METROPOLITAN
Community College

The Commercial Energy Code: Session 2

Nebraska Commercial Energy Code Basics

Instructor: Matt Belcher

Tuesday, January 17, 6-8p.m.

Housekeeping

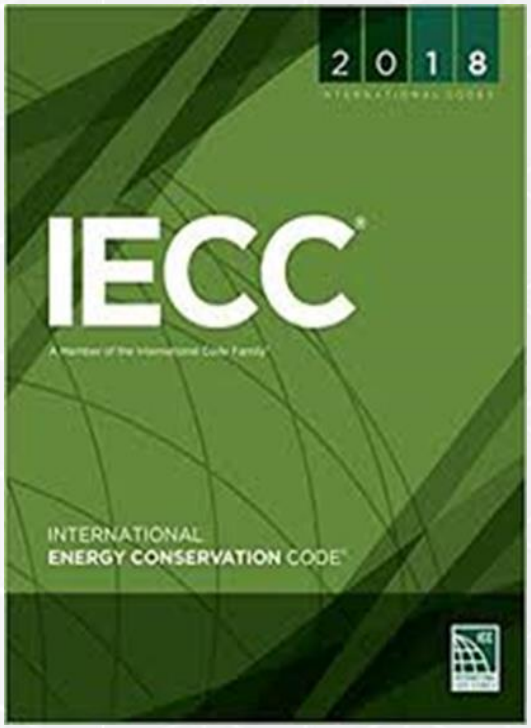
- Attendees are muted upon entry
- Questions? Enter them in the chat box
- Webinar is being recorded – slides and recording will be sent to attendees
- CEUs available for AIA and ICC
- Email canderson@mwalliance.org with questions
- Course information available at: https://www.mwalliance.org/metropolitan-community-college-energy-code-course

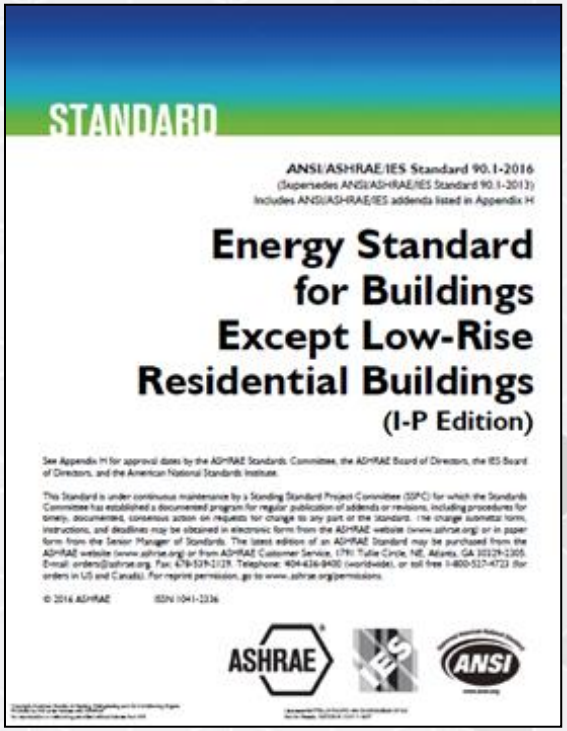
Today's Agenda

- The 2018 Commercial IECC
- Building Envelope Requirements
- Mechanical/Ventilation "Quick hit"
- Commissioning
- ASHRAE 90.1 2016 Option
- Existing Buildings
- Key Takeaways
- Q&A

Two Commercial Compliance Options

We will also discuss the ASHRAE 90.1-2016 Envelope Requirements.





THE 2018 IECC

Nebraska's New 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

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

- ✓ 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

What About Mixed Use? – C101.4.1

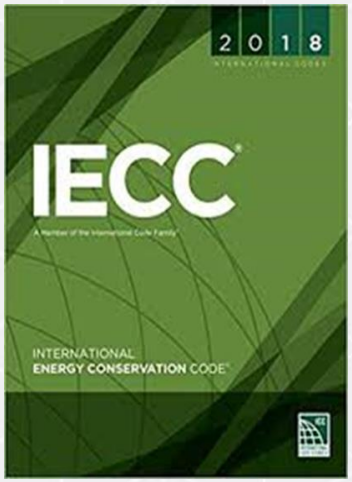
- Treat the residential building portion under the applicable residential code
- Treat the commercial building portion under the commercial code
- Code Official has final authority

Image: agarch.com

Commercial Compliance Options

ASHRAE 90.1-2016

OR



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

OR

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

Additional Efficiency Package Options
Section C406

- One additional efficiency feature ***must*** be selected to comply with the IECC:
  - C406.2 – Eff. HVAC Performance
  - C406.3 – Reduced Lighting Power
  - 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

