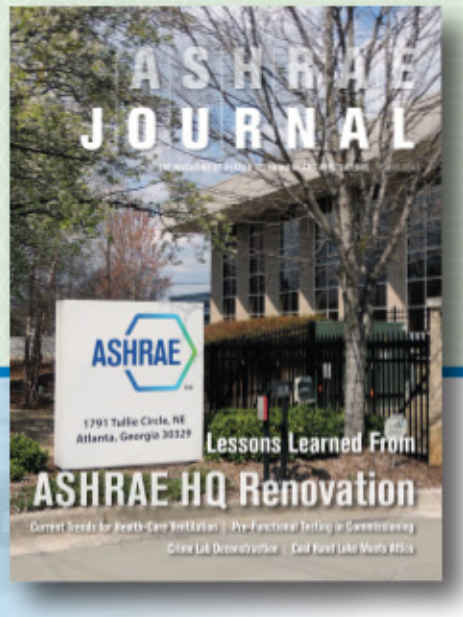
Lessons Learned From ASHRAE HQ Renovation



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"Since it has been more than five years of occupancy since ASHRAE Headquarters was renovated, this is a good time to revisit the details of the renovation project, the successes, and lessons learned."

APRIL, 2014

"The original building was constructed in 1965 and was occupied by an insurance company until ASHRAE purchased it in 1980 and relocated to Atlanta from New York City.

ASHRAE did its first major renovation in 1990 by gutting the interior, updating the mechanical systems, installing a new insulated glass curtain wall system, and abating asbestos materials on the interior.

The building was extensively renovated again in 2007–08 and approximately 4,000 ft2 (371 m2) of space was added to the existing 30,000 ft2 (2800 m2) building. A significant portion of this larger building was used to create the new ASHRAE Foundation Learning Center, which allows ASHRAE to host large meetings and training sessions on-site.

The building is unique in that it contains three mechanical systems for heating, cooling and ventilation:

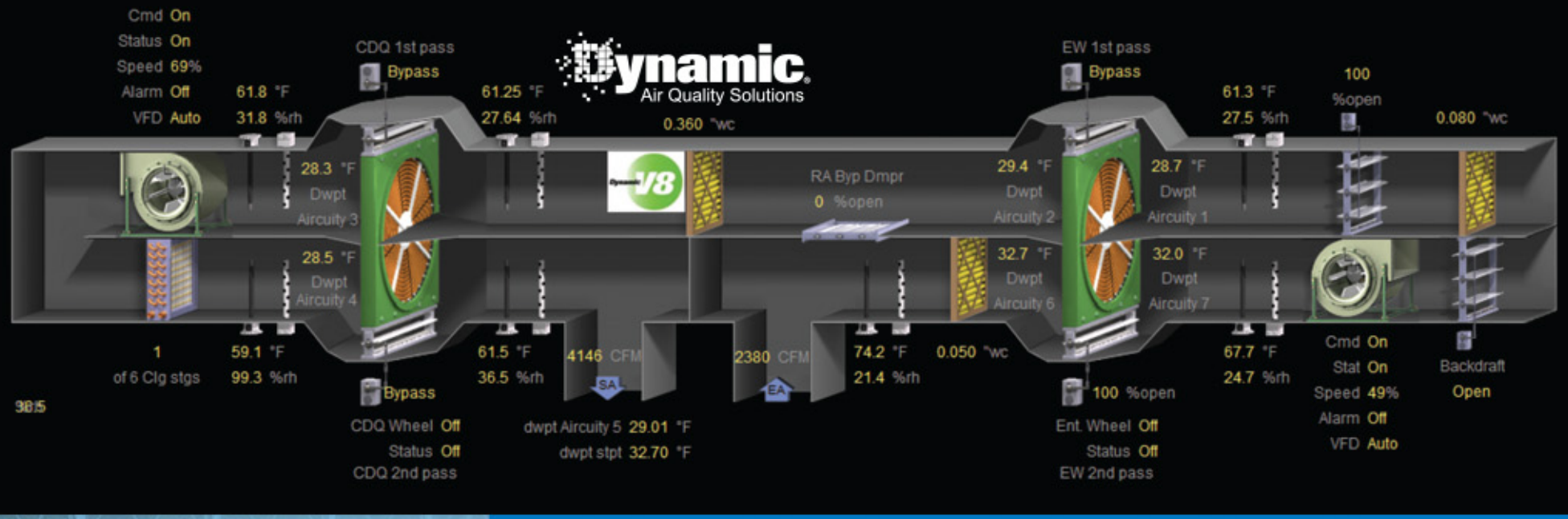
1. Dedicated outdoor air system (DOAS) for first and second floor ventilation;
2. Variable refrigerant flow (VRF) system with heat recovery for first floor heating and cooling; and
3. Ground source heat pump (GSHP) system for second floor heating and cooling.

LESSONS LEARNED

Living Lab

The reason for having three mechanical systems was to achieve the goal of creating a "Living Lab" for ongoing research by the Society and its members. More than 1,300 points are monitored and stored on the systems and spaces in this building. The stored and real-time data are then made available to our members around the world via Internet. Only a small group of building owners would allow their building to be used in such a fashion.

ASHRAE hopes to learn more about the long-term operation, maintenance and performance of buildings with the various types of systems used throughout this project.



