Is ASHRAE 90.1-2010 or IECC-2012 the Right Energy Code for Your New Facility?

Jeff Boldt, PE, LEED® AP, HBDP
KJWW Engineering

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October 24, 2013

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- **You can request today's presentation material by contacting:**
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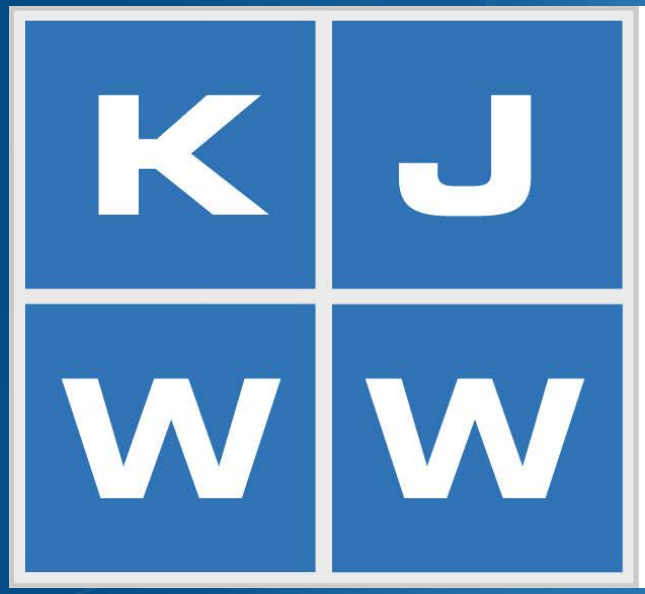

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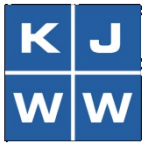

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October 24, 2013

Presenter

Jeff Boldt, PE, LEED® AP, HBDP

KJWW Engineering (500 staff)

Principal – Director of Engineering

- Voting Member ASHRAE SSPC-90.1

  Chair – Advanced Energy – Hydronic Working Group (WG), Elevator WG, Duct Leakage WG

- Member ASHRAE 189.1
- Author AEDG Small Healthcare & AEDG Large Hospitals
- Member WHEA Code Committee, WI Energy & HVAC CCs
- Member FGI Acoustical Working Group

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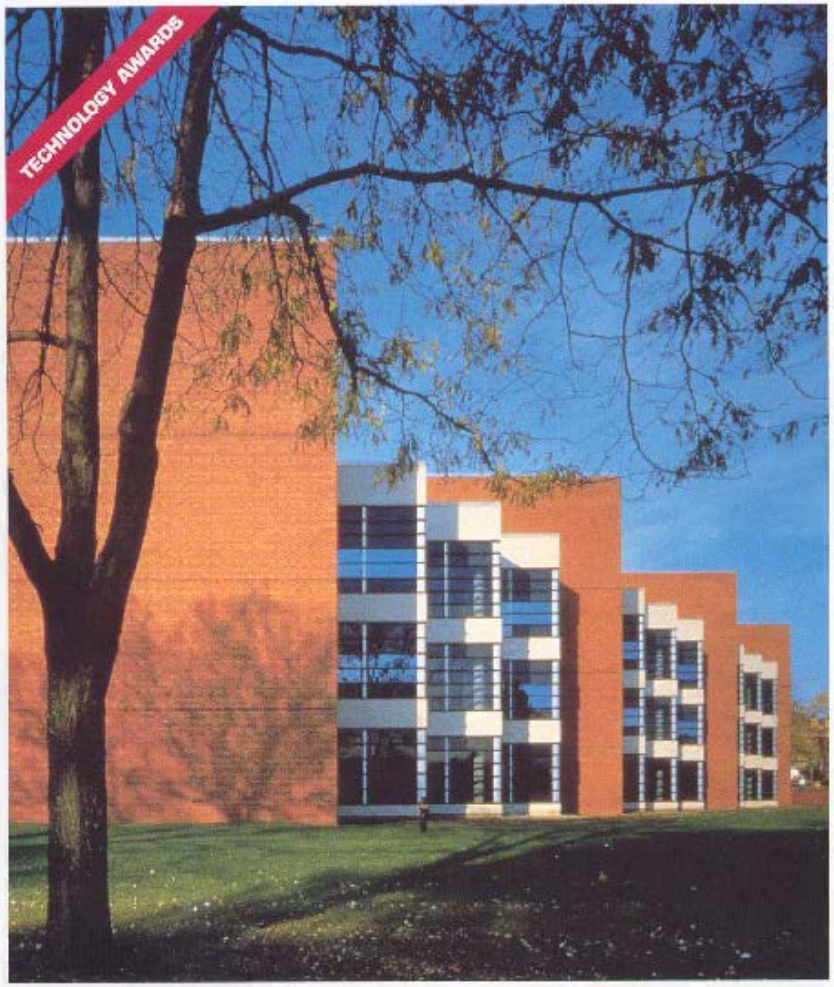
April
1993

ASHRAE JOURNAL

The magazine of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.



