State Building Codes & Building Science:

“Understanding the Requirements of a Building as a Living Breathing Machine”

Introduction

David Ruffcorn, AIA

State Building Code Commissioner

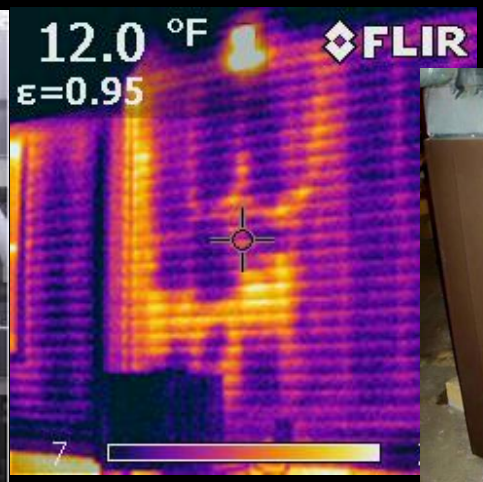
Iowa State Fire Marshal's Office

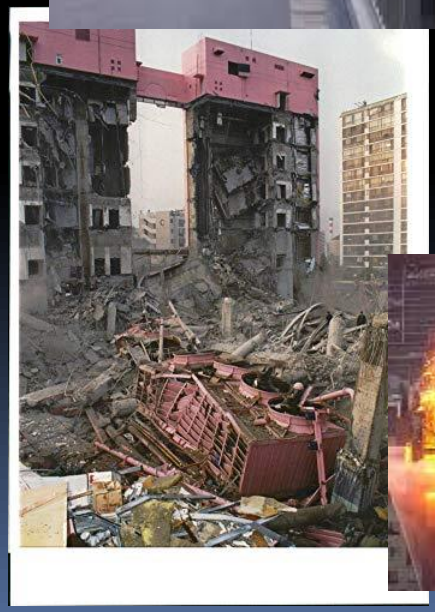
State Building Code Bureau

What is a Building Code? What is it for?

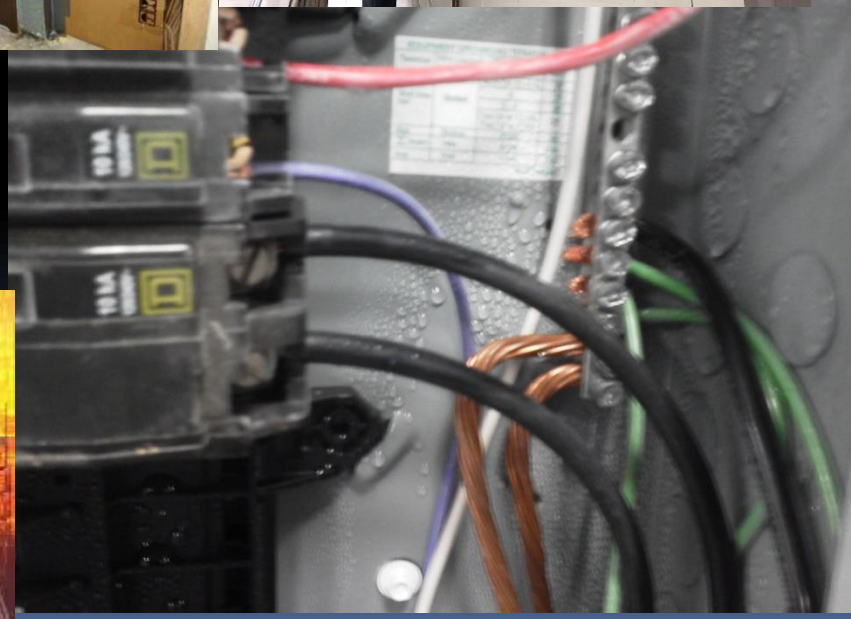
- is a set of rules that specify the minimum standards for constructed objects such as buildings and nonbuilding structures. The main purpose of building codes are to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings and structures.

Why do we need codes?





IF everyone did it right
We wouldn't need codes



When did Iowa adopt building codes?

- State Fire Marshal – 1911
- First Building Codes enforced in Des Moines 1927
- Iowa Association of Building Officials – 1959
- State Building Code – 1973
- State Energy Code - 1975

What Codes are used

- International Fire Code
- International Mechanical Code
- International Plumbing Code/UPC
- International Existing Building Code
- International Energy Conservation Code
- International Building Code
- International Residential Code
- National Electric Code
- American with Disabilities Act 2010
- NFPA Life Safety Code 101
- State of Iowa Code
- Others

International Family of Codes

Published by the International Code Council

- International Fire Code
- International Mechanical Code
- International Plumbing Code
- International Existing Building Code
- International Energy Conservation Code
- International Building Code
- International Residential Code
- International Green Construction Code
- International Fuel Gas Code
- International Solar Energy Provisions
- International Spa and Pool Code
- International Private Sewage Disposal Code
- www.iccsafe.org

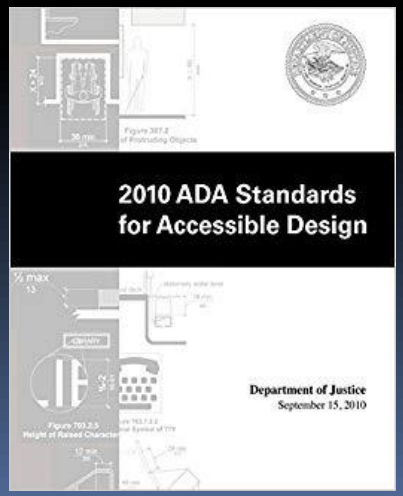
What Published Year is Used?

- International Code Council – Publishes every three years.
- National Electric Code – Publishes every three years.
- National Fire Protection Association, Life Safety 101 – Publishes every 6 years.
- American with Disabilities Act – Whenever
- State of Iowa Code – Yearly if needed

American Disabilities Act 2010

Adopted Statewide

- Authority: Iowa Code 104A.2
- Applies To: All public buildings and private buildings intended for use by the general public and multiple-unit dwellings with four or more units.
  - Exception: Iowa Code 104A.2 does not apply to structures or facilities within the building if the primary use of the building is to serve as a place of worship.
- Applicable Rules:
  - 2010 ADA Standards for Accessible Design, or:
  - International Building Code Chapter 11 and applicable accessibility provisions contained in IBC 2015.



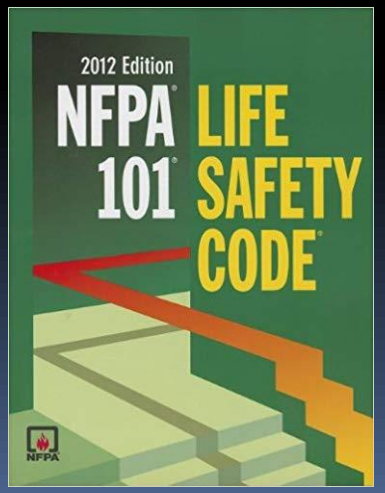
National Electric Code 2020

Adopted Statewide

- Authority: Iowa Code 103
  - Administrative Code 661-500 to 553
  - Applies To: All public buildings and private buildings.
  - Statewide Inspections Required with a few exceptions
    - Farm Buildings not open to the public.
    - Federal Installations

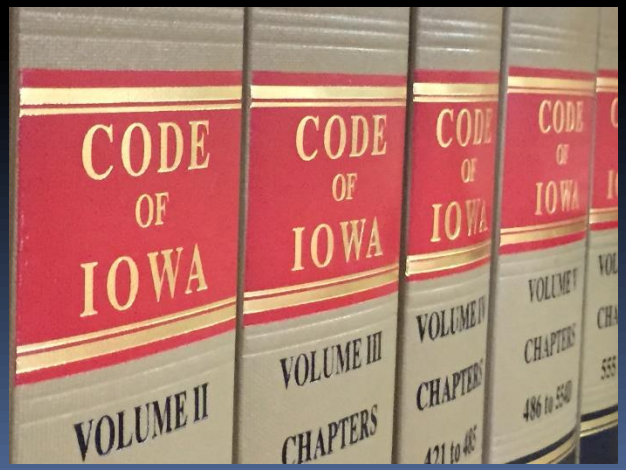
National Fire Protection Association – Life Safety Code 2012

- Federal Requirement for Licensed Health Care.
  - Iowa Code Section 135B & 135C
  - Administrative Code 661-481 chaper 51
  - Applies To: All public buildings and private buildings.
  - Statewide Inspections Required with a few exceptions
  - *As of July 1, 2013. any nursing home licensed under Iowa Code, Section 135C must comply with the State Building Code in the absence of a local building code.



State Building Code Administrative Rules

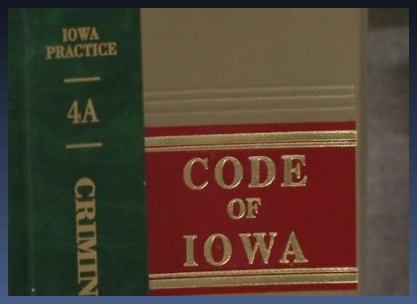
- Public Safety 661 – Chapters 300-350
- 300- Administration
- 301 – General Provisions
- 302 – Accessibility
- 303 – Energy Conservation
- 310 – Sustainable Design Standards
- 315 – Weather Safe Rooms
- 303 – Energy Conservation
- 350 – State Historic Building Code



Who Adopts Codes?

- **Iowa is a Hybrid Home Rule State**
  - State Adopts Statewide- Energy Code, Mechanical Code, Fire Code and Electrical Code Statewide
  - IBC, IRC, IEBC, are Home Rule and have various adopted years depending on jurisdiction
  - Creates Implementation Issues with years