More Efficient Lighting System

Onsite Renewables

Insulation, windows, doors, roof and floors

BUILDING ENVELOPE

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

Mandatory Requirements

- Air leakage
- Air barriers
- Fenestration air leakage
- Rooms containing fuel-burning appliances
- Air intakes, exhaust openings, stairways and shafts
- Loading dock weatherseals
- Vestibules
- Recessed lighting
- Commissioning

Prescriptive Compliance: Insulation

Climate Zone 5													
	Roofs			Walls, above grade					Floors		Slab-on-grade floors		
	Insulation entirely above roof deck	Metal buildings[b]	Attic and other	Mass[g]	Metal building	Metal framed	Wood framed and other	Below grade wall[d]	Mass[e]	Joist/ framing	Unheated slabs	Heated slabs[h]	Opaque, non-swinging doors
All Other	R-30ci	R-19 + R-11 LS	R-38	R-11.4ci	R-13 + R-13ci	R-13 + R7.5ci	R-13 + R3.8ci or R-20	R-7.5ci	R-10ci	R-30	R-10 for 24" below	R-15 for 36" below + R-5 full slab	R-4.75
Group R	R-30ci	R-19 + R-11 LS	R-49	R-13.3ci	R-13 + R-13ci	R-13 + R7.5ci	R-13 + R-7.5ci or R-20 + R3.8ci	R-7.5ci	R-12.5ci	R-30	R-10 for 24" below	R-15 for 36" below + R-5 full slab	R-4.75

ci – Continuous insulation
LS – Linear system
See Table C402.1.3 for other footnotes

Prescriptive Compliance: Fenestration

Climate Zone 5		
Vertical Fenestration		
U-Factor		
Fixed Fenestration	0.38	
Operable Fenestration	0.45	
Entrance Doors	0.77	
SHGC		
Orientation	SEW	N
PF < 0.2	0.38	0.51
0.2 ≤ PF < 0.5	0.46	0.56
PF ≥ 0.5	0.61	0.61
Skylights		
U-Factor	0.50	
SHGC	0.40	

Vertical Fenestration Requirement
Section C402.4.1 – Prescriptive (Max area)

- Percentage of Vertical Fenestration Area to Gross Wall Area
- Allowed up to 30% maximum of above grade wall
- In Climate Zones 1-6, up to 40% maximum of above grade wall with daylighting controls
- Total fenestration area (includes frame and glazing)
- Does not include opaque door area

Image: socalbudgetwindows.com

Skylight Minimum Fenestration Area
Section C402.4.1 Prescriptive

- Limited to ≤ 3% of Roof Area
- Up to 6% allowed if automatic daylighting controls installed in toplit zones

Image: Velux.com

Fenestration Product Rating
Section C303.1.3

- Install fenestration product rating in accordance to NFRC 100 (Windows, Doors, Skylights)
- Fenestration must be labeled and certified by the manufacturer
- Non-NFRC 100 rated fenestration
- Default Glazed Fenestration U-factor Table C303.1.3(1)
- Difficult to meet requirements using default U-factors

Fenestration SHGC Requirements

The Effect of Overhangs on Fenestration SHGC:

- Overhangs allow a higher SHGC product to be installed
- Projection factor must be calculated
- Evaluate separately when different windows or glass doors have different PFs

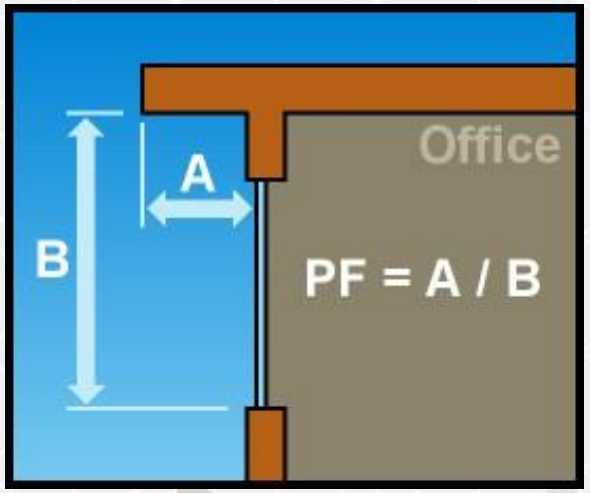


Image: energycode.pnl.gov

Air Leakage

Section C402.5 (Mandatory)

