CCLEP® Reduce Energy Consumption More Than 50% in a Luxury Shopping Mall

Lixia Wu, Xiufeng Pang, Mingsheng Liu, Gang Wang
Energy Systems Laboratory
University of Nebraska Lincoln

Jinrong Wang, Thomas G. Lewis
Omaha Public Power District
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- System Optimization
  - Terminal boxes
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  - Chilled water system
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Introduction

- The **1st comprehensive CCLEP process** for a luxury shopping mall.

- **Unique characteristics of a shopping mall**
  - There are multiple stores with dynamic requirements.
  - Load is mainly from occupants.
  - HVAC system operation schedule mainly determined by occupancy schedule.
  - A shopping mall has high thermal comfort requirements.
Facility: Regency Mall, Omaha, NE

- Built in 1975
- 230,000 square feet
- Energy Management System
- 10 dual-duct VAV AHUs
- 123 dual-duct terminal boxes
- Central chilled water plant
- Central hot water plant
Fig. Schematic Diagram of Air Handling Unit
Retrofits

Schematic Diagram of Chilled Water System
Retrofits

Old boilers 13,400 MBH each

New boilers 1,800 MBH each
Retrofits

Schematic Diagram of Hot Water System
System Optimization
Terminal Boxes

- Reset minimum airflow
- Identify malfunction
- Reset actuator operation range
Supply Air Temperature

55 ≤ \( T_{OA} \) ≤ 65

### Outside Air Temperature [°F]

<table>
<thead>
<tr>
<th>HDST- after CC</th>
<th>HDST-before CC</th>
<th>CDST- after CC</th>
<th>CDST-before CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
</tr>
</tbody>
</table>

### Duct Supply Temperature Set Point [°F]

<table>
<thead>
<tr>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
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<tbody>
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<td>50</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
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</table>
Supply Fan Speed

![Graph showing Supply Fan Speed with reset sp and fan motor power with sp reset. The graph includes data points for static pressure [inw.g.] and fan motor power [kW] over time. The graph indicates variations in static pressure and fan motor power throughout the day, with possible peaks and troughs at various times.]
Chilled Water System

- Chillers
- Chilled water temperature
- Pump speed control
Hot Water System Control
Comparison of Electricity Consumption

- Measured annual electricity consumption savings: 56%.
- Power factor is improved from 0.75 (before CC) to 0.98 (after CC).
Comparison of Gas Consumption

- Measured annual gas consumption savings 36%
Conclusions

- Comprehensive CCLEP process for a luxury shopping mall.
- Measured electricity energy savings: 56% and measured gas savings: 36%.
- The CCLEP makes it possible for major system retrofits/upgrades through energy cost savings.
- The simple payback is less than 3 years.
Acknowledgement

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Any questions or comments would be appreciated!