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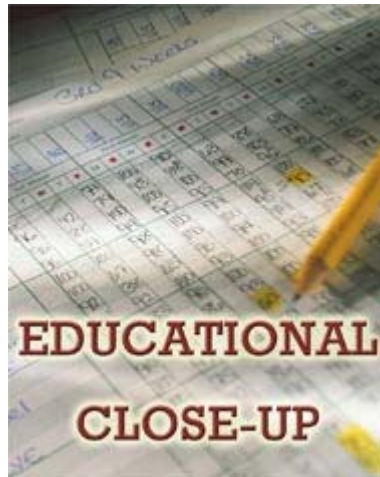
Building Better Schools

High-performance schools are retaining teachers, improving test scores, and bringing communities together

Facilities are rarely discussed when the quality of education is called into question. However, the physical environment can *significantly* impact students' learning and instructors' teaching capabilities. With a rising number of studies validating this, a new philosophy of school design and operation has been born. The high-performance school seeks to solve many of the ills associated with inadequate school building conditions and resulting problems with poor student performance, faculty retention, and excessive operating costs.

With the general public begging for tax cuts, the ability for school districts to secure funding and voter approval on bond issues has become increasingly difficult. As a result, budgets for new school buildings and necessary maintenance and repairs have shrunk, resulting in the proliferation of overcrowded facilities that are costly to operate, inhibit learning, and are sometimes unhealthy for staff and young students.

The most recent statistical analysis completed by the U.S. Department of Education, *Condition of America's Public School Facilities: 1999*, reports that \$127 billion is needed for repairs, renovations, and modernizations in order for U.S. schools to be in good overall condition. While this estimate is sizable, some organizations report less conservative



Resources

2005 Infrastructure Report Card, American Society of Civil Engineers

Building Healthy, High Performance Schools: A Review of Selected State and Local Initiatives, Environmental Law Institute

Classroom Acoustics: A Resource for Creating Learning Environments with Desirable Listening Conditions, Acoustical Society of America

projections. As stated in the American Society of Civil Engineers' 2005 *Infrastructure Report Card*, "The National Education Association (NEA) reported in 2000 that the need was even greater, more than \$268 billion." These numbers are now 5 years old; imagine the need today.

Rising enrollments, combined with the mandates of the *No Child Left Behind Act*, are exacerbating the situation. A report published by the 21st Century School Fund, titled *For Generations to Come: A Leadership Guide to Renewing Public School Buildings*, identifies the following impacts of inadequate schools:

- Alienated students.
- Low staff morale.
- High rates of teacher attrition.
- Inability to provide specialized curricula.
- Reduced learning time.
- Distractions from learning.
- Reduced ability to meet special needs.
- Lack of technological proficiency.
- Health problems for staff and students.
- Safety hazards.
- Less supervision of students' behavior.

Ushering in hope and guidance for better school buildings, organizations and associations have rallied together to define what the next generation of school buildings can offer. High-performance schools seek to decrease or eliminate the negative side effects associated with inadequate learning environments. They not only remove obstacles to learning and teaching, but provide a comfortable environment in which students can excel, teachers can explore new methods and approaches, and the community can congregate.

The Benefits of High-Performance Schools

Students learn. Better environments result in greater learning potential. It may sound obvious, but quantifying the impact of school building conditions on student productivity and performance has been the subject of numerous studies. The results are overwhelming: Higher test scores result when students are taught in an environment that provides appropriate lighting and/or daylighting, is not plagued by poor indoor air quality, provides comfortable thermal conditions, and is free of excessive noise. "If the kids can hear, see, not be sick, and are comfortable - thermally, visually, and acoustically - they're going to perform better," says Charles Eley, executive director, Collaborative for High Performance Schools (CHPS), San Francisco. Better grades aren't the only benefit to students. With improved IAQ and ventilation, students are less likely to miss school due to illness. They can learn in an environment that is both

Condition of America's Public School Facilities: 1999, U.S. Department of Education, National Center for Education Statistics

Do School Facilities Affect Academic Outcomes? Mark Schneider, professor of political science, State University of New York, Stony Brook

For Generations to Come: A Leadership Guide to Renewing Public School Buildings, 21st Century School Fund

High-Performance School Building Resource and Strategy Guide, 2nd edition, Sustainable Buildings Industry Council

Windows and Classrooms: A Study of Student Performance and the Indoor Environment - CEC PIER 2003, Hescong Mahone Group Inc.

