AIA Houston

International Energy Conservation Code 2015

Course Number: AIA012017

Gary Short, PE

January 24, 2017

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

This course will provide an overview of the International Energy Conservation Code (IECC) 2015 and the changes that have been made since the 2009 code.

The requirements of the new code will be discussed as well as how to implement and comply with the 2015 version of the codes.

Learning Objectives

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

1. Identify the requirements of IECC 2015.

2. Learn how to implement IECC 2015.

3. Explore ways to improve system energy performance in buildings.

4. Analyze how to implement energy strategies in new and existing buildings.

Course Outline

- Introduction
- Lighting & Power
- Building Envelope
- Service Water Heating
- Other Equipment
- HVAC & Mechanical
- Summary
- Questions

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Learning Objectives

- Learn of several updates from the 2009 to 2015 versions of the code
- Learn how to implement and comply with IECC 2015
- Identify the HVAC portion of the more than 100 updated requirements from previous versions of the standard.
- Explore ways to improve system energy performance in buildings.
- How ASHRAE 90.1 –is incorporated into IECC
- How to implement energy strategies in new and existing buildings

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

2015 IECC – Purpose & Scope

- Purpose
  - To establish the minimum energy efficiency requirements of buildings, for:
    - Design, construction, and a plan for operation and maintenance, and
    - Utilization of on-site, renewable energy resources
- Scope
  - Standard provides
    - Minimum energy-efficient requirements for the design, construction and a plan for operation and maintenance of:
      - New buildings and their systems
      - New portions of buildings and their systems
      - New systems and equipment in existing buildings
      - New equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes
      - Criteria for determining compliance with these requirements.

US Building Energy

- In 2015, about 40% of total U.S. energy consumption was consumed in residential and commercial buildings
- In 2013, the US consumed 18% of global energy consumption

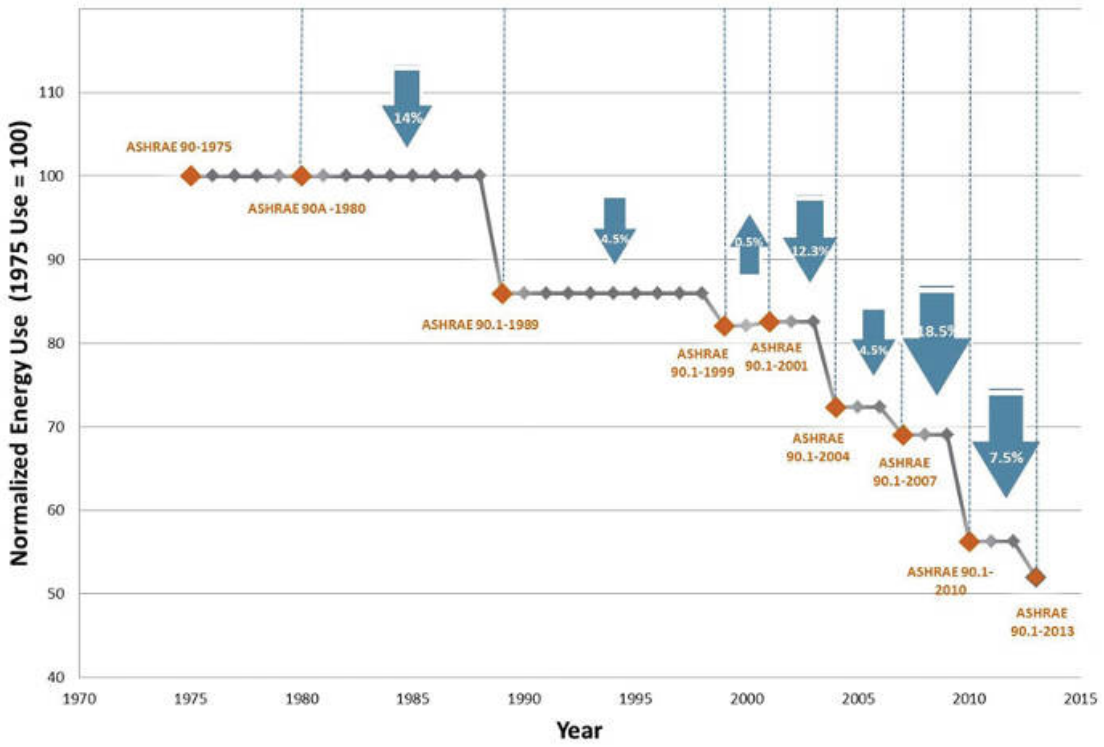
US buildings:

- Use 65% of the nations electricity
- Account for over 41% of total primary energy usage
- Space heating, space cooling and lighting use almost halfof all energy by buildings

- A 30% improvement in energy efficiency would generate net positive annual cash flow of $65 billion for buildings
  - This would produce a cash flow 4 times better than the average yield for corporate bonds

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Energy Savings Using Codes



sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Construction Documents

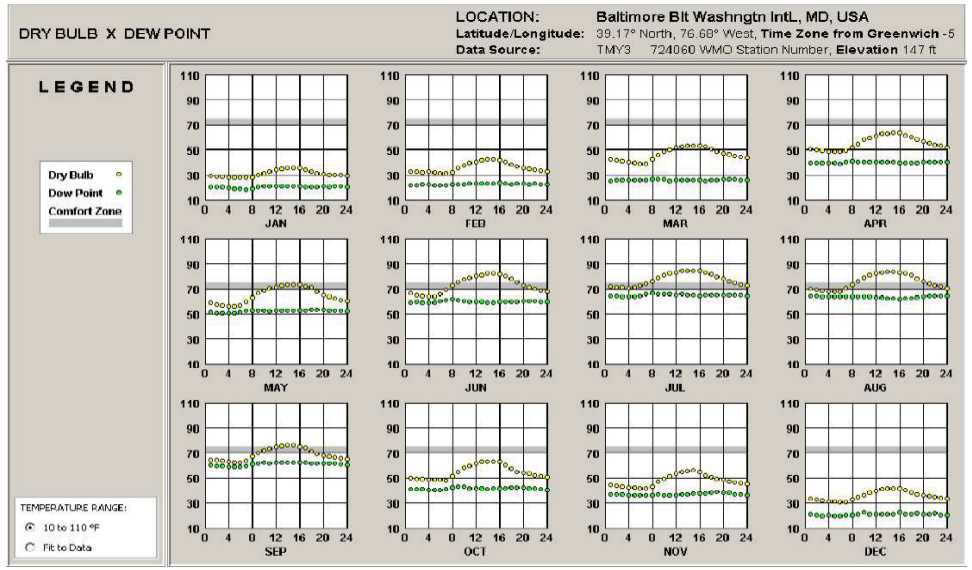
- Details Required (not typically provided)
  - Insulation materials and their *R-Values*
  - U-factors and solar heat gain factor for glass with area weighted calculations
  - Mechanical system design criteria
  - Economizer description
  - Duct sealing, duct and pipe insulation and location
  - Light fixture schedule with wattage and control narrative
  - Location of *daylight* zones on floor plans
  - Air sealing details

