Illinois Resource Guide for Healthy, High Performing School Buildings

Illinois Capital Development Board
Illinois State Board of Education
Healthy Schools Campaign

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Foreword

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Building a new school is one of the most important investments a community can make. Decisions made *now* about the design and construction of a new school will affect how students learn and staff members teach for several generations. Decisions made *now* also will impact a school district's finances for decades.

That's why one of the first decisions by a community planning a new school should be a strong commitment to building a healthy, high-performing facility. Healthy, high-performing schools contain elements designed to help educators achieve their core mission – educating children. These schools form the foundation of a favorable learning environment for students, enhance the productivity of teachers and staff, and create an overall sense of comfort, health and well-being.

A healthy, high performing school:

- Improves student academic performance.
- Promotes student and staff health.
- Supports healthy lifestyle choices among students and staff.
- Is cost-effective and lowers a building's operating expenses.
- Reduces a building's environmental impact and serves as a good neighbor.
- Creates a centerpiece for the community.

This Resource Guide for Healthy, High-Performing School Buildings is intended to help Illinois school administrators, school board members and other key decision makers learn the principles of healthy school design so they can engage in a meaningful dialogue with their design team about the plans for their new school.

This resource guide also can influence the renovation of existing buildings with technologies and new materials that enable older structures to become more healthy and high performing. In addition, the students and staff at an existing school can benefit from the strategies and recommendations in this guide to help them improve conditions in their classrooms and the procedures used to operate a building.

This is not a prescriptive document – you should work with your design team to identify and incorporate only the design features that are right for *your school* and *your community's* unique needs. This resource guide can act as a supplement for architects and other design professionals that have the expertise, experience and access to technical references needed in the construction of healthy, high-performing schools. This guide also contains information about people and programs in Illinois that can help you build your healthy, high-performing school.

We hope this resource guide will give you the tools you need to make the best decisions for your students, staff and community.

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Using This Document

The information in this resource guide provides school administrators, school boards and other community members with guidance to help make informed decisions about health and energy efficiency issues important to schools. We recognize that school districts have different needs and that the decisions about school buildings must be made at a local level. Our intention is to provide tools that will allow communities to build schools that provide healthy learning environments and energy efficient operations.

This resource guide contains the design elements of a healthy, high performing school and the policies to support the school once it is open. This extensive resource also offers case studies from new schools in Illinois, information on financial resources, tips on selecting a design team and a glossary of terms. Additionally, this guide provides information about educational materials that can help turn a school into a hands-on learning laboratory for students.

This resource guide can be used as a stand alone document, or it can accompany other green design practices, such as LEED (Leadership in Energy and Environmental Design). The document was written specifically for Illinois schools, based on national best practices, and it includes new information about designing cafeterias and health service areas to promote student well-being.

We developed this resource guide in order to promote long-term thinking and to build our future schools in line with the goals of improving learning environments, reducing operating costs, supporting health and safety, and protecting our natural environment. As we construct new schools to educate our future leaders, we believe the values we instill in our students should be embodied in the buildings we use to teach them.

What Is a Healthy, High Performing School Building?

Characteristics

A healthy, high performing school building is an educational facility designed to provide a productive learning environment for students and staff, promote a healthy lifestyle, save operating costs and help sustain the environment.

Healthy, high performing school buildings have a positive effect on student learning. Studies have demonstrated improved student performance and increased daily attendance in these buildings. Studies have also found that employees who work in these buildings report better employee satisfaction. These schools also promote student and staff health, well-being and safety.

This resource guide is intended to help districts create superior buildings that meet their educational and operational needs.

Goals

The first step in building a healthy, high performing school is to set goals that guide the design and construction process. Establishing these goals up front is more cost-effective than making these decisions once the building design process is under way, at which time changes can add extra costs.

The four main goals of a healthy, high performing school:

- **Improve the Learning Environment** – By providing natural daylighting, acoustical comfort and superior indoor air quality, schools can decrease student and staff absenteeism and increase test scores. Also, a healthy, high performing school can provide powerful hands-on learning activities for students.

- **Reduce Operating Costs** – By designing the building through an integrated approach where efficient systems work together, schools can save upwards of 25 percent on energy and water costs per year.

- **Support Health and Safety** – By creating a school that supports the environmental, nutritional and physical well-being of students and staff, schools can promote a healthy and safe lifestyle.

- **Protect our Environment** – By using environmentally responsive site planning, reducing water and energy use and promoting renewable energy, schools can help protect the natural environment and be stewards for the environment in their community.

Assessing Needs and Establishing a Planning Team

A key factor in the success of a healthy, high performing school is building support in your school and in your community. Creating opportunities for community participation can provide a variety of benefits including allowing you to build support for financial assistance. Broader community involvement may help identify important issues and increase dialogue among all stakeholders. One way to include community involvement is to establish a planning team composed of school board representatives, administrators, staff, parents, students or others. It is important to involve a wide spectrum of representatives while assessing the needs for your healthy, high performing school.

Once a district has decided to design a healthy, high performing school, steps should be taken to complete the assessment of needs to identify educational, financial and facility requirements. The ultimate goal of the assessment is to ensure the principles of healthy, high performing schools are incorporated throughout the design and construction process to create a healthy and effective learning environment.

The planning team will play a critical role in translating the assessed needs to the architect and engineer design team. The planning team should participate in periodic reviews of the district's goals in order to ensure the healthy, high-performing design criteria are implemented as intended. This review process should continue throughout the design and construction process until the building is complete.

Resources

- The Illinois Capital Development Board online Reference Library includes downloadable manuals and forms, including the Fee Negotiation Handbook, Professional Services Agreement and Design and Construction Manual – www.cdb.state.il.us/CDBWEB.nsf/forms

Making Legal and Proper Selections

When selecting architectural and engineering design professionals in Illinois, school districts are required to follow the Local Government Professional Services Selection Act (50 ILSCS 510/ 0.01). When evaluating design professionals for a healthy, high-performing design, experience with energy efficient design, familiarity with LEED building criteria and openness to new concepts and techniques should be criteria for selection.

Design Elements of a Healthy, High Performing School Building

This portion of the resource guide breaks down the process for designing a healthy, high performing school into four sections. Each section contains a series of brief chapters that provide an overview of a major element of healthy, high performing design. All of the chapters address:

- What – the design element
- Why – reasons it is important to students, staff and the district's bottom line
- How – ways it can be incorporated into the school's design
- Impact – how the design element influences other building components
- Resources – lists for additional information

The **Plan Your Building** section describes several design processes and tools to help the district and design team plan for a building. The chapters contain information about evaluating cost considerations over the life of the building (rather than just considering initial costs) and choosing a site that takes into account factors such as energy needs and environmental sensitivity. The chapters also include tools for modeling the energy needs of the building and information on ensuring that systems are installed as designed.

The **Reduce Operating Costs** section provides information about major design considerations that can lower energy usage and reduce long-term operating costs. Each of these considerations also plays a role in ensuring the learning environment is comfortable and productive. Elements in this section include the building shell design, efficient electric lighting, and heating, ventilation and air conditioning (HVAC) systems.

The **Design for Health, Safety and Comfort** section discusses creating a school environment optimally suited for learning, teaching and working. The daylighting and indoor air quality chapters provide information about design techniques that may aid student performance and health. The thermal and acoustic comfort chapters outline information for creating a comfortable atmosphere in which students can focus on learning. Design elements that also facilitate safety are addressed. Finally, this section focuses on two innovative elements for building design: creating kitchens and cafeterias that promote healthy lifestyles; and building health facilities to support the best care for students.

The final section, **Protect Our Environment,** provides additional design elements that can make buildings environmentally friendly. Renewable energy systems not only generate power, but they can also serve as powerful learning tools for students. Water efficient systems and landscaping can save on operating costs as well as provide environmental benefits. Environmentally preferable materials that have health and environmental advantages over traditional materials are discussed.

An additional section is dedicated to operational issues for new or existing school buildings. For information about helping your school operate as a healthy, high performing building, including learning activities to help students understand the benefits of their new school, please see the **Operations, Maintenance and Education Considerations for Your School Building** section of this resource guide.

Life Cycle Cost Analysis

What

Life cycle cost analysis is a way of assessing the total cost of facility ownership over time. Total life cycle cost consists of:

- Initial costs (design and construction)
- Operating costs (energy, water, other utilities, personnel)
- Maintenance, repair and replacement costs

Life cycle analyses are used to predict these costs at various points during the design of a school. Predicted costs for alternative design approaches can then be compared, leading to an approach that provides a facility with the lowest overall cost of ownership at the desired level of quality.

Additionally, many strategies offer benefits that can be factored into the long-term educational improvements of a building and make education more effective. For example, natural daylighting has been shown in studies to increase student academic performance by 20 percent.[1]

Natural daylight has been shown to increase student performance by 20 percent

Why

The true cost of a school is much more than the price to design and build it. The long-term costs of operating and maintaining the facility must also be considered. Only by evaluating all three of these parameters can a community understand how much a new school really "costs." And only by looking at all three parameters simultaneously can the impact of alternative design approaches be evaluated.

For example, healthy, high performing classroom windows may cost more upfront, but may result in energy savings that pay for the upgrade in a few years and continue to save money for years to come. A life cycle cost analysis is the key to making these comparisons and creating new schools with lower long-term ownership costs.

Special Note: One of the key impediments to optimizing school facilities from a life cycle perspective is the separation of capital and operating budgets. This situation gives little incentive to make capital spending decisions based on their potential for operational or maintenance savings. New schools may meet their budgetary targets for design and construction, but be more expensive to use from a total facility cost perspective. The best way to ensure operation and maintenance concerns become part of capital spending decisions is to make life cycle cost analysis an integral part of the design process. The result will be schools that represent better long-term investments of a community's short-term capital funds.

How

A variety of life cycle cost analysis tools are currently available. Some are appropriate for the early stages of a project when rough cost estimates are all that are required. Others have been developed for use in the later phases, when detailed product and material “take offs” are possible. One or a combination of these tools should be used to assess design alternatives during each of the following design phases:

- Programming
- Schematic Design
- Design Development
- Construction Documents
- Bidding

The true cost of a school is much more than the price to design and build it

Impact on Other Systems and Technologies

Life cycle cost analysis impacts virtually every system in a school. Used properly, this tool can optimize the integrated performance of all these systems and thereby reduce a school’s total cost to the community.

Resources

Life Cycle Cost Analysis Tools

- U.S. Department of Energy – www.eere.energy.gov/buildings/tools_directory
- Geoexchange – www.geoexchange.org/publications/software004.htm
- Whole Building Design Guide – www.wbdg.org
- National Clearinghouse for Educational Facilities, National Institute of Building Sciences, “Life Cycle Cost Estimating for School Facilities” – www.edfacilities.org/rl/lifecycle.cfm

Construction Costs

- U.S. Cost – www.uscost.com
- R.S. Means – www.rsmeans.com

Maintenance Costs

- Whitestone Research – www.whitestoneresearch.com
- Building Owners and Managers Association – www.boma.org

[1] *Daylighting in Schools*, Heschong Mahone Group, Pacific Gas and Electric Company on behalf of the California Board of Energy Efficiency Third Party Program, August 1999

Environmentally Responsive Site Planning

What

A healthy, high performing school should be located on a site that helps reduce a school's energy needs, minimizes adverse impacts on the local environment, and serves as an amenity for the surrounding community. An environmentally responsive site should be planned to enhance the school's energy efficiency, minimize storm water runoff and control erosion, reduce heat islands, minimize light pollution, and conserve existing natural areas and restore damaged ones.

Why

An environmentally responsive site can help reduce a school's operating costs by enhancing, rather than inhibiting, the healthy, high-performing features of a facility (e.g., energy conservation, water conservation, renewable energy, safety and security, etc.). A healthy, high-performing site is also good for the local and regional environment, and it can be an exciting natural learning laboratory for students and the community.

