



# Nebraska's Energy Code: The Intersection of Building and Energy Codes

Nebraska Energy Code Training Program

Instructor: Matt Belcher

January 12, 2023: 10 a.m. – 11:30 a.m. CST



# Housekeeping

- Attendees are muted upon entry
- Enter questions in the chat box
- This training is being recorded
- Slides and recording will be emailed to attendees and posted on the MEEA website
- CEUs are provided (ICC and AIA)
- Email Corie at [canderson@mwalliance.org](mailto:canderson@mwalliance.org) with any questions



# Our Instructor



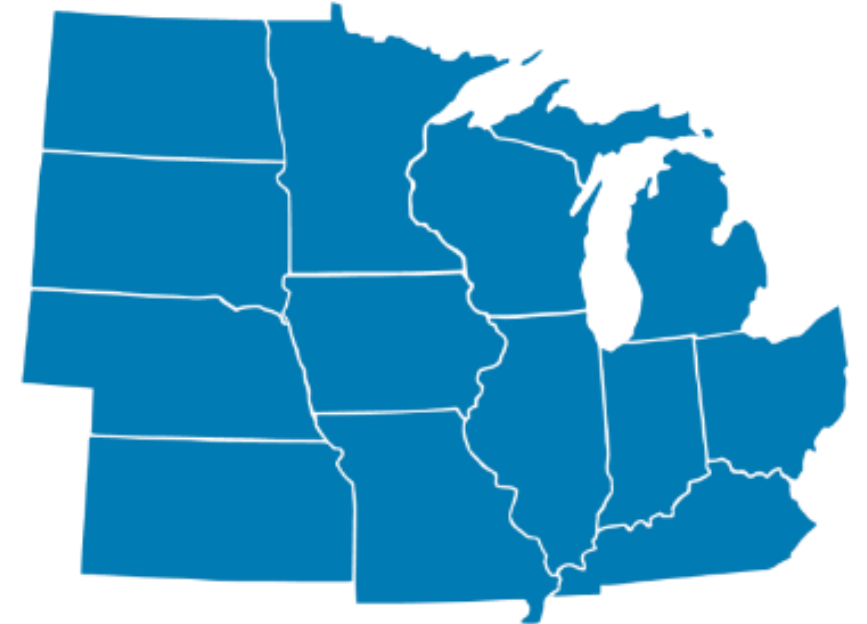
**Matt Belcher**  
[matt@verda-solutions.com](mailto:matt@verda-solutions.com)



# About MEEA

## *The Trusted Source on Energy Efficiency*

- Nonprofit membership organization with 160+ members
- Serves 13 Midwest states
- Resource and champion for energy efficiency
- Our mission: advancing energy efficiency in the Midwest for sustainable economic development and environmental stewardship



# Nebraska Energy Codes Training Program

- Goal: prepare the Nebraska workforce for upcoming changes in construction best practices
- Residential and Commercial Energy Code
- Focused on providing training to builders, code officials, design professionals, public officials and students
- For more information, visit:  
<https://www.mwalliance.org/nebraska-energy-codes-training-program>





# Poll Question #1

- What is your profession?
  - Student
  - Academic
  - Residential Builder
  - Commercial Builder
  - Energy Rater/Consultant
  - Code Official
  - State/Local Government
  - Non-profit
  - Utility
  - Other (type in chat)



# Poll Question #2

- How much experience do you have in the construction industry?
  - 0-5 years
  - 6-10 years
  - 11-15 years
  - 16-20 years
  - 21+ years



# Poll Question #3

- How familiar are you with the commercial provisions in the 2018/21 IECC?
  - Extremely Familiar
  - Somewhat Familiar
  - Somewhat Unfamiliar
  - Not familiar at all





# Building Code History

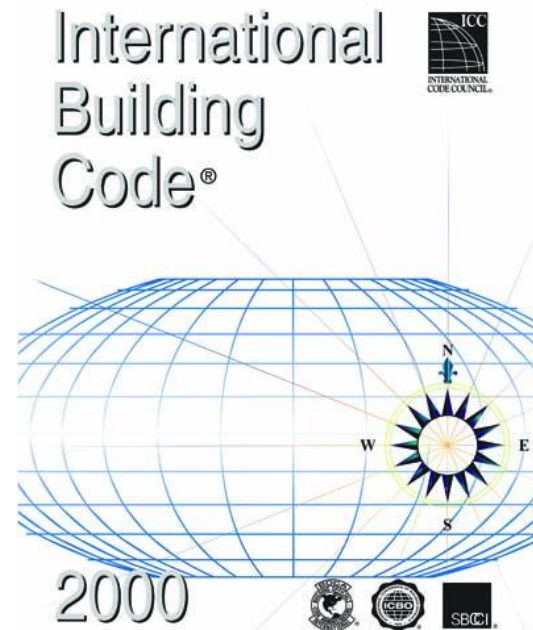


“Legacy Codes”



# Building Code History

- The first edition of the International Building Code (IBC) was published in 2000 by the International Code Council (ICC)
- Combines the three model building codes published by BOCA, ICBO and SBCCI



# Nebraska Residential Field Study

- Conducted in 2017 by **Nebraska Department of Environment and Energy**. 2009 IECC was the baseline.
- Collected and analyzed several data points for new homes, including:
  - Envelope air leakage
  - Efficacy in lighting
  - Duct leakage
  - Ceiling & exterior wall insulation
  - Basement & slab insulation
  - Windows

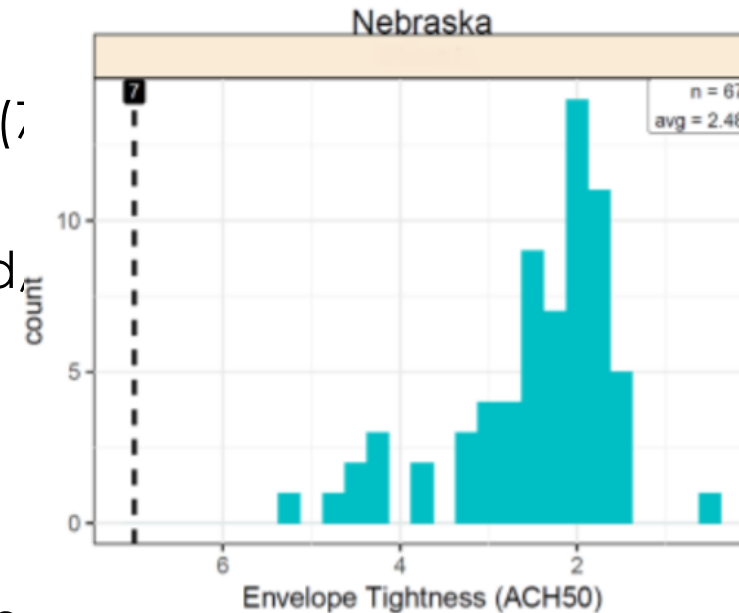
## For More Information and Data:

