Manassas Park Elementary School and Prekindergarten (MPES) engages students to be stewards of their own environment. Green lights signal it’s time to open the windows. A gage on a cistern shows the rainwater level. A bioretention area doubles as an outdoor classroom. Even the pipes of the HVAC system are painted red and blue to mimic illustrations of veins and arteries in human bodies. Every detail of this school is designed to be an educational opportunity.

**Building At A Glance**

**Name:** Manassas Park Elementary School and Prekindergarten  
**Location:** Manassas Park, Va.  
**Owner:** Manassas Park City Schools  
**Principal Use:** Public Elementary Education  
**Includes:** Dedicated prekindergarten building, upper elementary building for grades three through five has 59 classrooms, gym, cafeteria plus dining commons, media center, offices and breakout spaces for informal and non-traditional learning  
**Employees/Occupants:** 840 students and educators, with 56 plus visitors per day  
**Gross Square Footage:** 140,463 (MPES and Prekindergarten)  
**Conditioned Space:** 135,702  
**Total Construction Cost:** $24,698,200 ($28,026,925 including site work)  
**Cost Per Square Foot:** $175.83 ($199.53 total hard costs)  
**Substantial Completion/Occupancy:** April 2009  
**Occupancy:** 85%  
**Distinctions/Awards:** LEED Gold-NC v. 2.2; AIA Committee on the Environment 2010 Top Ten Award; AIA Committee on Architecture for Education 2010 Educational Facility Design Award of Merit

**Cost**  
At a completed hard cost of $199.53 per ft² (including site work), this high performance, LEED Gold school was constructed at a 12% premium above the state average for new public elementary schools in the same manner as MPES, making it an accurate, real-world comparison. In its first year of operation MPES saved $0.576 in utility costs per square foot compared to Cougar, for an adjusted total savings of $75,560.  

**In fact, the new building is so efficient to operate that the school system held the 2010 summer school program (kindergarten through 12th grade) at MPES, allowing all other school buildings to be placed in unoccupied mode for almost three months. Since school operating budgets come from annual property tax revenue, the utility savings were especially valued in a down market.**

**Building as the Teacher**

Come forth into the light of things,  
Let Nature be your teacher.  
—William Wordsworth

BY WYCK KNOX, AIA; AND STEVE DAVIS, AIA
All artificial lights are off in this typical elementary classroom. Exterior shading devices protect view windows from direct sunlight, while fixed parabolic light louvers cast an even warm light across the tilted ceiling plane. The teaching wall is glare-free, which is even more critical when using a SMARTboard (an interactive projection display). When the lights are on, each row automatically dims to provide only the illumination needed to supplement the daylight.

The sustainable feature with the greatest differential first cost is the ground-source heat pump mechanical system, which includes 221 vertical bores of 3.50 ft each. Life-cycle cost analysis predicted a payback in seven to nine years.

In contrast, the rainwater harvesting system has a longer payback. An induced stack effect, with favorable winds, natural ventilation is possible. The design team optimized daylighting with standard 90.1-2004 requirements.

In the prekindergarten building, daylight floods each classroom. Continuous glazing at MPES from 3 ft above the finished floor to the 11 ft ceilings allows children to see out and creates a transparent environment.

The principal bioretention area also serves as a partially shaded outdoor classroom and performance stage. Students queue on the benches while waiting to be picked up. Intentionally carved out at a campus low point, the outdoor classroom and adjacent biofiltration area can accommodate a 100-year storm event before slowly releasing the excess water downstream. The stopped terraces regulate the relative scale of storms as the water rises.

The signal lights make the children active participants in energy conservation. The students are the first to open the windows, and when the light turns off, they quickly remind teachers that open windows need to be shut tightly.

Daylight floods each classroom. Continuous glazing at MPES from 3 ft above the finished floor to the 11 ft ceilings allows children to see out and creates a transparent environment. In south-facing classrooms, exterior sunshades block direct sunrays, while clerestory parabolic light louvers redirect sunlight to the ceiling. Acoustical ceilings also slope to reflect more ambient light while absorbing more noise than a flat ceiling.

The result is a glare-free teaching wall with no artificial light. When lights are needed, three rows of pendant fluorescent fixtures (each with its own photosensor) automatically dim to adjust to changing exterior light conditions. Motion sensors automatically turn lights off after five minutes and occupants must tap a switch to turn them on. Each row of pendant lights has four lamps, but only two of the four come on with the press of a button. The user must press a second button to turn on all of the lamps, although this is rarely needed.

Add in the benefits of BAS-controlled light switching, and the total power required for interior and exterior lighting is significantly below Standard 90.1-2004 requirements (30% and 54% less, respectively).
Envelope
The building envelope was designed as a full air barrier system with 2 in. of spray polyurethane foam. Anecdotal evidence during construction indicated that the spray foam was performing well, even before occupancy. The construction manager indicated that no temporary heat was required on the third floor. Over the full course of construction, only half of the anticipated temporary heating was used. The city’s energy manager reports that when city-wide school temperatures were set back during the 2009–10 winter break, MPES recovered to its occupancy temperature in one-half the time of other city schools.

Ground-Source Energy
Rather than using a large centralized HVAC system, each of the 59 classrooms has a dedicated ground-source heat pump, and large spaces and corridors also are independently served. The pumps are neatly organized in mechanical penthouses, providing easy access while keeping the noise far away from the teaching space. Heating and cooling setpoints are set via the BAS, but users can adjust the setpoint two degrees in either direction. Main supply and return pipes are visible through wood slat ceilings in the corridor. They are painted red and blue as in illustrations of arteries and veins of the human body. Efficient mechanical systems include variable-speed pumping, high-volume low-speed fans in the gymnasium, and total energy recovery for ventilation air using sensible and total heat recovery wheels.

