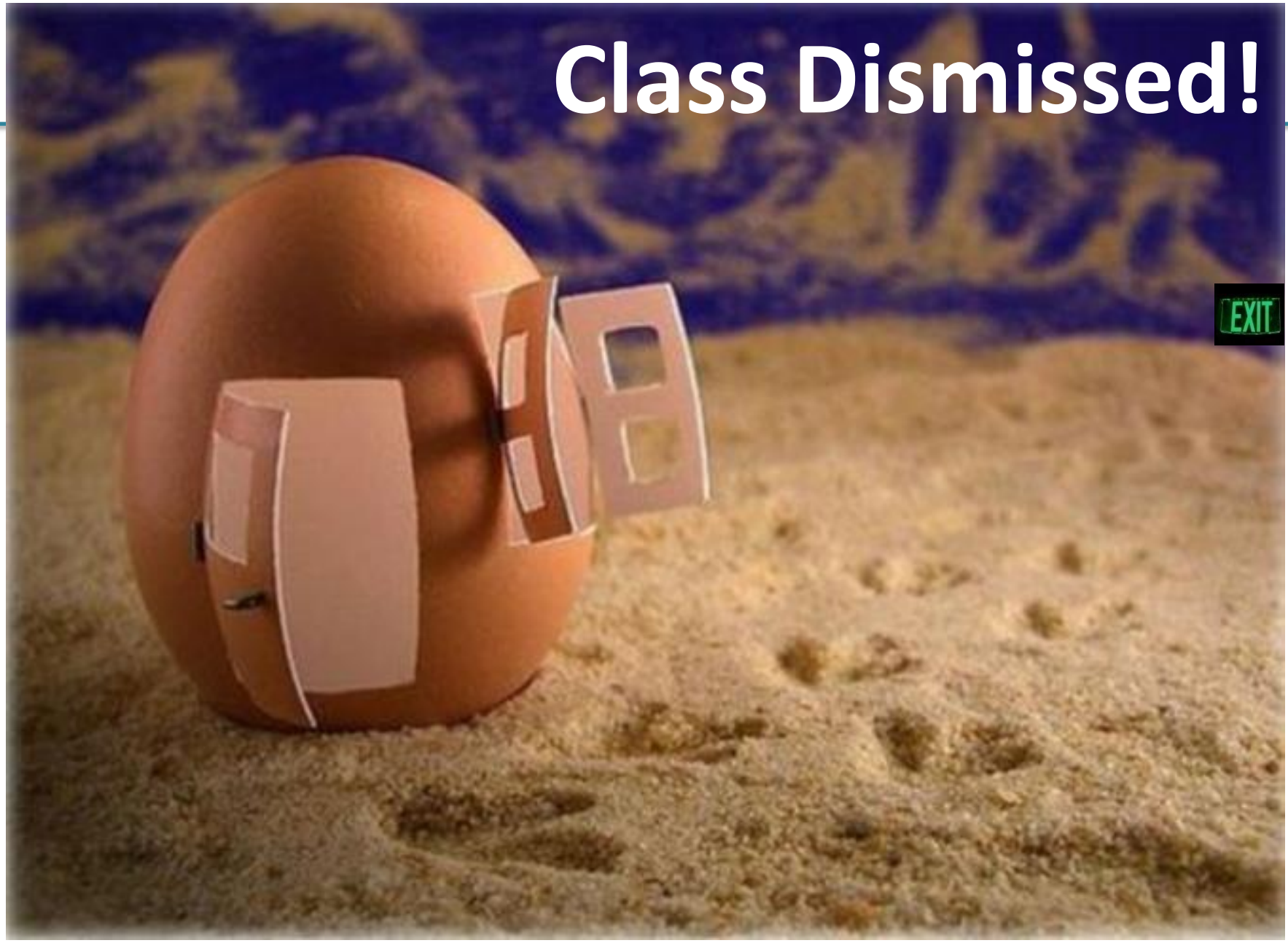
Are available through the Building Energy Codes Program

