



Radnor Middle School Wayne, PA



Radnor Middle School Provides a Model for Green Schools with Efficient Geothermal Heating and Cooling System from ClimateMaster

Over the past decade, Pennsylvania's Radnor Township School District (RTSD) has blazed a trail in building schools that are both good for the environment and good environments for students. Initially prompted on this path after one of its schools was forced to shut its doors due to mold contamination, the school district – and the Radnor Township community at-large – was prompted to make a priority of indoor air quality and environmental safety in its schools.

With this aim in mind, when the time came to build the new Radnor Elementary School in 2001, RTSD was thoughtful in including features to ensure a better environment for its students. In addition to elements such as solar PV panels and low-toxicity paints, the school district identified geothermal heating and cooling as a means of improving both indoor air quality and energy efficiency. The result was the Radnor Elementary School, which opened in 2001 as one of the first green public elementary schools in the state of Pennsylvania.

Commercial Case Study

Leo Bernabei, RTSD director of operations, said it was an obvious choice. "Radnor demands the very best in learning environments for children," he said. "That includes many of the attributes now found common in green buildings. Our designs were not intended to be green necessarily, but are so because of our interest in paying attention to every built detail."

While RTSD blazed a path with Radnor Elementary in 2001, the district's tour de force has since become Radnor Middle School—a LEED® Silver-certified green building that was unveiled in 2007 after approximately one year in development and 21 months of construction. The four-story building earned this designation from the U.S. Green Building Council on the strength of its many green features, including the use of recycled materials, a green roof, waterless toilets, a building orientation that makes use of natural light, motion-activated light sensors, and innovative storm water management techniques such as groundwater recharge beds.





The 195,000 square foot building is also exceptionally energy efficient thanks to the incorporation of a geothermal heating and cooling system from ClimateMaster.

“Energy efficiency is a complex combination of things, but the geothermal was at the center of all of that,” highlighted the building’s architect Darin Jellison, from Philadelphia-based firm Blackney Hayes Architects. According to Jellison, geothermal and a highly insulated building were the main keys to keeping energy consumption at a minimum.



Jellison said that when his firm started planning the design of the middle school, the school district staff emphasized its desire to build on its positive experience with geothermal heating and

cooling at Radnor Elementary. Extrapolating on the original system by incorporating the latest in geothermal technology, Jellison and his firm designed a system, driven by geothermal heat pumps from ClimateMaster, which would provide maximum energy efficiency, comfort and indoor air quality.

“In some rooms we brought the air in from under the floor instead of at the ceiling because some of the rooms in our building were very tall, not just the standard nine or 10-ft ceilings, but 2-story tall spaces,” said Jellison. “So we wanted to bring in the air from below where the people were.”

John Marchiafava, the project engineer from the mechanical engineering firm Concord Engineering, was enlisted to specify the equipment for the Radnor Middle School geothermal heating and cooling system that would eventually provide approximately 400 tons of cooling and 3,000 MBH of heating. The firm selected a total of 128 Tranquility® 20 Single-Stage Series (TS) horizontal and vertical packaged water-source heat pumps from ClimateMaster, which, at the time, had just been released on the market.

“At the time, the Tranquility TS from ClimateMaster was the most energy efficient product on the market,” said Marchiafava, “and I had good experiences with ClimateMaster products in the past.”

In addition to providing credits for LEED certification, the ClimateMaster geothermal heat pump units incorporated user-friendly direct digital controls, which were attractive to the school’s maintenance staff. Two ClimateMaster Genesis Large Water-to-Water (GLW) units, which also cutting-edge technology at the time as they integrate snow melt into their operation, were also included in the



design.

The system’s borehole field, consisting of 144 500-foot deep boreholes drilled under the school’s sports field, required unique engineering due to a storm drain that runs across the property. In addition to accommodating the storm drain, civil engineering firm Gilmore & Associates designed a storm water management system to eliminate flooding formerly common to the location.

Tom Hanna, vice president with Gilmore & Associates, worked with the entire project team to ensure the borehole drilling process ran smoothly.

