

Facility Dynamics

ENGINEERING

Controlling the Mixed Air Section

Mixing Air (Supplemental)

Presented By:

David Sellers; Facility Dynamics Engineering

Senior Engineer

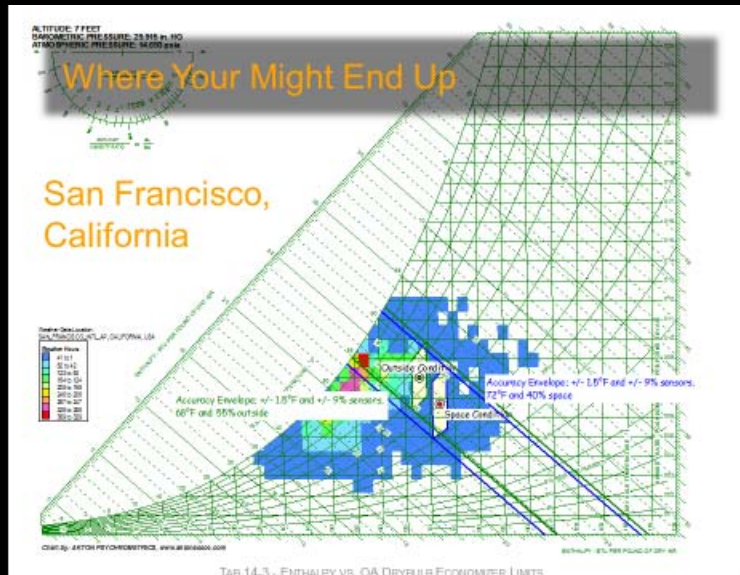
NAVFAC, San Diego

A Bit More about High Limit Controls

Controlling the Mixed Air Section

Tab 14-3
Limiting Economizer Operation Based on Enthalpy vs. Dry Bulb Temperature

Presented By:
David Sellers, Senior Engineer
Facility Dynamics Engineering

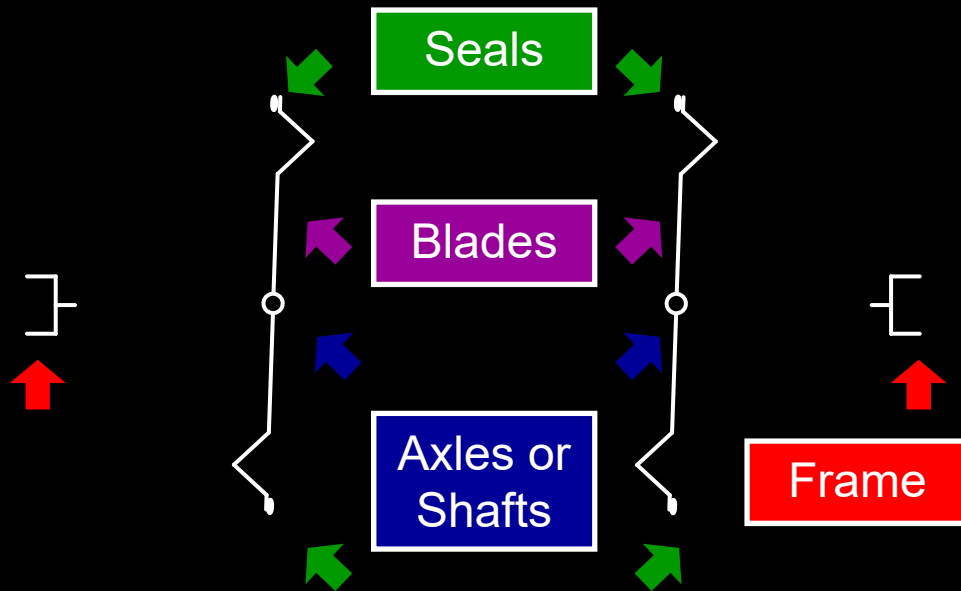


Not Perfect, But Pretty Good when Cost and Persistence are Considered

For more information, see *Economizer High Limit Devices and Why Enthalpy Economizers Don't Work* at <http://tinyurl.com/SteveTaylorsArticle> (November 2010 ASHRAE Journal)