RENOVATION Quick Facts

- 92% of building structure/shell retained
- 91% of construction waste was diverted from landfills and recycled (2,200 tons)
- 22% of the total materials cost for the project came from recycled content
- 25% of the total materials cost for the project came from regionally supplied materials (extracted and manufactured within 500 miles from building site)
- Abated remaining asbestos on-site in exterior building soffit paneling
- LEED New Construction (NC) 2.2 rated Platinum building: 55 points attempted; 54 points earned; 69 possible points
- Energy Star-Labeled Building in 2010, and 2012
- Prior to Renovation (2007) Energy Star Score: 35; Site EUI: 79 kBtu/ft2·yr (908 MJ/m2·yr)
- After Renovation (2012) Energy Star Score: 95; Site EUI: 38 kBtu/ft2·yr (437 MJ/m2·yr)
- 52% EUI reduction between 2007 and 2012

A DOAS provides 6,000 cfm outdoor air at 55°F supply air temperature with 46°F dew point, providing 40 tons of cooling and 250 MBH heating.

Ventilation System

A dedicated outdoor air system (DOAS) provides 6,000 cfm (2832 L/s) outdoor air at 55°F (12.8°C) supply air temperature with 46°F (7.8°C) dew point, providing 40 tons (141 kW) of cooling and 250 MBH (73 MW) heating. It uses dual stage air-to-air heat recovery with Type 1 desiccant wheel and dehumidification with Type 3 desiccant wheel, variable speed outdoor air and exhaust air fans, six staged packaged air-cooled DX condensing units and an air-cleaning system that uses active-field technology to polarize both filter media fibers and airborne particles. The polarized particles are drawn to the fibers of the media and other particles. This process brings about a deep cleaning of the air, a near MERV 13 filter performance level, and a longer service by loading the filter through its full depth and not just on the upstream face as with passive filters.

Air is distributed throughout the building using a system of 24 supply VAV boxes and two exhaust VAV boxes, which are all connected to the DOAS. The 40 tons (141kW) of capacity for the DOAS when combined with the 28 tons (98 kW) for the VRF and 32 tons (113 kW) for the GSHP gives us a total of 100 tons (352 kW) of capacity. For comparison, the previous building was cooled by a 70 ton (246 kW) air-cooled chiller.

Indoor Air Quality

The building uses low-emitting materials, such as furnishings, paint, linoleum, and carpet, throughout to reduce indoor air contaminants that are odorous, irritating or harmful to the comfort and well-being of occupants. Based on the reduction of volatile chemicals, ASHRAE was able to save time, money, and energy by performing the IAQ test option to achieve LEED NC 2.2 credit IEQ 3.2, rather than using the "flush out" option.

Flush out is very energy-intensive, requiring 14,000 ft3/ft2 (4268 m3/m2) of outdoor air that is heated and/or cooled to 60°F (15.5°C), 60% RH before the building can be occupied. Also, the permanent ventilation airflows in the building exceed minimums of ASHRAE Standard 62.1-2004 by 30%, allowing the award of LEED credit IEQ 2 for increased ventilation.

Further, in spaces with high variable occupancy (e.g., ASHRAE Foundation Learning Center), ventilation airflows are modulated based on CO2 to reduce outdoor air rates during partial occupancy.

The capability to closely monitor/assess the indoor spaces of the building through the Living Laboratory, occupant surveys, and other measures allows the potential for better understanding the relationship between ventilation rates, occupant comfort, productivity, and energy consumption in future studies.

Photocells, occupancy sensors, and occupancy schedule are used to control lighting use. A change-out to LED lights in some locations is being considered.

Lessons Learned

Occupant surveys were conducted in 2005 (prior to renovation), 2010, and 2013. Air quality satisfaction increased from 26% in 2005 to 77% in 2010 and 70% in 2013. Cleanliness and maintenance satisfaction increased from 21% in 2005 to 83% in 2010 and 79% in 2013. The small drop in satisfaction between 2010 and 2013 could be due, in part, to changes in staff between the two surveys.

A donated air-monitoring system tracks temperature (dry bulb and dew point), relative humidity, enthalpy, carbon dioxide, total volatile organic compounds (TVOCs), and particulates (PM 2.5) in 24 room locations, two outdoor air locations and seven locations in the DOAS unit (sensors are recalibrated every six months). Similar sensors are also provided as part of the BAS and are compared with the readings.

The donated air system has allowed us to monitor more areas of the building, which has been useful in troubleshooting occupant comfort complaints.

For example, dew-point temperature readings inside the air handler were found to be more accurate using sensors from this donated system. Since many of the inside sensors are also located adjacent to BAS sensors, it is now much easier to identify sensors that have gone bad or are out of calibration.

MERV 13 filter modules are installed in the DOAS unit and on all VRF fan coil units and GSHPs.

Somewhat unexpectedly to us, but not the manufacturer, all of the original filter media, except for the media servicing the building's vestibule entrance, is still in place after five years of operation. The media in the vestibule was replaced early at the request of the manufacturer to provide them with a sample for marketing purposes about a year ago. Differential pressures (DP) across all filters are still low (current: DOAS: 0.38 in. w.g., highest VRF FCU: 0.100 in. w.g., highest GSHP: 0.244 in. w.g.) and a change-out is not required yet (replacement level: DOAS: 0.53 in. w.g., highest VRF FCU: 0.418 in. w.g., highest GSHP: 0.418 in. w.g.).

As of February 2014, the filter modules that service the building's vestibule entrance (equipped with a walk-off mat) and second floor main landing at the top of stairs have the highest DP readings right now at 0.100 and 0.244, respectively, as one would expect. In addition, since anything on the filter media is electrically bonded to the fibers, we have not seen a need yet to change out the media due to microbiological growth on the media because we have not seen increasing VOC levels in the building with the donated air monitoring system.

CONCLUSION

ASHRAE had the opportunity prior to the latest renovation to lease new space elsewhere or build new, but recognized that the greatest opportunity to change energy consumption in the built environment is through modification of existing buildings. By looking forward and taking the path to renovate, ASHRAE showed what can be done with a nearly 50-year-old building."

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