Nebraska's Energy Code 2018 IECC Compliance Issues and Solutions

Nebraska Energy Code Training Program Instructor: Matt Belcher August 13, 2024





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Housekeeping

are

Attendees are muted upon entry

Questions? Enter them in the chat box, or simply unmute yourself and ask

Webinar is being recorded – slides and recording will be sent to attendees

CEU's will be available upon request (ICC and AIA)



Email: jgossman@mwallian <u>ce.org</u> with questions







Who We Are

The Midwest Energy Efficiency Alliance (MEEA) is a collaborative network, promoting energy efficiency to optimize energy generation, reduce consumption, create jobs and decrease carbon emissions in all Midwest communities.

MEEA is a non-profit membership organization with 170+ members, including:



Energy Service Companies & Contractors





State & Local Governments



Academic & Research Institutions

Good Life. Great Resources.



Electric & Gas Utilities Communitybased Organizations





About the Nebraska Training Program



Goal: **prepare** the Nebraska workforce for changes in construction best practices



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







Training Objectives

- What is the 2018 Energy Code?
- Inside the Energy Code:
 - Building Envelope
 - Interior Comfort/Health
 - Remodeling/Rehab
 - Local Application/Amendments
- '21 Code \rightarrow '24 National Standard
- Marketing Energy Efficient/High Performance Buildings









Nebraska's Energy Code

- Nebraska adopted the full suite of 2018 International Code Council's (ICC) Codes, including the unamended International Energy Conservation Code (IECC)
- The IECC...
 - Applies to new and renovated buildings
 - Sets minimum requirements for energy features and performance
 - Reduces energy use and polluting emissions over the life of complying buildings
 - Benefits commercial building owner, homeowners, and society by improving cost-effectiveness, comfort, productivity, and durability
- The IECC covers both residential and commercial buildings, but we are focused on commercial today







The 2018 IECC



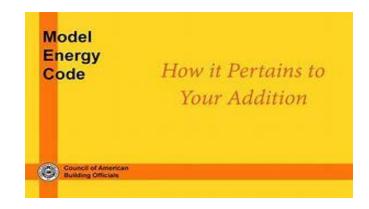






The Energy Code

- 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

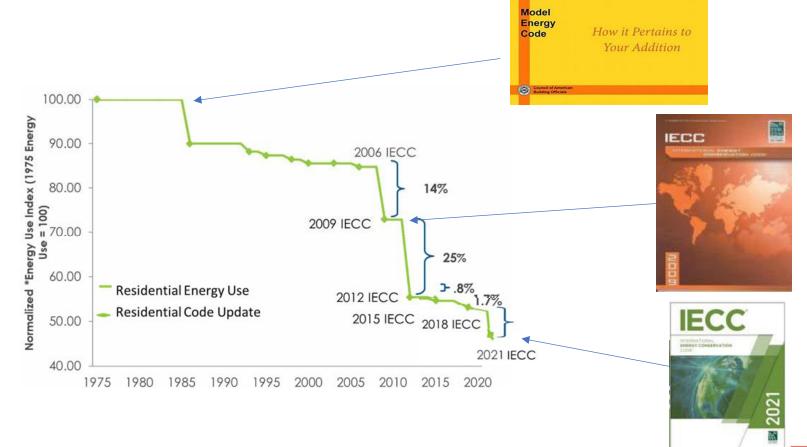








Energy Code Background









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:

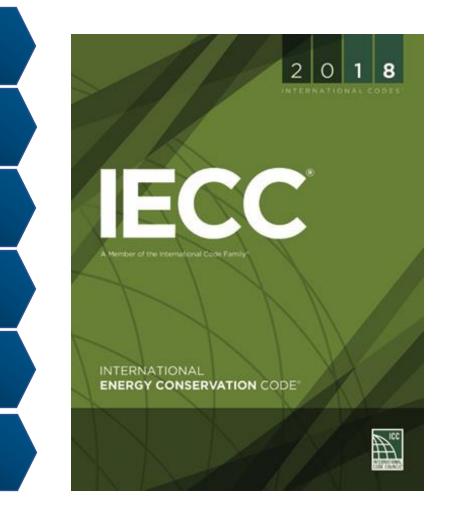
https://www.energycodes.gov/sites/default/files/documents/ Nebraska_Residential_Compliance_Evaluation_final.pdf







So, What's Changed since 2009?



