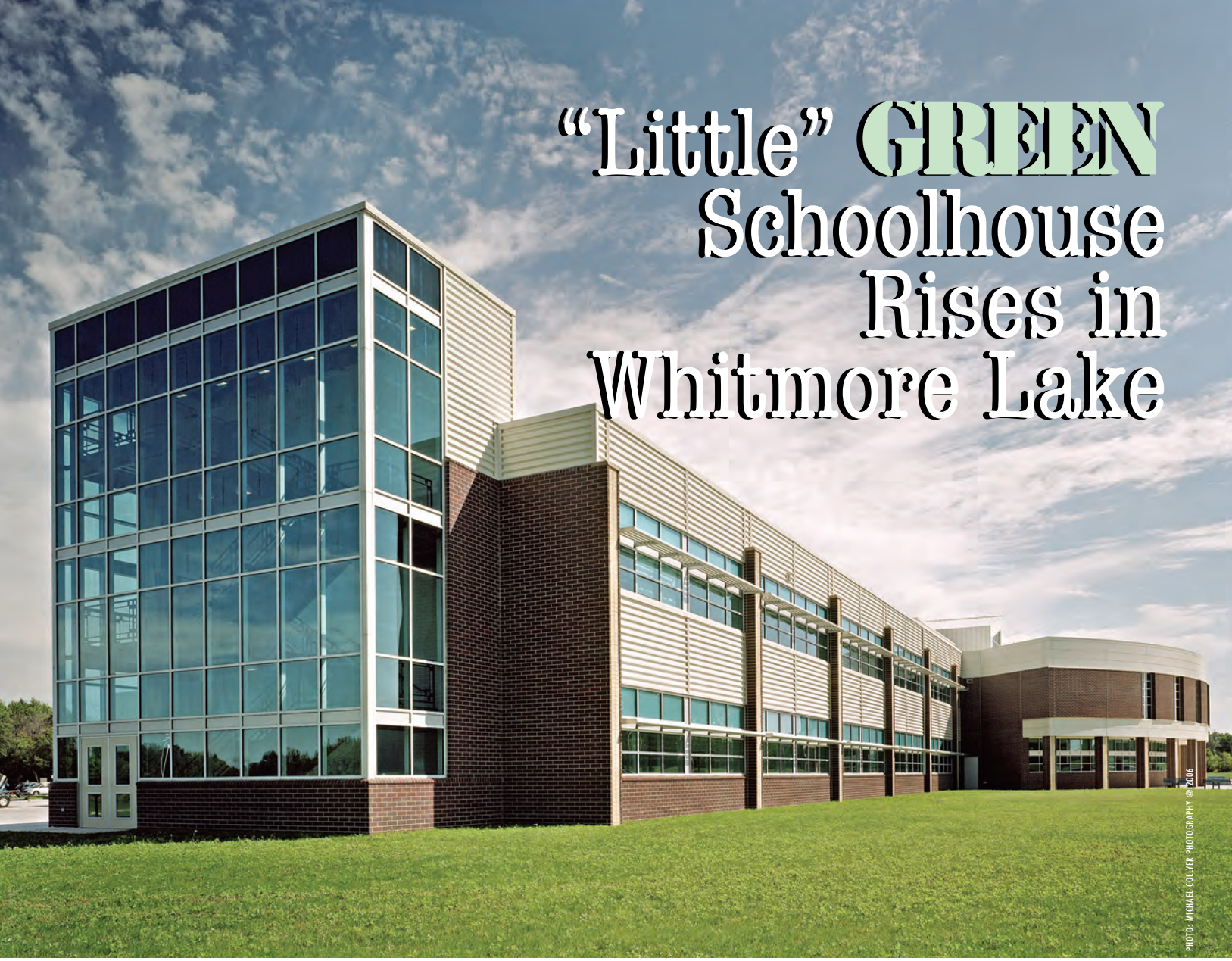
"Little" GREEN Schoolhouse Rises in Whitmore Lake



By Mary E. Kremposky, Associate Editor

Photos by: Michael Collyer

Whitmore Lake Public School District should go to the head of its class for building a "little" green schoolhouse on Whitmore Lake Road. A deep commitment to sustainability delivered a green building on a tight budget with the school board never veering from its chosen course. Designed by Bloomfield Hills-based TMP Associates, Inc. and Mitchell and Mouat Architects, Inc., Ann Arbor, the building's elegant economy of space helped to trim the budget and its energy efficiency is helping to reduce annual operating costs dramatically. Built by Southfield-based Barton Malow Company, the efficiency and sheer tenacity of the project management team produced a job with an 83 percent recycling rate for all construction waste, and brought a building out of the ground despite bitter cold, heavy rains, and a site bogged down in 3 feet of mud in some sections.

