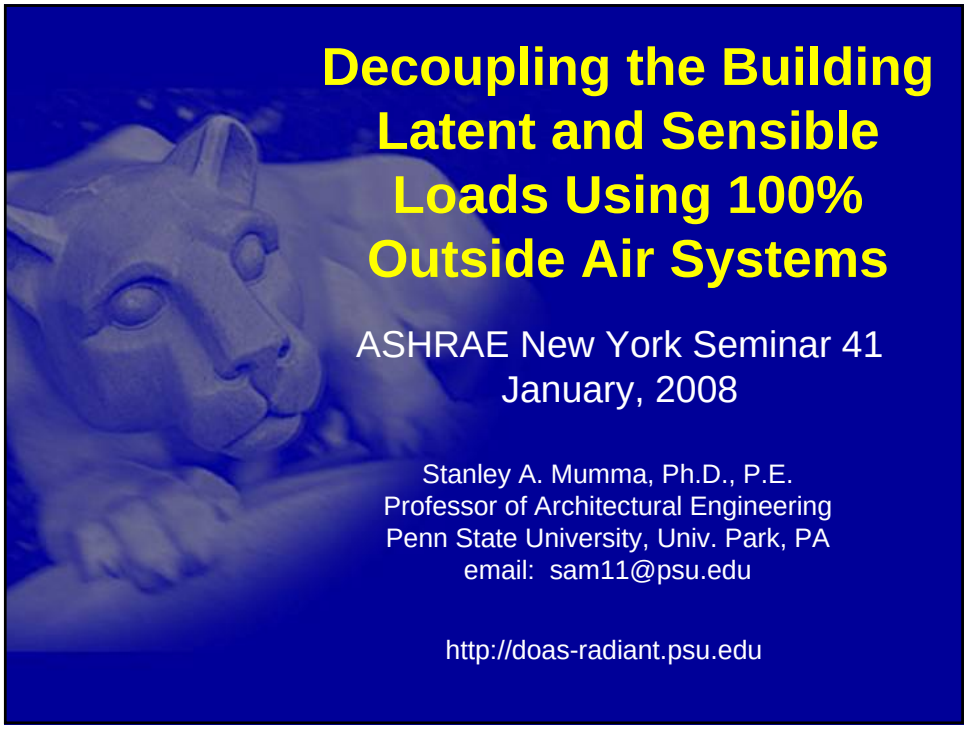

Decoupling the Building Latent and Sensible Loads Using 100% Outside Air Systems

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Outline

- What are 100% OA systems?
- What is the benefit of decoupling the space sensible and latent loads?
- What parallel sensible cooling equipment is available when dry ventilation air is delivered to the space?
- What are the operating benefits of these decoupled systems, including op. cost?
- A few pitfalls to avoid when applying these systems?

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100% OA Systems

1. 100% OA, but at a low flow rate, approximately the rate required by ASHRAE Std. 62.1-2007: i.e. ***DOAS.*** Also needed: Parallel sensible cooling only system to meet the thermal loads.
2. 100% OA, at the flow rate required to meet the entire space sensible load—frequently up to 5 times the flow needed for ventilation alone.

   Will not be discussed here—but could be during the question time if interested.

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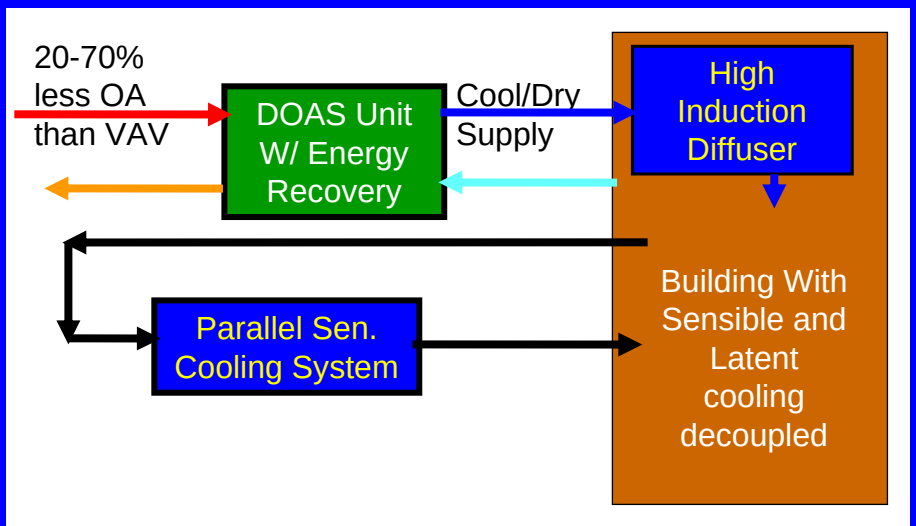
DOAS Systems