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healthy and safe.

Faculty benefits. Teachers reap the rewards of high-performance schools for the same reasons. "New schools that are opening and embody a lot of these characteristics seem to have a much higher retention rate for teachers and waiting lists - not just because they're new," says Deane Evans, executive director at New Jersey Institute of Technology's Center for Architecture and Building Science Research, and author of the Sustainable Buildings Industry Council's *High-Performance School Buildings Resource and Strategy Guide*. The ability of the school to become a teaching tool allows instructors to expand curricula. Jim Jones, director for the Center for High Performance Learning Environments, and associate professor at Virginia Tech's College of Architecture and Urban Studies, Blacksburg, VA, explains: "For example, the integration of energy systems such as thermal solar heating or photovoltaics not only can reduce the use of purchased energy, but could be used as experiments for science classes."

Environmental impact is minimized. Because high-performance schools strive to reduce the building's impact on the environment, resources are conserved. With the implementation of energy-efficient technologies and systems, less energy is consumed, reducing greenhouse gas emitted by power plants. While it may seem like the goals for high-performance schools and green building initiatives are the same, the philosophies differ. "Green design solutions *can* result in better learning environments," says Jones. "However, high performance should go beyond green to consider the interactions and relationships between students, teachers, [the] building, and technology." In other words, while many high-performance schools are green buildings, not all green schools can be considered high-performance schools.

Owners and operators save. It goes without saying that the more efficient a building is, the less it costs to operate. This makes high-performance schools not only highly cost-effective, but also a dream come true for taxpayers. Additionally, with so much emphasis placed on providing the optimum environment for learning, the owner's exposure to liability is reduced.

Communities gather. High-performance schools serve as the ideal location for neighborhood meetings, gatherings, and events. They can bring together groups of people for numerous functions. This is important because it integrates the school into the community and, conversely, involves the community with the school. The building becomes more than a school - it's a community center as well.

High-Performance School Benefits	
The Benefit to Students	Putting it to the test: Students thrive in buildings that are safe, healthy, and designed for learning. Test scores are proof.
	Don't despair - incorporate fresh air: > Due to improved ventilation and indoor air quality, high-performance schools report less absenteeism, the result of healthier students.
The Benefit to Teachers	Great working conditions: > Teachers and staff reap the same benefits as

	students, breathing healthier air and working in more comfortable conditions. The result is increased teacher retention rates.
	Expanded curriculum possibilities: > The building itself becomes a teaching tool, providing greater flexibility and real-world application of lessons.
The Benefit to the Environment	Protecting and preserving natural resources: > High-performance schools consume less water and energy and help reduce greenhouse gas emissions.
The Benefit to the Owner/Operator	The bottom line looks better: > The efficiency of high-performance schools results in reduced operating costs, a win-win for taxpayers and building owners.
	Controlling liability: > Because high-performance schools are healthier, more environmentally friendly buildings, an owner's exposure to liability is reduced.
The Benefit to the Community	A community center in disguise: > What's good for students is also good for the community. High-performance schools serve as the ideal place for meetings, gatherings, and events.

> High-Performance Schools by Design

These high-performance goals are achieved by using a whole building integrated design strategy. CHPS defines this process in the following way: "From the beginning of the design process, each of the building elements (windows, walls, building materials, air-conditioning, landscaping, etc.) is considered part of an integrated system of interacting components. Choices in one area often affect other building systems; integrated design leverages these interactions to maximize the overall building performance." While every high-performance school differs from one another, each is designed to optimize IAQ, thermal comfort, lighting and daylighting, and acoustics (among many other factors).

