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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Awareness and Requirements of the 2012 IECC

Residential Workshop 1



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Introductions

Stephen Johnson

Project email:

energycodeworkshop@shawgrp.com

Code officials:

Name

Municipality

Status of Residential Codes



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Overview

Project funded by the Missouri Department of Natural Resources (MDNR) with American Recovery and Reinvestment Act of 2009 (ARRA) funding.

4 Locations and Webinars:

- St. Louis (December 1st – 2nd)
- Springfield (December 5th – 6th)
- Kansas City (January 24th – 25th)
- Columbia (February 27th)

Objective of the Workshop: Work with municipalities and counties across the state to identify opportunities to adopt or enhance compliance with the 2009 or 2012 International Energy Conservation Code (IECC) at a local level.



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Agenda

Topic	Approx. Time
Introduction	15 minutes
Awareness of 2009 IECC	30 minutes
2009 IECC Highlights	70 minutes
Summary	5 minutes
Total	2 hours



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Some Important Points

Overall

- Discussion-based

What can you expect?

- Can follow code citations in []

Before we get started...

- Cell phones

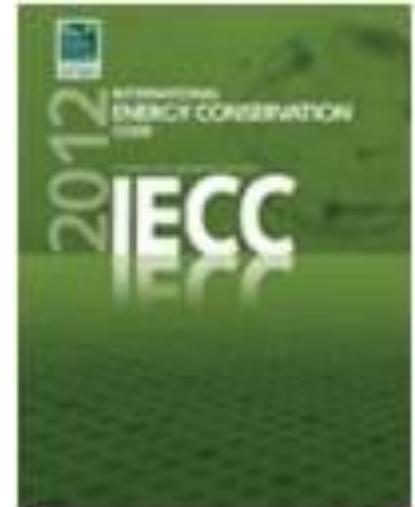


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Overview

- The International Code Council® (ICC) develops codes
- The IECC looks at energy consumption and cost savings in buildings
- Three year cycle for updates
- Several codes by the ICC
 - International Building Code®
 - International Residential Code®
 - International Fire Code®
 - International Mechanical Code®
 - International Property Maintenance Code®



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Overview

Relationship between International Residential Code (IRC) and IECC

- IECC addresses only energy (commercial and residential)
- IRC addresses all topics (structural, plumbing, energy, etc.)
- IRC – Chapter 11 - Energy Efficiency
 - Exactly the same as the IECC Residential Section

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Overview

2012 IECC – Residential Section

1. Administration
2. Definitions
3. General Requirements
4. Residential Energy Efficiency
5. Referenced Standards



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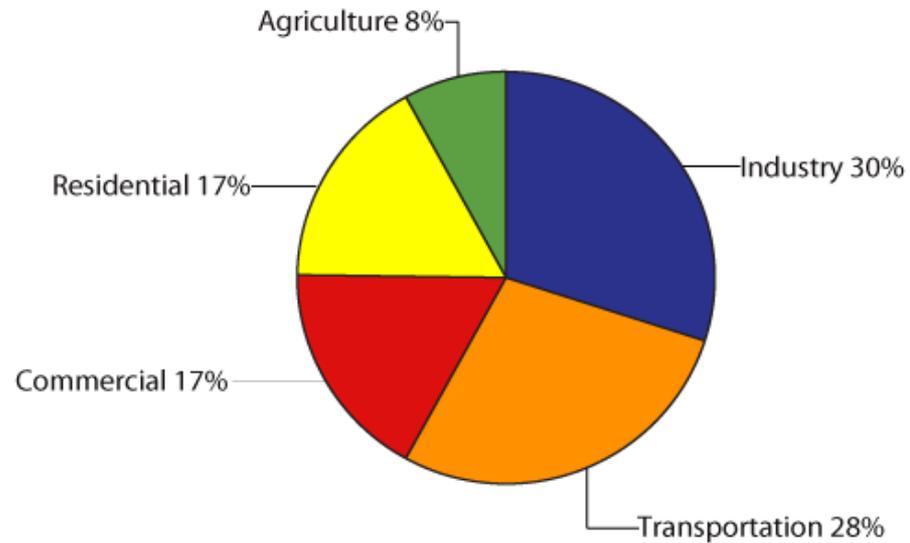
Overview

R101.3 Intent. This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.



Greenhouse Gas Emissions by Sector

United States, 2004



Source: US EPA Inventory of Greenhouse Gas Emissions and Sinks, 2006.

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Overview

Residential provisions of the IECC attempts to regulate energy use:

- [R402] Building thermal envelope
- [R403] Systems
- [R404] Lighting

IECC does NOT regulate:

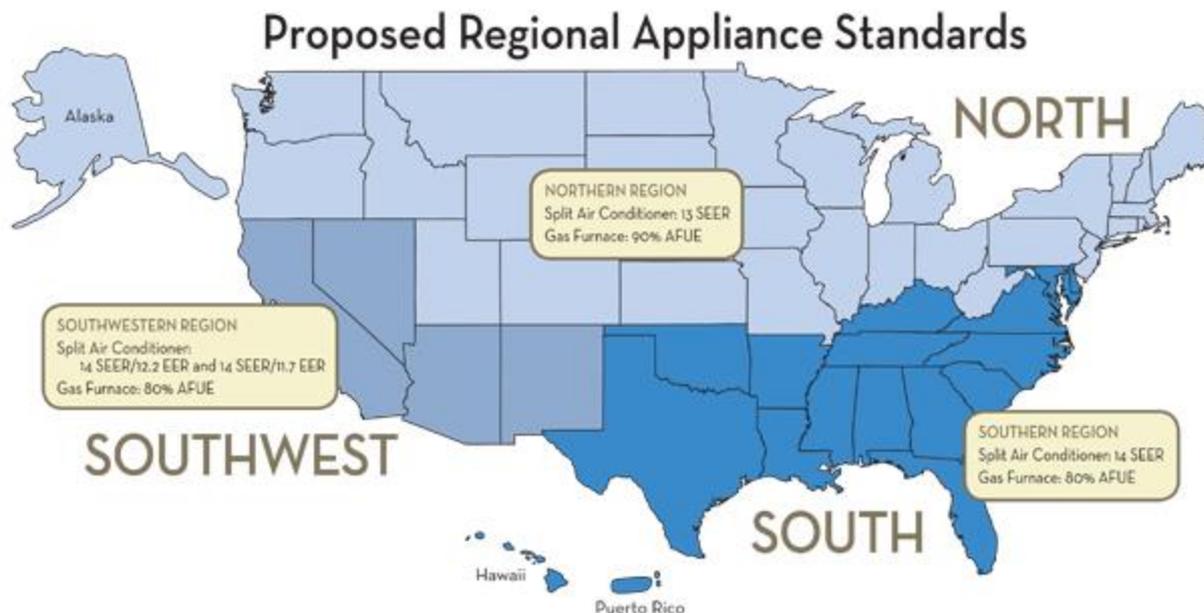
- Mechanical system efficiencies
- Appliances
- Water consumption

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Overview

New federal mandate on heating (May 2013) and cooling systems (Jan. 2015)



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Overview

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.

- Single family house
- Duplex/townhouse
- Triplex (or larger units if 3 stories or less in height above grade)
- Apartment Buildings (if 3 stories or less in height above grade)
- Assisted Living Communities (if 3 stories or less in height above grade)

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COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of “Residential buildings.”

R101.4.6 Mixed occupancy. Where a building includes both *residential* and *commercial* occupancies, each occupancy shall be separately considered and meet the applicable provisions of the IECC—Commercial and Residential Provisions.

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Overview

- A 10 unit, 2 story apartment complex?
- References the IBC (IRC is for one- and two-family dwellings or townhouses)
- Still the residential portion of the IECC per the ICC definitions

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Topic 1

Awareness of the 2012 IECC



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Topic 1 Objectives

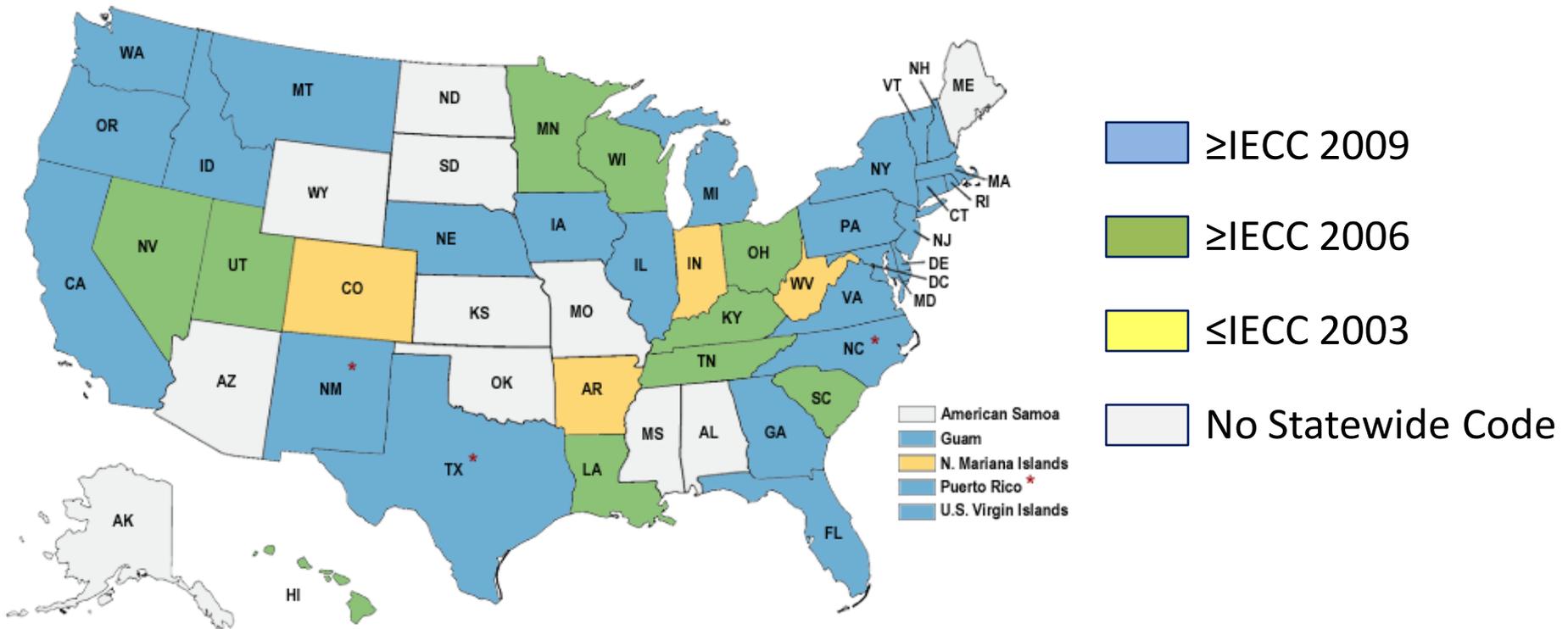
- Current Implementation
- Benefits
- Challenges
- Cost impact of compliance
- Promote awareness



