CASE STUDY

ensuring environmental integrity

Providence Regional Medical Center

Background

Serving Northwest families for more than 100 years, Providence-Everett hospital has provided exceptional, compassionate care for the community since 1905. Providence-Everett has changed dramatically since its

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humble beginnings and evolved into an award-winning hospital that continues to focus on advancing healthcare excellence. The recent completion of the Cymbaluk Medical Tower in June 2011 has dramatically changed the way patients and their families experience hospital care. With a total cost of $500 million, this 10-story, 730,000 square foot medical tower is one of the largest private investments ever in the community and by the Providence Health System and will help to ensure that the hospital is well-equipped to provide award-willing healthcare to this ever-growing region.

The Situation

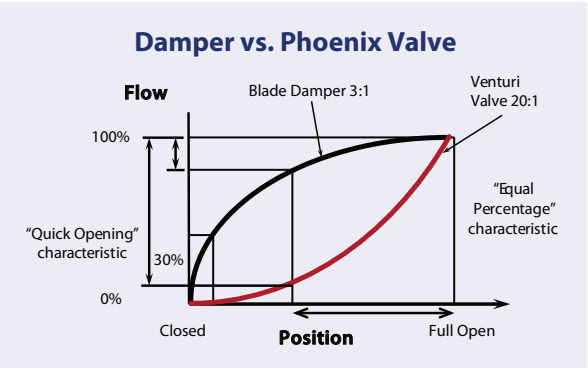
Hospitals have always struggled to manage their ever-increasing operating expenses, one of which includes their increasing energy expenses. According to the Department of Energy, healthcare buildings rank fourth in terms of energy consumption. In actuality, they consume 250% more than a typical commercial building. Prior to 2007, the healthcare code used by the state of Washington did not allow the use of VAV systems within patient care areas. Old standards that were written when the cost of energy was much less did not provide enough incentive to "rock the boat", especially when airborne infection control was a concern. However, as energy costs began to skyrocket the state of Washington and other states utilizing the FGI "Guidelines for the Design and Construction of Health Care Facilities" were subject to a national code interpretation that allowed for the use of VAV systems within certain areas of a hospital.

Although Providence Everett was opened in 2011, the planning and design for the facility occurred much earlier. As is often the case, although codes may change, it takes a while for them to be adopted. The initial HVAC design for the patient tower was constant volume with many rooms requiring an average 11.6 ACH of 100% outside air depending on the time of day. Due to its climate, location, and the owner's directive, the use of a 100% outdoor air system was not prohibitive from an energy perspective. However, running constant volume at almost 12 ACH as opposed to the minimum required 6 ACH clearly was.

The engineering plans were complete, the building materials necessary to start the construction using a CV system were already purchased, and then a new facility director who had the foresight to ask the question "Why are we running a Constant Volume system if VAV is allowed?"

The Discovery

It is commonly known that proper ventilation design is a critical part of ensuring healthcare facilities in balancing the needs of controlling airborne pathogens, implementing energy conservation measures, and reducing HVAC maintenance. Constant volume systems can do this quite well from a strictly functional prospective, but consume large amounts of energy in the process. Terminal Boxes are the common device used in many facilities including healthcare to control airflow. Terminal boxes, however, have been shown to be extremely inaccurate when reducing airflows and thereby inhibit the practice of reducing ACH for energy conversation. In fact, "the successful performance of



VAV systems is often compromised by flawed conception, faulty design, defective installation, poor start-up, inaccurate operation, and inadequate maintenance" (ASHRAE RP 1137 pg. 73).

Fortunately, precision airflow control devices, such as Phoenix Controls venturi valves, do possess the accuracy and turndown capabilities that can enable energy savings and provide the precision airflow control required in high consequence spaces. Phoenix Controls devices can achieve up to a 20:1 turndown with ± 5% error of commanded flow. The diagram below illustrates this turndown vs. a traditional damper. Realizing the tremendous potential for saving energy, while not compromising safety, the Providence Everett team wanted to look into using Phoenix Controls.

The local Phoenix Controls partner ATS brought the engineering team from CDi to the Phoenix Control factory in Acton, MA. They participated in airflow education classes, saw the demonstration suites, toured the manufacturing floor, and witnessed the quality and engineering involved with the Phoenix Controls products. When they returned, a study was commissioned in conjunction with the local utility to gauge the potential savings associated with changing from a CV HVAC system to Phoenix Control venturi valve VAV system.

The Finding

CDi engineers showed that switching to a Phoenix Controls VAV design offered a tremendous opportunity for cost savings. Their recommendation was to use Phoenix Controls venturi valves because their historical accuracy and repeatability allowed for confidence in:

- Preserving needed airborne infection measures
- Consistent year over year energy savings
- No required scheduled maintenance
- Overall industry leading life cycle cost

CDi's preliminary analysis calculated that the total anticipated savings would be $55,936 per floor per year (see below). The projected cost to change the original plans to a VAV system would be an additional $262,500 per floor. Using a simple payback formula ($262,500/$55,936), the anticipated payback to participate in this endeavor would be 4.6 years.