Environmentally responsive site planning can actually reduce a school's operating costs

How

Conserve Existing Natural Areas and Restore Damaged Ones.

- Whenever possible, preserve local vegetation already in place, especially mature trees.
- Reduce parking and building footprints.
- Landscape with indigenous plants to restore damaged areas of the site.

Minimize Storm Water Runoff and Control Erosion.

- Minimize impervious surfaces (e.g., asphalt parking lots, paved paths, etc.) that contribute to runoff.
- Consider designing driveways with porous alternatives including pavers, cobblestones, bricks or pervious pavement.
- Consider providing for on-site storm water retention. If you should elect to have a retention pond, protect the perimeter with fencing for safety purposes.
- Maximize on-site storm water infiltration.
- Use vegetation to keep soil in place.

- Consider anti-erosion grading and stabilization techniques.
- Minimize storm water runoff during construction.
- Consider including a green roof that can reduce storm water runoff and provide additional insulation for the building.

Use the Site to Enhance the School's High Performance Features.

- Whenever feasible, orient the building on the site to take advantage of the sun (usually along an east-west access to maximize southern exposure), the prevailing breezes, shade trees and any landforms that might reduce the building's energy use, increase its access to natural daylight, enhance its acoustical environment, and/or improve its security.

Reduce Heat Islands Whenever Possible (while still conforming to local ordinances, and on and off site traffic needs).

- Use landscape elements (preferably existing trees and vegetation) to shade roads, walkways and parking lots.
- Consider using light-colored materials for the school's roof to reflect, rather than absorb, sunlight.

Reduce Light Pollution.

- Design site lighting to minimize contribution to nighttime skyglow while still maintaining a safe parking lot during evening hour events.
- Consider outdoor lights with covered tops so that the light shines down, rather than up into the nighttime sky.

Impact on Other Systems and Technologies

Site conditions impact virtually every system in a building, such as energy use, water use and lighting. A well-integrated design and site planning process will reduce the needs for oversized mechanical systems, increase your school's overall performance, and improve your school's classroom learning environment.

Resources

- Illinois Department of Natural Resources, Office of Realty and Environmental Planning
  - √ The Interagency Wetlands Policy Act (20 ILCS 830)
  - √ The Illinois Natural Areas Preservation Act (525 ILCS 30)
  - √ The Endangered Species Protection Act (520 ILCS 10)
- Center of Excellence for Sustainable Development, U.S. Department of Energy – www.ncat.org/cesd/db

Chicago Public Schools

The Chicago Public School District has constructed green roofs at Ellington, Claremont and Tarkington Elementary Schools as a part of their sustainable design initiative. These green roofs occupy approximately 10 percent to 25 percent of the total roof area, while the remainder has a reflective coating that helps reduce the urban heat island effect.

Green roofs have several environmental benefits, including providing improved insulation and decreasing the amount of stormwater run-off, and they serve as demonstration projects for the community. These green roofs are strategically located on the buildings to use in the educational curriculum. Students can see the green roof year round and are able to witness seasonal changes in the foliage.

At Tarkington Elementary School, the green roof is a part of a site-wide sustainable stormwater management plan. This plan includes harvesting all roof and parking lot stormwater to help replenish the Marquette Park lagoon.

For more information:

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Claremont photo by: James Steinkamp - Steinkamp-Ballogg Photography

- Cool Roofing Materials Database, Lawrence Berkeley National Laboratory – http://eetd.lbl.gov/CoolRoofs
- Energy Star Roof Products, U.S. Environmental Protection Agency – www.energystar.gov
- International Dark Sky Association – www.darksky.org
- Soil and Water Conservation Society – www.swcs.org
- Storm Water Management for Construction Activities, U.S. Environmental Protection Agency – www.epa.gov
- Sustainable Site Design, National Park Service – www.nps.gov
- National Clearinghouse for Educational Facilities, National Institute of Building Sciences, “Smart Growth and Schools” – www.edfacilities.org/rl/smart_growth.cfm

Energy Analysis Tools

What

Energy analysis tools are computer programs designed to predict a building's annual (and in some cases, even hourly) energy consumption. These tools can be used to evaluate the energy impacts of various design alternatives. In particular, these tools help quantify and compare the contributions of various low-energy strategies (such as higher insulation levels, better glazing, and increased thermal mass) in terms of their influence on the building's overall performance. Combined with accurate cost estimates, energy analysis programs can help create a healthy, high performing school that optimizes its overall energy performance, provides long-term operational savings, increases comfort for students and staff, and serves as an environmentally friendly model for the community.

The design team for a healthy, high performing school should begin using an energy analysis tool at the outset of the design process (ideally during pre-design, when sustainable building strategies can be integrated at the lowest possible cost) and continue using analysis tools through the bidding phase.

Why

Reducing energy consumption is good for a school district's bottom line and for the environment

Reducing energy consumption in a cost-effective manner is good for a school district's bottom line and for the environment. Doing so requires the ability to quickly compare and contrast a variety of alternate design strategies so that the optimal approach, in terms of overall results and cost, can be selected. Fast, accurate estimates of a building's energy performance—which the current generation of energy analysis tools can provide—are critical to this process.

How

A wide array of energy analysis tools are currently available, some appropriate for the early stages of a project, others developed with the later phases in mind. The following list contains a sampling of tools for both time periods. There are five phases of a new construction project where energy analysis tools are useful:

- Programming
- Schematic Design
- Design Development
- Construction Documents
- Bidding

Energy performance analyses should be conducted using one or a combination of the tools below:

Architectural Design Tools – to be used primarily during the programming, schematic design and design development phases of a project.

- *ENERGY-10*, Sustainable Buildings Industry Council – www.sbicouncil.org/store/e10.php
- Building Design Advisor, Lawrence Berkeley National Laboratory – http://gundog.lbl.gov/bda
- Energy Scheming, Iris Communications – www.oikos.com/esb/37/scheming.html

Load Calculation and HVAC Sizing – to be used primarily during the design development and construction documents phases of a project.

- HAP, Carrier Corporation – www.carrier.com
- TRACE, Trane Corporation – www.trane.com
- Softdesk Energy, Pacific Northwest National Laboratory – www.pnl.gov
- BLAST, University of Illinois – www.bso.uiuc.edu
- VisualDOE, Architectural Energy Corporation (formerly Eley Associates) – www.archenergy.com
- Simulation Research Group at Lawrence Berkeley National Laboratory – http://gundog.lbl.gov

Impact on Other Systems and Technologies

Energy analysis tools allow interactions between all of a school building's key systems (building shell, windows, lighting and space conditioning) to be analyzed, compared and optimized for energy performance. This can save a school district money on initial construction costs as well as on long-term operating expenses.

For example, by looking at energy use in an integrated way, the district may be able to install smaller (and less expensive) systems with lower operating costs. A school that combines daylighting strategies and highly efficient electric lighting in its classrooms will require less electricity to illuminate those classrooms—a long-term operating savings. In addition, because the rooms take advantage of daylight and use high efficiency lamps, fewer overall light fixtures may be needed in order to achieve a high quality visual environment. This results in savings on initial construction costs. Finally, highly efficient lighting and the resulting reduction in the number of light fixtures will result in less waste heat in each classroom. This, in turn, allows the cooling system for the classrooms to be smaller (and less expensive), yielding additional up-front savings.

Chicago Public Schools

A renewed emphasis on energy efficiency and indoor environmental quality has led to an evaluation of Chicago Public Schools' mechanical system designs. OWP/P Architects used energy simulation software to perform an analysis of fifteen possible changes to the current system, with the goal of providing a more efficient design for new schools. The fifteen cases included various heating and cooling plant options, control system changes and options for air handling and air distribution configurations.

While the previous system design was compliant with current energy codes, the new mechanical systems design that resulted from the analysis saves approximately 24 percent, or nearly $20,000 in annual energy costs compared to the previous design. There is a modest increased initial cost associated with this system; however, because of the reduced maintenance and energy cost, the simple payback for this system is less than six years.

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Photo by: James Steinkamp - Steinkamp-Ballogg Photography

Resources

- *Illinois Energy Conservation Code, (71 ILCS 600) – www.ilga.gov/commission/jcar/admincode/071/07100600sections.html*
- *ASHRAE Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings,* American Society of Heating, Refrigerating and Air Conditioning Engineers – www.ashrae.org
- *Energy Analysis Tools Directory,* U.S. Department of Energy, Office of Building Technology, State & Community Programs – www.eere.energy.gov/buildings/tools_directory/doe_sponsored.cfm
- *Energy Star for K – 12 School Districts,* U.S. Environmental Protection Agency – www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12

Commissioning

What

Building commissioning is a quality assurance process that was developed to address the increasing number of operational problems owners experience in a new building. By using commissioning, districts can be more confident that they will save the energy predicted by their design, that all systems will work together in the building properly and that operation and maintenance will keep acoustic, lighting and mechanical features in working order.

Commissioning begins with documenting the owner's design intent and continues through testing selected building systems to ensure proper performance. In the design-phase, the commissioning agent reviews the owner's project requirements relative to the design implementation. During the construction phase, the agent reviews progress and tests new systems as they become available. Once the systems are operating properly, the commissioning agent ensures that operation and maintenance manuals are complete. Commissioning can also be performed during and after the warranty period to confirm that the systems operate properly throughout the year.

A robust commissioning process will ensure that systems meet the goals of the school's students, teachers and administrators

Why

Commissioning ensures that a school district gets what they pay for. A study of 60 buildings by Lawrence Berkeley National Laboratory (LBNL) found that half of the building owners surveyed experienced control problems, 40 percent had HVAC equipment problems, 15 percent were missing equipment and 25 percent had energy management systems that were not functioning properly. Commissioning can make sure these problems are minimized before a building is operational.

Commissioning can also save a district money. By reducing the number of change orders, troubleshooting problems during the design review, and catching problems while they are still easy to fix during construction, cost overruns can be reduced. Commissioning can help establish a proper maintenance process ensuring equipment that lasts longer and runs more efficiently.

How

For a successful commissioning process, consider implementing the following:

- Engage a commissioning agent before or during the design phase of the project to review the construction documents so commissioning requirements are incorporated.

- Create an Owner's Design Intent document and a written commissioning plan. These documents are used to ensure that the owner's requirements are adhered to during design, construction and operation.
- Ensure that the design professionals recognize the role of commissioning agents as owners' representatives.
- Have a design professional and commissioning agent jointly review submittals of the commissioned systems.
- Have commissioning agent verify installation and functional performance of systems and provide a written list of open issues during design and construction phases.
- Verify that operations and maintenance personnel have been properly trained and that system manuals, with the appropriate information, have been provided by the contractor.
- Document results and develop a commissioning report.

Note: It is important that the definition of the roles and responsibilities for commissioning be included in bid documents whenever possible.

Impact on Other Systems and Technologies

The use of a commissioning process can help assess whether a design can effectively be constructed, operated and maintained, and if it will work as an integrated part of the building. For example, the most energy efficient cooling system would include a cooling tower. This makes sense for a school with a large and well-trained maintenance staff. However, for a school with a small or inexperienced staff, a less energy efficient, but simpler to maintain air-cooled chiller would be more appropriate. A commissioning agent can interface with design professionals and building owners to make sure the option best suited for the school is selected. Once systems are installed, commissioning ensures that systems are operating properly.