The Whitmore Lake School Board committed its resources to Leadership in Energy and Environmental Design (LEED) certification wholeheartedly. "The landscape is littered with abandoned LEED attempts," said Scott A. Menzel, superintendent, Whitmore Lake Public Schools. "Many schools start on the journey and they end up leaving because of hard financial decisions or just the cumbersome paperwork. We made a fundamental commitment at the very beginning that LEED was non-negotiable."

LEED was a key factor in the selection of the project team for Whitmore Lake High School. "We asked both the construction manager and the design team to explain how they would assist in helping us achieve LEED certification," said Menzel.

The 155,000-square-foot building with sky-blue panels of energy-efficient glass is the project team's well-formulated answer. The site's broad open field resembles any other landscape in the Midwest. But beneath the stalks of new vegetation is a

horizontal geothermal system with 47 miles of pipe snaking below a section of field and beneath the surface of a 5-acre pond. Coupled with 71 heat pump units and four energy heat recovery units, this heating and cooling system – designed by Peter Basso Associates, Inc., Troy, and commissioned by Novi-based Horizon Engineering Associates, LLP – provides a comfortable, energy efficient interior with stellar indoor air quality.

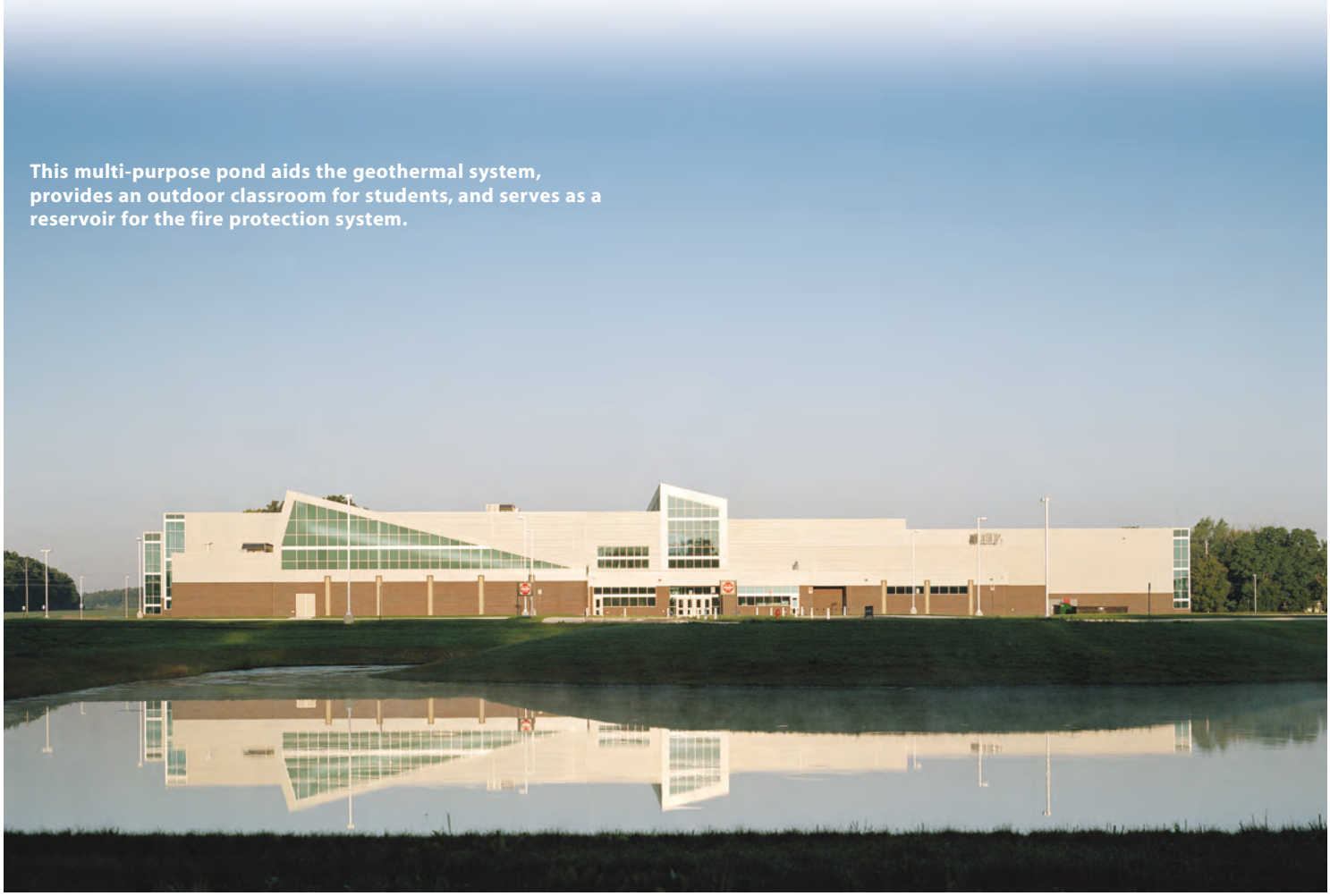
The building may appear to be a conventional high school, but on closer inspection it is definitely a departure from the "old school" way of thinking. According to Eric R. Sassak, AIA, LEED AP, TMP senior associate, part of the building is clad in painted aluminum versus anodized aluminum to render it recyclable; the roof is a white, reinforced PVC membrane designed to reduce the building's heat load and the heat island effect (a dark membrane absorbs and radiates heat, leading to temperature increases); and overhangs along the first-story windows act as sunshades for the building interior.

