“Temperature & Humidity Control in Surgery Rooms”
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Introduction

- Goal: Control temperature and humidity in surgery rooms
- Influencing factors
  - Temperature and humidity requirements
  - High air change rates

<table>
<thead>
<tr>
<th></th>
<th>Dry Bulb</th>
<th>Relative Humidity</th>
<th>Room ACH</th>
<th>Outdoor ACH</th>
<th>Outdoor Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHRAE¹</td>
<td>68°F–75°F (20°C–24°C)</td>
<td>30%–60%</td>
<td>25</td>
<td>5</td>
<td>20%</td>
</tr>
<tr>
<td>AIA²</td>
<td>68°F–73°F (20°C–23°C)</td>
<td>30%–60%</td>
<td>15</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td>VA³</td>
<td>62°F–80°F (17°C–27°C)</td>
<td>45%–55%</td>
<td>15</td>
<td>15</td>
<td>100%</td>
</tr>
</tbody>
</table>
Designs

- **Temperature only design**
  
  \[ Q_s = 1.085 \times 1,125 \text{cfm} \times (62^\circ F - T_{sa}) = 8190 \text{Btu/h} \]

  - Smaller \( \Delta T \) (\( T_{sa} = 55^\circ F \))
  - Results in \( \Phi \) that is too large (\( \Phi = 70\% \))

- **Temperature and Humidity design**
  
  \[ Q_L = 0.7 \times 1,125 \text{cfm} \times (50 \text{gr/lb} - W_{sa}) = 1600 \text{Btu/h} \]

  - Low humidity ratio (\( W_{sa} = 48 \text{ gr/lb} \))
  - Will overcool room (\( T_{sa} = 47^\circ F \))
One Cooling Coil

- Reheats air to avoid overcooling
- Requires a new chiller to cool water
  - Water from existing plant may not be cold enough
- Could be adapted to work with an existing central plant
Two Cooling Coils

- **Upstream coil**
  - Cools and partially dehumidifies air
  - Uses existing chiller

- **Downstream coil**
  - Requires new chiller
  - Finishes dehumidifying air

- **Advantage over single coil**
  - New chiller can be smaller
Series Desiccant Wheel

- Desiccant wheel
  - Absorbs water vapor
  - Delivers drier air without affecting coil temperature
  - Has added airside pressure drop
- Benefits
  - No regeneration air stream required
  - Warmer air leaving coil
Conclusion

- **Design comparisons**
  
<table>
<thead>
<tr>
<th>Description</th>
<th>Space RH</th>
<th>Cooling Capacity</th>
<th>Leaving-Coil DB</th>
<th>Reheat Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cool and Reheat (Single Cooling Coil)</td>
<td>60%</td>
<td>3 tons (10.6 kW)</td>
<td>48°F (9°C)</td>
<td>8,500 Btu/h (2.5 kW)</td>
</tr>
<tr>
<td>Cool and Reheat (Two Cooling Coils In Series)</td>
<td>60%</td>
<td>3 tons (10.6 kW)</td>
<td>48°F (9°C)</td>
<td>8,500 Btu/h (2.5 kW)</td>
</tr>
<tr>
<td>Upstream Cooling Coil</td>
<td></td>
<td>1.8 tons (6.3 kW)</td>
<td>55°F (13°C)</td>
<td></td>
</tr>
<tr>
<td>Downstream Cooling Coil</td>
<td></td>
<td>1.2 tons (4.2 kW)</td>
<td>48°F (9°C)</td>
<td></td>
</tr>
<tr>
<td>Series Desiccant Wheel</td>
<td>55%</td>
<td>2.1 tons (7.4 kW)</td>
<td>52°F (11°C)</td>
<td>0 Btu/h (0 kW)</td>
</tr>
</tbody>
</table>

- **Series Desiccant Wheel is most favorable**
  - Lower Humidity
  - Sufficiently warm air
  - Compatible with existing chiller plants
  - Less overall cooling capacity