2018 IECC / IRC Section 11

- Creates a Residential Energy Code separate from the Commercial Energy Code
- Adds testing and verification requirements
- Promotes Innovation through Energy Ratings Index (ERI)
 - Uses a HERS-type index as an "equivalent" for residential applications
 - Mandatory requirements still apply







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







Energy Certificate

 Energy Certificate located on circuit breaker box includes key energy efficiency measures and is signed by the builder

Air Sealing

- All holes between floors and through exterior walls/ceilings have been sealed in **accordance with table R402.4.1.1**
- Building or dwelling unit is tested to verify air leakage rate of ≤ 3 Air Changes per Hour (ACH)
- Building or dwelling unit must have continuous air barrier installed







Ducts

- All ducts are sealed with approved materials (e.g. mastic or UL 181 tape) duct tape is not acceptable
- All ducts outside conditioned space are tested to verify duct leakage with a total duct leakage or leakage to the outside test
- Supply & return ducts in attic insulated to \geq R-6 when ducts are outside conditioned space and \geq R-8 when ducts are outside the building thermal envelope

Building Cavities

 Building framing cavities shall not be used as supply ducts or plenums







Heating and Cooling

- Controls: Programmable thermostat installed
- Equipment sized per ACCA Manuals S & J

Lighting

- Minimum of 90% high-efficacy lamps installed
- Recessed lighting in thermal envelope IC-rated and airtight

Mechanical Ventilation

- Installed according to requirements in the International Mechanical Code
- Required for all homes ≤ 5 ACH per Section M303.4 (3 ACH is a 2018 IECC mandatory requirement)







Other requirements

- Wood-burning fireplaces have tight flue dampers or doors, and outdoor combustion air
- Mechanical system piping insulated to min R-3 for fluids >105° F or <55° F
- Circulating hot water systems shall be insulated to at least R-2. Systems shall include an automatic, or readily accessible, off-switch.







Energy Code Compliance Pathways

Prescriptive Method Requirements

• All mandatory and prescriptive requirements must be met

Total UA Method Requirements

- All mandatory and prescriptive requirements (other than Table R402.1.2) must be met
- Include documentation to demonstrate compliance with the UA Trade-off method. Compliance software submittal must include completed compliance form, inspection checklist and certificate demonstrating compliance with 2018 IECC levels







Energy Code Compliance Pathways

Simulated Performance Requirements (Section R405)

- All mandatory requirements must be met
- Submit an energy cost analysis report which demonstrates that the proposed design (as built) home is more efficient than the standard reference design home

Energy Rating Index Requirements (Section R406)

- All Mandatory requirements met. Meet or exceed 2009 IECC prescriptive envelope requirements
- ERI score of 61 or lower. Submit report demonstrating compliance







Structure of Commercial 2018 IECC

- Ch. 1 Scope and Application / Administrative and Enforcement
- Ch. 2 Definitions
- Ch. 3 General Requirements
- Ch. 4 Commercial Energy Efficiency
- Ch. 5 Existing Buildings
- Ch. 6 Referenced Standards
- Index







Commercial Buildings in the IECC

Under the Purview of the Commercial Code

- $\checkmark\,$ 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 ANSLASHRAE IES Standard 90.1-2016 (Separator ANSLASHRAE IES Standard 90.1-2017) Incide ANSLASHRAE IES addres bis in Agendic H Energy Standard for Buildings

Except Low-Rise Residential Buildings (I-P Edition)

See Appendix IV for approval dates by the ADHTAE Standards. Committee, the ADHTAE Board of Directors, the ES Board of Directors, and the American National Standards Institute.

STANDARD

The factor is under continuum meterization by Scondig Standard Private Convolution SIPC for which the School meterization of the standard standard standard standard standard standard standard standard meterization, advantation may be independent on the SPME which may be appreciated to in meterization, advantation may be independent and standard standard standard standard meterization, advantation may be independent and standard standard standard meterization, advantation may be independent and standard standard behavior and standard standard standard Developments and standard standard Developments and the independent standard standa

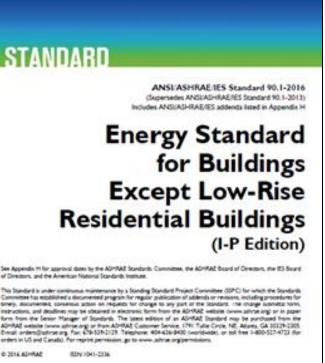






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Structure of Standard 90.1-2016





- . 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
- 1. Energy Cost Budget Method
- 12. Normative References