“The process of drilling these holes generates a lot of



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Single-Stage Unit**

mud, water and rock fragments, so part of our planning for the erosion and sediment control during construction was to minimize the mud and water running off the site unfiltered and getting into the storm drain system during a rainstorm or during the drilling," he said. "So we had to design containment areas and control measures to help prevent all of this from running off the site." According to Hanna, this was a big job, but also an important one, since the middle school is a small

site in the middle of town. In addition, much of the waste created by the construction was recycled.

Construction began in January of 2006 after more than a year of finalizing the plans for the building. Work on the borehole field was conducted over the summer and fall of 2006. In early 2007, the engineers did the flushing, testing and balancing of the system. All of the construction was completed by September 2007, just in time for the school's inaugural school year.

According to Marchiafava, system efficiency and sustainability were top-of-mind throughout the project.

"Making sure that the systems that we were designing for Radnor would provide the efficiency that they were expecting and anticipating was key," he said. "It also kept us on our toes to make sure the end product was functional and sustainable."

According to RTSD's Bernabei, the geothermal heat pump system from ClimateMaster has delivered on all expectations, and has made a marked difference in how the school functions.

"We have no more large industrial boilers or chillers or fuel tanks. No more messy supply lines or waiting for fuel trucks. No more worrying about reintroducing exhaust from the fuel system back into the building," Bernabei said. He also denotes the school's notably reduced energy bills. "The energy savings could be as high as 30 percent," said Bernabei.

Bernabei also shares that the system has cut down on required maintenance when compared to the previous mechanical system.

"The vertically-mounted ClimateMaster heat pumps are installed in sound-isolated closets outside of the classrooms, so the only terminal gear that we have to deal with, aside from two large variable speed pumps, are the heat pumps," Bernabei explained. "And when you buy a quality piece of equipment like ClimateMaster's, even that maintenance is very little." He further shared that even when they require maintenance, the heat pump units' installation outside of the classrooms eliminates any disruption in the regular school day.

To optimize the learning environment, Blackney Hayes' Jellison said that the architecture firm took special care to fully insulate the mechanical closet in which the heat pump units are located, which, in tandem with their already quiet operation, render them virtually silent. "We worked pretty hard on designing the closets that the heat pumps are in to reduce the acoustical impact of the unit on the classroom environment to basically zero," said Jellison.

Bernabei denotes that the success of Radnor Middle School as a green building project has also provided an authentic learning experience for students.

"Part of our educational aims include learning about environmental stewardship and energy efficiency," said Bernabei. "All the building's systems, from the vegetative roofing, to the underground storm water recharge system, to the renewable geothermal heating and cooling system, therefore become teaching tools." According to Bernabei, the building itself has actually now become a part of the school curriculum, providing authentic examples of concepts including energy capture and use, engineering, pressure and electricity.

Feeling strongly about the benefits of geothermal heating and cooling, Bernabei says that the Radnor Township School District has now integrated geothermal heating and cooling systems into four out of its five school buildings. In addition, in 2012, Radnor Middle School was named a Green Ribbon School by the U.S. Department of Education in recognition of its provision of a sustainable green environment for learning. Denoting his personal pride in this achievement, Bernabei shared, "It was not only because of the building attributes, but because of the way we utilize the building to help teach children."

According to local ClimateMaster representative Sass, Moore & Associates president Bill Moore, the Radnor Township School District exemplifies a growing trend in the education construction market.

"We have worked with the design teams and contractors on all of the geothermal school building projects that incorporate heat pumps from ClimateMaster, and have seen a consistent interest in this type of system," said



Radnor Middle School

Architect:

Blackney Hayes Architects

Civil Engineer:

Gilmore & Associates

Mechanical Engineer:

Concord Engineering

Manufacturer's Representative:

Sass, Moore & Associates

ClimateMaster Equipment:

128 Tranquility® 20 Single-Stage Series (TS) horizontal and vertical packaged water-source heat pumps

Project Website:

<http://www.rtsd.org/radnorms>



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