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Overview - Residential State Energy Code Status (*)



(*) as of November 1, 2011, DOE – Building Energy Codes Program

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Missouri Facts

Missouri: A Patchwork of Codes

Due to its history of strong local government, **Missouri does not have a mandatory statewide energy code**, however all local jurisdictions except class III counties have the right to adopt an energy code. As expected, this system creates a sometimes confusing patchwork of different codes throughout the state.

Regardless of the system in place, the bottom line is that **many jurisdictions in Missouri still don't have an energy code**—meaning that many residents do not receive the benefits of energy-efficient construction.



(Building Codes Assistance Project)



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Missouri Facts

Statewide Savings

\$318 million

Annual energy savings by 2030.

26 trillion

Btu of energy avoided annually by 2030.

1.4 million

Metric tons of CO₂ prevented annually by 2030.³

By adopting and enforcing the 2009 IECC starting in 2011, Missouri municipalities and counties would **significantly improve the state's economy and environment** now and into the future.

(Building Codes Assistance Project)



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Overview - Missouri Residential Energy Efficiency

State Level:

- No mandatory efficiency code

Local Level:

- St. Louis City and County – 2009 IECC
- Clay County – 2006 IRC
- Springfield – 2006 IRC with 2012 IRC this year, but with amendments

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Benefits - Municipality

- Reduces strain on energy and utility resources
- Create economic opportunities for business and industry by promoting new, energy-efficient technologies
- Job creation and enhanced skills of workforce
- ISO rating and insurance rates



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Benefits - Homeowner

- Marketplace does not protect the homeowner
 - Not all homeowners are experts on efficiency
 - Difficult to gauge utility costs of a new home
- New construction is a unique opportunity
- Upfront cost vs. long-term operating costs – remove risk
- Emissions from energy consumption
- Improved thermal comfort
- Quieter spaces
- Better product through inspections and testing

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Benefits - Contractor

- Customer satisfaction and recommendations
 - Increases comfort
 - Fewer call-backs
- Competitive advantage in the marketplace
 - Advertising can be used to explain energy-efficiency advantages
 - Can leverage available incentives and increase revenue
- Common basis for education and practice

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Challenges

Municipality

- Limited municipal staff/availability to attend trainings
- Ability to accurately enforce the code

Homeowner

- Public perception of energy codes
- Added costs to homeowners

Contractor

- Added costs and time

Homeowner:
I'd rather have the granite countertops.

Contractor:
It's always been done this way.

Contractor:
Come on, that's not necessary.

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Costs of the 2012 IECC

Analysis of Costs and Benefits of 2012 IECC

- Difficult to estimate:
 - Current baseline construction specification
 - Construction upgrade costs
 - Energy savings
- Building Codes Assistance Project (BCAP) compared 2006 to 2012 IECC
 - Extra initial cost of only \$1,460
 - Annual energy savings of \$621
 - Cash positive in 7 months with mortgage
 - Savings of \$16,338 over a 30 year mortgage

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Promoting Awareness

- Where is our municipality relative to our neighbors?
- Transparency to stakeholders
 - Utilize your municipality's website
 - Distributing handouts/information to applicants as early as possible



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Promoting Awareness

Resource Inventory

- Compilation of resources
- Living document

Residential/ Commercial	Residential/Commercial 2009 IECC	Guide	2009 IECC with commentary	Basic Energy Code definitions from the 2009 IECC with short commentary. Purchase available at this link.	http://www.iccsafe.org/Store/Pages/Product.aspx?id=3810S09
Residential/ Commercial	REScheck and COMcheck	Presentation	Building Energy Codes Online Training	This website provides links to a variety of courses, including information about REScheck, the requirements of the 2009 IECC, etc.	http://www.energycodes.gov/moodle/
Residential/ Commercial	REScheck and COMcheck	Presentation	2009 IECC, REScheck and COMcheck	IECC, REScheck and COMcheck presentation developed by U.S. DOE.	http://www.energycodes.gov/training/pdfs/2009_iecc_rescheck_comcheck.pdf
Residential	Additions and Renovations and the 2009 IECC	Transcript	Residential Requirements of the 2009 IECC	Transcript for a presentation given by the U.S. DOE on the residential requirements of the 2009 IECC (pg. 7 is relevant to additions and renovations).	http://www.energycodes.gov/training/pdfs/2009_iecc_residential_transcript.pdf
Residential	REScheck	Compliance Report	REScheck Compliance Report	Sample REScheck compliance report with sample energy efficiency certificate on pg 5.	http://kwhdesign.net/site/Permit & Construction Documents_files/REScheck.pdf
Residential	Compliance	Frequently-Asked Questions	Frequently-Asked Questions - Module 3 provided by ICC	Frequently-asked questions around the residential energy code; includes answers to questions about the 2009 IECC and roofs, wood-burning fireplaces, windows, thermal envelopes, etc.	http://media.iccsafe.org/geo/docs/FAQ_Module-3.pdf
Residential/ Commercial	General Code Information	Fact Sheet	Policy Maker Fact Sheet, Building Energy Code Compliance; October 2010	One-page tool that provides answers to questions such as: (1) What are energy codes? (2) What are the benefits of building energy codes? (3) What can policy makers do to enhance code compliance and enforcement?	www.imt.org/files/PolicyMakerFactsheet-EnergyCodeCompliance.pdf
Residential/ Commercial	Mechanical	Article	Bigger is not always better with HVAC systems	Article describes why sizing appropriately is of importance, links to article regarding how to size equipment correctly, and to diagrams outlining the mechanical systems covered by the IECC	http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/article/136
Residential/ Commercial	Mechanical	Articles, web tools, photos, presentations	Building Codes Energy Resource Center	Numerous sources for information regarding HVAC systems and the IECC. Use "browse topic" drop down menu at upper right to choose "mechanical."	http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter

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Promoting Awareness

Resource Inventory

- Central location
- Sort-able
- Variety of resources
 - Presentations
 - Pamphlets
 - Factsheets
 - Articles
 - Guides
 - Websites

– Reports

- Frequently-asked questions

Sources

- U.S. Department of Energy
- International Code Council
- Other states and municipalities

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Promoting Awareness

Resource Inventory

Topics:

- Code requirements
- RES*check* and COM*check*
- Additions/renovations
- Duct pressure testing
- Mechanical systems
- Inspections
- Incentives available

Interpretation questions

- Website:
<http://www.iccsafe.org/cs/Pages/opinions.aspx>
- Phone: 1-888-ICC-SAFE (422-7233)
- ext. 338077

US Department of Energy

- Website:
<http://www.energycodes.gov/help/>

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Promoting Awareness

Example of Resources

- [Top 10 Reasons for Building Energy Codes](#), U.S. Dept. of Energy
- [Duct Leakage Frequently-Asked Questions](#), U.S. Dept. of Energy
- [Bigger is not always better with HVAC systems](#), U.S. Dept. of Energy

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Promoting Awareness

Contractor awareness

- Inform contractors with the energy code
 - Create cheat sheet, require short training, or take notes about failed inspections
- Identify and address knowledge gaps upfront to enhance compliance with the IECC
- Possible to require registration
- Create opportunities to promote awareness



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Promoting Awareness

Summary of Mechanical Requirements

- Size and select appropriate heating and cooling systems – submit documents to city prior to installation
- Seal all duct connections
- Building cavities can not be used as ducts or plenums
- Install furnace and ducts in conditioned space
 - If ducts cannot be fully located in conditioned space
 - » Insulate supply ducts to R-8 and all others to R-6
 - » Test for duct tightness and meet requirements

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Topic 1 Summary

- There are several benefits that result from energy codes, to all stakeholders
- The challenges of implementing the 2012 IECC can easily be overcome
- There are several options available which municipalities can use to promote awareness of the 2012 IECC

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Topic 2

Highlights of the Residential portion of the 2012 IECC



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Topic 2 Objectives

- Overview
- Compliance
 - Mandatory Provisions
- Compliance Paths
 - Prescriptive [R402.1]
 - U-Factor [R402.1.3]
 - UA Alternative [R402.1.4]
 - Simulated Performance Alternative [R405]

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Overview

Applicability

- Code applies to residential buildings
- New construction, additions, alterations, renovations or repairs
- Additions can comply alone or in combination with existing building

Exempted Buildings

- Existing buildings
- Historic buildings
- Buildings (or portions of) that are neither heated or cooled (e.g. garage)

Exempted Alterations

- Eight exceptions for alterations

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Overview

8 Exceptions

1. Storm windows installed over (E) window.
2. Glass only replacements in an (E) window.
3. (E) cavities are filled with insulation.
4. (E) cavity is not exposed.
5. Reroofing for roofs where neither the sheathing nor the insulation is exposed.