What About Mixed Use? - C101.4.1

- Treat the residential building portion under the applicable residential code
- Treat the commercial building portion under the commercial code
- Code Official has final authority



Image: agarch.com







Commercial Compliance Options

ASHRAE 90.1-2016



2018 IECC – Prescriptive ✓ C402 – Envelope ✓ C403 – Mechanical ✓ C404 – SWH ✓ C405 – Lighting AND Pick at Least One C406: □C406.2 – Eff. HVAC Performance □C406.3 – Reduced Lighting Power □C406.4 – Enhanced Lighting Controls □C406.5 – On-site Supply of Renewable Energy C406.6 – Dedicated Outdoor Air System □C406.7 – High Eff. Service Water Heating

- C406.8 Enhanced Envelope Performance
- C406.9 Reduced Air Infiltration



2018 IECC – Performance

- C407 Total Building Performance
- C402.5 Air Leakage
- C403– Mandatory Mechanical Provisions
- C404 SWH
- C405 Lighting
- Building energy cost to be < 85% of standard reference design building

Building Envelope Compliance Options

3 Methods for compliance of building components:

- C402.1.3 Insulation component R-value based method
- C402.1.4 Assembly U-factor, C-factor or F-factor based method
- C402.1.5 Component Performance Alternative







Building Envelope

- <u>All</u> of the elements of the envelope and the assembly methods (and details) determine how well the building envelope performs.
- The building envelope must be an unbroken boundary surrounding the structure.
- All elements must be in close alignment with each other.



Photo courtesy of U.S. Gypsum







Performance Testing

A Great Quality Control Tool





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Air Leakage & Continuous Air Barrier Testing Section C402.5

- Continuous Air Barrier Required
- Two Compliance Options
 - ASTM E 779 (blower door test)
 - Compliant assemblies
 - C402.5.1 through C402.5.8









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.



- Blower door test documents a home's air leakage performance
- Required by code
- Third party verification (some areas; performed by Inspectors)
- Provides solid data for final equipment adjustment and energy use/cost forecast
- Great liability protection for all involved





AIR LEAKAGE REPORT			
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Building Name:	802EastMcCartyStreet	Rating Org.:	ASERusa
Owner's Name:	River City Habitat for Humanit	Phone No.:	314-894-2300
Property:	802 East McCarty Street	Rater's Name:	Gary Fries
Address:	Jefferson City, MO 65101	Rater's No.:	8016891
Builder's Name:	River City Habitat for Humanit		
Weather Site:	Columbia, MO	Rating Type:	Confirmed
File Name:	8016891 - 097 - eSTAR 2.0, TC, NR - 802 East M	Rating Date:	12/01/11

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	ACH @ 50 Pascals:	3.78	3.78
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Whole Ho

Duct Leal

Vent

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	CFM25 / CFMfan:	0.0214
	CFM25/CFA:	0.0181
	CFM per Std 152:	N/A
	CFM per Std 152 / CFA:	N/A
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	Cooling Ventilation:	Natural Ventilation

ASHRAE 62.2 - 2010 Ventilation Requirements

For this home to comply with ASHRAE Standard 62.2 - 2010 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, a minimum of 44 cfm of mechanical ventilation must be provided continuously, 24 hours per day. Alternatively, an intermittently operating mechanical ventilation system may be used if the ventilation rate is adjusted accordingly. For example, a 88 cfm mechanical ventilation system would need to operate 12 hours per day, as long as the system operates to provide required average ventilation once each hour.

REM/Rate - Residential Energy Analysis and Rating Software v12.98



Date:	May 02, 2012
Building Name:	123 Main Street
Owners Name:	Jane Smith
Property Address:	123 Main Street Omaha, NE 68007
Builder's Name:	ABC Construction
Weather Site:	Omaha, NE
File Name:	101682391-097 eSTAR

Rating No.: 81158891-901 Rating Org.: **Raters USA** Phone: 555-555-5555 Rater's John Williams Name: Rater's No: 1234567 Confirmed **Rating Type: Rating Date:** 12/01/20

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Rating Type:

Confirmed

12/01/11

Weather Site

File Name:

Columbia, MO

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Systems Commissioning and Completion Requirements Section C408

- Commissioning is critical to ensure that buildings are working as designed
- Preliminary and final reports required
- Mechanical and lighting commissioning detailed in section C408

Improved occupant comfort Increased and satisfaction building system life the operational resulting in higher productivity Efficient and Increase in the asset and expected rental value associated leading to lower with a building, etc





Ventilation and I.A.Q.



