Newsletter

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B2E CONSULTING ENGINEERS, P.C. IS A SERVICE ORIENTED ENGINEERING FIRM BASED IN NORTHERN VIRGINIA

B2E PRINCIPAL BRUCE BEDDOW FEATURED IN SCHOOL CONSTRUCTION NEWS

Bruce Beddow, PE, CEM, GBD is founder and Principal here at B2E. Last spring he contributed an article to School Construction News Magazine, where he details the HVAC system upgrade at Alexandria City's James K. Polk Elementary school. This upgrade incorporated a geo-solar system and photovoltaic panels to meet the sustainable design goals of Alexandria City Public Schools. We are proud that our sustainably designed HVAC system sets James K. Polk school apart - the school now generates 60% lower carbon emissions per square-foot than the average school in the region!

SEE THE FULL ARTICLE BELOW

BOARD MEMBER SPOTLIGHT

Delivering on Sustainable Design

By Bruce Beddow, PE, CEM, GBD
Principal, B2E Consulting Engineers, P.C.

Alexandria City Public Schools (ACPS) engaged B2E Consulting Engineers, PC, a mechanical, electrical, and plumbing consulting firm located in Leesburg, Va., to design an energy-efficient replacement for its 57,000-square-foot, two-story and 29-classroom James Polk Elementary School. The original school was built in 1965 and was added to in 1969 and was never previously renovated. The school was 44 years old at the time of this HVAC system upgrade.

Beddow

In order to develop the best possible project, first, the team worked to develop the best possible approach. A master planning process took place with the engineer, architect and the owner for Sustainable System Design.

B2E was hired by Maginness + del Nino Architects (M+N) from Alexandria, Va. to assist in developing a master plan of sustainable design initiatives for the facility. B2E and M+N worked together on the plan. The plan was broken down into specific tasks, which involved producing a PowerPoint presentation to ACPS to showcase possible sustainable systems; providing a sustainable design checklist to ACPS; prioritizing the sustainable design systems and features that were accepted; develop renderings; develop floor plans; develop construction cost budgets for each sustainable design objective; and finally ACPS decided which sustainable design objectives would be included in the project, and the design process was underway. Simple, right?

Energy Efficiency

The master plan considered the use of a geo-solar heat pump system. This system was used at another ACPS facility and was generating excellent energy savings. The decision was made to incorporate the geo-solar system and include photovoltaic panels to generate electricity as well. The 10 kW photovoltaic system would be more than enough to power the solar pumps making operation of the solar domestic hot water heating system essentially off-grid. ACPS requested that the solar thermal and PV panels be incorporated into the building architecture. ACPS wanted to use the energy-saving features of the building as an educational showcase, including a Greenovation Lab to teach students the fundamentals of energy savings. In addition, ACPS wanted the energy-saving features of the building to be visible to the general public.

B2E determined that a ductless variable refrigerant multiple zone (VRMZ) heat pump system was appropriate for this building because it can be incorporated into buildings with a low slab-to-slab height. Ductwork had to be greatly reduced. The VRMZ system delivers heating and cooling through refrigerant piping using ductless ceiling mounted terminal units in lieu of hot water and CHW piping and ducted ceiling mounted fan coil units. B2E Engineers have been trained to use the Mitsubishi VRMZ software, and the system design was based on the City-Multi System.

B2E designed the VRMZ system with a ground loop heat exchanger in lieu of an air-cooled or typical hydronic (boiler and cooling tower) solution. A roughly graded play area was the only location large enough for the ground loop heat exchanger. The decision was made to use the existing play field area to install the underground heat exchanger piping. The bore field size was estimated with 90 bore holes at 350 feet deep. A conductivity test was performed which indicated we would not hit rock until 135-150 feet depth. In order to reduce the cost for steel casing we decided to drill fewer, deeper borings. The final ground loop heat exchanger used 72 bore holes which are 470 feet deep.

This was the second ground-source project for ACPS and we learned previously that the children become very interested in the magnitude of the drill rig and the process of drilling deep into the ground. The architect worked with the school principal to let the kids observe the process and used the opportunity to learn about renewable energy and energy savings as the wells were drilled over a three month period. This also reduced complaints due to the noisy drilling procedure during the school day, because the entire school was excited about their new and efficient HVAC system.

In order to reduce natural gas consumption a solar hot water array was used to generate solar hot water year round. It was decided to set the solar panel angle at 45 degrees to maximize hot water generation during the winter.

Since the ground loop heat exchanger piping would be hidden under the new play field, the solar array could be visible as two-story side of the building faces due south. M+N performed a study to set the panels in front of the two-story classroom wing to shade the fenestration in summer and allow daylight to enter the classroom in winter.

The concept of the geo-solar system is to have the hot water storage tank designed to store the solar hot water continuously generated by the array. This array is designed to generate 190,000 BTUH. The heat is stored in the tank using a solar double wall tube bundle in the bottom half of the tank. The solar panels make water temperatures up to 180 degrees in full sun.

Seeing Results

The project at James Polk Elementary School was a success because all the team players paid attention to detail and followed through to complete the overall sustainable vision for the building.

The owner, (ACPS), was engaged and pushing for an architecturally integrated engineering solution, which could be used as a learning tool via the Greenovation Lab.

The architect (M+N) Architects were the visionary using the master plan documents, renderings and perspectives to allow the owner to visualize and internally discuss the possible solutions for the building.

The engineering firm (B2E Consulting Engineers) were the nuts and bolts driving force to ensure the sustainable systems were economically viable, had space to be installed properly for operation and maintenance, were installed properly and finally were commissioned to operate in accordance with the engineers design.

The school generates roughly 60 percent lower carbon emissions per square-foot than the average school in the region. The school system will pay off the initial incremental investment cost and provide a calculated net savings of approximately $1.2 million over the 25-year system lifetime compared to a "do nothing" scenario, whereby equipment is replaced as it fails. Simple payback is calculated at eight to 12 years, depending on existing equipment replacement schedule.