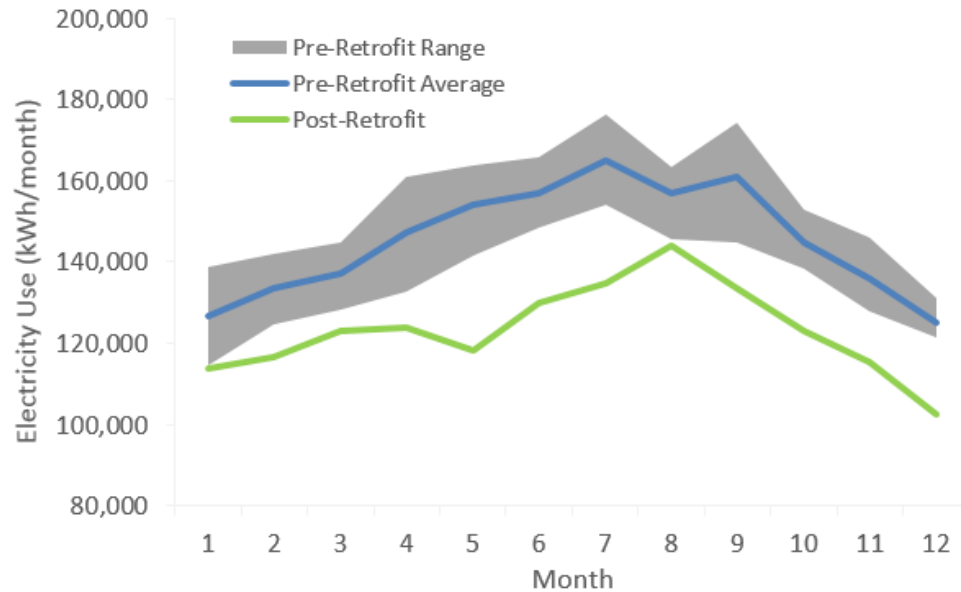


555 COUNTY CENTER

COUNTY OFFICE BUILDING 2 (COB2)

REDWOOD CITY, CA

Puget Sound ASHRAE Chapter



Hwakong Cheng, PE

Steve Taylor, PE



TAYLOR
ENGINEERING

COB2 Project Overview



Original 1999 construction

- 5-story office building
- 140,000 gross sf
- HVAC control retrofit (for end of service life)

Results:

- 56% natural gas savings
- 15% electricity savings (whole building)
- \$50,000 annual energy savings
- <7 year simple payback

Mechanical Details

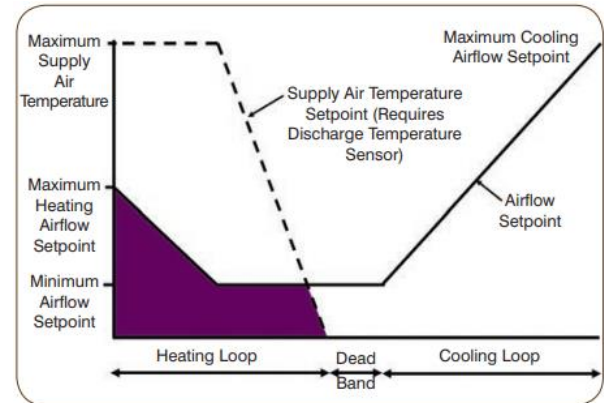
“Plain vanilla” VAV Reheat

- **Two VAV AC Units**
 - 70,000 cfm each
 - Evap-cooled condensers
 - Return fans
- **Gas-fired boilers**
 - Non-condensing, natural draft
 - Primary-only, variable flow
- **Closed-loop CW for aux loads**
- **Existing DDC to the zone**



Low-Energy Control Measures

- **Dual Maximum VAV Logic**
- **Low VAV Minimum Setpoints**
- **Demand-based Resets**
 - Duct Static Pressure Reset
 - Supply Air Temperature Reset
- **CO2 Demand Controlled Ventilation**
- **Zone Groups**



