



The Newsletter

PROVIDING
FINANCIAL AND
TECHNOLOGY
STRATEGIES FOR
ENERGY-EFFICIENT
DESIGN IN
SCHOOLS

Let the Sun Shine!

Can we shine some daylight on kids' test scores and save energy at the same time? A recent study by a California energy consulting firm suggests that children learn faster and do better on standardized tests in classrooms with more natural daylight.

Researchers analyzed test score results from over 21,000 student records and visited more than 2,000 elementary school classrooms in three states. In addition, they gathered information about student demographics, administrative structure, and school building characteristics. They used a rigorous methodology to isolate other potential influences and report specifically on the effect of daylighting on student performance.

Daylighting is the art of harvesting sunlight to supplement lighting fixtures in buildings. Effective daylighting directs sunlight up on ceilings and other horizontal planes to diffuse and evenly distribute the light on work surfaces. One of the biggest energy costs in schools is operating the lighting system; using daylighting to augment lighting systems can significantly lower operating costs.

In California, the Capistrano Unified School District in Orange County provided the researchers with data on 27 elementary schools. Northwest Evaluation Association (NWEA) level test scores were used from the 1997–1998 school year. The students were administered the

test in both the fall and spring within one school year. Thus, the researchers were able to compare individual student progress during the school year.

The California School District has numerous building types,

including: finger schools with ample daylighting; wing schools with low transmission glass ("black" glass); open plan schools with few, if any, windows; modular plan schools with clustered class

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Welcome to The Newsletter

The Newsletter is aimed at you—the person who influences the way new schools are designed, built, and operated. Comfortable, productive, and energy-efficient buildings happen on purpose, not by accident. It takes individuals who are interested in building schools that improve the learning and teaching environment to ask the right questions and demand the right solutions. That means you!

The purpose of this newsletter is to provide you with tangible strategies and benefits for constructing and operating new schools using energy-efficient designs. Over the next several months, you will receive quarterly issues. Each issue will cover different aspects of designing, building, and operating new schools, including:

- Introducing integrated building designs for new schools.
- Increasing comfort and productivity for students and teachers.
- Using return on investment criteria for making informed design decisions.
- Knowing what services to demand from architects and engineers.
- Closing the design/construction loop through building commissioning for school maintenance staffs.

Take a moment to review *The Newsletter*. It may help you improve the way your school buildings are contributing to a child's education experience.

This newsletter is funded by California utility customers and administered by Southern California Edison Company, under the auspices of the California Public Utilities Commission. We encourage you to give us feedback. Our hope is that you use this newsletter as a vehicle to share building and operating experiences with other school administrators. Please contact us via email at editor@energydesignresources.com with your comments.



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Energydesignresources is funded by California utility customers and administered by Southern California Edison, under the auspices of the California Public Utilities Commission.

Newport Coast Elementary School

Savings By Design is a program to encourage high-performance design and construction for new buildings. The program is sponsored by Southern California Edison (SCE) under the auspices of the Public Utilities Commission and offers the following services:

- Design assistance to provide information and analysis tailored to meet the needs of your project.
- Owner incentives to help offset the initial costs of energy-efficient buildings.
- Design team incentives to reward designers who meet ambitious energy-efficiency targets.



Savings By Design seeks to improve the comfort, efficiency, and performance of buildings by creating a team approach to design. The program's purpose is to provide the owner and the design team with the energy design tools and information they need to improve building performance.

School administrators should contact their SCE new construction representative at 800-338-8502 in the early planning stages for a new school to determine available funding for energy-efficient designs for classrooms, kitchens, auditoriums, hallways, libraries, and gyms. You will be pleasantly surprised to learn about the financial and technical assistance available to you and your school district.

In late 1997, Southern California Edison's Design and Engineering Services (D&ES) initiated an energy-efficiency and sustainability showcase project with the Newport Mesa Unified School District. D&ES's in-house staff of engineers and architects agreed to provide consulting services to the design team for the Newport Coast Elementary School, led by the architectural firm of Perkins and Will. The plan was to build a new, 25-classroom, K-6 campus that would be the district's first new school in many years. The site was located in an area of new residential development in Newport Beach.