CONTROL SYSTEMS

THERMAL COMFORT

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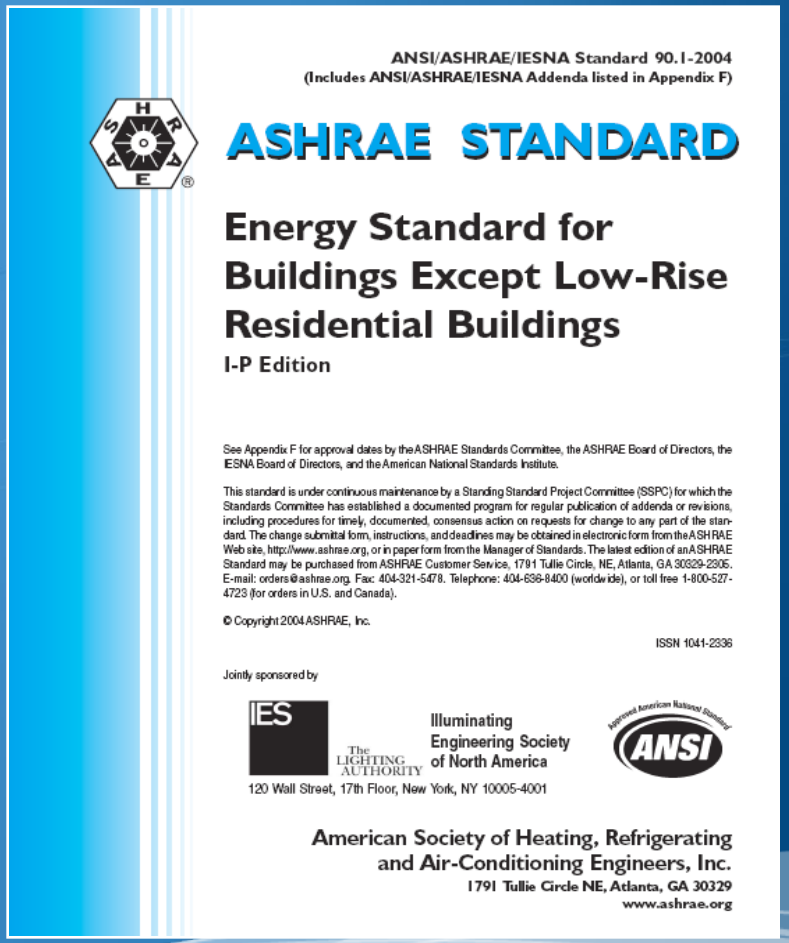
Learning Objectives

At the end of the this course, participants will be able to:

- Understand the general purpose, requirements, and applicability of the International Energy Conservation Code (IECC) and the option of choosing ASHRAE 90.1
- Understand the recent changes to the IECC-2012 and ASHRAE 90.1-2010
- Understand how these codes affect the architectural, mechanical, and electrical design of a building
- Understand strategies for compliance with these codes
- Understand how to decide whether to choose IECC or 90.1 for your plan review submittals

Scope of ASHRAE 90.1

- Energy conservation code for buildings, except low-rise residential
  - Envelope
  - HVAC
  - Service Water Heating
  - Power & Lighting
  - Other



ANSI/ASHRAE/IESNA Standard 90.1-2004
(Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F)

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the IESNA Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site, http://www.ashrae.org, or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in U.S. and Canada).

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ASHRAE 90.1-2010

- 90.1-2010 was released in October 2010
  - Goal was 30% less energy than 90.1-2004
  - 2007 version saved only a few %
- IECC has incorporated most changes
  - 2009 has some
  - 2012 major edition accepts 90.1-2010 and has many 90.1-2013 upgrades

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States

- DOE ruled all states must comply with 90.1-2010 or approved equivalent by October of 2013
- Illinois
  - January 1, 2013 adopted IECC 2012 statewide with no provisions for home rule. 2nd state to adopt.
  - State-funded projects must follow ASHRAE 90.1-2010.
  - CDB projects with A/E contract prior to 2013 can follow previous codes (ASHRAE 90.1-2007).
- Wisconsin
  - Will wait until IECC-2015
  - 6-year cycle

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States

- Iowa
  - The Iowa Department of Public Safety and the Iowa State Energy Office are currently convening multiple stakeholder meetings to seek feedback on the 2012 IECC, with a goal of adoption on January 1, 2014.
  - Dave Ruffcorn:
    - Rules are approved
    - 120-day public review will start soon
    - January 1 target date for enactment
    - March 1 target for plan submittals
    - If there are adverse public comments, the date may slip; but probably IECC-2012 will become law.

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LEED Compliance

- LEED 2009 references ASHRAE 90.1-2007.
- LEED v4 references ASHRAE 90.1-2010
- Teams will be able to register for the 2009 version until June 1, 2015, although there may be penalties
- Prerequisite in v4 requires 5% below 90.1-2010.
  - 6% to start gaining energy points

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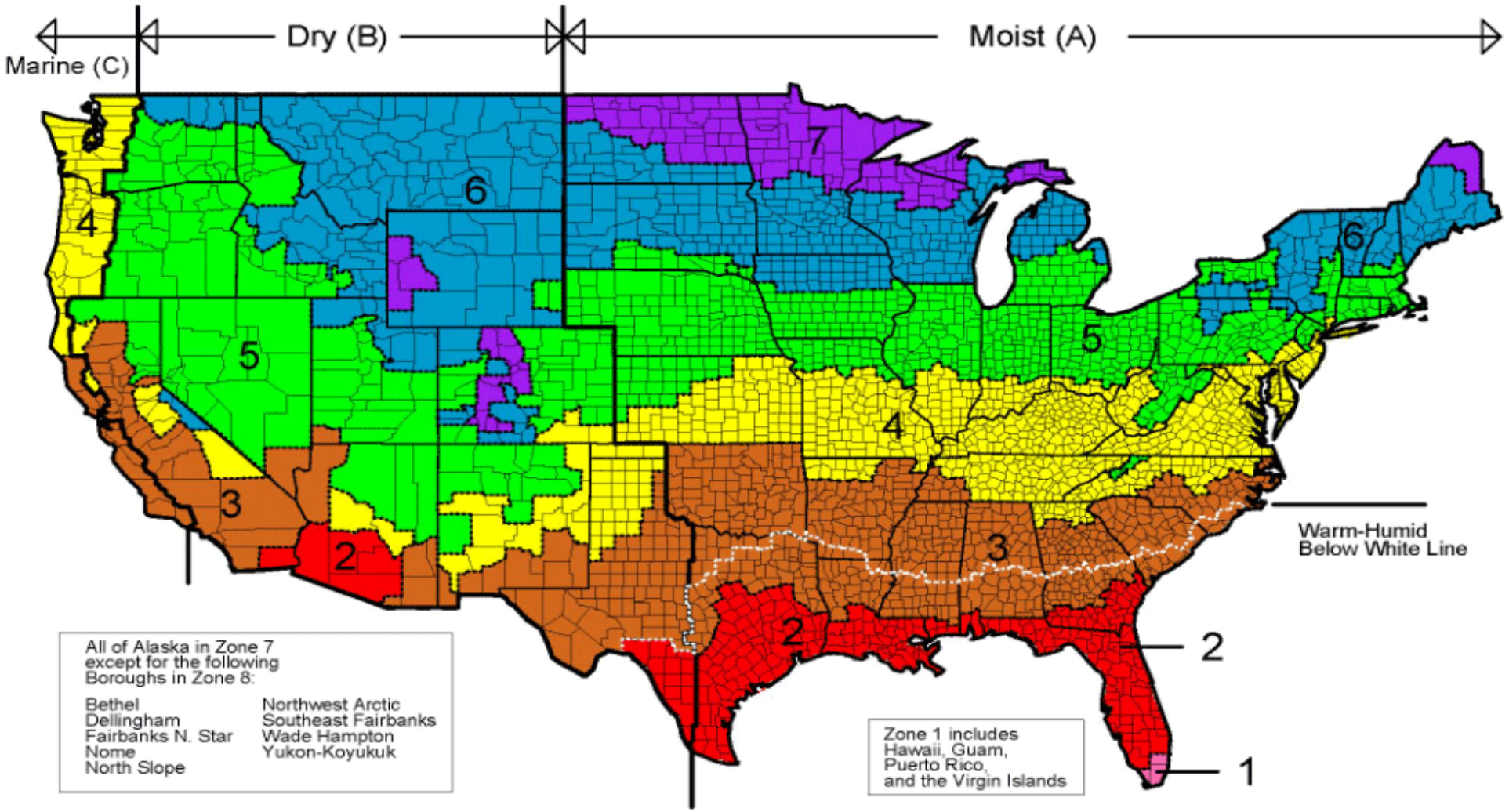
8 Temperature ‘zones’ + ABC = 17