Resources

- American Society of Heating, Refrigerating and Air-Conditioning Engineers, *The HVAC Commissioning Process*, ASHRAE Guideline 1-1996 and The Commissioning Process, ASHRAE Guideline 0. 2005 – www.ashrae.org
- Building Commissioning Association – www.bcxa.org
- Federal Energy Management Program, *Continuous Commissioning Guidebook* – www.eere.energy.gov/femp/operations_maintenance/commissioning_guidebook.cfm
- High Performance Commercial Building Systems, *Integrated Commissioning and Diagnostics* – http://buildings.lbl.gov/hpcbs/Element_5/02_E5.html
- National Clearinghouse for Educational Facilities – www.edfacilities.org/rl/commissioning.cfm
- Portland Energy Conservation, Inc., *Model Commissioning Plan and Guide Specifications* – www.peci.org/library/mcpgs.htm
- U.S. Department of Energy, Energy Smart Schools Program, *National Best Practices Manual for Building High Performance Schools* – www.rebuild.org/Lawson/attachments/ESSBestPracticesHighPerfSchools.pdf, pages 19-20, 423-450
- U.S. Environmental Protection Agency, *IAQ Design Tools for Schools* – www.epa.gov/iaq/schooldesign/commissioning.html
- U.S. Green Building Council, *LEED rating system* – www.usgbc.org/LEED/

Energy Efficient Building Shell

What

A school's building shell (walls, roofs, floors, windows and exterior doors) plays a key role in saving energy and money. An energy efficient building shell prevents air from entering and leaving the building through leaks rather than through the ventilation system. Healthy, high-performing building shells also reduce the amount of heat that transfers through wall, roof and window surfaces. By reducing energy and heat loss, an energy efficient building shell can reduce operating costs and provide a more comfortable learning environment for students and staff.

Why

The building shell of a healthy, high performing school enhances energy efficiency without compromising factors such as maintainability or comfort. The building shell also is an important component of building a durable school, one that is designed to have the longest possible lifespan and to reduce operations and maintenance costs over the long term.

In fact, the building shell is a key element in ensuring acoustic and thermal comfort for occupants, which are important factors for maintaining a productive learning, teaching and working environment.

By reducing energy and heat loss, an energy efficient building shell can reduce operating costs

How

Successful building shell design is achieved through an integrated approach. Designers must understand how building shell materials interact with each other and how the building shell systems interact with lighting and heating, ventilation and air conditioning (HVAC) systems. The selection of building shell materials should be based upon local climate conditions and building site orientation. Tools are available to aid design teams in creating an optimal building shell. The design team can use these tools to measure the “total system performance” for various combinations of design elements.

Through an integrated approach, the design team should consider the following building shell components:

Insulation Levels

- Specify insulation levels with R-values (a measure of insulation efficiency) appropriate to local climatic conditions to prevent uncontrolled thermal transfer. Also specify types of insulation that will remain stable throughout the life of the building.

Thermal Mass (These are materials like concrete or brick that can absorb or emit heat and reduce temperature swings in a school's interior)

- Use the building's thermal mass to store heat and temper heat transfer.
- Consider adding thermal mass to increase the storage capacity and energy efficiency of the school.

Window Glazing

- Specify window glazing that represents the best combination of insulating value, daylight transmittance and solar heat gain coefficient for its specific application and local climatic conditions.

Shading

- Consider exterior shading devices to reduce solar heat gain and minimize glare.

Air Leakage Control

- Consider air retarding systems (also referred to as 'air infiltration barriers') as a means of improving energy performance and reducing potential water damage to walls and roofs.

Light-Colored Surfaces

- Consider using light-colored materials for exterior walls and roofs in order to reflect, rather than absorb, solar energy.

Impact on Other Systems and Technologies

The efficiency of the building shell strongly influences the performance of heating, ventilation and air conditioning (HVAC), and lighting systems. The amount of heat the building shell allows to pass in and out of the building determines how much heating and cooling the HVAC system must provide. The more efficient the building shell, the less the HVAC system will have to operate, thus reducing energy and maintenance costs. Additionally, a highly efficient building shell may allow designers to specify smaller and less expensive HVAC systems. Likewise, buildings with window systems designed to maximize natural daylight utilize less electric light, thus reducing the school's electricity costs. Additionally, electric lighting systems generate a significant amount of waste heat when operated, so lower levels of use will also result in lower cooling demand and greater HVAC system savings.

Electric lighting systems generate a significant amount of waste heat when operated, so lower levels of use will also result in lower cooling demand and greater HVAC system savings

Resources

- Building Research Council at University of Illinois – http://brc.arch.uiuc.edu
- U.S. EPA Energy Star Program – www.energystar.gov
- U.S. Department of Energy – www.eere.energy.gov
- Whole Building Design Guide – www.wbdg.org
- Efficient Windows Collaborative – www.efficientwindows.org

High Performance Electric Lighting

What

A healthy, high performing school should provide a rich visual environment—one that enhances learning and teaching. These environments are achieved by carefully integrating natural and electric lighting strategies, by balancing the quantity and quality of light in each room, and by controlling or eliminating glare. The school's lighting system has an enormous impact on the productivity of students, teachers and staff, and on the facility's operating budget.

A healthy, high performing school should provide superior electric lighting by optimizing 'watts per square foot,' while retaining visual quality through the reduction of glare.

Why

Electric lighting accounts for 30 to 50 percent of a school's electric power consumption and peak demand. Even modest efficiency improvements can generate substantial bottom-line savings, especially in locations subject to utility demand charges. Since demand charges usually occur during daytime hours when schools are in full operation, reducing peak demand for power will yield immediate savings. Efficient lighting systems also produce less waste heat, thus reducing the need for cooling and further reducing operating costs. The lighting system, especially the controls, can also be used to help teach students about energy and the environment.

How

High performance lighting can be accomplished by specifying high efficiency lamps and ballasts, optimizing the number and type of luminaries (light fixtures) for each application, incorporating controls to ensure peak system performance, and integrating complementary electric lighting and daylighting design strategies.

Design for High Efficiency and Visual Comfort.

- Develop individual lighting designs for individual rooms or room types (e.g., classrooms, hallways, cafeteria, library, etc.).
- Consider a mix of direct and indirect light sources for each design.
- Optimize each design so that overall lighting levels (watts per square foot) are as low as possible, while still providing optimal illumination for the tasks at hand.
- Avoid excessive lighting in any space.

- Analyze the impact of the lighting system on the HVAC system, and resize as appropriate.
- Design systems to facilitate cleaning and lamp replacement.

Specify High Efficiency Lamps and Ballasts.

- Use T-8 fluorescent lamps with electronic ballasts for most general lighting applications (classrooms, offices, multipurpose rooms, cafeterias).
- Consider using T-5 lamps if justified on a life cycle cost basis.
- Consider dimmable ballasts, especially in rooms that are daylit.

Optimize the Number and Type of Luminaries (lighting fixtures).

- Use suspended indirect or direct /indirect luminaries in classrooms to provide uniform illumination throughout the room, eliminating glare and contrast between bright and dark areas.
- Consider incorporating additional accent and directional task lighting for specific uses (display areas, white boards, team areas, etc.).
- Consider the potential for using a smaller number of higher efficiency luminaries to light specific spaces, resulting in fewer fixtures to purchase, install, maintain and clean.

Incorporate Controls to Ensure Peak System Performance.

- Use occupancy sensors with manual overrides to control lighting (on-off) in classrooms, offices, rest rooms, storage areas and other intermittently occupied spaces. Consider scheduled dimming and/or time clocks in other rooms.
- Consider incorporating lighting controls into the facility's overall energy management system, as appropriate.

Integrate Electric Lighting and Daylighting Strategies.

- Treat the electric lighting system as a supplement to natural light (i.e., design for daylighting first and use the electric system to add light as needed during the day while providing sufficient illumination at night).
- Install controls that dim or turn lights off at times when daylight is sufficient.
- Consider controls that provide continuous, rather than stepped, dimming.
- Consider photovoltaic lighting systems with their own battery storage for remote exterior applications such as parking areas or walkways.
- Use systems that do not require significant training or knowledge.

Lighting Upgrade Grants

The Illinois Clean Energy Community Foundation's (ICECF) Energy Efficient Lighting Upgrade grants are available for all public and private K-12 school districts in Illinois.

The ICECF works to improve the quality of lighting for students and staff and help reduce operating expenses for school. These grants may pay for energy-saving upgrades for schools that are looking to improve their existing lighting.

For more information or details about ICECF grant opportunities, contact Bob Romo at (312) 372-5191 or visit them online at www.illinoiscleanenergy.org.

Impact on Other Systems and Technologies

Electric lighting systems interact strongly with a school's building shell and HVAC systems. Window systems can provide daylighting that,

when integrated with lighting equipment and controls, will reduce the demand for electric light. In addition, less electric lighting means less waste heat and, therefore, less demand for cooling. Specifying high efficiency lighting systems can allow you to downsize cooling equipment, resulting in initial cost and operating cost savings to the school. *Note: Using suspended fixtures in classrooms will require ceiling heights of at least 9'6".*

Resources

- Daylighting Collaborative – www.daylighting.org
- Designlights Consortium – www.designlights.org
- ENERGY STAR PROGRAM – www.energystar.gov
- Illuminating Engineering Society of North America – www.iesna.org
  - √ Use the 9th edition of the Illuminating Engineering Society of North America's *Lighting Handbook: Design and Application* as a guide.
- Lighting Research Center, Rensselaer Polytechnic Institute – www.lrc.rpi.edu
- Advanced Lighting Guidelines – www.newbuildings.org
- National Clearinghouse for Educational Facilities – www.edfacilities.org/rl/lighting.cfm
- Lawrence Berkeley National Laboratory – www.lbl.gov

Heating, Ventilation and Air Conditioning

What

A school's heating, ventilation and air conditioning system (HVAC) maintains the thermal comfort for students, teachers, administrators and visitors. A high-performance HVAC system should economically deliver healthy air to building occupants, while maintaining optimal temperature and humidity levels.

Why

HVAC systems are the largest energy users in a school, consuming 50 percent to 60 percent of all energy used. Even modest improvements in system efficiency yield relatively large savings for operating budgets. With the advent of today's highly efficient systems (and the sophisticated analysis tools that can be used to select and size them), every school HVAC system can be designed to the highest levels of performance. Additionally, a high performance HVAC system will help ensure the health of students and employees by delivering sufficient volumes of fresh air throughout the building.

How

The key to optimizing HVAC performance is to design a system that recognizes the operational and energy interactions of the building's primary systems. If accurate energy use estimates have been calculated to determine the "right-sized" HVAC system, a school can benefit from long-term operational savings. This approach will save money over commonly used rule-of-thumb approaches, which tend to oversize equipment, leading to larger initial costs and less efficient energy use. Designers should consider the following actions in developing the HVAC system:

Use High Efficiency Equipment.

- Select equipment and systems based on life-cycle costs and not initial cost.
- Specify equipment that meets or exceeds ASHRAE 90.1 standards and the Illinois Energy Conservation Code (71 ILCS 600).
- Use ENERGY STAR®-approved products.
- Consider recovery systems that pre-heat or pre-cool incoming ventilation air.
- Consider economizer cycles for small, packaged systems.
- Investigate the potential for on-site cogeneration.

Right-Size the System.

- Consider standard HVAC sizing safety factors as upper limits.
- Apply any safety factors to a reasonable base condition for the building (i.e., not the hottest or coldest day of the year with maximum attendance; not the most temperate day of the year with the school half full).

A high performance HVAC system will help ensure the health of students and employees by delivering sufficient volumes of fresh air

- Select systems that operate well under part-load conditions.
- See Energy Analysis Tools chapter.

Incorporate Controls that Will Boost System Performance.

- Consider integrated building management systems that control HVAC, lighting, outside air ventilation, water heating and building security.
- Consider individual HVAC controls for each classroom.

Create Facility Maintenance Expectations.

- Maintenance is often not considered when a system is being designed. If the school will not have experienced mechanical service personnel to maintain the systems, then those systems and the associated controls must be much simpler.
- Air-cooled chilled water systems, while less efficient to operate, are simpler to maintain and require less interior floor space than a chiller and cooling tower. A chiller and cooling tower are better fits in a large school with a more experienced mechanical staff, and are less expensive to operate.