Along with its environmentally friendly elements, the building's skin of glass, metal and yellow and brown brick gives the exterior a contemporary flair. "We wanted a building for the 21st century," said Menzel. "We wanted a building that points toward Whitmore Lake High School's future."

For the school board, the future pointed to LEED certification. "We were over budget, but we said we are going to do what is necessary to make LEED work," said Menzel. The board cut $2.1 million out of the scope without compromising LEED certification or the quality of the building. "We took a million dollars from the renovation of the old high school, and we took money from unallocated interest earnings on the $47.5 million dollar bond issue," said Menzel. "We had only one opportunity to build a new facility right."

By going green, Whitmore Lake is also building for the broader future. In early February 2007, the Intergovernmental Panel on Climate Change issued the global weather report: increasing temperatures, high winds and violent storms for the next three centuries. This forecast may mean escalating energy costs and possibly restrictions on emissions from everything from cars to a building's energy use. Visionary facilities like Whitmore Lake High School are already reducing annual operating and energy costs to handle a future that is already arriving.

Three years ago, Peter Basso Associates estimated that the school's geothermal system and the energy recovery units could reduce the school's annual operating costs by $80,000, said Menzel. "That figure was given to us three years ago when the cost of natural gas was significantly less than it is now," continued Menzel. The reduction in operating expenses is already helping Whitmore Lake School District grapple with declining funds from the state government. "Local communities build a school, but we are tied to the state in terms of operating costs," said Jim Vibbart, Whitmore Lake school board president. "We haven't really received any real increases in state funding in years, so we have to be very conservative in the dollars that we have for operating a building." Thanks to the school



This multi-purpose pond aids the geothermal system, provides an outdoor classroom for students, and serves as a reservoir for the fire protection system.

board and an equally committed project team, the school's grand opening on August 27, 2006 has certainly given this forward-thinking high school a head start in meeting the challenges of today and the future.

BUILDING A GREEN INFRASTRUCTURE

The new Whitmore Lake High School rises up out of a broad expanse of open field with the woodlands of Washtenaw County ringing the building in a distant halo of trees. "It is a great site in terms of the profile it gives the school district for this new building," said Eric Geiser, AIA, vice president, TMP Associates. "The building sets the stage for what this stretch of road is."

Before the launch of construction, the "stage" had to be reset. The historic farmhouse and barns on the property were moved less than a mile away to the corner of Whitmore Lake and Six Mile Roads. "We are seeking a LEED credit for preserving these pieces of Whitmore Lake's heritage," said Sassak.

Barton Malow officially broke ground on July 24, 2004, first facing the formidable task of bringing site utilities to this bare field in Washtenaw County. Without easy access to power or even any water,

Barton Malow had to bring in three-phase power from over a mile way, while some contractors initially had to drive two miles to a fire station for water, said Chris Pomey, LEED AP, project superintendent, Barton Malow.