[https://www.energycodes.gov/sites/default/files/documents/Nebraska\\_Residential\\_Compliance\\_Evaluation\\_final.pdf](https://www.energycodes.gov/sites/default/files/documents/Nebraska_Residential_Compliance_Evaluation_final.pdf)



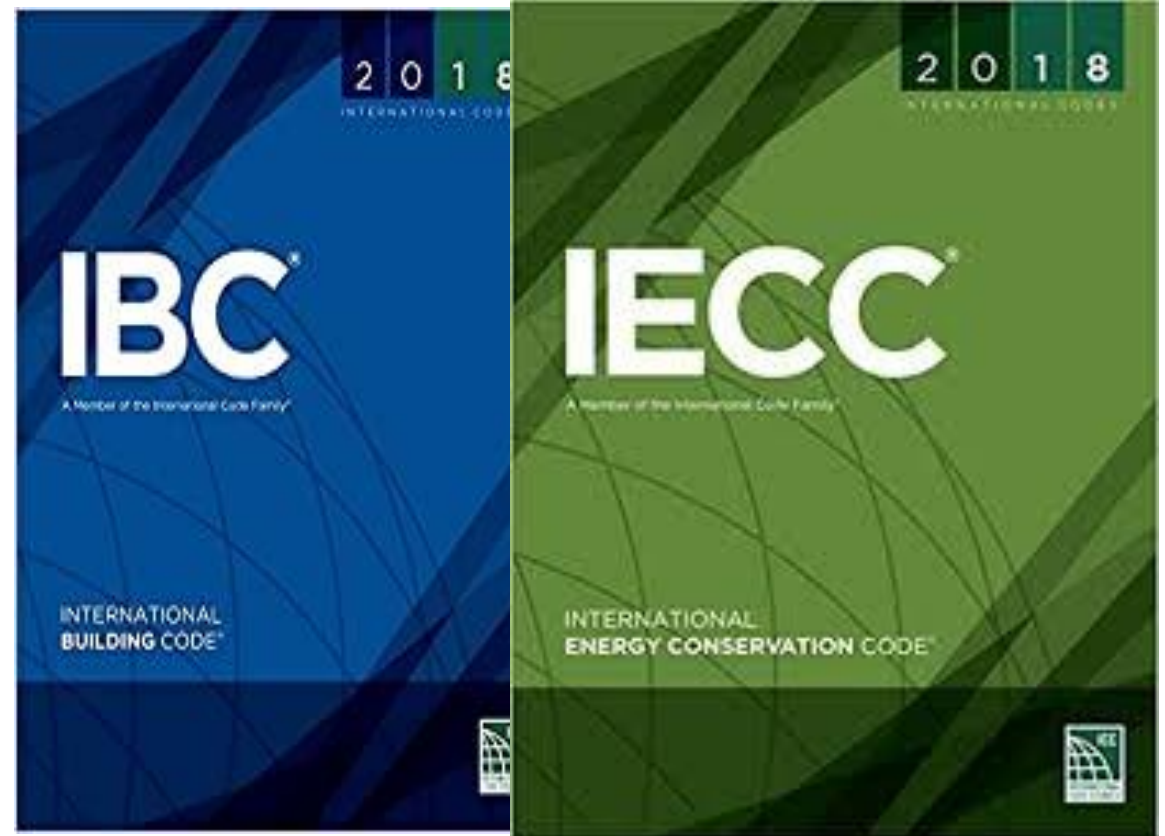
# Nebraska Residential Field Study - Results

- Overall, not too bad! But room to improve.
  - **Envelope Air Leakage:** Better than code (ACH50)
    - Not all would meet 2018 IECC
  - **Efficacy in Lighting:** Average; some good, some not
  - **Duct Leakage:** Ugh!
    - Needs significant improvement to meet 2018 IECC
  - **Ceiling Insulation:**
    - Amount: Good+ (Average: R-42.5)
    - Install: Not as good. Reduces compliance (R-factor)



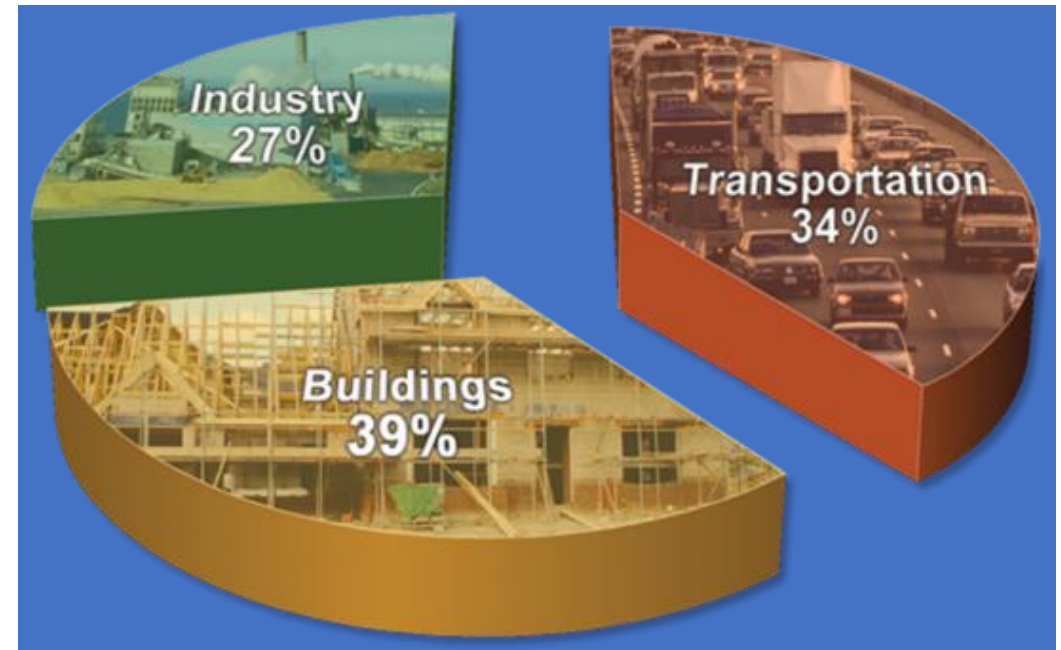
# IECC and IBC

- Chapter 13 in the International Building Code (IBC) references the energy efficiency requirements found in the IECC