(E)=Existing

Exceptions 6-8 are more relevant to commercial buildings

The IECC “is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.”

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Overview

Mandatory Requirements:

- Air sealing
- Duct insulation and sealing
- HVAC controls
- Piping Insulation
- Equipment sizing
- Lighting

Climate-Specific Requirements:

- Roofs
- Above grade walls
- Foundations
 - Basements
 - Slabs
 - Crawlspace
- Skylights, windows, and doors

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Overview

IECC Terminology

- Mandatory
 - Required, no trade-offs
- Prescriptive
 - Required, certain items can be traded-off in certain compliance paths

There are two “hard limit” – aka “trade-off limits” [R402.5]

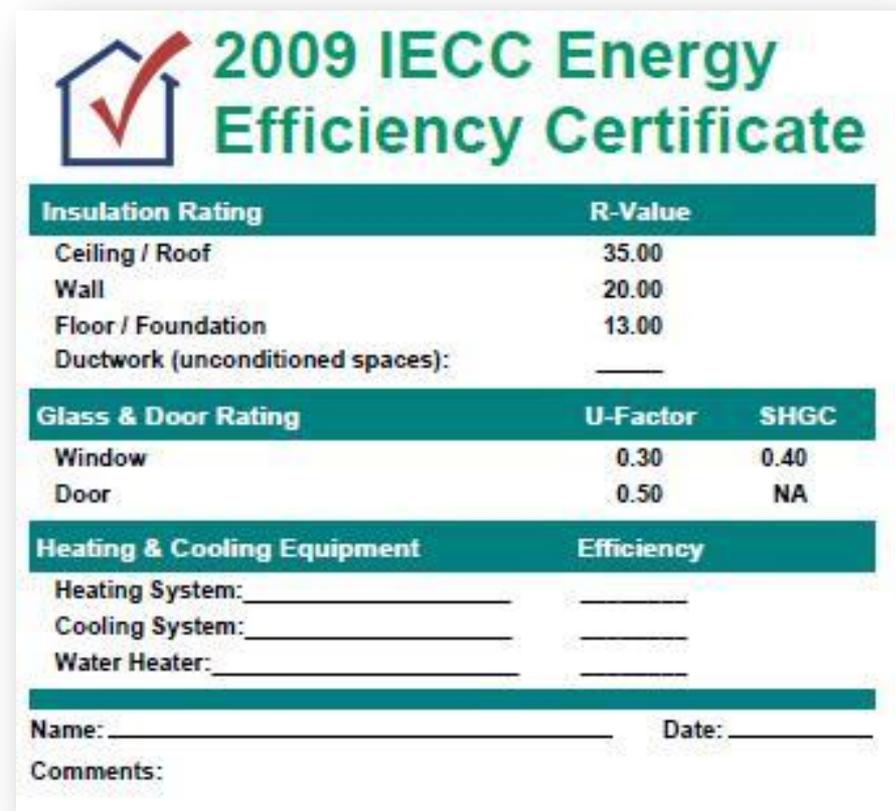
- A requirement that can only be traded so far
 - Windows
 - » U-Factor of 0.48 (CZ 4-5)
 - Skylights
 - » U-Factor of 0.75 (CZ 4-8)

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Mandatory Provisions – Certificate [R401.3]

- Install certificate on in the electrical panel stating:
 - Insulation
 - Windows
 - Duct and house test results
 - Mechanical equipment types and efficiencies



2009 IECC Energy Efficiency Certificate

Insulation Rating		R-Value
Ceiling / Roof		35.00
Wall		20.00
Floor / Foundation		13.00
Ductwork (unconditioned spaces):		_____

Glass & Door Rating		U-Factor	SHGC
Window		0.30	0.40
Door		0.50	NA

Heating & Cooling Equipment		Efficiency
Heating System:	_____	_____
Cooling System:	_____	_____
Water Heater:	_____	_____

Name: _____ Date: _____

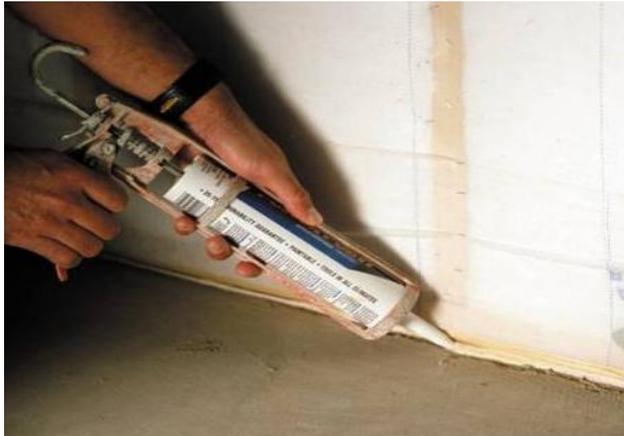
Comments: _____

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Mandatory Provisions – Air Leakage [R402.4]

- Air Barrier and Insulation Installation [R402.4.1.1]
- AND**
- Testing and verification [R402.4.1.2]
 - 3 ACH @ 50 Pascals (CZ 3-8)



Pictures from The Energy Conservatory

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Mandatory Provisions – Air Leakage [R402.4]

Specifications:

Floor Area – 2,400 ft²

Height (average floor) – 9 ft

Tested Fan Flow at 50 Pa – 1,015 CFM

$$\text{Volume}_{\text{house}} = \text{Area} \times \text{Height} = 2,400 \times 9 = 21,600 \text{ ft}^3$$

$$\text{ACH}_{50} = \frac{60 \times \text{CFM}_{50}}{\text{Volume}} = \frac{60 \times 1,015}{21,600} = 2.82 \text{ ACH}$$

$$\text{CFM}_{\text{max at 50}} = \frac{\text{ACH} \times \text{Volume}}{60} = \frac{3 \times 21,600}{60} = 1,080 \text{ CFM}$$



Picture from The Energy Conservatory

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Mandatory Provisions – Air Leakage [R402.4]

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	CRITERIA ^a
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.

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Mandatory Provisions – Air Leakage [R402.4]

IRC - “M1503.4 Makeup air required. Exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.”



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Mandatory Provisions – Air Leakage [R402.4]

- Wood-burning fireplaces shall have tight-fitting flue dampers and outdoor combustion air [R402.4.2]
- Fenestration air leakage [R402.4.3]
 - Windows, skylights, and sliding glass doors ≤ 0.3 cfm/ft²
 - Swinging doors ≤ 0.5 cfm/ft²
 - Exception: Site built fenestration
- Recessed lighting [R402.4.4]
 - Must be IC-rated and ≤ 2.0 cfm/can



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Mandatory Provisions – Controls [R403.1]

- Thermostat installed for each (combined heating and cooling) system
- Must be programmable if primary heating system is a forced-air furnace
- Requires initial set points of:
 - Heating: $\leq 70^{\circ}\text{F}$
 - Cooling: $\geq 78^{\circ}\text{F}$
- Prevent electrical-resistance supplemental heat operation in heat pumps
 - Except for: defrost mode or when heat pump can not meet heating load

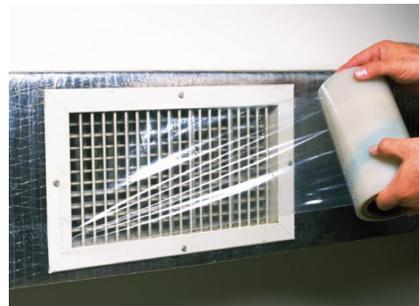


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Mandatory Provisions – Duct Sealing [R403.2.2]

- Connections must be sealed
- Testing and verification if all ducts are not located completely inside the building thermal envelope
 - Total duct leakage must be ≤ 4 cfm @ 25 Pascals/100 ft² of CFA



Pictures from The Energy Conservatory

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Mandatory Provisions – Duct Sealing [R403.2.2]

Specifications:

Floor Area – 2,400 ft²

Tested Fan Flow at 25 Pa – 74 CFM

– ≤4 cfm @ 25 Pascals/100 ft² of CFA

$$[\text{CFM}/100\text{ft}^2] = \frac{100 \times \text{CFM}_{25}}{\text{Area}} = \frac{100 \times 74}{2,400} = 3.08$$

$$\text{CFM}_{\text{max at 25}} = \frac{\text{Area} \times [\text{CFM}_{25}/100\text{ft}^2 \text{ allowed}]}{100} = \frac{2,400 \times 4}{100} = 96 \text{ CFM}$$



Picture from The Energy Conservatory

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Mandatory Provisions – Ducts [R403.2]

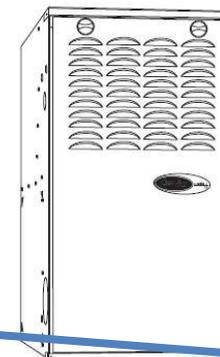
- Sealed air handler [R403.2.2.1]
 - Air handler designated for air leakage of $\leq 2\%$ of the design air flow rate
- Building cavities [R403.2.3]
 - Building framing cavities shall not be used as ducts or plenums

Certified to leak 2 percent or less of its nominal air conditioning CFM delivered when pressurized to 1-In. Water Gauge with all present air inlets, air outlets, and condensate drain port(s) sealed.

