

Building Green for the Future

Case Studies of Sustainable Development in Michigan

Zeeland West High School, Zeeland



UrbanCatalystAssociates

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Ann Arbor, Michigan

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Students at Zeeland West High School not only learn from their teachers, but also gain an education in sustainable living from the building and natural environment around them.





Project type	Educational
Project scale	Building
Construction type	New Construction - Greenfield
Date completed	August 2002
Address	3390 100th Avenue, Zeeland, MI, 49464
Subjects:	Energy Efficiency
	Stormwater Management
	Funding Sources
	Lessons Learned
Total project costs	\$25 million (\$16.2 million building costs)
Building square footage	173,500 sq. ft.
Cost/square foot	\$144 total/sq. ft. (building alone: \$93/sq. ft.)

Zeeland, Michigan

Zeeland West High School

History

In the fall of 1996, residents of Zeeland, a fast-growing community on Michigan's west coast, opened a new high school facility, Zeeland East High School. Soon after, however, district officials realized that the district would need additional space in the very near future. In 2002, after receiving approval for a bond issue, the second high school building, Zeeland West High School (ZWHS), opened next to the 1996 building. The dual facility provides classroom space for over 1500 students, with room for expansion planned into the site design.

The school district wanted Zeeland West to be "a high performance school for high performance students." Energy savings, achieved through building design and on-site power generation, provide the community with a public building that respects the environment and fulfills the goals set out by the school district. Green elements—including photovoltaic panels, a geothermal heat exchange system, and a wind turbine—allow teachers to integrate environmental awareness into their curricula. "The building is like a textbook," says project engineer Steve Hamstra.

"We, as architects, need to realize that the spaces we design impact the quality of people's lives."

Steve Hamstra

photovoltaic - (PVs) Solid state cells (typically made from silicon) that directly convert sunlight into electricity.

geothermal - Geothermal power is energy generated by utilizing naturally occurring geological heat sources. It is a form of renewable energy.

Energy Efficiency

From the start, the school district recognized that an energy-efficient building would result in significant cost savings over the life of the school. For educational facilities, utilities are typically the second or third highest expenses. By integrating energy conservation with on-site generation, ZWHS saves \$40,000-\$50,000 each year on energy costs alone. The reduced maintenance costs associated with the energy efficiency improvements are difficult to quantify but no less significant; the district saves an estimated \$20,000 per year through less frequent mechanical-system repairs and light bulb replacements.

Throughout the planning process for Zeeland West, the designers worked to reduce energy costs by reducing energy loads. The long axis of the school is oriented east-west, minimizing the negative effects of solar gain while maximizing opportunities for daylight harvesting. High-performance windows with specially designed shades admit daylight to classrooms and office spaces while reducing unnecessary solar heating. Interior science laboratories lack outside windows, but employ clerestories to bring daylight into these spaces. Throughout the new school, low-energy artificial lighting contributes to the building's reduced electricity demand, even in the gymnasium where high-efficiency fixtures use 41% less energy than typical gym lights.

District guidelines specify that schools have black rubber roofs to maximize solar heating in the winter, even though snow covers the roofs for most of the season and black roofs retain summer heat. With the installation of a **white roof** made of thermopolyolefin at ZWHS, the cooling load of the building was cut in half, and insulating the roof to increase its **R-value** resulted in an additional 25% energy savings. To save energy, occupancy sensors and automatic thermostats in each room in the building turn off lights and lower room temperatures to save energy.



The simple action of using light-colored roofing materials reduces the absorption of solar radiation and the energy costs to counteract associated heating.

The geothermal system at Zeeland West comprises 20 miles of pipes extending 400 feet into the ground. Instead of using the more common propylene glycol, the heat exchange medium is potable water; in the rare event that the system develops a leak, the risk of environmental damage is minimal.



white roof - A daylighting strategy that allows natural light to bounce off a shelf located in a window and onto the ceiling to bring light deep into the interior of a space.

R-value - Low-emissivity windows: glazing that has special coatings to permit most of the sun's light radiation to enter the building, but prevents heat radiation from passing through.

The wind turbine at Zeeland West High School represents the collaboration of numerous individuals and firms, including the utility company, local contractors, and the school district.

