Commissioning of
Underfloor Air Distribution Systems

Lessons Learned From the Field

Presented By:
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Portland Energy Conservation Inc
What We Will Cover

- Coordination issues
- What needs to be tested and why
- Issues that relate to plenum integrity
- Plenum pressure test
- Air handler issues
- Special applications
Coordination Issues

- Ensure adequate room for routine maintenance and equipment removal

- Locate equipment where access is unencumbered (i.e. hallways, open spaces)

- Coordination between trades (mechanical, electrical, plumbing, flooring)
Coordination Issues
Note how the sheet metal in the red circle was bent out of shape when the floor support leg was installed. This racked the damper frame to the point where it would not close properly.
Coordination Issues
Coordination Issues
Note the electrical conduit is mounted directly flush with the underfloor slab. This can impede water flow to the drains should a leak occur.

Note the junction box is mounted directly flush with the underfloor slab. The concern is that water on the slab could penetrate the junction box and cause an electrical short if the box contains any wire connections.
What Needs to be Tested

- **Underfloor plenum for leaks**
  - Reduce energy usage
  - Reduce comfort complaints

- **Air handling unit operation**
  - Economizer
  - Discharge air temperature control
  - Humidity control

- **Special Applications**
  - Perimeter zones
  - Conference rooms
Why Test the Plenum for Leaks?

Uncontrolled flow of plenum air into return air plenum

Furred-out interior wall

Exterior wall

Space temperature sensor influenced by plenum air surrounding the sensor

Uncontrolled flow of plenum air into work space from an electrical socket

No seal between the raised floor and the exterior wall

Raised floor

Underfloor plenum

Raised floor supports

Source: PECI
Quick Example

Open floor space

- 120 feet by 120 feet
- 1/16” to gap around perimeter
- About 2.5 square foot hole

Put another way ……

- 60% of one tile completely missing
Note that not only do the exterior penetrations need to be sealed, but the inside of each conduit needs to be sealed as well.
Air Leak from Wall Socket

Something just isn’t right!
Design I ssues

Designing an air tight assembly

Specifications clearly outline each contractor’s responsibility and scope of work

Provide drawing details for critical or unconventional situations
Design Detail

- Exterior wall
- Pipe
- Raised floor tile cut to shape

Areas in red indicate spaces that need to be sealed tightly. Designer should provide detail.

Source: PECI
Plenum Pressure Test Procedures

- Floor must be complete
- Seal all diffusers
- Command return dampers closed
- Command outdoor air damper open
- Return fan is off
- Manually adjust supply fan VFD until plenum reaches design pressure
- Measure outdoor air flow
## Plenum Leakage Test Results

<table>
<thead>
<tr>
<th>Plenum Test Procedure</th>
<th>Low CFM Value</th>
<th>%Total Supply Flow</th>
<th>High CFM Value</th>
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</thead>
<tbody>
<tr>
<td>First plenum test</td>
<td>4,000 CFM</td>
<td>29%</td>
<td>4,400 CFM</td>
<td>31%</td>
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<tr>
<td>Second plenum test</td>
<td>3,500 CFM</td>
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**Measured Leaks**

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<td>Leaks into work space</td>
<td>920 CFM</td>
<td>6.6%</td>
<td>1,120 CFM</td>
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<td>Estimated damper leakage ¹</td>
<td>50 CFM</td>
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**Total plenum leakage**

| Total plenum leakage      | 2,250 CFM     | 16%                | 2,480 CFM      | 18%                |

Note: ¹ – Estimated damper leakage rate is based on properly operating natural ventilation dampers
Measuring the amount of air discharged from the diffusers with the fan-power terminal box primary damper and duct end damper shut and the natural ventilation dampers took some creativity.
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Air Handler Issues

Economizer operation
- Typical plenum air temperature about 65F

Discharge air temperature
- Humidity Control
- Face and by-pass
- Transfer air
Special Zone Requirements

Perimeter Zones

- Plenum Divider
  - Leakage from perimeter zone to core zone
  - Look for temperature change in core zone plenum

- VAV Box with Reheat
  - Zone temperature sensor
  - Reheat coil
  - Box fan (if applicable)

Conference Rooms

- VAV box
- Occupancy sensor
Questions

I knew I should have at least asked how to find the freeway.