

Energy Code Enforcement and (Lost) Opportunities in New and Existing Buildings

Michael P. Kuk, CxA, CPMP, OPMP, BEAP
Owner-CERx Solutions LLC
Midwest Building Energy Codes Conference

CERx Solution



CERx Solutions

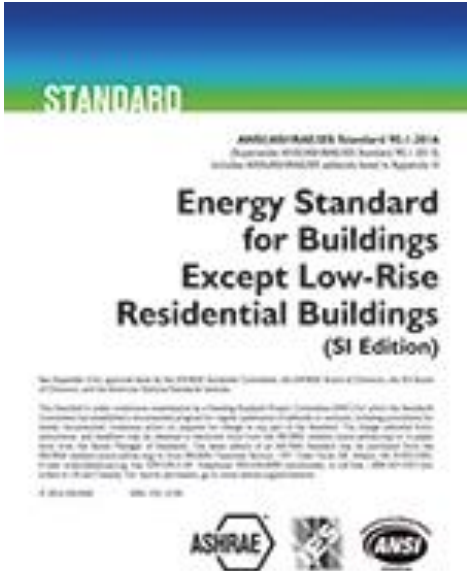
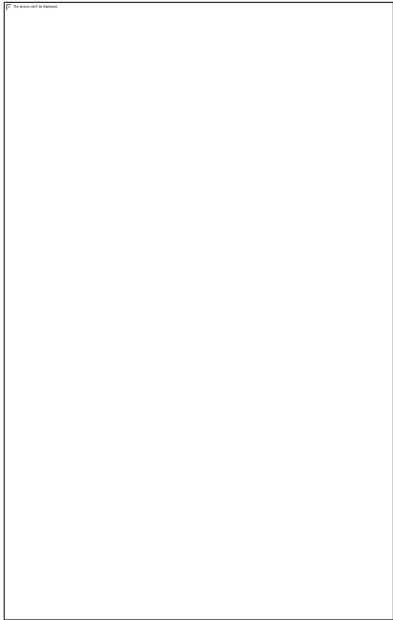
Speaker Background

- Owner CERx Solutions LLC
- Veteran Owned Small Business Enterprise founded in 2013
- 27+ years of energy efficiency experience
- Been performing State of Illinois / Illinois Utility efficiency studies since 2005
- Commissioned 95 new buildings
- Re-commissioned 35 existing buildings
- Conducted 100's of Energy Efficiency Evaluations
- Instructor in MEEA Building Operator Certification (BOC) program throughout the Midwest

AGENDA

- Energy Code Primer
- Key Opportunities in New And Existing Buildings (HVAC, DHW, Lighting only)
- ASHRAE Standard 100 primer
- Q/A

Energy Code Primer





Energy Code Enforcement and (Lost) Opportunities in New and Existing Buildings

Energy Code Primer

State	Current Code	Effective Date	Adopted
Illinois	2015 IECC with Amendments	1/1/2016	12/11/2015
Indiana	2010 Indiana Energy Conservation Code based on ASHRAE 90.1-2007	5/6/2010	12/23/2009
Iowa	2012 IECC	6/1/2014	3/12/2014
Kansas	None Statewide	4/10/2007	Voluntary
Kentucky	2013 Kentucky Building Code (Equiv. to 2012 IECC)		
Michigan	2015 IECC with Amendments	9/20/2017	5/23/2017
Minnesota	2012 IECC with Amendments	6/2/2015	6/2/2015
Missouri	None Statewide. Jurisdictions may adopt energy codes	10/1/2014	2/1/2014
North Dakota	2009 IECC with reference to 2012 IECC and 2012 IBC	1/1/2014	1/1/2013
Nebraska	2009 IECC	8/24/2011	4/14/2011
South Dakota	None Statewide		
Ohio	2012 IECC with Amendments	11/1/2017	9/30/2016
Wisconsin	State Specific (equivalent to 2015 IECC)	1/1/2017	



Energy Code Primer

- In my experience I find that:
 - Energy Codes are “typically” followed by designers in new construction
 - But design engineers don’t always follow ALL code requirements
 - AHJ’s lightly enforce energy codes for new buildings
 - AHJ’s rarely enforce energy codes for existing buildings
 - Just because a system meets Energy Code, it doesn’t mean that it will actually perform as such
 - If systems are not properly designed, installed, commissioned the lost savings will last the life of the system
 - Substantial energy savings potential is lost by not enforcing energy code compliance, and enforcing commissioning requirements



Energy Code Primer

Existing Building Energy Code: Chapter 5 IECC (Section 6.1.1.2 ASHRAE 90.1)

- C505.1 **Scope**: The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing buildings and structures
- C502.2.3 / C503.4 **Building Mechanical**: Shall comply with Section C403
- C502.4 / C503.5 **Service Hot Water systems**: Shall comply with section C404
- C502.5 **Pools and inground permanent** install spalls shall comply with Section C404.9
- C502.6 / C503.6 **Lighting Systems**: Shall comply with Section C405



ASHRAE Standard 100

1. PURPOSE

1.1 This standard provides criteria that will result in reduced energy consumption through improved energy efficiency and performance in existing *buildings*.