58DLA/DLX
COMFORT™ 80 DELUXE 4-WAY MULTIPOISE
INDUCED-COMBUSTION GAS FURNACE
Input Capacities: 45,000 thru 155,000 Btuh
Series 140



Product Data



STANDARD FEATURES

- QuietTech™ noise reduction system
- SmartEvap™ -Humidity control when using a Thermostat Control
- Comfort Fan™ -adjustable constant fan speed from the thermostat
- Microprocessor based control center
Enhanced diagnostics with LED and reflective sight glass
Stores fault codes during power outages
Adjustable heating air temperature rise
Adjustable cooling airflow
Dehumidification selection for summer-time cooling
- 4-way Multipoise furnace, 13 vent applications
- Compact design - only 33-1/3 in. (846 mm) tall
- Power Heat™ Igniter
- Draft safeguard switch to ensure proper furnace venting
- Insulated blower compartment

THE CARRIER Comfort™ 80 GAS FURNACE

The 58DLA/DLX 4-way Multipoise Gas Furnaces offer deluxe features not found in other single-stage 80% gas furnaces. Carrier's QuietTech™ noise reduction system makes the Comfort™ 80 an incredibly quiet induced-draft gas furnace. The furnace control system provides a dehumidification mode and a third motor speed selection for continuous fan operation, selectable at the thermostat, and fault code storage in the event of power outages. Applications are easy with the multipoise design, through-the-furnace downflow wiring, 13 different venting options, and a design for easy service access. An inner blower door is provided for tighter sealing in sensitive applications. The 58DLA/DLX furnaces are approved for use with natural or propane gas, and the 58DLX is approved for use in Low NOx Air Quality Management Districts.

- Certified to leak 2 percent or less of its nominal air conditioning CFM delivered when pressurized to 1-In. Water Gauge with all present air inlets, air outlets, and condensate drain port(s) sealed.

- Inner door for tighter sealing
- HYBRID HEAT® Dual Fuel System compatible
- All models are chimney friendly when used with accessory vent kit
- Twinning in Upflow, Downflow and Horizontal
- Residential installations eligible for consumer financing through the Retail Credit Program

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Mandatory Provisions – Mechanical Piping [R403.3]

- Insulate piping to $\geq R-3$ if fluids are $\leq 55^{\circ}\text{F}$ or $\geq 105^{\circ}\text{F}$
- Protect insulation from weather
 - Sunlight, moisture, maintenance, wind, etc.



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Mandatory Provisions – Circulating Hot Water Systems [R403.4.1]

- Systems must be provided with an automatic or readily accessible manual switch that can turn off the hot-water circulating pump



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Mandatory Provisions – Mechanical Ventilation Installed [R403.5]

- Defined in 2012 IRC [R303.4 and M1507.3]
- Required when home is < 5 ACH @ 50 Pascals
- Similar to ASHRAE 62.2 ventilation standard

• System Options:

- Exhaust Only
- Supply Only
- Exhaust/Supply with Balancing Vent
- Balance of Supply and Exhaust
- ERV/HRV

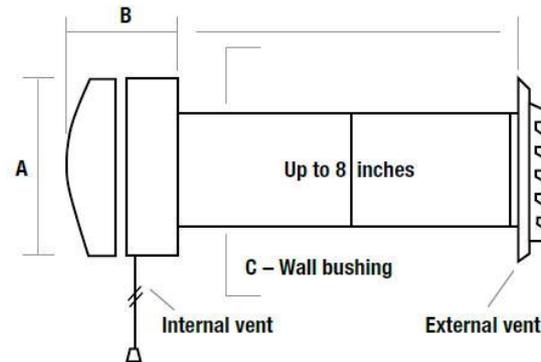
DWELLING UNIT FLOOR AREA (square feet)	NUMBER OF BEDROOMS				
	0 - 1	2 - 3	4 - 5	6 - 7	> 7
	Airflow in CFM				
< 1,500	30	45	60	75	90
1,501 - 3,000	45	60	75	90	105
3,001 - 4,500	60	75	90	105	120
4,501 - 6,000	75	90	105	120	135
6,001 - 7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

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Mandatory Provisions – Mechanical Ventilation Installed [R403.5]

- Exhaust
- Supply
 - ECM furnace

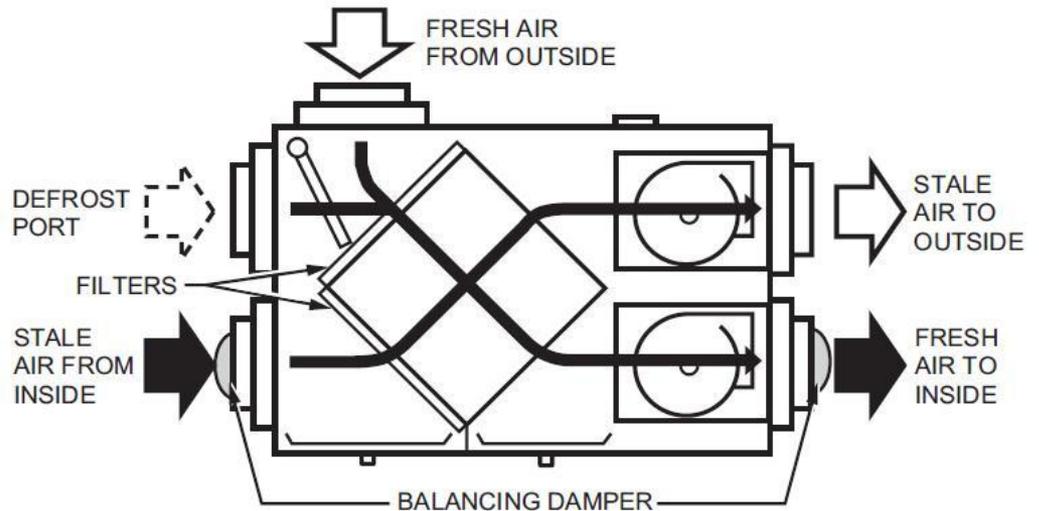


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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Mechanical Ventilation Installed [R403.5]

- Energy Recovery Ventilator
- Heat Recovery Ventilator



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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Mechanical Ventilation Installed [R403.5]

- If ventilation system uses range hoods, bathroom or utility room exhaust fans the must meet fan efficacy requirements
- If ventilation system uses HVAC equipment then the fan shall be powered by an electronically commutated motor (ECM)

This furnace qualifies for AMACF Federal Energy Efficiency Tax Credit when placed in service between February 17 2009 and December 31 2011.

Certificate of Product Ratings

AHRI Certified Reference Number: 2008404 Date: 12/20/2011

Product: Residential Furnace Heating Equipment
Model Number: TDHMD120ACV5VA
Manufacturer: TRANE
Trade/Brand name: XC35M

Rated as follows in accordance with Department of Energy (DOE) furnace test procedures as published in the latest edition of the Code of Federal Regulations, 10 CFR Part 430 and SUBJECT to verification of rating accuracy by AHRI-sponsored, independent, third party testing:

AFUE:	92.1%
Output Heating Capacity:	109 MBTUH

The following data is for reference only and is not certified by AHRI:

Input:	120 MBTUH
Et:	99.0 MMBTU/yr
Eae:	519 kWh/yr
PE:	80 Watts
Furnace Type:	Non-Weatherized
Config:	Downflow,Horizontal
Fuel Type:	Natural Gas,Propane Gas

Advanced Main Air Circulating Fan
"e" Electrically Efficient Furnace
FootNote 79 - This furnace is equipped with an Electronically Commutated Motor (ECM)

1 Models with an "Active" status are those that are currently in production. Models with a "Discontinued" status are those that the manufacturer has elected to stop producing, yet stock is still available. Models with an "Obsolete" status are those that the manufacturer is required to stop manufacturing due to an AHRI modification program test failure.
2 Ratings followed by an asterisk (*) indicate a change from previously published data, unless accompanied with a WAS, which indicates an involuntary rating.

on this Certificate and makes no representations, warranties or guarantees as to, and assumes no responsibility for, expressly disclaiming all liability for damages of any kind arising out of the use or performance of the product(s), or the Certificate. Certified ratings are valid only for models and configurations listed in the directory at www.ahri.org.

ry products of AHRI. This Certificate shall only be used for individual, personal and confidential reference purposes, not to be reproduced, copied, disseminated, referred into a computer database, or otherwise utilized, in any form, without the prior written consent of AHRI.

ertificate can be verified at www.ahri.org.
AHRI Certified Reference Number and the date on the Certificate above, and the Certificate No., which is listed below.

g. and Refrigeration Institute

AHRI Air-Conditioning, Heating, and Refrigeration Institute
CERTIFICATE NO.: 129688715017250850

Advanced Main Air Circulating Fan "e" Electrically Efficient Furnace

FootNote 79 - This furnace is equipped with an Electronically Commutated Motor (ECM)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Equipment Sizing [R403.6]

- Heating and cooling equipment shall be sized to ACCA Manual J and S
- Interior design temperatures:
 - Cooling: minimum of 75°F
 - Heating: maximum of 72°F

ACCA - Air Conditioning Contractors of America
 Manual J – Residential Load Calculation
 Manual S – Residential Equipment Selection

wrightsoft Project Summary
 Entire House
 Gil Rossmiller

Job: Feb 2018
 By: Gil Rossmiller

Project Information

For: Energy Codes 2010

Notes:

Design Information

Weather: Denver, CO, US

Winter Design Conditions		Summer Design Conditions	
Outside db	3 °F	Outside db	90 °F
Inside db	70 °F	Inside db	75 °F
Design TD	67 °F	Design TD	15 °F
		Daily range	14 °F
		Relative Humidity	50 %
		Moisture difference	-36 gr/lb

Heating Summary		Sensible Cooling Equipment Load Sizing	
Structure	28025 Btuh	Structure	15738 Btuh
Ducts	0 Btuh	Ducts	0 Btuh
Central vent (64 cfm)	3867 Btuh	Central vent (64 cfm)	877 Btuh
Humidification	0 Btuh	Blower	0 Btuh
Piping	0 Btuh		
Equipment load	29801 Btuh	Use manufacturer's data	0 y
		Rate/swing multiplier	1.00
		Equipment sensible load	16613 Btuh