Natural ventilation is another feature that can be incorporated that can save energy costs by reducing the need for mechanical venting. Through natural ventilation one can facilitate the circulation of 'nonconditioned' outside air through the building and take advantage of the natural movement of air.

Impact on Other Systems and Technologies

High performance HVAC systems are optimized when designed in conjunction with an energy efficient building shell and lighting system. Energy efficient building shells reduce the amount of conditioned air lost to the outdoors, while minimizing the amount of unconditioned air allowed into the building, thus reducing overall demand on the HVAC system. High performance lighting systems generate less waste heat, also reducing overall demand on HVAC systems.

The HVAC system is one of the largest energy consumers in a school

Resources

- Illinois Energy Conservation Code 71 Ill. Adm. Code 600
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) – www.ashrae.org
- Energy Star Program, U.S. EPA – www.energystar.gov
- Federal Energy Management Program – www.eere.energy.gov/femp/
- U.S. Department of Energy – www.eere.energy.gov
- Energy Design Guidelines for High Performance Schools, Cool & Humid Climates – www.energysmartschools.gov/

Even modest improvements yield relatively large savings for operating budgets

Daylighting

What

Daylighting is the controlled admission of natural light into a space through windows, skylights or roof monitors. A healthy, high performing school should use as much natural daylight as possible (especially in classrooms) while avoiding excessive heat loss, heat gain and glare. Optimum daylighting design reduces energy consumption and creates healthier learning environments that may result in increased attendance and improved grades. When properly designed, windows, clerestories and roof monitors can provide a large portion of lighting needs without undesirable heat gain or glare.

Why

Access to natural light may be one of the most important attributes of a healthy, high performing school. Daylight is the highest quality light source for visual tasks because it enhances the color and appearance of objects. Studies clearly indicate that daylighting can enhance student performance. One prominent study found that students with the most daylighting in classrooms progressed 20 percent faster on math tests and 26 percent faster on reading tests than students in classrooms with the least daylighting[1] (see Resources section for more information). Views from windows also provide a connection with the natural world and promote healthy vision by allowing frequent changes in focal distance.

Daylighting also can save a school money. Effective daylighting strategies reduce both lighting and cooling loads. Properly designed systems can substantially reduce the need for electric lighting, which can account for 35 to 50 percent of a school's electrical energy consumption. As an added benefit, waste heat from the lighting system is also reduced, which in turn reduces stress on the school's cooling equipment. These savings can be as much as 10 to 20 percent of a school's cooling energy usage. It's also worth noting that daylight provides these savings during the day, when demand for electric power is at its peak and rates are at their highest.

How

Proper daylighting is accomplished by designing to maximize your daylight while minimizing direct-beam sunlight and glare. Designers should consider the following actions in developing a daylighting strategy:

- Use a daylighting analysis tool to help guide the design process (see Resources in High Performance Electric Lighting chapter).
- Design windows to allow daylight to penetrate as far as possible into a room. Consider using light shelves to reflect daylight deep into the room. For example,

a south-facing window can be easily transformed into a well-controlled lighting source by adding a light shelf below the top of the window. This is an effective strategy for rooms up to 20 feet deep and can be employed in a multi-story school.

- Design for diffuse, uniform daylight throughout the room. For example, roof monitors and clerestories can help provide uniform light within the room while eliminating glare.
- Utilize windows that are of high quality construction, incorporate thermal breaks and include the appropriate glazing for each application. Windows should be designed to meet the overall objective and should not be oversized.
- Consider interior (shades, louvers or blinds) and exterior (overhangs, trees) strategies to control glare and filter daylight.
- Design room layouts that take advantage of daylight. Consider sloped ceilings and/or light colored ceiling surfaces to help reflect daylight within the room.
- Integrate daylighting with the electric lighting system. Provide controls that turn off lights when sufficient daylight exists. Consider dimming controls that continuously adjust lighting levels in response to daylight conditions.
- Use systems that do not require significant training or knowledge.

Impact on Other Systems and Technologies

Daylighting strategies should interact strongly with a school's lighting and HVAC systems. Properly designed daylighting systems will reduce the need for electric light, thus lowering overall electricity usage. Less electric light also means less waste heat from the lighting system, reducing the need for cooling. Operable windows and skylights can also be opened to provide natural ventilation when outdoor conditions permit, further reducing the need for mechanical heating and/or cooling.

Resources

- Greening Schools - a joint project between the Illinois EPA and the Waste Management Research Center with ideas on daylighting – www.greeningschools.org/resources/view_cat_admin.cfm?id=7
- *Analysis of the Performance of Students in Daylit Schools,* M. Nicklas and G. Bailey, Proceedings of the 1997 Annual Conference, American Solar Energy Society – www.innovativedesign.net/studentperformance.htm
- *Daylighting in Schools,* Heschong Mahone Group, Pacific Gas and Electric Company on behalf of the California Board of Energy Efficiency Third Party Program, August 1999 – www.cashnet.org/resource-center/resourcefiles/127.pdf

Mater Dei School

Mater Dei High School incorporated natural daylight into its new gymnasium and band and weight rooms.

By integrating clerestory windows, a reflective white roof, large windows with light shelves and highly efficient supplemental light fixtures, Mater Dei was able to cut energy costs and provide a bright and cheerful environment for its students.

For more information:

Mater Dei High School
Dennis Litteken
900 Mater Dei Drive
Breese, IL 62230
(618) 526-7216
www.materdei.breese.il.us

- *Effects of School Lighting on Physical Development and School Performance- A Case of Daylight Robbery,* W. Hathaway, Policy and Planning Branch, Alberta Education, January 1992
- Illuminating Engineering Society of North America – www.iesna.org
- Lawrence Berkely National Laboratory – www.lbl.gov
- Lighting Research Center, Rensselaer Polytechnic Institute – www.lrc.rpi.edu
- Skylighting Guidelines – www.energydesignresources.com
- Advanced Lighting Guidelines – www.newbuildings.org
- Designlights Consortium – www.designlights.org
- ENERGY STAR Program – www.energystar.gov
- Lighting Research Center, Rensselaer Polytechnic Institute – www.lrc.rpi.edu
- Sustainable Site Design, National Park Service – www.nps.gov
- National Cleaninghouse for Educational Facilities, National Institute of Building Sciences, “Smart Growth and Schools” – www.edfacilities.org/rl/smart_growth.cfm

[1] *Daylighting in Schools*, Heschong Mahone Group, Pacific Gas and Electric Company on behalf of the California Board of Energy Efficiency Third Party Program, August 1999

Indoor Air Quality

What

The quality of the air inside a school is critical to the health and performance of children, teachers and staff. A healthy, high performing school should provide superior quality indoor air by controlling the sources of contamination, providing adequate ventilation, preventing unwanted moisture accumulation and implementing effective operations and maintenance procedures.

Why

According to the U.S. Environmental Protection Agency, the concentration of pollutants inside a building may be two to five times higher than outside levels. Children are particularly vulnerable to such pollutants because their breathing and metabolic rates are high relative to their size – much higher than for adults. Maintaining superior indoor air quality is therefore a critical issue for schools to address. According to the EPA, failure to do so may:

- Negatively impact student and teacher performance.
- Increase the potential for long- and short-term health problems for students and staff.
- Increase absenteeism.
- Accelerate deterioration and reduce efficiency of the school's physical plant.
- Create negative publicity that could damage a school's image.
- Create potential liability problems.

Designing for superior indoor air quality from the beginning is the most cost-effective way to avoid these negative outcomes and ensure a healthy and productive indoor environment.

How

Control Sources of Contamination.

- When selecting a site, test for potential sources of contamination, such as: radon, hazardous waste and releases from nearby industry or agricultural sites.
- Design location of odor and vehicle exhaust sources (e.g., from garbage dumpsters, buses, cars or trucks) away from air intake vents and from areas of occupancy.

- Consider recessed grates, walk-off mats, and other techniques to reduce the amount of dirt entering the building.
- Specify materials and furnishings that are low emitters of indoor air contaminants. Consider:
    - Adhesives and sealants with low levels of volatile organic compounds (VOCs);
    - Paints and coatings that meet or exceed the VOC and chemical component limits of the *Green Seal* standards;
    - Carpet systems that meet or exceed the Carpet and Rug Institute's Green Label Indoor Air Quality Test Program;
    - Composite wood or agrifiber products containing no added urea-formaldehyde resins.
- Allow adequate time for vapors to be released from all installed materials and furnishings before the school is occupied. Assist the process by running the HVAC system continuously at the highest possible outdoor air supply setting for at least 72 hours after all materials and furnishings have been installed in order to decrease vapor concentrations.

Provide Adequate Ventilation.

- Design the ventilation system to provide a minimum of 15 cubic feet per minute per person of filtered outdoor air to all occupied spaces (consider 20 cubic feet per minute).
- Ensure that ventilated air is effectively delivered to and distributed through the school rooms.
- Provide local exhaust for restrooms, kitchens, science labs, janitor's closets, copy rooms and vocational/ industrial shop rooms.

Prevent Unwanted Moisture Accumulation.

- Avoid ventilated air that is too humid; design the ventilation system to maintain the indoor relative humidity between 30 percent and 60 percent.
- Design to minimize water vapor condensation, especially on walls and the underside of roof decks, and around pipes or ducts.
- Design to keep precipitation out of the building, off the roof and away from the walls.

Operate and Maintain the Building Effectively.

- Regularly inspect and maintain the ventilation system so that it continues to operate as designed.
- Consider installing carbon dioxide (CO_2) sensors that integrate with your HVAC system in large assembly areas (auditorium, gym) to maintain healthy indoor air quality.

Cuba Middle–Senior High School

The design team at Cuba Middle-Senior High School, in Cuba, Illinois, integrated many design principles for superior indoor air quality. Carbon dioxide (CO_2) sensors installed in the gym detect increased levels of CO_2 and accordingly adjust the volume of outdoor air circulating into the gym. The rest of the building design focuses on providing superior indoor air quality. Building occupants frequently comment about how good the building feels to them.

For more information:

Cuba Middle–Senior High School
Dr. Janice Spears
20325 N. IL 97 Hwy.
Cuba, IL 61427
(309) 785-5023
http://cuba.fulton.k12.il.us

- Design cleaning and maintenance programs to minimize the use of toxic materials (see Green Cleaning chapter).
- Use Indoor Air Quality – Tools for Schools by the U.S. Environmental Protection Agency to guide the operations and maintenance (O&M) process (see Indoor Air Quality Management Plans chapter).

Impact on Other Systems and Technologies

Increasing ventilation to improve indoor air quality will have an impact on the size and operation of the overall HVAC system. The entire system should be "right sized" and make use of appropriate technology to provide the optimum level of ventilated air in the most energy-efficient and cost-effective manner possible.

Resources

- ASHRAE Standard 6. 2004, *Ventilation for Acceptable Indoor Air Quality and ASHRAE 129-1997*, Measuring Air Change Effectiveness Association of Heating, Refrigerating and Air Conditioning Engineers – www.ashrae.org
- *ASTM D 6245-98(2002): Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation,* American Society for Testing and Materials – www.astm.org
- Carpet and Rug Institute – www.carpet-rug.com
- Green Seal – www.greenseal.org
- *Indoor Air Quality Design Tools for Schools*, U.S. Environmental Protection Agency – www.epa.gov/iaq/schooldesign/
- *School Indoor Air Quality Best Management Practices*, Washington State Department of Health – www.doh.wa.gov/ehp/ts/IAQ.htm
- *National Clearinghouse for Educational Facilities* – www.edfacilities.org/rl/iaq.cfm
- GREENGUARD Environmental Institute – www.greenguard.org
- Healthy Schools Network – www.healthyschools.org
- Minnesota Department of Public Health, Indoor Air Quality in Schools – www.health.state.mn.us/divs/eh/indoorair/schools

Thermal Comfort

What

Thermal comfort is a function of the temperature and relative humidity in a room. While the building code requires minimum levels of temperature and humidity in occupied spaces, it does not specify how these levels are to be achieved, leaving open the possibility that individual areas within a room may be too hot or too cold. Furthermore, code levels are only minimums—the optimal levels for specific applications may be quite different. A healthy, high performing school should ensure that rooms and HVAC systems are designed to allow temperature and humidity levels to remain within the comfort zone at all points in an occupied space.

