Clearview Elementary School

Hanover, Pennsylvania

Highlighting high performance

Clearview Elementary School in Hanover, Pennsylvania, is filled with natural light, not only in classrooms but also in unexpected, and traditionally dark, places like stairwells and hallways. The result is enhanced learning. Recent scientific studies conducted by the California Board for Energy Efficiency, involving 21,000 students, show test scores were 15% to 26% higher in classrooms with daylighting. Clearview's ventilation system also helps students and teachers stay healthy, alert, and focused on learning.

The school's superior learning environment comes with annual average energy savings of about 40% over a conventional school. For example, with so much daylight, the school requires about a third less energy for electric lighting than a typical school. The school's innovative geothermal heating and cooling system uses the constant temperature of the Earth to cool and heat the building. The building and landscape designs work together to enhance solar heating in the winter, summer cooling, and daylighting all year long. Students and teachers have the opportunity to learn about high-performance design by studying their own school.

At Clearview, the Hanover Public School District has shown that designing a school to save energy is affordable. Even with its many innovative features, the school's $6.35 million price tag is just $150,000 higher than average for elementary schools in Pennsylvania. Projected annual energy cost savings of approximately $18,000 mean a payback in 9 years. Reasonable construction costs demonstrate that other school districts can build schools that conserve energy, protect natural resources, and provide the educational and health benefits that come with high-performance buildings.

Clerestory windows allow light into a classroom (above). A curved sunscreen wall shades the school's glass corridor along the front of the school (left).

High-performance features enhance learning environment

Materials

Clearview Elementary School's innovative building materials require less energy to produce and use, create less pollution, and deplete fewer resources than their conventional counterparts. For example, about 70% of the building materials were **locally manufactured**. There are significant energy savings when materials, such as the building's hemlock siding, don't have to be hauled long distances. About 75% of the building materials are manufactured with a high-recycled content. More than 5% of the building materials, such as the wheat board millwork and wainscoting, are made from rapidly **renewable resources**. Wheat board is manufactured from wheat stalks and chaff, an agricultural waste, and is as durable as particle-board. During construction, more than 50% of construction wastes were diverted for reuse or recycling. The school also has a central space for materials separation and recycling.

Lighting

Energy-efficient **electric lighting** complements the school's natural lighting. Light-level sensors dim the electric lights on bright, sunny days and turn them up on cloudy days or at dusk. High-efficiency fluorescent lights and compact fluorescent fixtures save energy, as do occupancy sensors that turn off the lights when no one is around. Many lights throughout the school are also manually dimmable.

Daylighting

The design ensures that daylight reaches all educational spaces in the school. The classroom wing is oriented along an east-west axis to maximize the amount of light streaming in north- and south-facing windows. The wing is long and narrow to help light penetrate into the center of the building. High, south-facing **clerestory windows** (located behind and above the corridor) bring abundant natural light into second-floor classrooms. There, white reflective exposed roof decking and classroom walls evenly distribute the sunlight. A large, north-facing window wall brings daylight into first-floor classrooms. Highly insulated skylights funnel natural light into the music room.