www.energycodes.gov

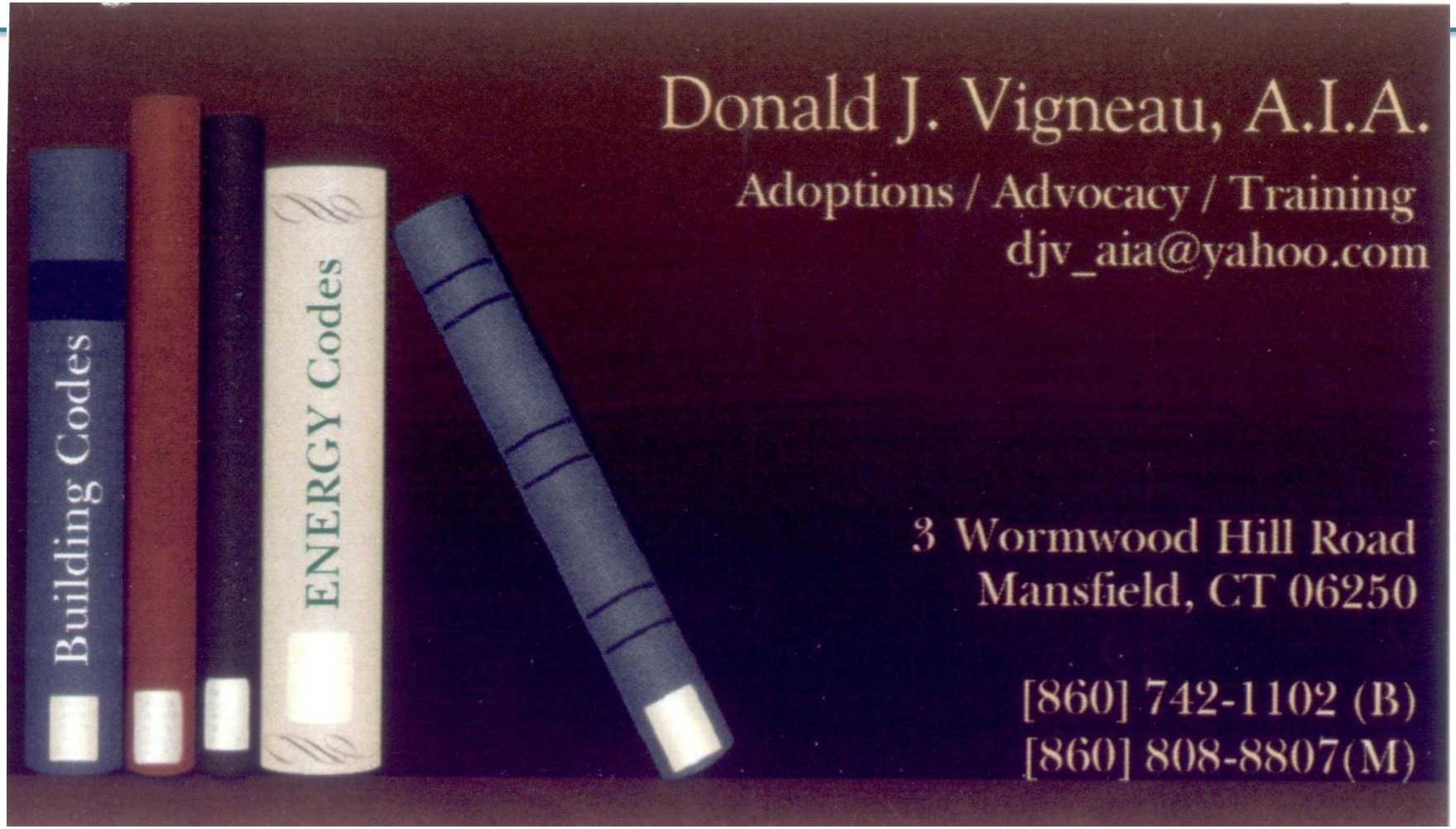
ADDITIONAL DOE RESOURCES

Building Energy Codes Assistance for States	**Status of State Energy Codes**	Check on the current code status of any U.S. state or territory using BECP's interactive map tool. Also find links to state specific portions of BECP's recent nationwide analysis reports, state-level energy official contact information, and many other details.	www.energycodes.gov/states
	Technical Assistance to States	BECP provides specialized technical assistance to the states in the form of economic analysis, code comparisons, webcast training, and compliance material development requested by states to help them adopt, upgrade, implement, and enforce their building energy codes.	http://www.energycodes.gov/states/techAssist.stm
	State Compliance Assistance	BECP has developed an approach states can use for measuring compliance with building energy codes.	http://www.energycodes.gov/arra/compliance_evaluation.stm
No-cost Compliance Tools	**Residential Code Compliance Software**	RES*check*™ and RES*check-Web*™	http://www.energycodes.gov/software.stm
	Commercial Code Compliance Software	COM*check*™ and COM*check-Web*™	
Training	**Codes University**	To help stakeholders broaden and deepen their knowledge of building energy codes, BECP is collecting its diverse training resources in an extensive Codes University that features webcasts, training videos, self-paced online courses, presentations, and other BECP materials and tools.	www.energycodes.gov/training
Resource Center	**Building Energy Codes Knowledge Base**	This knowledge base provides a variety of different media types, including articles, graphics, online tools, presentations, and videos that anyone can use to create their own training and presentations.	http://resourcecenter.pnl.gov/
Advocacy	**The Building Codes Assistance Project (BCAP)**	BCAP is an initiative of the Alliance to Save Energy, the American Council for an Energy-Efficient Economy, and the Natural Resource Defense Council that provides states with code advocacy assistance on behalf of DOE.	www.bcap-energy.org

Class Dismissed!



QUESTIONS?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