IAQ. What does the energy crisis of the 1970s have to do with poor indoor air quality in America's schools? Unfortunately, as the push to save energy swept across the nation, more tightly sealed buildings were constructed and ventilation rates were reduced in an effort to cut consumption. Factor in the use of synthetic building materials and furnishings, pesticides, and cleaning supplies and it's no wonder that faculty and students who are breathing increasing supplies of contaminated air in schools are experiencing more respiratory illnesses. According to Mark Schneider, professor of political science, State University of New York, Stony Brook, in the 2002 report *Do School Facilities Affect Academic Outcomes?* "... enhanced ventilation rates not only deliver more adequate supplies of fresh air, but also help dilute or remove contaminants, especially chemical (e.g. formaldehyde, toluene, and styrene) and biological (e.g. mold and bacteria) contaminants that have highly demonstrable negative health effects."

"Some kids are pretty tolerant of bad air quality - others are not. And if you

look at the incidence of asthma and other breathing-related diseases in schools, they've grown significantly in the last few decades," Eley says. The U.S. Department of Education analysis noted that 26 percent of schools ranked ventilation as the most unsatisfactory environmental condition in their facility(s). The effects that poor indoor air quality can have on students range from mild or severe asthma attacks to drowsiness, headaches, and dizziness - not to mention the school days missed while recuperating at home.

According to CHPS, "High-performance schools mitigate poor indoor air quality by using materials that do not off-gas hazardous chemicals, [by] utilizing properly designed ventilation and air-conditioning systems, and [by] focus[ing] on preventative maintenance."

Thermal comfort. The issue of thermal comfort in schools deserves more than a shrug of the shoulders and a you-can't-please-everyone attitude. As noted in Schneider's report, numerous studies prove there is an optimum range for both temperature and humidity at which students are best able to perform tasks and remain healthy. According to the *Academic Outcomes* report, "... students will perform mental tasks best in rooms kept at moderate humidity levels (40 to 70 percent) and moderate temperatures in the range of 68 to 74 degrees F."

Unfortunately, many schools (29 percent, according to the U.S. Department of Education) are plagued by inadequate heating, ventilation, and air-conditioning systems. The aim of high-performance schools to provide environments that are not too warm, cold, or humid mandates the use of well-designed ventilation and cooling systems.

Lighting and daylighting. Environments with the right lighting design enhance visual acuity and comfort. Not only is artificial lighting design critical, but many researchers have proven that access to outdoor views and the infiltration of daylight can have a positive effect on pupils. "Students who are in classrooms with more natural daylight have been shown to achieve higher scores on standardized tests, progress faster in math and reading, pay attention longer, and even miss fewer days of school," reports the 21st Century School Fund in *For Generations to Come*.

The most frequently cited study on the impact of daylight on students was completed by the Fair Oaks, CA-based Heschong Mahone Group Inc. Results from previous studies highlighted in *Windows and Classrooms: A Study of Student Performance and the Indoor Environment* have quantified the value of daylight in classrooms by charting between a 7- and 26-percent improvement in student learning rates. However, the Heschong Mahone Group findings warn against the negative impacts of glare and direct sun penetration, which can be detrimental to student performance, especially with respect to math comprehension. According to Eley, high-performance schools should eliminate direct sunlight penetration; provide gentle, uniform illumination; avoid glare; provide control of electric lights; and be planned with daylighting design principles in mind.

Acoustics. Noise levels can affect learning. After all, if students can't hear, they can't learn. However, the problems resulting from poor acoustics can be even more serious. "Noise levels influence verbal interaction, reading comprehension, blood pressure, and cognitive task success, and may induce feelings of helplessness, inability to concentrate, and lack of extended

application to learning tasks,” states Schneider in his *Academic Outcomes* report. To ensure that students are able to remain focused, concentrate on tasks, and communicate effectively, high-performance schools must take measures to reduce the excessive noise resulting from building equipment and adjacent spaces. The Melville, NY-based Acoustical Society of America has published information on the basics of classroom acoustics and their impact on student and teacher performance.