Working in brutal winter temperatures eliminated the prospect of storing water on site, making "just-in-time delivery" of water par for the course in the very beginning of the job. Barton Malow had to drill a temporary well to supply this basic need. "We were able to use the temporary well as the basis for testing the two permanent wells for the facility," said Pomey. Installation of a sanitary lift station was another task in this intricate assembly of site utilities from scratch. Bringing gas to the jobsite by tapping a gas line running parallel to the site was the only fairly routine part of this first phase, said Arlene Samuel, project manager, Barton Malow.

Barton Malow had to build another type of site infrastructure at the beginning of the job, namely formulating and supervising a construction waste management program. "We had to implement it at the front end of the job, making sure each contractor was aware of what they had to comply with," said Samuel. Barton Malow established dumpsters on site for brick, block, wood and steel and patrolled the dumpsters to ensure the container held only the stipulated material. "Chris probably spent many hours of his day making sure that those dumpsters were properly sorted, so we would obtain the LEED points for tonnage of waste recycled," said Samuel.

Pomey explained further, "We had to track and record the weight of all waste leaving the site. We then keep track of the percentage of waste that we actually recycle to obtain the LEED credit. The difficult part on our end was if the dumpster has mixed materials (wood gets mixed with brick for example) it can't be recycled, and the weight is considered trash weight." Basically, it lowers the percentage of recycled construction waste and could eventually impact the gaining of a LEED credit.

"Barton Malow really cared, and we would like to compliment them on their construction waste management program," said Menzel. Barton Malow recycled 83 percent of all construction waste, and even obtained money back for recycled materials for the district, said Samuel.

Building green didn't grant the project a reprieve from Mother Nature's bad moods during the course of construction. Cold was the first plague. Frigid temperatures shut down the job for 42 days during the first winter on site, said Pomey. The next plague was mud. The virtually flat site

PHOTOGRAPH COURTESY OF THE BARTON MALOW COMPANY

One third of the geothermal system's piping coils are in the pond. Attaching weights and filling the coils with fluid keeps this aquatic geothermal system submerged and in place.

With an elevated track and multiple windows, the new gymnasium is a far cry from the old high school's box-like facility.

with poor drainage and a high water table, coupled with relentless rains, generated 3 feet of mud in some areas. "It was probably the wettest Fall on record in 2005," said Samuel.

Deep levels of muck altered the sequence of work. "We had to shift work from the north area of the building over to the south, because the north was just mired in mud," said Samuel. "… Initially we were going to excavate the pool and build around it, but instead we constructed the building shell and dug the pool to allow contractors to work inside a covered area to cut down on the mud." Wind completed this trifecta of foul weather. Without any surrounding structures to block its force, the winter wind blew free and hard over the site's wide expanse of field and even disrupted the building's temporary protection on occasion.

FROM FARM FIELD TO GEOTHERMAL FIELD

Mother Nature relented in the next building phase. The weather was perfect and the flat, broad expanse of this old Michigan farm proved to be the perfect spot for a different kind of field, namely a geothermal field. Given the expansive site, Whitmore Lake installed a horizontal as opposed to a vertical geothermal system in the northeast quadrant of the site. According to Pomey, installation of the horizontal system entailed excavating 28 trenches in a 490 x 570-foot section of field to two different depths, one reaching six feet and the other reaching a depth of 4 feet to take advantage of the heat conductivity of different soil types.

Trenching a horizontal system is much less costly than drilling vertical cores to a depth of 200 to 400 feet and then inserting pipe grouted in with concrete slurry, said Robert N. Roop, CPD, vice president, Peter Basso Associates. Conversely, the piping loops in a horizontal system are in direct contact with the soil, eliminating the cost of grouting. "The horizontal system is approximately one third the cost of a vertical system on an install cost per ton," said Roop. "If you have the real estate it is the best choice."

Matt Tunnard, LEED AP, Horizon senior project engineer, explains the basic operating principles of a geothermal system: Two pumps in the mechanical room each push 1500 gallons per minute of a glycol/water mix to the geothermal field and pond where the fluid reaches 55 degrees F – the constant temperature of the Earth. The water then travels to the heat pump units. In the winter, the heat pump extracts heat from the water and transfers it to the air of the building. In the summer, the heat pump transfers heat from the air to the water where the heat is rejected into the ground or pond.