Building Envelope + Air Sealing Package + HVAC Design, Equipment & Installation + ERV/HRV + Water Heating Design

= Occupant Comfort







Moisture Management

It Connects EVERYTHING!







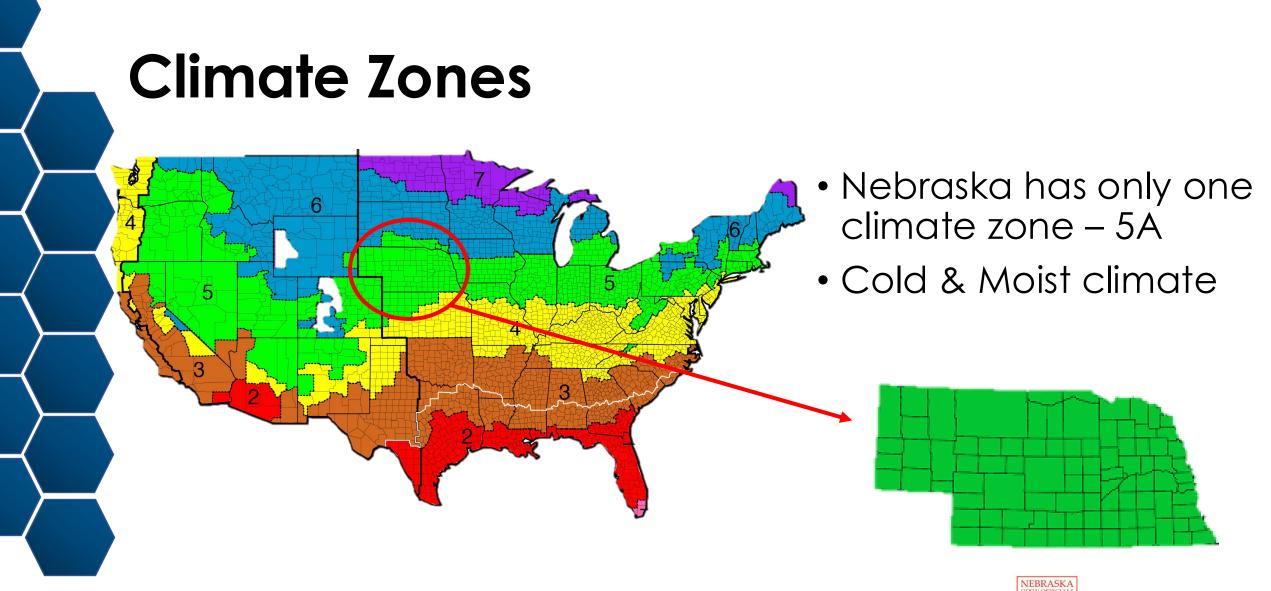
The Major "Damage Functions"

- Liquid water (bulk and capillary)
- Air-borne water
- Vapor
- Radiation (UV degradation)
- Pests
- People









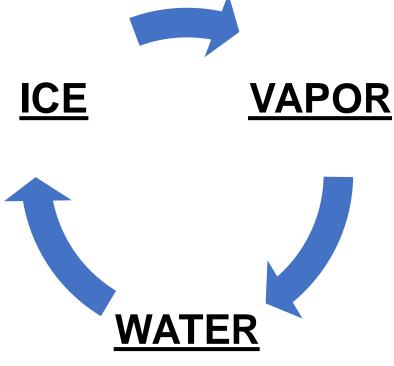






Prioritizing Moisture Movement

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









Bulk Water Management – Priority #1

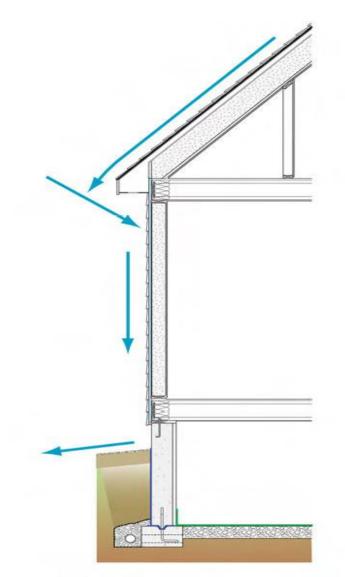




The key is proper drainage!