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Why decouple sensible and latent space loads with DOAS?

Tight humidity control minimizes the potential for IAQ problems and related sick-building illnesses*, and improves thermal comfort and productivity.

*Which are caused largely by *biological contaminants* breeding in damp ducts, ceiling tiles, insulation, behind vapor barriers and carpet.

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Potential Health/productivity Related Economic benefits of DOAS

The significance of DOAS is illustrated by estimates that US companies lose as much as ***$48 Billion*** annually to cover medical expenses and ***$160 Billion*** annually in lost productivity as a result of sick-building illnesses.

Source: ASHRAE Literature.

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How Much is $208 Billion/yr.--- in light of the ~ $13,800 Billion/yr 2007 USA GDP (value of goods and services)

- Medical & productivity cost (loss) to US business as % of GDP: (208/13,800)*100 = 1.5%
- National debt annual increase as a % of GDP: (500/13,800)*100 = 3.6%
- Katrina Gov. appropriations as %of GDP: (150/13,800)*100 = 1.1%

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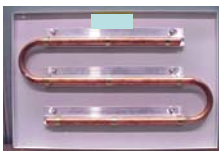
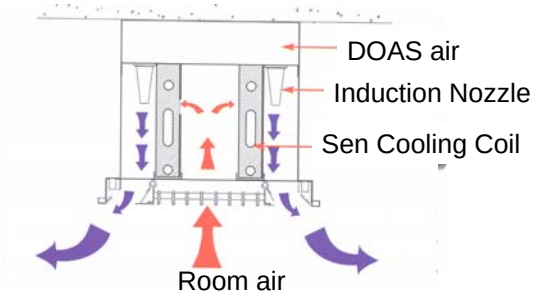
Parallel Terminal Systems



Radiant Cooling Panels



Chilled Beams

Fan Coil Units

Air Handling Units

Unitary ACs

VAV problems solved with DOAS plus Radiant or Chilled Beam

- Poor air distribution.
- Poor humidity control.
- Poor acoustical properties.
- Poor use of plenum and mechanical shaft space.
- Serious control problems, particularly with tracking return fan systems.
- Poor energy transport medium, air.
- Poor resistance to the threat of biological and chemical terrorism, and
- Poor and unpredictable ventilation performance.

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Additional benefits of DOAS

Beside solving problems that have gone unsolved for over 30 years with conventional VAV systems, note the following benefits:

- Greater than 50% reduction in mechanical system operating cost compared to VAV.
- Equal or lower first cost.
- Simpler controls.
- Generates up to 80% of points needed for basic LEED certification.

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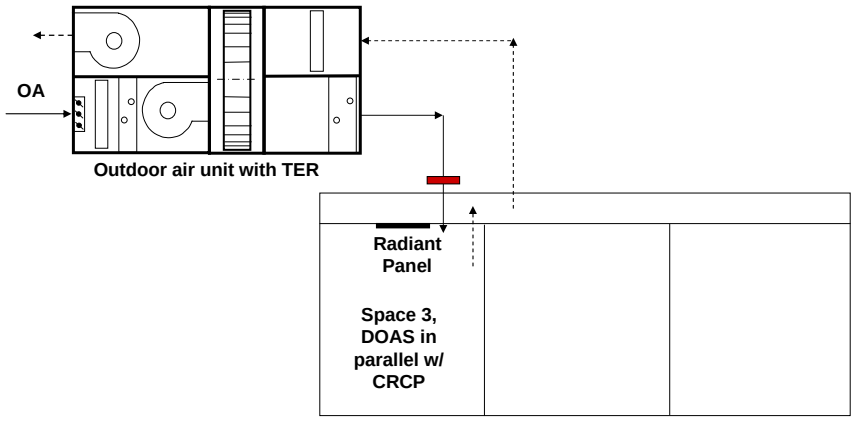
DOAS with Parallel Radiant



Sample DOAS pitfalls?