ADA
Americans with Disabilities Act

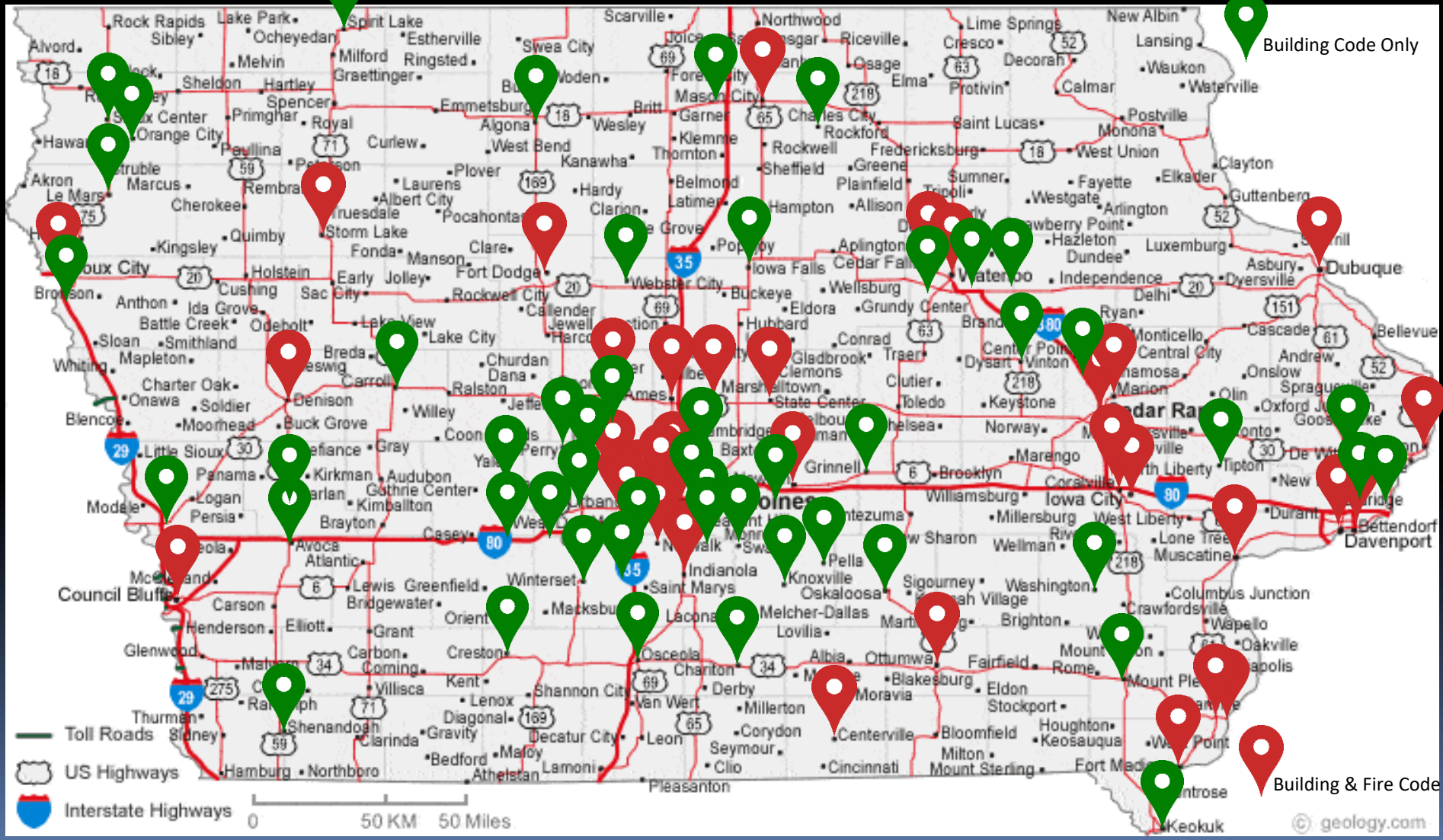


Who has Jurisdiction?

- Is your project in a town?
  - Does this town have Building Code requirements?
  - Is there a Building Code review process or just permitting?
  - Does the County in which your project is located have Building Code requirements?

- Does the State have Jurisdiction?
  - All Licensed Healthcare
  - State Owned Projects
  - State Funded Projects
    - Can do in conjunction with local Jurisdiction

Iowa Building Code Jurisdictions



How do I find out what code to use?

- City or Town Website
  - Google: City of Storm Lake, Iowa
    - Building Department

- Iowa State Fire Marshal's Website
  - Building Code

Adoption of Codes

- Codes are published on a 3 year cycle
- State of Iowa looks at new codes on a 6 year cycle
- Jurisdictions can adopt or amend codes whenever they want.
- Statewide codes are the State Minimum and can't be amended to be less strict.

State Adopted Codes

State Building Code - IAC 103A

- 2015 International Building Code
- 2015 International Fire Code - **Statewide**
- 2015 International Residential Building Code
- 2012 International Energy Conservation Code – **Statewide**
- 2015 International Existing Building Code
- 2012 NFPA 101 Life Safety Code – **Federal**
- ADA 2010 or Chapter 11 IBC 2015 - **Statewide**
- Carbon Monoxide Alarms – Administrative Rule - **Statewide**
- 2021 International Mechanical & Plumbing Code under the Iowa Department of Public Health – **Statewide**
- 2020 National Electrical Code - **Statewide**

Adoption of Statewide Codes

- Staff does not adopt, vote or ask for codes to change – you do!
- Statute is the Law written by Legislators.
- Administrative Code is the details of how the Law functions.
- Staff writes administrative code and handles the meetings.

  - Work groups – work through possible changes
  - Governors Office - Politics
  - Codes Council – Have a yes or no vote
  - Hearings – Everyone has their say!
  - Legislative Committee – Did staff do their due-diligence?

Codes by Other Jurisdictions

Home Rule Codes

Dates vary by Jurisdiction

- International Building Code – *By Jurisdiction*
- International Residential Building Code - *By Jurisdiction*
- International Existing Building Code - *By Jurisdiction*
- Can be more restrictive with statewide adopted codes.

What happens if there is NO Jurisdiction?

- There are still Statewide required codes! Just no enforcement.
- Construction Liability

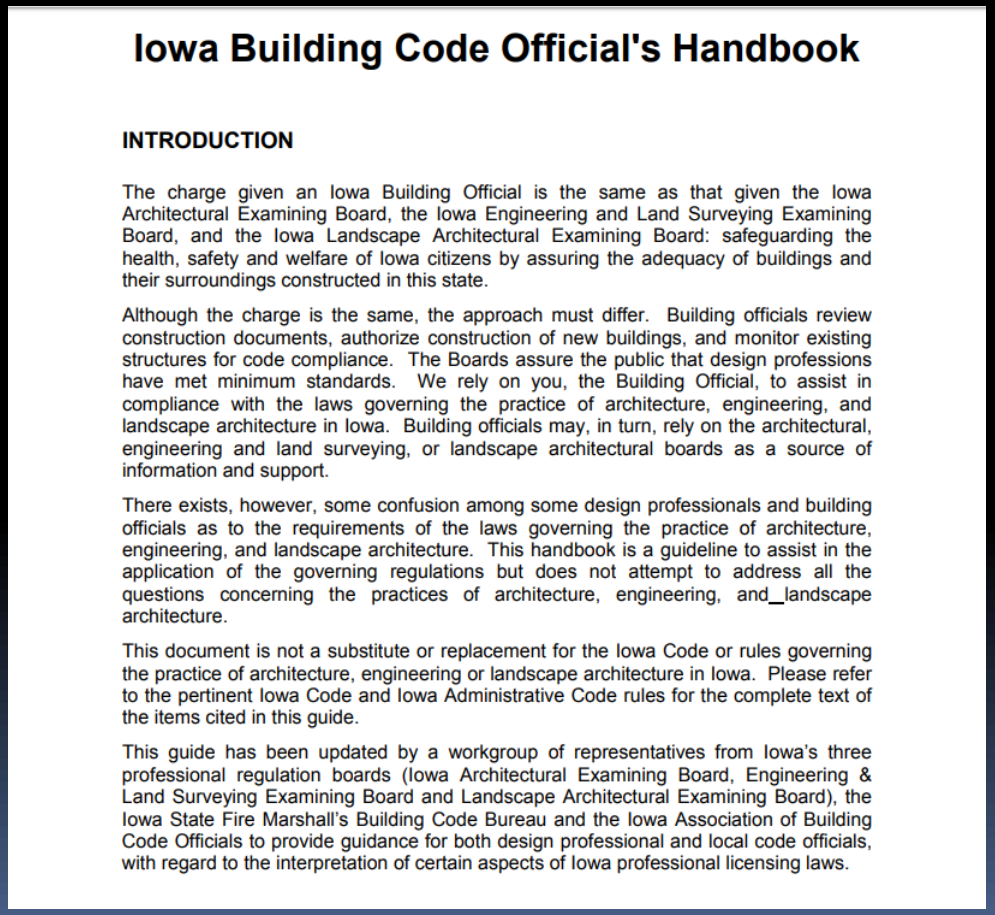
- **Statute of Repose** for all claims arising out of a defective or unsafe condition of an improvement to real property, 8 years for commercial construction and 10 years for residential construction.

What Happens If I don't use a Code

- Some locations and types of construction the only Enforcement maybe Electrical Permit Inspections.
  - State Electrical can deny final power from the Utility.
- Even in areas where there are no inspections for Statewide Codes, Contractors still have liability to meet minimum code requirements.
  - Court cases have gone against Contractors in all cases I'm aware of.

Do I need an Architect?

https://plb.iowa.gov/sites/default/files/documents/Handbook%20Final%202019.pdf



Iowa Building Code Official's Handbook

INTRODUCTION

The charge given an Iowa Building Official is the same as that given the Iowa Architectural Examining Board, the Iowa Engineering and Land Surveying Examining Board, and the Iowa Landscape Architectural Examining Board: safeguarding the health, safety and welfare of Iowa citizens by assuring the adequacy of buildings and their surroundings constructed in this state.

Although the charge is the same, the approach must differ. Building officials review construction documents, authorize construction of new buildings, and monitor existing structures for code compliance. The Boards assure the public that design professions have met minimum standards. We rely on you, the Building Official, to assist in compliance with the laws governing the practice of architecture, engineering, and landscape architecture in Iowa. Building officials may, in turn, rely on the architectural, engineering and land surveying, or landscape architectural boards as a source of information and support.

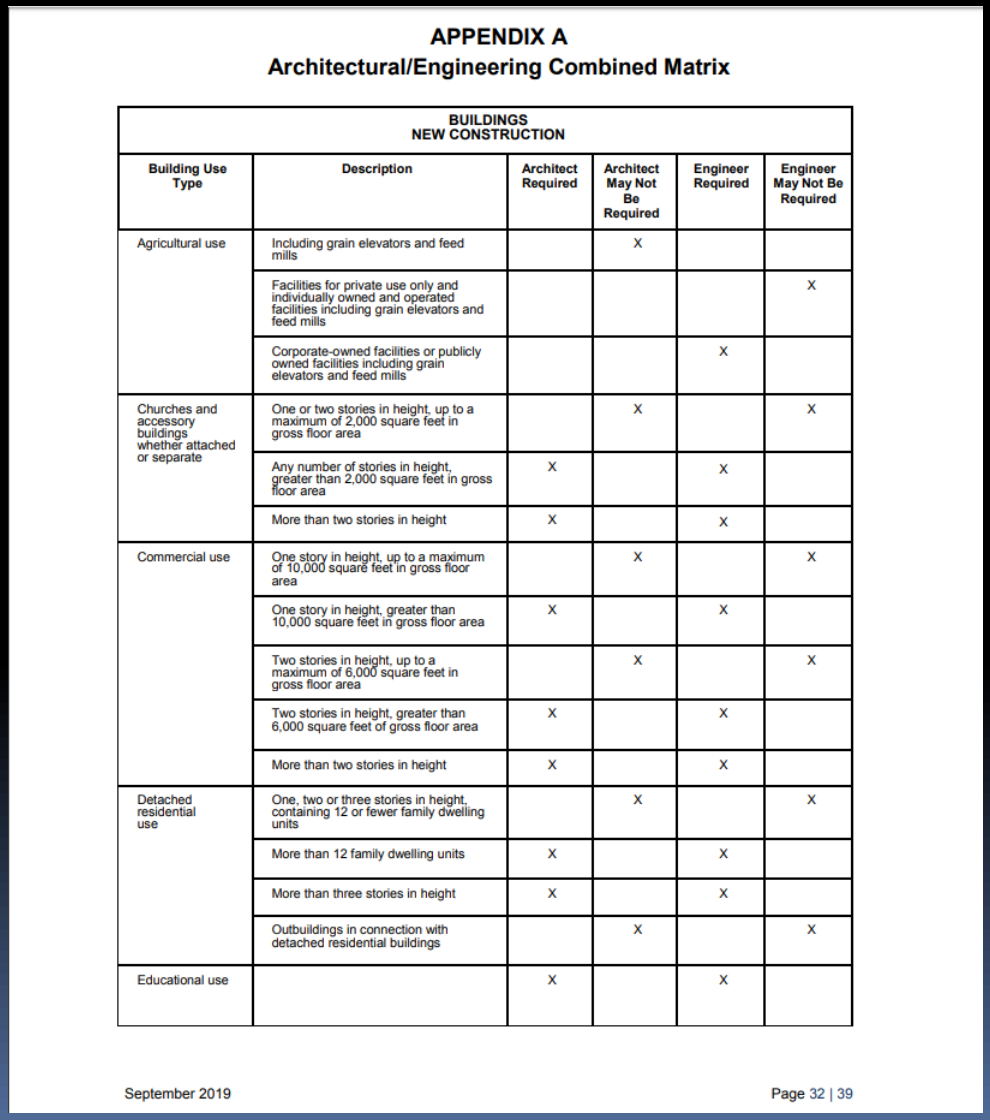
There exists, however, some confusion among some design professionals and building officials as to the requirements of the laws governing the practice of architecture, engineering, and landscape architecture. This handbook is a guideline to assist in the application of the governing regulations but does not attempt to address all the questions concerning the practices of architecture, engineering, and landscape architecture.