Commercial Compliance Paths

- New construction (C401.2)
  - Comply with ASHRAE 90.1 (2010)
  - Prescriptive path:
    - Comply with C402 (Envelope),
    - C403 (Mechanical),
    - C404 (Service Water Heating),
    - C405 (Electrical/Lighting),
    - and additional efficiency requirements (C406)

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Commercial Compliance Paths

- Existing buildings (C401.2.1)
  - Comply with ASHRAE 90.1 (2010)
  - Prescriptive path: Comply with C402, C403, C404, C405
    - Does NOT require additional efficiency package options

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Building Envelope

- Many revisions to opaque thermal envelope assembly requirements
- New roof solar reflectance and thermal emittance requirements for Zones 1, 2, 3

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Building Envelope

OPAQUE THERMAL ENVELOPE REQUIREMENTS		
CLIMATE ZONE	**2009 VERSION**	**2012 VERSION**
Roofs		
Insulation Entirely Above Deck	R-20ci	R-25ci
Metal Buildings (with R-5 Thermal Blocks)	R-13 + R-13	R-19 + R-11 LS
Attic and Other	R-38	R-38
Walls, Above Grade		
Mass	R-11.4ci	R-11.4ci
Metal Buildings (with R-5 Thermal Blocks)	R-13 + R-5.6ci	R-13 + R-13ci
Metal framed	R-13 + R-7.5ci	R-13 + R-7.5ci
Wood Framed and Other	R-13 + R-3.8ci	R-13 + R-3.8ci or R-20

- Timing Differences
  - IECC-2012 incorporates 90.1-2013 envelope changes
  - 90.1-2010 does not

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Building Envelope

- Vertical and Horizontal Fenestration
  - <40% vertical and <5% horizontal in 90.1
  - <30% vertical allowed in IECC, unless you meet exceptions which allow 40% if:
    - At least 50% of floor area is within daylight zone
    - Automatic daylight controls are provided
    - Visible Transmittance of vertical fenestration is greater than or equal to 1.1 times the SHGC
  - 3% Horizontal allowed in IECC, unless you provide daylight controls which allow up to 5%.

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Is Envelope Important?

- I think envelope matters!

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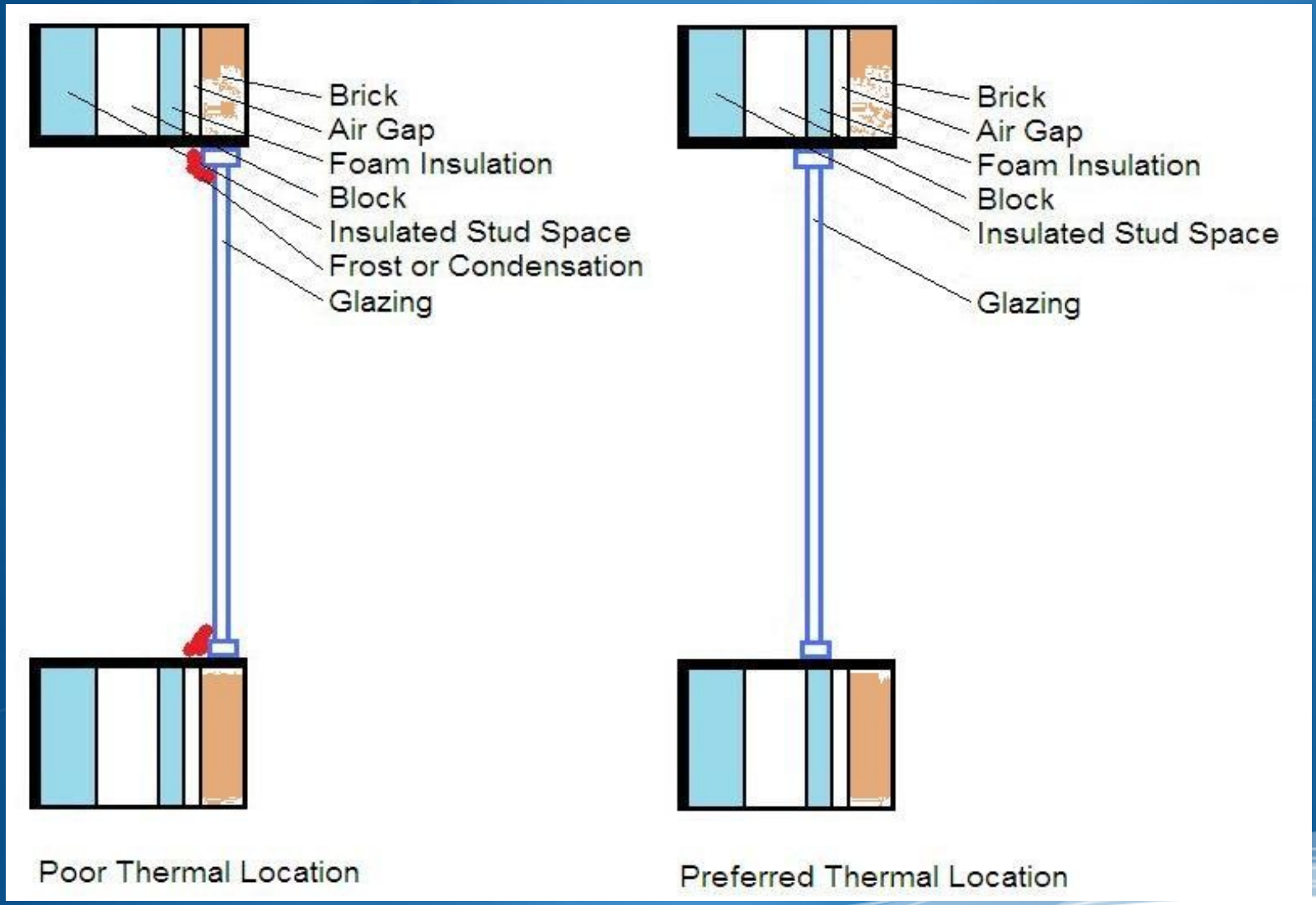
Envelope – Continuity – Too Late