Damper Parts

Parallel Blade Damper





Contrasting Greenheck's Blade Designs and Blade Seals

A Typical Jamb Seal



A Typical Jamb Seal

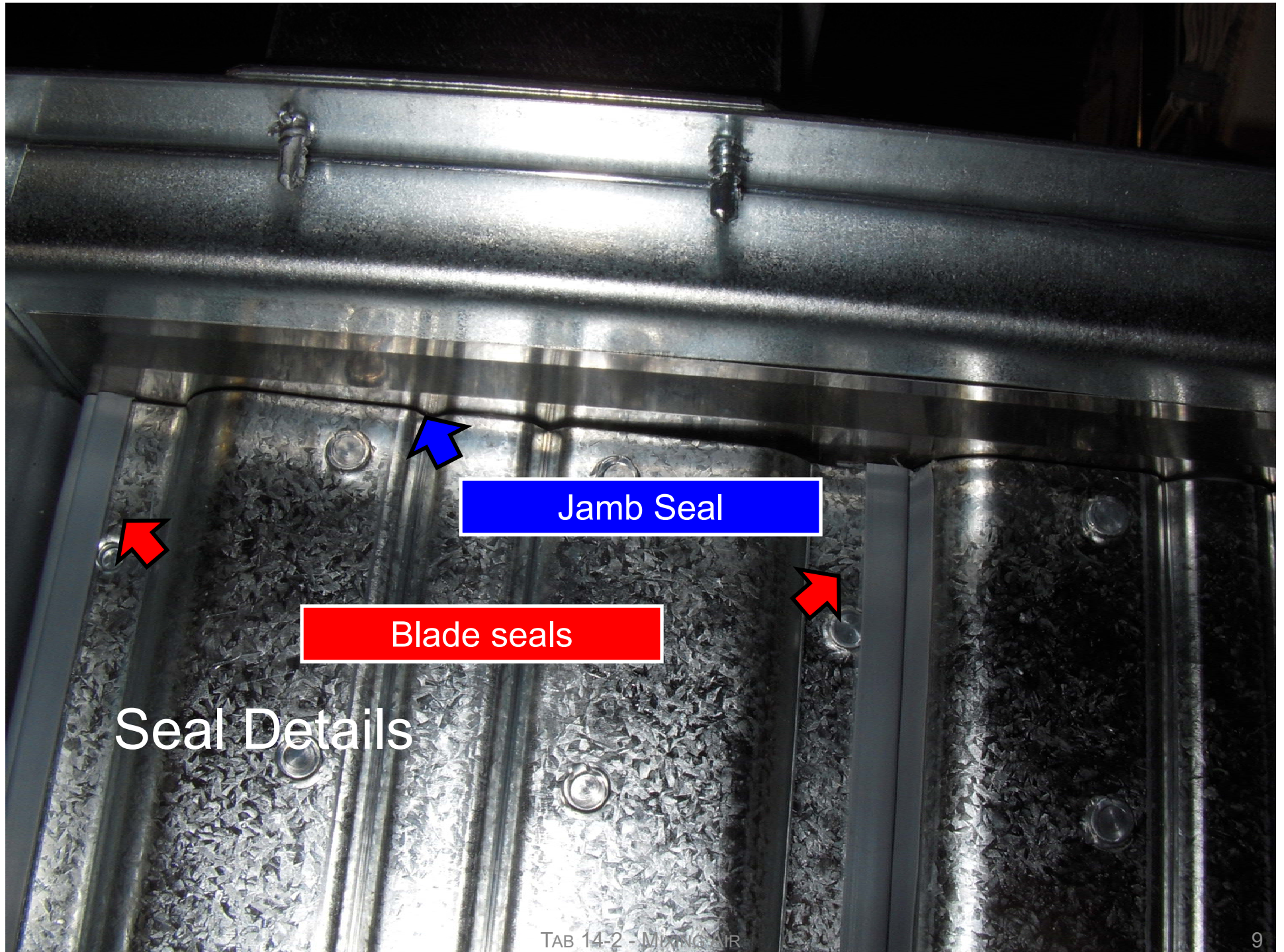


A Typical Jamb Seal



Typical Blade Seals





Jamb Seal

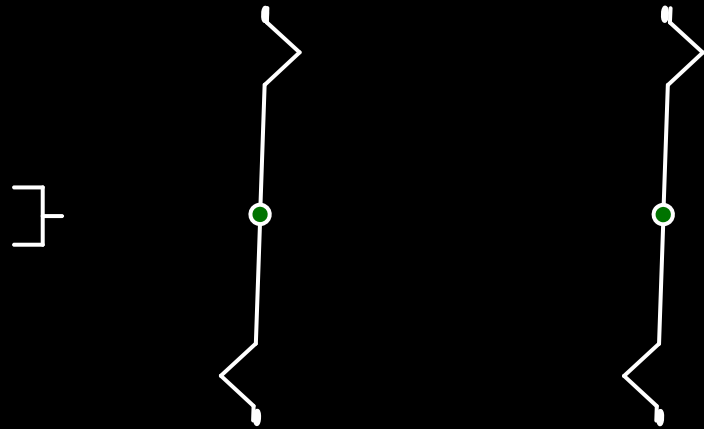
Blade seals

Seal Details

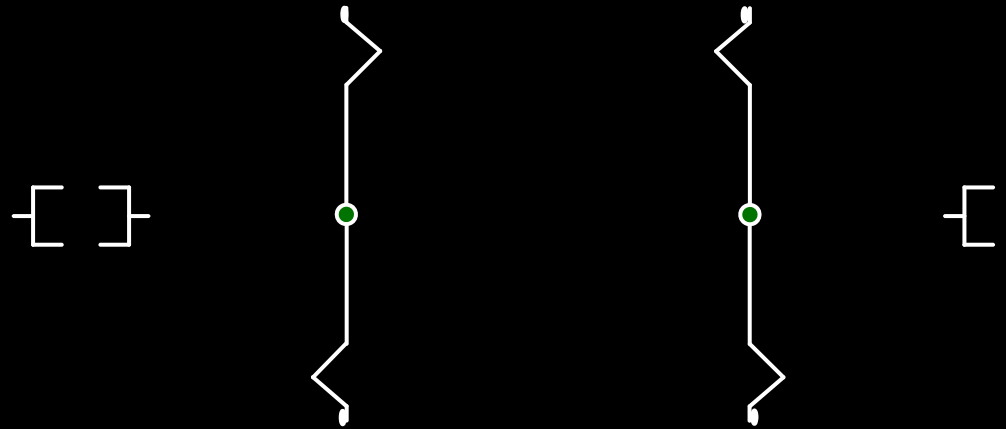
TAB 14-2 - MIXING AIR

Parallel vs. Opposed Blade Dampers

Parallel Blade Damper



Opposed Blade Damper



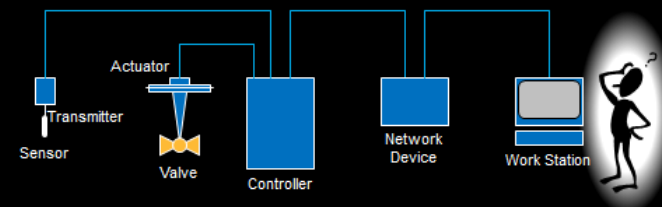
Mixing Performance Depends On:

- Good sensing input for control



What You See is What You Get;
Maybe or maybe not

- There are many elements between the sensor and the observer and the observer and the actuator
- All of them can impact accuracy, precision, and performance



INTEGRATING ECONOMIZERS WITH OTHER HVAC PROCESSES