Why

Thermal comfort is an important variable in student and teacher performance. Hot, stuffy rooms and cold, drafty ones reduce attention spans and limit productivity. They also waste energy, adding unnecessary cost to a school's bottom line. Excessively high humidity levels can also contribute to microbial growth.

How

- Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 55-1992 (with 1995 Addenda) *Thermal Environmental Conditions for Human Occupancy*.
- Insulate to latest code levels. See Energy Efficient Building Shell chapter.
- When a design incorporates natural ventilation (e.g., opening windows to provide direct outdoor air during temperate times of the year), consider adjusting the requirements of ASHRAE Standard 55-1992 to account for the impact.
- Analyze room configurations and HVAC distribution layouts to ensure that all parts of a room are receiving adequate ventilation.
- Analyze placement of windows and skylights and provide adequate, controllable shading to avoid “hot spots”’ caused by direct sunlight. See Daylighting chapter.
- Consider providing a temperature and humidity monitoring system to ensure optimal thermal comfort performance.
- Evaluate the inclusion of temperature and humidity monitoring as part of the building’s overall energy management system.
- Consider providing controls in each room to offer teachers more direct control over thermal comfort within a specified allowable range.
- Evaluate the potential impact of such controls on the overall efficiency of the HVAC system.

Building code levels for heat and humidity are minimums...the optimal levels may be quite different

Impact on Other Systems and Technologies

Thermal comfort is strongly influenced by how a specific room is designed (How much heat do its walls and roof gain or lose? How much sunlight do its windows let in? Can the windows be opened?) and by how effectively the HVAC system meets the specific needs of that room. Balancing these two components—room design and HVAC system design—is a back-and-forth process that continues throughout all stages of new facility development.

In a healthy, high performing school, the process results in an optimal blend of both components: the rooms are configured for high student and teacher productivity; and are served by an energy efficient HVAC system. The system is designed, sized and controlled to maintain thermal comfort under all conditions.

Resources

- Illinois Energy Conservation Code, (71 ILCS 600) – www.ilga.gov/commission/jcar/admincode/071/07100600sections.html
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) – www.ashrae.org
- U.S. Department of Energy, *Energy Design Guidelines for High Performance Schools: Cool and Humid Climates* – www.ashrae.org

Cuba Middle–Senior High School

The Cuba Middle-Senior High School, in Cuba, Illinois, ensures that students and staff have a comfortable learning environment.

In this facility, teachers are able to control the temperature in their classrooms, within a specified range, for heating and cooling.

The school also has the capability to push a button on a thermostat to heat or cool a room for after-hours meetings, without having to heat or cool the entire wing or building. That way, meeting occupants are comfortable and the school saves energy. The school also has additional insulation installed above ceiling and exterior walls to further ensure thermal comfort and efficient energy use.

For more information:

Cuba Middle–Senior High School
Dr. Janice Spears
20325 N. IL 97 Hwy.
Cuba, IL 61427
(309) 785-5023
http://cuba.fulton.k12.il.us

Acoustic Comfort

What

Parents, students, teachers and administrators across the country are increasingly concerned that classroom acoustics are inadequate for proper learning. Noise from outside the school (vehicular traffic and aircraft flyover), hallways (foot traffic and conversation), other classrooms (amplified sound systems and inadequate sound attenuation), mechanical equipment (compressors, boilers and ventilation systems), and even sound from within the classroom itself (reverberation) can all hamper students' concentration. The message has even reached the Access Board, the organization that supports implementation of the Americans with Disabilities Act, which has received complaints concerning the effects of bad acoustics on hearing impaired students.

Why

Trying to hear in a poor acoustical environment is like trying to read in a room with the lights off: stress increases, concentration decreases and learning is impaired. This is especially true for younger students (the ability to sort meaningful signals from noise is not fully developed until children reach their teens), those for whom English is a second language, and those with hearing impairments. Although little consideration has historically been given to acoustic design in classrooms—as opposed to lighting and ventilation—this situation is beginning to change. The information and tools needed to design classrooms for high acoustical performance now exist. They can be used to ensure that any newly constructed classroom provides an acoustic environment that positively enhances the learning experience for students and teachers.

A healthy, high performing school should address these potential problems and ensure a superior acoustical environment by:

- Reducing sound reverberation time inside the classroom;
- Limiting transmission of noise from outside the classroom; and
- Minimizing background noise from the building's heating, ventilation and air conditioning system.

How

Modify the environment.

- Configure classrooms to dampen sound transmission.
- Specify sound absorbing materials (especially on exposed surfaces) to reduce echoing.

Limit noise from outside the classroom.

- Design walls with high sound absorbing qualities to prevent noise between classrooms.
- For classrooms adjacent to loud spaces, including the outdoors, music room, mechanical equipment room, cafeteria, gymnasium or indoor swimming pool, consider using additional materials (including sound absorption blankets) for walls, windows and roofs to dampen noise transmission.

Minimize background noise from the building's heating, ventilation and air conditioning system.

- Consider using larger ducts with lower air flow speeds (1000 feet per minute maximum).
- Select diffusers with low noise ratings.

In multistory schools, design the building to block noise from being transmitted to classrooms below.

- Design floor/ceiling assemblies with high sound absorbing qualities to reduce sound transmission.
- Do not locate gymnasia, dance studios or other high-impact activities above core learning spaces.

The Walls Make a Difference

Depending on the materials used in a building's walls, sound can be reduced at different levels. How well do your walls block sound from adjacent rooms?

Materials Used	Sound absorption
4"-wide stud construction with one layer of 5/8" drywall on each side of metal studs with no insulation	Loud speech audible but not intelligible
4" brick, mortared together	Must strain to hear loud speech
8" dense concrete block wall, two coats of paint each side	Loud speech not audible

Impact on Other Systems and Technologies

When designing classrooms for optimal daylighting, acoustical ceilings are often eliminated. Acoustical steel decking and acoustical block can be used to help improve the acoustics in this situation. In a retrofit, suspended ceilings can be added and sound absorbing tiles can be installed on the walls.

The open space under the skylights or monitors can also dampen reverberation and may compensate for the lost portions of acoustical ceiling.

Resources

- *Acoustical Performance Criteria, Design Requirements and Guidelines for Schools,* ANSI S12.60-2002, Acoustical Society of America – http://asastore.aip.org
- *Summary of ANSI S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools* – www.acoustics.com/ansi_education.asp
- *Architectural Graphic Standards,* Tenth Edition, Ramsey/Sleeper/Hoke Jr., pages 63-70, John Wiley and Sons, Inc. – www.wiley.com
- Guidelines for Classroom Acoustics in New Construction – www.nonoise.org/quietnet/qc/workshop/dec97shp/guide.htm
- National Clearinghouse for Educational Facilities, National Institute of Building Sciences, "Classroom Acoustics" – www.edfacilities.org/rl/acoustics.cfm
- Acoustical Society of America – http://asa.aip.org
- American Speech-Hearing-Language Association – www.asha.org/index.htm

Lake Zurich Elementary/Middle School

Classroom design at the new Lake Zurich Elementary/Middle School creates an effective learning environment. Sound absorptive finishes include carpet tile flooring; fabric-wrapped glass fiber panels on higher wall surfaces; and acoustic plaster sprayed onto exposed classroom ceilings of precast concrete planks. The plaster balances overall room reverberation, but still reflects sound so students can clearly hear their instructors.

The central space for both schools is a combined-use cafeteria/auditorium. Wood acoustic panels hanging from the exposed ceiling respond to the room's shape and provide lateral reflections. Designers calculated the height and angle of the panels so sound could be reflected to the audience.

For more information:

Lake Zurich Elementary/Middle School
Grant Seaholm
One Hubbard Lane
Lake Zurich, IL 60047
(847) 719-3300
www.lz95.org

Safety and Security

What

Safety and security have become critical concerns for students, teachers and parents. A healthy, high performing school building should create a safe and secure environment by design. School safety relates to students, teachers and staff following their daily routines without risk of accident or injury. School security relates to protecting people from harm and assets from theft and vandalism. Opportunities for establishing continual lines of communication between classrooms and school administrators should be developed. Natural surveillance should be optimized, a sense of territoriality reinforced, access controlled, and technology used to complement and enhance, rather than substitute for, a facility's security-focused design features.

Why

Crime and vandalism—and the fear they foster—are problems facing school populations throughout Illinois and the United States. While better buildings cannot solve these problems alone, they can be powerful factors in helping reduce crime and other anti-social behavior.

How

There are a number of design strategies that can provide safe and secure environments for students and staff. Consider the following:

Establish Continual Lines of Communication Between Classrooms and Local Officials or School Administrators.

- Include in each classroom direct telephones lines to local officials and/or school administrators in case of emergency.

Increase Opportunities for Natural Surveillance.

- Design landscaping to minimize places that are hidden from view.
- Ensure that key areas such as parking, bicycle storage, drop-off points, play equipment and entryways are easily observable from inside the building.
- Design exterior lighting to facilitate nighttime surveillance. Specify full cutoff luminaries to focus all usable light on school grounds and to maintain dark skies.
- Consider open stairwells, as well as providing views (using glazed doors or windows) from classrooms into corridors.
- Design to minimize areas within the building that are hidden from view.

Reinforce a Sense of Territoriality.

- Foster a sense of ownership of the school by students and teachers.
- Clearly define borders (i.e., what is part of the school and what is not).
- Consider decorative fencing and special paving treatments to delineate the boundaries of the school grounds.

- Consider designing common areas, particularly corridors, that are less institutional and more “room like.”
- Consider materials and finishes that are graffiti resistant.

Control Access to the Building and the Grounds.

- Consider decorative fencing with lockable gates to control access to school grounds.
- Limit the number of entries to the building without limiting the number of exits.
- Allow visual surveillance of all entries from inside the school.
- Provide the ability to “lock down” parts of the school when the facility is used for after-hours activities.

Integrate Security Technology.

- Consider incorporating interior and exterior surveillance cameras with digital recording capability and other security technologies as appropriate.
- Consider installing sensors on the doors that will sound an alarm if the door is left open for too long.
- Ensure that all high-risk areas (office, cafeteria, shops, labs, etc.) are protected by high security locks and are monitored by an intrusion detection system (IDS).
- Consider issuing student and teacher identification cards that can double as access control cards.

Impact on Other Systems and Technologies

Security-based design strategies will influence a school's basic layout and site plan. If properly integrated from the outset of the development process, these strategies will complement and enhance other high-performance design strategies used in the facility. For example, daylit classrooms can share their natural light with adjacent corridors through windows or glass doors provided primarily for surveillance purposes. This natural light can, in turn, be used to offset the need for artificial lighting in the corridors.

In many communities, schools double as disaster shelters. Ensure schools are designed to withstand weather events typical for the area. Consider providing an emergency power source such as a generator or renewable energy source (e.g., a photovoltaic array).

Drawing in outdoor air provides the potential for bringing contaminants into the building. Locate the intakes on the roof or high on the sidewall to make them much less susceptible to sabotage. In addition, isolating the areas that are more susceptible to contamination, such as loading docks and mailrooms, with their own HVAC system reduces the potential for contaminants to be distributed throughout other parts of the building.