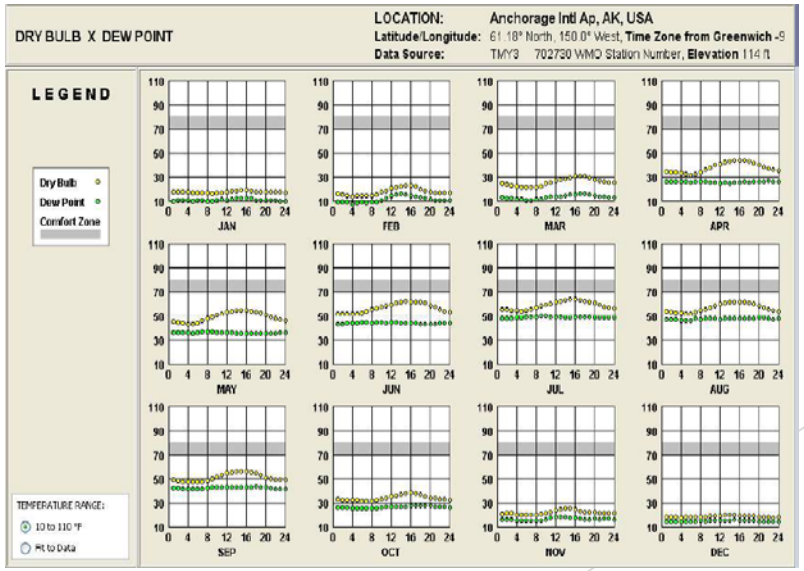
Building Envelope

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Climate

- Climate zone building is located in plays a huge roll on meeting this Standard.
  - Texas contains climate zones: 2A, 2B, 3A, 3B & 4
  - Zones are determined based on historical climate data



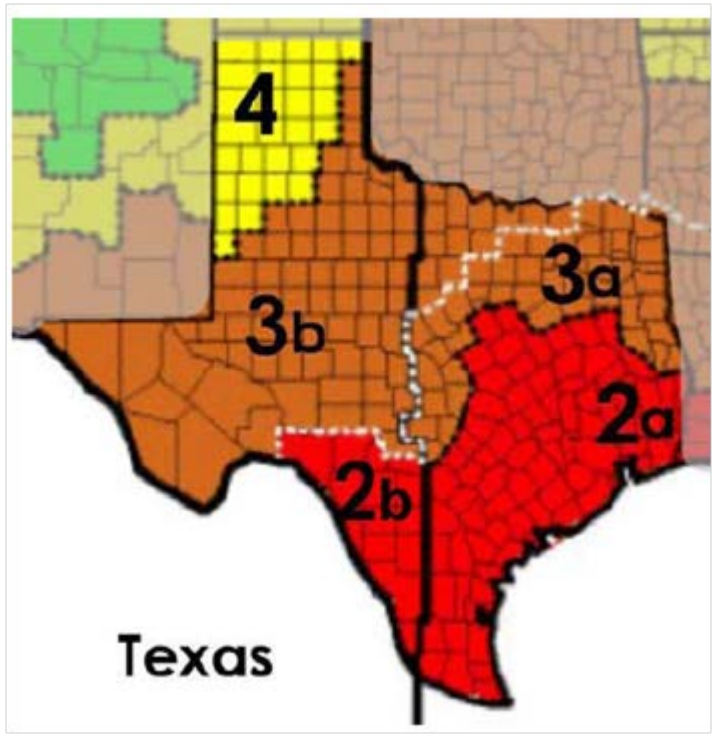


sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

- Effective Nov. 1, 2016, Texas established IECC 2015 as the energy code for commercial construction.
- Texas Code History

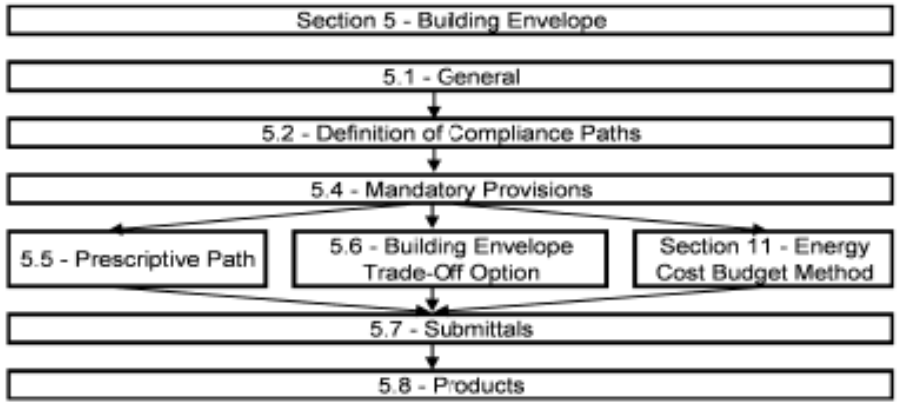
Effective Dates	Codes
Prior to 1999	TX had no mandatory statewide energy codes
Sept.1,2001 – Mar. 31, 2001	2000 IECC w/ 2001 Supplement
Apr.1, 2001 – Oct. 31, 2016	2009 IECC
Nov. 1, 2016	2015 IECC