This document is not a substitute or replacement for the Iowa Code or rules governing the practice of architecture, engineering or landscape architecture in Iowa. Please refer to the pertinent Iowa Code and Iowa Administrative Code rules for the complete text of the items cited in this guide.

This guide has been updated by a workgroup of representatives from Iowa's three professional regulation boards (Iowa Architectural Examining Board, Engineering & Land Surveying Examining Board and Landscape Architectural Examining Board), the Iowa State Fire Marshall's Building Code Bureau and the Iowa Association of Building Code Officials to provide guidance for both design professional and local code officials, with regard to the interpretation of certain aspects of Iowa professional licensing laws.

Do I need an Architect?

https://plb.iowa.gov/sites/default/files/documents/Handbook%20Final%202019.pdf

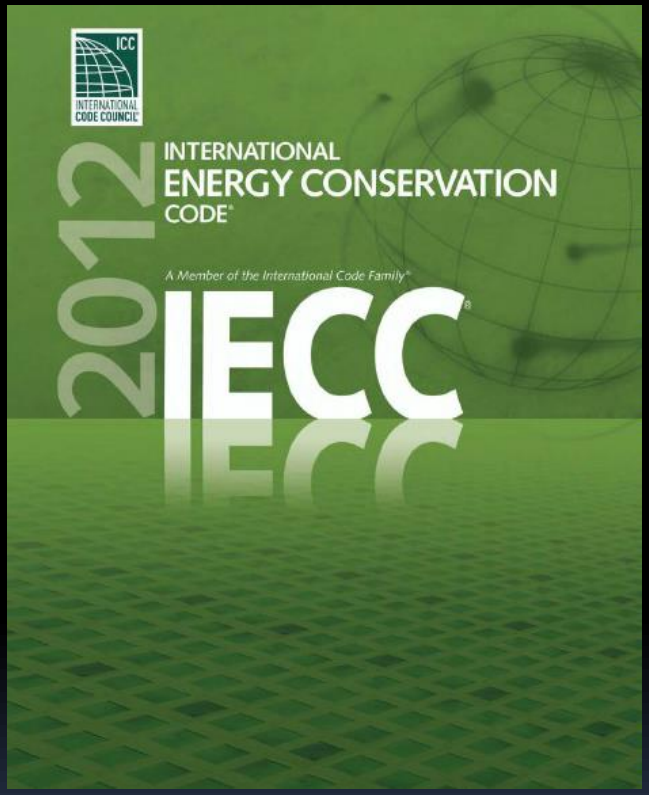


APPENDIX A

Architectural/Engineering Combined Matrix

BUILDINGS NEW CONSTRUCTION					
Building Use Type	**Description**	**Architect Required**	**Architect May Not Be Required**	**Engineer Required**	**Engineer May Not Be Required**
Agricultural use	Including grain elevators and feed mills		X		
	Facilities for private use only and individually owned and operated facilities including grain elevators and feed mills				X
	Corporate-owned facilities or publicly owned facilities including grain elevators and feed mills			X	
Churches and accessory buildings whether attached or separate	One or two stories in height, up to a maximum of 2,000 square feet in gross floor area		X		X
	Any number of stories in height, greater than 2,000 square feet in gross floor area	X		X	
	More than two stories in height	X		X	
Commercial use	One story in height, up to a maximum of 10,000 square feet in gross floor area		X		X
	One story in height, greater than 10,000 square feet in gross floor area	X		X	
	Two stories in height, up to a maximum of 6,000 square feet in gross floor area		X		X
	Two stories in height, greater than 6,000 square feet of gross floor area	X		X	
	More than two stories in height	X		X	
Detached residential use	One, two or three stories in height, containing 12 or fewer family dwelling units		X		X
	More than 12 family dwelling units	X		X	
	More than three stories in height	X		X	
	Outbuildings in connection with detached residential buildings		X		X
Educational use		X		X	

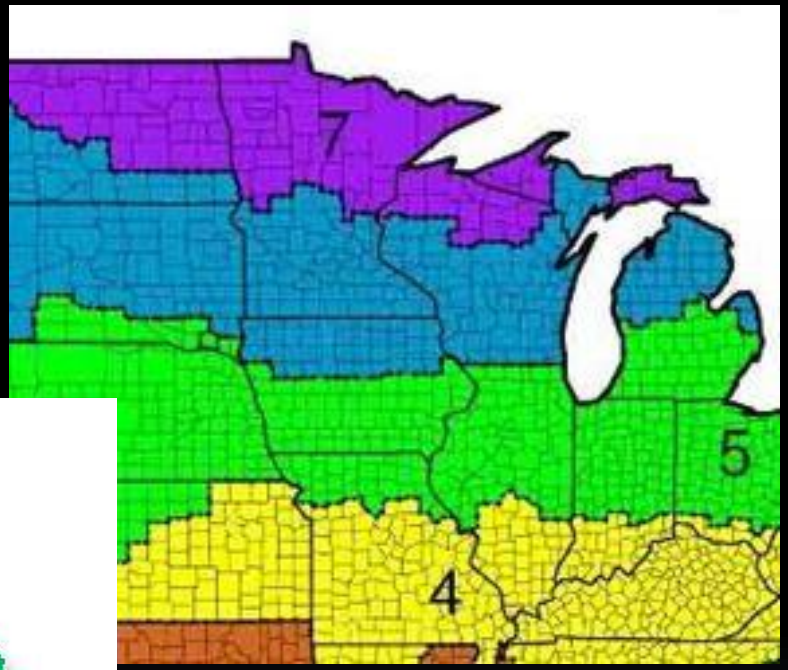
The International Energy Conservation Code 2012

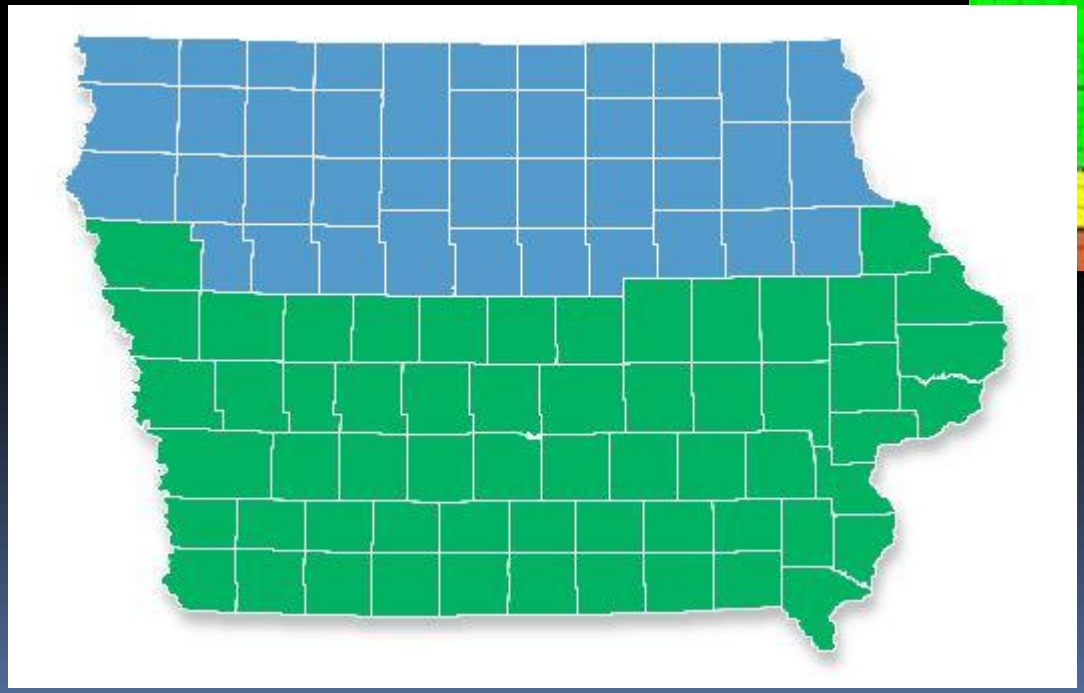


Statewide mandatory since June of 2014

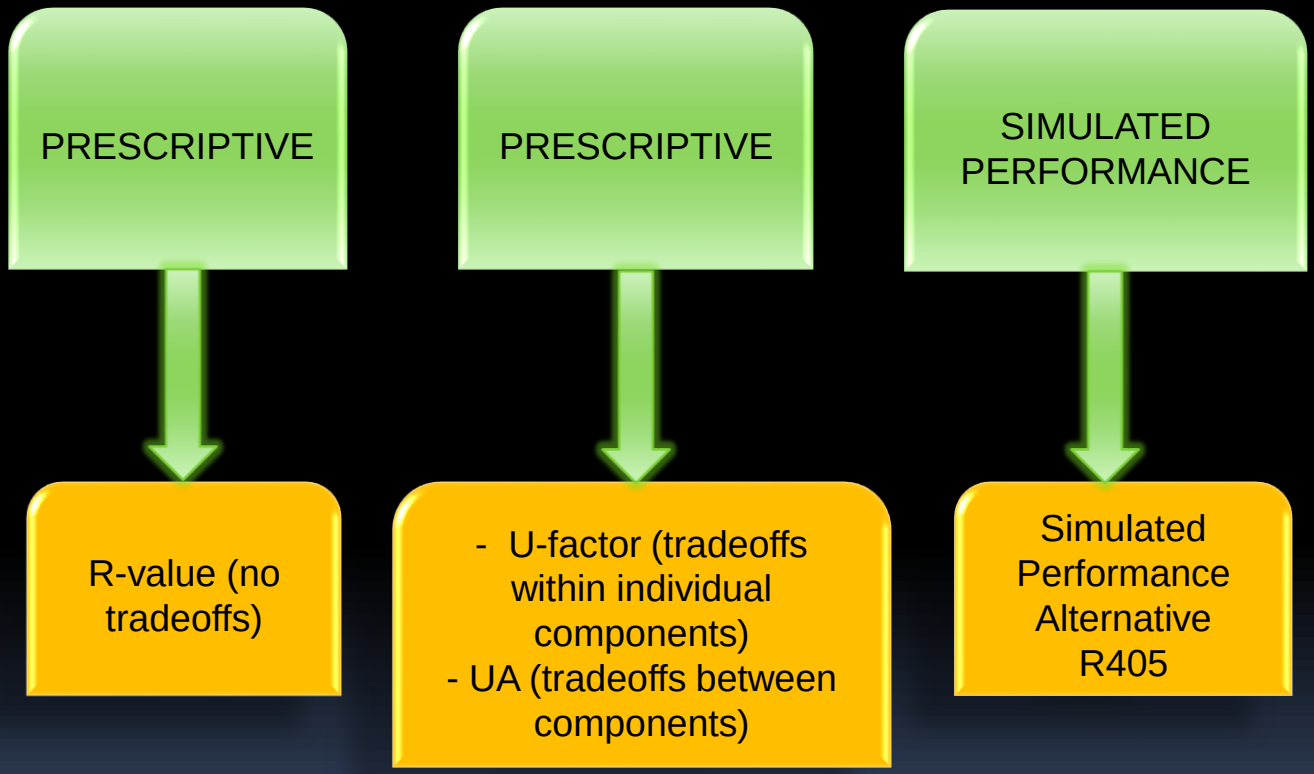
Energy Code Compliance, Iowa's Two Climate Zones