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Building Envelope – Air Barrier (bf)

- Air barrier & joint sealing required (C402.4)
  - ASHRAE has detailed design requirements
  - IECC permits blower-door test

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Building Envelope

- More S glazing than either E or W (bn)
  - Building orientation
  - Land purchases and campus planning
  - No public review comments
- Exceptions
  - Storefront, Shaded building, Infill with nearby building on south, Alterations with no increase in glazing

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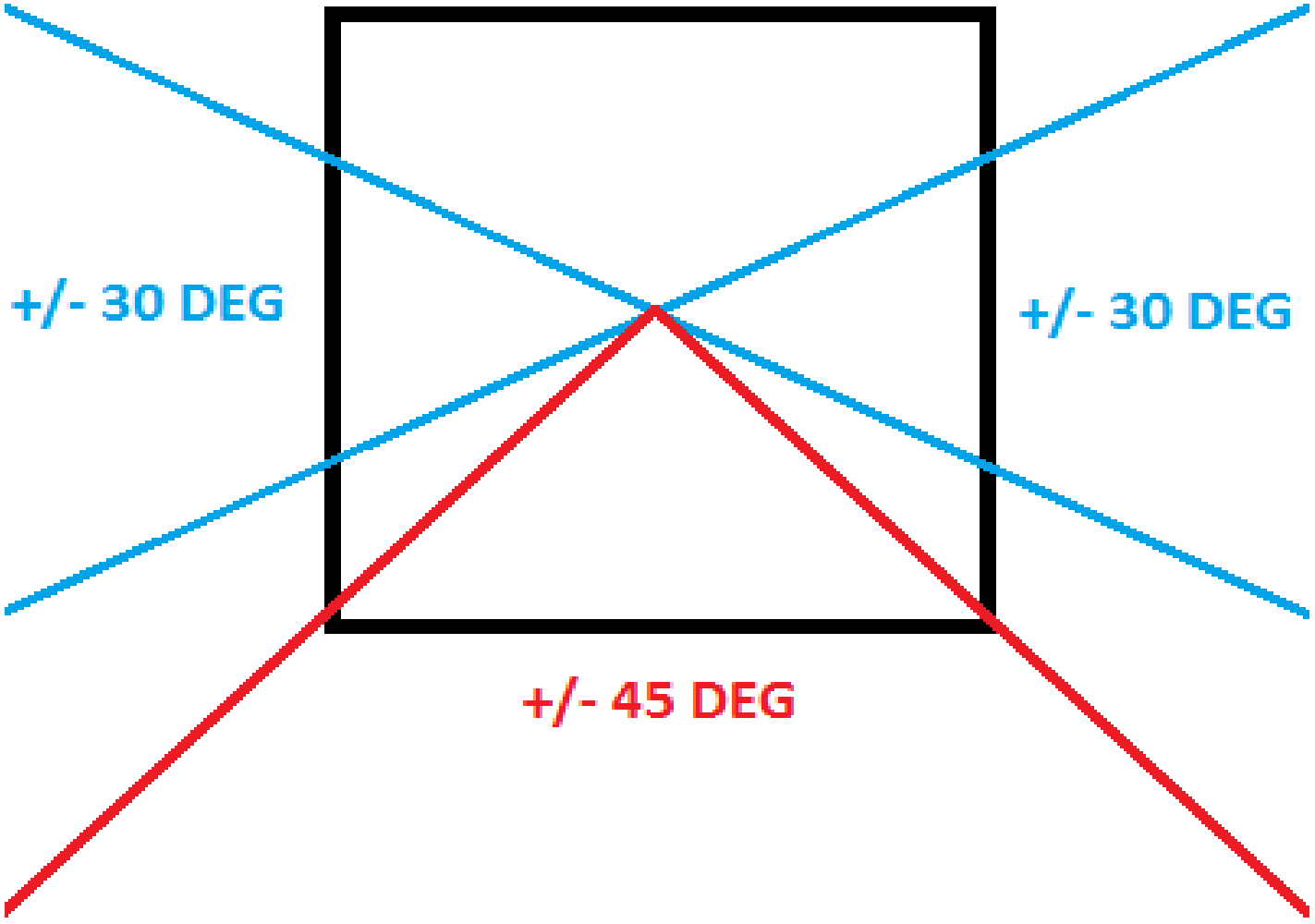
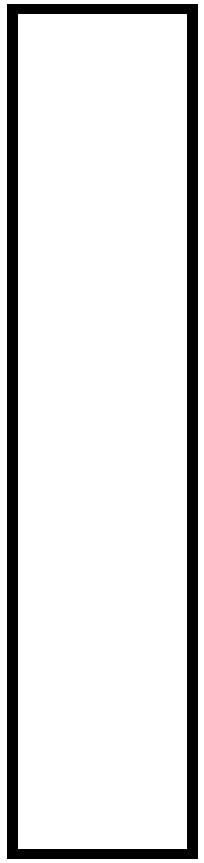
Building Envelope – Changing 2013





Hmm...

