Low Energy School Case Study

Photos: Mark Luthringer

OVERVIEW

Building Size: 72,000 SF Main Campus
10,500 SF Gym

Location: Los Altos, CA

Construction Type: Retrofit

Completion Date: 2002

Building Type: Education

CA Climate Zone: 4

Energy Use: Electric, gas

Constuction Costs: $14.6 million

Measured Energy Stats

33	- 0 =	33
BUILDING'S TOTAL EUI	RENEWABLE PRODUCTION RPI	BUILDING'S NET EUI

Site Energy Use Index (EUI) kBtu/SF/year

The Energy Equation: **the building energy use** *minus* **the renewables production** *equals* **the net energy of the building**. Buildings may be 'Getting to Zero' and have a net EUI above zero. If renewable production exceeds energy use its net EUI is below zero (negative) and it is creating surplus energy.

nbi new buildings institute

For more information:
newbuildings.org/zero-energy

GEORGINA BLACH INTERMEDIATE SCHOOL

The Georgina Blach Intermediate School, part of the Los Altos School District, located in Los Altos, California, serves 450 students in seventh and eighth grades. Facilities at the school were unimproved since their construction in 1958, 1962-63 and 1978 and in need of significant upgrades. The 2002 retrofit project included complete infrastructure replacement, modernization of existing buildings and replacement of temporary structures with new construction. In 2002, the district completed a renovation project to demolish 10,000 square feet of the original school and expand the remaining 34,000-square-foot facility to 71,500 square feet, as well as modernize nine of the existing buildings. The expansion involved construction of three new classroom buildings, a performing arts building, and a gymnasium. The modernization project included the library, multi-purpose building, administration building, and four classroom buildings. The Blach School was also a pilot project for the Collaborative for High Performance Schools (CHPS) and is an exemplary building which employs strong fundamental design principles to limit energy consumption.

Planning & Design Approach

The design approach for this project was focused on the students and classrooms. The goal of the design team was to foster a healthy classroom space by incorporating daylighting and natural ventilation, which studies say improve student performance. This primary goal of incorporating daylighting and natural ventilation organically led to a high performing building which takes advantage of these features to save both lighting and ventilation energy. Rather than relying on sophisticated systems and controls, the design team adhered to a "keep it simple" philosophy. This approach has led the way to sustained performance with minimal upkeep.

Some design elements were ruled out based on feedback from stakeholders, for example, adding insulation to the north wall of the existing building was deemed too technically complex, clerestories were used instead of skylights due to

Team/Owner Details

Owner: Los Altos School District

Architect: Gelfand Partners Architects

Civil: Telamon Engineering

Structural: Biggs Cardosa Associates

Mechanical: MHC Engineers

Electrical: Pete O. Lapid & Associates

Landscape: The Miller Company

Construction Manager: Cory Manzo

Awards

Savings By Design Energy Efficiency Integration Award, 2003

Photos: Mark Luthringer

concerns about leakage, and the school decided to forgo automated controls for the ventilation system because of cost and complexity.

In addition to the technical measures that save energy, the design helps visibly highlight sun and shading. The walkway cover at the front of the school is a sundial gnomon, casting a shadow on a student drop-off location with paving that is scored to tell the time. The walkway itself has skylights which cast patterns on the pavement and culminate in the student store/clock tower, where a sky window casts light on the face of the tower.

Policy

The project's energy savings influenced the school board to consider other high performance building retrofits. A study of all district buildings was commissioned by the school board to provide recommendations for priority buildings and campuses and highlight key strategies.

Integrated Design Process

The following design process elements contributed to the success of the project:

- The school district and its architect committed early to a high-efficiency design.
- A collaborative process was established among all parties on the project team.
- An energy consultant and CA Title 24 consultant brought technical resources to the project team.
- The team completed a commissioning process to ensure that specific building systems performed according to the design intent and the school district's operational needs.

Financing

Re-using the existing structure from the start helped decrease the costs of the project. The total cost of the project was approximately $15 million, primarily funded through a school bond. The project also received funding from a Pacific Gas & Electric (PG&E) grant as part of the CHPS pilot program and funding from the "Savings by Design" (SBD) program after the project was completed.

Photos: Mark Luthringer

Through renovations, the school was able to reduce its site energy use intensity (EUI) by 45%.

By using strong design fundamentals for low-energy use (e.g., proper orientation, massing, etc.), the school still maintains strong energy performance nearly 15 years after the project was completed.