- Tested (blower door) in accordance with ASTM E 779 at pressure differential of 0.3 inch water gauge or an equivalent method approved by code official when tested air leakage rate < 0.40 cfm/ft^2

OR

- Comply with Sections C402.5.1 through 5.8

Air Barrier Construction
Section C402.5.1.1 (Mandatory)

- Air barrier placement allowed:
  - Inside of building envelope
  - Outside of building envelope
  - Located within assemblies composing envelope

    OR

  - Any combination thereof
- Must be continuous for all assemblies and joints that are part of the thermal envelope

Image: bcapcodes.org

Rooms Containing Fuel-burning Appliances
Section C402.5.3 (Mandatory)

- Appliances and combustion air openings to be located outside the building thermal envelope or enclosed in a room isolated from inside the thermal envelope in **Climate Zones 3-8**, one of the following to comply:
  - Rooms to be sealed and insulated per envelope requirements
  - Doors into the rooms fully gasketed
  - Water lines and ducts insulated
  - Combustion air ducts that pass through conditioned space, insulated to $\geq$ R-8

Vestibules
Section C402.5.7 (Mandatory)

- Required to reduce infiltration into spaces
- Required on entrance doors leading into spaces ≥ 3,000 ft^2
- Doors must have self-closing devices
- **Exceptions:**
  - Buildings in Climate Zones 1 and 2
  - Doors from a sleeping unit or dwelling unit
  - Revolving doors
  - Doors that have an air curtain meeting requirements

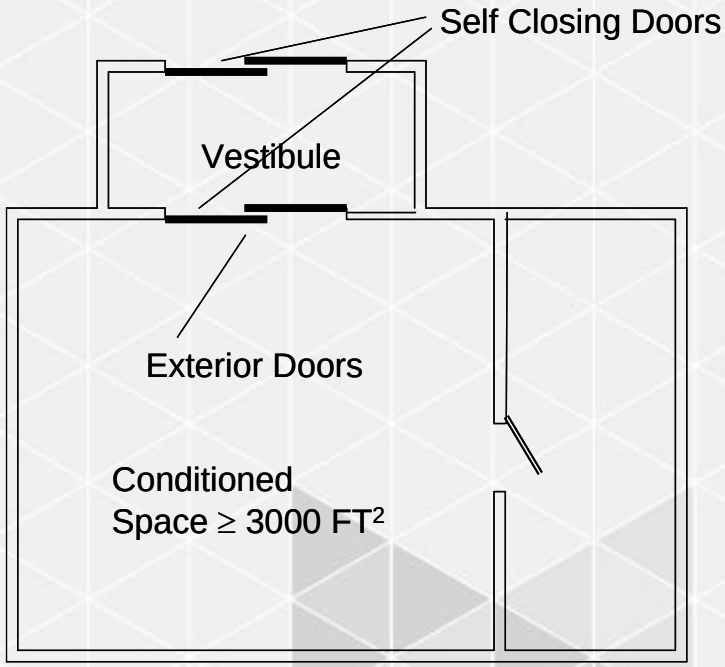


Image: U.S. Dept of Energy

ASHRAE 90.1 2016 Overview

- Applies to:
  - New, and new portions of, *buildings* and their *systems*
  - New *systems* and *equipment* in *existing buildings*, and
- Does not apply to:
  - Single-family houses, low-rise multi-family ≤ 3 stories above *grade*, manufactured houses (mobile or modular)
  - *Buildings* that use neither electricity nor *fossil* fuel
- Does not circumvent any safety, health, or environmental requirements

MECHANICAL SYSTEMS

Section C403 Reorganization

- For 2018 IECC, there was a major reorganization of the mechanical section (C403)
- Rather than separate mandatory (C403.2) and prescriptive requirements by section group:
  - Similar requirements were brought together
  - Mandatory requirements were indicated (Mandatory) for each section. Sections without the “Mandatory” designation are prescriptive.
- As a result, familiar section numbers have likely changed
- **See individual sections for exceptions**

Mechanical Sections:

C403.1: General (Loads)

C403.2: System Design

C403.3: Equipment Efficiencies & Specs

C403.4: HVAC Controls

C403.5: Economizers

C403.6: Multi-zone/VAV

C403.7: Vent & Exhaust

C403.8: Fan Eff. & Controls

C403.9: Heat Rejection

C403.10: Refrigeration

C403.11: Construction

C403.12: Outside Bldg.