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Building Envelope

- Radiant panels require insulation of (C402.2.8) ≥ R-3.5
- Vestibules
  - IECC requires vestibules for standard doors even when adjacent to revolving doors (402.4.7)
  - 90.1 requires 7’ minimum vestibule length

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Building Mechanical Systems

- Minimum Efficiency Requirements for various unitary equipment increased
  - Boilers
  - Chillers
  - Condensing Units
  - Heat Pumps
  - Cooling Towers

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Building Mechanical Systems

- Automatic start capabilities required for each HVAC system (C403.2.4.3.3)
  - Controls capable of adjusting daily start time to bring each space to the desired temperature immediately prior to occupancy
- Demand Control Ventilation (C403.2.5.1)
  - Requirement reduced to 25 people per 1000 SF from 40 people in 2009

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Building Mechanical Systems

- Energy Recovery Requirements (C403.2.6)
  - Instead of former requirement, now a table based on climate zone and %OA
  - Example: Energy recovery now required on a system with 35% Outdoor Air and greater than 5,500 CFM Supply.
  - In 2009 , energy recovery was required below 70% OA.

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Building Mechanical Systems

- Fan Power Limitations (C403.2.10.1)
  - Limits the motor size or BHP of system fans based on cfm
  - Fume hood fans no longer exempt
  - Credit for fully ducted return/exhaust systems for laboratory and vivarium systems CHANGED from 0.5 in w.c. to 2.15 in w.c.
  - Credit for biosafety cabinets was ADDED
  - Credit for exhaust system serving fume hoods, laboratories, and vivariums in high rise buildings ADDED

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Building Mechanical Systems

- Economizers (C403.3) – Simple Systems
  - Required on cooling systems ≥ 33,000 Btuh (reduced from 54,000 BTUH)
  - Expanded exemptions for simple systems
  - Increased control requirements for economizers
    - Must sequence with mechanical cooling
    - High limit economizer shutoff control was added to turn off economizer when not useful
  - Economizer control shall be such that it does not increase the building heating energy (exception for VAV system reheat)
  - NO EXCEPTION FOR DX/VRF in IECC

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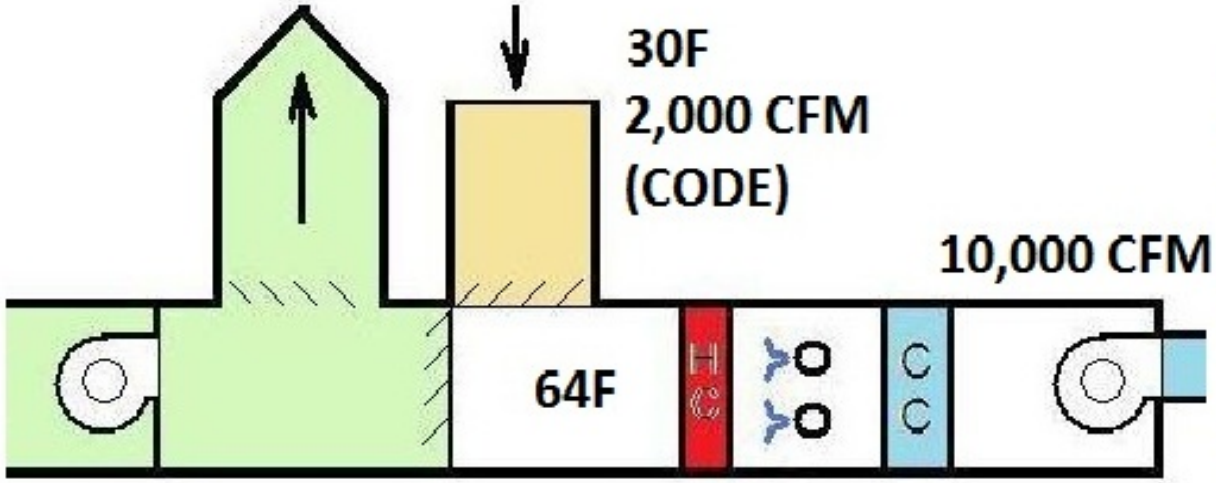
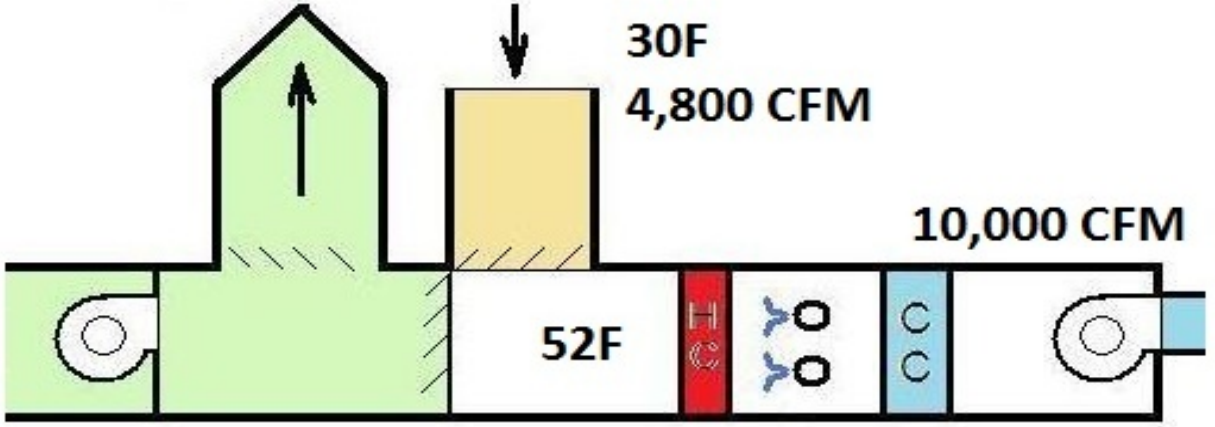
Economizers – None vs. Air