1.2 This standard is directed toward providing procedures and programs essential to energy efficient operation, maintenance, management, and monitoring; increasing the energy efficiency of the energy-using systems and components; and upgrading the thermal performance of the *building* envelope.

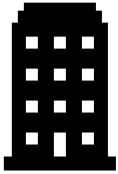
2. SCOPE

This standard applies to existing *buildings*, portions of *buildings*, and *building* complexes, including the envelope and all systems in the *building*. This standard excludes industrial and agricultural processes in *buildings* for which the *energy targets* do not include those processes.

Compliance Path
The qualified person determining compliance shall:

1. Establish EUI or Perform Energy Audit for those w/o an EUI
2. Complete documentation
3. Submit to AHJ





Key (Missed) Opportunities in New And Existing Buildings

1. Commissioning
2. HVAC controls
3. Demand Control Ventilation
4. Temperature resets
5. Lighting Controls
6. Economizers (air and water)
7. Energy Recovery
8. High efficiency fractional HP motors
9. Hydronic Balancing /Pump oversizing
10. DHW heater heat traps, pool covers

Key (Missed) Opportunities in New And Existing Buildings

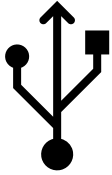
- # 1: COMMISSIONING
- Applicable Section(s): C403.2.11 (mech), C404.11 (service water heating), C405 (lighting) C408.2 (general)
- Summary: HVAC, service water heating and lighting shall be commissioned
- Issue: Rarely Enforced by Code Officials
- Code Enforcement: Rare
- Implementation: High when mandatory or critical (LEED, State funded projects, Data centers, Health Care) Rare all others.
- Opportunity / Benefit: HUGE!!!!
- Cost / Payback: \$5,000-?, payback immediate

Key (Missed) Opportunities in New And Existing Buildings

- # 1: Commissioning (Continued)
Commissioning Agent (CxA)
 - Creates a Commissioning Plan
 - Verifies compliance of TAB work
 - Performs functional testing
 - Verifies proper functionality of HVAC/ DHW/ Lighting controls
 - (A good CxA) will also review design and submittals for code compliance
 - Create a commissioning report

Key (Missed) Opportunities in New And Existing Buildings

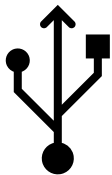
- # 1: Commissioning (Continued)
 - Lost opportunity to use the commissioning agent to help enforce codes and ensure savings actually are achieved
 - Little to no extra effort of AHJ to enforce
 - Review evidence that mechanical systems were commissioned.
 - IE: Review submitted commissioning report
 - Best way to guarantee savings is to ensure the system is commissioned



Key (Missed) Opportunities in New And Existing Buildings

2 HVAC Controls

- Applicable Section(s): C403.2.4 (and multiple subsets)
- Summary: Each heating and cooling system shall be provided with thermostatic controls
- Issue: Even if documented, my experience is that not properly applied and implemented
- Code Enforcement: ? How?
- Implementation: Best verified with commissioning
- Opportunity / Benefit: High
- Cost / Payback: Low cost-no cost



Key (Missed) Opportunities in New And Existing Buildings

- # 2 HVAC Controls that find most often not installed or properly set up
 - C403.2.4.1.2 Deadband: Calls for 5F deadband between heat and cool.
 - C403.2.4.1.3 Set point overlap restriction (works on individual thermostat, but not when 2 separate t-stats in same space)
 - C403.2.4.2 Off-Hour Controls
 - C403.2.4.2.3 Automatic start capabilities
 - C403.2.4.3 Shut off dampers (typically exhaust fans)
 - C403.2.4.4 Zone Isolation
 - C403.2.4.7 Economizer fault detection and diagnostics (FDD)
 - C403.4.1.2 Static pressure sensor location (frequently above 1.2" W.C., and location not shown on drawings)

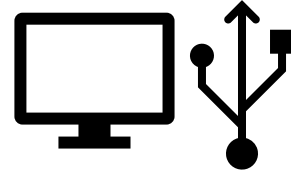


Key (Missed) Opportunities in New And Existing Buildings

3 Demand Control Ventilation

- Applicable Section(s): C403.2.6.1
- Summary: >500 SF, 25 people/1000 SF
- Issue: Infrequently installed, even rarer set up properly. Not detailed in energy code how to implement.
- Code Enforcement: ? Rarely?
- Implementation: Best verified with commissioning
- Benefit: High
- Cost / Payback: Variable