Consistent with ASHRAE Guideline 36 High Performance Sequences of Operation for HVAC Systems

Ensuring Project Success

- Detailed Control Specs
 - Detailed sequences
 - Graphics requirements
 - Careful reuse of existing
- Focused Commissioning
 - Functional Performance Testing
 - Trend Reviews
- Operator Training

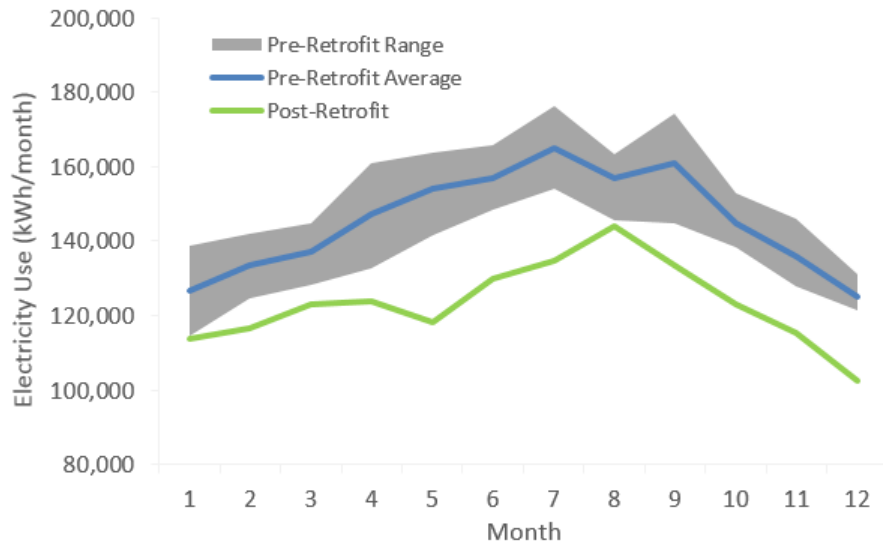
| 5th Floor Units | | | | | | | | | | | | |
|-------------------|---------------------|--------------|------------|------|------------|--------------|-----------|------------|----------|------------|-------------|-----------|
| Served by RTU - 1 | | | | | | | | | | | | |
| VAV ID | Area Served | Box Type | Occupancy | Mode | Space Temp | Effective SP | SP CurReq | SP ReqRate | SP Imptd | SAT CurReq | SAT ReqRate | SAT Imptd |
| V-1-01 | Restrooms | Reheat | Unoccupied | Off | 75.1 °F | 90.0 °F | 0.0 | 9.0 | 1.0 | 0.0 | 3.4 | 1.0 |
| V-1-02 | Office 511 | Reheat | Unoccupied | Off | 77.8 °F | 90.0 °F | 0.0 | 1.9 | 1.0 | 0.0 | 0.7 | 1.0 |
| V-1-03 | Office 512 | Reheat | Unoccupied | Off | 77.0 °F | 90.0 °F | 0.0 | 2.0 | 1.0 | 0.0 | 1.4 | 1.0 |
| V-1-04 | Open Office 518 | Reheat | Unoccupied | Off | 77.2 °F | 90.0 °F | 0.0 | 2.6 | 1.0 | 0.0 | 1.7 | 1.0 |
| V-1-05 | Open Office 510 | Reheat | Unoccupied | Off | 77.7 °F | 90.0 °F | 0.0 | 2.9 | 1.0 | 0.0 | 1.3 | 1.0 |
| V-1-06 | Conference Room 536 | Reheat | Unoccupied | Off | 78.5 °F | 90.0 °F | 0.0 | 2.4 | 1.0 | 0.0 | 6.2 | 1.0 |
| V-1-07 | Conference Room 535 | Reheat | Unoccupied | Off | 78.7 °F | 90.0 °F | 0.0 | 1.5 | 1.0 | 0.0 | 1.8 | 1.0 |
| V-1-08 | Office 533 | Reheat | Unoccupied | Off | 76.4 °F | 90.0 °F | 0.0 | 3.0 | 1.0 | 0.0 | 1.4 | 1.0 |
| V-1-09 | Open Office 510 | Reheat | Unoccupied | Off | 76.8 °F | 90.0 °F | 0.0 | 2.0 | 1.0 | 0.0 | 1.0 | 1.0 |
| V-1-10 | Office 538/531/532 | Reheat | Unoccupied | Off | 76.3 °F | 90.0 °F | 0.0 | 2.5 | 1.0 | 0.0 | 0.9 | 1.0 |
| V-1-11 | Office 529 | Reheat | Unoccupied | Off | 77.5 °F | 90.0 °F | 0.0 | 2.9 | 1.0 | 0.0 | 1.6 | 1.0 |
| V-1-12 | Office 538 | Reheat | Unoccupied | Off | 77.2 °F | 90.0 °F | 0.0 | 4.8 | 1.0 | 0.0 | 3.3 | 1.0 |
| V-1-13 | Office 527 | Reheat | Unoccupied | Off | 76.8 °F | 90.0 °F | 0.0 | 8.0 | 1.0 | 0.0 | 8.8 | 1.0 |
| V-1-14 | Open Office 518 | Cooling Only | Unoccupied | Off | 77.1 °F | 90.0 °F | 0.0 | 19.3 | 1.0 | 0.0 | 25.6 | 1.0 |
| V-1-15 | Lobby | Cooling Only | Unoccupied | Off | 76.8 °F | 90.0 °F | 0.0 | 2.9 | 1.0 | 0.0 | 1.4 | 1.0 |
| V-1-16 | Open Office/Meal | Reheat | Unoccupied | Off | 77.2 °F | 90.0 °F | 0.0 | 4.9 | 1.0 | 0.0 | 3.8 | 1.0 |
| V-1-17 | Open Office 514 | Cooling Only | Unoccupied | Off | 77.1 °F | 90.0 °F | 0.0 | 2.9 | 1.0 | 0.0 | 3.4 | 1.0 |
| V-1-18 | Breakroom | Cooling Only | Unoccupied | Off | 77.4 °F | 90.0 °F | 0.0 | 23.8 | 1.0 | 2.0 | 168.3 | 1.0 |