- Wrong supply air temperature.
- Wrong controls for the enthalpy wheel.
- Wrong controls for the heating coil.
- Wrong controls for the cooling coil.
- Wrong location for the heating coil.

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Quick Review of DOAS system psychrometrics

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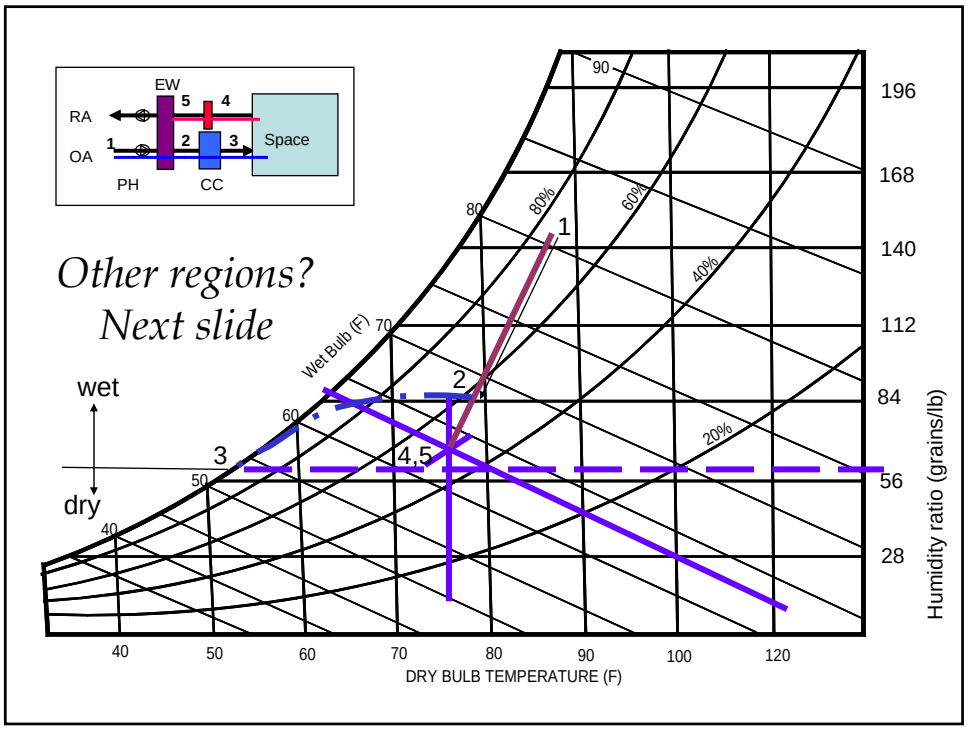
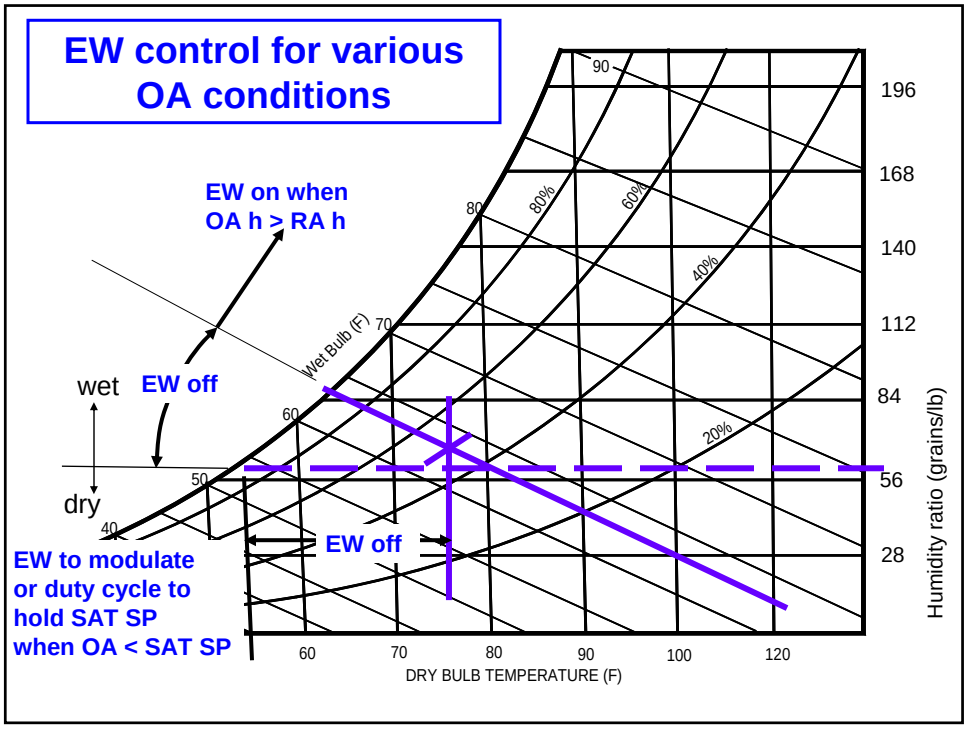
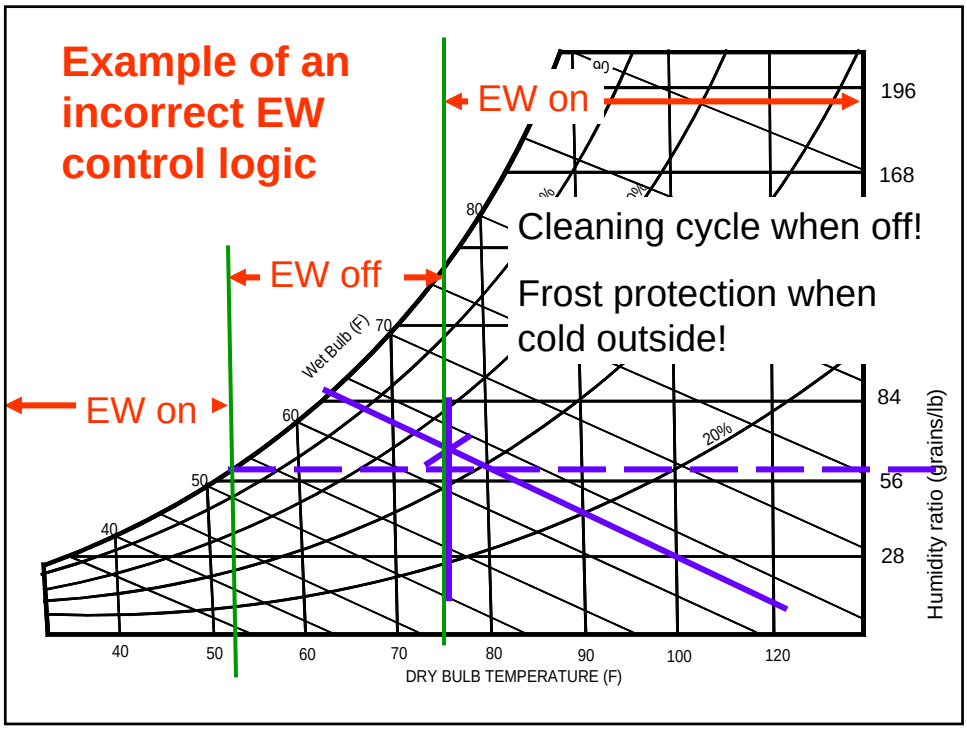
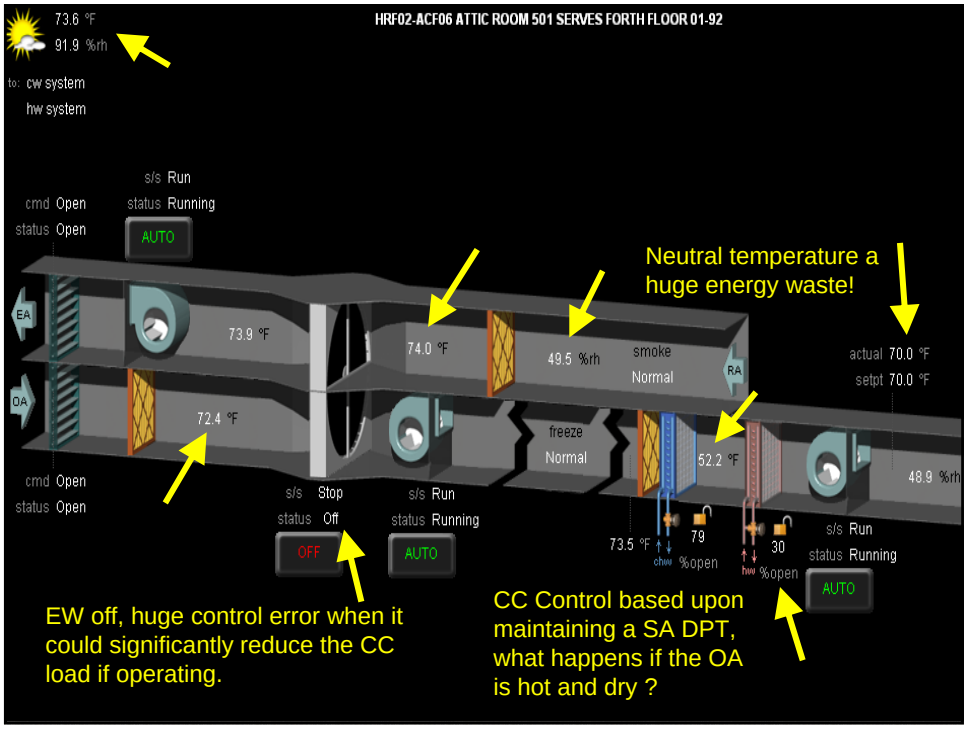