30

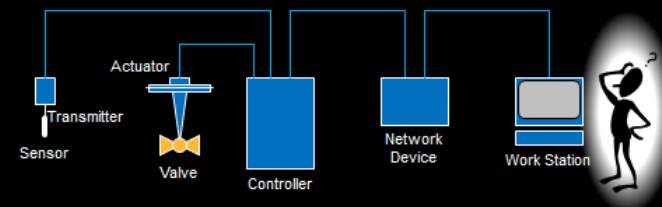
Mixing Performance Depends On:

- Good sensing input for control
- Damper blade rotation directs air streams to promote mixing



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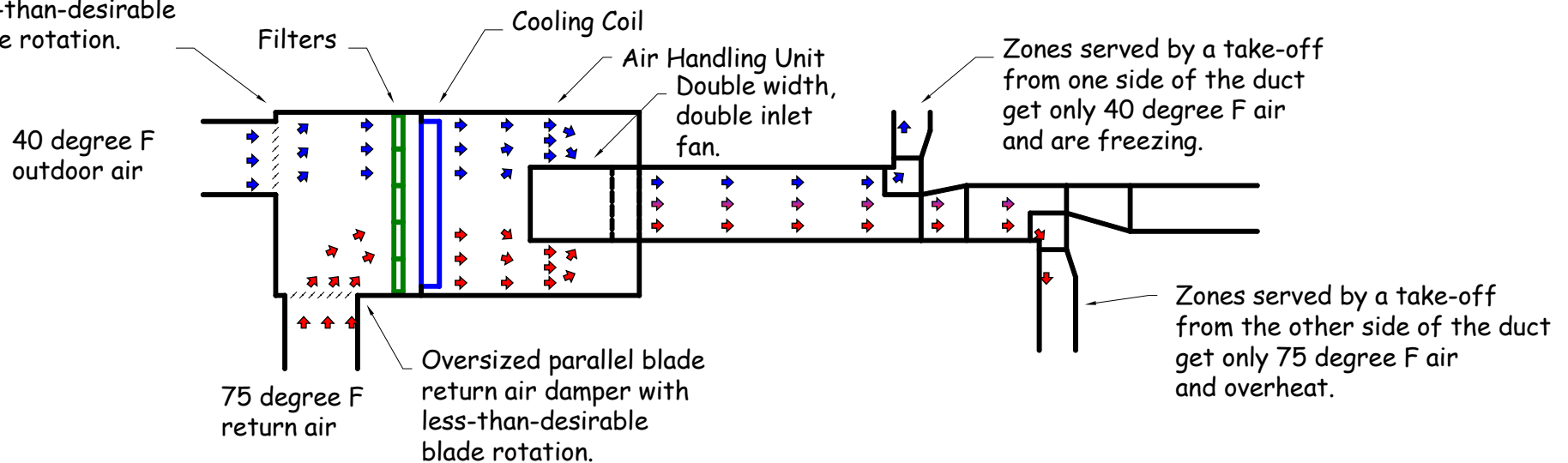


INTEGRATING ECONOMIZERS WITH OTHER HVAC PROCESSES

30

Strange Things Can Happen

Oversized parallel blade outdoor air damper with less-than-desirable blade rotation.



Corrections:

- Disable some damper blades to increase velocity
- Flip dampers to direct airstreams together

Mixing Performance Depends On:

- Good sensing input for control
- Damper blade rotation directs air streams to promote mixing
- Sufficient distance to mix

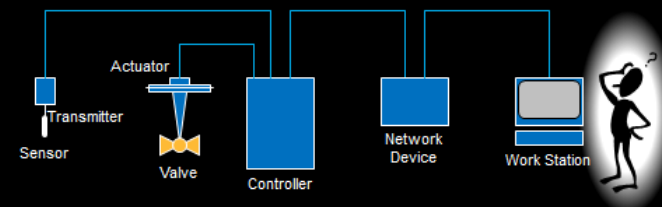


What You See is What You Get;

Maybe ...