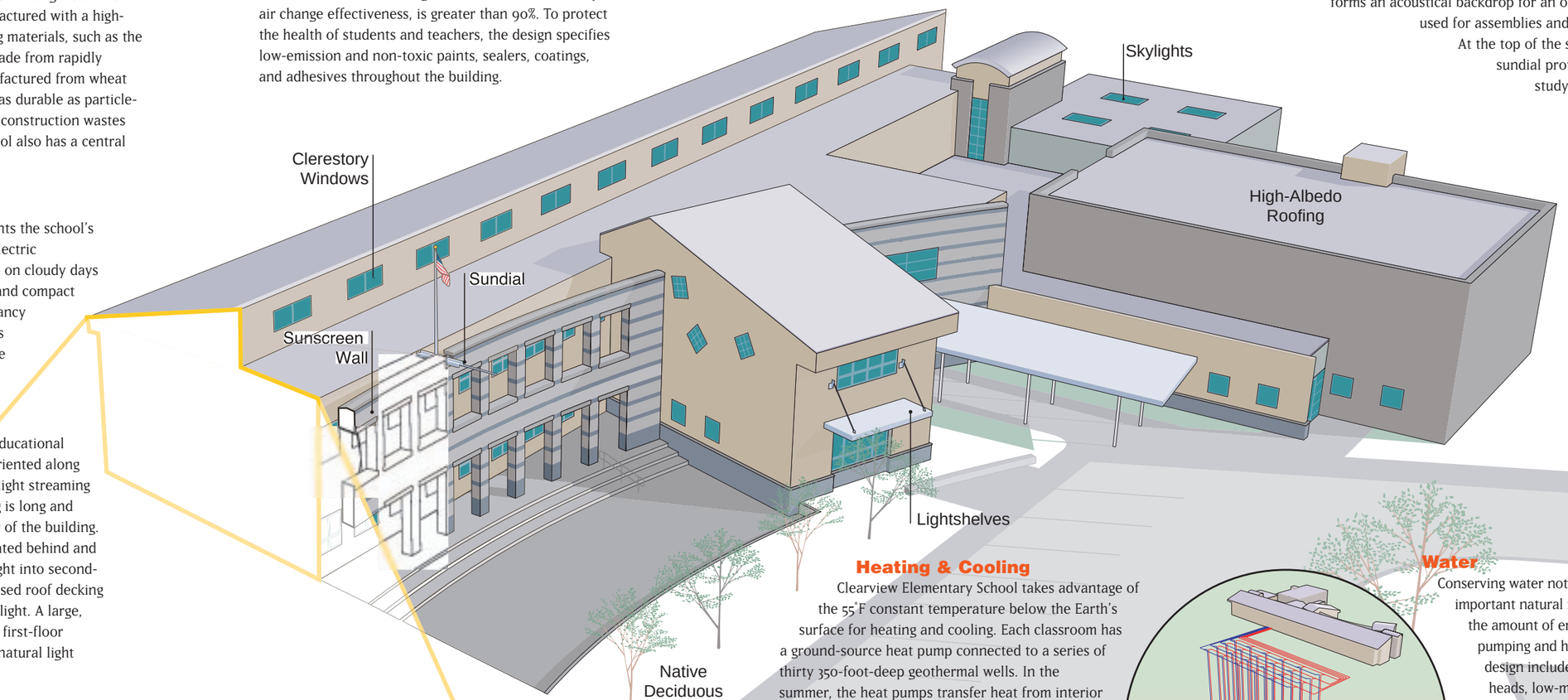
Indoor Air Quality

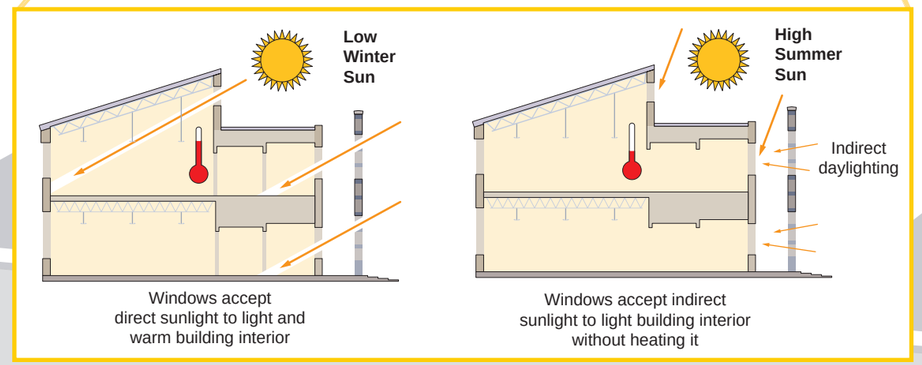
The design emphasizes superior indoor air quality. Floor-mounted air diffusers deliver fresh air to each classroom in response to changes in temperature, humidity, and carbon dioxide levels. Because fresh air comes up from the floor (close to where people breathe) rather than high above them as in conventional buildings, the ventilation efficiency, or air change effectiveness, is greater than 90%. To protect the health of students and teachers, the design specifies low-emission and non-toxic paints, sealers, coatings, and adhesives throughout the building.

Building Envelope

Insulation throughout the building envelope helps keep the building warm in winter and cool in summer. The building's insulating windows are triple-pane, filled with argon gas, and have a low-e coating to reduce heat loss while allowing light to enter. Insulated concrete form (ICF) exterior walls provide high levels of insulation as well. A curved sunscreen wall in front of the building's two-story glass corridor wall provides shading from the hot summer sun and helps support a horizontal sunshade for second-floor windows. The sunscreen wall also forms an acoustical backdrop for an outdoor amphitheater used for assemblies and presentations.