A collection of innovative energy-harvesting equipment allows Zeeland West to decrease its dependence on purchased electric and gas power. A 120-loop geothermal exchange system located under the marching band practice field provides a stable source of winter heating and summer cooling. Photovoltaic panels produce power from sunlight, and their installation at ground level, instead of on the roof, slightly decreases their efficiency but allows for direct student observation. A 10kW, 23-foot-diameter wind turbine mounted on an 85-foot tower behind the school converts wind power into electric power, saving the district \$1,200 each year on electricity costs.



In energy comparisons of schools throughout the state, Michigan does not factor the presence of air conditioning units into its calculations. Located in the southern part of Michigan, ZWHS is fully air conditioned (including the gymnasium); however, with its energy-saving equipment, the school uses only two-thirds the energy of the average Michigan school. The public has enthusiastically accepted this “green” high school, finding it more comfortable than Zeeland East and shifting many programs to the new building. This extended use results in additional operating hours and energy use at ZWHS, but the school is still 25% less energy consumptive than other schools.

Stormwater Management

While Zeeland West High School's primary green development emphasis focuses on energy efficiency, elements of the site design and landscaping contribute to responsible stormwater management as well. By siting the new school adjacent to the existing Zeeland East campus, the district shares parking, building, and athletic facilities between the two schools, reducing the need for additional impervious surfaces on the site. A recent initiative involves replacing 11 acres of turf grass with native prairie plantings. This conversion will decrease stormwater runoff, provide additional educational opportunities, and save the district more than \$250,000 (in reduced maintenance) over 10 years.

Funding Sources

Funding for the ZWHS project came from a variety of sources. The initial revenue was generated in 1999 from a \$39 million bond issue passed by local residents. AEP, a regional power company, provided a \$5,000 grant for the photovoltaic panels. The on-site wind turbine came from donations from individuals and organizations. A grant from the Zeeland Board of Public Works, along with services donated from a local electrical contractor, covered the installation costs. Another local contractor donated a tower to the school to mount the turbine. In the end, Zeeland West's project costs were below average to average for a Michigan high school.

“Well-designed, energy efficient mechanical systems cost from zero percent to a maximum of ten percent more. The key is designing a building to minimize the need for mechanical systems.”

-Steve Hamstra

Lessons Learned

Zeeland West High School's design is progressive and the project marked the first sustainable school construction project in the state. Other schools across Michigan have embraced principles of green development since, but ZWHS stands as a model of environmentally sound choices in an educational facility. Based on the success of this project, the local school district changed its collective view of facility management, and the board of education included sustainable operation as one of its five overall goals.

GMB Architects-Engineers, the architectural and engineering consultants for the project, discovered the importance of up-front education to the process of green development. Zeeland West was GMB's first large-scale geothermal project, requiring those involved-GMB, the school district, and the contractors-to learn about installation and operation procedures. A pre-bid information session for potential contractors minimized the chances of "surprise" costs derailing the project.

After completing construction and opening the school, the project team realized that the daylight harvesting controls posed a challenge to effective calibration and operation. Building users needed to learn to properly use the low-energy lights. From this, GMB learned that in the future, artificial lights needed to stay on, although dimmed, even when not needed, so that building occupants would not think the lights were broken.

For ZWHS, integrated design allowed mechanical systems to be "right-sized," saving on both capital and operating costs by not installing more capacity than necessary. Steve Hamstra from GMB says, "Well-designed, energy-efficient mechanical systems cost from 0% to a maximum of 10% more. The key is designing a building that minimizes the need for mechanical systems." Examining the design early in the project allowed the project team to work together efficiently and to avoid over-designing the building's mechanical systems.

Zeeland West High School not only provides a place for learning, but serves as a learning tool itself. Through the Internet, students monitor in real-time the geothermal system, photovoltaic panels, wind turbine, and the building's overall energy use. The impact of changing weather conditions on the school's power generation and use is tracked and teachers are able to incorporate this information into the school's science curricula.



Integrating the power generation and energy use monitoring programs into the curriculum at Zeeland West HS give students the unique opportunity to more closely observe and understand the link between humans and the environment.

"The building is like a textbook, not just a receptacle for education."

- Steve Hamstra

The Bottom Line

Zeeland West High School set the standard as the first “green” school in Michigan. The incorporation of energy-saving and energy-producing features into an educational building demonstrates the feasibility and desirability of green development and, at the same time, provides environmental awareness to students, parents, faculty, and the community. Steve Hamstra believes that architects can learn from this project by recognizing that “the spaces we design impact the quality of people’s lives.” Designing sustainable spaces and facilities positively impacts communities for years to come.