Anticipated Annual Energy Savings	
Fan Energy Savings	$ 35,509.00
Reduced Reheat	$ 17,885.00
Reduced Hot Water Pumping	$ 110.00
Reduced Cooling	$ 2,301.00
Reduced Chilled Water Pumping	$ 122.00
Total Projected Annual Savings (per floor)	**$ 55,926.00**

Very early in the design phase the Northwest Energy Efficiency Alliance (NEEA), a non-profit organization whose goal is to, "maximize energy efficiency to meet our future energy needs", assisted with funding for energy modeling. The energy conservation measures (ECM) that would qualify for utility incentives were identified and presented to the electric and gas utilities. After further coordinated analysis, the project team was able to obtain energy savings incentive funding from Snohomish County PUD, the electric utility, and Puget Sound Energy, the gas utility, for direct payment to the owner to offset the incremental ECM costs, and reduce the payback period.

Shohomish calculated that switching to VAV would save an estimated 7,560,000 Kwh per year in energy. Puget Sound identified an estimated savings of 2,800,000 Kwh per year. Realizing the tremendous opportunity to save energy, Shomomish offered the biggest rebate they have ever given of $1,405,000. Puget Sound also saw the remarkable benefit of using VAV and offered $375,523 in rebates. These rebates helped to reduce the payback period from 4.6 years to 3.16 years for the entire project.

Benefits of Switching To VAV			
Utility	**Energy Savings/yr**	**Rebate Amount**	**Payback**
Electric	7,560,000 Kwh	$1,405,000	—
Gas	2,800,000 Kwh	$375,523	—
Total	**10,360,000 Kwh**	**$1,780,523**	**3.16 yrs**

This payback period did not initially sway the construction management team who was reluctant to spend money associated with redesign, materials, and labor. In addition, the project schedule was rapidly approaching and it was uncertain if the required changes could be made in order for the project to stay on-time.

The Solution

The construction management team was eventually overruled by the facilities and energy team who realized the numerous benefits of switching to a Phoenix VAV system. The most significant benefit being the ratio of revenues to savings. According to Clark Reed, Director of the Healthcare Facilities Division for the Energy Start Program of the EPA, "For a hospital with a 3 percent operating margin, saving a dollar in energy is equivalent to generating $33 in new revenues" (2011 Hospital Energy Management Survey).To put this in perspective, the total projected annual savings (per floor) was $55,926 which would be equivalent to the hospital generating $1,845,558 in new revenues. These savings in turn can be used to reinvest into other revenue development programs, improve patient care, and community benefit programs.

Providence Everett facilities and CDi Engineers decided to use tracking pairs in each patient room. They felt it was important to have as much control over each space as possible to really run the most efficient building possible. In addition, they knew there would be large fluctuations between 12 ACH and 6 ACH at times and they wanted to make sure that regardless of the time of day they could have confidence that they would be achieving their minimum ventilation requirement by code.

The use of flow control devices on the room exhaust also provided a benefit of easily becoming a pandemic ready facility. Since hospitals and clinics are often the first place people go when they are sick, it is important to design facilities that can sustain an influx of patients in the event of a pandemic influenza outbreak, bioterrorism, or other incidents affecting large number of people. During a pandemic incident, many patients with potentially highly communicable diseases may be placed in close proximity within an emergency department or other containment areasof a hospital.

Few hospitals have sufficient numbers of Airborne Infection Isolation (AII) to accommodate a surge. In fact, according to a survey of U.S. hospitals emergency preparedness in 2006, 40% do not have enough everyday isolation. Built into the Phoenix Controls' VAV systems are sequences that have the flexibility and ease to adjust ACH to desired flows, ability to go from a neutral pressure relationship patient room to a negative or positive pressure relationship and then revert back to the original design. This is something that is not possible with CV systems and very difficult to achieve with a typical terminal box.

Becoming more competitive with other hospitals that are VAV and becoming a leading modern facility are added ancillary benefits. From a technical standpoint, switching to VAV had many additional benefits, which are detailed in the following table.

Other Advantages of Going VAV
1. Reduced noise generated from AHU fans and ductwork
2. No periodic rebalancing of exhaust required
3. Superior room pressure control if needed
4. Long fan life (running at reduced speeds)
5. Reduced risk of rain and/or snow entrainment in the air handing units as they are running at reduced speeds during the winter heating season

In the end, choosing to convert to Phoenix Controls VAV system proved to be an incredibly beneficial decision for Providence Regional. The long term benefits and energy savings achieved greatly exceeded original goals.

The Result

Today, The Providence Regional Medical Center Everett is among the 50 Best Hospitals in America aside such well known names as Cedars-Sinai, Mayo Clinic, and John Hopkins Clinic. HealthGrades, the nation's leading provider of independent hospital ratings, ranks Providence Regional in the top five percent in the nation with the 2010 Distinguished Hospital Award for Clinical Excellence for the past four years. Providence Regional serves as a model of how hospitals can effectively cut expenses with HVAC retrofits while maintaining their healthcare excellence.