- Iowa Has Two Climate Zones
  - Zone 5
  - Zone 6

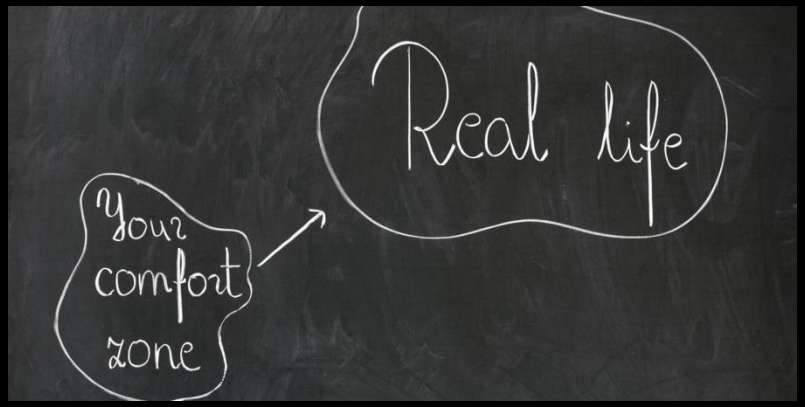




Residential Energy Code Compliance
Three Options for New Construction

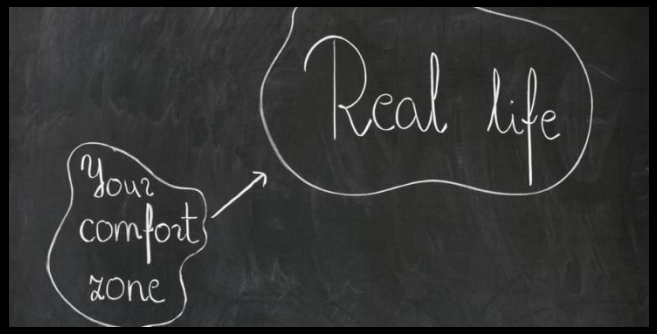


Energy Efficiency
What does it mean to you ?



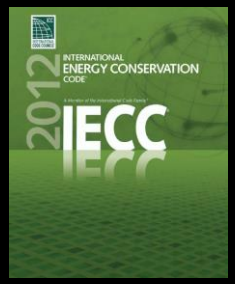
- Comfort – Temperature, Humidity, Smells, Noise and Light at comfortable levels.
- Bottom Line – "Money!" More money in your pocket and less in the Utility Companies pocket.

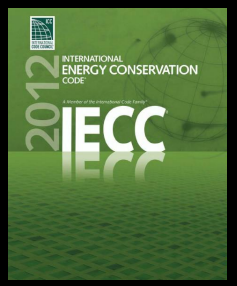
Building Science
What does it mean to your building



- Comfort – Temperature, Humidity, Smells, Noise and Light at comfortable levels.
- Health, Safety, Welfare in other words “Codes”.
- Durability – How long do you want it to last?
- These all have to work together!

Energy Code: International Energy Conservation Code





- 40% of all energy used in the US is consumed by buildings.
- Good starting point for the energy efficiency of any house.
- Levels the playing field for Homeowners and Contractors.
- Every Energy Efficiency measure require by Code, has a payback, if it is installed correctly.

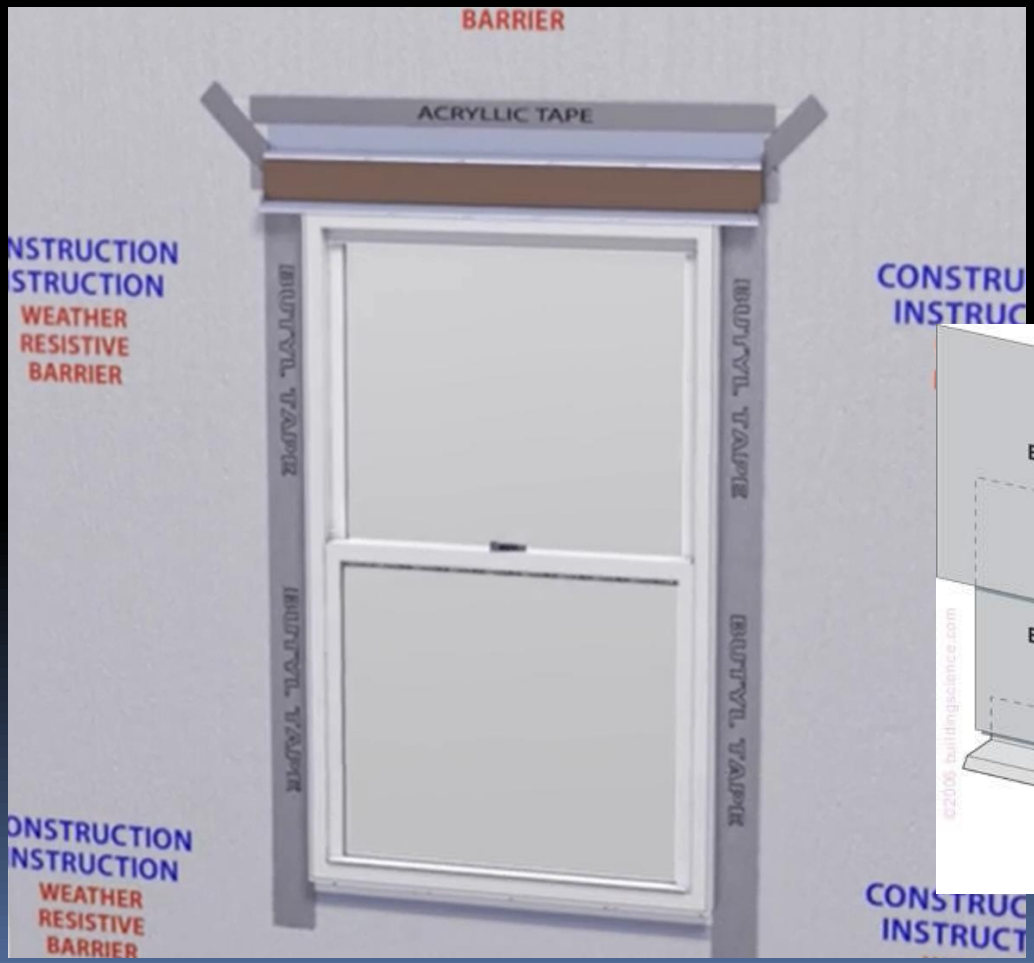
What do you mean: Installed Correctly

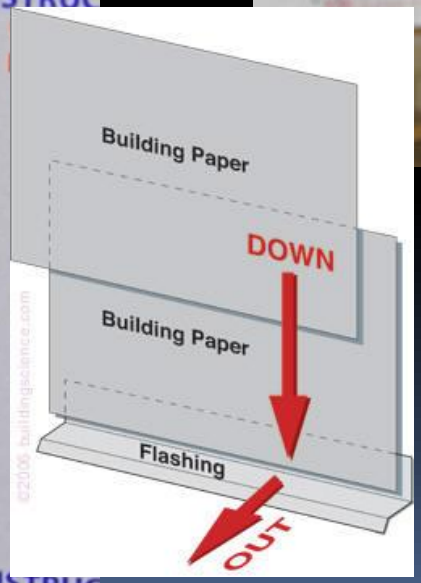
- Many products installed in a new home are not installed to manufacturers specifications.

Insulation: Faced or Un-faced Batt

What do you mean: Installed Correctly

Air/Moisture Barrier - TyVek





What do you mean: Installed Correctly

Duct Design and Sealing

Mandatory Code Sections

Section R402.4.1.2 – Air Leakage Pressure Test

Two Mandatory requirements to demonstrate compliance

- ✓ Whole-house pressure test (Iowa Amended)

Air Leakage Rate	Climate Zone	Test Pressure
≤ 4 ACH	5-6	50 Pascals

  - Testing may occur any time after creation of all building envelope penetrations
- ✓ Required verification of items listed in Table R402.4.1.1

Requirements for inspections

Blower Door Results

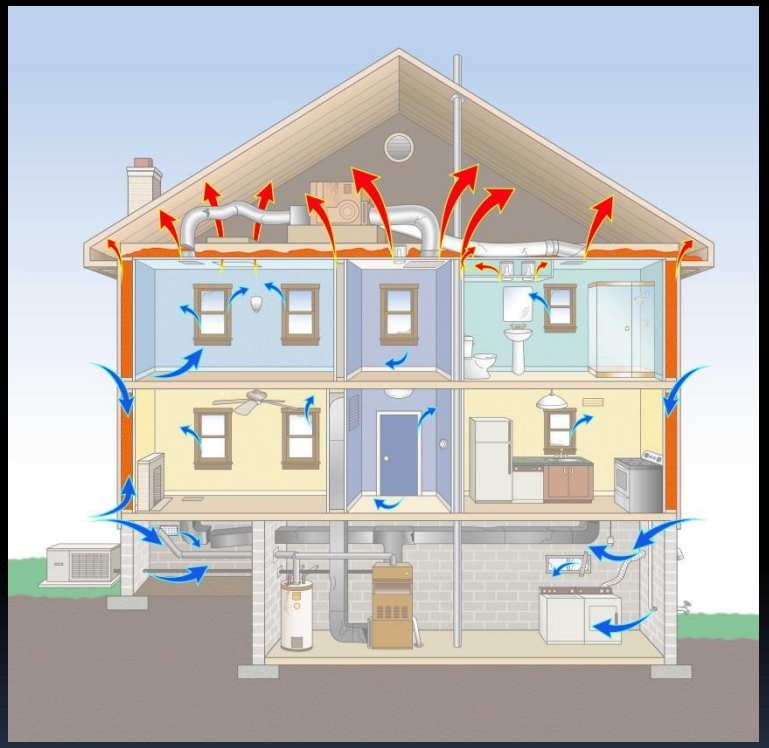
The Blower Door Test results x 60 minutes divided by the Volume of the House.

467 CFM x 60 Minutes / 9600 ft3 =

2.92 air exchanges per hour

Air Sealing a Home
A Code Requirement

=



More efficient air doesn't fix a leaky home

Review: Why do we need to airseal?