# Why are Energy Codes Important?

- Reduces energy use of buildings
- Impacts energy use for the life of a building
  - Most cost-effective to implement during initial design and construction
- Benefits building owners and operators by guaranteeing a minimum of efficiency
- Health and resilience benefits to building owners and occupants



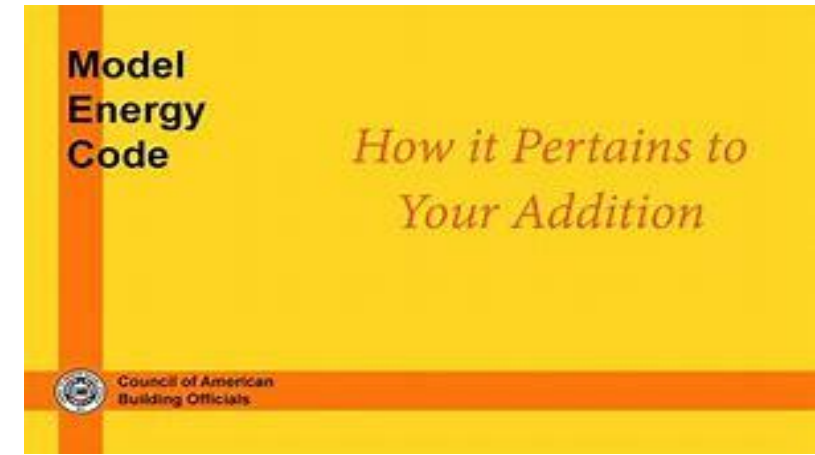


# The Energy Code and Building Energy Efficiency



# The Energy Code

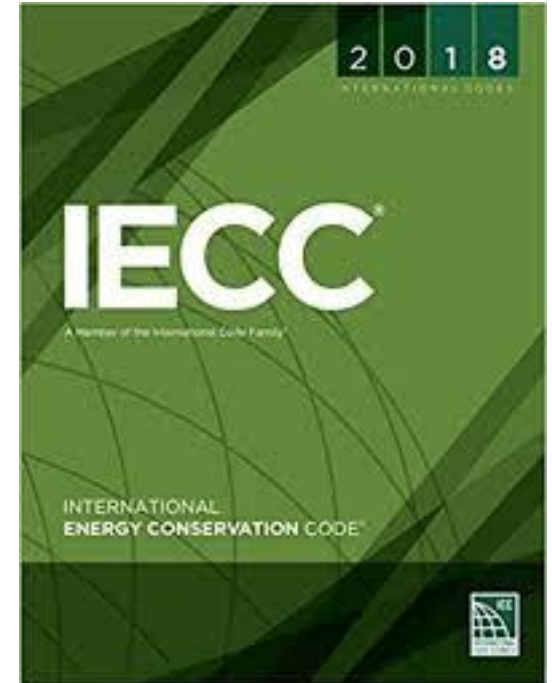
- Model Energy Code (MEC) developed in 1983 under a U.S. Dept of Energy Contract
- Editions of the MEC released from 1983-1995
- Title changed to International Energy Conservation Code in 1998



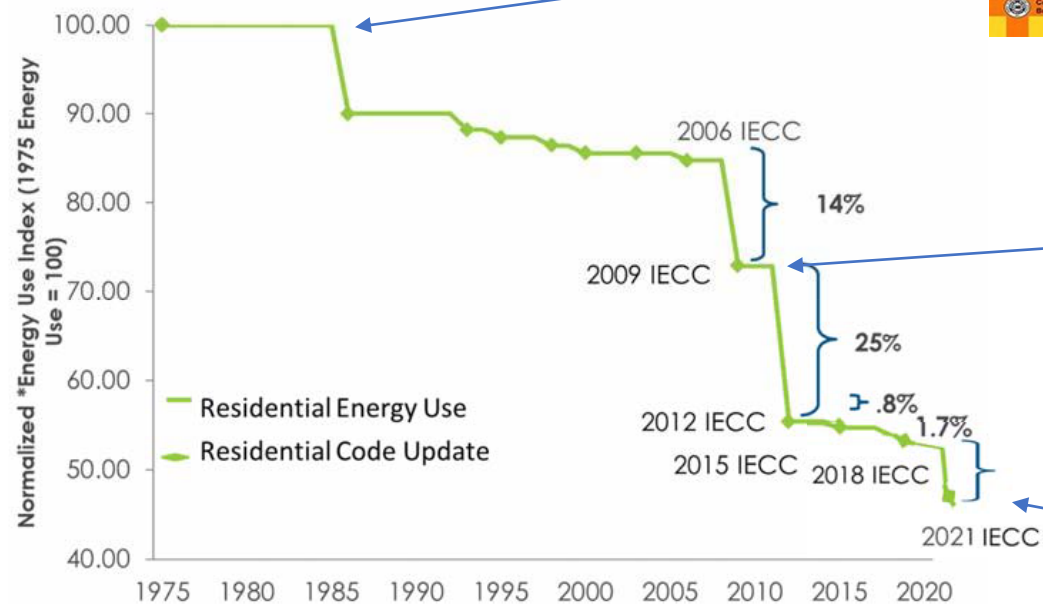
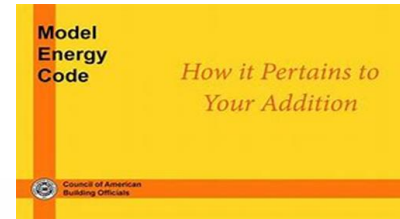


# International Energy Conservation Code (IECC)

- Developed by the International Code Council
  - Robust stakeholder process
  - Proposed changes accepted from all parties
- New editions published every 3 years



# Energy Code Background



# The Energy Code is Everywhere

- Unlike most other codes, the energy code directly impacts the work of many disparate building trades and systems, including:
  - Framing/Envelope
  - Plumbing
  - HVAC
  - Electric
  - Moisture management
  - Concrete
  - Caulking



# Advanced Framing

- Everything lines up!
- 2x6 framing @ 24" centers
- **Fewer studs = more insulation = better efficiency**