... or maybe not

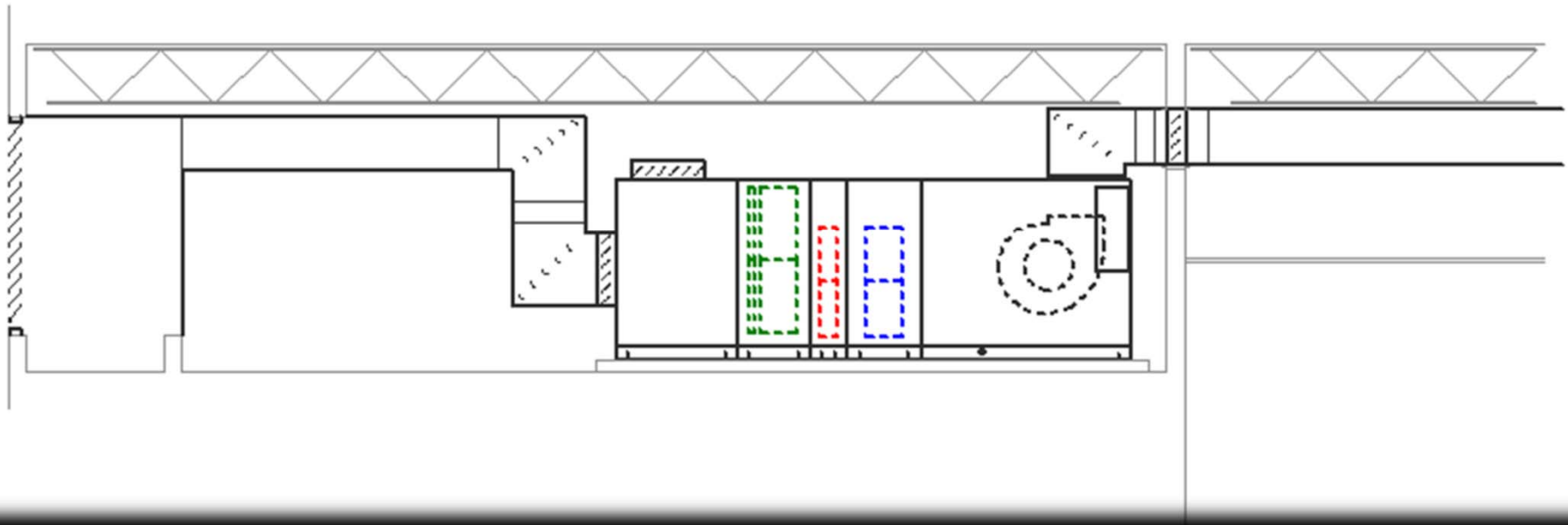
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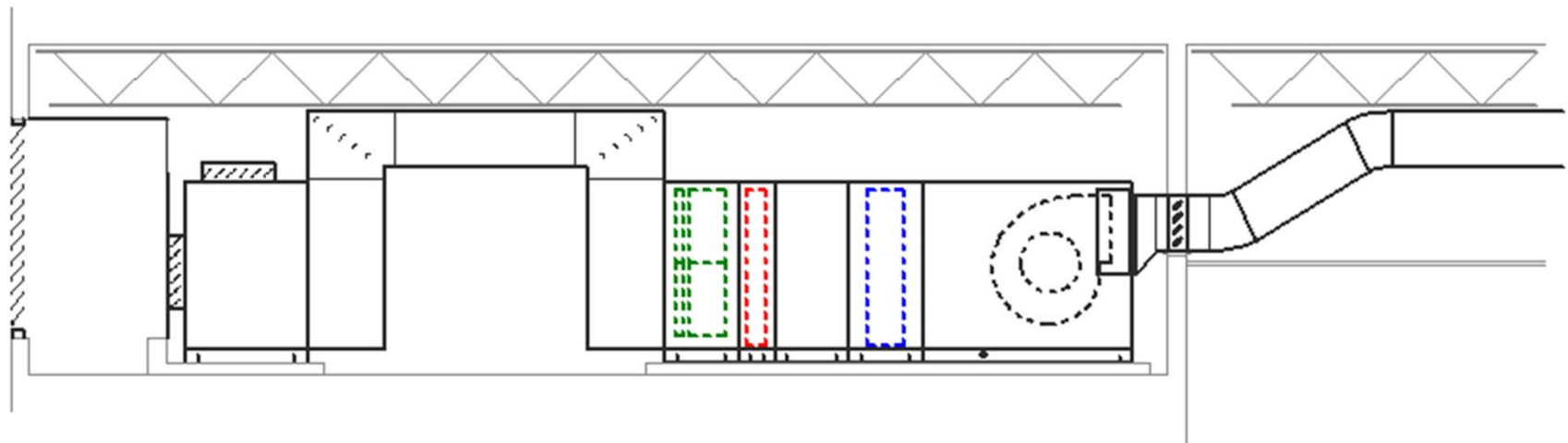
INTEGRATING ECONOMIZERS WITH OTHER HVAC PROCESSES

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Mixing Boxes Don't Have to be Bolted to the Air Handling Unit

