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RALEIGH TRANSIT
OPERATIONS FACILITY
CASE STUDY

A NEW LEVEL OF EFFICIENCY
RALEIGH TRANSIT OPERATIONS FACILITY

What could be greener than public transit? A LEED® Platinum public transit facility that operates at 50% better than ASHRAE, 90.1, that's what. The new Raleigh Transit Operations Facility in Raleigh, North Carolina raises the bar for all governmental buildings, not just mass transit.

"WE DID A LIFECYCLE COST STUDY ANALYSIS THAT LOOKED AT CHILLED BEAMS, GROUND SOURCE HEAT PUMPS, LIGHTING CONTROLS, AND OCCUPANCY SENSORS. THE CHILLED BEAMS HAD THE LOWEST OPERATING COST WITHOUT MUCH OF A PREMIUM ON THE FIRST COST."

- MIKE TALBOT,
TALBOT & ASSOCIATES CONSULTING ENGINEERS

Funded by $11.1 million from the American Recovery and Reinvestment Act, this new public bus maintenance and operations facility replaced a 30-year-old downtown facility that was designed to handle only about half of what this new facility can. It is state-of-the-art in every way, especially in terms of energy efficiency. North Carolina mandates that all government buildings over 20,000 sq ft. exceed ASHRAE 90.1 energy efficiency standards by at least 30%. The actual energy use of the facility is beating ASHRAE standards by as much as 50%![1]

It was a tall order for Talbot & Associates, the engineering firm selected for the mechanical design. Facilities can quickly exceed construction budgets and lengthen payback periods in the name of efficiency. However, Mike Talbot, President of Talbot & Associates was determined to beat the odds with a proven energy recovery and chilled beam strategy that not only enhanced payback but provided better comfort and overall indoor air quality.

Talbot knew that the combination of these two technologies had been successfully applied over the last several years in many large governmental and institutional facilities, including several in the southeast. He believed (and still believes now that the project is complete) that this is the simplest and best way to achieve North Carolina's efficiency mandate while also meeting the additional outdoor air requirement of LEED NC 2.2.

NOT YOUR AVERAGE BUS FACILITY

The new transit facility serves the bus maintenance, operation, and administrative needs for the entire Raleigh transit system. Drivers start and end their routes here and often spend several hours in between, eating and resting. The facility is fully equipped with lockers, shower rooms, an exercise room, a computer room, lounge, a "quiet room," kitchen, administrative offices, and an enormous bus maintenance facility with adjacent paint booth.

Providing continuous outdoor air to a 110,470 sq. ft. space like this and still meeting such a high efficiency standard demanded more than energy recovery. That's where the combination of FläktGroup® SEMCO Flexicool® active chilled beams and Pinnacle® Primary Ventilation Units comes into play. There are 85 chilled beams and 13 recovery units (including 3 dual wheel Pinnacle® units) serving the administrative, operations, and maintenance wings of the transit facility. The Pinnacle® units deliver continuous 100% outdoor air to the administrative and operations spaces and provide all of the preconditioned air that supplies the chilled beams.

1 - Based on actual energy bills and an aggregate energy budget for this facility completed by the City of Raleigh, initial savings projections are 32.5%. When compared to more traditional HVAC building approaches, the savings comparative per square foot of building would be approximately 50% of a conventional baseline system.

Throughout the year, the dual heat wheel units work in concert with integral heating and cooling coils to deliver preconditioned air to the chilled beams at suitable wet bulb temperatures so building occupants enjoy near perfect indoor humidity conditions year round. The units provide all the necessary dehumidification during the cooling/ latent load periods, as well as humidification during the winter season. Most importantly, they do it efficiently, using the maximum possible recovered energy from the building exhaust. The heating and cooling coils inside the energy recovery units modulate only as needed to further dehumidify or heat the supply air.

Additional space heating and cooling is carried out via the chilled beams. During the cooling season it is important that supply air is sufficiently dehumidified before entering the chilled beams to avoid any condensation. Decoupling this aspect of the cooling system via the Pinnacle® units is what makes this configuration work so well.

The chilled beams only provide sensible heating or cooling to the space as needed while the Pinnacle® units provide all the necessary ventilation and latent conditioning. Because of the excellent induction rates of the chilled beams, the only ducted airflow that is needed is that which is required to meet the outdoor air requirement. According to Talbot, this significantly reduces the amount of system fan energy that is consumed when compared to a typical VAV system.

The energy performance is also superior to the traditional European approach to chilled beams, which utilizes larger quantities of higher dew point air and not just ventilation air. Furthermore, chilled beams utilize a higher chilled water temperature to cool the space, approximately 57°F, which lightens the load on the chilled water system.