Infiltration		Latent Cooling Equipment Load Sizing	
Method	Simplified	Structure	274 Btuh
Construction quality	Average	Ducts	0 Btuh
Fireplaces	0	Central vent (64 cfm)	-1281 Btuh
		Equipment latent load	0 Btuh
Area (ft²)	Heating	3000	
Volume (ft³)	Cooling	14464	
Air changes/hour		0.25	
Equiv. A/VF (cfm)		0.7	
		36	

Heating Equipment Summary		Cooling Equipment Summary	
Make	Carrier	Make	Carrier
Trade	Carrier	Trade	Base 13 Puron AC
Model	58MCB040-12x	Cond	24ABA324A30
GAMA ID	144278	Coil	CAP**2414A**++TDR
		ARI ref no.	738723
Efficiency	82.1 AFUE	Efficiency	11.6 EER, 13 SEER
Heating input	40000 Btuh	Sensible cooling	18148 Btuh
Heating output	33156 Btuh	Latent cooling	3203 Btuh
Temperature rise	44 °F	Total cooling	21350 Btuh
Actual air flow	830 cfm	Actual air flow	66 cfm
Air flow factor	0.032 cfm/Btuh	Air flow factor	0.065 cfm/Btuh
Static pressure	0.70 in H2O	Static pressure	0.70 in H2O
Space thermostat		Load sensible heat ratio	1.00

Printout certified by ACCA to meet all requirements of Manual J 8th Ed.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Equipment Sizing [R403.6]

Heating Summary

Structure	26025	Btuh
Ducts	0	Btuh
Central vent (64 cfm)	3867	Btuh
Humidification	0	Btuh
Piping	0	Btuh
Equipment load	29891	Btuh

Heating Equipment Summary

Make	Carrier	
Trade	Carrier	
Model	58MCB040-12x	
GAMA ID	144278	
Efficiency		92.1 AFUE
Heating input	40000	Btuh
Heating output	33156	Btuh
Temperature rise	44	°F
Actual air flow	830	cfm
Air flow factor	0.032	cfm/Btuh
Static pressure	0.70	in H2O

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Systems for Multiple Dwellings [R403.7]

- Must comply with Commercial sections of the code in lieu of Section R403
 - C403: Building Mechanical Systems
 - C404: Service Water Heating

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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Snow Melt, Pools, Spas [R403.8-9]

- Snow melt System controls [R403.8]
 - Automatic controls dependent on precipitation and temperature
- Pools and inground spas [R403.9]
 - Accessible on-off switch
 - No continuously burning pilot lights
 - Automatic time controls for heaters and pumps except for public health reasons or if required for solar- and waste-heat systems
 - Vapor-retardant covers
 - » Exception: heating from renewable energy

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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Power and Lighting Systems [R404]

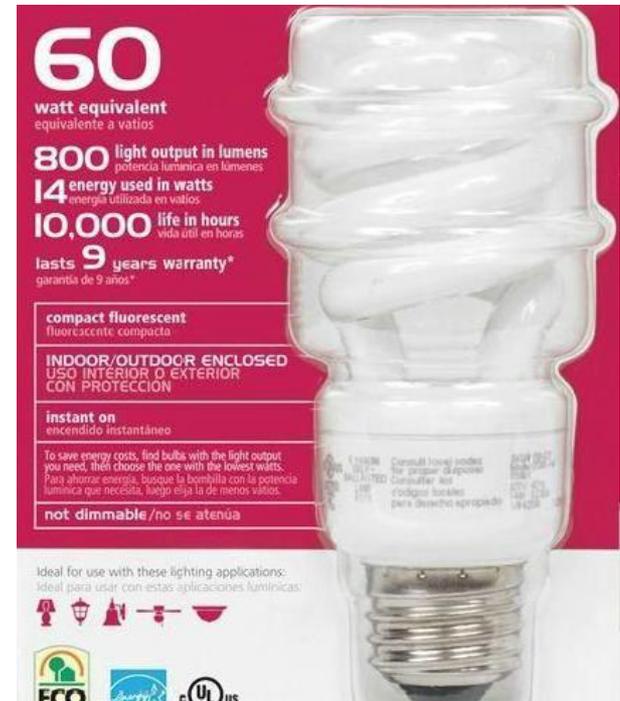
- At least 75% of permanently installed lighting fixtures/lamps on the site shall be high-efficacy [R404.1]
 - Exempt: low-voltage lighting
- What is high-efficacy? [Chapter 2]
 - Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:
 - » 60 lumens per watt for lamps over 40 watts,
 - » 50 lumens per watt for lamps over 15 watts to 40 watts, and
 - » 40 lumens per watt for lamps 15 watts or less

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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions – Power and Lighting Systems [R404]

$$\frac{\text{Lumens}}{\text{Watt}} = \frac{800}{14} = \frac{57.1 \text{ Lumens}}{\text{Watt}}$$



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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance

Mandatory Provisions

AND

Compliance Path

(Four Options)



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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance

Mandatory Provisions

AND

- A. Prescriptive
- B.1 U-Factor
- B.2 UA Alternative
- C. Simulated Performance Alternative

Prescriptive Approaches

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance Path – Prescriptive Approaches

- Choose R-Value, U-Factor, or UA Alternative
AND
- Meet prescriptive requirements

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Prescriptive Requirement – Eave Baffle [R402.2.3]

- Vented attics with air permeable insulation, must have baffles installed at all soffit and eave vents

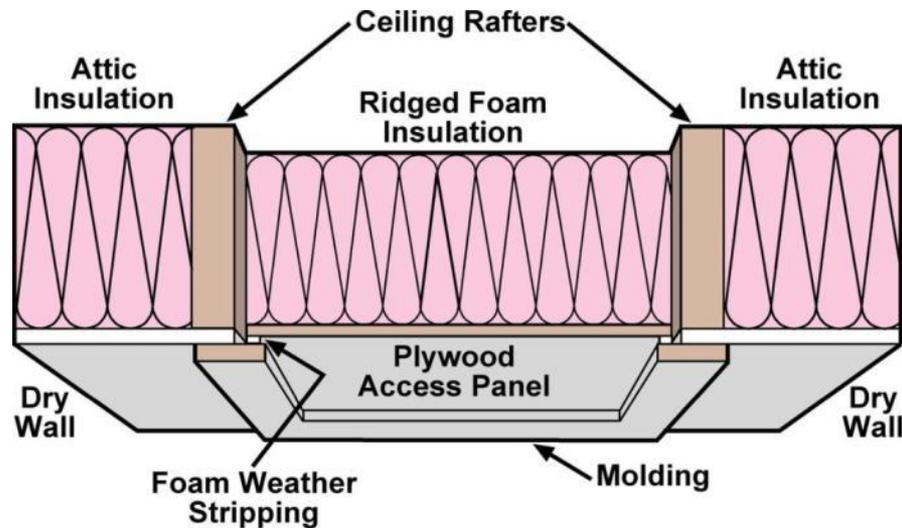


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Prescriptive Requirement – Access Hatches and Doors [R402.2.4]

- Access must be weatherstripped and insulated to meet requirements
- Loose fill insulation, at access, must be framed so that insulation will not move from location



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Prescriptive Requirement – Floors [R402.2.7]

- Insulation must be installed to maintain permanent contact with underside of the subfloor decking

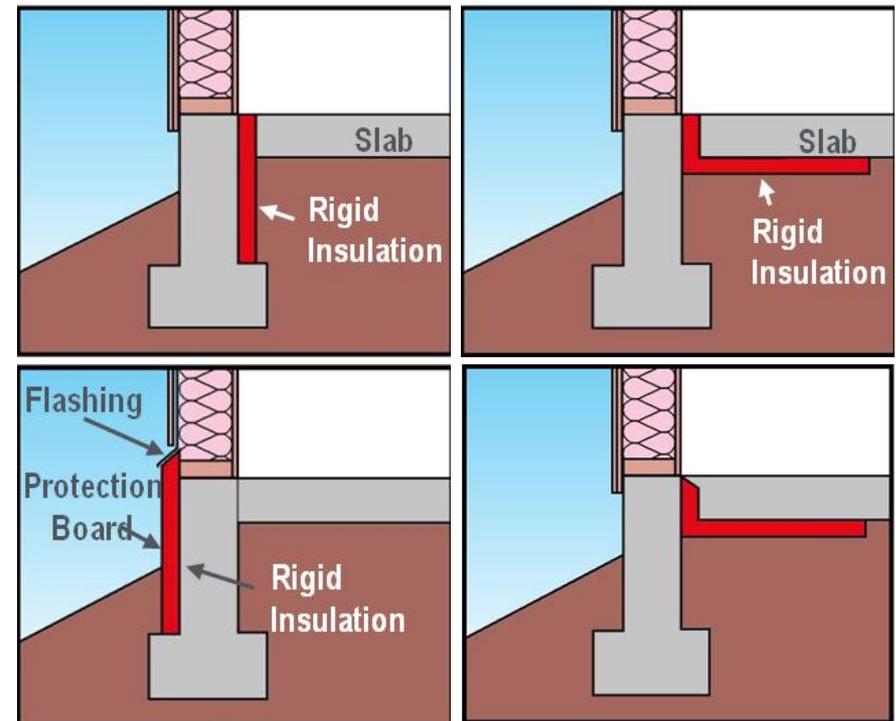


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Prescriptive Requirement – Slab-on-Grade Floors [R402.2.9]

- Floor surface <12” below grade
- “Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation”
- R-5 insulation shall be added to the required slab edge R-values for heated slabs