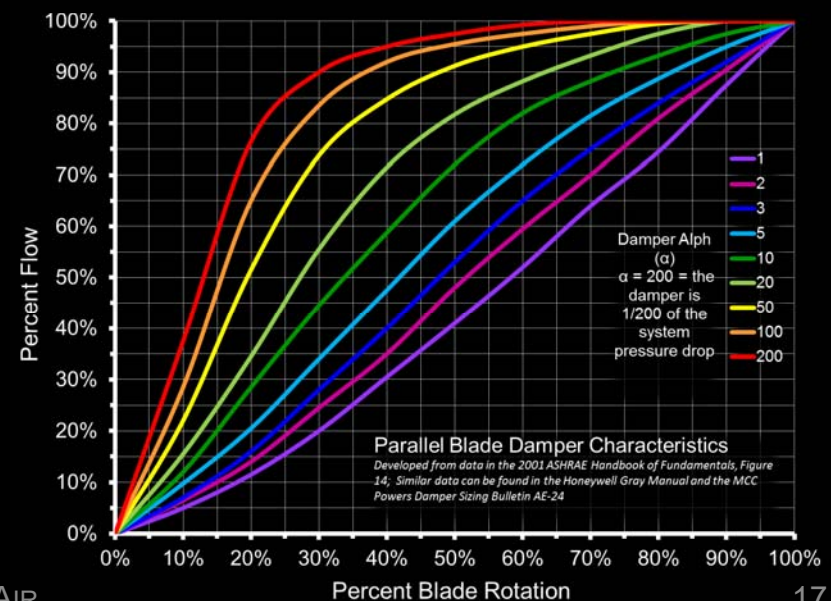
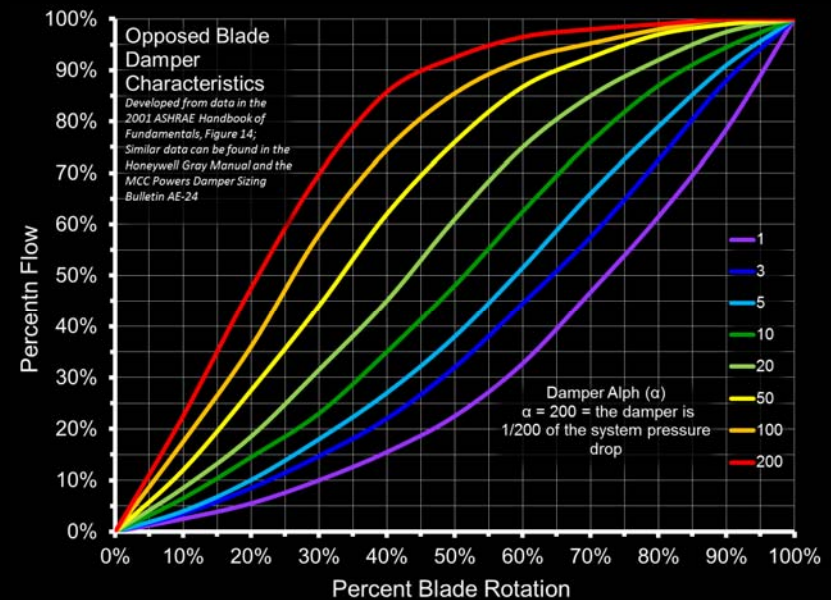


Mixing Boxes Don't Have to be Bolted to the Air Handling Unit

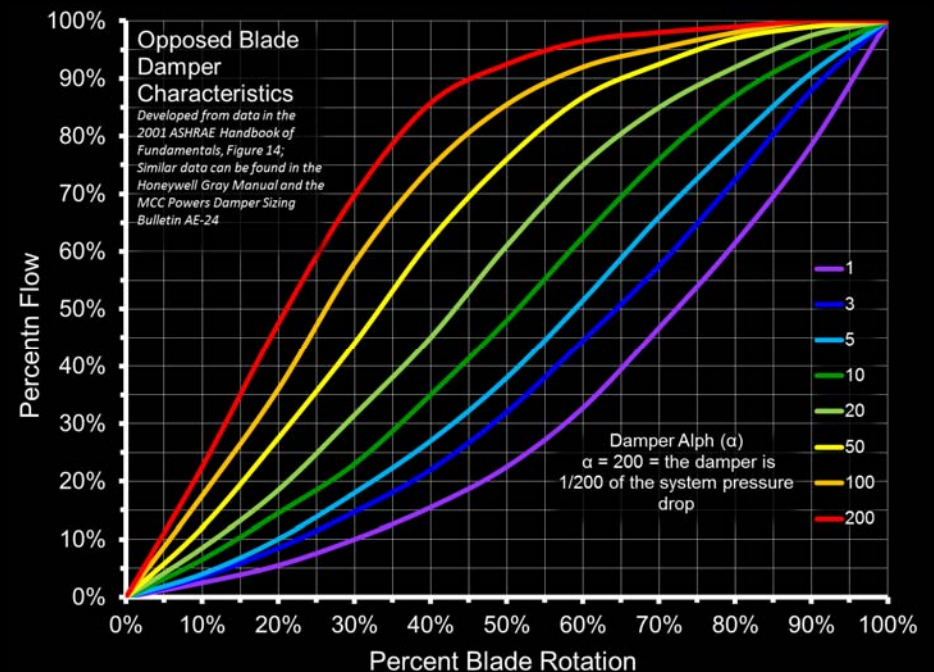
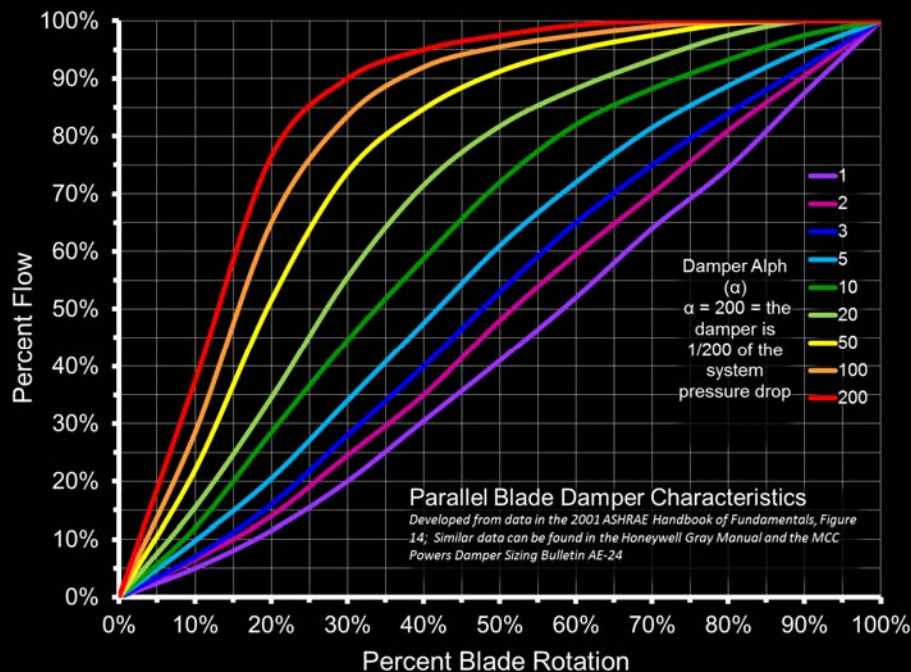