Climate Zones



sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Compliance



- Prescriptive is accomplish by complying with the code for wall, floors and roofs
- Building Envelope Trade Off is done by computer modeling and comparing to a base under the Prescriptive method
- Energy Cost Budgeting is accomplish by modeling the entire building including all lighting, HVAC, power and alternative energy sources. Building budget must be lower then a base line building that is similar

Performance Alternatives

- Section C402 Building Envelope
  - Perspective method insulation and glazing meets or exceed code
  - Performance alternative sum of weighted construction (Trade Off)
    - Is the sum of the difference where difference = proposed * area
    - A+B+C+D+E < Zero
    - A = Walls, B = Slabs C = Below Grade, D= Glazing and E = Skylights & Roof
  - Zone 2: roof reflectance 3-year aged of .55 and 3-year aged emittance of .75
    - Exceptions include Soalr systems, roof gardens, skylights, roof shading, ballasted at 17 psi or 23 psf pavers
  - Modeling method – Energy Cost Budgeting

Fenestartion

- Less than 30% of gross grade wall area
- Skylight cannot exceed 3% of gross roof area
  - Increase to 5% and increase u-factor using *daylight controls*
  - Minimum skylight required for floor areas greater 2,500 sqft and ceiling greater than 15 ft
- Increase vertical fenestration to 40% with daylight responsive controls
  - Less than 2 stories and not less than 50% area within *daylight zone*
  - Greater than 2 stories and not less than 25% within *daylight zone*
  - Daylight controls complying with 405.2.3.1
  - Vertical fenestration is not less than 1.1 time SHGC
- Can use area weighted U-factor by category
- Air leakage (maximum CFM/SQFT)
  - Use rated materials for compliance to avoid envelope testing

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Use Certified Label Products

- Fenestration & Doors
  - Strict compliance to meet insulation and leakage
  - Products require certification by an approved agency such as the National Fenestration Rating Council (NFRC). This includes:
  - U-Factor
    - Solar Heat Gain Factor
    - Visible Light Transmittance
    - Air leakage

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Exemptions

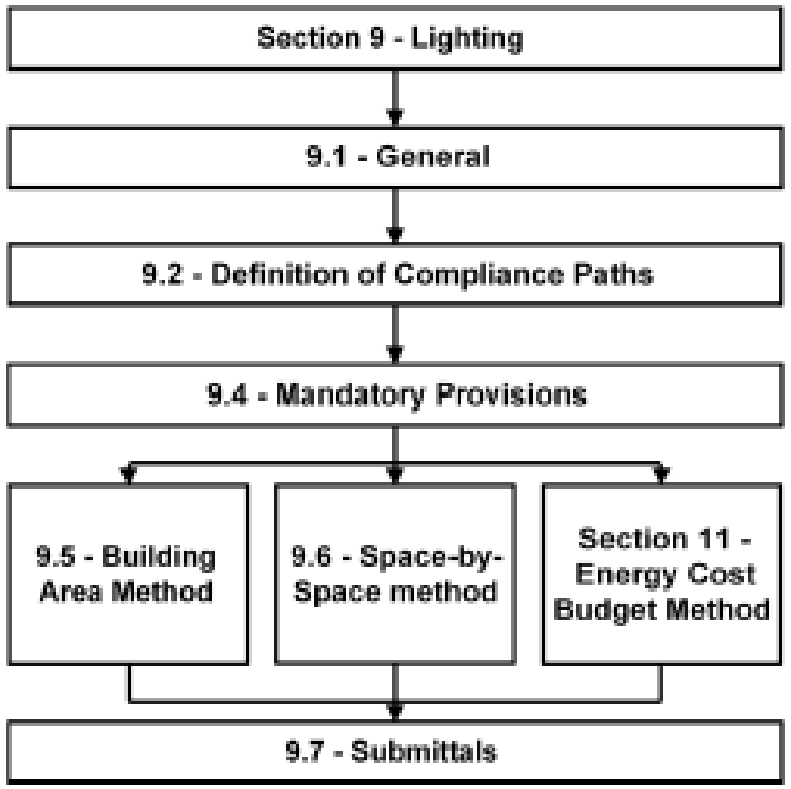
- Floor area less than 500 sqft
- Data centers exceed 7 watts/sqft
- Heating only with capacity less than 17,000 BTUH and setpoint no greater than 50F
- Average wall and roof *U-factor* less than 0.2

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Lighting & Power Overview

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Compliance



- Comply with Lighting Power Density Level (LPD) watts/sqft
- Alteration of any light system shall comply with LPD
- Building area method is watts/sqft
- Space – by – Space allows trade-offs
- Cost budget compare building energy use to comparable buildings

Lighting Systems

- Lighting controls are mandatory
- Occupancy Sensors are required
  - Classrooms/lecture/training rooms., Conference/meeting/multipurpose rooms, Copy/print rooms, Lounges, Employee lunch and break rooms, Private offices, Restrooms, Storage rooms, Janitorial closets, Locker rooms and Warehouses
  - Other spaces 300 square feet or less that are enclosed by floor-to ceiling height partitions.
  - All other areas must us time-switch controls exceptions for paths of egress, occupant safety or security and laboratory class rooms
- Control
  - Automatically turn off lights within 30 minutes of all occupants leaving the space
  - Be manual on or controlled to automatically turn the lighting on to not more than 50 percent power
  - Provide occupant control to turn off lights
  - Override time limited to two hours
- Exterior lighting for building site in zone 2 is 600 watts