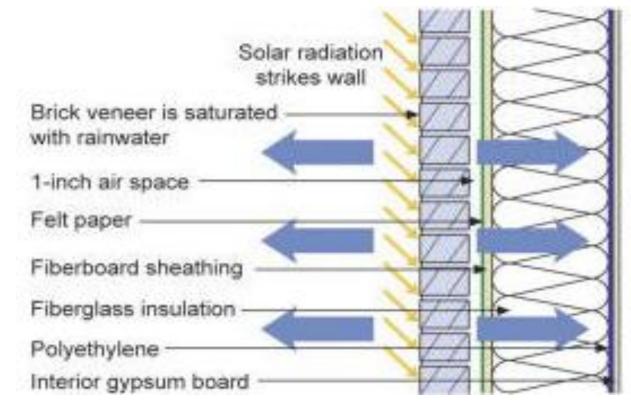




Always Allow For Drying

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

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

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.









Direct Water Away From Corners



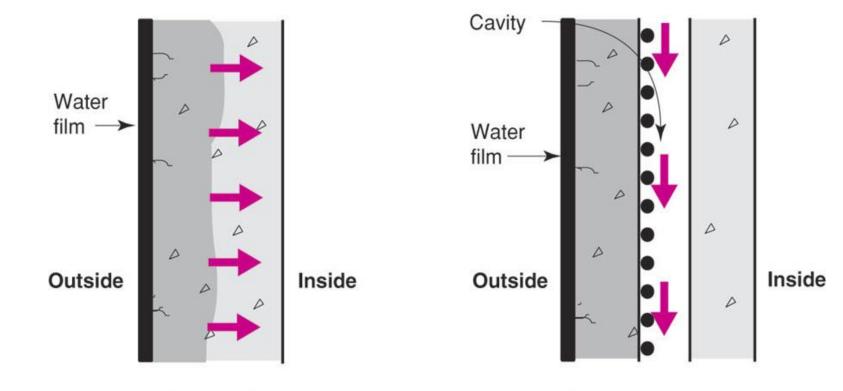








Capillary Moisture Flows - Priority #2



Capillary suction draws water into porous material and tiny cracks Cavity acts as capillary break and receptor for capillary water interrupting flow

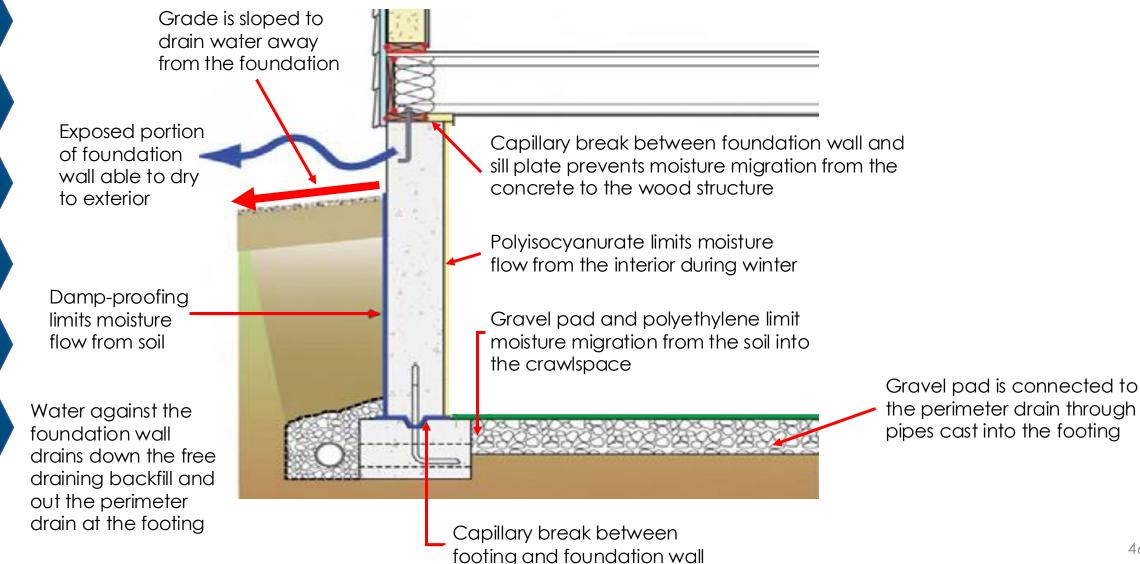
Image courtesy of Building Science Corp.



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Foundation Moisture Management



Sill Plates Need Capillary Breaks











Air Transport of Moisture – Priority #3

- Air carries a **lot** of water
- Air leakage
 - Moisture flow
 - 4X8 Drywall
 - 70 F
 - 40% RH
 - 1 square inch hole
- Flow quantity
 - 30 Quarts of water!!