No Economizer

Cooling =	126,440 Btuh
Humidifier =	22,388 Btuh
Pump =	0 Btuh
Cooling Tower =	0 Btuh
Reheat (Baseline)	0 Btuh
Total =	**148,828 Btuh**



Air Economizer

Cooling =	0 Btuh
Humidifier =	53,305 Btuh
Pump =	0 Btuh
Cooling Tower =	0 Btuh
Reheat (Baseline)	0 Btuh
Total =	**53,305 Btuh**

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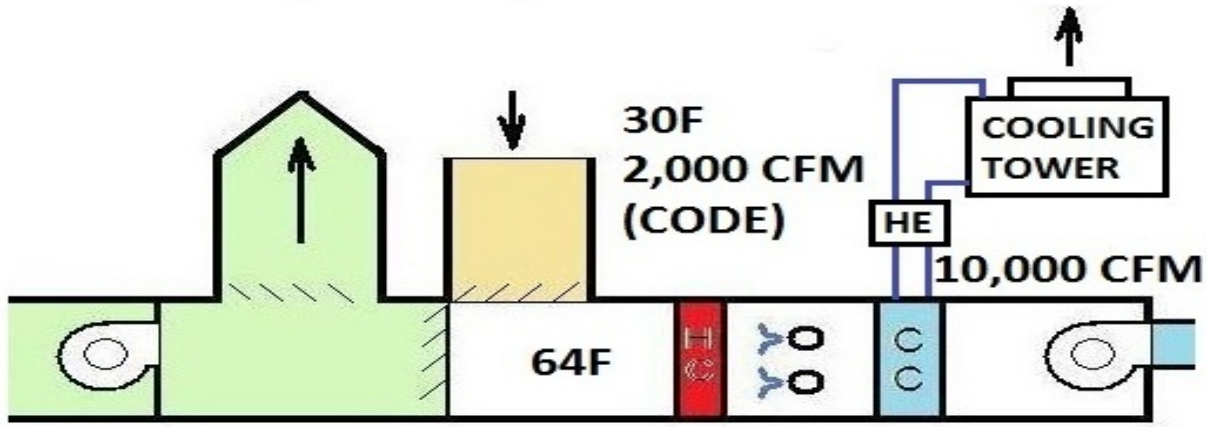
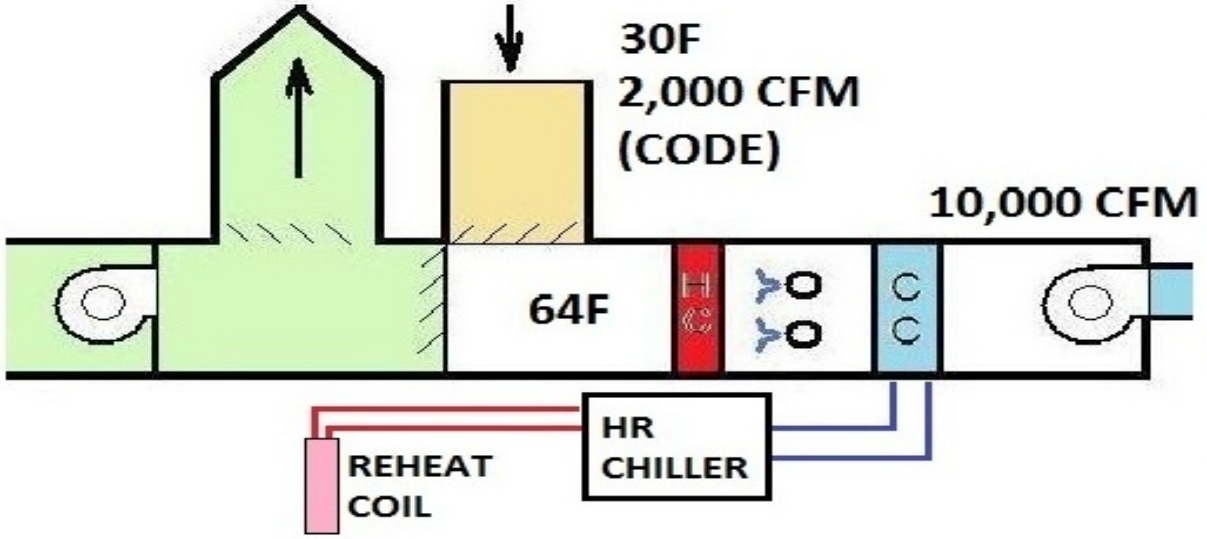
Economizers – Water vs. Condenser



Water Economizer

Cooling =	0 Btuh
Humidifier =	22,388 Btuh
Pump =	2,545 Btuh
C Tower =	2,545 Btuh
Reheat (Baseline)	0 Btuh
Total =	**27,478 Btuh**



Condenser Reheat

Cooling =	50,576 Btuh
Humidifier =	22,388 Btuh
Pump =	1,273 Btuh
Cooling Tower =	0 Btuh
Reheat =	-177,016 Btuh
Total =	**-102,779 Btuh**

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Building Mechanical Systems

- VAV Control (C403.4.2)
  - Fan motors requiring VFD reduced from 10 HP to 7.5 HP
  - Static pressure sensors used to control VAV fans shall be placed in a position such that the setpoint is no greater than 1/3 the total design fan static pressure
    - Systems with zone reset control are exempted. This resets the static pressure setpoint LOWER until at least one zone damper is wide open.