Corner Framing Stud Configurations

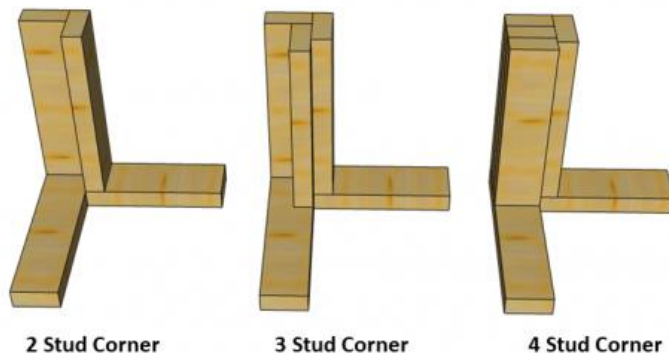
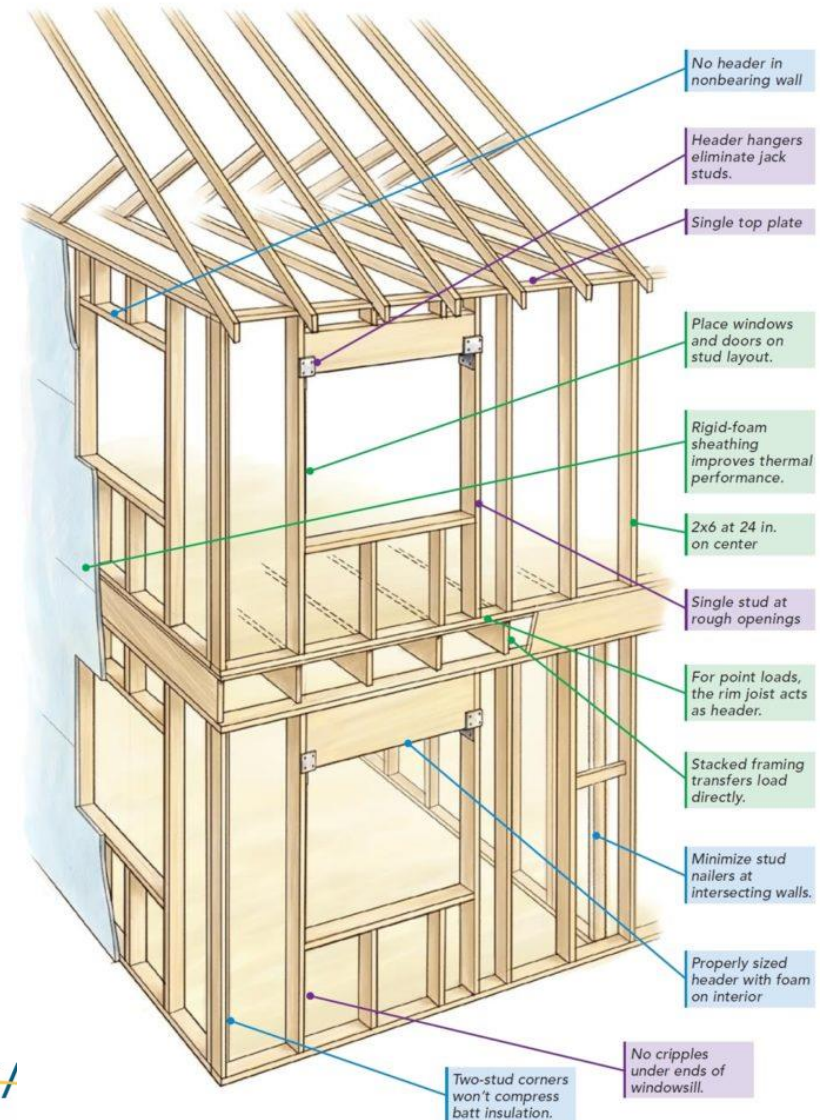


Image: [greenbuildingadvisor.com](http://greenbuildingadvisor.com); [builderscalculator.com](http://builderscalculator.com)



# Continuous Insulation - Typical Framing

- Typical wall with continuous insulation on the exterior
- Be sure to **seal all seams** in continuous insulation
- Stud cavity can accommodate various types of insulation

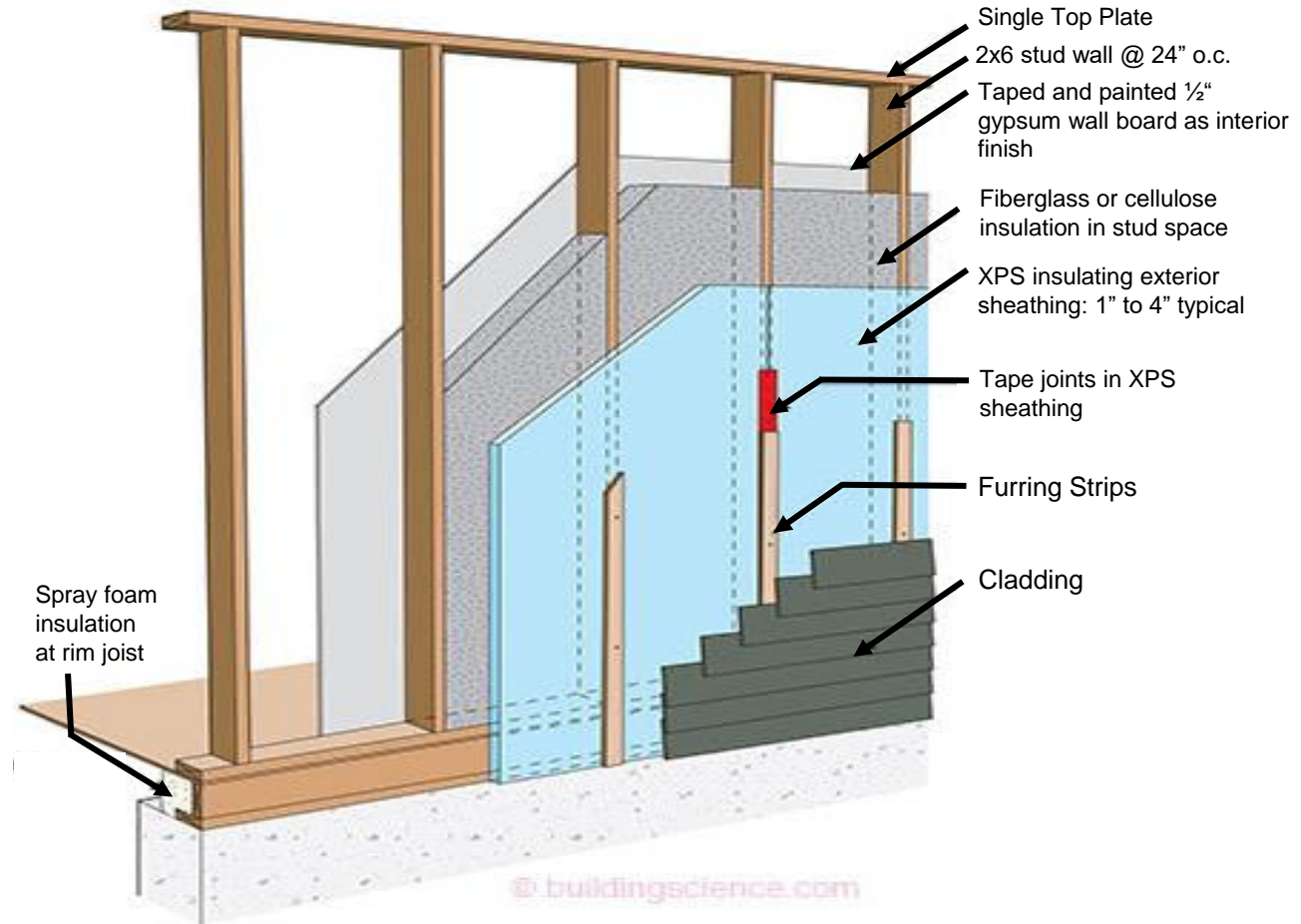


Image: [buildingscience.com](http://buildingscience.com)