ENHANCED COMFORT FOR DRIVERS AND MECHANICS

Bus drivers have a superior indoor environment awaiting them when they return from their bus routes. The time between routes can sometimes be two or more hours, so the operations facility provides an ideal space for drivers to rest, eat or even exercise, saving them the time and fuel they might otherwise spend driving home. Meanwhile, mechanics in the 61,500 sq. ft. bus maintenance facility get year round comfort from radiant heat in the winter and a displaced air delivery system

Mechanics in the maintenance facility enjoy year round comfort.

that keeps conditioned air concentrated where it is most needed, at the floor level of the garage. Traditional heating and cooling in this area would not be practical given the large doors that are frequently open. However, singlewheel SEMCO Energy Recovery Ventilators (ERVs) help keep the space quite comfortable, especially when compared to other garage spaces that are usually unconditioned or only heated in the winter.

Talbot conservatively estimates a 10-year payback or better on both the chilled beams and the Pinnacle® ERVs. However, this payback is likely to be reduced even further given the strong likelihood that the facility will add a third shift to its bus driver operations.

"This is definitely the most cost effective way to achieve 30% better than ASHRAE 90.1 and still meet your outdoor air requirement," said Talbot. "You have to have a dual wheel dehumidification system to use in conjunction with the chilled beams. It is the only way to provide neutral dehumidified air to the space so you don't run the risk of overcooling."

A LEG UP ON LEED

From geothermal heat pumps to an employee-maintained organic vegetable garden, the transit facility is a virtual showplace for environmental stewardship. The application of the chilled beams and ERV units provided energy reduction points needed to achieve LEED Platinum certification in 2013.

"We really feel this is one of the most cost effective strategies a facility of this scale can have for energy reduction and overall comfort," said Talbot.

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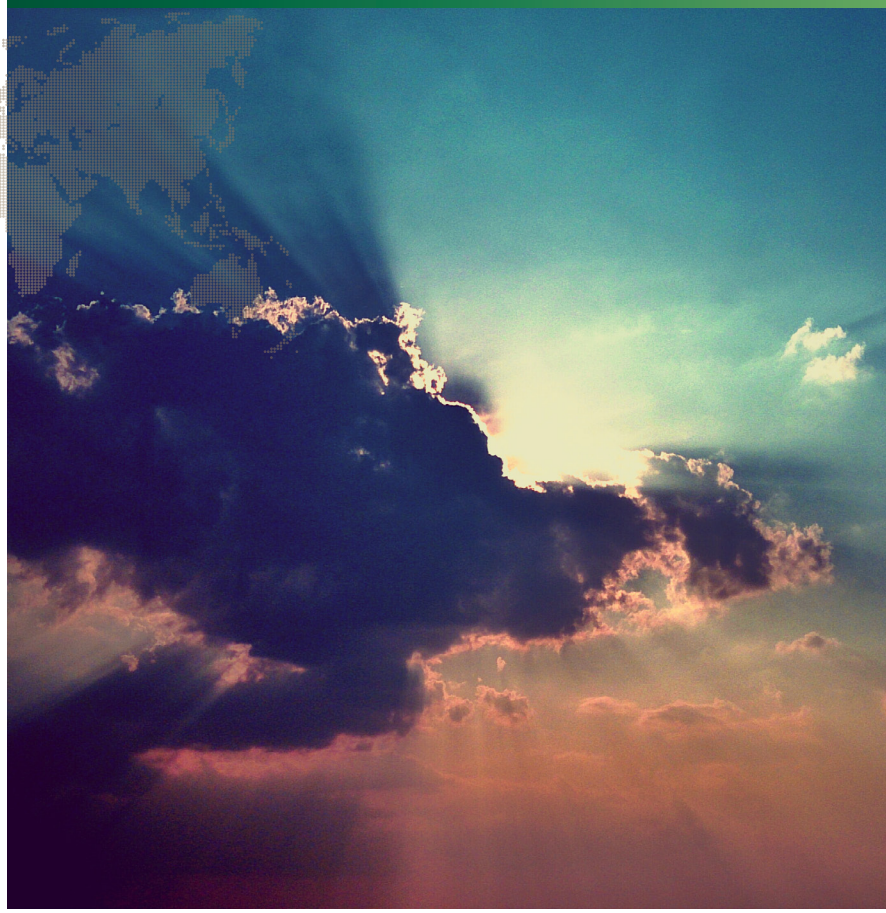

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Our constant aim is to provide systems that precisely deliver the best indoor air quality and performance, as well as maximize energy efficiency.

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