TAYLOR ENGINEERING

Case Study: Advanced HVAC Controls

555 County Center (also known as County Office Building 2 or COB2) is a 5-story office building, with a basement, underground garage and penthouse. Spanning 140,000 gross square feet, the facility was constructed in 1999 and houses the administrative offices for the County of San Mateo. Taylor Engineering provided design and commissioning services to upgrade the HVAC building automation system (BAS) and provide energy efficiency improvements. The project achieved whole building energy savings of 15 percent of electricity and 56 percent of natural gas use in the first year compared to the average use from the previous several years. Though the project was primarily intended to replace the obsolete control system, the retrofit reduced annual energy costs by nearly $50,000 with a payback period of less than 7 years, and received an ASHRAE Chapter Technology award in 2017 and Regional Technology award in 2018.

Project Type

HVAC Controls Retrofit

Services Provided

Controls Design

Commissioning

Completion Date

2015

Innovation

Advanced HVAC Control System Design

Key Accomplishments

15% annual electricity use reduction

56% annual natural gas use reduction

Awards

ASHRAE Chapter Technology Award, 2017

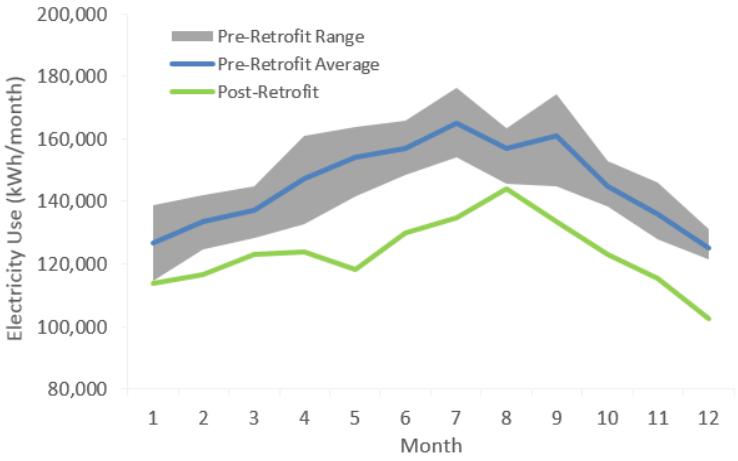
ASHRAE Region XI Technology Award, 2018

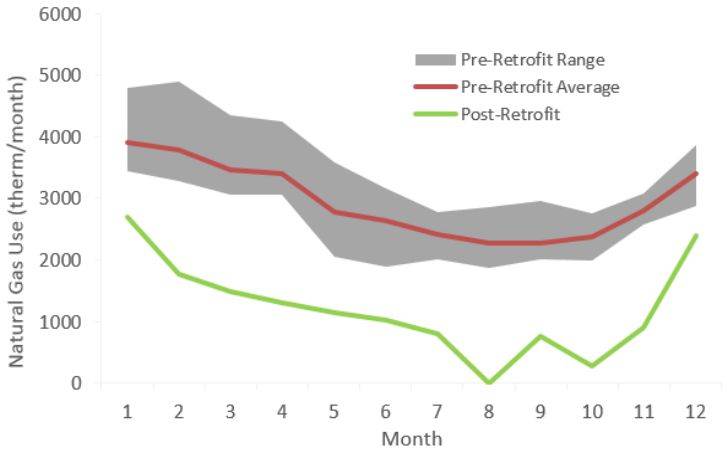
The HVAC system consists of two variable air volume (VAV) rooftop units with reheat VAV terminals at the zones. Cooling is provided by direct expansion cooling coils and evaporative-cooled condensers. Each air handling unit supplies 70,000 cfm. The original HVAC control system included direct digital control (DDC) down to the zone level. Two boilers provide hot water to the reheat terminals through primary-only variable flow distribution.

The new BAS incorporates innovative VAV control sequences largely consistent with those in ASHRAE Guideline 36 High Performance Sequences of Operation for HVAC Systems. Advanced control strategies include demand-based supply air temperature and duct static pressure resets, CO_2-based demand controlled ventilation, dual maximum VAV zone logic, and low VAV minimums which are generally set equal to the ventilation requirement. The new controls also feature zone groups (aka isolation areas) which allow the system to operate after-hours as needed to serve individuals floors (instead of conditioning the entire building), and graphics and calculations to help identify rogue zones and ensure that the system resets are able to operate effectively.

Focused commissioning was critical to the success of the project to ensure that the new sequences were implemented correctly and that the system performed as intended. The intimate project knowledge and understanding of the control system design intent was leveraged by having the lead design engineer also perform the detailed functional testing and trend reviews.

In the first full year after the BAS retrofit, 15% of whole building electricity use and 56% of natural gas use were saved, compared to the average of the previous several years (not normalized for weather). The energy savings highlight the importance of advanced control sequences and thorough commissioning, as well as the significant opportunity to improve efficiency in modern buildings with VAV systems. This project was strictly a controls system retrofit; there were no mechanical or lighting improvements and the existing BAS already included DDC down to the zone level. The deep energy savings are also an indication of the tremendous savings potential associated with the widespread use of Guideline 36, both for new construction and for retrofit projects.





The project significantly reduced the environmental impact associated with the building operation and resulted in annual energy savings of $50,000. Retrofit costs were controlled through careful reuse of select BAS components and a comprehensive specification that provided a clear scope of work with no change orders. With a final implementation cost of $330,000, the project would have been cost effective as a stand-alone energy efficiency project based on a simple payback of 6.7 years.

More About Taylor Engineering: TE has been pioneering innovative VAV and HVAC control strategies for more than two decades, and has proactively worked to share and disseminate these strategies throughout the industry through real projects, teaching and lectures, Title 24 and 90.1 code change proposals, and research. TE was the prime contractor on ASHRAE research project RP-1455, which largely developed the sequences that have been incorporated in Guideline 36, and was also recently awarded the follow up research project RP-1711 to develop high performance sequences for central plants and hydronic systems. TE is also actively involved with multiple research projects funded by the California Energy Commission to study advanced control strategies and radiant energy systems.