# Key Energy Code Components

- Insulation R-value (ceiling, wall, foundation)
- Insulation installation quality
- Continuous air barrier/sealing and testing
- Efficient windows
- Mechanical ventilation
- HVAC system sizing location detailing
- Envelope testing
- Efficient lighting & verification testing

# 2018 IECC

- Advances Energy Code approximately 28% over the 2009 IECC
- Residential and Commercial provisions
- Testing and verification required
- Equipment details and location identified.
- Design/performance verification of lighting controls
- Adds an appendix for “Solar Ready Zones”

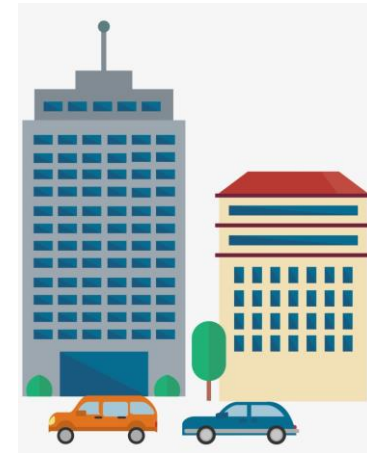
# Commercial Buildings in the IECC

Under the Purview of the Commercial Code

- ✓ Buildings with commercial use
- ✓ Multifamily residential buildings four stories or greater in height

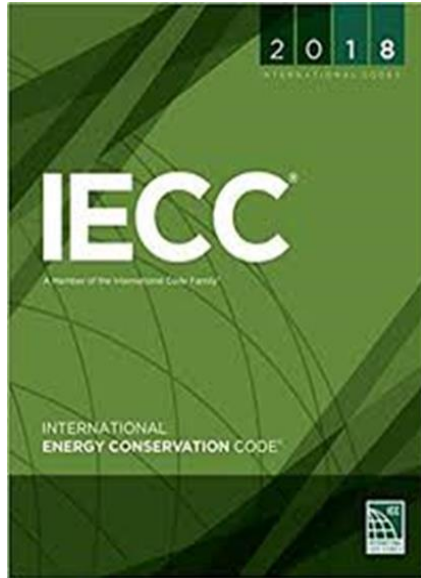
**Not** Under the Purview of the Commercial Code

- × One- and two-family residential
- × R-2, R-3, R-4 three stories or less in height



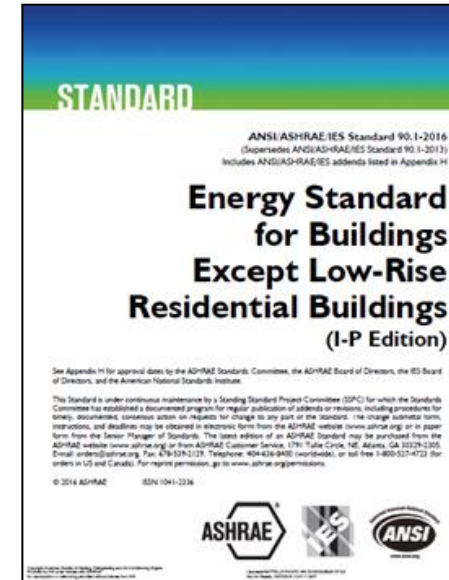


# New in 2018: *Two Commercial Compliance Options*

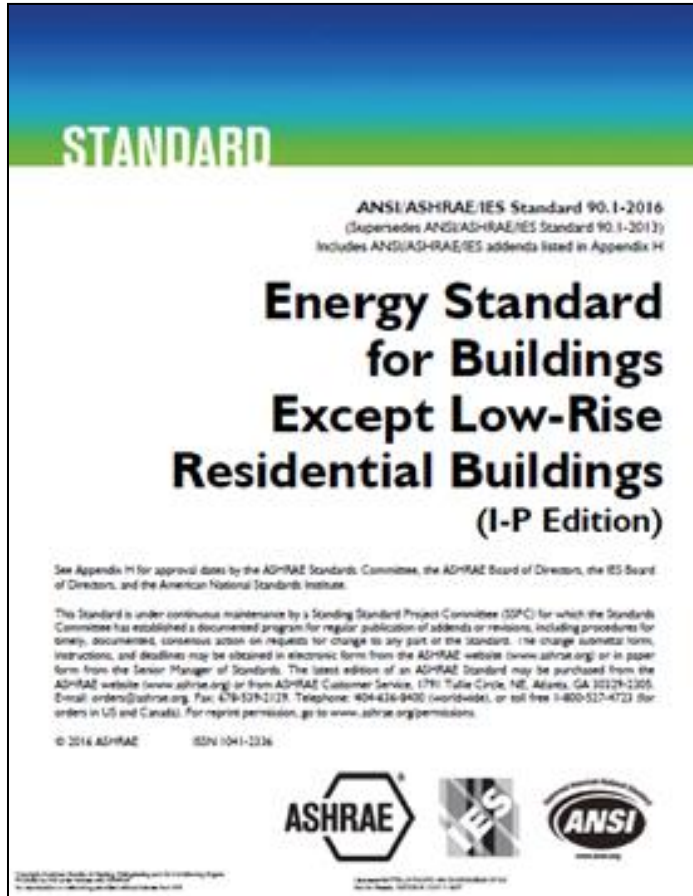


ASHRAE 90.1-2016

Alternative Method to IECC



# Structure of Standard 90.1-2016



1. Purpose
2. Scope
3. Definitions, Abbreviations & Acronyms
4. Administration and Enforcement
5. Building Envelope
6. Heating, Ventilating and Air Conditioning
7. Service Water Heating
8. Power
9. Lighting
10. Other Equipment
11. Energy Cost Budget Method
12. Normative References