Lighting Controls

- Light reduction controls
  - Uniform pattern at least 50%
  - Not required in daylight zones
  - Occupancy sensor or time of day
  - Lighting level control to allow 50% reduction
- Daylight responsive controls
  - Daylight controls shall be capable of complete shutoff of controlled lights
  - Sidelight daylight control shall extend laterally to nearest full height wall or up to 1.0 time height for floor to top of fenestration. Longitudinally from edge of fenestration to nearest full height wall or up to 2 feet whichever is less
  - Skylight control both direction at .7 times ceiling height or wall greater than .7 time ceiling height
- Specific application controls for display cases, hotels, medical,
- Integration with HVAC system and zone controls
- Local control

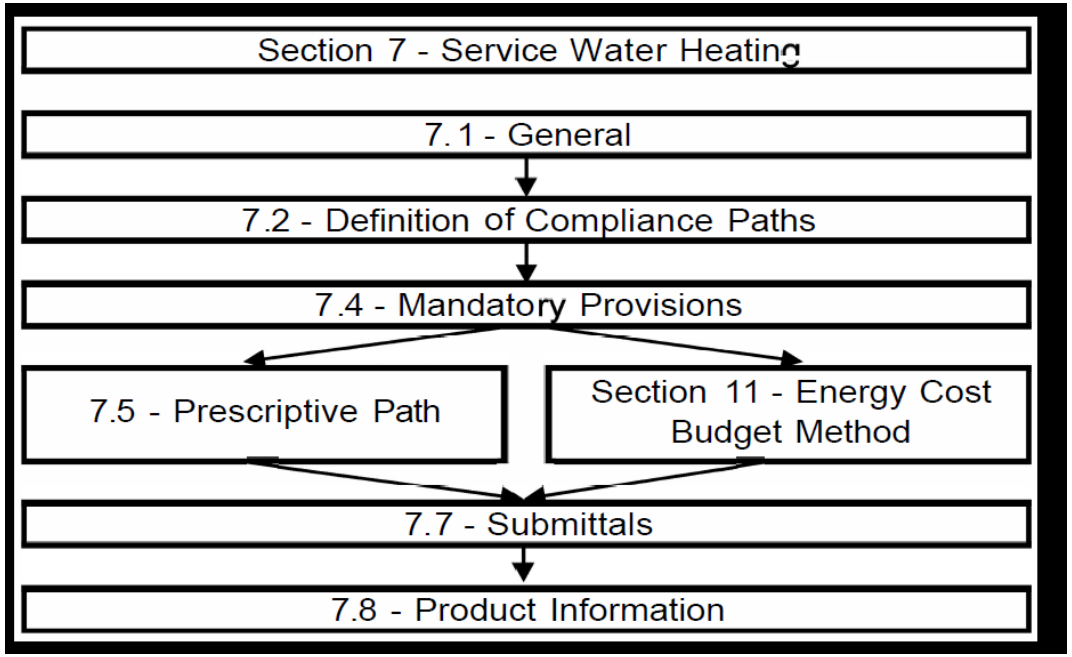
Power

- Minimum efficiency for transformers, motors, elevator, moving walks
- ASHRAE 90.1 2013 requires power plug load reduction of 50% during unoccupied periods
- Additional Efficiency Package Options must comply with one of the following:
  - Exceed HVAC efficiency
  - Reduced lighting power density
  - Enhanced lighting controls
  - On-site renewable energy
  - Dedicated outdoor air system for hydronic and multizone systems
  - High efficiency water heating systems

Service Water Heating

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Compliance



- Prescriptive is accomplished by complying with the code under this section
- Energy Budget Method is part of the whole building analysis and would be included in that computer model

Mandatory Requirements

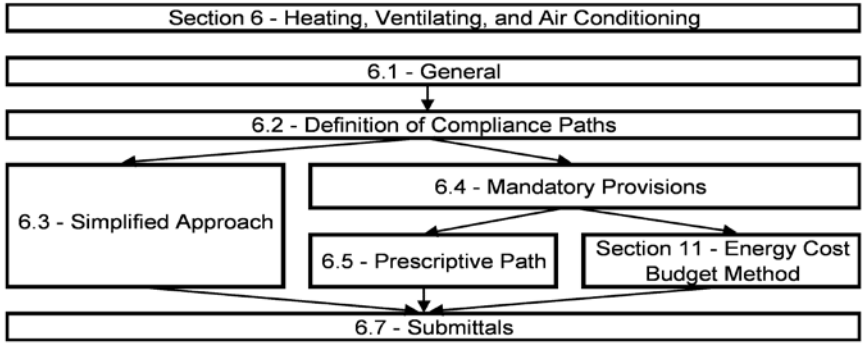
- Load calculations must be performed (no more rules of thumb)
- Equipment must meet efficiency tables
- Hot water supply boilers and water heaters must meet standby loss requirements
  - Exception: Systems with 140 gallons for storage or more the tank must be insulated using R-12.5 and fuel fired heater must have a flue damper or fan-assisted combustion
- Condenser heat recover for system where facility operates 24 hours per day and where heat rejection exceeds 500 TONs and water heating loads exceeds 1,000,000
- Controls
  - Storage temperature down to 120F
  - Time switches to deactivate pumps during unoccupied periods
  - Outlet for public restroom to 110F
  - Circulating pump controls. Must turn off so that heating cycle less than 5 minutes
- Maximum allowable pipe length and volume