Mixing Performance Depends On:

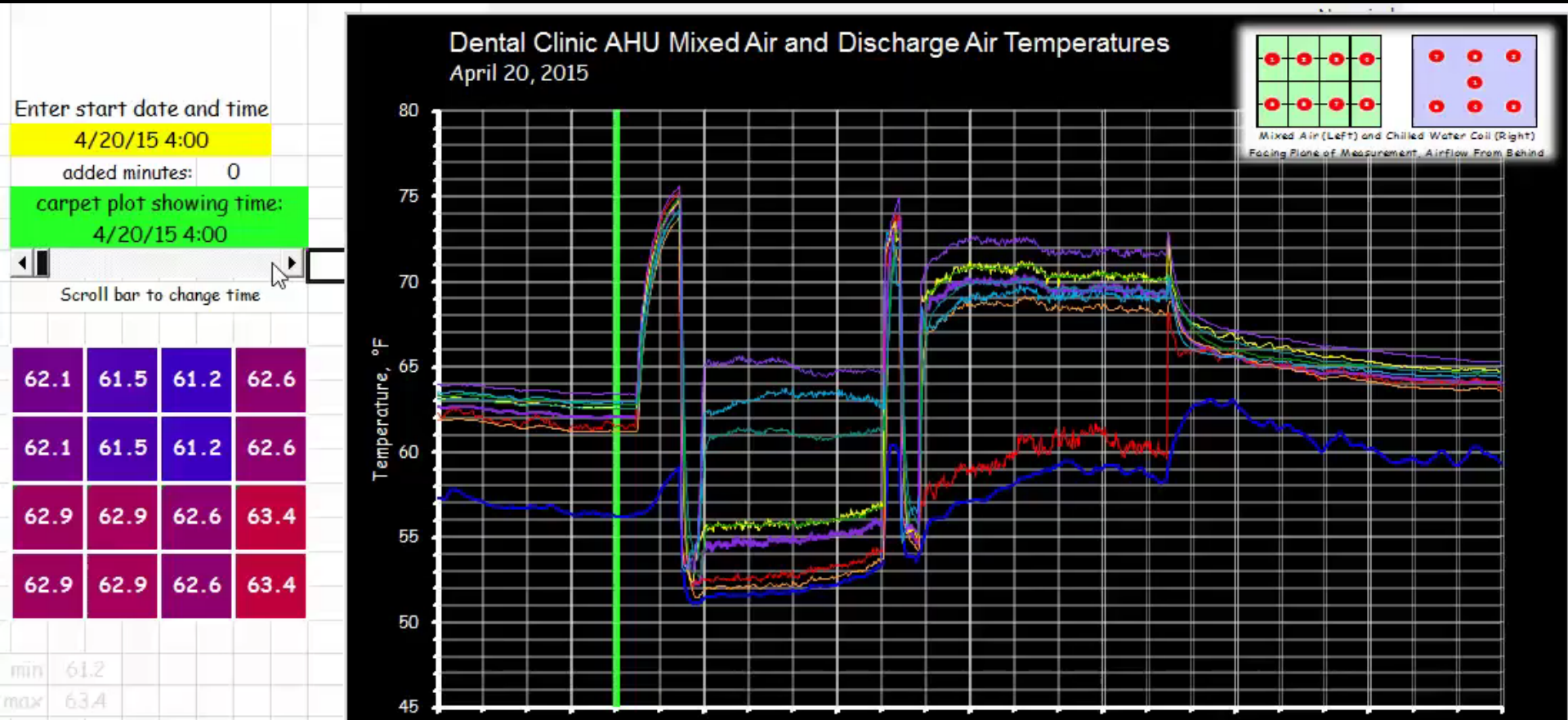
- Good sensing input for control
- Damper blade rotation directs air streams to promote mixing
- Sufficient distance to mix
- Dampers sized to have some measure of authority in the system in terms of the pressure drop through them
 - Velocity, entry and exit conditions, and blade design determine the specific pressure drop characteristic
 - Velocity promotes mixing by creating a jet