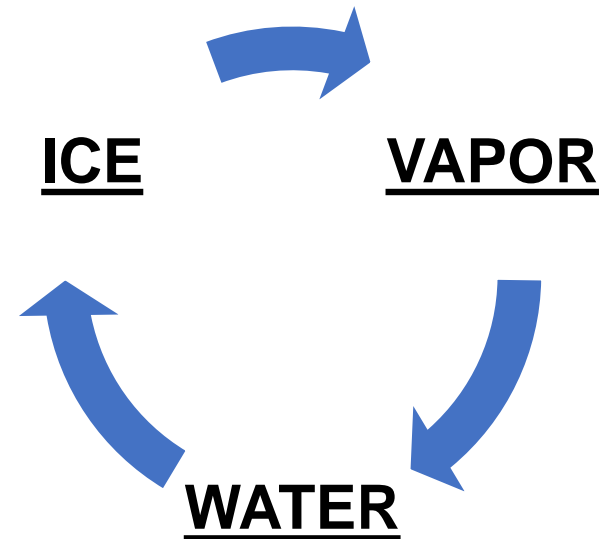
# Moisture Management

*It Connects EVERYTHING!*



# Prioritizing Moisture Movement

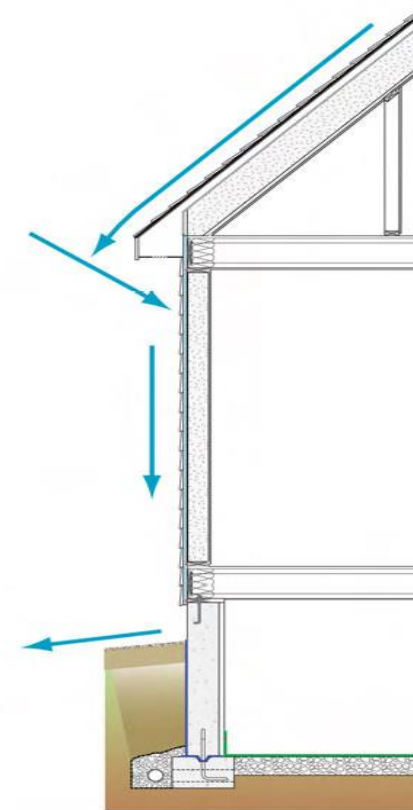
- #1 – Bulk Water
- #2 – Capillary Water
- #3 – Air-Transported Moisture
- #4 – Diffusive Moisture Movement



# Bulk Water Management – Priority #1



The key is proper  
**drainage!**





# Properly Lap Flashing

- The mason's flashing (black) was installed after and in front of the house wrap (green). This is reverse flashing that will trap any drain water that gets past the brick veneer.



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# Always Allow For Drying

## Exterior Conditions

Temperature: 80° F  
Relative Humidity: 75%  
Vapor Pressure: 2.49 kPa

## Conditions Within Cavity

Temperature: 120° F  
Relative Humidity: 100%  
Vapor Pressure: 11.74 kPa

## Interior Conditions

Temperature: 75° F  
Relative Humidity: 60%  
Vapor Pressure: 1.82 kPa

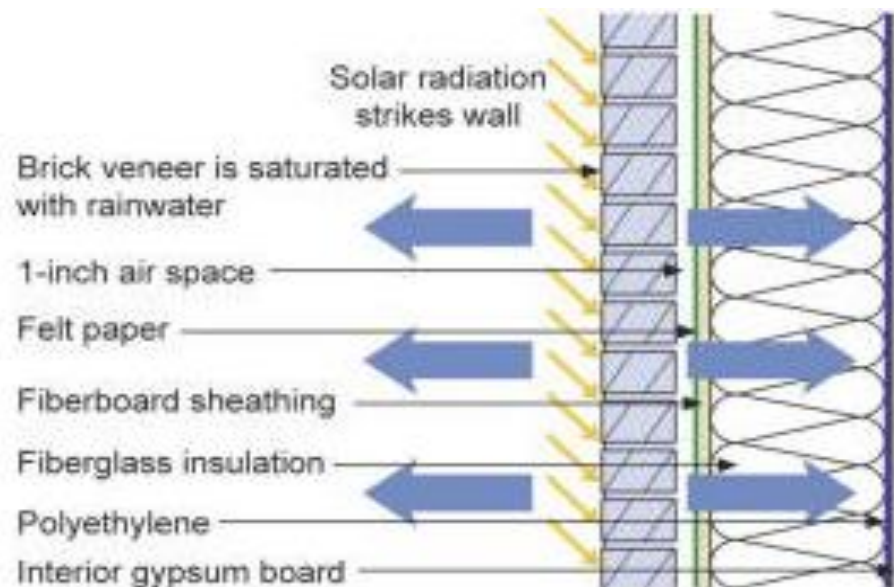


Image by Building Science Corp.

Vapor is driven both inward and outward by a high vapor pressure differential between the brick and interior and the brick and exterior

# IECC and IMC

- Whole-house mechanical ventilation required by energy code
- Ventilation rate and equipment requirements in the International Mechanical Code (IMC)







# HVAC Design and Loads

## Oversized systems:

- Less comfort
- Less efficient
- Poorly handles moisture
- Premature equipment failure

## Right-sized systems:

- Better operating efficiencies
- Greater comfort
- Healthier indoor environments
- Better moisture control

# HVAC Design and Loads




- Properly designed HVAC systems rely on scientific criteria and a systematic method to match the loads required for health and comfort:
  - *ACCA Manual J – Residential Load Calculation*
  - *ACCA Manual S – Residential Equipment Selection*
  - *ACCA Manual D – Residential Duct Systems*
- Reports should be submitted with permit application

# HVAC Load Calculations

## Section C403.1.1 (Mandatory)

Heating and cooling load sizing calculations required:


- ASHRAE/ACCA Standard 183
  - OR -
- Other approved computation procedures – defined in Chapter 3
  - Interior design conditions specified by Section C302
    - $\leq 72^{\circ}\text{F}$  for heating load
    - $\geq 75^{\circ}\text{F}$  for cooling load
- Loads reduced from energy recovery systems utilized in the HVAC system shall be accounted for in accordance with the ASHRAE HVAC Systems and Equipment Handbook



# Ventilation

## *Section C403.2.2 (Mandatory)*

- Natural and mechanical ventilation to be provided in accordance with Chapter 4 of the IMC
- If mechanical: system to provide the capability to reduce outdoor air supply to minimum required by IMC Chapter 4



# Equipment and System Sizing

## *Section C403.3.1 (Mandatory)*

- Output capacity of heating and cooling equipment only SHALL NOT be greater than calculated loads
- Select the system which serves the greater load – heating or cooling