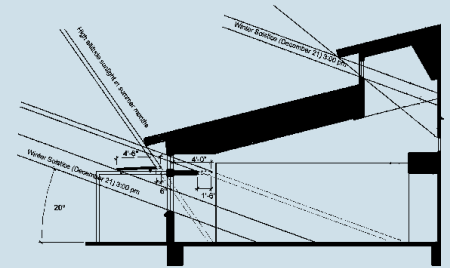
D&ES's role in the project was to facilitate an integrated building design approach for all building systems in order to optimize all energy usage, and improve the environmental performance of the building. D&ES agreed to provide:

- Detailed energy modeling using the DOE-2 computer energy simulation program.
- Natural ventilation studies using a graphical airflow visualization technique called "computational fluid dynamics."
- A "green" materials matrix addressing environmental and indoor air-quality issues.
- Physical daylighting modeling using 1/2" scale models with light sensors to measure interior daylighting throughout the year.
- Commissioning.
- Post-occupancy monitoring.

D&ES's involvement is funded by California utility customers under the auspices of the California Public Utility Commission, with funds earmarked to demonstrate emerging energy-efficiency technologies and the latest design tools for evaluating buildings.

Working closely with the design team from early priority setting, to schematics to design development and construction documents, D&ES has delivered detailed energy and cost analyses of design alternatives for integration into the project. In terms of interior space conditions, classrooms are by the nature of the equipment and number of people in a room, internally loaded spaces. In the sunny, temperate, coastal climate of Newport,

EXAMPLE OF SOLAR ANALYSIS USED FOR DESIGNING SOUTH-FACING CLASSROOMS AT THE NEW NEWPORT COAST ELEMENTARY SCHOOL.



this meant that the goals were to reduce the need for electric lighting while minimizing solar heat gain, and to use natural ventilation for thermal comfort when possible. The energy-efficiency measures that were incorporated included:

- Exterior corridors, and classrooms clustered around courtyards.
- Operable windows, cross-ventilation, and natural air stratification through stack effects.
- Exterior sun shading of glazing.
- Light shelves for daylighting.
- Sectional molding of ceiling planes for improved daylighting distribution.
- Increased roof and wall insulation.
- High-efficiency, direct/indirect fluorescent lighting with multilevel controls.
- High-efficiency heat pumps.
- Solar domestic hot water collectors for preheating (cofunded by a grant from the U.S. Department of Energy).
- Strategic landscaping.

These measures are expected to reduce energy usage significantly as compared to a minimally compliant Title 24 school building.

The project broke ground in September 1999 and is scheduled for completion in late 2000. Many people are following the project, most importantly the teachers, administrators, and schoolchildren who anticipate occupying the new school. Southern California Edison's D&ES staff will monitor the school through its first full year of use and assess the actual energy and user benefits of the elements incorporated in the project, so that other school districts can use this information.

Integrated Building Design

Building a new school can be like educating a child. In educating a child, one develops a fundamental plan:

- Assemble a team of teachers, counselors, coaches, and administrators.
- Conceive the basic skills to be learned.
- Put together a budget for material and labor.
- Identify a process for learning from kindergarten through high school graduation.
- Establish testing requirements along the way.

Building a new school follows the same blueprint:

- Assemble a team of architects, engineers, contractors, and facility personnel.
- Conceive the basic design for the school.
- Define a budget for the project.
- Identify the design and construction process with a given completion date.
- Establish project goals and milestones.

Sounds easy. However, building a school, like educating a child, is challenging. How you implement the plan greatly influences the quality of the child's education or, for our subject, the quality of the building environment.

When we talk about a building environment,

we mean the overall comfort and productivity level provided to the students and teachers during the life of the building. This involves how the building performs and sustains itself. Performance means how difficult it is for the facility staff to maintain and operate the building systems. Sustainability is the impact of the school on the occupants, the surrounding neighborhood and landscape, and our natural resources.

To construct the best-quality building, you must begin during the conceptual phase and with the team that you assemble. The sharing of information among the architects, facility staff, engineers, and contractors is the key to producing a new school with an exceptional building environment. An integrated and interdisciplinary team can design and build a school with a comfortable learning environment, low operating costs, an easy system to maintain, and a positive impact on the surrounding neighborhood.

This approach to building is called "integrated building design." The result is a quality school building that provides an exceptional environment with low operating costs to a multitude of students and teachers over its lifetime.