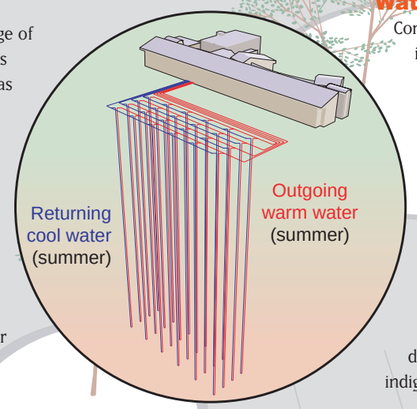
At the top of the sunscreen, a working sundial provides focus for the study of the sun.





Heating & Cooling

Clearview Elementary School takes advantage of the 55˚F constant temperature below the Earth's surface for heating and cooling. Each classroom has a ground-source heat pump connected to a series of thirty 350-foot-deep geothermal wells. In the summer, the heat pumps transfer heat from interior air to water inside the pipes. The air is cooled in the ground to 55˚F before being returned to the school. In winter, the heat pumps withdraw heat from the 55˚F water in the ground to help heat air to 90˚F. The cold water is then sent back into the Earth for rewarming. Ventilating units make classrooms more comfortable by dehumidifying the air in summer and adding moisture in winter. Floor-mounted air diffusers send conditioned air from the heat pumps into the classrooms.



Water

Conserving water not only protects an important natural resource, it also reduces the amount of energy needed for water pumping and heating. The building design includes low-flow shower-heads, low-maintenance waterless urinals, and mechanical push button faucet controls to reduce water consumption for hand washing by more than 30% relative to conventional construction. The faucet controls alone reduce water consumption by more than 40%. The landscaping design also saves water by using indigenous plants that don't require irrigation.

The building's **passive solar** design enhances winter heating and summer cooling. Clerestory windows, horizontal sunshades, reverse-baffle solar shading devices, and a sunscreen wall keep hot, direct sunlight out of the building in the summer. These features allow only cooler, indirect natural light into the building when the sun is high in the sky. During the winter when the sun is low in the sky, clerestories allow direct sunlight inside to light and warm the building. The main corridor's north masonry wall and terrazzo floor help retain solar heat.

Buildings for the 21st Century

Buildings that are more energy efficient, comfortable, and affordable…that's the goal of the U.S. Department of Energy's Building Technologies Program. To accelerate development and wide application of energy-efficiency measures, the program:

- Conducts R&D on technologies and concepts for energy efficiency, working closely with the building industry and with manufacturers of materials, equipment, and appliances
- Promotes energy/money-saving opportunities to both builders and buyers of homes and commercial buildings
- Works with state and local regulatory groups to improve building codes, appliance standards, and guidelines for efficient energy use.

Computer Modeling

Computer modeling is an important part of high-performance design. It allows designers to test the impact of new ideas before construction begins. Modeling saves time and money while ensuring that a new design will perform as well as it can within specified budget constraints. Three computer models helped designers maximize Clearview Elementary School's energy efficiency and daylighting and minimize its environmental impacts.

One model analyzed the energy usage of building characteristics and energy-intensive equipment such as lighting, heating, and air conditioning. A second model allowed architects to test strategies for maximizing the amount of daylighting in classrooms. The architects used a third tool for analyzing building materials. The model allowed them to compare innovative and conventional construction materials with respect to the energy needed for production and transport, environmental impacts, and life-cycle costs.

Clearview Elementary School is one of the buildings selected to represent the United States team in the 2002 Green Building Challenge (GBC). GBC is an international competition that encourages development of buildings that contribute to sustainability.

Key Energy-Efficiency Features

	Base Case	Clearview Elementary School
Wall insulation	R-value = 13	R-value = 27
Roof insulation	R-value = 19	R-value = 31
Floor insulation – Perimeter	R-value = 7.5	R-value = 12
Windows – Solar heat gain coefficient – Visual transmittance – U-value	.49 0.44 .57 - .67	0.27 0.26
Artificial Lighting	.97 sq. ft	1.67 sq. ft

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U.S. Department of Energy
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