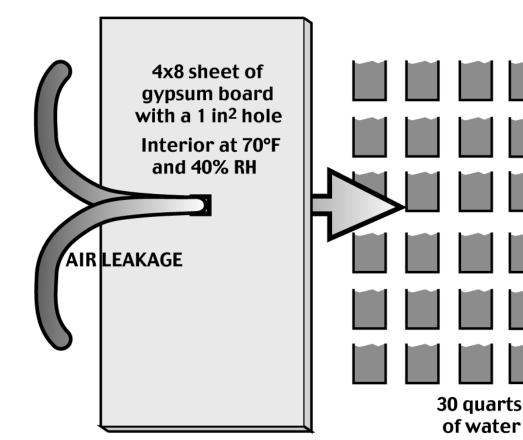


Image courtesy of Building Science Corp.







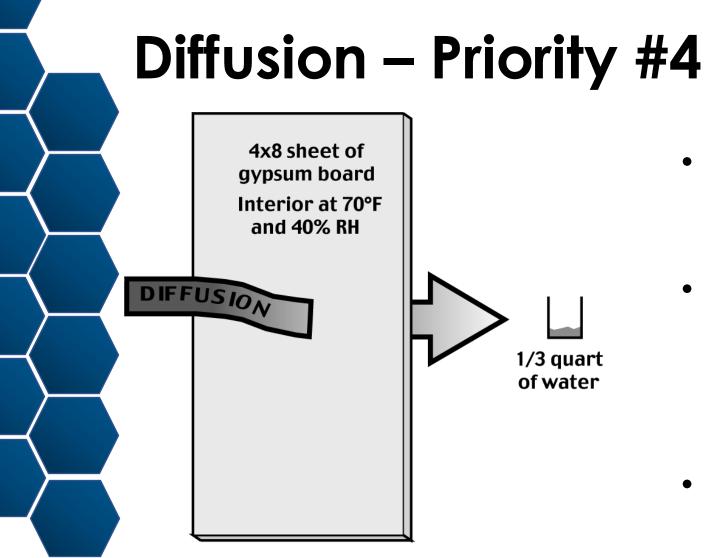


Image courtesy of Building Science Corp.



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NEBRASKA CODE OFFICIALS ASSOCIATION

Migration of moisture by

differential

humidity

means of vapor pressure

Occurs in either direction

exterior/interior levels of

• Different building materials

have different permeability

based on climate

conditions and

Air Movement

Air Movement Seeks Balance





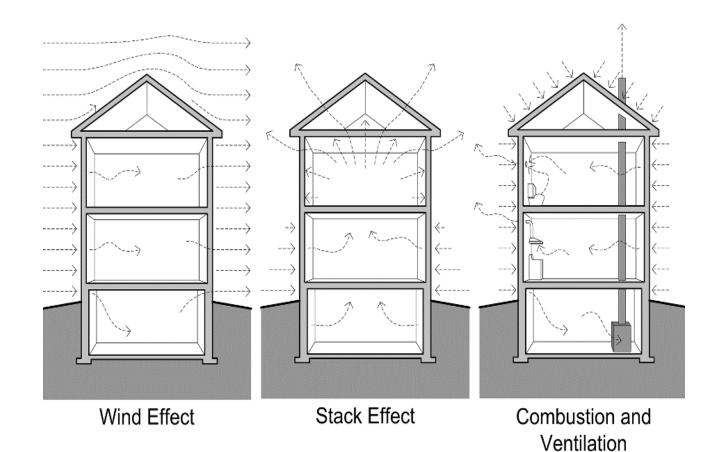


How Does Air Get Around?

Air In = Air Out

For air movement you need:

- A hole
- A driving force
- Another hole

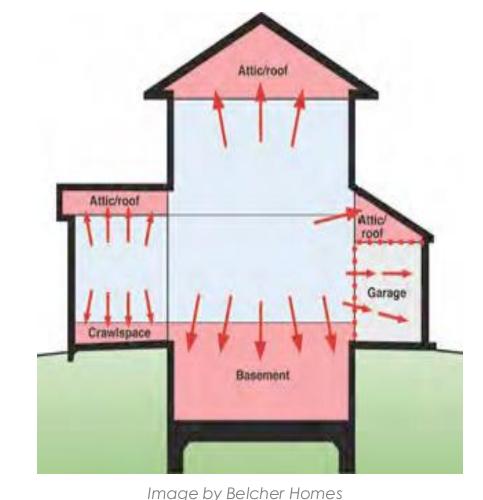








Internally Generated Air Pressure



Expansion of Conditioned Space

- Conditioned space boundaries moving towards exterior surfaces of building
- Garage isolated from house by air barrier/pressure boundary
- Garage ventilated and conditioned independently of rest of conditioned spaces