Security technology strategies individually will not strongly impact other systems in the school. However, it is recommended that IDS, CCTV and access control be incorporated into a comprehensive automated control system for the entire facility.

Matteson

The new 6th-8th Grade Center building in Matteson, Illinois integrates several passive security techniques into the overall design. The building floor plan is strategically intersected with wide, glass-clad courtyards and corridors that create clear lines of vision between the school's interior, classroom wings, main entrances and outdoor space. The layout creates an overall sense of openness and reduces the need for costly security technology and more intrusive surveillance measures. Administrators and teachers have a broad view of all campus activity that enables them to be proactive and in control. This type of design also helps foster student independence, safety, accountability and ownership.

For more information:

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Matteson, IL 60443
(708) 720-1300
www.dist159.com

Resources

- National Clearinghouse for Educational Facilities, National Institute of Building Sciences, “Disaster Preparedness and Response for Schools” – www.edfacilities.org/rl/disaster.cfm
- National Clearinghouse for Educational Facilities, National Institute of Building Sciences, “Safe School Facilities” – www.edfacilities.org/safeschools
- National Clearinghouse for Educational Facilities, National Institute of Building Sciences, “Safety and Security Design for Schools” – www.edfacilities.org/rl/safety_security.cfm
- FEMA Risk Management Series, *Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds* – www.fema.gov/pdf/fima/424/fema424.pdf
- FEMA Risk Management Series, *Primer to Design Safe School Projects in Case of Terrorist Attacks* – www.fema.gov/pdf/fima/428/fema428.pdf
- *Crime Prevention through Environmental Design*: *Applications of Architectural Design and Space Management Concepts (2nd Edition),* Timothy D. Crowe, Boston, MA: Butterworth-Heinman, January 2000

Kitchen and Cafeteria Design

What

A properly designed kitchen and cafeteria support student and staff health. Effective planning and design choices for these areas, plus policies that facilitate these choices, are important elements in healthy, high performing school design.

Why

Improved dietary practices have been linked to student achievement and attendance. Since many students rely on school meal programs for up to one-half of their daily calorie intake, a school kitchen designed to facilitate fresh food storage and healthy food preparation can play an important role in creating nutritious meals for students. In addition to the food served, the environment in a school cafeteria can affect whether students have a place that is conducive to socializing and eating healthy meals. A cafeteria that is designed to minimize student wait time to get food, and is sized appropriately to allow all students adequate eating space, can provide a comfortable eating environment for students and encourage healthy eating habits. Additionally, designing facilities to account for waste recycling, hand-washing space and other elements for students and staff can help support a healthy, high performing school.

How

Kitchen and cafeteria design choices can promote healthy eating behaviors among students. Additionally, several policies can be implemented that support healthy practices. The following kitchen design recommendations assume some onsite food preparation.

Healthy Kitchen Design.

- Design the kitchen with cooking equipment to support healthy food preparation including adequate oven and stove-top space. Do not install fryers at the expense of adequate oven and stove-top space.
- Consider investing in a convection steamer and a commercial ice machine, which are important for properly cooking vegetables and quickly cooling down hot items.
- Include refrigeration space that is large enough to not only store fresh foods but also to allow for adequate circulation around it.
- Include adequate countertop space for meal preparation. Consider ergonomically designed and moveable stainless steel worktables for greater working flexibility.
- Consider designating an area where allergy-free meals can be prepared. The area should be kept free of ingredients that allergic students must avoid.
- Size kitchen and serving facilities to meet lunch period peak serving needs. This can minimize student and teacher wait times and maximize eating and socializing time.

- Include dishwashing equipment to reduce the need for disposable plates, trays and eating utensils.
- Design the kitchen so the space can double as a teaching space for cooking, nutrition or health classes.
- Ensure that all food storage and preparation areas are able to be closed off and locked when not in use.
- Provide adequate hand washing-facilities.

Healthy Cafeteria Design.

- Size cafeteria to provide adequate seating for peak lunch period occupancy. Design cafeteria to allow for a flow of students entering the cafeteria, receiving meals, walking to seats and exiting the cafeteria.
- Design for visual, thermal and acoustical comfort to provide a quality experience for students. See chapters on Thermal Comfort, Acoustic Comfort, Daylighting and High Performance Electric Lighting.
- Include daylighting and natural ventilation design strategies. Consider locating cafeteria with an exterior wall to facilitate daylighting and access to outdoor seating.
- Consider designing for a space to include a salad bar.
- Locate cafeteria and kitchen so that the facility can be independently accessed while the rest of the school remains secured. This is an important concern for before- and after-school programs, such as a school's breakfast program.
- Provide an adequate number of sinks or bathroom facilities near the cafeteria for hand washing.
- Provide space for ample covered, moveable trash and recycling receptacles.
- Utilize easily maintainable and cleanable materials in the cafeteria and kitchen.
- Consider providing smaller round and rectangular tables with detached seats to facilitate student interaction.

Kitchen and cafeteria design choices can promote healthy eating behaviors among students

Policies to Facilitate a Healthy Eating Environment.

- Reduce the use of toxic substances that come into contact with eating areas by using green cleaning and integrated pest management (see Green Clean and Integrated Pest Management chapters). Install a locked storage unit that is not near food storage or prep areas for all cleaners.
- Reduce the amount of waste that is going into landfills by implementing recycling and composting programs. Furthermore, if possible invest in reusable plates/trays and stainless steel flatware.
- Provide students with at least 10 minutes to eat after sitting down for breakfast and 20 minutes after sitting down for lunch.
- Schedule meal periods at appropriate times (e.g., lunch should be scheduled between 11 a.m. and 1 p.m.).
- Avoid scheduling tutoring, club or organizational meetings during mealtimes, unless students may eat during such activities.
- In elementary schools, schedule lunch periods to follow recess periods. Studies show students are more likely to consume their full lunch when the lunch period follows recess.
- Provide students access to hand sanitizers if hand washing facilities are not adequate.
- Tables, seats and floors should be cleaned between each period or shift.

Impact on Other Systems and Technologies

If planning on doing any significant amount of stovetop cooking (i.e., sautéing, grilling, pan-roasting) you may be required to install a ventilation hood that exhausts out to the roof. Adequate electric and gas lines will be needed to power commercial kitchen equipment—have an engineer perform an audit and make recommendations.

Resources

- Illinois State Board of Education Nutrition services – www.isbe.state.il.us/nutrition
- Illinois Nutrition Education and Training Program – www.kidseatwell.org
- Illinois Department of Public Health (IDPH) food handling and nutrition programs – www.idph.state.il.us
- National Alliance for Nutrition and Activity – www.cspinet.org/nutritionpolicy/nana.html
- Centers for Disease Control, *School Health Index: A Self-Assessment and Planning Guide*, 2004 – www.cdc.gov/nccdphp/dash/SHI
- National Coalition for Food-Safe Schools – www.foodsafeschools.org
- The Food Allergy and Anaphylaxis Network – www.foodallergy.org/school/cafeteria.html

Health Facilities

What

A properly designed school health facility will support student health and well-being. While some older school buildings lack the necessary facilities to support adequate privacy, storage, hygiene or maneuverability for a school nurse, a new building or renovated space can be designed to serve the health needs for today's student population.

Why

The Centers for Disease Control and Prevention recognizes not only the important role that school nurses play in maintaining and promoting a healthy student population, but also the important role of a properly designed school health facility. A school health facility should be designed to support health-promoting efforts while at the same time complying with OSHA requirements and the Americans with Disabilities Act guidelines for accessibility.

The facility where a school nurse works has a profound impact on the quality of services offered. Taking steps to provide access to proper sanitation, making health facilities accessible to all students and emergency personnel, and accounting for the important spatial needs of a school health facility can promote health and wellness for staff and students alike.

How

General Layout.

- Consider including four specific areas that could provide for optimal functionality. These areas include:
    - A waiting area/rest area with chairs and cots. Design space to allow one cot for every 300 students separated by floor-to-ceiling curtains on tracks with a minimum of three feet between cots to decrease the risk of spreading airborne diseases.
    - A treatment area where medication can be dispensed and injuries addressed. This area should include a sink with eye wash attached, countertop, locked medication cupboard, supply cupboard and refrigerator with ice maker.
    - A private area where a school nurse can hold a conversation or isolate a sick student. This area should include space for a cot, chair and telephone. A window should provide visibility both into and out of the room.
    - A bathroom that is wheelchair accessible with a grab bar next to the toilet. Consider including a hand shower with a seat to help facilitate easy washing. The placement of the plumbing should allow for both wheelchair accessibility and assisted care.

Sanitation Considerations.

- Include hard surface floors to aid in easy cleaning and to reduce dust and mold potential. Consider installing a floor drain to facilitate wet floor cleaning and/or showering needs.

A school health facility should support health-promoting efforts but also comply with OSHA requirements

- Include a foot operated sink in the main treatment area for washing hands and dispensing of medications.
- Consider including a washing machine and dryer on school grounds.
- Consider an exhaust system that directs air to the outdoors and prevents the circulation of potentially infectious germs.

Office Access.

- Design office space with a minimum of 650 square feet and a bathroom that is at least 130 square feet. The office entryway door should be made wide enough to allow easy access for emergency personnel or medical gurneys.
- Place health facilities on the first floor for easy access for those with special needs.
- The health facility should be clearly marked and located near a building entrance for easy access.

Privacy and Spatial Considerations.

- Confidentiality is of primary concern in a health facility. Because of these concerns, health facilities should have an entry and office space that is independent to the main administrative office.
- Adequate space for two refrigerators (one to hold perishable food items that includes an ice maker and one to hold perishable medicines) should be made available. Refrigerators for medication must be equipped with a lock.
- Facility should be designed so cots are visible from the school nurse's main desk.

Impact on Other Systems and Technologies

A well-designed health facility has ventilation and plumbing needs beyond that of a typical office or classroom. To design a health facility that supports student health and well-being requires an approach that plans for these needs early on in the process. By doing so, the ventilation and plumbing systems as well as the space needs can be incorporated from the beginning.

Resources

- Occupational Safety and Health Administration: Toxic and Hazardous Substances, Bloodborne pathogens, Standard Number: 1910.1030 - www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10051
- Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities – www.access-board.gov/adaag/html/adaag.htm
- Journal of School Nursing – www.nasn.org/josn/journal.htm

Gallitan County Health Center

In 2003, the Gallatin County School-Based Health Center was opened with the goal of bringing wellness care to Gallatin County's Pre-K through 12th grade students. Design of the facility began in 2001 when Dianne King, an English teacher and health advocate, developed a plan to create a school-based health center. After two years of planning, the Gallatin County School-Based Health Center opened and began providing services expected to lead to a decrease in school absences, an increase in immunization rates and a decrease in the number of students who smoke. The facility included measures aimed at providing top quality medical services to students while at the same time being open to the community at large. By connecting the health center directly to the school building, as well as providing an exterior entrance for the community, the center has been able to balance the accessibility needs of students with student privacy.

Dianne King has emphasized the importance of integrating school programs with the broader community, noting that "Whatever we do at school has to be part of the community as well. We want families to reinforce our health message so we can create healthier families and celebrate healthy children. The goal is to provide the medical care and counseling services children need and the health education curriculum necessary to give students the skills to make lifelong healthy choices."

For more information:

Gallatin County Schools
Dianne King
5175 Hwy 13
Junction, IL 62954
(618) 272-3821

Renewable Energy

What

Renewable energy systems can reduce your school's operating costs by providing electricity and heating at minimal cost. A high performance school should maximize the cost-effective use of on-site renewable systems to meet its energy needs. If renewable systems are not feasible at your location, you could consider purchasing "green power" from your local utility company or purchasing renewable energy certificates to help reduce the environmental impact of your facility's energy use.