Water
All rainwater that falls on building roofs is filtered and collected in a 79,000-gallon concrete cistern, yielding an estimated 1.3 million gallons per year. This water is used for toilet flushing, irrigation, and other non-potable uses.
performing buildings

Perf. Bldgs. R-24.2

Building Envelope

Roof
Type: 4 in. min. of polysiocyanurate insulation, cover board and a fully adhered, white thermoplastic polyolefin (TPO) membrane; air barrier membrane connection to wall at all roof edges; limited use of standing seam roof on prekindergarten addition
Overall R-value: R-24.2
Reflectivity: 0.79 reflectance and 0.92 emittance (TPD)

Walls
Type: Cold formed metal studs, sheathing, 2 in. of closed-cell spray foam insulation, and either brick or metal siding; air barrier transition strips at every change of material and around all openings
Overall R-value: R-20.8
Glazing percentage: 32%

Foundation
Slab edge insulation R-value: R-10
Under slab insulation R-value: R-50 for first 2 horizontal ft of slab edge; R-10 on the entire inside vertical surface of footing or foundation wall

Windows
U-value: 0.29
Solar Heat Gain Coefficient (SHGC): 0.38
Visual Transmittance: 70%

Location
Latitude: 38.45°
Orientation: 13.14° from true north

The kitchen’s gas water heater has a combustion efficiency of 98%, and mini-tank water heaters are located close to classroom and bathroom fixtures. Low-flow and automatic faucets minimize municipal potable water use.

Indoor Environmental Quality
Good IEQ doesn’t stop with elimination of allergens, VOCs and formaldehyde. Children are highly susceptible to harmful effects from ethanol and ether found in many conventional school cleaning materials.
The building’s high performance flooring tiles never require stripping, waxing or polishing—one of the leading causes of poor indoor air quality in schools. The maintenance staff also uses green cleaning products and procedures.

**Ripple Effects**

The city’s construction of its first LEED building quickly expanded a dialogue about sustainability issues within the school and community. MPES created the first green cleaning program, first recycling program, and first meadow landscape in the municipality. In addition, the school realized that the cafeteria was the largest source of waste on its campus. While most schools have moved to disposable trays and plastic sporks, MPES has reverted back to washable trays and silverware.

**An Educational Ecosystem**

Design decisions were made with the specific goal of showcasing as many teachable moments as possible. Interior extended learning spaces offer dramatic and intimate views of the neighboring mixed oak forest, while elementary school children face shady moss- and fern-covered eastern deciduous forest floor. Each academic house is named and themed according to seasons and creatures. Random patterns of clear finished poplar, cherry, ash, oak and maple planks compose “trees” on the hallway wall. The planks are interspersed with full-length mirrors, giving students the abstract effect of walking in the woods. Each species grows in the adjacent forest.

More than just a teaching tool, the building is an educational ecosystem, encouraging direct knowledge of light, energy, water and the world that these natural resources sustain.

**Lessons Learned**

The green light mode proved beneficial during the commissioning process, unambiguously signaling programming errors. The necessity for the building automation system to be fully operational at opening also provided leverage, giving the architect and construction manager real-time feedback as to whether the systems were operating as designed.

The owner required the commissioning agent to commission the building under actual, rather than simulated, conditions. This delayed the final commissioning report (and subsequent LEED certification) until seven months after occupancy, but it has resulted in much more tightly integrated building systems.

An educational ecosystem integrated with the elementary curriculum provides a new level of real-time feedback to the building operators of any system variances or issues.

**The Rainwater Cistern**

MPES building levels and classrooms are named and themed according to seasons, forest levels and species found in the corresponding areas. Signs also explain sustainable building systems and elements of the local ecosystem.

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Design decisions were made with the specific goal of showcasing as many teachable moments as possible. Interior extended learning spaces offer dramatic and intimate views of the neighboring mixed oak forest, while elementary school children face shady moss- and fern-covered eastern deciduous forest floor. At MPES, children have exceptional views of the forest, and can explore the piedmont landscape via many exterior breakout spaces. The principal bio retention area, for example, is designed to serve as an outdoor classroom, performance stage and parent pickup queue.

Previously conducted through 400 ft of concrete pipe, existing storm drainage was rerouted through the bio retention area, which is capable of holding the runoff from a 100-year storm event. Combined with the rainwater cistern, this eliminated the need for any new storm water management ponds. The cistern and outdoor classroom create usable learning space out of what would otherwise be a fenced off, muddy retention pond.

Every classroom is named after a species commonly found in that season and place. In this way, children associate their homerooms with local plants and animals rather than numbers.

Way finding signs throughout the building highlight facts specific to seasons and creatures. Random patterns of clear finished poplar, cherry, ash, oak and maple planks compose “trees” on the hallway walls. The planks are interspersed with full-length mirrors, giving students the abstract effect of walking in the woods. Each species grows in the adjacent forest.

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**BUILDING TEAM**

Building Owner/Representative Manassas Park City Schools
Architect: Environmental, LEED Consultant: VMDO Architects
General Contractor: Hoss Construction
Mechanical, Electrical Engineer: Energy Modeler; 2rw Consultants
Structural Engineer: Fox + Associates
Civil Engineer: Bowman Consulting Group
Landscape Architect: Siteworks Studio
Lighting Design: VMDO Architects/2rw Consultants

**ABOUT THE AUTHORS**

Wynd Knoe, AIA, LEED AP was the VMDO Architects project manager and co-project architect for MPES.
Steve Davis, AIA, LEED AP is the director of Sustainable Design for VMDO Architects.