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

HVAC

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

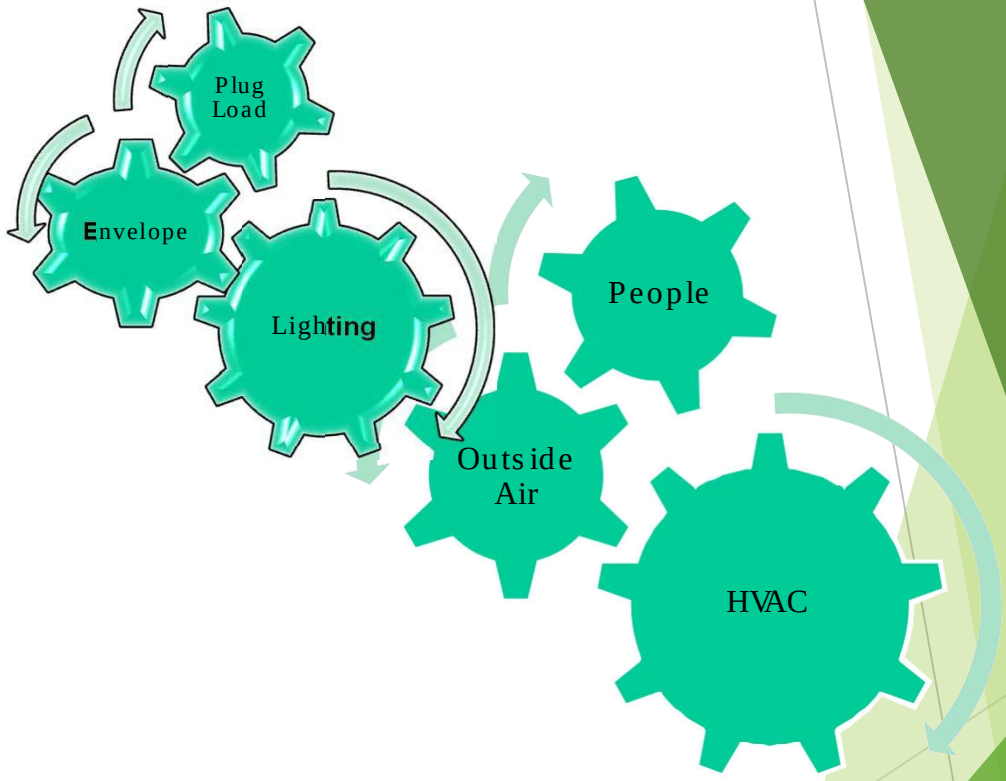
Compliance



- Simplified Approach
  - Building less than 2 stories
  - Gross area less than 25,000 SQFT
  - System serves a single HVAC zone
  - Control method requirements for setback, economizers, heat recovery etc.
- Energy Budget Method is part of the whole building analysis and would be included in the computer model

Requirements

- New building construction
- Additions to existing buildings must comply
- Renovation of existing buildings must comply unless HVAC systems are not replaced. Can be repaired
- Direct replacement of HVAC equipment must comply
- Calculate heating & cooling loads
  - Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system
- Calculate pump head pressure drop in critical circuit



sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

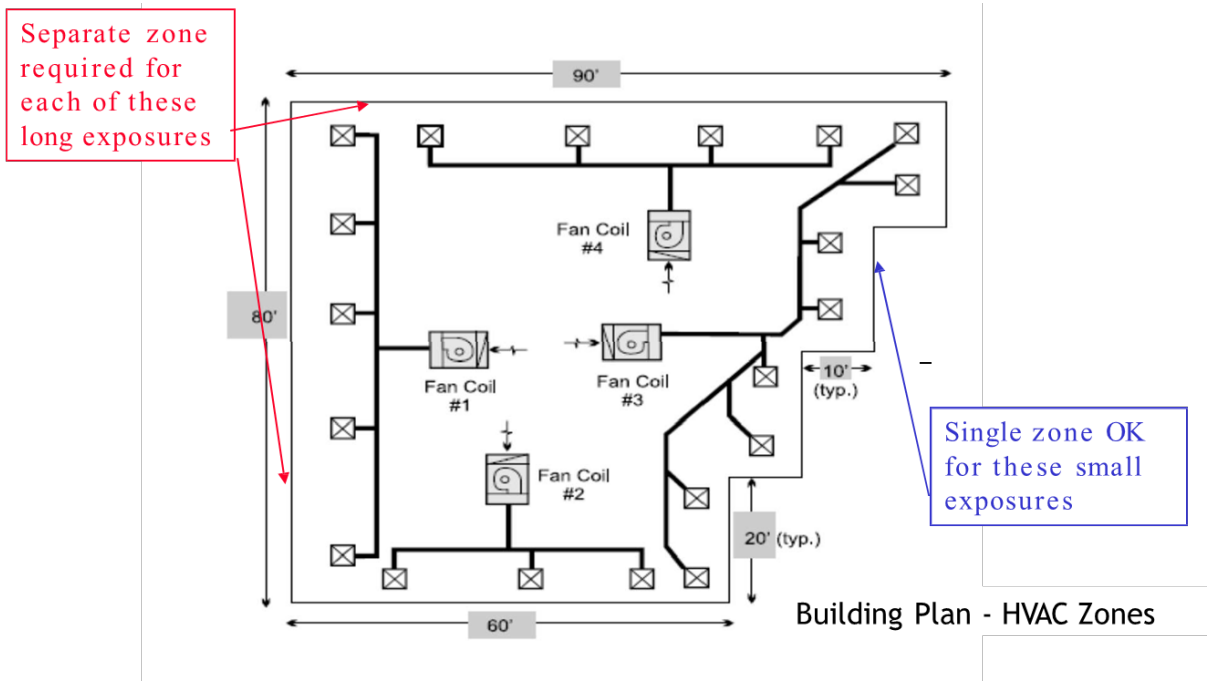
Minimum Equipment Efficiency

- Mandatory zone temperature control
  - No simultaneous heating and cooling (exceptions for dehumidification, labs, hospitals etc.)
  - Dead band control Cooling 75F and heating 72F
  - Setpoint overlap restrictions (limit switch, mechanical stop or DDC)
  - Off-hour controls
    - Exceptions for continuous operating and systems less than about ½ ton of cooling
  - Setback controls (10 hour power backup or ROM)
    - Override timer limited to 2 hours
  - Optimum start controls (conflicts with equipment sizing)
  - Shutoff control dampers outdoor air and exhaust
  - Zone isolation
    - HVAC systems serving zones greater than 25,000 sqft of floor area or span more than one floor with different schedules
    - Exception for systems less than 5,000 CFM