The geothermal field and pond serve as a heat reservoir with most of the water circulating only through the building the majority of the time. "We only go to the ground if we need to reject or add heat," clarifies Roop. "Unless the water is below 34 degrees F or in that range in the winter or greater than 85 degrees F or in that range in the summer, that water just stays in the building and moves the heat around inside the building."

At Whitmore Lake High School, two-thirds of the piping loops are in the soil and one third is in a constructed pond, continued Roop. The glycol/water mix in the pipe coils, plus the attachment of weights to the coils, keep this aquatic geothermal system submerged and in place. The 14-feet-deep pond acts as an additional source of heat transfer, aiding the geothermal system in its function as a heat source in winter and as a heat sink in the summer.

This 5-acre pond serves several different functions beyond aiding the geothermal system. "This multipurpose pond also serves as a reservoir for the fire protection system, and as an outdoor classroom to the students," said Sassak. "We constructed a peninsula into the pond for observation, science projects, and other learning activities."

SUMMERTIME AND THE BUILDING IS EASY

Excavation of this multi-purpose pond provided another benefit - the use of perfect sand fill for a portion of the building pad in the northwest corner of the emerging structure. "We needed to build up that corner by 6 to 8 feet to level it out with the rest of the site," said Pomey. "Using the sand from the pond's creation provided perfect conditions for the footings in that location."

Perfect summer weather aided in the swift installation of the footings, foundation and structural steel frame. "Foundations and steel were probably the smoothest part of the project, allowing us to get back on schedule," Samuel said.

As the next piece of the project, the building envelope wraps the structure in a

cloak of energy-efficient and environmentally friendly materials, including a white, reinforced PVC membrane roof able to reflect heat. The membrane is a newer generation of PVC less apt to become brittle and shatter in the winter. "Reinforced PVC is a newer technology that offers a much more durable and long-lasting roofing material," said Sassak. The wall cavity is filled with a soy-based, spray-on foam insulation for energy efficiency. "This insulation has very good thermal properties," said Sassak. "It also is an air barrier, which means it seals the wall so effectively that moisture and water vapor cannot be transmitted into or through the wall. This moisture blockage helps prevent the growth of mold."

The soy-based insulation doesn't contain any volatile organic compounds, meaning it does not off gas any deleterious chemicals and it can be easily recycled into harmless components at the end of its life cycle. Following LEED, the building skin is formed of highly recyclable, local or regional materials transported from within a 500-mile radius. Overall, the building skin is formed of brick, energy-efficient glass, and painted aluminum panels. "We tried to chose products that are highly recyclable and with a high recycled content," said Sassak.

The interior finishes had to meet the same criteria of sustainability. The school's center spine or Main Street is blanketed in sustainable materials from floor to ceiling. Sassak details Main Street's green material palette: The linoleum floor is a natural, rapidly renewable product, the brick wall is minimal maintenance and will never require painting, and the gypsum board forming the upper wall is covered in low VOC paint. Other building areas follow this same course. The gymnasium has a tectum deck with a high recycled content of wood fibers; the theater has a cork floor cladding the stage foreground; and the athletic wing corridor features a skid-resistant, recycled rubber flooring material.

Quite a learning curve exists for proper submittals and LEED documentation of materials. "Many of the mainstream suppliers of different building products weren't prepared to tell us the exact recycled content of a product or its last point of assembly in relationship to the jobsite," said Sassak. "It was a challenge for everybody, but it is becoming easier as green building becomes more common. Barton Malow just kept on it." Barton Malow tenaciously pursued obtaining timely submittals to avoid project delays, sometimes working with the architects or engineers to expedite approval.

TRADING SPACES

Beyond its "green" skin, the building's compact design minimizes the amount of shell exposed to the elements, inherently boosting the energy efficiency of the facility, said John H. Mouat, principal of Mitchell & Mouat Architects. The two-story building's center spine links the main and student entries. Built for future expansion, two classroom wings flank both sides of the main entry; a south athletic wing and a north art and music wing are arranged in a compact block behind the linear classroom sections.

This compact building has an inspired economy of space with numerous multipurpose rooms designed to save the district money and eliminate wasteful space. "Conceptually, it has been part of the whole LEED system and sustainability in general not to have any redundant space as a means of reducing material waste," said Mouat.