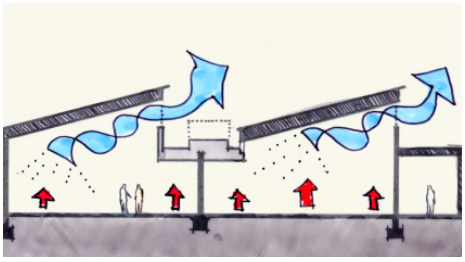
The Blach School qualified for both owner and design team incentive payments from the SBD program totaling $23,708, of which $18,443 went directly to the District and $5,265 was paid to the design team. As part of the pilot program, these grants increased the available budget to study and improve the school design. Specifically, this additional support allowed for enhanced commissioning, daylighting studies, and technical support from consultants.

Energy Efficiency Strategies and Features

By and large, the Georgina Blach Intermediate School does not require sophisticated design technologies. Rather, cost-effective measures were used which had significant impact on the building's energy usage. Automatic sensors modulate direct/indirect lighting to harvest daylighting, stack ventilation reduces active cooling, and right-sized mechanical equipment increased efficiency and reduced capital costs.

Lighting and Daylighting

The school takes full advantage of daylighting opportunities with a large, North-facing façade to gather indirect sunlight in the classrooms. Lighting is provided by clerestory windows. Using this daylighting, controls at the fixture level are able to dim the artificial lights to maintain a constant work-surface lighting level. In doing so, lighting energy is greatly reduced throughout the year, which contributes to the low overall energy usage. Effective use of daylighting through clerestories and windows augments electrical lighting so that combined, the two light sources provide 40 foot-candles (fc) of illumination on all work surfaces. This was an approved change from the District's former standard of providing 70 fc solely from electrical lighting. Dimming ballasts with photocell controls reduce electric light output when adequate daylight is available, and lower ongoing electricity costs.



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Envelope

Increased insulation in the older buildings improved thermal comfort, saved heating and cooling energy, and reduced heating and cooling equipment requirements. The asphalt shingle roof surface was replaced with a reflective single-ply membrane or painted metal in order to reduce absorption of thermal energy from the sun and therefore reduce heat gain.

HVAC

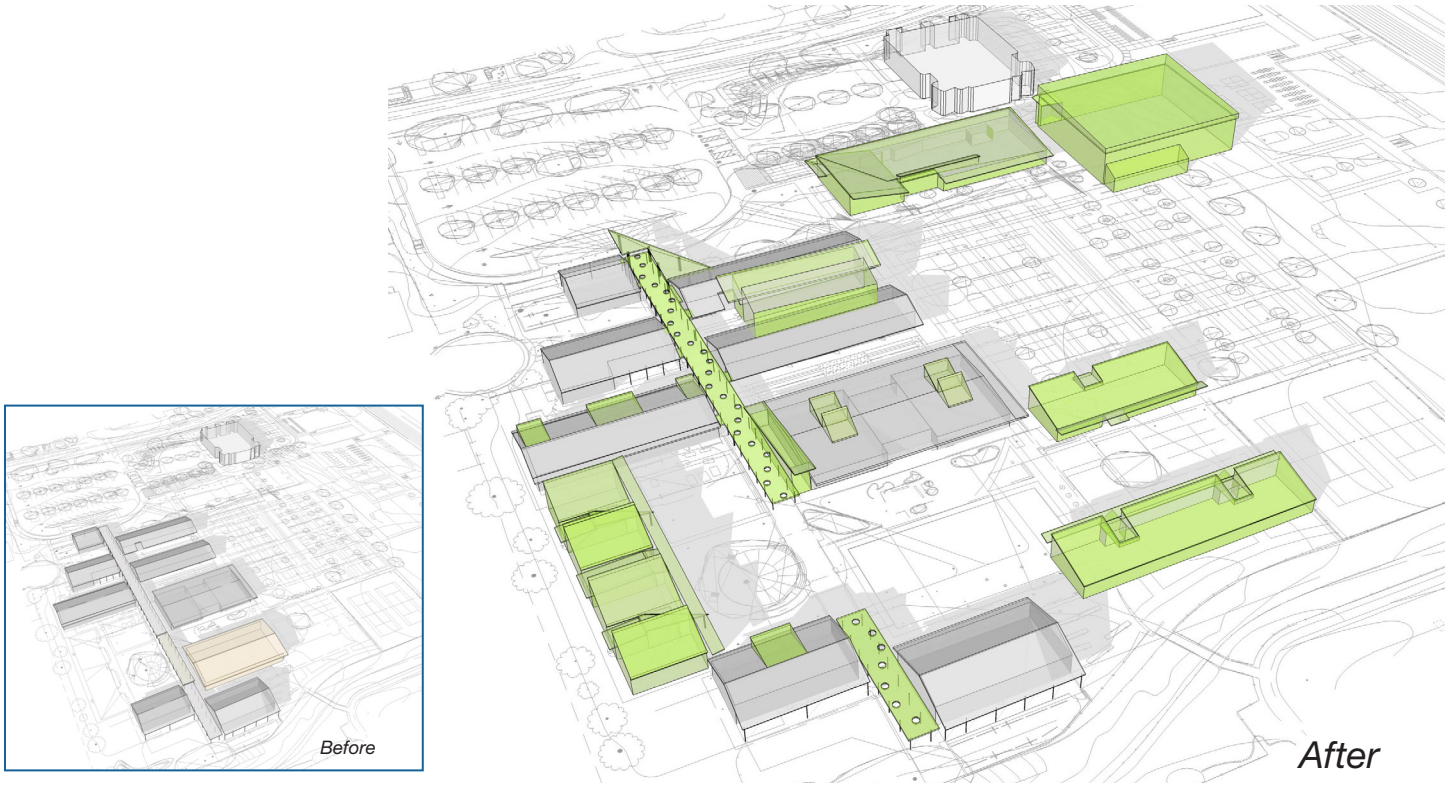
Passive louvers in the new gymnasium and other new buildings provide ventilation without utilizing mechanical equipment. Each classroom has two three-foot doors on opposite sides of the room, one six-foot entrance door, and an operable clerestory. Teachers can open the doors and clerestories to provide natural ventilation when needed.