- Occupant comfort
- Construction durability/moisture control
- Oversized mechanical systems/ $ savings
- Code Required
- Building pressure differential
- Energy/ $ savings

AIR SEALING

- **Air Barrier Types – Selecting an Air Barrier**

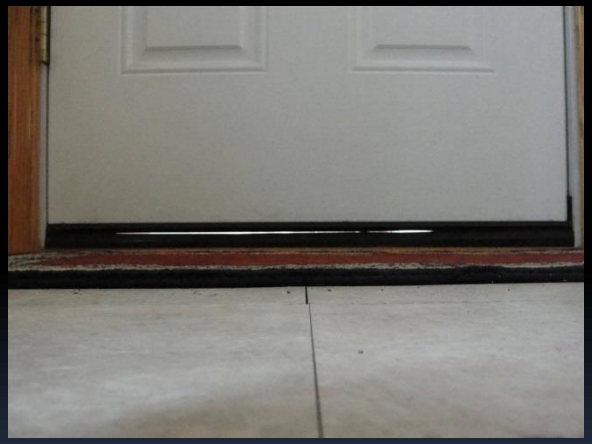
Air Sealing a Home
A Code Requirement

- You don't save much money if the air from your new 96% efficient furnace leaks out quickly!
- A typical Non – Code built House can leak the entire volume of the house out in 5 minutes. 12ACH50

- Ever noticed the furnace runs more during a wind storm?

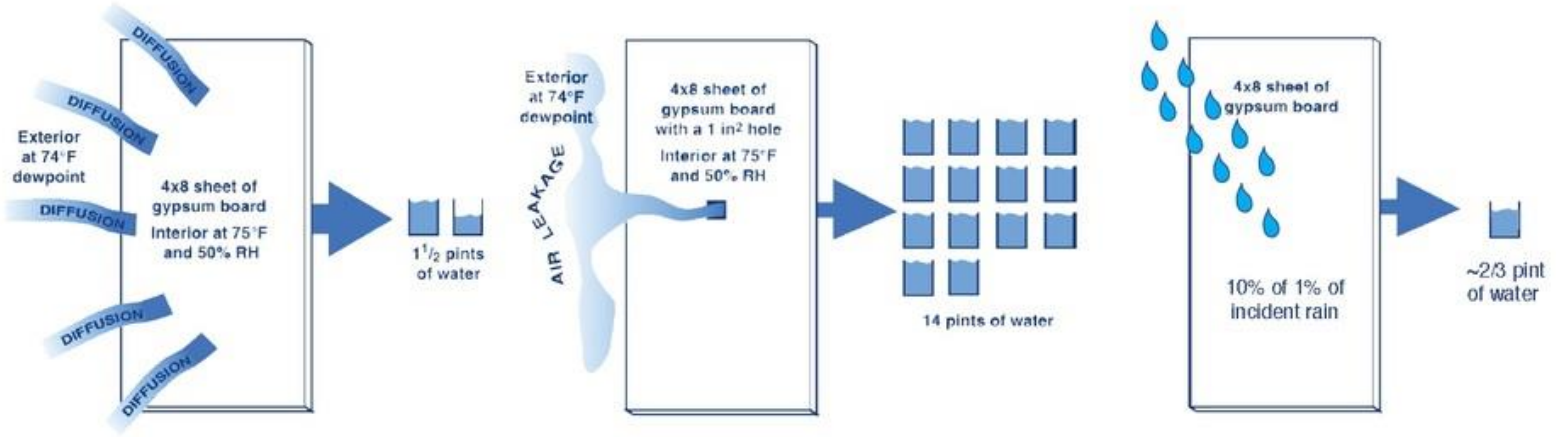
Air Sealing a Home

- Air Sealing is one of the most important things a Contractor can do to a house
  - Tighter is better – Seal it tight and ventilate it right!



Air Sealing

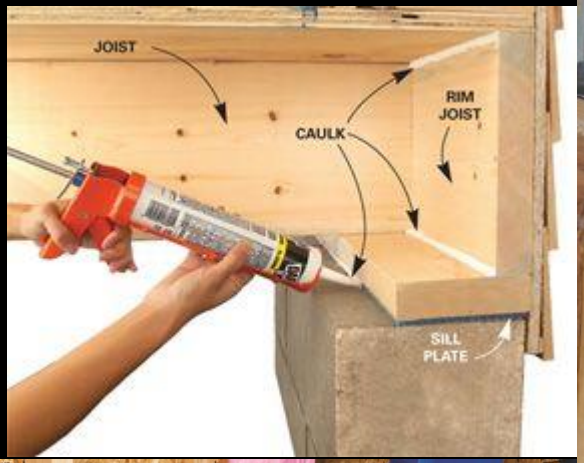
Section R402.4.1 – Air Leakage - Mandatory

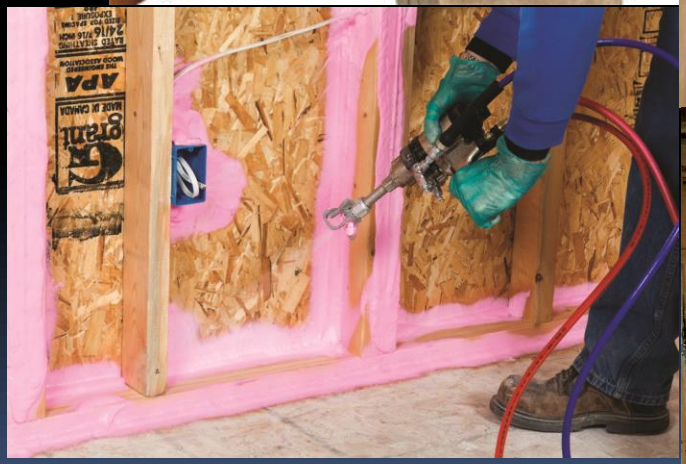


*Diffusion & air leakage graphic courtesy of Lstiburek, "Builder's Guide to Hot Humid Climates" (2006); bulk transport graphic

Air Sealing

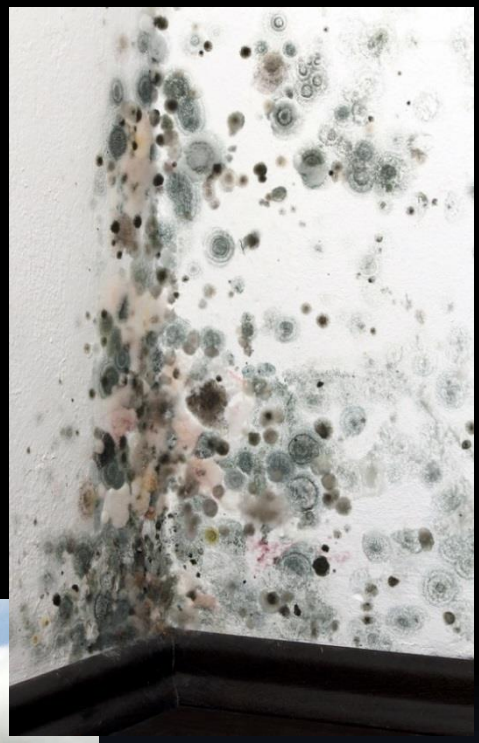
Section R402.4.1 – Air Leakage - Mandatory





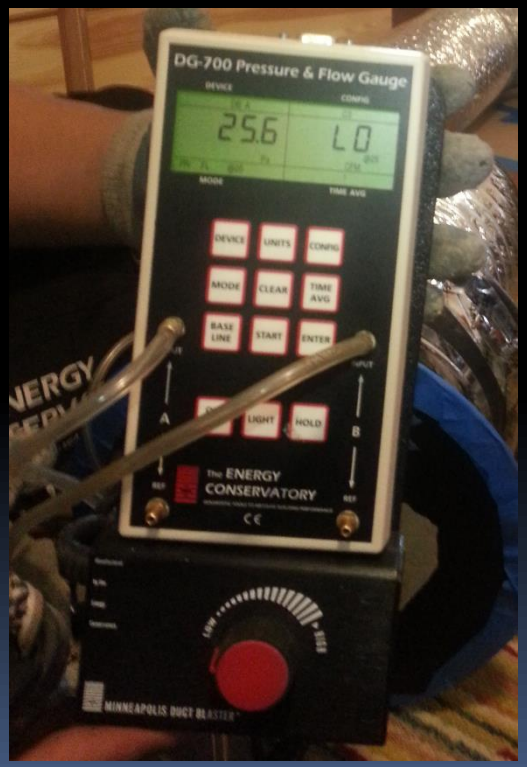
The Death of a Wall System – Sick Building

- Moisture/Water
  - Liquid
  - Gas
  - Ice
- Transport Mechanism
  - Leakage from liquid water
  - Air Leakage
  - Vapor Drive – Inside and Outside
  - Pressure & Stack Effect
- Bi-Products
  - Decay – Durability
  - Mold/Mildew



Requirements for inspections

Duct Blaster Results



Conditioned Floor Area divided by 100 x Code Max Leakage CFM

2400 sf / 100 x 3 CFM

= 72 CFM of total Duck Leakage

Mandatory Table R402.4.1.1

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.

Mandatory Table R402.4.1.1

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.

Mandatory Table R402.4.1.1

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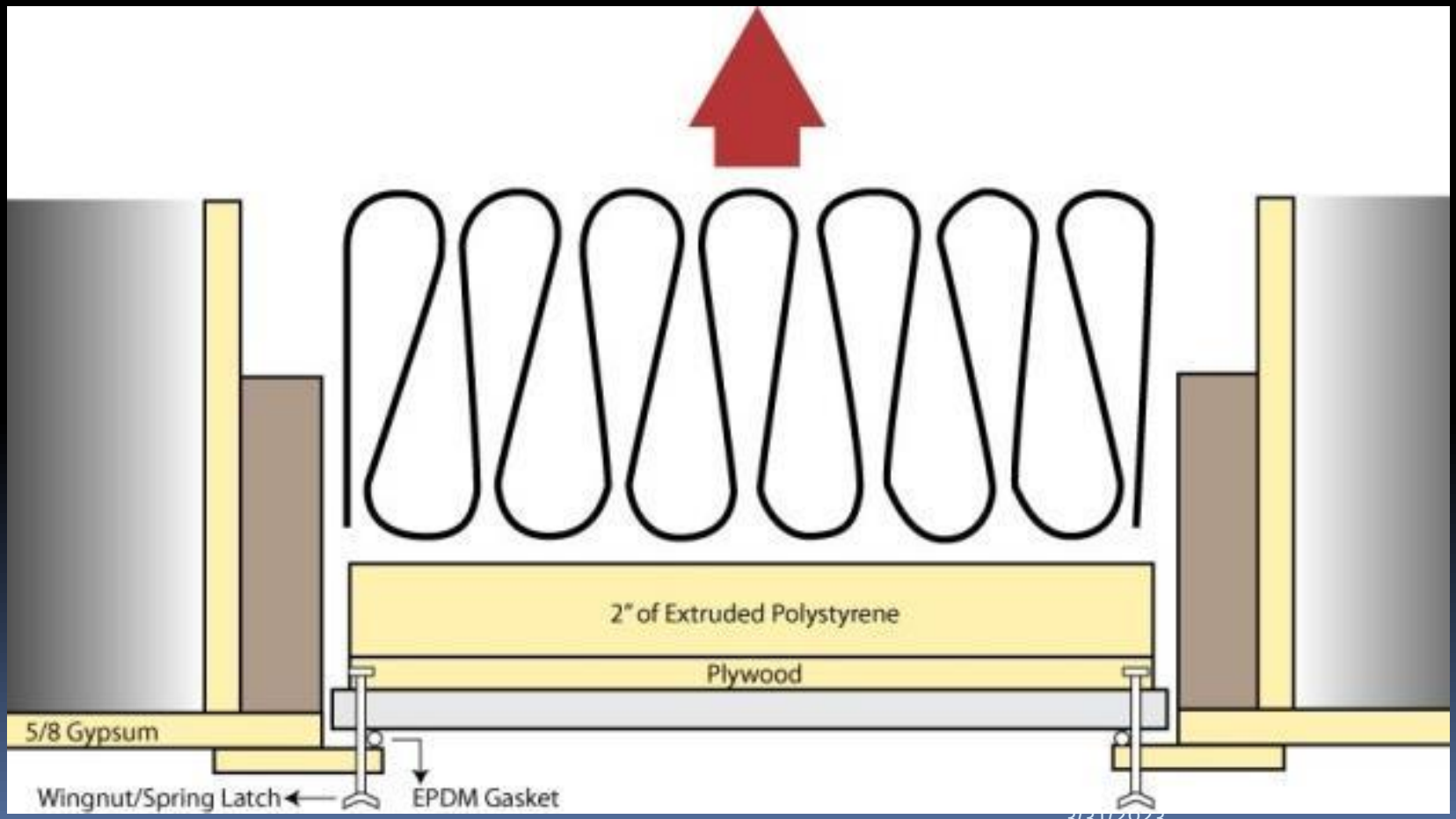

Mandatory Table R402.4.1.1

Walls	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.