In the north wing, telescoping bleachers form a type of faux wall between the cafeteria and theater. The telescoping bleach-

The building's center spine is a gathering space for students and an organizing axis of the entire structure.

Telescoping bleachers expand backward into the cafeteria and increase the theater's seating capacity from 179 fixed seats to 663 seats.

ers expand backward into the cafeteria, connect to a balcony, and expand the theater's seating capacity from 179 fixed seats to 663 seats.

In the south wing, the fitness room overlooking the 6-lane competition pool is a large multipurpose room, serving in one capacity as an observation deck for swimming meets, a rental space for parties serviced by an adjacent kitchenette or a practice room for the cheerleading team. Two classrooms share science labs located near the end of the two academic wings. "We saved square footage in the building by sharing science labs and lecture rooms versus building 8 full size lecture-lab rooms," said Sassak. "We realized a tremendous economy by being able to shares spaces."

BREATHING EASY

Green schools are not just about saving energy and operating costs. Whitmore Lake High School is protecting its natural, fiscal and human resources in what may become Michigan's fourth LEED-certified high school. Filling every space with natural light and fresh air and dwelling daily in a well-designed building seems to be boosting the spirits of students. "It is a calmer, nicer feeling building," said Tom DeKeyser, principal of Whitmore Lake High School. "Attendance has improved significantly in this building, and grades have seen the same improvements."

Key to creating a comfortable environment, indoor air quality initiatives began as soon as the building was enclosed. "Once the building was enclosed contractors could not smoke inside the structure, said Samuel who undertook a vigorous anti-smoking campaign on the jobsite.

Part of the air quality campaign was to virtually banish VOC products. Initiatives included "using low VOC paints and flooring materials and keeping products with VOC content to a minimum," said Sassak. "The school district has also implemented a green cleaning practice using low VOC cleaners in their cleaning products."

The entire building "breathes," drawing in deep breaths of outside air via a ventilation system bringing in outside air at or above code requirements with no energy penalty. "By using energy recovery units, the school is not paying the penalty of higher energy costs to ventilate the building," said Roop. "Each space is given the measured code required or a greater quantity of outside air, eliminating the sense of stuffiness, contributing to the lack of odor, and improving the general environment of the building."

The heat pump units work in tandem with energy recovery units to pretreat and warm the outside air. Roop explains: The building "exhales" warm waste air. The warm air passes over and heats the surface of an energy recovery unit. The unit transfers the waste heat to the cold air being introduced into the building. "We are able to pick up 70 percent of the waste energy being blown out of the building," said Roop.

The building has carbon dioxide monitors to boost indoor air quality. A building's buildup of higher levels of carbon dioxide throughout the day has been linked to the common afternoon slump in energy and concentration among office workers and students. "The amount of fresh air in this building is at a whole different level than the old high school," said Sassak. "We are actually monitoring the carbon dioxide levels in the school and, when necessary, additional fresh air is