EW control for various OA conditions
EW on when OA h > RA h
wet
EW off
dry
EW to modulate or duty cycle to hold SAT SP when OA < SAT SP
EW off
Wet Bulb (F)
80%
60%
40%
20%
90
80
70
60
50
40
196
168
140
112
84
56
28
Humidity ratio (grains/lb)
60
70
80
90
100
120
DRY BULB TEMPERATURE (F)


Example of an incorrect EW control logic
EW on
Cleaning cycle when off!
EW off
Frost protection when cold outside!
EW on
Wet Bulb (F)
80%
20%
90
80
70
60
50
40
196
168
84
56
28
Humidity ratio (grains/lb)
40
50
60
70
80
90
100
120
DRY BULB TEMPERATURE (F)



Failing to minimize the use of a chiller when it is cool outside — can be a pitfall for DOAS systems.

- EW binary control—a duty cycle saves chiller operation.
- EW using a VFD, maximizes the free cooling of a DOAS.

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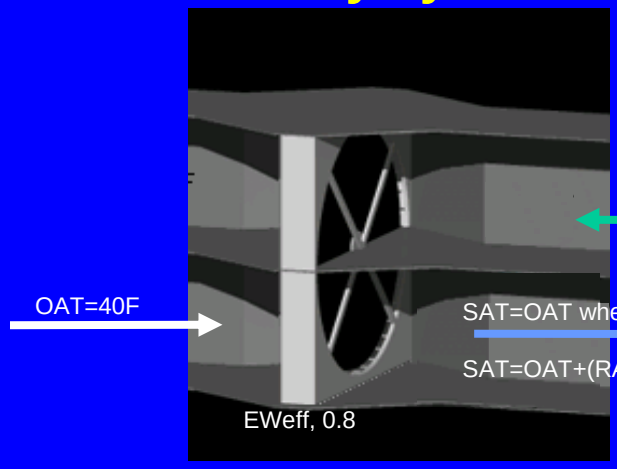
EW Duty cycle defined



By adjusting the EW ON time (54.7% or 8.2 min) in 1 period (15 min) can get an avg. temperature equal to the desired SAT (54F). Duty cycle changes to 100% ON at 40F OAT to avoid tripping freeze stats. NOTE: HC must be off since when EW off, DAT < DATSP and the CC must be off when the EW on!