Mandatory Table R402.4.1.1

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Mandatory Table R402.4.1.1

Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.

Mandatory Table R402.4.1.1

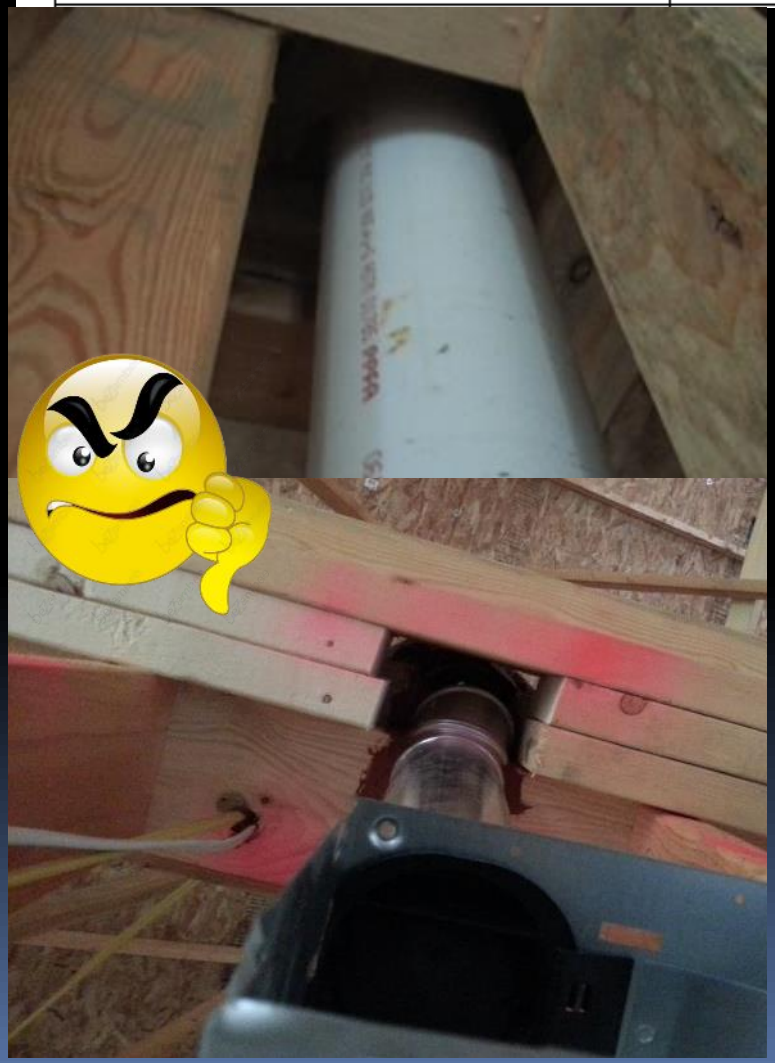
Rim joists	Rim joists shall be insulated and include the air barrier.

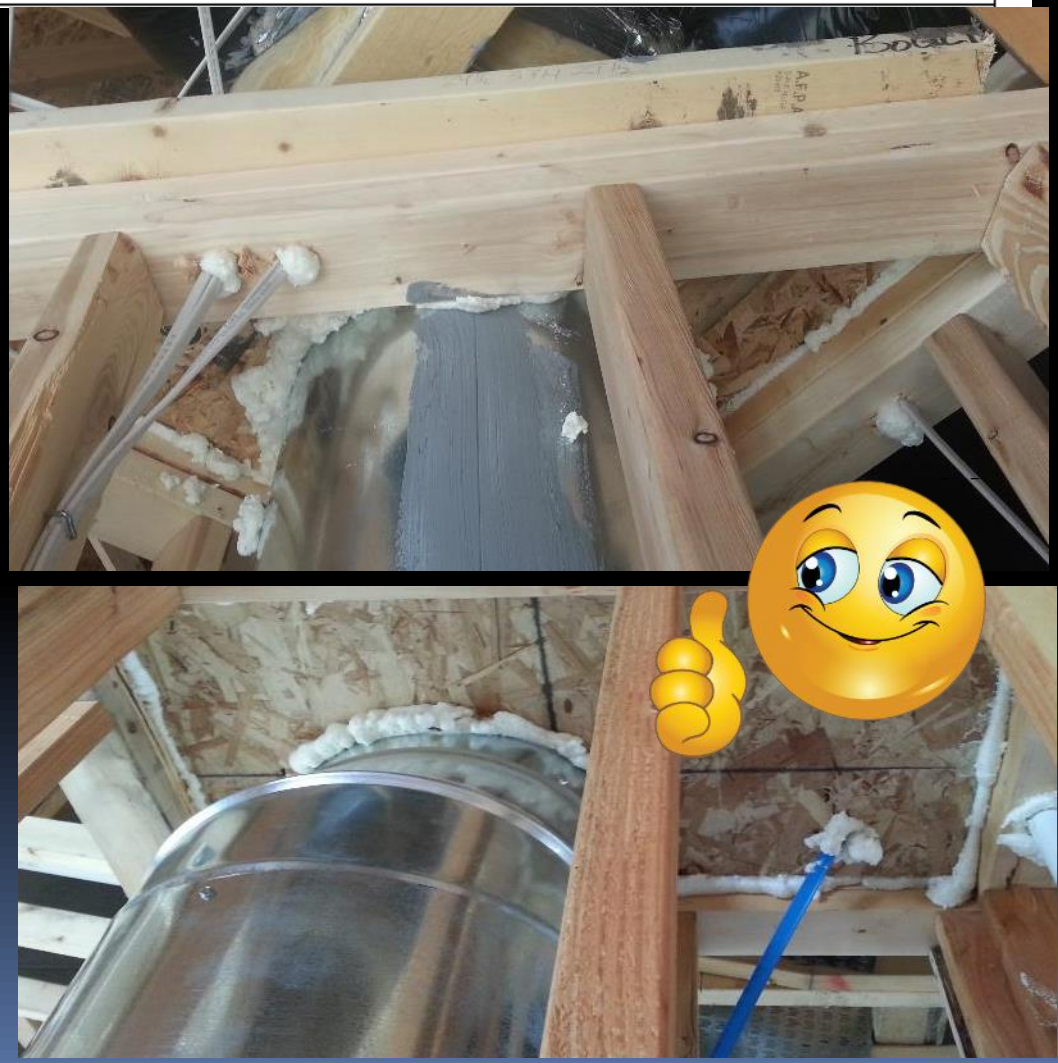
Mandatory Table R402.4.1.1

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.
Crawl space walls	Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawlspace walls. Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.

Mandatory Table R402.4.1.1

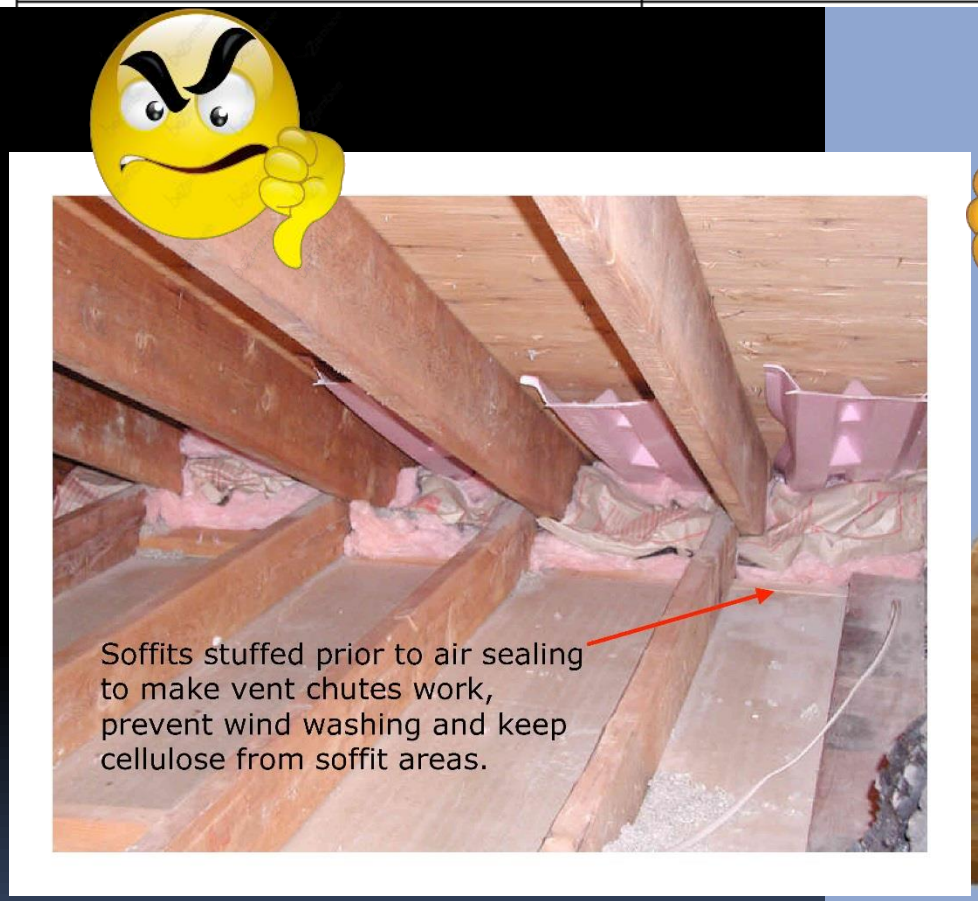
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.





Mandatory Table R402.4.1.1

Narrow cavities	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.