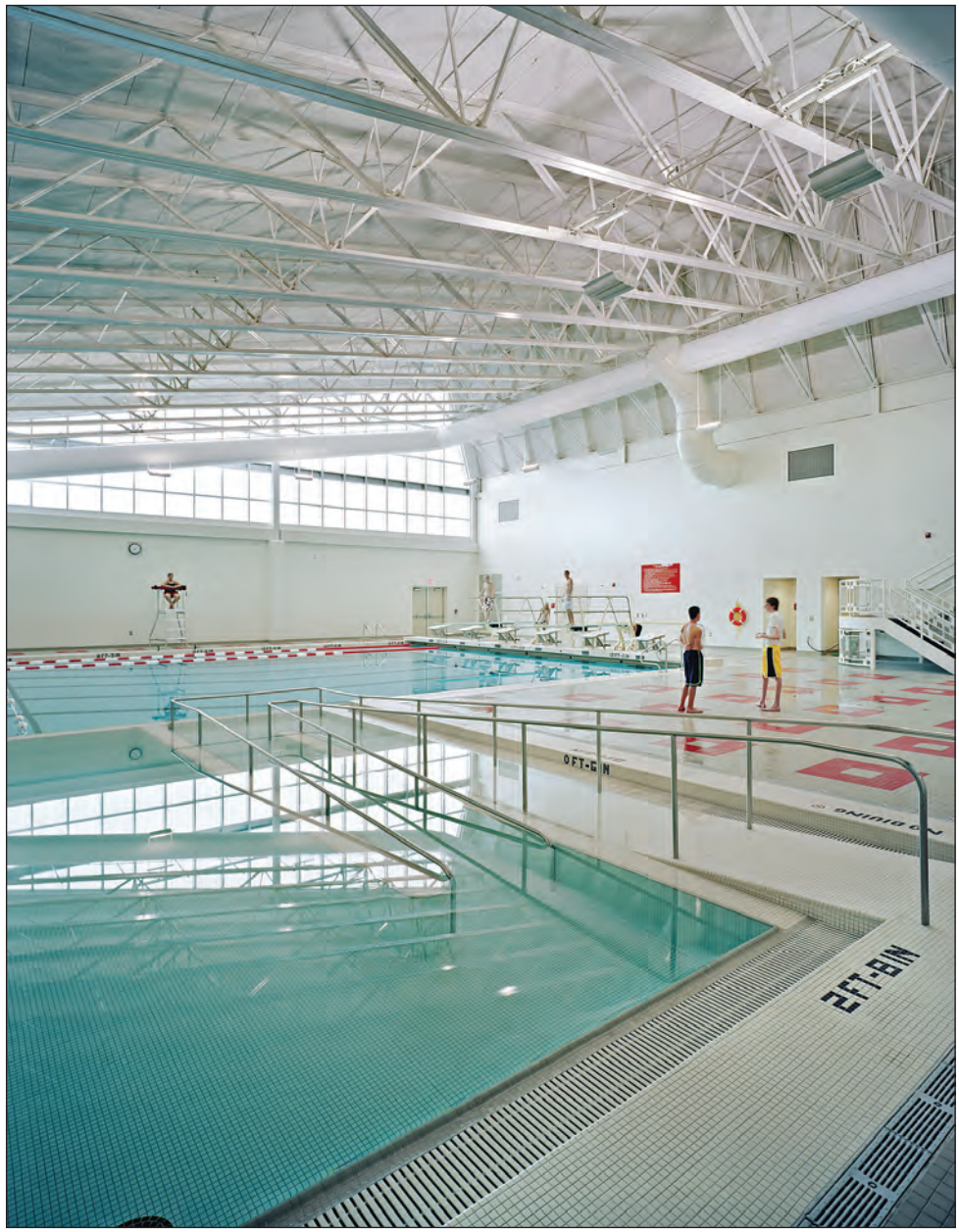
brought into the space to maintain optimal air quality."

Again, the system balances the inflow of outside air with energy costs. "We only ventilate to maintain carbon dioxide at a certain level based on occupancy of a space," said Roop. "If 600 people are in the gym, outside air quantity is increased, but it is reduced when occupancy levels fall to lower levels."

The 6-lane competition pool is also another example of an energy-efficient, comfortable space at Whitmore Lake High School. The pool's air is pretreated with its own energy recovery unit. "Nine months out of the year in Michigan outside air, pretreated with an energy recovery unit, can be used to maintain the proper humidity levels the pool," said Roop. The mechanical system also carefully controls the temperature and airflow. "The mechanical system moves air gently through the space, because it is introduced through formed nozzles, molded outlets and fabric air ducts," said Roop. "Fast-moving, high-velocity air would chill the swimmers and increase the pool's evaporation rate." As a community pool, it contains a handicapped entrance ramp and hydrotherapy jets for seniors.

Whether one is swimming in the pool or sitting in a classroom, the ultimate comfort is to live, work and study in a building with the optimal temperature. The building's geothermal heat pump units provide individual temperature control for each room, a fact offering innumerable advantages over conventional systems. "If the sun is shining on one side of the building, the system cools the space," said Tunnard. "If the other half needs heating at the same time, the heat pump system automatically responds to the temperature in that particular space." Plus, if a conventional boiler/chiller system breaks down, the entire building is debilitated. If a heat pump unit malfunctions, only one space is shutdown.

Horizon performed building commissioning for the school's mechanical and HVAC system, including its geothermal system. Commissioning – making sure the system operates as designed – saves energy and provides another LEED credit. "Building commissioning can be an advantage to the installation contractor," said Tunnard. "The commissioning process assures the contractor that he completed the job to the satisfaction of the owner. The more complex the system, the more important it is to have the building commissioned."



With air pretreated by a dedicated energy recovery unit, the community pool is yet another energy-efficient space in this 155,000-square-foot high school.

