

More Daylight Means Healthier Environments

In the last 50 years we have industrialized many landscapes to maximize production with the lowest investment of time, resources, and labor. The educational landscape is much the same. In many modern schools, we have turned classrooms into windowless sweatshops.

Joel Loveland **M**ies van der Rohe's classic call to action, "Less is more," has meant less fresh air, less natural light, and less building in many dimensions. Our children spend nearly 20 percent of their lives between the ages of 5 and 18 in school buildings that have been cost-engineered within an inch of their lives. Gone are high ceilings and great daylight, exchanged for generic shoebox classrooms with an 8' ceiling and, if students are lucky, a single small window. Especially in

the average large high school today, it's not at all unusual to find "land-locked" classrooms without a window, buried deep within the core of the school. Who needs a window, say "value" engineers, when we have electric light, forced air, and fire-rated exiting pathways? These modern buildings are supposed to offer more efficiency and lower capital cost with a better building value. But what values are we accepting in the value equation? And most importantly, how do these designs affect the education, health, and well-being of our children and the teachers who spend their workdays in these buildings?

In the late 1990s, a massive change began in our understanding of what makes for a good learning environment. (*See sidebar for a brief history of classroom design.*) Lisa Heschong, with the initial support of the Pacific Gas and Electric Company of San Francisco, started to look at what physical characteristics of the classroom had the greatest influence on learning. Up until this time, laboratory research on such concerns as visibility and glare were the driving force behind the setting of building design standards.

Heschong, an architect, researcher, author, and teacher, used epidemiological techniques to study the effects of daylight on children's learning. She used standardized test scores for children in specific school populations, correlated to the demographics of the kids, their teachers, and the physical characteristics of their classrooms.

The Heschong Mahone Group (HMG) looked at 21,000 kids in 1,000 classrooms in three school districts in the western United States: San Juan Capistrano, California, Seattle, Washington, and Fort Collins, Colorado. (Reports of their work and the follow-up peer-group re-analysis by the State of California PIER Project are available at www.H-M-G.com.) Well daylighted classrooms in the 1999 study population correlated to a 20 percent increase in student math scores and a

School Design History in Brief

In the United States, our first public, or "common," schools were created in the late eighteenth century. These schools were sometimes in new buildings, but often were placed in storerooms just off the shop floor. By the late nineteenth century, public education had taken a firm hold across the US. One of Seattle's first public school buildings, BF Day Elementary School, constructed in 1896 and still in use today, best represents the nineteenth century design. It has small classrooms of 700–900 sq. ft. with tall ceilings, upwards of 13' high, and windows to match. The classrooms are shallow, no more than 26' deep from the window wall and wide across the building façade so as to gather the most light and fresh air.

With the post-World War II baby boom, design and construction of schools also boomed. The new schools were mostly suburban and one-story, since they had more room to sprawl. Because they were one-story, they tended to have much lower ceilings with daylight coming from one side or through skylights or clerestories. Daylight and natural ventilation were still the first items for consideration in these designs, but the late 1950s began to see the broad application of more efficient fluorescent lighting, fan-forced ventilation, and air conditioning. With the first highly engineered and detailed lighting and indoor air quality standards set in the late 1950s and 1960s, daylight and natural ventilation were deemed too uncontrollable and unreliable. The window was seen as of no value to the classroom. The last nail in the coffin of the window was the energy crisis of the early 1970s. Those schools that hadn't adopted the open classroom of the 1960s and eliminated most, if not all, windows now boarded up their windows to reduce their use of energy for heating.

By the late 1970s the typical classroom had gone from 24' deep and 32' feet wide across the window wall to 32' deep and 30' wide. The exterior wall was mainly solid, with only 5 percent of its surface glazed with an inoperable window, in contrast to the classroom of 1900, where as much as 50 percent of the wall in the shallow and wide classrooms windowed! ■

26 percent increase in reading scores over non-daylighted classrooms. This epidemiological correlation was built with 99.8 percent certainty. A 2002 re-analysis of this work by the California PIER project confirmed the 1999 results. Since 2002, the HMG has reported other similar work in other school districts that correlates about half of this increase in test scores to access to daylight and half to the access to views of nature.

