Metrovation

2201 Broadway, Oakland, CA

Wireless Pneumatic Thermostat Project

BUILDING PROFILE

Located in the Uptown District of Oakland, 2201 Broadway was one of the most successful HVAC energy efficiency projects in the Oakland Shines program. Originally built in 1931, this 8-story building has 192,893 sq. ft. of rentable space used primarily for commercial offices. This building relied on pneumatic thermostats that sent individual signals to the HVAC system from each zone to address occupant comfort. This outdated system could not be centrally controlled, and was in fact generally controlled by individual tenants, leaving energy management out of the equation. Legacy pneumatic controls are unable to meet the needs of building engineers today as energy efficiency standards grow stronger. The major disadvantages of legacy pneumatic thermostats include:

- Limited remote monitoring capabilities
- No electrical power/signals
- Require continuous calibration and maintenance
- Non-Programmability

HVAC SYSTEM

The HVAC system for 2201 Broadway was originally designed to have Variable Air Volume (VAV) with inlet

guide vanes (IGV) but has since been converted to a Variable Frequency Drive (VFD) VAV system. The building has a total of five Air Handling Units (AHUs). The two large AHUs on the roof condition floors two through eight. There is a minimal amount of return air from the eighth floor ducted into units before the filters. The return air ducts have dampers that do not modulate. For cooling, each of the rooftop AHUs has two dedicated air cooled chillers serving cooling coils in the AHU. The chillers have local Honeywell controls and utilize an outside air lockout for cooling. The other three AHUs are located on the second floor and are served by two direct-expansion (D/X) chillers. These smaller packaged units serve the first floor and the mezzanine level. The 2201 Broadway building does not include any return/exhaust fans. However, there are small openings through the building shell in the zones that allow the air to be exhausted. For heating, each zone has perimeter reheat fed by a 4,000,000 Btu boiler located in the building basement. Hot water is piped to the zones by a 5HP, 140 GPM pump.

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THE TECHNOLOGY

In the majority of cases in which an older building such as 2201 Broadway is considered for a pneumatically controlled HVAC to Direct Digital Control (DDC) HVAC System conversion, the major concerns are: costs, time required to change out pneumatic piping for electrical wiring, and interference in the business of building tenants for prolonged periods.

WPT—Installs in minutes

The Wireless Pneumatic Thermostat (WPT) by Cypress Envirosystems provides the ideal solution for building owners to address these concerns. This emerging HVAC technology is a retrofit that allows a pneumatically controlled HVAC system to have all the same functionality as a Direct Digital Control (DDC) system at less than half the cost and installation time. A full DDC retrofit would require removing all of the pneumatic tubes and controllers and re-wiring the entire system with digital controllers. The WPTs, however, can be installed in a matter of minutes by removing the old pneumatic thermostat in the zone and connecting the branch and main line pressure tubes to the WPT. Each WPT has a pressure transducer in it that converts a pneumatic pressure signal (both branch and line pressures) to a digital signal. The digital signals can then be wirelessly relayed back to the building's Energy Management and Control System (EMCS) where it is stored. The Cypress system utilizes a hybrid mesh wireless network. This network has wireless repeaters running through the building. The backbone receives the signals from each of the new thermostats and transmits the data back to a "Green Box" which is a Cypress product that can be used as a control system for just the thermostats.

PROJECT OVERVIEW

2201 Broadway did not have a computer-based EMCS for monitoring or optimizing the building's mechanical and electrical equipment for comfort, safety and efficiency. This included the approximately 290 thermostats controlling space temperature throughout the building. These thermostats were stand alone systems, and a building operator had no information about what each thermostat was doing at any given time. The scope of work began with the establishment of a wireless building EMCS by installing the Johnson Controls Facility Explorer System (JCIFX) and components.

Installation included the integration of JCIFX programmable controllers in existing HVAC control panels, pressure transmitters and temperature sensors in building HVAC equipment. The final phases of work included the replacement of the aforementioned 264 pneumatic thermostats with Cypress Wireless Pneumatic Thermostats (WPT) and then integration of the WPTs into the JCIFX system through a wireless network. The overall installation, programming and training of building personnel was led by Comfort Air Mechanical Systems (CAMS) from Alameda, CA.

ENERGY SAVINGS

By replacing each thermostat in the zones on every floor with the Cypress WPT, the building operator gained

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insight as to how each floor is being run. With information on the temperature and actions of every zone in the building, 2201 Broadway was able to implement the following energy efficiency measures in place:

- Occupancy Override - 2201 Broadway has historically been about 8% vacant. WPTs in every zone will allow the building operator to shut the VAV boxes in every vacant zone, saving energy by not providing HVAC to the empty spaces.
- Duct Static Pressure Reset - with zone temperature and set-point information from each thermostat, a duct static pressure reset strategy can be implemented. Currently the supply fans control to a constant DSP set-point. A reset strategy will employ a trim-and-respond type of control loop. For example, if all the zones are satisfied, the DSP set-point will be incrementally lowered until it either hits a minimum or the zones call for cooling. Once the zones call for cooling, the DSP will be incrementally raised until the zones are satisfied again.
- Supply Air Temperature Reset - with zone temperature and set-point information from each thermostat, a supply air temperature reset strategy can be implemented. Currently the cooling coil is controlled to provide a constant supply air temperature. The reset strategy will be a linear temperature change based on the zone.
- Zone Temperature Reset - with digital thermostats, a zone temperature reset can be programmed as an inverse linear relationship to outside air, reducing zone reheat in the winter and cooling load in the summer.

The estimated annual aggregate savings of these measures is expected to be:

133 KW	175,063 kWh	2,686 Therms

PROJECT FINANCIALS

Total Project Cost:	$ 212,075
Cost to Customer:	$ 90,116
Simple Payback:	2.8 years
Net Present Value*: (over 10 years @ 3% discount rate)	$ 178,328

* Based on energy savings only; maintenance benefits are not included in calculations.

PROJECT BENEFITS

- The building operator now receives detailed information on hot and cold spots throughout the building. This reduces maintenance costs because efforts can immediately be focused on problem areas.
- Increase in occupant comfort due to targeted maintenance efforts.
- Reduced building operating costs due to decreased energy use.
- Reduction in environmental impact and carbon footprint of the building.