Lighting in large areas, such as school gymnasiums, often accounts for a large portion of utility costs. In the gym at Zeeland West High School, lights are only used when needed instead of remaining on throughout the day (as is typical with older gymnasium lighting).

Awards

- Association of School Business Officials Certificate of Excellence (awarded to GMB), October 2003, New K-12 School Building category

Contact Information

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Urban Catalyst Associates

Urban Catalyst Associates

Urban Catalyst Associates (UCA) is an interdisciplinary team of recent University of Michigan graduate students who have combined their experiences, interests, and educations to create a positive impact on the future of the State of Michigan. The team holds a strong passion for fostering innovative, sustainable development that will shape the evolution of the new urban environment.

In collaboration with the Michigan Department of Environmental Quality, Urban Catalyst Associates developed this handbook to serve as inspiration and ready reference to the development community and other interested groups. As the State furthers its investment in green development, the UCA team hopes that this handbook will encourage developers to infuse elements of environmental sustainability into their planning and development processes.

Urban Catalyst Associates can be contacted via email at uca@uca-michigan.com. See the contact information below for information on contacting individual team members.

Zeb Acuff

Zeb holds Master's degrees from the School of Natural Resources and Environment and the Taubman College of Architecture and Urban Planning, both at the University of Michigan in Ann Arbor. He is also a 2001 graduate of the College of Agriculture and Natural Resources at the University of Delaware. Zeb has extensive experience in farmland preservation and local planning research, as well as familiarity working with demographic and social science media. His professional interests include parks and recreation planning, non-motorized transportation, trails and greenway development, and public transit systems. Zeb and his wife currently reside in Dexter, Michigan. Zeb can be contacted via email at zeb@theacuffs.com.

Bryan Magnus

Bryan graduated from the University of Michigan in April, 2005, with an MBA from the Ross School of Business and a MS from the School of Natural Resources. His undergraduate degree is in Finance and Actuarial Math from Bryant University in Smithfield, Rhode Island. Bryan has extensive knowledge of socially and environmentally responsible business with an emphasis on renewable energy and alternative transportation. He has interned with General Motors' Fuel Cell Activities Group as well as Honeywell's Transportation Systems, and is currently employed by Honeywell TS as a Marketing Analyst. Bryan, his wife Lynn, and their "child" Meadow (dog) live in Ann Arbor, Michigan. Bryan can be contacted via email at magnusb@umich.edu.

Aaron Harris

Aaron will complete his final year at the University of Michigan in spring 2006 with both an MBA from the Ross School of Business and an MS from the School of Natural Resources and Environment. Prior to Michigan, Aaron co-founded Harris Brothers LLC, a real estate development/management company based in Chicago and focused on green building design and environmentally sensitive renovation projects. Upon completion of graduate studies, Aaron plans to return to the real estate field to pursue urban brownfield redevelopment projects. Aaron graduated from the University of Wisconsin-Madison with a BA in Sociology (Honors) and a Certificate in Environmental Studies. Aaron can be contacted via email at aaronmh@umich.edu.

Allyson Pumphrey

Allyson graduated from the School of Natural Resources & Environment with a Master's degree in Landscape Architecture in April 2005. Prior to attending the University of Michigan, she received her BS in Landscape Horticulture & Design from Purdue University in West Lafayette, Indiana. Allyson has experience in residential site design and urban redevelopment projects. Her professional interests include urban trails and greenways, brownfield redevelopment, and urban design. Allyson is employed by InSite Design Studio, Inc. in Ann Arbor, Michigan. Allyson can be contacted via email at apumphrey@insite-studio.com.

Larissa Larsen

Larissa Larsen, Ph.D., is an assistant professor with positions in both the School of Natural Resources and Environment and the Urban Planning Program at the University of Michigan. Larissa has a Master's in Landscape Architecture degree from the University of Guelph in Canada and a Ph.D. in regional planning from the University of Illinois at Urbana-Champaign. Prior to becoming a professor, Larissa practiced landscape architecture and urban planning in Chicago. Her current research investigates the ecological and social impacts of urban settlement patterns. Larissa can be contacted via email at larissal@umich.edu.