| Served by RTU - 2 | | | | | | | | | | | | |
|-------------------|-----------------|--------------|------------|------|------------|--------------|-----------|------------|----------|------------|-------------|-----------|
| VAV ID | Area Served | Box Type | Occupancy | Mode | Space Temp | Effective SP | SP CurReq | SP ReqRate | SP Imptd | SAT CurReq | SAT ReqRate | SAT Imptd |
| V-2-10 | Open Office 514 | Reheat | Unoccupied | Off | 77.4 °F | 90.0 °F | 0.0 | 21.7 | 1.0 | 0.0 | 13.0 | 1.0 |
| V-2-20 | Open Office 514 | Reheat | Unoccupied | Off | 77.1 °F | 90.0 °F | 0.0 | 2.7 | 1.0 | 0.0 | 1.3 | 1.0 |
| V-2-21 | Open Office 514 | Reheat | Unoccupied | Off | 77.1 °F | 90.0 °F | 0.0 | 4.8 | 1.0 | 0.0 | 10.2 | 1.0 |
| V-2-22 | Office 524/525 | Reheat | Unoccupied | Off | 76.9 °F | 90.0 °F | 0.0 | 7.9 | 1.0 | 0.0 | 2.0 | 1.0 |
| V-2-23 | Office 522/523 | Reheat | Unoccupied | Off | 76.8 °F | 90.0 °F | 0.0 | 4.3 | 1.0 | 0.0 | 1.3 | 1.0 |
| V-2-24 | Open Office 513 | Reheat | Unoccupied | Off | 77.2 °F | 90.0 °F | 0.0 | 2.5 | 1.0 | 0.0 | 4.5 | 1.0 |
| V-2-25 | Open Office 513 | Reheat | Unoccupied | Off | 77.0 °F | 90.0 °F | 0.0 | 5.7 | 1.0 | 0.0 | 2.7 | 1.0 |
| V-2-26 | Electrical Room | Cooling Only | Unoccupied | Off | 82.5 °F | 90.0 °F | 0.0 | 60.4 | 1.0 | 2.0 | 350.8 | 1.0 |
| V-2-27 | Trako Room | Cooling Only | Unoccupied | Off | 78.1 °F | 90.0 °F | 0.0 | 46.0 | 1.0 | 0.0 | 29.3 | 1.0 |
| V-2-28 | Open Office 513 | Cooling Only | Unoccupied | Off | 77.0 °F | 90.0 °F | 0.0 | 35.5 | 1.0 | 0.0 | 52.0 | 1.0 |
| V-2-29 | Library | Cooling Only | Unoccupied | Off | 75.6 °F | 90.0 °F | 0.0 | 12.5 | 1.0 | 0.0 | 4.1 | 1.0 |
| V-2-30 | Open Office 514 | Cooling Only | Unoccupied | Off | 77.1 °F | 90.0 °F | 0.0 | 5.5 | 1.0 | 0.0 | 3.8 | 1.0 |

