HVAC Controls & Energy Savings Strategies

Presented by:
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Cost Effective Control Strategies

- Energy Recovery
- Dedicated Outdoor Air Treatment
- Demand Control Ventilation
- Static Pressure Reset
- Economizers
- Supply Air Temperature Reset
ENERGY RECOVERY

Plate Air to Air Heat Exchanger

Heat Pipe – *Thermo syphoning*

Heat Wheel
Energy Recovery Application

- Great Retro-fit on some RTU’s and most DOAS
- Energy Code (ASHRAE 90.1) requires Energy Recovery with at least 50% effectiveness for AHU’s with more than 5,000 CFM
- Most effective in higher temperature differentials as in peak design conditions (Winter / Summer)
DEDICATED OUTDOOR AIR SYSTEMS (DOAS)

- Meets CHPS criteria for best design practices
- Preferred Methodology of ASHRAE 90.1 to treat large ventilation loads
- Improved IAQ & Control
- Single Source for Heavy Duty Filtration
- Maintenance & Cost Savings
- ASHRAE’s Humidity Control Design Guide for Commercial and Institutional buildings specifically recommends against introducing OA thru incremental units.
Potential LEED Points for DOAS – Up to 19 Points (10-14 Points Reasonably)

- LEED Green Building Rating points *Water Efficiency* (1 point)
  - (Reduce Water use during Winter by Humidification gain thru Energy Wheel)
  - *Energy & Atmosphere* (4 Points)
    - (Optimize Energy Performance up to 25% reduction in the system operating costs.)
  - *Materials & Resources* (4 Points)
    - (Radiant systems can be utilized and made from post-industrial recycled materials)
  - *Indoor Environmental Quality* (8 Points)
    - IEQ 1: CO2 Monitoring
    - IEQ 2: Increased Ventilation Effectiveness
    - IEQ 3: Construction IAQ Management Plan (Achieved by Preventing absorptive material from OA moisture & Two Week Purge)
    - IEQ 6: Controllability of Systems
    - IEQ 7: Thermal Comfort (Achieved by decoupling space sensible and latent loads)
- Innovation Credits (2 Points)
  - Radiant cooling integrated with DOAS
DEMAND CONTROL VENTILATION (DCV)

- Prevents energy loss from over ventilation while maintaining indoor air quality.
- Saves Energy by avoiding additional Heating / Cooling Loads imposed by Maximum Ventilation Rates and saves fan energy.
- Mature Technology - *CO2 Sensors have been readily available for about 12 years*
- Installed Costs for new system $600-$700 per zone & for retro-fitted systems $700-$900 per zone.
DEMAND CONTROL VENTILATION (DCV)

DCV System At Full Occupancy

- Fully Open Out Side Air Damper
- 100 CFM Exhaust Air
- 200 CFM Outside Air
- Control Panel
- CO

DCV System Partial Occupancy

- Partially Open Out Side Air
- 100 CFM Exhaust Air
- 120 CFM Outside Air
- Control Panel
- CO2 Sensor
DCV Application

- Uses CO2 sensors to control ventilation rates instead of ventilation rates based on Maximum Occupancy of spaces (Code Driven).

- Controls OA values by increasing OA CFM when CO2 levels exceed 1100 PPM & Decreases levels to Code Mandated Minimum Levels when PPM >1100. *(Typical Industry Standard)*

- Minimum Ventilation rates must be maintained during Normal Occupied Times. Typically 0.15 CFM/Sq. Ft. for most commercial spaces.

- Good Rule of Thumb – DCV should be applied to any system with outdoor air volume exceeding 25% of supply volume.
Static Pressure Reset (SPR)

- Reduce Fan Energy use in VAV systems up to 30% with simple payback in as little as 10 months.

- Typical VAV systems waste fan energy because the fan speed is controlled to maintain a constant pressure in the supply duct which is high enough to provide sufficient airflow during full load conditions.

- Static Pressure Reset (SPR) Reduces duct pressure at part-load conditions by determining the Critical Supply duct pressure (SDP) – the lowest duct pressure at which the VAV Terminal can remain in control of the Critical Zone (CZ) Space Temperature.
Figure 1: Schematic of a variable-air-volume air handling system

Conventional variable-air-volume systems cut energy use by reducing fan power at part-load conditions, but save less than they could because they maintain a constant supply duct static pressure.
When the CZ VAV Terminal is less than 85% open and Space temp is satisfied, the System Duct Pressure (SDP) is reduced incrementally, reset down by 0.10” wg every 10 minutes to the system minimum SDP.

When the CZ VAV Terminal is greater than 85% open and Space Temp is not satisfied the reverse occurs until the system reaches the Maximum SDP.

Typical Static Pressure setpoints range from 0.30” - 1.50” w.g. The initial SDP setpoint is typically set at 0.75” during initial TAB work.

Most effective where zones are dissimilar and internal loading is uneven. (So you are not overcooling the non-critical zones)

Other Control Methodologies exist which also monitor flow and may provide even more savings. The strategy presented here is the simplest. Reference ASHRAE Standard 62.1-2007, 6.2.7 Dynamic Reset
ECONOMIZERS

- Economizers provide Free Cooling or Heating in applicable climates and seasons.
- Can be controlled by OA Sensible or Enthalpy (BTUH of Energy in Air)
- Required by Title-24 in HVAC systems meeting Specific Criteria
- Most effective in seasonal and less humid climates
SUPPLY AIR TEMPERATURE RESET

- SAT Reset also referred to as DAT (Discharge Air Temperature)

- Potential to minimize heating/cooling, pumping and reheat energy associated with delivering conditioned air during part-load conditions

- Typically raises DAT when OA is Cold and Lower DAT when OA is Hotter

- A typical reset schedule may be 65°F DAT @ 45°F OA and 55°F DAT @60F.

- May not be practical in Humid conditions, or when applied to zones with high internal gains

- Best application where all zones have similar load and DAT is based on OA Temperature. Independent Engineered Analysis recommended to determine application for your systems.
Commissioning HVAC Systems for Optimum Performance

CxA
Commissioning
Re-Commissioning
Retro-Commissioning
What is Commissioning?

A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements.
What Do Commissioning Providers Do?

- The Commissioning Process involves steps that are integrated into every phase of the project:

  - Commissioning is NOT just testing at the end!
When is Re-Commissioning or Retro-Commissioning Warranted?

- Buildings have problems
- Occupancy or use changes
- Energy use is inefficient
- Looking to LEED certify your existing building
  - Solves Specific Performance Problems
  - Better Efficiency & Energy Use Reduction
  - System Degradation Reversal
  - Adapts System to Current Building Use
What Issues Are Typically Discovered?
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What Deficiencies is the CxA looking for during Commissioning or Retro-Cx

- Inaccurate sensors
- Improperly functioning control sequences
- Excessive, simultaneous heating and cooling
- Out-of-range or inappropriate setpoints during unoccupied periods
- Disabled free-cooling economizers
- Equipment running excessively or inefficiently
- Inaccurate equipment operating schedules to match building use
- Stabile Control of building pressurization to prevent unwanted infiltration and exfiltration.
What Deficiencies is the CxA looking for during Commissioning or Retro-Cx

- Air and water systems that are out of balance
- Variable-air-volume boxes that are not working properly
- Loose fan belts
- Leaking control valves
- Leaking damper seals
- Malfunctioning variable-speed drives
- Unsealed ductwork to identify leaks
- Over or Under Ventilated Buildings
Thank You!

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