SEEING THE LIGHT

The school's grand opening marked the dawn of a new day at Whitmore Lake High School. Students and faculty can literally see the light in every room of this 155,000-square-foot building. The bright presence of daylight was a refreshing change from the old high school's many windowless rooms. "We had several classrooms and science labs in the old school that didn't have any view to the outside," said Menzel. "Plus, the heating and cooling systems were inferior in the old building."

Several studies have extolled the benefits of daylighting and proper ventilation. "Studies have shown that student classroom performance improves substantially in classrooms with good daylighting," said Mouat. Daylighting has been shown to improve student attendance and boost the general well being of staff and students, he continued, while proper building ventilation and appropriate construc-

tion products aids those with asthma and allergies.

The design brings natural illumination into the center spine or Main Street of this compact building. "We used high clerestory windows to project light deep into the heart of the building, instead of making the space dark and cavernous," said Sassak

Windows in every classroom, coupled with light maple furnishings and a neutral whitish paint, create a bright, pleasant atmosphere conducive to learning. On the second floor, fritted glass forms the top window panel and diffuses any strong glare; overhangs on the exterior act as sunshades for the first level.

Classroom sound systems were even installed to allow the teacher to speak in a conversational tone and still be heard throughout the room. "Research shows that allowing the teacher to speak in a normal tone helps time-on-task for students and helps with stress levels," said Paul Twigg, technology services, Barton Malow. "The teacher doesn't have to yell across a group of kids to be heard in the back of the room."

The same emphasis on comfort and natural light shaped the school's other spaces, including the pool and gymnasium. The old high school school had a traditional gym – a square box without any windows. The new gymnasium has an elevated track, windows to the outside and added windows overlooking the center spine. "We wanted an open feel that was less confining," said Menzel.

ENERGY EFFICIENCY FOR THE 21ST CENTURY

The project team focused on energy-efficiency and resource conservation throughout the building, employing the use of waterless urinals and energy-efficient hand dryers in the restrooms, and light sensors operating on either dim or full settings throughout the facility. Thanks to the geothermal system, the building only uses gas for domestic hot water (AMP1). Besides saving energy, the geothermal system saves water resources when compared to a conventional cooling tower. "A cooling tower relies on evaporation, so you end up using a lot of water that also must be chemically treated," said Tunnard.

Another energy and spatially efficient strategy is the use of flat-panel computer monitors in the library and media center. Barton Malow and TMP together designed the building's technology systems, following the LEED principles of sustainability.

"The overall building design tries to keep a small footprint and strives for energy efficiency," said Twigg. "When we designed the computer labs with TMP, we planned flat-panel monitors, enabling the whole lab to be smaller. The flat-panel monitors use less energy and give off less heat, reducing the strain on the ventilation and air-conditioning systems and lowering energy costs.

"Plus, the thin-client computer systems do not have to be replaced as often," continued Twigg. "The district purchased systems that would have a longer life. This is important because every computer contains mercury and lead. Also, 100 percent of the systems are Energy Star compliant, which helps with LEED certification."

This environmentally friendly high school was created by a committed team who did their homework and poured their professional expertise into its geothermal pipes, heat pumps, light sensors, panes of glass, and cork floors and who can now pass this building on to the next generation learning within its walls. The school building will continue to be a teaching tool for its 416 students. "We would like to incorporate an alternative energy program into our high school curriculum and use this building as a launch pad for providing that kind of instruction to our students," said Menzel.

The jobsite of Whitmore Lake High School, itself, was a living textbook on green building, part of the industry's ongoing course work in sustainable design and construction. "I have talked to several contractors who really appreciate having gone through the LEED process, because they feel they are now in a stronger position to get future jobs," said Mouat.

Whether contractor, architect, owner, subcontractor or supplier, Sassak believes a sense of shared responsibility and commitment among all team members is the key ingredient in attaining LEED certification and building a green building. "Many people think that LEED is something only the architect or only the contractor is responsible for attaining," said Sassak. "There is so much shared responsibility in LEED, it is vital that everybody be on board and fully committed. Having an owner, a construction manager and engineers on our team all committed to achieving this goal is the only way it is going to happen." Fortunately, a passionate school board and a dedicated project team made that commitment at Whitmore Lake High School, delivering a textbook example of fiscal, spatial and energy efficiency. This showpiece building even hosted the first meeting of the Michigan chapter of the Council of Educational Facilities Planners International in March.