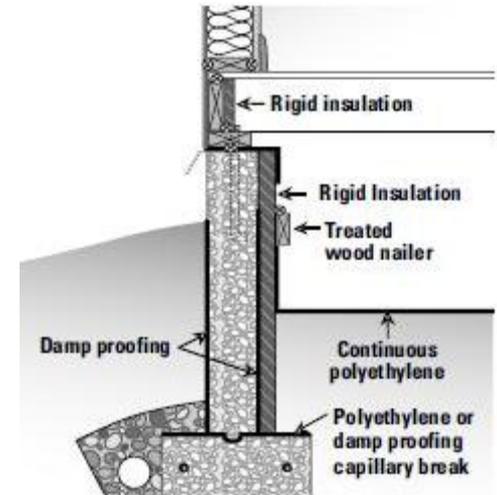
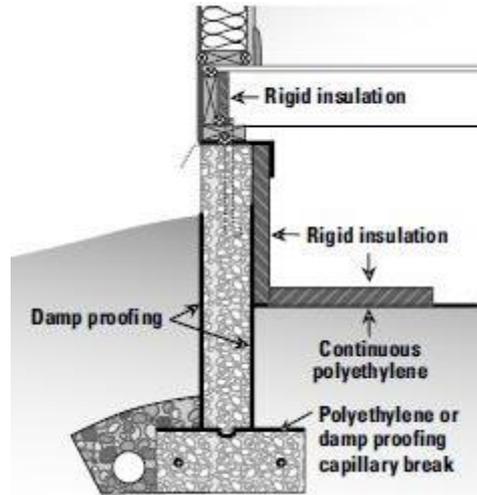
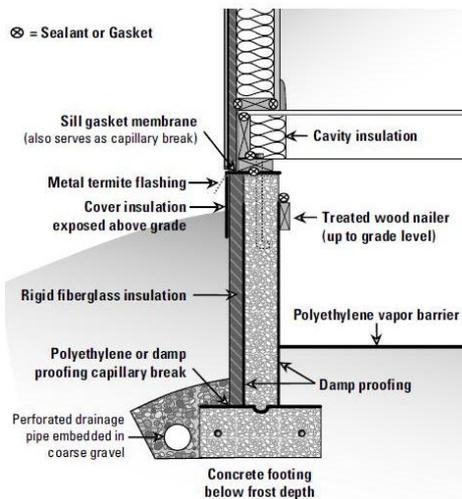


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Prescriptive Requirement – Crawl Space Walls [R402.2.10]

- Crawl space wall insulation instead of floor insulation
- Crawl space must not be a conventionally vented space
- Insulation must extend down or inward for at least two feet below grade



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MISSOURI DEPARTMENT OF NATURAL RESOURCES

Prescriptive Requirement – Crawl Space Walls [R402.2.10]

Reference to the IRC [IRC R408.3]

- Crawl space is a conditioned space
- The crawlspace ground surface must be covered and sealed with an approved vapor retarder (*e.g., plastic sheeting*)
- Crawlspace must be mechanically ventilated (*1 cfm per 50 square feet*) through exhaust or supply

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Prescriptive Requirement – Fenestration [R402.3]

- An area-weighted average fenestration U-factor and SHGC is allowed to meet requirements



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Prescriptive Requirement – Duct Insulation [R403.2]

- Supply ducts in attics: R-8
- All other ducts: R-6
 - Exempt: ducts located inside the building thermal envelope



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Prescriptive Requirement – Hot Water Pipe Insulation [R403.4]

- Hot water pipes: R-3
 - Piping larger than ¾” nominal diameter
 - Piping serving more than one dwelling unit
 - Piping from the water heater to kitchen outlets
 - Piping located outside the conditioned space
 - Piping from the water heater to a distribution manifold
 - Piping located under a floor slab
- Buried piping
- Supply and return piping in recirculation systems other than demand recirculation systems
- Piping with run lengths greater than the maximum run lengths for the nominal pipe diameter given in Table R403.4.2

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Prescriptive Requirement – Hot Water Pipe Insulation [R403.4]

TABLE R403.4.2
MAXIMUM RUN LENGTH (feet)^a

Nominal Pipe Diameter of Largest Diameter Pipe in the Run (inch)	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	$> \frac{3}{4}$
Maximum Run Length	30	20	10	5

For SI: 1 inch = 25.4 mm, 1 foot 304.8 mm.

- a. Total length of all piping from the distribution manifold or the recirculation loop to a point of use.

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Prescriptive Requirement – Definition

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



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Compliance Path - Prescriptive

Mandatory Provisions

AND

- A. Prescriptive
- B.1 U-Factor
- B.2 UA Alternative
- C. Simulated Performance Alternative

Prescriptive Approaches

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Prescriptive Reduction

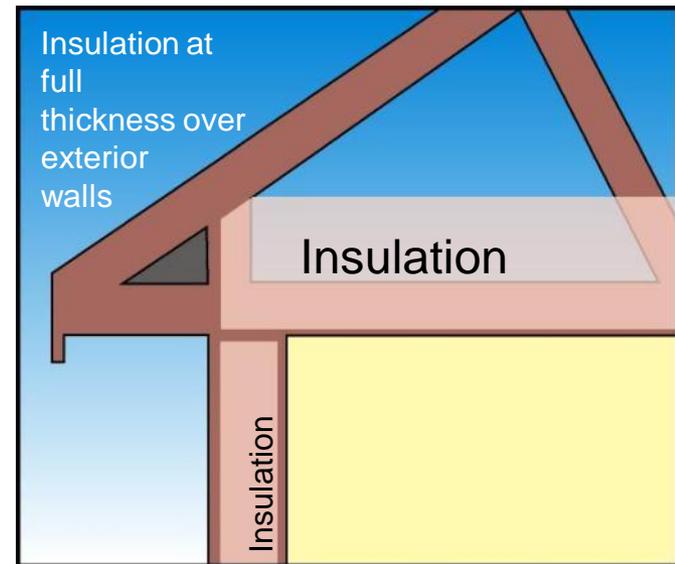
- “This reduction shall not apply to the U-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.”

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Prescriptive Reduction – Ceilings with Attic Spaces [R402.2.1]

- Energy heel truss, if constructed then:
- R-38 will meet the required R-49
- Prescriptive assumes non-energy heel truss



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Prescriptive Reduction – Ceilings without Attic Spaces [R402.2.2]

- Vaulted ceiling insulation can be reduced to R-30 if design of the roof assembly does not allow for sufficient space for the required insulation
- Only can be:
 - 500 ft² or 20% of roof area, whichever is less

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Prescriptive Reduction – Fenestration [R402.3]

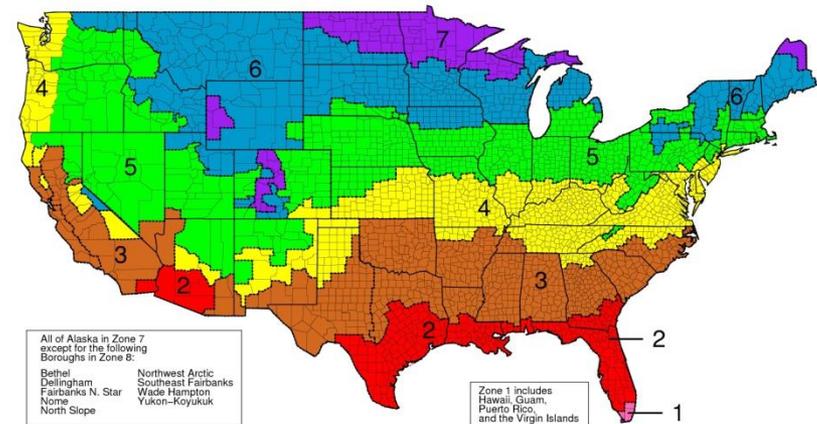
- One door (24 ft²) can be exempt of the prescriptive requirements (e.g. decorative main entry wood panel door)
- 15 ft² of windows can be exempt of the prescriptive requirements (e.g. block glass in shower instead of typical code compliant window)

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Compliance Path – Prescriptive [R402.1]

- R-values dependent on climate zone
- *Insulation and Fenestration Requirements by Component* [Table R402.1.1]
- <http://energycode.pnl.gov/EnergyCodeReqs/>
- Could cite values directly from code
- No software needed
- No trade offs



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Compliance Path – Prescriptive [R402.1]

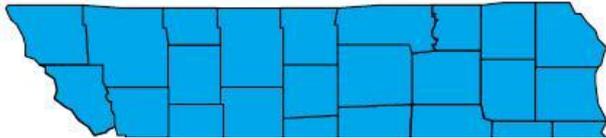


TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

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



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Compliance Path – Prescriptive [R402.1]

- R-value
 - Minimum requirement
- U-factor
 - Maximum requirement
- SHGC (solar heat gain coefficient)
 - Maximum requirement

$$R - \text{value} = \frac{1}{U - \text{factor}}$$

$$U - \text{factor} = \frac{1}{R - \text{value}}$$

$$U - \text{factor} = \frac{1}{3.5} = 0.286$$

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Compliance Path – Prescriptive [R402.1]

10/13

R-10 continuous insulation

OR

R-13 cavity insulation

15/19

R-15 continuous insulation

OR

R-19 cavity insulation

OR

R-13 cavity and R-5 continuous insulation

CLIMATE ZONE	BASEMENT ^c WALL R-VALUE
1	0
2	0
3	5/13 ^f
4 except Marine	10 /13
5 and Marine 4	15/19
6	15/19
7 and 8	15/19

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Compliance Path – Prescriptive [R402.1]