Zone Isolation

Section C403.2.1 (Mandatory)

- Divided into isolation areas:
  - HVAC systems serving zones > 25,000 ft^2 in floor area OR
  - Span > one floor and are designed to operate or be occupied non-simultaneously

- Isolation areas controlled independently by a device meeting C403.4.2.2

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
    - ≤ 72ºF for heating load
    - ≥ 75ºF 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

Unmute or type in chat

QUESTIONS SO FAR?

Section 408

COMMISSIONING

Building Controls are Complicated

- Since 2004, about 30% of all new requirements have been related to building controls
- Control requirements can be difficult to implement and verification is beyond the expertise of most building code officials
- Assumption is that they are implemented and working correctly
- Source: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26348.pdf

Systems Commissioning and Completion Requirements

Section C408

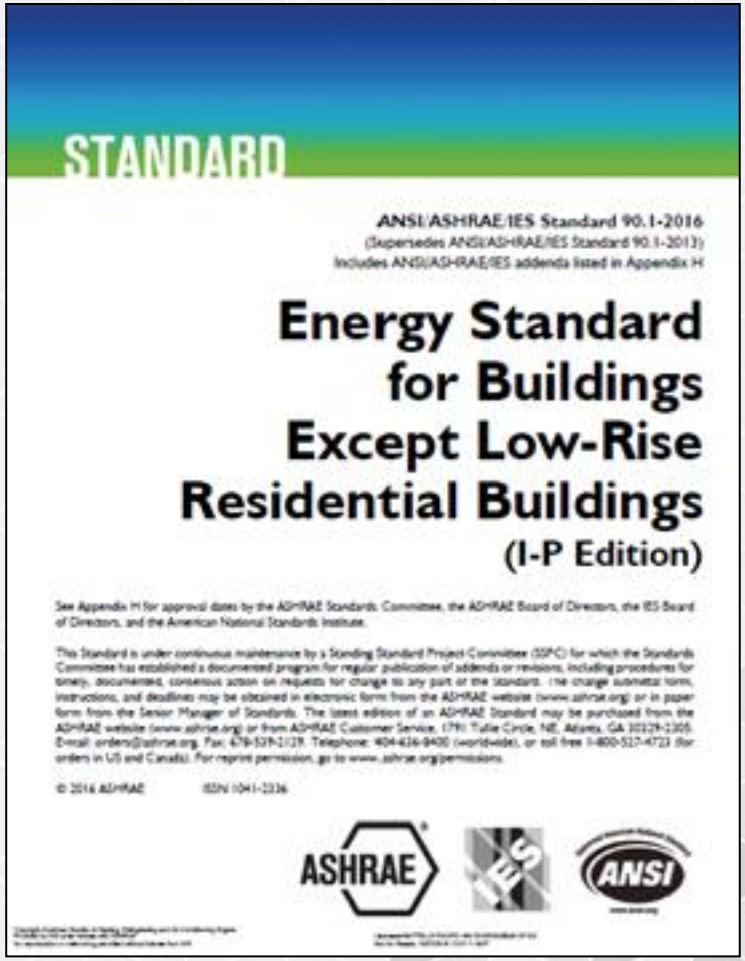
- Commissioning is critical to ensure that buildings are **working as designed**
- Preliminary and final reports required
- Mechanical and lighting commissioning detailed in section C408

Structure of Standard 90.1-2016

1. Purpose
2. Scope
3. Definitions, Abbreviations, and 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

Normative Appendices A-H

Appendix G – is a new compliance path!



Some of the Key Changes

- ✓ Major format changes
- ✓ New climate maps
- ✓ New performance-based compliance path
- ✓ Significant energy savings
- ✓ Increased HVAC equipment efficiency
- ✓ Requirements for replacement equipment

Text in red indicates a new requirement in ASHRAE 90.1-2016

Compliance Paths

Building System

- Envelope
- HVAC
- SWH
- Power
- Lighting
- Other

Mandatory Provisions

Must be met for all compliance options

Compliance Options

- Prescriptive Option
- Trade Off Option (only envelope)
- Energy Cost Budget
- **Performance Rating Method**

Energy Code Compliance

New Compliance Path – Appendix G

Appendix G (Performance Rating Method) uses a stable baseline approach with set efficiency levels

- Values are not updated with each new edition of the code
- Proposed energy performance needs to exceed baseline by an amount commensurate with the efficiency of the code year being evaluated.

Appendix G credit is available for strategies not credited in ECB

- Optimized window area and orientation
- More efficient HVAC and SWH equipment
- Right sizing HVAC equipment
- Efficient use of thermal mass

QUESTIONS?

Next Week

- January 24, 6-8p.m.
- Topic: Building Science
- Contact Matt with Questions:

matt@verda-solutions.com

SEE YOU NEXT WEEK!