The difficulty in such epidemiological work is the detection of the mechanism for the difference in observed behavior. What actually caused the increase in test scores? The idiosyncratic nature of the activities in buildings complicates an understanding of the effects of the complex variables of the built environment on our behavior or performance.

Bringing daylight back into schools

In many districts, such as in Spokane, Washington, the building process has started with community input on the priorities for building values. Fresh air and daylight rise consistently to the top of the list. In California, schools must be certified as meeting the Collaborative for High-Performance Schools (CHPS) criteria (see www.chps.org). In Washington, the state has invested in an elective set of high-performance criteria titled the Washington Sustainable Schools Protocol.

With Heschong's ongoing epidemiological research in human performance as related to building design, these new research efforts have been the major stimulus to the setting of new "high-performance" building and school design standards in the Pacific Northwest. This advanced work in building performance can be seen in the integrated high-performance designs of such completed schools as Ashcreek Middle School in Independence, Dalles Middle School in The Dalles, and Riverview Elementary School in Lebanon, Oregon. The three Oregon schools, designed by Heinz Rudolf, a partner at BOORA Architects of Portland, were completed in 2002 and 2003 for standard construction budgets for Oregon public elementary and middle schools.

The high-performance classrooms of the twenty-first century are illuminated with diffuse and well-balanced daylight and need no electric light for more than half of the school year. Many of these schools use their daylighting windows for natural ventilation, thus eliminating the requirement for refrigerated air conditioning.

School building design has arrived at a moment in time where less does equal more. Less electricity used for lighting and air conditioning means students of the Pacific Northwest will feel healthier and learn more, while districts use less electricity. 🐾

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UW BetterBricks Daylighting Lab

Riverview Elementary School, in Lebanon, Oregon, is an example of the new direction school building design is taking. Large, operable windows allow both daylight and fresh air into all parts of the classroom.

Lighting Commercial Buildings

Research efforts in commercial settings have linked large increases in retail sales to daylight from skylights. Major retailers such as Wal-Mart and Albertsons have designed their national prototype stores to consider daylight as their primary source of ambient illumination during daylight operating hours. By extension of this research, designers of other buildings, such as hospitals, senior housing, health care, and offices, are adjusting their designs to reflect the importance of daylight and views to the outdoors.

The non-vision effects of light and daylight, in particular, are drawing increasing attention. It has long been known that the window-side patient in a two-patient hospital room tends to improve more quickly. More recently the *New York Times* reported that the neonatal intensive care unit at Duke University had experimented with brighter illumination during the day, when the babies' mothers would have been exposed to higher daylight illumination. This circadian simulation was found to be associated with quicker growth and earlier release than non-circadian-stimulated babies. Dr. Roger Ulrich, director of the Center for Health Systems and Design at Texas A&M University, has linked patient recovery rates from surgery to daylight and views from hospital recovery room windows. Similar associations have been discovered in Alzheimer's patient care facilities. Again, getting patients exposed to daylight (or illumination using daylight spectrum) during critical daytime periods was found to better orient the patients and allow for less wake-interrupted sleep at night. In the last year an elderly housing facility was built in the Portland area with careful consideration of these daylighting and circadian rhythm concerns. Dayrooms where residents can be exposed to serotonin-stimulating "showers" of daylight illumination in the winter months were built as an integrated part of the facility.

The BetterBricks program of the Northwest Energy Efficiency Alliance, a nonprofit agency funded by Pacific Northwest region electrical utilities and public and private agencies, is at the forefront of supporting these new integrated building design concepts, since they also conserve energy. The Alliance's BetterBricks Design Labs in Seattle, Portland, Eugene, Spokane, Boise, and Bozeman are tasked with supporting the implementation of these integrated design concepts in commercial and institutional buildings throughout the Pacific Northwest. ■