Batt Insulation Grading

Code Compliant Not Acceptable Grade II: Up to 2% Grade III: 2% - 5% Grade I: Almost no gaps RESNET protocol for the effect of missing insulation on installation grade

Diagrams from the HERS Standards







Heat Transfer

A Triple Threat

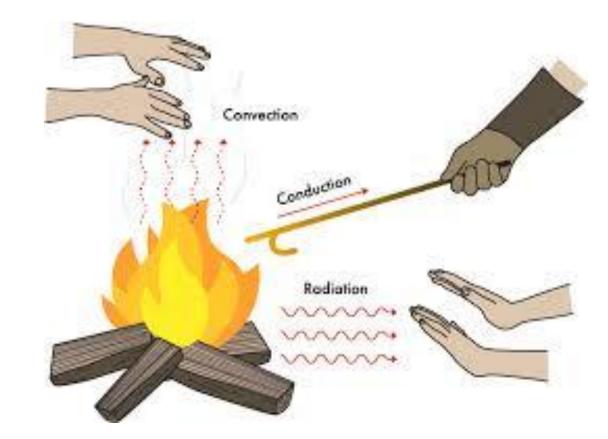






Heat Transfers in 3 Ways

- Convection Through fluids (liquid or gas)
- Conduction Through solids
- **Radiation** Mostly windows



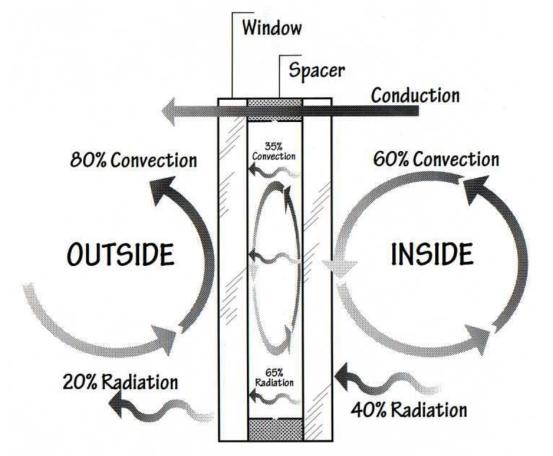






Practical Application - Windows

- Heat always moves from hot to cold
- Always a mix of transfers
- Different rates of transfer can be important



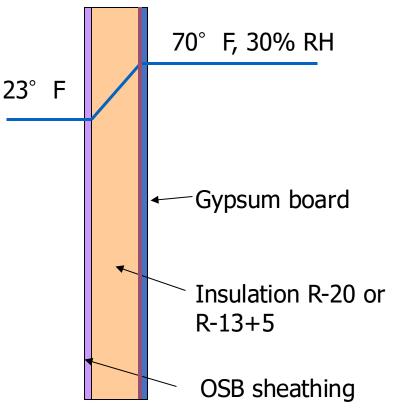






Condensing Surface Temperatures

- Dewpoint of interior air = $37^{\circ}F$
- Where will condensation occur? Inside surface of exterior sheathing
- One Solution? Interior vapor retarder, but what type and at what "cost?"









Major Building Envelope Protection Systems

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







"You don't get what you expect, you get what you inspect!"









HVAC System

Don't Forget the **"V"**







HVAC Design and Loads

Oversized systems:

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

<u>Right-sized systems</u>:

- 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 - Commercial 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°F for heating load
 - \geq 75°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







$H\underline{V}AC \ Design \ and \ Loads$

Today's homes risk health problems for occupants because:

- They are not properly ventilated:
 - < 3 ACH
- More chemicals and products are used in and around a house:
 - Concentration levels are often 2 to100 times higher than outside.







Balanced Ventilation

- Blows air into and out of the house
- Is cost effective by reclaiming energy from exhaust and supply airflows (60%-80%!)
- Balances exhaust and supply flows (minimizes pressure differential)
- Maintains the Minimum Ventilation Guideline automatically with proper set-up







Appraisals and Resale Value

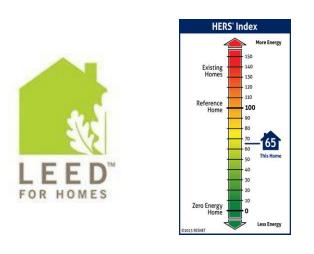






Appraisers

- Unlike granite countertops, energy efficiency investments are not always visible at a glance
- Utilize certifications, labels, ratings, and scores
- Make sure appraisers are accurately valuing sustainable properties
 - Residential Green and Energy Efficient Addendum - Assists appraisers in analyzing residential "Green" features and properties.