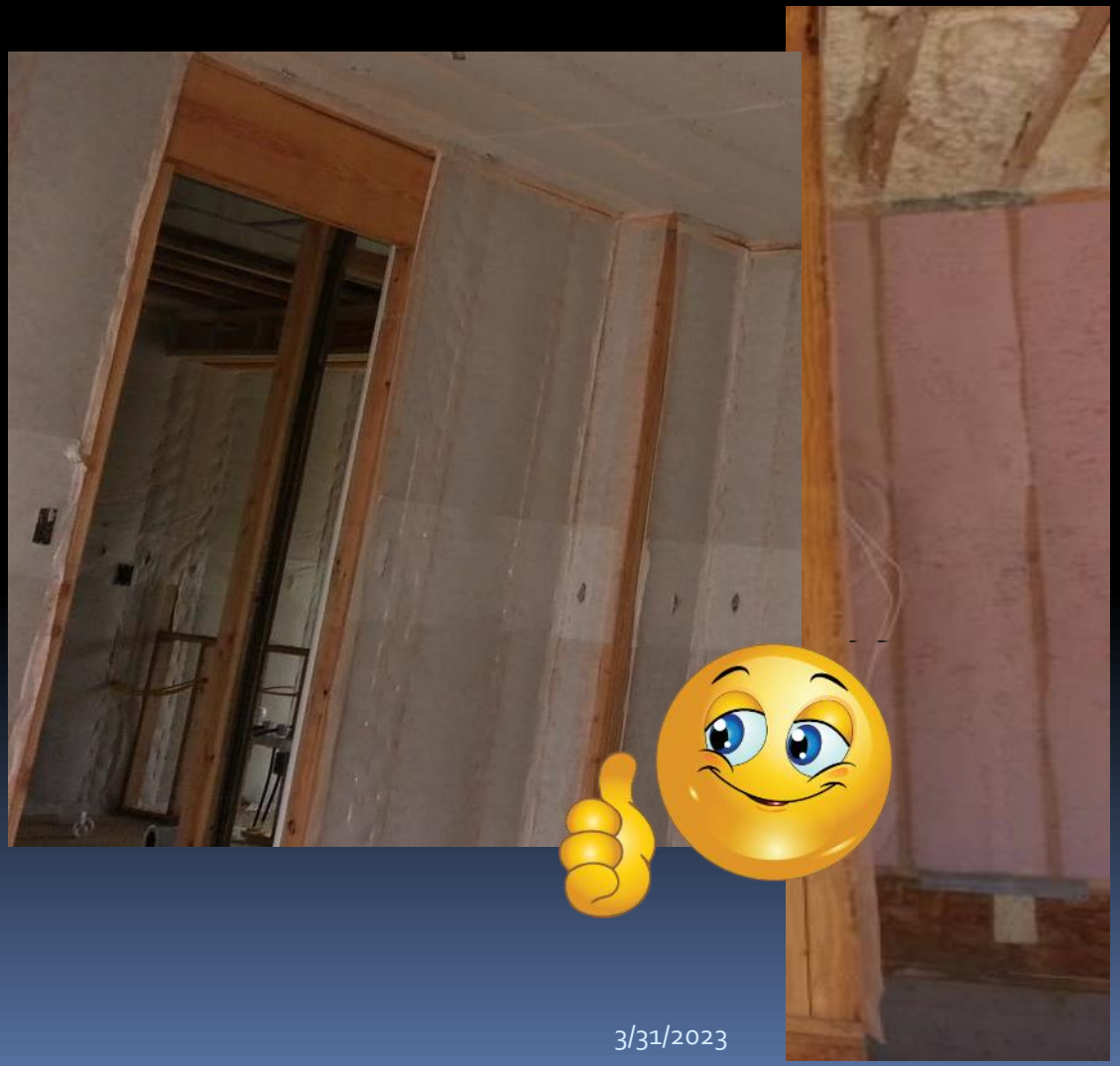


Mandatory Table R402.4.1.1

Narrow cavities	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.

Mandatory Table R402.4.1.1

Garage separation	Air sealing shall be provided between the garage and conditioned spaces.



Mandatory Table R402.4.1.1

Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and sealed to the drywall.

Mandatory Table R402.4.1.1

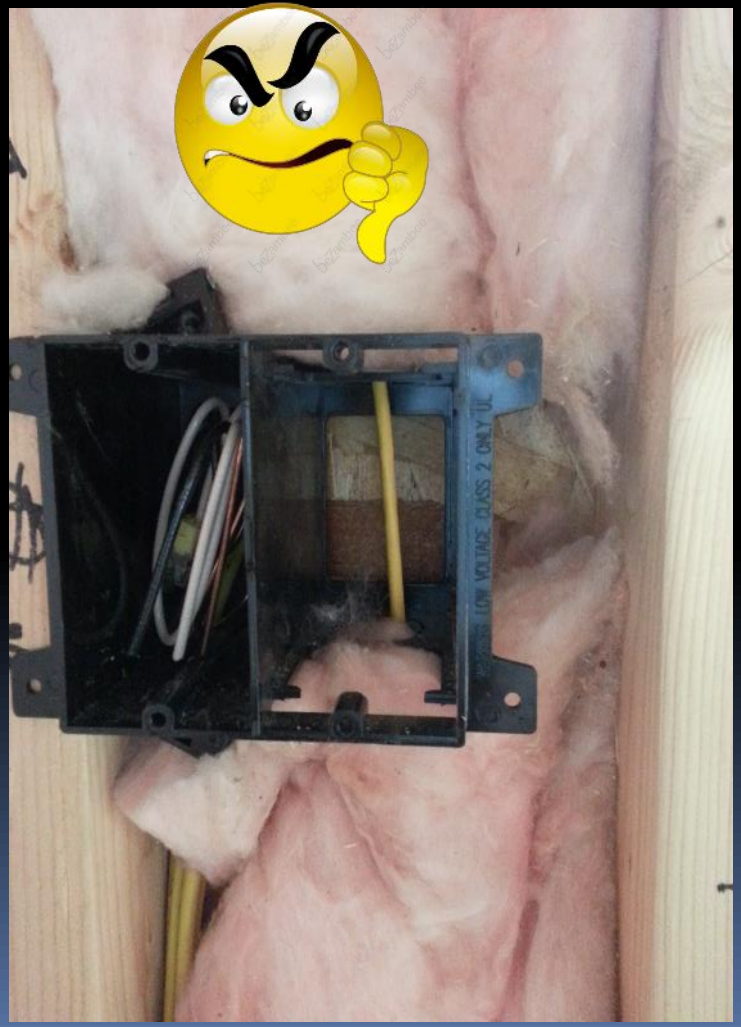
Plumbing and wiring	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.

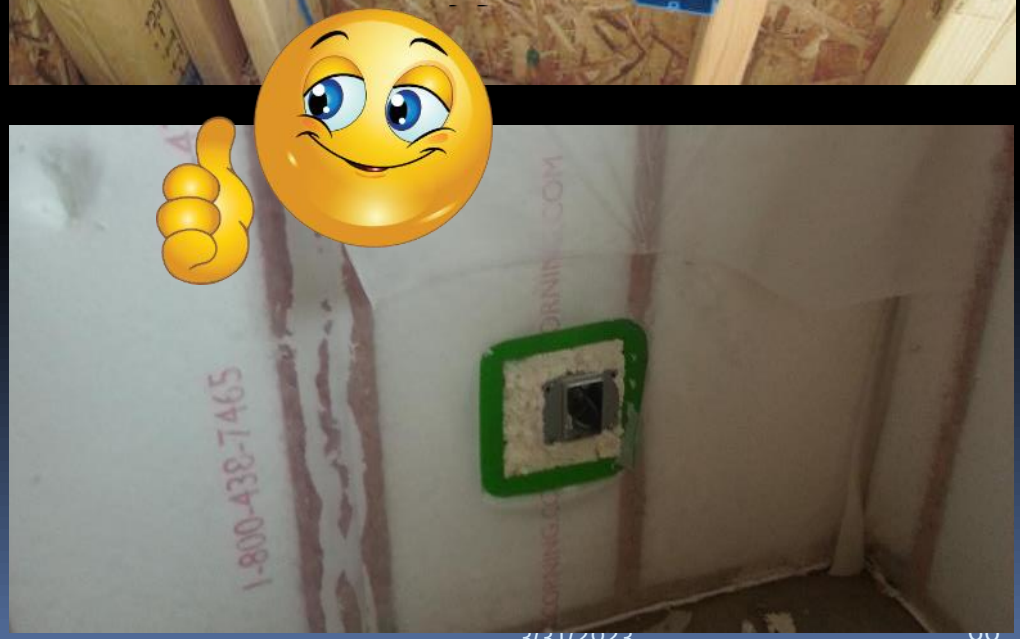
Mandatory Table R402.4.1.1

Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.

Mandatory Table R402.4.1.1

Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.





Mandatory Table R402.4.1.1

HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.

Mandatory Table R402.4.1.1

Fireplace	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.