By Nature, Most HVAC Components Have Analog, Non-linear Characteristics



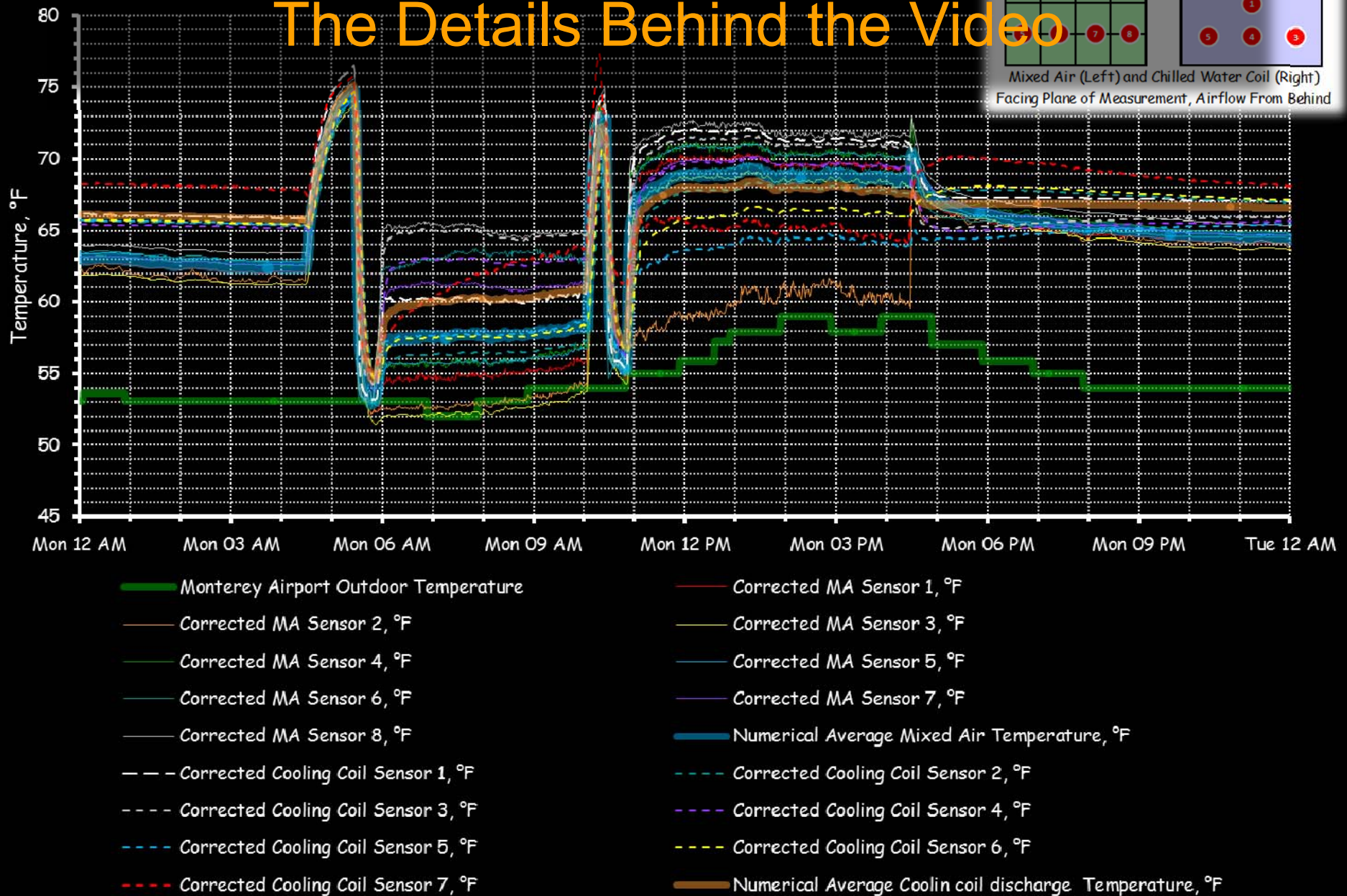
Another Recent Example



Dental Clinic AHU Mixed Air and Discharge Air Temperatures

April 20, 2015

The Details Behind the Video



Mixing Performance Depends on Accurate Measurement of the Mixed Air Temperature



Entering Filter Temps.