# Holistic Approach to Building

Site Planning  
and Design

Resource  
Efficiency

Energy  
Efficiency

Water  
Efficiency

Indoor  
Environmental  
Quality

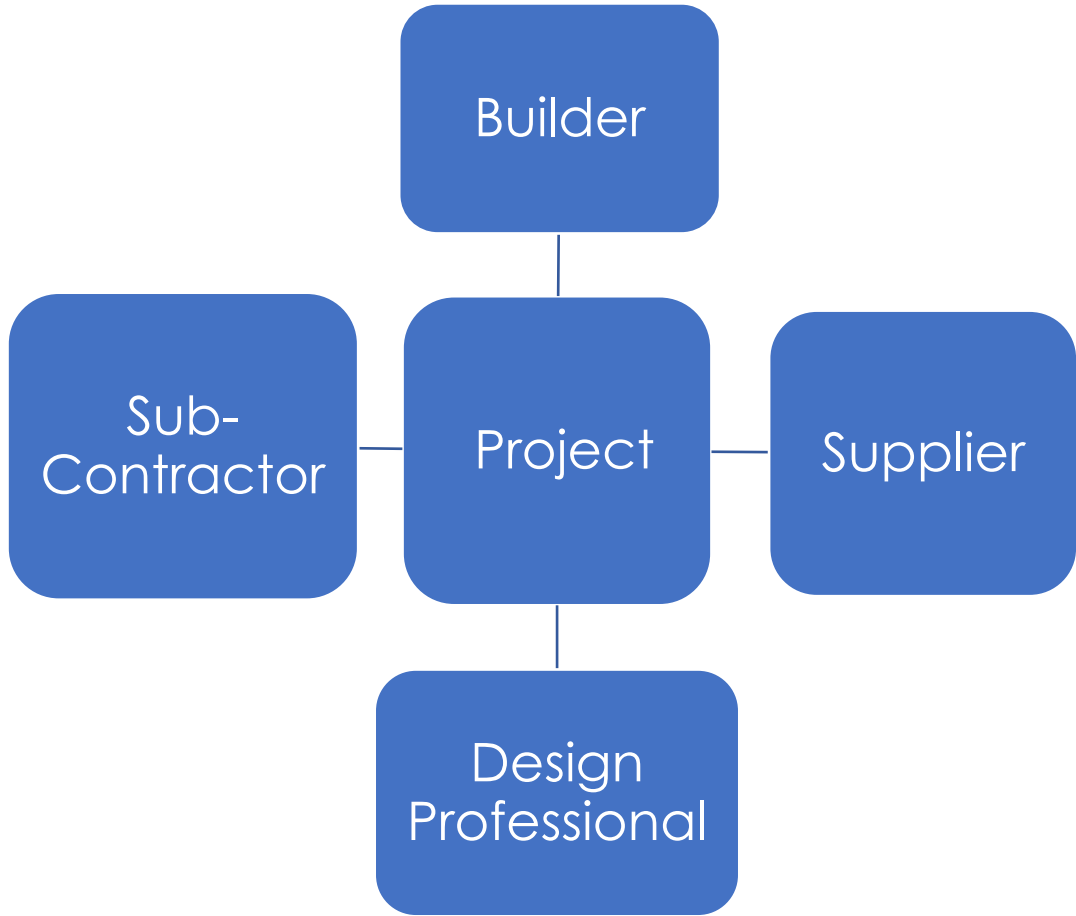
Homeowner  
Education

Global  
Impact

# Establishing a Knowledgeable Team

- Begins with /Builder/Design Professional
- Customer/Client
- Building Trades
- Suppliers/Sub-contractors
- Certifications
  - LEED-AP
  - ICC

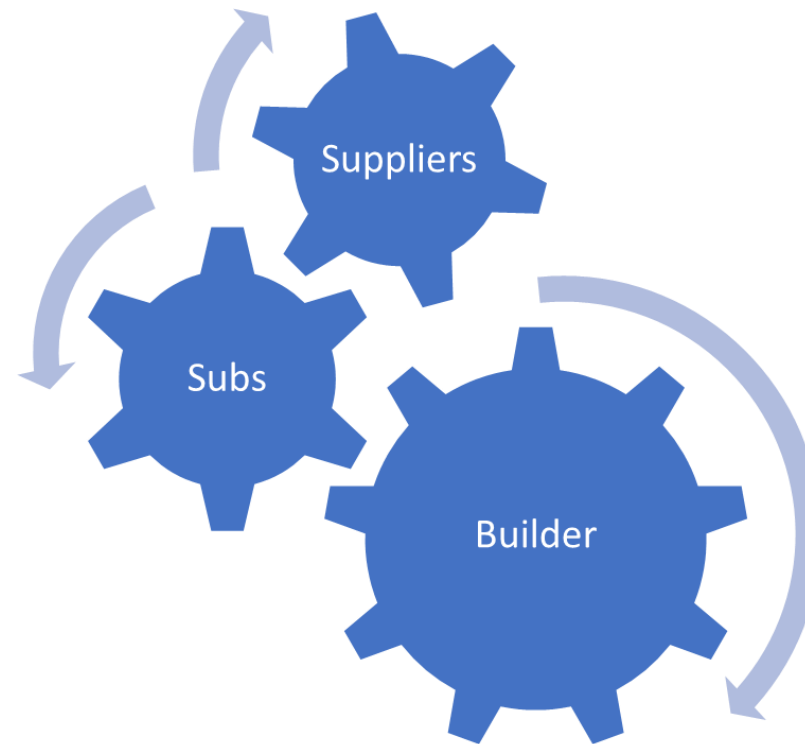
# Establishing a Knowledgeable Team





# Establishing a Knowledgeable Team

- It takes about 90 people directly and indirectly to construct an average building



# Existing Buildings

## Section C503 - Alterations

- Code applies to any new construction
  - Additions or new work in existing structures
- Unaltered portion(s) may not need to comply
- When complying via ASHRAE 90.1-2016, alterations do not need to comply with C402-C405
- Where existing building exceeds fenestration area limitations of Section C402.4.1 prior to alteration, building is exempt from C402.4.1 provided there is no increase in fenestration area



Image: montgomerycountymd.gov



# Major Building Envelope Protection Systems

- Water Barrier
- Air Barrier
- Thermal Barrier
- Vapor Profile (not just the designated vapor retarder)
- Maintenance documents

# Ventilation and Air Sealing

- Both natural and mechanical ventilation provide fresh air that can dilute and remove indoor pollutant levels
- Per the IMC/IRC, mechanical ventilation is required when homes are  $<5$  ACH 50
  - Need to do a blower door test to determine leakage rate
  - **Liability concerns when not performed**
- A blower door test measures a building's existing air leakage
- Can not design a code compliant system without knowing air leakage



*Courtesy of AC Tool Supply, Inc.*

“You don’t get what you expect, you get what you inspect!”