Simple Energy Design Strategies

Many design opportunities exist for building schools that are more energy-efficient. Understanding some simple energy design strategies is instrumental to achieving a high-performance design.

In Southern California, high-performance lighting systems provide the biggest opportunity for energy savings. Not only is lighting directly responsible for 40 percent of electricity consumption, but the heat produced by lighting must be removed by energy-intensive air conditioners. Efficient choices in lighting include T8 lamps, dimmable electronic (high-frequency) ballasts, compact fluorescent lamps (CFL) in place of incandescents, and high-intensity discharge (HID) in place of high-wattage incandescent lamps.

Upgrading heating, ventilation, and air conditioning (HVAC) equipment is the second line of attack for energy savings. Air-conditioning and ventilation systems consume more than

one-fourth of all the electricity in most buildings in Southern California. It is worthwhile to spend time on high-quality HVAC design that yields greater efficiency as well as increased comfort levels. In a school setting, direct cost savings and increased student productivity can justify increased equipment efficiencies. Improved efficiency for individual system components, such as lamps, ballasts, chillers, fans, pumps, and motors, can result in 20 percent lower energy costs. Buildings constructed in conjunction with Southern California Edison's Savings By Design program, for example, on average consume less energy than if they had been built to Title 24's minimum requirements.

Sources: Architectural Energy Corporation ■ *Savings By Design*, Southern California Edison ■ U.S. DOE, Energy Information Administration ■ *Energy Savings Opportunities in Colorado's Government Owned Centers*, JCEM Technical Report

rooms divided by movable partitions; and portable classrooms with two small windows.

Controlling for all other variables, the study of the Capistrano Unified School District suggests:

- Classrooms with the most amount of daylighting appear to be associated with a **20 to 26 percent faster learning rate** over one school year, compared to classrooms with the least amount of daylighting.
- Students with the most daylighting in their classrooms appeared to **progress 20 percent faster on math tests** and **26 percent faster on reading tests** in one year than those students in classrooms with the least natural lighting.
- Classrooms with the most window area appear to be associated with a **15 to 23 percent faster rate of improvement** when compared to classrooms with the least amount of windows.
- Classrooms with operable windows are seen to be associated with a **7 to 8 percent faster improvement** in three out of four cases, when compared to classrooms with fixed windows.

The study suggests that students in classrooms with the most daylighting score higher on standardized tests. The school district is also saving money with lower light bills. Designing daylighting in schools appears to benefit both the children and the school district.

For more information about the study, please contact via email: editor@energydesignresources.com

Source: *Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance*, July 21, 1999, Heschong Mabone Group

California Energy Commission (CEC), Energy Efficiency Division

The California Energy Commission regulates energy efficiency in commercial buildings. On this site you will find information about Title 24, Part 6: California Energy Efficiency Standards for Nonresidential Buildings. This code specifies minimum energy and equipment requirements for new buildings.

www.energy.ca.gov/efficiency

Energy Crossroads

This energy resource collection is sponsored by the Lawrence Berkeley National Laboratory. It now lists more than 400 Websites in more than a dozen categories, including energy-efficiency publications, green buildings, and major conservation programs and initiatives.

www.eandl.lbl.gov/CBS/eXroads/EnergyXroads.html



Energy Design Resources
123 Energy Drive
San Dimas, CA 91111

The Bright Schools Program Can Help!

If you are building a new school, the Bright Schools Program can help. This California Energy Commission program offers specific services to help you become more energywise, such as identifying cost-effective, energy-efficient systems and providing design and implementation assistance—at little or no cost to you.

The Bright Schools Program can provide design consultation ■ identify cost-effective, energy-saving measures ■ compare different technologies ■ develop specifications for energy-efficient equipment ■ help select architects and other design professionals with school construction and energy-efficiency expertise ■ review construction plans ■ complete value engineering of specific energy-efficiency measures.

Schools built with energy-efficient designs will cost less to operate, offering continuous savings and leaving more money for education. Contact Judy Brewster with the California Energy Commission at 916-654-4008 for more information. In some cases, the program offers loans at competitive interest rates for energy-saving projects. The loans can be used to pay for the incremental cost of the energy-saving measures versus their standard counterpart.

**We want to hear
from you!**

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