Thermal comfort studies indicated that a reduction in the size of the cooling equipment could be made without impacting comfort. When operating, the cooling equipment had less excess capacity, which improved its efficiency at a lower first cost.

High-efficiency HVAC rooftop package units with energy efficiency ratings (EERs) in the range of 13 were specified and premium efficiency motors were used for the supply fans on the air conditioning units. While not technically sophisticated, this simple system is reliable with basic maintenance.

Controls

From a control standpoint, the HVAC system is tied into the natural ventilation system. When the system would typically be in economizer mode due to favorable outside air conditions (i.e., the units would simply bring in unconditioned outside air), the clerestory windows are automatically opened by actuators. By opening the windows and allowing natural ventilation to handle the space loads, the rooftop units can then turn off their fans, resulting in considerable energy savings. In the Los Altos climate, a typical rooftop unit can be in economizer mode anywhere from 40-60% of operational hours, depending on the control system settings.



"The inclusion of serious energy conserving technologies makes a powerful statement to our youth, that our commitment to environmentalism comes not only from the heart, but also from the wallet."

- Arthur Harris, Principal Blach School

Renewable Energy Generation and Storage

Although the school currently does not have any renewable energy on site, an energy report published in 2013 for the school district concluded that the Georgina Blach School could offset its current loads with a 160 kW photovoltaic (PV) system.

Behavior

The focus on energy efficiency of the project has helped increase an overall consciousness of energy consumption for the broader school community. For example, in an effort to support the school, many parents would donate old refrigerators to teachers and staff. Redundant refrigerators were being used throughout the school causing unnecessary plug loads. By removing or limiting these appliances, the school business officer identified these inefficient appliances as a simple, no-cost energy savings opportunity.

Successes

At only a 50% modernization, the design has transformed the entire campus so thoroughly that the school community routinely refers to it as "our new school." Through these renovations, the school was able to reduce its site energy use intensity (EUI) by 45% with a 38% savings above Title 24. Leading by example, Blach's success caused the district to adopt its strategies for all the future projects in the district. By using strong design fundamentals for low-energy use (e.g., proper orientation, massing, etc.), the school still maintains strong energy performance nearly 15 years after the project was completed.

To date, the project has not needed to be re-commissioned. This is likely attributable to the relatively simple control system and technology implemented when compared to modern systems.

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Lessons Learned

- Although an energy saving feature, the automatically dimming lighting controls took several months to commission and the system was replaced in future school designs with a more robust dimming solution.
- The collaborative process established between all of the project team parties is an important factor which contributed to the success of this project. The level of efficiency reached by this project has been attributed to the fact that the architect acted as an advocate for daylighting and natural ventilation from the beginning of the project and that technical support was available through the energy consultant and Title 24 consultant.
- Incorporating the Title 24 energy consultant early in the process provided a valuable technical resource for the team, which set up the project for successful commissioning, ensuring that the goals and design intent were faithfully met at the project's completion.

For More Information:

- Collaborative for High Performance Schools (CHPS) — www.chps.net
- Energy Design Resources — www.energydesignresources.com/category/schools/
- Bright Schools Program — www.energy.ca.gov/efficiency/brightschools/
- U.S. DOE Building Catalog: Case Studies of High Performance Buildings — https://buildingdata.energy.gov/project/georgina-blach-intermediate-school

Brought to you by the California Investor Owned Utilities' Proposition 39 Zero Net Energy (ZNE) School Pilot Program.

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