Air-Handler Systems

<Presenter>
Chilled-Water CRAC Units
Split System Air Cooled CRAC Units
Water Cooled CRAC

Heat exchanger connected to cooling towers at central plant on roof
Underfloor supply

Cold Aisle

Hot Aisle

Only 1 pressure zone for UF!
Overhead supply

You can incorporate VAV on each branch

Overhead Supply

Cold Aisle

Hot Aisle

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How Do You Balance Airflow?

- Spreadsheet
- CFD
- Monitoring, infrared thermography or other site measurements
Air system design overview

• Data center layout
• Airflow configurations
  – Distribution: overhead or underfloor
  – Control: constant or variable volume
• Airflow issues
• Economizers
• Humidity control issues
Custom CRAH Unit (Large)
# Example custom CRAH unit comparison

<table>
<thead>
<tr>
<th></th>
<th>Option 1</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>Std CRAC</td>
<td>Custom Model 1</td>
</tr>
<tr>
<td><strong>Budget Cost</strong></td>
<td>$16,235</td>
<td>$23,000</td>
</tr>
<tr>
<td><strong>Number of units</strong></td>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td><strong>net total cooling (btuh)</strong></td>
<td>434,900</td>
<td>410,000</td>
</tr>
<tr>
<td><strong>net sensible (btuh)</strong></td>
<td>397,400</td>
<td>399,000</td>
</tr>
<tr>
<td><strong>sensible (tons)</strong></td>
<td>33.1</td>
<td>33.3</td>
</tr>
<tr>
<td><strong>CFM</strong></td>
<td>16,500</td>
<td>25,000</td>
</tr>
<tr>
<td><strong>SAT</strong></td>
<td>49.90</td>
<td>59.30</td>
</tr>
<tr>
<td><strong>airside dT</strong></td>
<td>25.10</td>
<td>15.70</td>
</tr>
<tr>
<td><strong>Internal SP</strong></td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>no. fans</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>fan type</strong></td>
<td>Centrifugal</td>
<td>Plenum</td>
</tr>
<tr>
<td><strong>no. motors</strong></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>HP/motor</strong></td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td><strong>total HP</strong></td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td><strong>BHP/motor</strong></td>
<td>15</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Unit BHP</strong></td>
<td>15</td>
<td>14.1</td>
</tr>
<tr>
<td><strong>unit width</strong></td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td><strong>depth</strong></td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td><strong>height</strong></td>
<td>76</td>
<td>156</td>
</tr>
<tr>
<td><strong>filter type</strong></td>
<td>ASHRAE 20%</td>
<td>MERV 13</td>
</tr>
<tr>
<td><strong>Water PD (ft)</strong></td>
<td>13.5 ft</td>
<td>11.1</td>
</tr>
<tr>
<td><strong>CHW dT</strong></td>
<td>14F</td>
<td>20</td>
</tr>
<tr>
<td><strong>GPM</strong></td>
<td>66.80</td>
<td>44.00</td>
</tr>
<tr>
<td><strong>Total GPM</strong></td>
<td>1,403</td>
<td>924</td>
</tr>
<tr>
<td><strong>Total BHP</strong></td>
<td>315</td>
<td>275</td>
</tr>
</tbody>
</table>
Example CRAH Unit Comparison

- 34% less water flow
- 13% less fan energy
  - More if you consider the supply air temperature and airflow issues
- Excess fan capacity on new units
- 36% higher cost for units, but
  - Fewer piping connections
  - Fewer electrical connections
  - Fewer control panels
  - No need for control gateway
  - Can use the existing distribution piping and pumps (case study)
  - Can use high quality sensors and place them where they make sense
- Possibly less turbulence at discharge?
Best HVAC Practices

- Air Management
- Air Economizers
- Humidification Control
- Centralized Air Handlers
- Low Pressure Drop Systems
- Fan Efficiency
- Cooling Plant Optimization
- Water Side Economizer
- Variable Speed Chillers
- Variable Speed Pumping
- Direct Liquid Cooling
Best Practices—Cross-Cutting and Misc. Issues

- Motor efficiency
- Right sizing
- Variable speed drives
- Lighting
- Maintenance
- Continuous Commissioning and Benchmarking
- Heat Recovery
- Building Envelope
- Redundancy Strategies
- Methods of charging for space and power
Best air delivery practices

- Arrange racks in hot aisle/cold aisle configuration
- Try to match or exceed server airflow by aisle
  - Get thermal report data from IT if possible
  - Plan for worst case
- Get variable speed or two speed fans on servers if possible
- Provide variable airflow fans for AC unit supply
- Consider using air handlers rather than CRACs for improved performance
- Use overhead supply where possible
- Provide aisle capping (preferably cold aisles, refer to LBNL presentation for more details)
- Plug floor leaks and provide blank off plates in racks
- Draw return from as high as possible
- Use CFD to inform design and operation
Airflow design disjoint

- IT departments select servers and racks – each having airflow requirements
- Engineers size the facility fans and cooling capacity
- What’s missing in this picture?