Why

Renewable energy systems reduce overall operating expenses by capturing and utilizing the free benefits available from the immediate environment, and play a significant role in preserving the environment. In addition to reducing costs, renewable systems such as solar thermal, geothermal, wind and photovoltaic technologies can be used to teach students about science, ecology and the environment. Other techniques like daylighting and natural ventilation also contribute to a high-quality learning environment by improving comfort.

How

Renewable energy system should be considered during the design process. School districts and their design teams should evaluate the integration of one or more of the following renewable energy systems into the building design:

Passive Solar Heating.

- Capturing the sun's energy through south facing windows to meet some of the school's heating needs.

Solar Thermal.

- Convert solar energy into heat that can be used to provide some or all of a school's hot water, space heating and cooling needs.

Geothermal Heat Pump.

- Transfer heat to and from the earth to generate energy efficient heating and cooling.

Antioch Community High School

Antioch Community High School built a unique Combined Heat and Power (CHP) system which utilizes biogas from a nearby landfill. A system was installed to transfer gas from the landfill to the school for combustion in micro turbines.

The CHP system utilizes twelve micro turbine generators with two heat exchangers that recycle the exhaust heat to provide power for the school. Each year, the system reduces greenhouse gas emissions equivalent to the pollution generated by 3,400 cars.

The effects of this system are similar to the pollution reduction that would result from planting 4,570 acres of trees, and the electric energy generated would satisfy the energy demands of 120 homes.

Benefits:

- A savings of more than $165,000 in annual energy costs
- Reduction of greenhouse gases
- School acts as a teaching aid for biology, economics and chemistry curricula

For more information:

Antioch Community High School
Bill Ahlers
1133 Main Street
Antioch, IL 60002
(847) 395-1421
www.sequoits.com

Wind.

- Generate on-site electricity by operating a wind turbine.

Photovoltaics.

- Generate on-site electricity by transforming sunlight into electricity with photovoltaic panel arrays.

Impact on Other Systems and Technologies

Renewable energy systems interact with the HVAC, hot water and electric power systems by either replacing or supplementing traditional equipment and systems. Passive solar and solar thermal systems provide heat, which reduces demand on the HVAC system. Solar heated water replaces mechanically heated water, and geothermal heat pumps replace conventional heating/air conditioning equipment. Wind and photovoltaics provide electricity, thus reducing the need for utility-provided power.

Resources

- Illinois Department of Commerce and Economic Opportunity – www.illinoisbiz.biz
- Illinois Clean Energy Community Foundation – www.illinoiscleanenergy.org
- Wind Energy in Illinois – www.windustry.com/illinois/
- American Bioenergy Association – www.biomass.org
- American Solar Energy Society – www.ases.org
- American Wind Energy Association – www.awea.org
- Center for Resource Solutions – www.resource-solutions.org
- Geothermal Heat Pump Consortium – www.geoexchange.org
- Green Power Network – www.eere.energy.gov/greenpower
- Green-E Renewable Electricity Program – www.green-e.org
- Solar Energy Industries Association – www.seia.org
- Solar Rating Certification Corporation – www.solar-rating.org
- Sustainable Buildings Industry Council – www.sbicouncil.org
- U.S. Department of Energy – www.doe.gov
- Solar Electric Power Association – www.solarelectricpower.org
- U.S. EPA, *Green Power Purchasing Guide* – www.epa.gov/greenpower/buygreenpower/guide.htm

Reagan Middle School

The Reagan Middle School, in Dixon, Illinois, has a 51-killowatt photovoltaic system that provides the equivalent annual electricity consumed by 7 to 10 homes.

It is a ground-mounted system, designed to increase its visibility to the community and to the students.

It is one of the largest photovoltaic systems at any public K-12 school in the world. Funding for the $373,000 system came from the Illinois Department of Commerce and Economic Opportunity, The Illinois Clean Energy Community Foundation and Commonwealth Edison, in partnership with the Foundation for Environmental Education.

For more information:

Reagan Middle School
Bruce Williams
620 Division Street
Dixon, IL 61021
(815) 284-7725
http://dps.k12.il.us

Water Efficiency

What

In parts of Illinois today, fresh water is an increasingly scarce resource. A healthy, high performing school should reduce and control water runoff from its site, consume fresh water as efficiently as possible, and recover and reuse gray water.

Why

Basic efficiency measures can reduce a school's water usage by 30 percent or more. These improvements can lower a school's operating expenses. Reducing water usage also helps the environment, locally and regionally. While cost savings may be modest now, there is a strong potential that the value of these savings will rise over time, especially as water becomes increasingly scarce and more expensive. Additionally, the technologies and techniques used to conserve water (especially landscaping, water treatment and recycling strategies) can be used to help instruct students about ecology and the environment.

Basic efficiency measures can reduce a school's water usage by 30 percent or more

How

Designers should consider the following actions to promote water efficient design:

Water-Efficient Landscaping.

- Specify hardy, native vegetation to your landscaper.
- Consider using an irrigation system for athletic fields only, not for plantings near buildings or in parking lots.
- Use high efficiency irrigation technology (e.g., drip irrigation in lieu of sprinklers).
- Use captured rain or recycled site water for irrigation. Design cisterns for capturing rain water.

Water Use Reduction.

- Set water use goals for the school. Recommendation: 20 percent less than the baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements.
- Specify water-conserving plumbing fixtures that exceed Energy Policy Act of 1992 requirements.
- Specify high efficiency equipment (dishwashers, laundry, cooling towers).
- Consider single-temperature fittings for student toilets/locker rooms.
- Consider automatic lavatory faucet shut-off controls.

- Consider low-flow showerheads with pause control.
- Consider using recycled or rain water for HVAC/process make up water.

Innovative Wastewater Treatment.

- Decrease use of potable water for sewage conveyance by using gray and/or black water systems. Opportunities include toilet flushing, landscape irrigation, etc.

Impact on Other Systems and Technologies

Using less hot water will reduce energy costs. This reduction should be factored into all life-cycle cost analyses performed for the facility.

Resources

- EPA Office of Water, U.S. Environmental Protection Agency – www.epa.gov/OW
- *Guiding Principles of Sustainable Design (Chapter 8)*, National Park Service – www.nps.gov/dsc/dsgncnstr/gpsd
- National Clearinghouse for Educational Facilities, National Institute of Building Sciences, "Water Conservation in Schools" – www.edfacilities.org/rl/water.cfm
- WaterWiser: The Water Efficiency Clearinghouse – www.waterwiser.org
- U.S. Department of Agriculture, Illinois Native Plant Guide – www.il.nrcs.usda.gov/technical/plants/npg/NPG-plntapps.html

Lakes Community High School

Before Lakes Community High School was constructed, the Gavin farm occupied a 65-acre site at the corner of Deep Lake and Grass Lake roads. When the project was envisioned, the owner made it a priority to protect the existing habitats on the site, in spite of the need to construct a 270,000 square foot high school and a separate 12,000 square foot Township Community Center.

To reduce disruption of the local habitat, on-site stormwater management ponds were built to collect and clean stormwater runoff, and sedimentation basins were included within the ponds to prevent larger, denser debris from leaving the system. Community School District 117 planted native wetland and prairie grass that filter the water in order to provide appropriate conditions for downstream aquatic life. Through the new ponds, additional wetland environments were created that enhance the native surroundings and encourage additional flora and fauna in the region.

For more information:

Lakes Community High School, District 117
Dr. Robert Crist
1600 Eagle Way
Lake Villa, IL 60046
(847) 838-7100
www.lakeseagles.com

Environmentally Preferable Materials & Products

What

Building materials can have a significant impact on human health and the environment. To the extent possible, a healthy, high performing school should be constructed of durable, non-toxic materials that are high in recycled content and are themselves easily recycled. Preference should be given to locally manufactured materials and those derived from renewable resources and sustainable-yield processes. Waste generated during construction should either be minimized or recycled to the extent possible.

Why

Significant learning, health and environmental benefits come from choosing environmentally preferable materials. For example, many of the materials selected, particularly those with recycled content, can serve as the basis for lessons on ecology and the environment, as can areas within the building designed for on-site recycling. Some building materials contain toxic substances or emit fumes that can harm workers during construction, and may also be harmful to students and teachers after occupancy. In addition, the mining, harvesting and production of certain building materials can pollute air and water, destroy habitats and deplete natural resources. Transporting building products long distances also contributes to pollution and energy waste.

Careful selection of materials can reduce or eliminate these problems, resulting in a school that not only contributes to the health and well-being of its occupants but also helps the environment.

How

There are many ways to use environmentally preferable materials and products. However, some methods may be more appropriate than others depending on where a school is located (urban, suburban, rural). Possible strategies include:

Design to Facilitate Recycling.

- Design an area within the building dedicated to separating, collecting and storing materials for recycling, including paper, glass, plastics and metals.
- Consider where and how materials will be collected and brought to the central area and allow space for easy collection and transport.

Reduce the Amount of Construction Waste that Goes to Landfill.

- During construction, develop and implement a management plan for sorting and recycling construction waste.
- Consider making a goal for recycling or salvaging a percentage of the waste generated from demolition, land-clearing and construction. This can be done both on-site and off-site.

Specify Materials and Products that are Environmentally Efficient.

- Use materials such as timber that can be harvested on a renewable basis.
- Consider a goal of having a certain percentage of the school's wood-based materials certified in accordance with the Forest Stewardship Guidelines for wood building components. Goals of up to 50 percent of the wood based materials have been achieved.
- Consider giving preference to locally manufactured materials and products, which stimulate the local economy and reduce transport distances.
- Consider specifying salvaged or refurbished materials, as appropriate. Possible ideas include reusing brick from the demolished building or using crushed concrete as a base for paving and foundations.
- Use durable materials, products and systems wherever feasible. Durable items are designed to have the longest possible life span and may help reduce operations and maintenance costs over the long term.

Maximize Recycled Content of All New Materials.

- Use EPA-designated recycled content products to the maximum practicable extent.
- Within an acceptable category of product, use materials and assemblies with the highest available percentage of post-consumer or post-industrial recycled content.
- Consider a goal of having 25 percent of the school's building materials contain a weighted average of 20 percent post-consumer or 40 percent post-industrial recycled content.

Eliminate Materials that Pollute or are Toxic During Manufacture, Use or Reuse.

- Within an acceptable category of product, use materials or assemblies with the lowest levels of volatile organic compounds (VOCs).
- Eliminate the use of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) as refrigerants in all HVAC systems.
- Consider alternatives to polyvinyl chloride (PVC) materials, which pose a major environmental health hazard during their manufacture, product life and disposal.
- Evaluate the potential impact of specified materials on the indoor air quality of the school (see Superior Indoor Air Quality chapter).

Cuba Middle–Senior High School

The Cuba Middle-Senior High School, in Cuba, Illinois, incorporated numerous recycled materials into the new school building. Bleacher seats are made from recycled milk jugs. Athletic fields use crumb rubber made from used tires to amend the soil on the football, baseball and softball fields. The crumb rubber serves several purposes: it protects the players from injury by cushioning a fall, provides better drainage and protects the roots of the grass.

For more information:

Cuba Middle–Senior High School
Dr. Janice Spears
20325 N. IL 97 Hwy.
Cuba, IL 61427
(309) 785-5023
http://cuba.fulton.k12.il.us

Impact on Other Systems and Technologies

Building products and materials impact the indoor air, acoustic and visual quality of a school. They can also affect operation and maintenance procedures. When new materials are used, new procedures may be required for their maintenance and upkeep. These new procedures should be no more complicated, costly or time consuming than those associated with standard products. However, they will be new, so maintenance staff will require some training to implement them effectively.