Top Design Considerations				
<p>According to the Washington, D.C.-based Sustainable Buildings Industry Council, the numerous building blocks of a high-performance school include:</p> <ul style="list-style-type: none"> ● Acoustical, thermal, and visual comfort. Superior indoor air quality. ● Environmentally responsive site planning. ● An energy-efficient building shell. ● High-performance lighting and HVAC systems. ● Daylighting. ● Renewable energy. ● Environmentally preferable materials and products. ● Water efficiency. ● Life-cycle cost and energy analysis. ● Safety and security ● Building commissioning. <p>Of these, the most-studied elements of building design found to impact students are IAQ, thermal comfort, lighting and daylighting, and acoustics.</p>	<p>IAQ > The effects that poor indoor air quality can have on students range from mild or severe asthma attacks to drowsiness, headaches, and dizziness - not to mention the school days missed while recuperating at home. According to the U.S. Department of Education, children are absent from school due to asthma 6 million days per year in K-12 schools.</p>	<p>Thermal Comfort > Inadequate heating and cooling can create an unnecessary distraction for students, who may spend more time sweating or shivering than learning. Mark Schneider's <i>Do School Facilities Affect Academic Outcomes?</i> reports that moderate temperatures (between 68 and 74 degrees F.) and moderate humidity levels (40 to 70 percent) allow students to perform mental tasks best.</p>	<p>Lighting/ > Daylighting > A school's design should provide views to the outdoors (when possible), eliminate direct sunlight penetration and glare, as well as provide gentle, uniform illumination. Additionally, daylighting is worth exploring. "Students who are in classrooms with more natural daylight have been shown to achieve higher scores on standardized tests, progress faster in math and reading, pay attention longer, and even miss fewer days of school," reports the 21st Century School Fund in <i>For Generations to Come</i>.</p>	<p>Acoustics > Excess noise can distract students and make speech intelligibility difficult. "In many classrooms in the United States, the speech intelligibility rating is 75 percent or less. That means that, in speech intelligibility tests, listeners with normal hearing can understand only 75 percent of the words read from a list," reports the Acoustical Society of America in its Classroom Acoustics booklet. The ideal conditions for learning are created when acoustics are considered as part of the school's integrated design.</p>

> The Price of High-Performance Schools

Designing, constructing, and operating schools that are buildings built for learning is obviously advantageous; so why aren't more people using this strategy for their new construction projects? The reasons vary from lack of information and fear of something new to the assumption that high-

performance means higher costs. “You can always build a better school for more money; you can always build a worse school for more money, too,” says Evans.

“In my opinion, soft costs add between \$1 and \$2 per square foot and hard costs are negligible,” says Eley. The increased initial expense is due in large part to additional design and commissioning time. To manage the initial costs, define priorities and - when possible - make trade-offs. “The schools that do a pretty good job of improving performance of the facility - particularly with respect to daylighting, energy, and indoor air quality, which are the big three - do it by trading things off and by integrating design,” he explains. For example, if it’s a priority to have a lavish auditorium on a grand scale, recognize that this may limit (or eliminate altogether) spending on high-performance building features that could improve the condition of classrooms (the spaces where students spend the most time each day).

Because of the integrated design approach, each decision impacts another and often balances costs, which might at first seem steep. For example, the initial investment for exterior lightshelves to enable daylighting without glare means that a classroom can be occupied a certain percentage of the time without the need for artificial lighting. Because of this, the lighting system can be downsized, resulting in lower initial costs and reduced energy consumption over the life of the building. According to CHPS, “High-performance design saves money on both sides of the ledger by reducing operating costs *and* increasing school funding.”

When you factor in the ability of high-performance schools to retain teachers, optimize student performance, benefit the community, and maximize resource efficiencies, implementing this strategy is well worth the money. It’s time to start recognizing the impact facilities have on education and start building better schools. Our children, teachers, communities, and the environment deserve better.

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