Minimum Equipment Efficiency

- IECC 2015 uses tables for minimum efficiency to get manufacturers of HVAC equipment to produce higher efficiency equipment
- When more than one requirement is listed then must comply with both requirements
- Economizer fault detection
  - Unitary equipment and variable refrigerant flow
- Mandatory temperature reset controls
  - Supply air reset based on load or outdoor air
  - Chilled and hot water reset based on load or outdoor air
- Ductwork construction
  - Measure leakage rate in cfm per 100 sqft of duct surface
  - Documentation furnished by designer totaling at least 25% of duct area has been tested
  - Pressure class differs for low, medium and high
  - City of Houston requires SMACNA Seal Class “A” for all ductowrk

HVAC Zoning

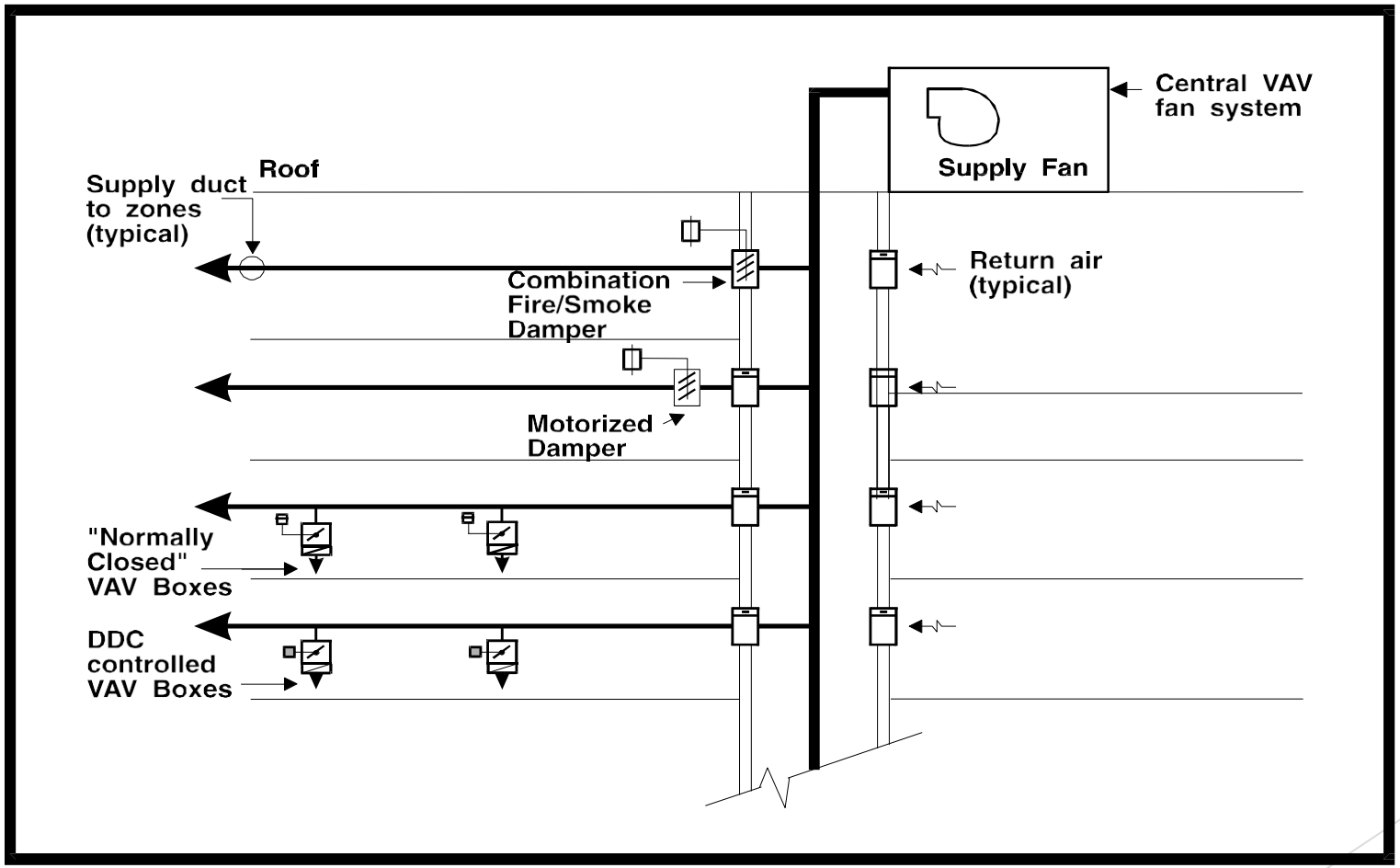


Building Plan - HVAC Zones

- Zones may be grouped into a single isolation area provided it does not exceed 25,000 ft2 of conditioned floor area nor include more than one floor.
  - HVAC systems serving *zones* that are over 25,000 square feet in floor area or that span more than one floor shall be divided into isolation areas.
  - Each isolation area shall be equipped with isolation devices and controls configured to automatically shut off the supply of conditioned air and outdoor air to and exhaust air from the isolation area.
  - Each isolation area must meet the mandatory requirements for control
  - Zones are limited by exposure

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Mandatory Zone Isolation



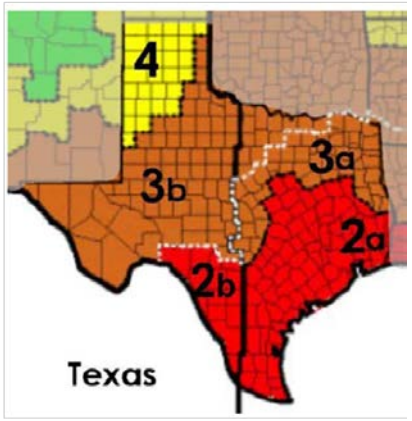
sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Demand Control Ventilation

- Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (46.5 m2) and with an average occupant load of 25 people per 1,000 square feet (93 m2) of floor area (as established in Table 403.3 of the *International Mechanical Code*) and served by systems with one or more of the following:
  - Systems with energy recovery complying with Section C403.2.7.
  - Multiple-*zone* systems without direct digital control of individual *zones* communicating with a central control panel.
  - Systems with a design outdoor airflow less than 1,200 cfm
  - Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm.
  - Ventilation provided for process loads only.