20 or 13+5

R-20 cavity insulation

OR

R-13 cavity and R-5 continuous insulation

- Installed insulation R-values shall represent actual installed thicknesses
 - Example: R-19 batt compressed to 2x6 cavity becomes R-18

CLIMATE ZONE	WOOD FRAME WALL R-VALUE
1	13
2	13
3	20 or 13+5 ^h
4 except Marine	20 or 13+5 ^h
5 and Marine 4	20 or 13+5 ^h
6	20+5 or 13+10 ^h
7 and 8	20+5 or 13+10 ^h

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Compliance Path – U-Factor [R402.1.3]

Mandatory Provisions

AND

- A. Prescriptive
- B.1 U-Factor
- B.2 UA Alternative
- C. Simulated Performance Alternative

Prescriptive Approaches

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Compliance Path – U-Factor [R402.1.3]

- U-factors dependent on climate zone
- Alternative to the R-Value Table
- *Equivalent U-Factors* [Table R402.1.3]
- Could cite values directly from code
- Can use software for help with basic U-Factor calculations
- No trade offs

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Compliance Path – U-Factor [R402.1.3]

TABLE R402.1.3
EQUIVALENT U-FACTORS^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

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

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance Path – UA Alternative [R402.1.4]

Mandatory Provisions

AND

- A. Prescriptive
- B.1 U-Factor
- B.2 UA Alternative
- C. Simulated Performance Alternative

Prescriptive Approaches

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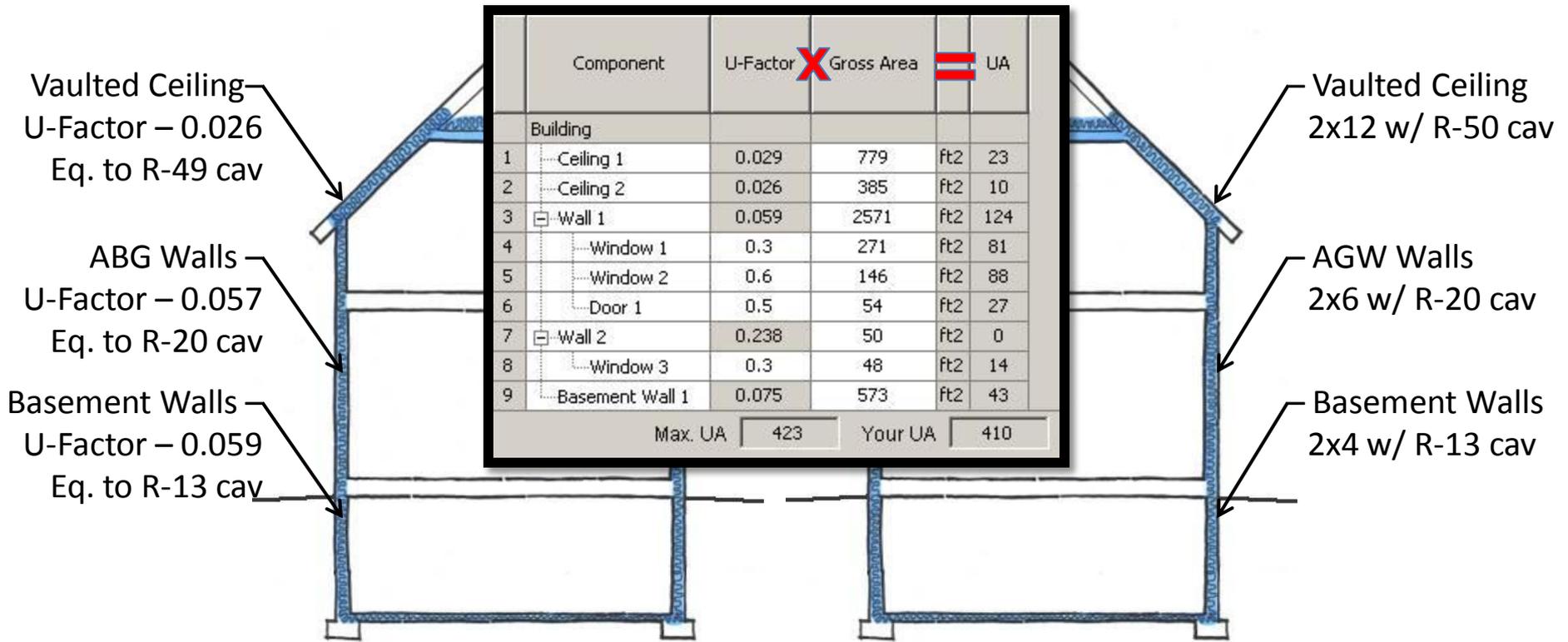
Compliance Path – UA Alternative [R402.1.4]

- Total UA is the sum of all the construction type areas multiplied by their respective U-factor
- Allows for trade offs between different portions of building envelope
- There is a hard limit on trade-offs
 - Area-weighted U-Factor of windows must be 0.48 or less
- REScheck – Department of Energy

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Compliance Path – UA Alternative [R402.1.4]



Max UA

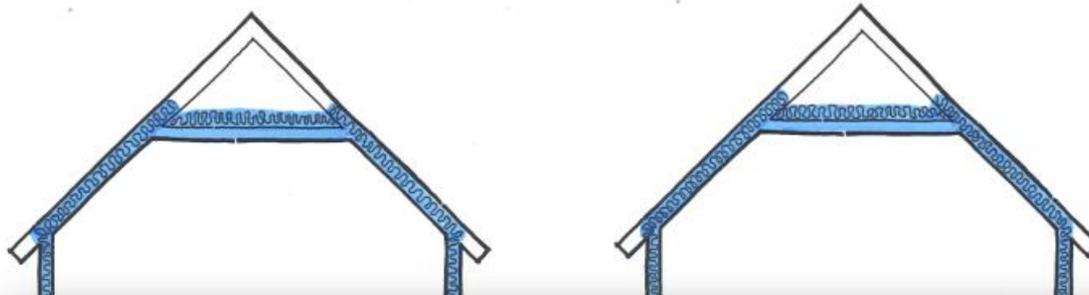


Design UA

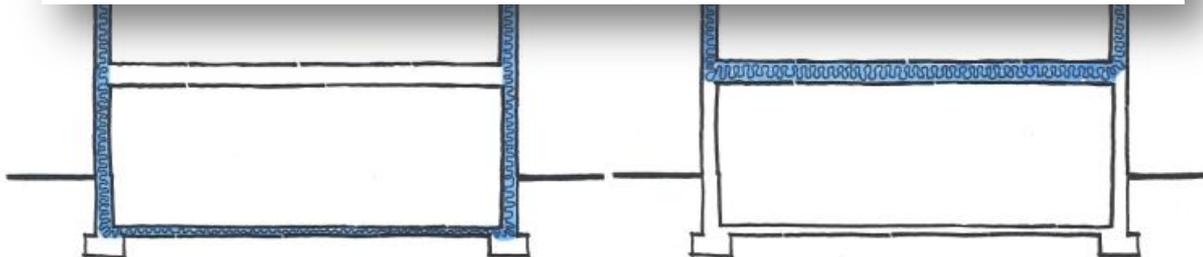
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Compliance Path – UA Alternative [R402.1.4]



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



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Compliance Path – Simulated Performance [R405]

Mandatory Provisions

AND

- A. Prescriptive
- B.1 U-Factor
- B.2 UA Alternative
- C. Simulated Performance Alternative

Prescriptive Approaches

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance Path – Simulated Performance [R405]

- Heating, cooling, service water heating energy only
- Design shown to have less than or equal to annual energy cost of standard reference design [R405.3]
- Standard reference design [Table R405.5.2(1)]

TABLE 405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

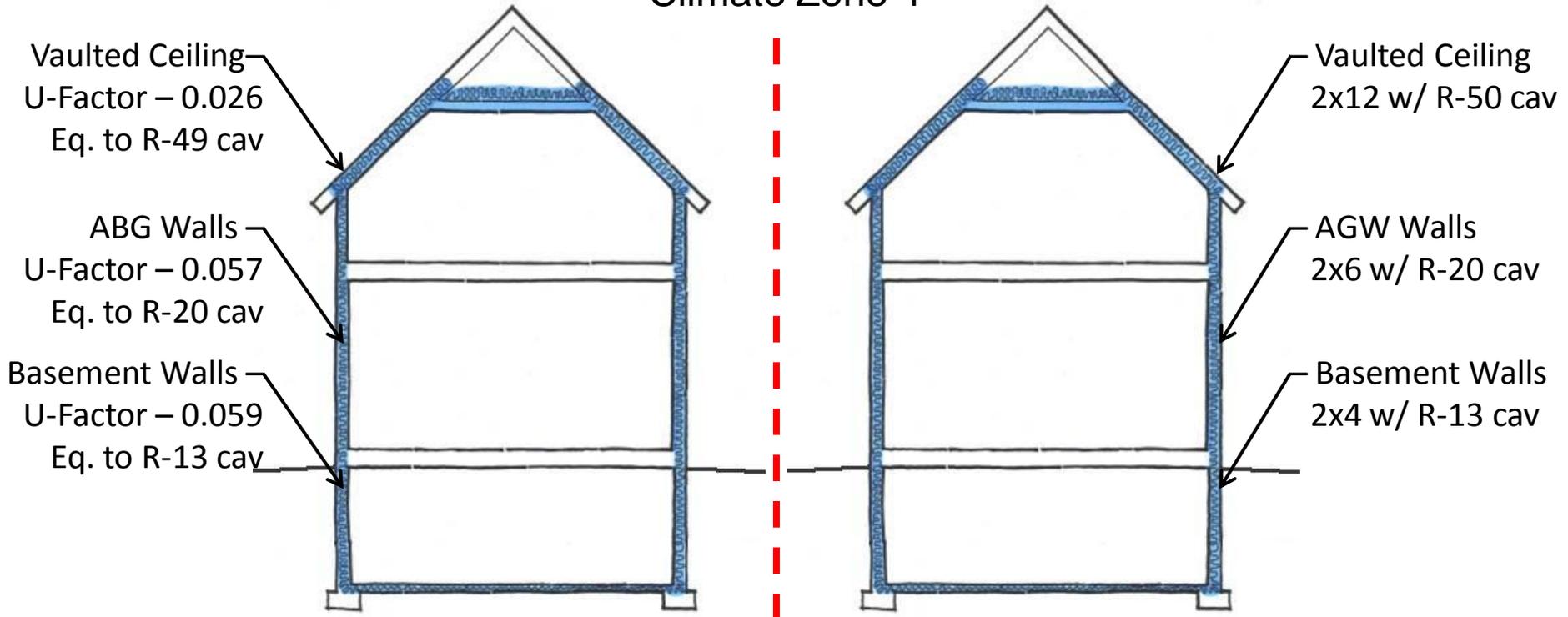
BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame. Gross area: same as proposed U-factor: from Table 402.1.3 Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed As proposed As proposed
Basement and crawl space walls	Type: same as proposed Gross area: same as proposed U-factor: from Table 402.1.3, with insulation layer on interior side of walls.	As proposed As proposed As proposed
Above-grade floors	Type: wood frame Gross area: same as proposed U-factor: from Table 402.1.3	As proposed As proposed As proposed
Ceilings	Type: wood frame Gross area: same as proposed U-factor: from Table 402.1.3	As proposed As proposed As proposed
	Type: composition shingle on wood sheathing Gross area: same as proposed	As proposed As proposed