55.1	53.4	52.7	56.1
55.1	53.4	52.7	56.1
56.1	63.6	60.9	64.8
56.1	63.6	60.9	64.8

The sensor to the left is located where the green dot is in the matrix above

Coils Impact Velocity and Temperature Profiles in a Very Short Distance



Temperature (left) and Velocity (right) measurements at 20% Commanded Outdoor Air between 10:00 am and 11:00 am on 2015-05-15

71.1	74.0	74.7	74.2
73.7	74.7	75.7	75.7
73.6	74.3	75.6	75.0
72.9	73.6	75.6	75.0

Temperatures in °F at the entering face of the filters

73.1	74.5	74.5	75.4
75.6	76.4	76.1	76.8
75.8	76.3	76.6	76.5
75.3	75.2	75.9	75.9

Temperatures in °F at the leaving face of the chilled water coil

28	180	198	264
447	551	598	494
136	329	234	272
127	145	102	134

Velocities in feet per minute at the entering face of the filters

308	290	299	284
276	275	268	292
247	271	286	289
253	288	276	300

Velocities in feet per minute at the leaving face of the chilled water coil

Outdoor temperature = 58°F, Return air temperature = 77°F. Supply fan speed = 75%, Return fan speed = 65%, Chilled water valve fully closed. The temperature color gradient is relative to the minimum (blue) and maximum (red) filter face temperatures. The velocity color gradient is relative to the minimum (orange) and maximum (green) observed filter face velocities.

Theoretical OA % based on the average mixed air temperature at the coil face = 7%. Flow rate based on coil face velocities = 10,004 cfm

Difference from commanded OA% = -13% (positive numbers = outdoor air above the commanded %)

Filter face velocity based measurement deviation from coil face velocity based measurement = -6% (negative numbers = low flow)

71.1	71.7	72.3	72.8	73.4	74.0	74.6	75.1	75.7	28	99	171	242	313	384	456	527	598
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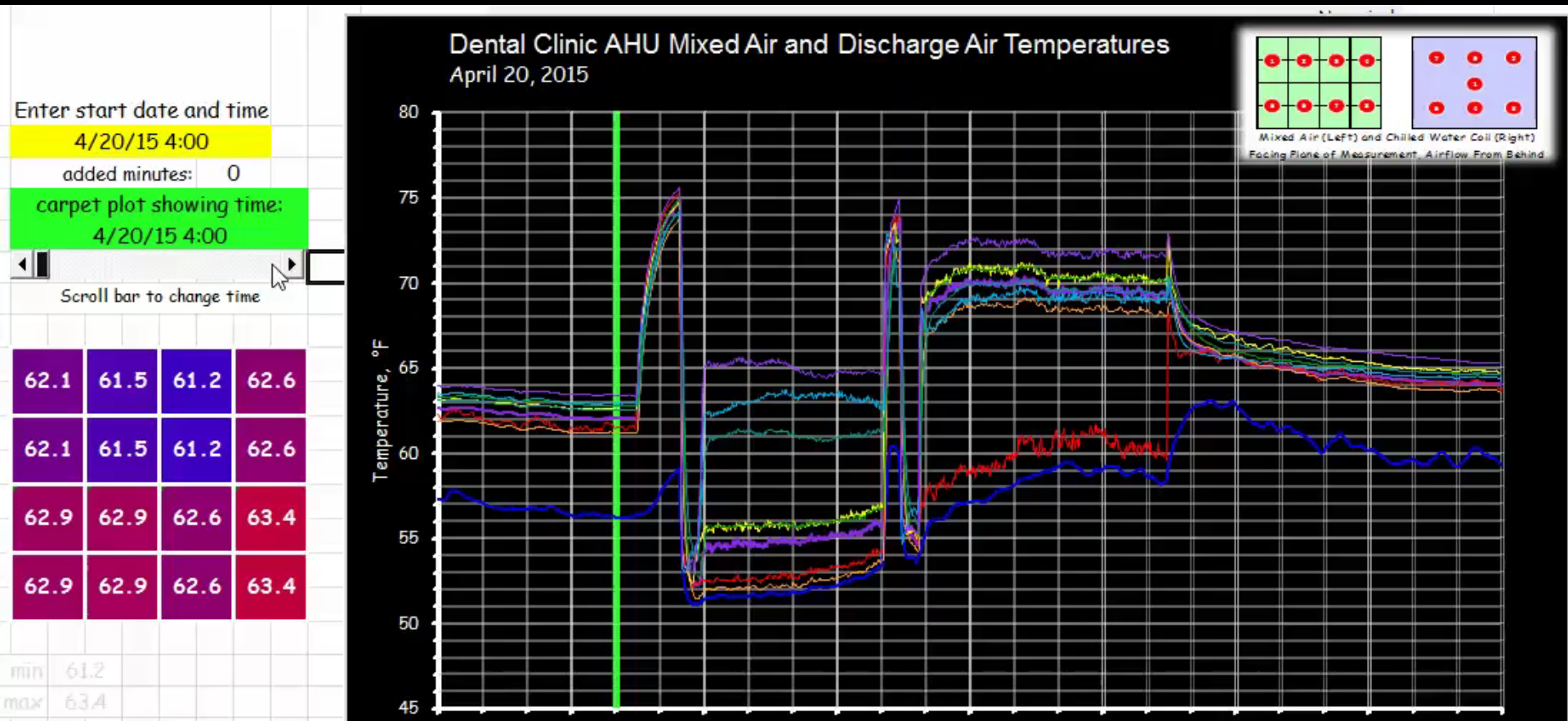
Temperature Gradient Colors

TAB 14-2 - MIXING AIR

Velocity Gradient Colors

22

Mixed Air Dynamics – The Movie



A Recent Example