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Service Water Heating

- Piping Insulation (C404.5)
  - Exception added that requires heat traced piping systems to be insulated per the manufacturer's recommendations. Untraced piping in a traced system shall have ~1" of insulation.
- Hot water system controls (C404.6)
  - Modified to require shut-off when there is low demand (2009 required shut-off when the system was not in operation)
- Pool covers are required unless 70% of the heating energy is from site recovered energy

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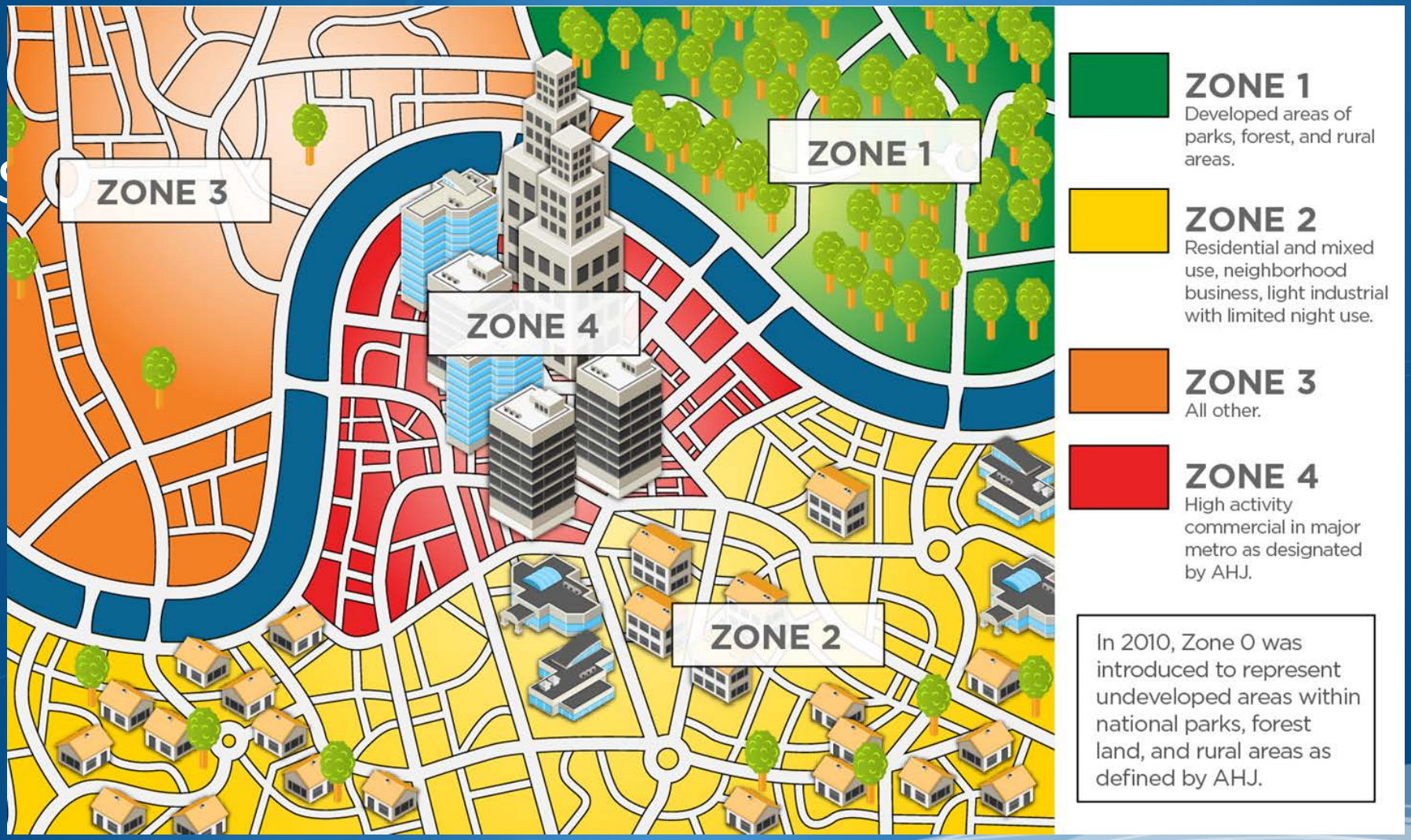
Method for computing Exterior



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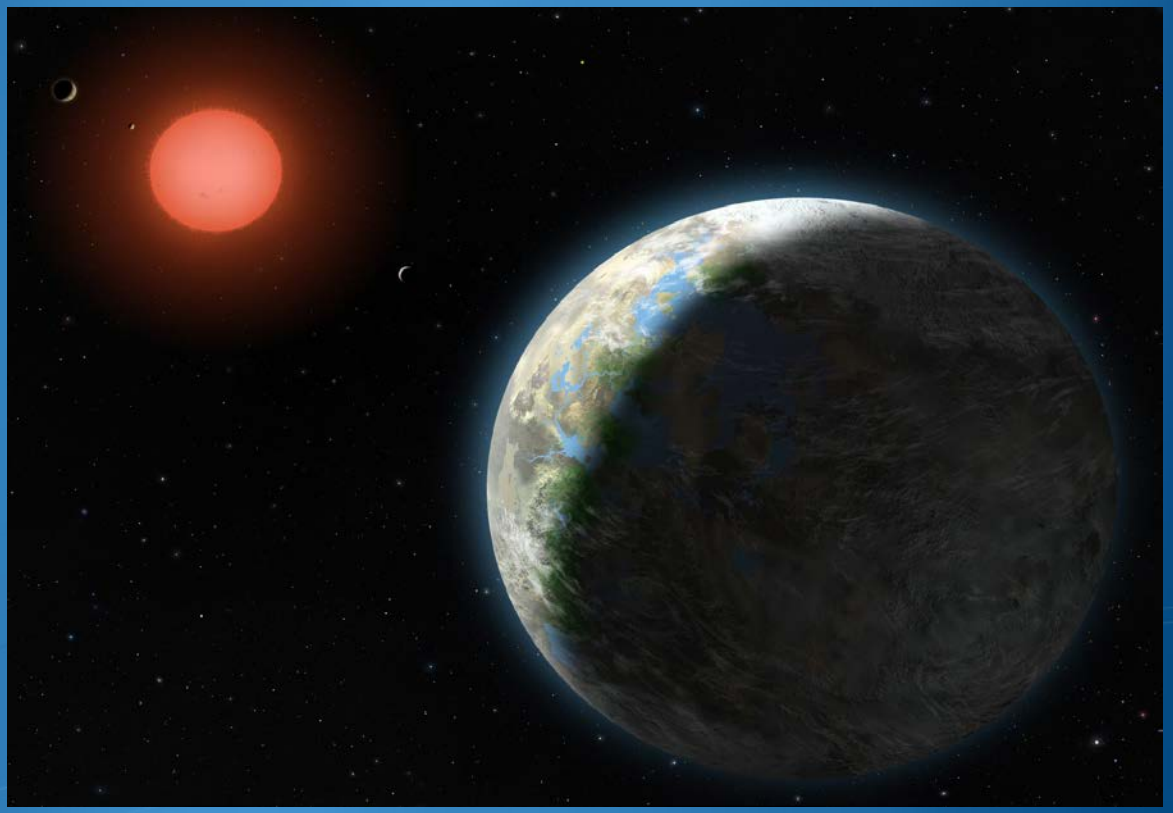
ASHRAE 90.1 Exterior Lighting