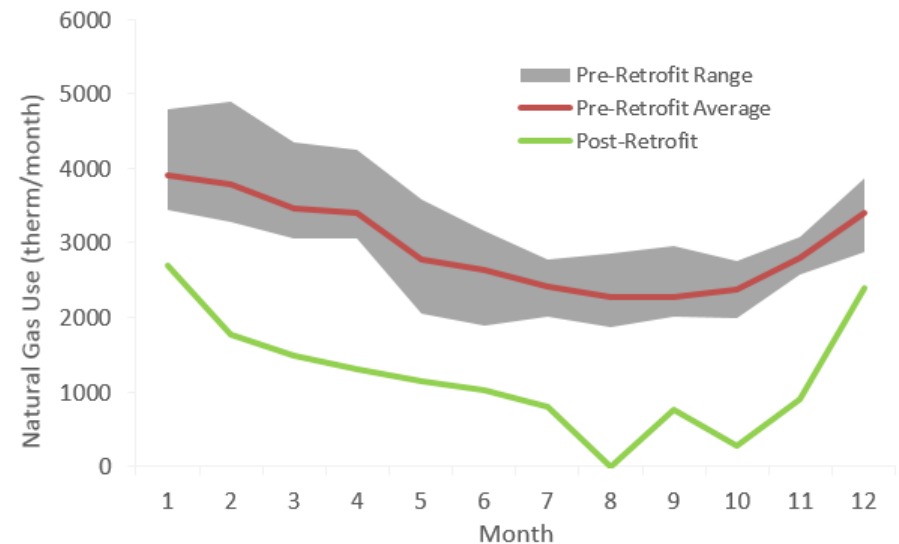


Energy Savings

15% electricity savings (whole building)



56% natural gas savings



- **\$50,000 annual energy savings**
- **< 7 year simple payback**

Controls-only, no mechanical or lighting upgrades
Also deferred maintenance

Conclusions and Takeaways

This Project:

- **Controls-only retrofit, no mechanical or lighting upgrades**
- **Not intended as an energy project**
- **Significant savings despite (E) DDC-to-the-zone**

Takeaways and Larger Opportunity:

- **Importance of HVAC controls**
- **Attention to details**
- **ASHRAE Guideline 36**
- **Effective Commissioning and Training**

Questions

hcheng@taylor-engineering.com

staylor@taylor-engineering.com

References:

ASHRAE Guideline 36

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Trim and Respond Resets

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