Key (Missed) Opportunities in New And Existing Buildings



4 Resets (temperature, outside air, pressure)

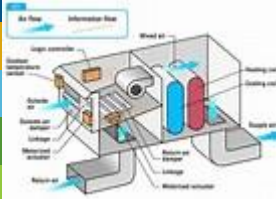
- Applicable Section(s): C403.4.4.5: supply air temperature reset, C403.4.4.6 OA reset, C403.4.6 Hot gas bypass limitation, C403.4.2.4 (hydronic) temperature reset, flow reset, C403.4.2.2 static pressure reset
- Summary: Automatic reset for supply air temperatures, outside air volume, duct pressure, water resets
- Issue: Even if documented, my experience is that not properly applied and implemented
- Code Enforcement: ? How?
- Implementation: Best verified with commissioning
- Benefit: High
- Cost / Payback: Low cost-no cost

Key (Missed) Opportunities in New And Existing Buildings

5 Lighting Controls

- Applicable Section(s): C405.1 (general), C405.2.1.1 (occupancy control), C405.2.2.2 (Light reduction controls), C405.2.3 (daylighting)
- Summary: Lighting controls must be installed, 50% lighting levels, daylighting controls, motion sensors
- Issue: Hardware installed, but not typically set up properly.
- Code Enforcement: Hardware highly enforced, commissioning and verifying proper operation not enforced
- Implementation: Best verified by commissioning
- Benefit: High
- Cost / Payback: High cost, fair to good payback

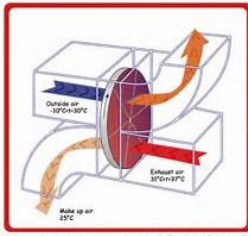




Key (Missed) Opportunities in New And Existing Buildings

6 Economizers (air and water)

- Applicable Section(s): C403.3 (prescriptive), C403.3.3.3 High Limit Shut off, C403.3.3.4 Relief of excess Outdoor air), C403.4 Water Side Economizer
- Summary: Economizer capabilities and controls shall be installed when stipulated
- Issue: 1) High limit shut offs often not properly set up 2) many small/mid sized RTU's do not have air relief capability, 3) Water side rarely installed 4) Relief of excess OA? (don't even know what that means)
- Code Enforcement: Hardware (high), actual performance (none)
- Implementation: water side economizer rare, air side economizer common but commonly not set up properly. Best verified by commissioning.
- Benefit: High
- Cost / Payback: Low-High cost, Quick payback



Key (Missed) Opportunities in New And Existing Buildings

- # 7 Energy Recovery
- Applicable Section(s): C403.2.7 Energy Recovery ventilation, C403.4.5 Heat recovery for service water heating
- Summary: Installation of energy recovery if exceeds values stipulated
- Issue: Often mis-applied in high CFM / low OA % systems. In VAV systems there is often no air being exhausted at part load. Rarely see service water heating heat recovery
- Code Enforcement: Loop holes for designers to avoid
- Implementation: Typically self contained controls, so works well if installed.
- Opportunity / Benefit: Med-High
- Cost / Payback: High cost, high benefit



Key (Missed) Opportunities in New And Existing Buildings

- # 8 Motor Efficiencies (fractional HP)
- Applicable Section(s): C403.4.4.4
- Summary: Motors for fans <1 HP shall be ECM or 70% efficient
- Issue: Large applications, but infrequently enforced.
- Code Enforcement: Rarely? But starting to see more.
- Implementation: Must also be properly set up by TAB contractor, best verified during commissioning
- Benefit: High due to vast number of small motors
- Cost / Payback: low cost / quick payback



Key (Missed) Opportunities in New And Existing Buildings

9 Hydronic Balancing / Pump Sizing

- Applicable Section(s): C408.2.2.2
- Summary: Pump impeller trimmed or pump speed adjusted to minimize throttle losses (5% of nameplate above if were trimmed)
- Issue: Trimming never done, pumps frequently over-sized.
- Code Enforcement: Rarely done. Requires late inspection after balancing.
- Implementation: Best verified during commissioning
- Benefit: High
- Cost / Payback: Med-Low cost to no cost, quick payback



Key (Missed) Opportunities in New And Existing Buildings

- # 10 Heat traps and pool covers
- Applicable Section(s): C404.3 (heat traps) , C404.9.3 (pool covers)
- Summary: heat trap on DHW heaters, pool covers
- Issue: Rarely find heat traps installed, pool covers rarely used in hotels, condos, apartments etc....
- Code Enforcement: ?rarely?
- Implementation: Heat traps rarely implemented easy to enforce, hard to enforce implementation of pool covers
- Benefit: Medium-High
- Cost / Payback: Low-Med cost, fast payback

Recommendations



- Enforce commissioning requirement
- Adopt recent IECC/ASHRAE Codes
- Enforce existing as well as new construction energy codes
- Closely review equipment schedules ensuring special code requirements are noted

Thank you!

Michael Kuk, LEED AP BD+C, CPMP, OPMP, BEAP, CxA

CERx Solutions

Commissioning, Energy Efficiency, Retro
Commissioning Solutions

A Certified Veteran Owned Small Business Enterprise

630-636-7118 (office / Fax)

630-631-9483 (mobile)

MKUK@CERxSolutions.com

CERx Solutions