- 5 zones (i)
  - National parks
    - Undeveloped
    - Developed
  - Residential
  - Other
  - Metro
- 0 – 1300W + 0-1.0 W/SF

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Control Requirements

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IECC – Exterior Controls

- Designated dusk to dawn
  - Astronomical time switch or photo sensor
- Not designated dusk to dawn
  - Astronomical time switch or photo sensor & time switch
- All time switches shall retain programming during loss of power for > 10hrs

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IECC – Other Requirements

- IC rating of all recessed luminaires in a unconditioned ceiling/ THERMAL-BOUNDARY
- Functional testing
  - Control devices & systems shall be calibrated, adjusted, programmed, and tested to ensure proper working condition
  - Construction docs shall state who will conduct testing
    - Shall not be directly involved with design or construction when required by the code official

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90.1 Includes Data Centers – IECC?

- New equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes
  - Computer rooms are the first inclusion

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Additional Efficiency Package Options

- New construction shall comply with at least ONE of the following (C406)
  - Efficient HVAC per C406.2
  - Efficient lighting per C406.3
  - On-site renewable energy per C406.4 (1.75 Btu or not less than 0.50 watts per square foot or no less than 3% of M and E energy addressed in IECC)
- Tenant spaces should comply with HVAC or lighting compliance path
- Does not apply to additions, alterations, repairs of existing buildings (C401.2.1)

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System Commissioning

- Commissioning is required in buildings where total mechanical equipment capacity is greater than 480 MBH cooling (40 Tons) and 600 MBH heating (C403.2.9 and C408)
- Impacts mechanical systems most
- Requirements more stringent than 90.1
- Requires a commissioning plan to be developed by a design professional or an approved agency
- Requires a commissioning report by the design professional or an approved agency

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90.1 - Other Equipment

- Elevators
  - Lighting efficacy ≥35 LPW
  - Ventilation ≤ 0.33 W/cfm
  - Lights & fans off if unused for >15 min
  - 2016 – Elevator movement efficiency
  - 2013 – Escalators & fast-walks

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Building Mechanical Systems

- Duct and plenum insulation
  - IECC more stringent, less allowances for climate and duct use
- High pressure duct systems (+3” w.c.)
  - 90.1 is more stringent, CL of 4 vs. 6 for IECC
- Commissioning
  - 90.1 based on floor area, IECC based on system capacity and generally more stringent and comprehensive

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Building Mechanical Systems

- Economizers
  - IECC more stringent in both capacity (33,000 Btuh capacity) and Climate Zone
  - More exceptions under 90.1
- VAV fan control
  - 7.5 HP threshold under IECC, 10 HP for 90.1
- Reheat Limitation
  - IECC removes exception to allow reheat if it can be shown that the annual system energy can be reduced with a higher air flow rate
    - Unintended INCREASE in energy use

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Electrical Power & Lighting

- Applicable for 10% alteration in 90.1 (vs. 50% for IECC)
- Lighting power density more stringent in 90.1, but Space-by-Space method has additional allowances All areas, except public areas, require manual on or max. 50% bright for auto on (vs. occupancy sensor areas for IECC)
- 90.1 - Stairwells require occupancy control to 50% light level
- 90.1 - Controls for parking garages and exterior lighting more stringent (automatic control, daylighting)
- 90.1 - Maximum voltage drops

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90.1 - Power - Receptacles (bs)

- 50% of 120V receptacles need automatic control in offices and computer classrooms
  - Includes modular partitions
- Options
  - Time of day
  - Occupancy sensor
  - Another control or alarm system
- NOT required in IECC-2012

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90.1-2010 Power - Receptacles (bs)

- **Exceptions:**
  - Receptacles specifically designated for equipment requiring 24 hour operation
  - Spaces where patient care is rendered
  - Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

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Efficiency Options & CX

- No comparable “Additional Efficiency Package” in 90.1
  - Lighting option is similar to 90.1; so normally selected
- Commissioning
  - Additional services required to comply with IECC
  - 90.1 included in base services on most jobs

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So…How do we comply????

Electrical

- Providing more efficient or efficacious luminaires
- Light levels to suit tasks, don’t “overlight”
- Extensive, possibly complicated controls:
  - More switched zones, multi-level & dimming fixtures
  - More occupancy/vacancy sensors
  - Daylight control at all windows (soon all automatic)

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Summary

- In general, 90.1 is typically the more stringent code, however, it provides flexibility to the designer in many cases that may prove worthwhile over IECC
- Several items likely to be ‘make it or break it’:
  - Vertical fenestration
  - Reheat limitations
  - Lighting scope, LPD and control
  - Receptacle control
  - Additional efficiency options
  - Commissioning

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Summary

- Mechanical systems possibly moving towards Dedicated Outdoor Air Systems with decoupled heating and cooling – 90.1 AES Working Groups
  - Chilled beams - maybe
  - VRF - maybe
  - Fan coil units
  - Distributed heat pumps
- IECC higher level of commissioning required

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Contact Information

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- Questions
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