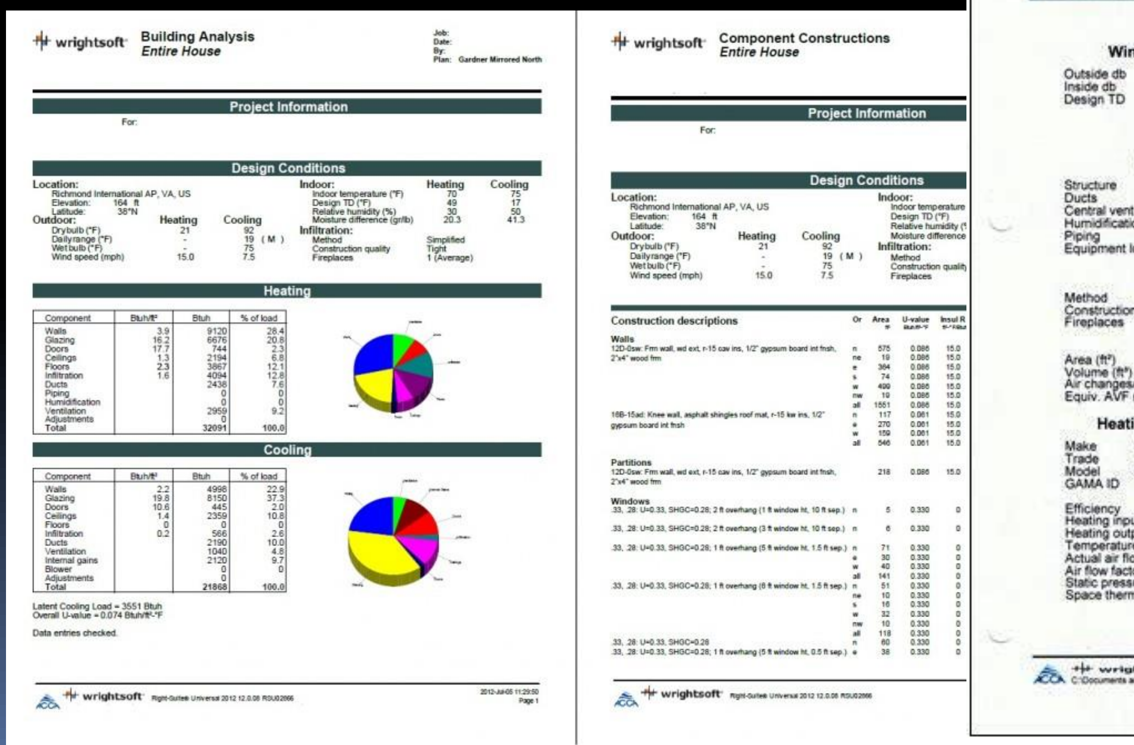
Mandatory Code Sections

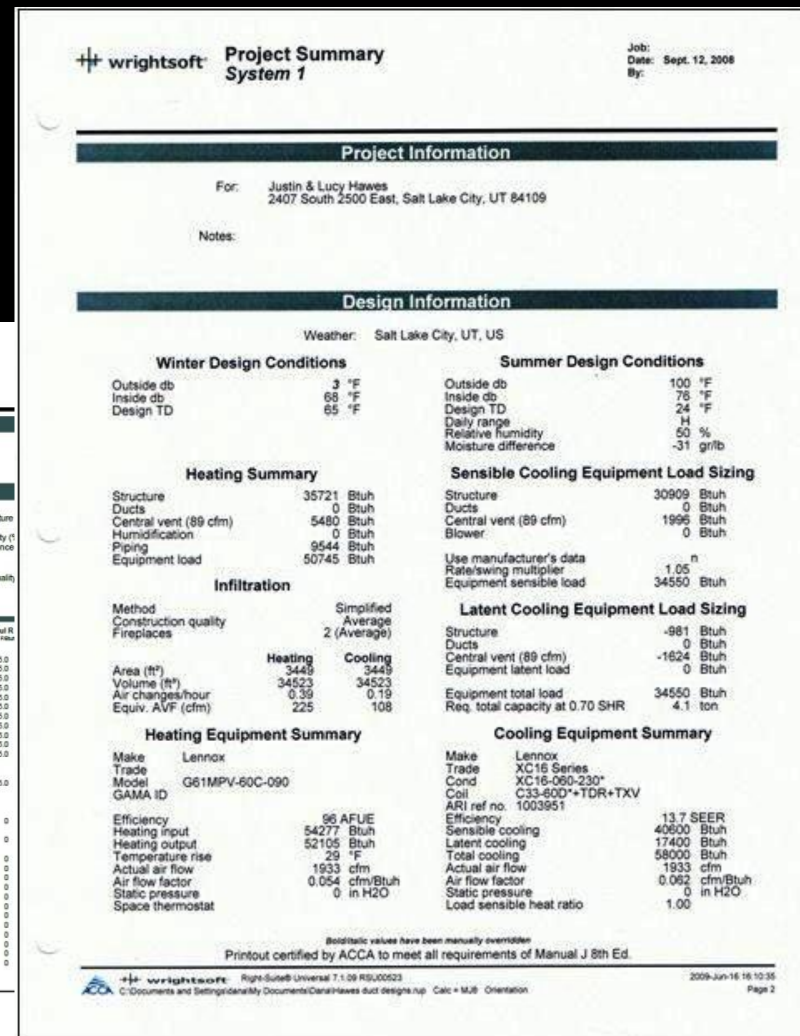
R404.1 – Lighting Equipment – Mandatory

75% of permanently installed lamps shall be high-efficiency

Requirements for inspections

ACCA Manual J & S




wrightsoft **Project Summary**
System 1

Job:
Date: Sept. 12, 2008
By:

Project Information

For: Justin & Lucy Hawes
2407 South 2500 East, Salt Lake City, UT 84109

Notes:

Design Information

Weather: Salt Lake City, UT, US

Winter Design Conditions

Outside db	3	°F
Inside db	68	°F
Design TD	65	°F

Summer Design Conditions

Outside db	100	°F
Inside db	76	°F
Design TD	24	°F
Daily range	H	
Relative humidity	50	%
Moisture difference	-31	gr/lb

Heating Summary

Structure	35721	Btuh
Ducts	0	Btuh
Central vent (89 cfm)	5480	Btuh
Humidification	0	Btuh
Piping	9544	Btuh
Equipment load	50745	Btuh

Sensible Cooling Equipment Load Sizing

Structure	30909	Btuh
Ducts	0	Btuh
Central vent (89 cfm)	1996	Btuh
Blower	0	Btuh
Use manufacturer's data	n	
Rate/swing multiplier	1.05	
Equipment sensible load	34550	Btuh

Infiltration

Method	Simplified	
Construction quality	Average	
Fireplaces	2 (Average)	
	Heating	**Cooling**
Area (ft²)	3449	3449
Volume (ft³)	34523	34523
Air changes/hour	0.39	0.19
Equiv. AVF (cfm)	225	108

Latent Cooling Equipment Load Sizing

Structure	-981	Btuh
Ducts	0	Btuh
Central vent (89 cfm)	-1624	Btuh
Equipment latent load	0	Btuh
Equipment total load	34550	Btuh
Req. total capacity at 0.70 SHR	4.1	ton

Heating Equipment Summary

Make	Lennox	
Trade		
Model	G61MPV-60C-090	
GAMA ID		
Efficiency	96	AFUE
Heating input	54277	Btuh
Heating output	52105	Btuh
Temperature rise	29	°F
Actual air flow	1933	cfm
Air flow factor	0.054	cfm/Btuh
Static pressure	0	in H2O
Space thermostat		

Cooling Equipment Summary

Make	Lennox	
Trade	XC16 Series	
Cond	XC16-060-230*	
Coil	C33-60D*+TDR+TXV	
ARI ref no.	1003951	
Efficiency	13.7	SEER
Sensible cooling	40600	Btuh
Latent cooling	17400	Btuh
Total cooling	58000	Btuh
Actual air flow	1933	cfm
Air flow factor	0.062	cfm/Btuh
Static pressure	0	in H2O
Load sensible heat ratio	1.00	

Bold/italic values have been manually overridden

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

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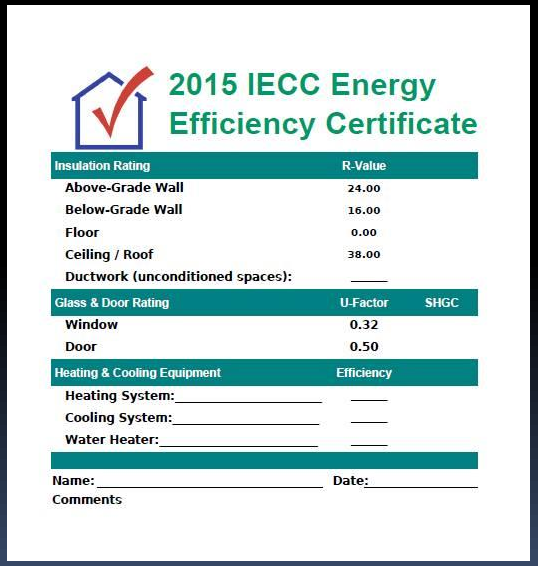
Page 2

Requirements for rural area inspections

Panel Certificate



2015 IECC Energy Efficiency Certificate

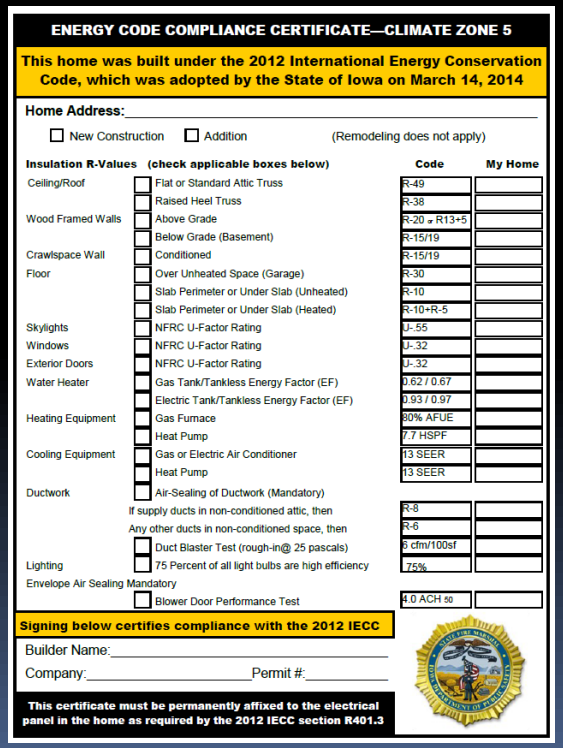
Insulation Rating	R-Value
Above-Grade Wall	24.00
Below-Grade Wall	16.00
Floor	0.00
Ceiling / Roof	38.00
Ductwork (unconditioned spaces):	_____

Glass & Door Rating	U-Factor	SHGC
Window	0.32	
Door	0.50	

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

Name:_____ Date:_____

Comments



ENERGY CODE COMPLIANCE CERTIFICATE—CLIMATE ZONE 5

This home was built under the 2012 International Energy Conservation Code, which was adopted by the State of Iowa on March 14, 2014

Home Address:_____

☐ New Construction ☐ Addition (Remodeling does not apply)

Insulation R-Values (check applicable boxes below)			Code	My Home
Ceiling/Roof	☐	Flat or Standard Attic Truss	R-49	
	☐	Raised Heel Truss	R-38	
Wood Framed Walls	☐	Above Grade	R-20 or R13+5	
	☐	Below Grade (Basement)	R-15/19	
Crawlspace Wall	☐	Conditioned	R-15/19	
Floor	☐	Over Unheated Space (Garage)	R-30	
	☐	Slab Perimeter or Under Slab (Unheated)	R-10	
	☐	Slab Perimeter or Under Slab (Heated)	R-10+R-5	
Skylights	☐	NFRC U-Factor Rating	U-.55	
Windows	☐	NFRC U-Factor Rating	U-.32	
Exterior Doors	☐	NFRC U-Factor Rating	U-.32	
Water Heater	☐	Gas Tank/Tankless Energy Factor (EF)	0.62 / 0.67	
	☐	Electric Tank/Tankless Energy Factor (EF)	0.93 / 0.97	
Heating Equipment	☐	Gas Furnace	80% AFUE	
	☐	Heat Pump	7.7 HSPF	
Cooling Equipment	☐	Gas or Electric Air Conditioner	13 SEER	
	☐	Heat Pump	13 SEER	
Ductwork	☐	Air-Sealing of Ductwork (Mandatory)		
		If supply ducts in non-conditioned attic, then	R-8	
		Any other ducts in non-conditioned space, then	R-6	
	☐	Duct Blaster Test (rough-in@ 25 pascals)	6 cfm/100sf	
Lighting	☐	75 Percent of all light bulbs are high efficiency	75%	
Envelope Air Sealing Mandatory				
	☐	Blower Door Performance Test	4.0 ACH 50	

Signing below certifies compliance with the 2012 IECC

Builder Name:_____

Company:_____ Permit #:_____

This certificate must be permanently affixed to the electrical panel in the home as required by the 2012 IECC section R401.3

Home Energy Rating Certificate

Sagaponack Modern Barn
121 Northwest Path
Sagaponack, NY 11962

5 Stars Plus
Projected Rating
HERS Index: 35
Efficient Home Comparison: 65% Better

Projected Rating: Based on Plans - Field Confirmation Required.

General Information

Conditioned Area	8860 sq. ft.	House Type	Single-family detached
Conditioned Volume	90184 cubic ft.	Foundation	Conditioned basement
Bedrooms	5		

Mechanical Systems Features

Heating:	Fuel-fired air distribution, Propane, 94.1 AFUE.
Cooling:	Air conditioner, Electric, 16.5 SEER.
Water Heating:	Integrated, Propane, 0.86 EF, 80.0 Gal.
Duct Leakage to Outside	0.00 CFM25.
Ventilation System	Balanced: ERV, 135 cfm, 105.0 watts.
Programmable Thermostat	Heat=Yes; Cool=Yes

Building Shell Features

Ceiling Flat	NA	Slab	R-10.0 Edge, R-10.0 Under
Sealed Attic	NA	Exposed Floor	R-42.0
Vaulted Ceiling	R-50.0	Window Type	U-Value: 0.140, SHGC: 0.490
Above Grade Walls	R-37.5	Infiltration Rate	Htg: 3993 Clg: 3993 CFM50
Foundation Walls	R-65.3	Method	Blower door test

Lights and Appliance Features

Percent Interior Lighting	100.00	Range/Oven Fuel	Propane
Percent Garage Lighting	100.00	Clothes Dryer Fuel	Electric
Refrigerator (kWh/yr)	1137.00	Clothes Dryer EF	3.01
Dishwasher Energy Factor	0.89	Ceiling Fan (cfm/Watt)	371.50

Questions