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: <u>http://www.appraisalinstitute.or</u> <u>g/education/green_energy_ad</u> <u>dendum.aspx</u>





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Lender Specification

"This Home/Building is being built/renovated/updated to nationally recognized standards above prevailing code. It is designed and constructed with unique features and materials and with high efficient equipment and in accordance with high efficiency standards. The Lender shall choose an Appraiser educated and knowledgeable in this type of valuation of these specialized Homes, preferably an appraiser who holds a professional appraisal designation that requires advanced education on such issues as the valuation of sustainable buildings (e.g. MAI or SRA designations from the Appraisal Institute). The appraiser shall provide verification of green valuation education of 14 hours or more from a qualified educational provider and knowledge to be permitted to conduct the appraisal for this project."





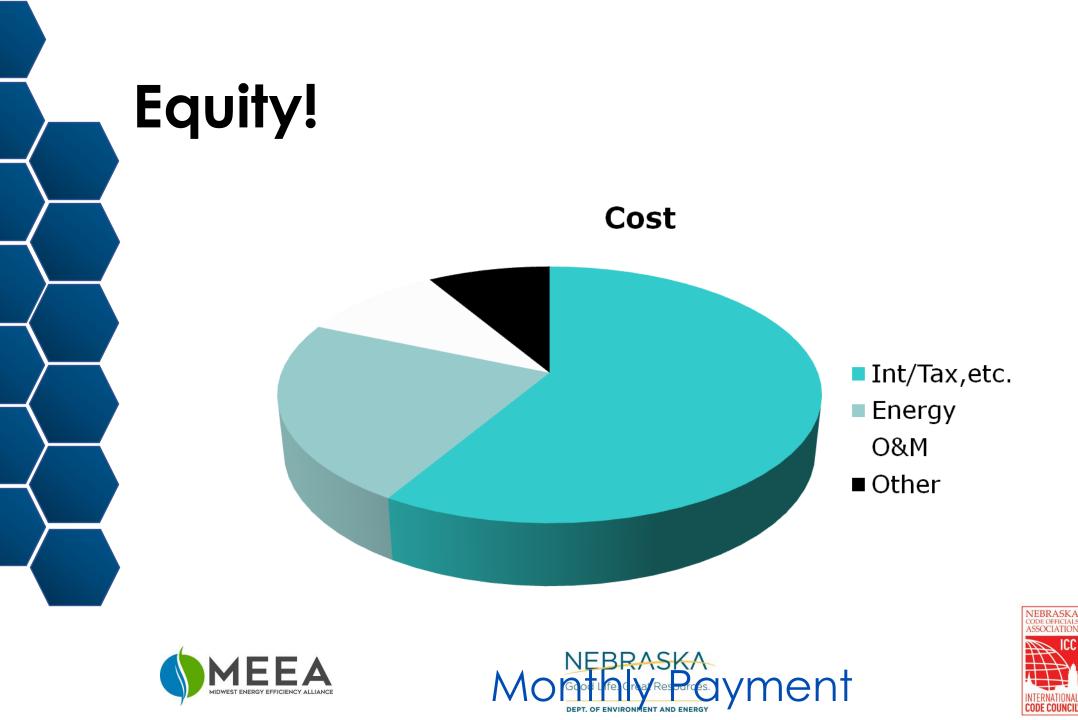


Marketing High Performance









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



mage: montgomery county md.gov







Key Takeaways

- 2018 IECC has new requirements for:
 - Air sealing
 - Duct sealing
 - U-Factor
 - R-Values
 - Performance Testing
- Controlling moisture is critical
 - Proper air sealing is key
 - Right-sizing HVAC is required
 - Mechanical ventilation must be installed and takes on new importance











- 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.







Upcoming Trainings

September

- In-person training in the Grand Island area, stay tuned - (Exact date TBD)

- Nebraska Energy Codes Collaborative – VIRTUAL – (Exact date TBD)

Would you like an in-person training in your area? Let us know!







Thank You! Questions?

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John Gossman, MEEA jgossman@mwalliance.org