# Looking Ahead:



- IECC changes to The National Energy Standard as of 2024.
- Uses 2021 IECC as a baseline.
- Introduces Carbon Impact into the conversation.
- On a trajectory for Net Zero Energy as of 2030.



# Appraisals and Resale Value

*Business Impacts*

# Residential Green and Energy Efficient Addendum

- Resources for realtors and appraisers on properly valuing energy efficiency/green features
  - Educational materials
  - List of designated appraisers
  - Trainings
- For more information:
  - [http://www.appraisalinstitute.org/education/green\\_energy\\_addendum.aspx](http://www.appraisalinstitute.org/education/green_energy_addendum.aspx)

Client File #:		Appraisal File #:	
<b>Residential Green and Energy Efficient Addendum</b>			
Form 820.04*			
Client Property:		State:	Zip:
Additional resources to aid in the valuation of green properties and the completion of this form can be found at <a href="http://www.appraisalinstitute.org/education/green_energy_addendum.aspx">http://www.appraisalinstitute.org/education/green_energy_addendum.aspx</a>			
The appraiser hereby certifies that the information provided within this addendum: <ul style="list-style-type: none"> <li>has been considered in the appraiser's development of the appraisal of the subject property only for the client and intended user(s) identified in the appraisal report and only for the intended use stated in the report.</li> <li>is not provided by the appraiser for any other purpose and should not be relied upon by parties other than those identified by the appraiser as the client or intended user(s) in the report.</li> <li>is the result of the appraiser's routine inspection of and inquiry about the subject property's green and energy efficient features. Extraordinary assumptions. Data provided herein is assumed to be accurate and found to be in error could alter the appraiser's opinions or conclusions.</li> <li>is not made as a representation or as a warranty as to the efficiency, quality, function, operability, reliability or cost savings of the reported items or of the subject property in general, and this addendum should not be relied upon for such assumptions.</li> </ul>			
<b>Green Building:</b> The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's lifecycle from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classic building design concerns of economy, utility, durability, and comfort (3C-DAs). High Performance building and green building are often used interchangeably.			
<b>Six Elements of Green Building:</b> A green building has attributes that fall into the six elements of green building known as (1) site, (2) water, (3) energy, (4) materials, (5) indoor environmental quality, and (6) maintenance and operation. The energy and water elements are the most measurable elements of green or high performance housing. Appraisers need savings amounts to develop an income approach to support energy efficient contributory value.			
<b>THIRD-PARTY VERIFICATIONS</b> (See types defined in glossary). The following verified items are considered within the appraisal analysis of the subject property:			
<b>Green Certification</b> Environmental Protection Agency (EPA) <input type="checkbox"/> Home Star <input type="checkbox"/> Green Star <input type="checkbox"/> Energy Star Energy Design Index (EDI) <input type="checkbox"/> Green Energy Ready Home (GERH) Certifications attest that the home meets: Home Innovation Research Labs (HIRL) Home Remodel <input type="checkbox"/> Bronze <input type="checkbox"/> Silver <input type="checkbox"/> Gold <input type="checkbox"/> Emerald Home Innovation Research Labs (HIRL) New Home <input type="checkbox"/> Home Building Challenge (HBC) <input type="checkbox"/> Final Certification Sustainable Greenworks <input type="checkbox"/> Green Building <input type="checkbox"/> Greenworks <input type="checkbox"/> Greenworks Passive House Institute US <input type="checkbox"/> PH100 2013 LEED: LEED <input type="checkbox"/> Certified <input type="checkbox"/> Silver <input type="checkbox"/> Gold <input type="checkbox"/> Platinum Other: _____			
Date Verified: / /		Organization URL: _____	
		ABOVE VALUED ONLY IF CHECKED: <input type="checkbox"/> Verification reviewed on site <input type="checkbox"/> Verification attached to this report	
<b>Energy Label</b> Label indicates the size the home's energy needs. RESNET's iStock Rating (0 to 150): _____ Estimated energy savings for this home: \$ _____ /year kWh rate dated: / / Energy Savings includes electricity, heating & cooling. <input type="checkbox"/> Sampling Rating Score below 250 indicates energy costs are expected to be lower than average local code home per square foot. iStock Index Report estimates energy cost based on number of bedrooms plus one. Only a "uniform rating" is a diagnostic test. <input type="checkbox"/> Confirmed Rating DOE Home Energy Score: _____ Estimated energy savings for this home: \$ _____ /year kWh rate dated: / / Score (1 to 100) Score below five indicates energy costs are expected to be lower than average local home. Home Energy Score estimates energy cost based on initial average energy. <input type="checkbox"/> Official Score LEED Official Score: _____ Estimated energy savings \$ _____ /year kWh rate dated: / / Range ( ____ to ____ ) Describe energy label system: _____			
Date Verified: / /		Score or Rating Version: _____	
		Organization URL: <a href="http://www.resnet.org">www.resnet.org</a> <input type="checkbox"/> <a href="http://www.energyscore.com">www.energyscore.com</a> <input type="checkbox"/> Other: _____	
		ABOVE VALUED ONLY IF CHECKED: <input type="checkbox"/> Verification reviewed on site <input type="checkbox"/> Verification attached to this report	
<b>Verified Energy Improvements</b> Explain energy-related improvements: Cost of improvements: \$ _____			
Date Verified: / /		Certificate of Efficiency Improvements Version: _____	
		Organization URL: <a href="http://www.energystar.gov">www.energystar.gov</a> <input type="checkbox"/> Other: _____	
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Completed by: _____ Title: _____ Date: _____			

\*NADCE: The Appraisal Institute publishes this form for use by appraisers when the appraiser deems use of the form appropriate. Depending on the assignment, the appraiser may need to provide additional data, analysis and work product not called for in the form. The Appraisal Institute makes no representations, warranties or guarantees as to, and assumes no responsibility for, the data, analysis or work product provided by the individual appraiser in the specific context of the appraisal. An 820.04 Residential Green and Energy Efficient Addendum Appraisal Institute 2017. All Rights Reserved. November 2016

Form  
820.04





# Questions?



# Duct and Envelope Tightness (DET) Verifier Training and Train-the-Trainer

- Free
- In-person in Lincoln, NE
- Become DET certified in 2 days or learn to train others in 3 days!
- **Tuesday January 24 - Thursday 26**
- **9a.m. – 5p.m.**
- ICC/AIA CEUs and certificate provided



For more info or questions contact Corie Anderson at [canderson@mwalliance.org](mailto:canderson@mwalliance.org)





# Thank you!

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