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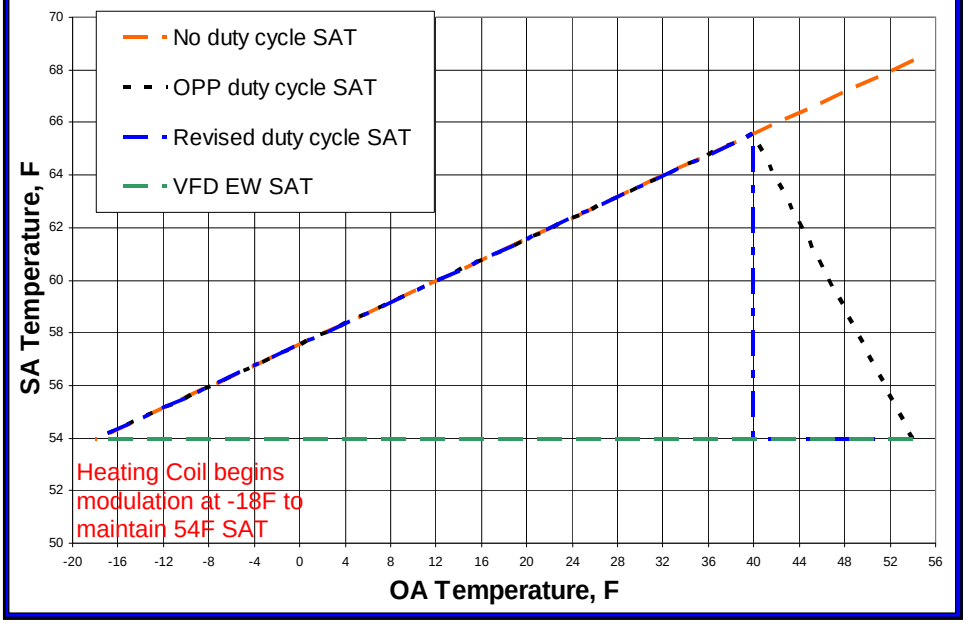
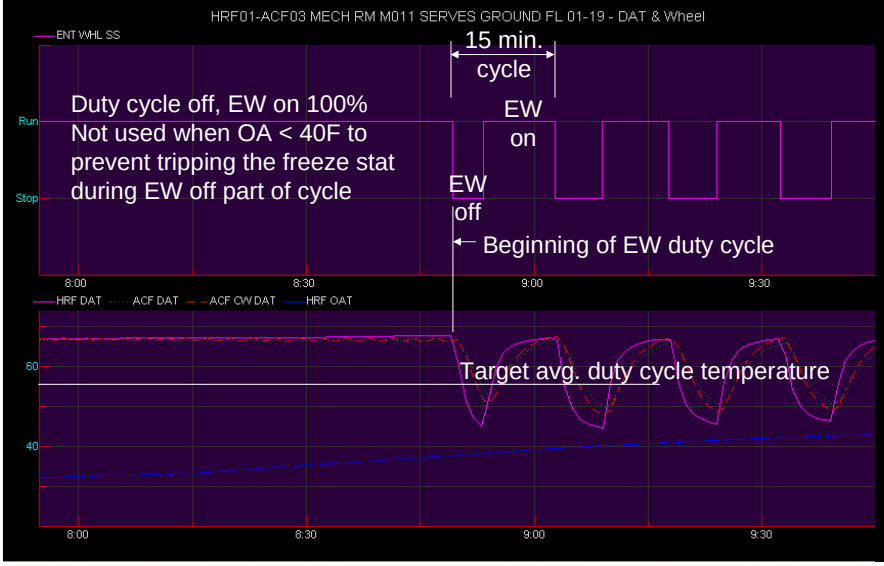
EW operation when OA below 54F



Sample of the duty cycle operation as the OA DBT rises through 40F



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Conclusions

- 100% OA DOAS systems discussed.
- IAQ cost benefits of decoupling discussed.
- A few parallel systems introduced.
- Operational benefits explored.
- Humans are still capable of falling into pits. A few pitfalls discussed.
- I am convinced DOAS is the future since it solves VAV problems at lower first and operating costs, while providing improved IEQ and safety!
- More information is available on the DOAS web site noted on the first page.

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