VENTILATION ENERGY RECOVERY

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
	≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	NR	NR	NR	NR
1B, 2B, 5C	NR	NR	NR	NR	≥ 26,000	≥ 12,000	≥ 5,000	≥ 4,000
6B	≥ 28,000	≥ 26,5000	≥ 11,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,500	≥ 1,500
1A, 2A, 3A, 4A, 5A, 6A	≥ 26,000	≥ 16,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 0
7, 8	≥4500	≥ 4,000	≥ 2,500	≥ 1,000	> 0	> 0	> 0	> 0



- Based on less than 8,000 hours per operation per year
- Any system that operates more than 8,000 hours per year MUST HAVE Ventilation Heat Recovery System Regardless of % OA
- Economizer mode – turn off HR wheel to avoid overheating and need to turn on chillers
- Exceptions:
  - Labs with VAV that can reduce air volume by 50%
  - Direct make-up air unit with no simultaneous heating or cooling.
  - Where largest source of exhaust air is less than 75% design outdoor air
  - Operate less than 20 hours/week
  - Exhaust corrosive fumes or duct

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Economizers (Prescriptive)

- Exceptions
  - Cooling load is less than 54,000 Btu/h
  - Where more than 25% of air designed to be humidified above 35F DP (not Houston)
  - Hospitals, surgical centers and other areas where the minimum Dewpoint temperature in the space is greater than 35F
  - In zone 2B where the cooling equipment performance improvement (EER or IPLV) has a 10% efficiency improvement
  - Operate less than 20 hours a week
  - System with condenser water heat recovery
  - Where the cooling equipment efficiency is compromised by using economizers
  - Refrigerated areas where there a anti-sweat controls. Has limitations
  - Passive cooling systems (no fan)
  - Systems that include ventilation energy recovery

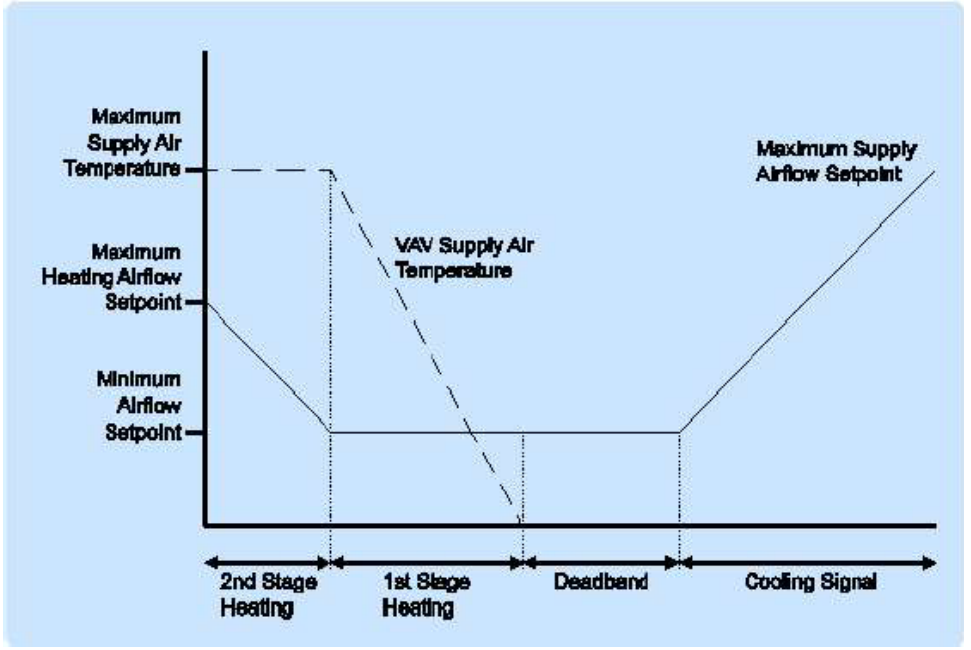
- Integrated control
  - Integrate with mechanical system
  - Controls cannot create false loads by limiting or disabling the economizer. Total design load is less than 3,000,000 and not served by a central plant
  - Have capability of providing 100% outdoor air
  - Sequenced with mechanical equipment
  - High limit controls using drybulb where outdoor air temperature exceeds the return air temperature
  - Fixed enthalpy control when outdoor air temperature exceed 28 Btu/lb or temperature exceeds 75F
  - Relief of excess outdoor air to prevent building over pressurization.
  - Water side economizers (Not Houston)
  - Where system is controlled by space temperature (single zone) mixed air temperature limit is allowed

VAV Static Pressure Reset Control

- For systems with direct digital control of individual zones reporting to the central control panel, the static pressure set point shall be reset based on the *zone* requiring the most pressure. In such case, the set point is reset lower until one zone damper is nearly wide open.
- Capable of monitoring *zone* damper positions or shall have an alternative method of indicating the need for static pressure that is capable of all of the following:
  - Automatically detecting any *zone* that excessively drives the reset logic.
  - Generating an alarm to the system operational location.
  - Allowing an operator to readily remove one or more *zones* from the reset

Reheat Limitations

- Airflow rate in deadband does not exceed the larger of:
  - 20% of peak airflow design
  - Minimum OA ventilation rate in accordance with ASHRAE 62.1
  - Applicable local codes (AHJ)
  - Airflow rate that is **reheated**, recooled or mixed shall be less than 50% of the zone peak supply rate
  - First stage of heat modulate zone supply setpoint to maximum while airflow is at deadband rate
  - Second stage modulate airflow up to maximum heating airflow rate
- Exceptions:
  - Laboratories
  - If 75% of reheat energy is from site recovered source (condenser heat, solar)
  - Air volume is at deadband flow rate by resetting the supply air temperature to the zone.
  - Where the cooling equipment efficiency is compromised by using economizers



sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

System Commissioning

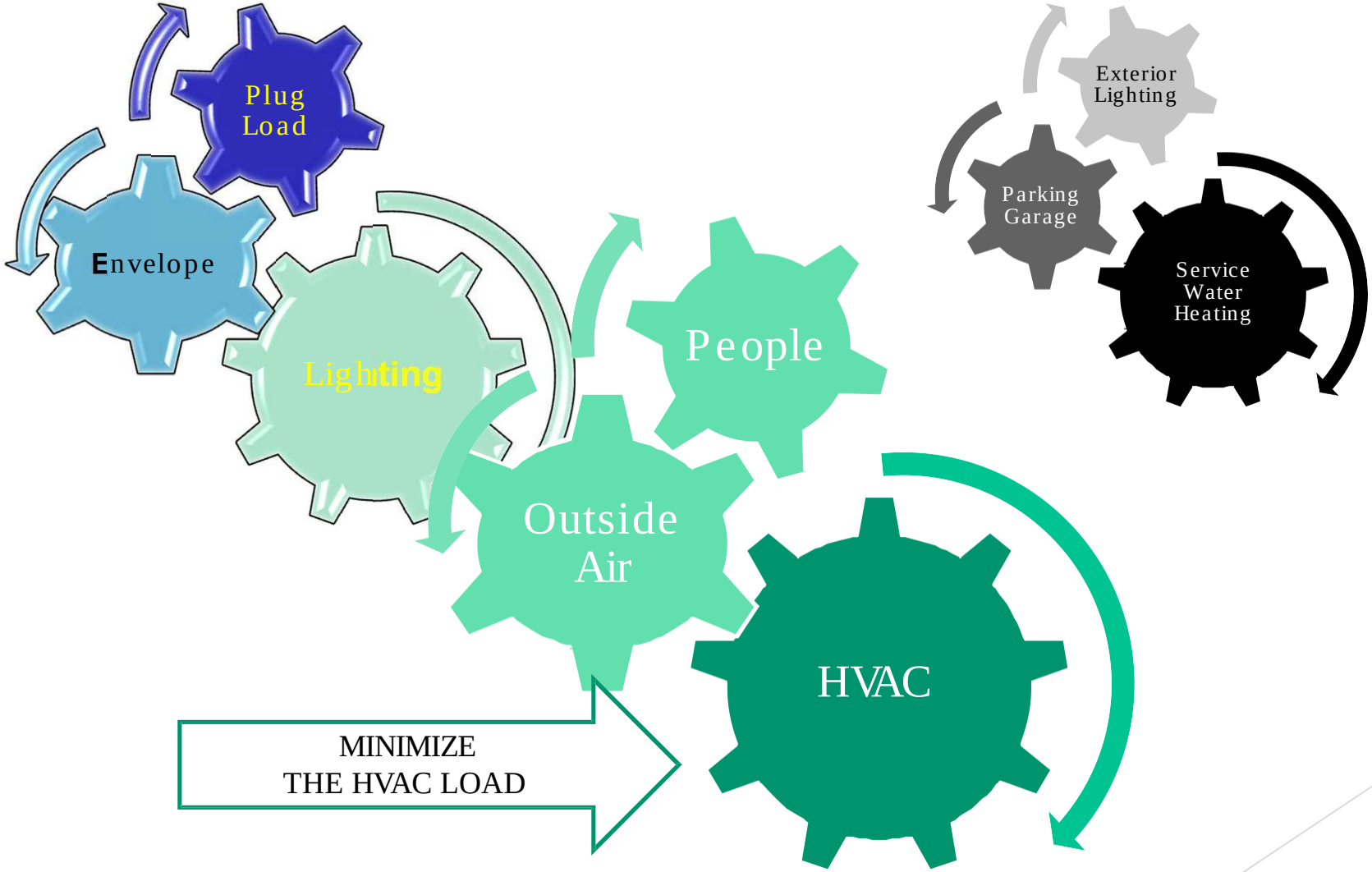
- Prior to the final mechanical and plumbing **inspections**, **the *registered design professional*** or ***approved agency*** shall provide evidence of mechanical systems *commissioning* and completion
  - *Construction document* notes shall clearly indicate provisions for *commissioning* and completion requirements and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the *code official* upon request
- Requirements
  - Commissioning plan
  - Equipment functional performance testing
  - Control testing
  - Lighting controls and occupancy sensors
  - Power shedding controls
  - Daylight responsive controls
  - A preliminary report of *commissioning* test procedures and results shall be completed and certified by **the *registered design professional*** or ***approved agency*** and provided to the building owner or owner's authorized agent.
- Approved agency is not defined

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Existing Buildings

- Adding fenestration must comply with new building codes
- Adding skylights must comply with new energy codes
- New mechanical and electrical systems that are part of an addition
- Alterations
  - Must comply with the new code except:
    - Existing building structure is no less then prior to alteration
    - Storm windows installed over existing
    - Surface applied window film can remain
    - Existing ceiling or cavities exposed during construction
    - Replace less than 50% lights as long as long as alteration does not increase lighting power
  - Change of occupancy or use where there is an increase in energy consumption

Consumption Breakdown



sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

ASHRAE 90.1 and IECC

- ASHRAE 90.1 issues every 3 years last version is 2016 and was released in November
- IECC issued every 3 years and last issue was 2015.
  - IECC is close to a direct copy of ASHRAE 90.1
- New requirements for 90.1-2016
  - Climate zones changed to match ASHRAE Standard 169. Added climate Zone Zero for places hotter than Miami
  - Wall and glass insulation and SHGC more stringent
  - Daylighting requirements increased
  - Envelop trade-off option to use whole building energy modeling **(Appendix G)**
  - Automation controls for hotels
  - Significant increases in mechanical efficiency
  - New requirements for replacement equipment (economizers and fan speed control)
  - Lower lighting power densities and more controls
  - Mandatory requirements for envelope verification
  - Energy monitoring chiller plants over 1,000. Air cooled chiller plants over 570 Tons

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

Questions and Discussion

Gary D. Short, P.E.
gary.short@sys-tek.com

sys-tek, P.A.
(713) 225-9009

sys-tek
TECHNICAL COMMISSIONING & ENGINEERS

This concludes The American Institute of Architects
Continuing Education Systems Course

AIA Houston

(713) 520-0155

rashida@aiahouston.org