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Compliance Path – Simulated Performance [R405]

Climate Zone 4



Reference Design
2012 IECC

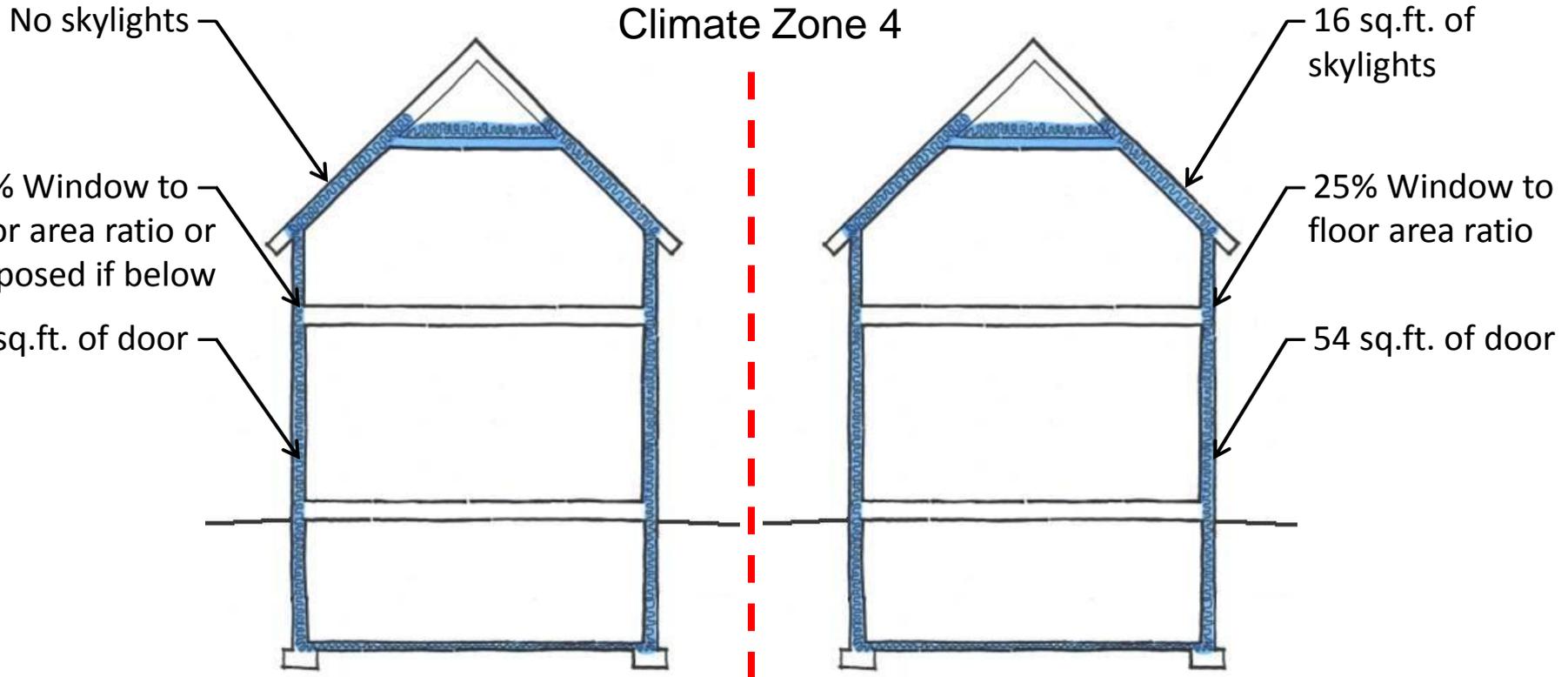


Proposed Design

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance Path – Simulated Performance [R405]



Reference Design
2012 IECC



Proposed Design

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance Path – Simulated Performance [R405]

Climate Zone 4

3 ACH @50 Pa

ACH not tested
then same as
reference OR
actual value

Mechanical
same as proposed

Mechanical as
proposed

Reference Design
2012 IECC



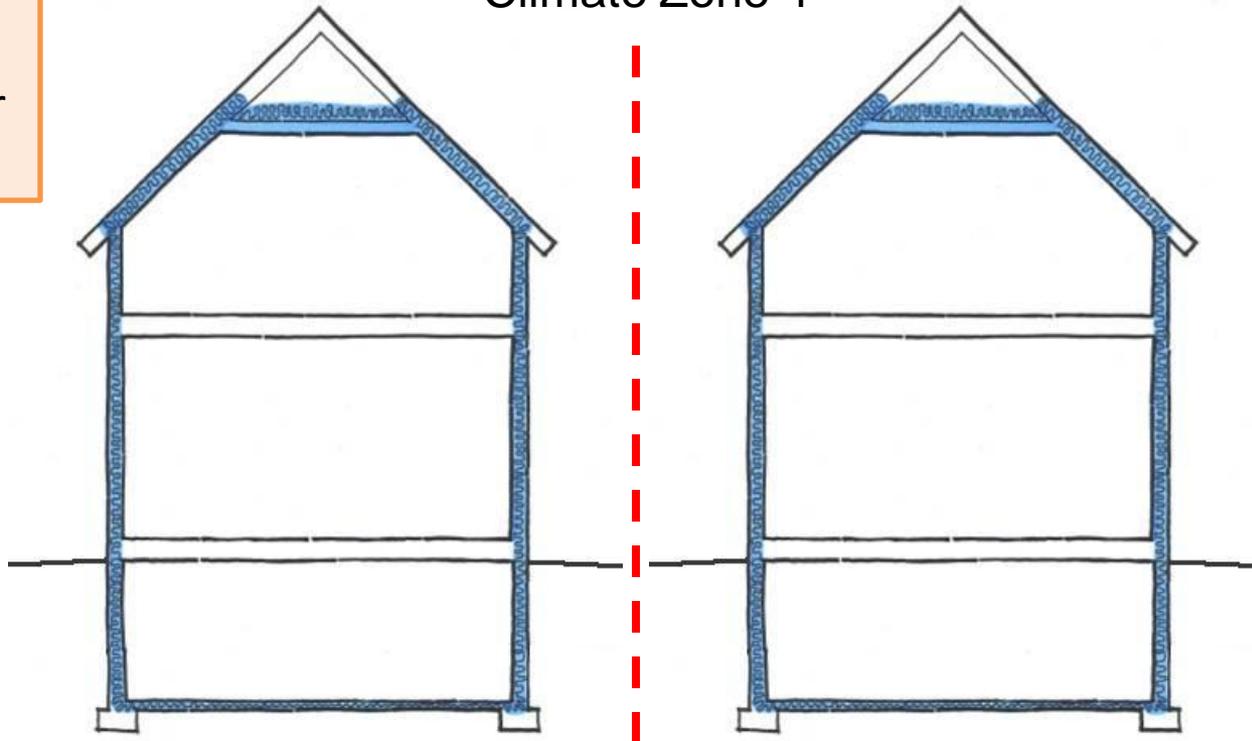
Proposed Design

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Compliance Path – Simulated Performance [R405]

Heat
+ Cool
+ Hot Water
= \$917



Heat
+ Cool
+ Hot Water
= \$770

Reference Design
2012 IECC



Proposed Design

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Compliance Path – Simulated Performance [R405]

Differences between UA and Performance

- Performance considers weather and unique passive designs
- Performance has limits to doors and windows
 - Glass house could be compliant in the prescriptive paths but not compliant in the performance path

Main Software

- REScheck
- REM/Design or REM/Rate (considers air infiltration and duct tightness)

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Topic 2 Summary

- Difference between the IECC and the IRC in how they pertain to residential buildings
- Applicability of the IECC
- Clarified some points about the IECC, building and duct tightness, and lighting efficacy
- Discuss compliance paths for applicants to meet the code
 - Four paths for compliance

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Overall Summary

- Topic 1 Awareness of the IECC
- Topic 2 Highlights of the Residential 2012 IECC

- Questions?



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Next Steps

Workshop 2

- Discuss Additions and Remodels
 - Applicability
 - Exemptions
- Implementing the code
 - Plans review process
 - Inspections

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Thank You – comment card

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