Significant learning, health and environmental benefits come from choosing environmentally preferable materials

Resources

- Illinois Interagency Task Force on Environmentally Preferable Purchasing, Report to the General Assembly
- Greening Schools – a joint project between the Illinois EPA and the Waste Management Research Center with resources on Environmentally Preferable Purchasing – www.greeningschools.org/resources/view_cat_admin.cfm?id=9
- BEES (Building for Environmental and Economic Sustainability), National Institute of Standards and Technology – www.bfrl.nist.gov
- Center for Resourceful Building Technology – www.crbt.org
- Forest Certification Resource Center – www.certifiedwood.org
- Construction and Demolition Waste Recycling Information, California Integrated Waste Management Board – www.ciwmb.ca.gov
- *Environmental Building News* – www.buildinggreen.com
- *EPA Comprehensive Guide for Procurement of Products Containing Recovered Materials*, U.S. Environmental Protection Agency – www.epa.gov/epaoswer/non-hw/procure/pdf/cpg1-fr.pdf
- U.S. General Services Administration's Construction Waste Management Database – http://cwm.wbdg.org
- Green Seal – www.greenseal.org
- GREENGUARD Environmental Institute – www.greenguard.org
- Healthy Building Network – www.healthybuilding.net/pvc/facts.html
- Recycled Content Product Database, California Integrated Waste Management Board – www.ciwmb.ca.gov/rcp
- Scientific Certification Systems – www.scscertified.com
- Sustainable Building Sourcebook – www.greenbuilder.com/sourcebook
- The Green Building Resource Guide – www.greenguide.com
- The Resources for Environmental Design Index – www.oikos.com

Section 5

Operations, Maintenance and Education Considerations for Your School Building

These next chapters differ from previous chapters in that they outline strategies a school can take to maintain and operate a building in a healthy and efficient manner, regardless of whether it was originally designed as a healthy, high performing school.

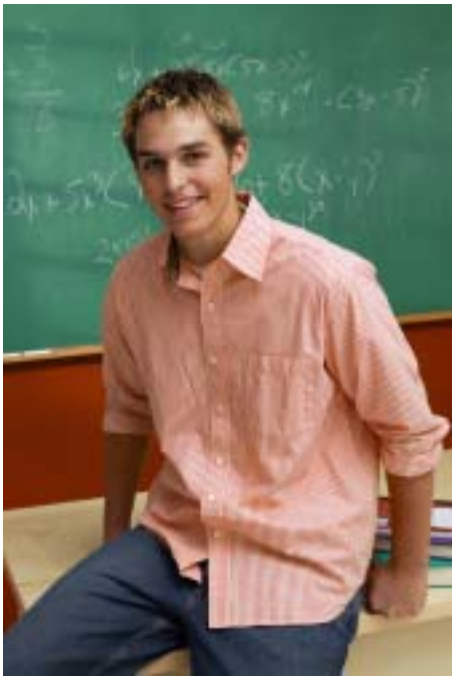
It is important that a school operates, to the extent possible, in a manner that provides optimal health, educational and performance benefits. These chapters are not intended to be a comprehensive maintenance and operations plan. Rather these chapters provide an overview of principles that can be built into a school's existing operations procedures.

Healthy, high performing school buildings also are dynamic, hands-on learning laboratories. Many of the building design elements provide students, teachers and the surrounding community with interactive tools to teach and learn about energy, resource and water conservation, indoor air quality and more. The Learning Activities chapter provides suggestions and curriculum resources to maximize the learning benefits of a school building.

Indoor Air Quality Management Plan

What

An effective Indoor Air Quality (IAQ) Management Plan is a comprehensive set of policies and procedures established to meet the goals and needs of your school. The written plan may include guidance for all school personnel on how to maintain various areas of a school facility, including classrooms and the ventilation system, as well as strategies to improve operations. These plans are low-cost or no-cost solutions that promote a healthier school environment for students and staff.



Why

A majority of the problems associated with indoor environments are related to a poor understanding of how occupants affect a school indoor environment. A well implemented indoor air quality management plan can proactively address IAQ problems, teach staff how to communicate problems and address issues before they escalate into expensive and health threatening crises.

How

The Environmental Protection Agency's IAQ Tools for Schools (TFS) has been recognized as the standard for IAQ management plans. This kit contains a set of flexible activities and communication strategies meant to help prevent and resolve IAQ problems.

EPA's "IAQ Tools for Schools" has been recognized as the standard for IAQ management plans

The TFS kit provides a detailed outline of how to begin an IAQ management plan. Not all information contained in the kit applies to all schools, therefore it is recommended that school officials review the materials and tailor the information to the needs of each individual school.

The implementation of an IAQ plan can be summarized by a series of four recommended steps.

1) **Establish Leadership**
   Initially, a school official should identify a staff person to oversee the IAQ plan. In addition to the staff, school officials will want to ensure that they have the support of school administrators and the school board.

2) **Assess Current Status**
   TFS includes a series of recommended steps that are followed on periodic basis. In the assessment phase, the coordinator and the IAQ team will conduct walk-throughs of the school to perform visual inspections, begin logging the inspections, develop action plans and

assess the status of known environmental hazards including radon, pest control, mold and lead.

3) **Perform Repairs and Upgrades**
In all likelihood, during the assessment phase some problems will be identified that will need to be addressed. Based upon the current resources, the IAQ team will establish repair and upgrade priorities and a to-do list. At this point, the IAQ team will need to work with the administration to gain consensus and approvals for building repairs. The team should distribute status reports and conduct follow-up inspections after repairs are made (see Maintenance Plans chapter and HVAC chapter).

4) **Final Steps**
The final parts of an IAQ plan are to ensure continued success of IAQ maintenance. This includes a review of past problem-solving performance, updating school policies based on current information, scheduling future IAQ inspections and proper record-keeping of checklists and reports.

Impact on Other Systems and Technologies

The IAQ plan is not a replacement for regular facility maintenance. Rather it is a process that can help facilitate regular maintenance and operation practices that affect the quality of indoor environments and in return help aid the efficiency of building systems.

Resources

- IAQ Tools for Schools, U.S. Environmental Protection Agency – www.epa.gov/iaq/schools/ or www.epa.gov/iaq/schools/pubs.html
- The IAQ Tools for Schools kit is available through the IAQ INFO Clearinghouse
  IAQ INFO
  P.O. Box 37133, Washington, D.C. 20013-7133
  (800) 438-4318 (703) 356-4020
  fax (703) 356-5386
  iaqinfo@aol.com
- Greening Schools - a joint project between the Illinois EPA and the Waste Management Research Center – www.greeningschools.org/
- National Safety Council – www.nsc.org/ehc/indoor/teachers.htm
- National Education Association – www.neahin.org/programs/environmental/iaq.htm
- Healthy Schools Network – www.healthyschools.org/guides_materials.html
- Minnesota Department of Public Health - Indoor Air Quality Management Plan Development – www.health.state.mn.us/divs/eh/indoorair/schools/plan/

Naperville School

In 1999, an indoor air quality issue at one school prompted Naperville School District 203 to order the EPA's Indoor Air Quality Tools for Schools kit for each building. Shortly thereafter, the administration hired an Indoor Air Quality Manager and established an IAQ committee. With the leadership of the IAQ Manager and the help of the committee, the district organized environmental inspections and made recommendations for improvements. The cornerstone of District 203's IAQ success is the IAQ team's pursuit of proactive solutions to indoor air quality problems. Together the IAQ Manager, IAQ Committee and the Buildings and Grounds Department, work to increase air quality awareness and take action to prevent problems from occurring.

Some of the improvements that were initially addressed included:

- More routine HVAC equipment cleaning.
- Modifying some of the cleaning procedures.
- Identifying sources of existing water infiltration, and becoming proactive in preventing the start of new sources of infiltration.
- Replacing problematic carpeting.

District 203's IAQ Manager and committee continue to work to improve the indoor air environment for all students and staff.

For more information:

Naperville Community Unit School District 203
Tom Malamos
203 West Hillside Road
Naperville, IL 60540-6589
(630) 983-2233
www.naperville203.org

Maintenance Plans

What

Preventive maintenance is critical to the operation and performance of schools and is a process that must be planned. Through planning and the correct timing of maintenance, appropriate investments are made in a facility, avoiding additional costs of last-minute and larger-scale repairs. These plans are effective solutions that can save money over the long term and promote reliable, comfortable and healthy school environments for students and staff.

Why

Although one goal of a healthy, high performing school is to build a facility that requires less maintenance, all buildings and systems still need preventative maintenance. A maintenance plan should identify systems in a school that need ongoing investment. These investments can be incorporated into short- and long-term budget priorities to ensure that proper funding is available for ongoing facility needs. Preventive maintenance improves reliability, longevity and efficiency of systems. Ultimately, proper maintenance saves money.

How

A maintenance plan includes documentation of materials, equipment and systems within a school. The maintenance of these elements requires funding, training and scheduling.

The implementation of a maintenance plan can be summarized by a series of steps:

Assess Current Status.

- Establish a database of all building materials, equipment, systems and schedules of necessary periodic functional tests.

Develop a Schedule of Maintenance.

- Establish checklists and develop a maintenance calendar.

Perform Regular Maintenance.

- Review monthly utility bills for unexpected changes in building energy use. Energy accounting software can be a useful tool to track building energy use.
- Update building documentation to reflect current building usage and recent equipment changes.

- Develop an Indoor Air Quality Plan as a part of the regularly scheduled system review (see Indoor Air Quality Management Plan chapter).
- Review Green Cleaning procedures regularly and evaluate appropriateness and effectiveness of cleaning procedures for various building materials and systems (see Green Cleaning chapter).
- Develop an Integrated Pest Management Program as part of regularly scheduled system review (see Integrated Pest Management Program chapter).
- Develop an ongoing plan for staff training. Assess the plan annually based on material and system changes.

Impact on Other Systems and Technologies

Maintenance plans ensure the operational goals of a healthy, high performing school are upheld over time. A maintenance plan should also include the topics of other healthy, high performing processes such as the Indoor Air Quality and Integrated Pest Management Programs and Green Cleaning. Regular maintenance and operation practices help aid the efficiency of building systems and affect the health of indoor environments including air quality, thermal comfort, acoustical comfort and visual comfort.

A maintenance plan begins during design and construction. During the design phase, the commissioning process establishes the basis of design and design intent. During construction the contractor and commissioning agent produce an operation and maintenance manual identifying building systems and their system attributes. These documents become the background for the preventative maintenance plan.

Resources

- Leadership in Energy and Environmental Design (LEED) for Existing Buildings – www.usgbc.org/DisplayPage.aspx?CMSPageID=221
- Planning Guide for Maintaining School Facilities, National Center for Education Statistics – http://nces.ed.gov/pubs2003/maintenance/index.asp
- School Operations and Maintenance: Best Practices for Controlling Energy Costs, Rebuild America, U.S. Department of Energy – www.energysmartschools.gov/attachments/SolutionCenter/SchoolEnergyGuidebookv2.pdf
- Energy Star Portfolio Manager – www.energystar.gov
- Fifteen O&M Best Practices – www.peci.org/library/PECI_15BestOM_0302.pdf

Through planning and the correct timing of maintenance, appropriate investments are made in a facility, avoiding additional costs of last-minute and larger-scale repairs

Green Cleaning

What

Traditional cleaning products can pose health risks to custodians, students and other school building occupants. These products also may contain harmful chemicals that contribute to air and water pollution and may require costly hazardous waste disposal. A healthy, high performing school can better protect students, staff and the environment by replacing conventional and potentially dangerous cleaning products with safer ones and by reducing the total number of chemicals used in the cleaning process. Using safer cleaning products, better cleaning technology and appropriate cleaning methods can provide a better learning environment for students and staff alike.

Users of green cleaning products report that performance can be equal, or even superior, to conventional products and complaints among janitorial staff have been reduced. And, for many applications, the green cleaning products are very cost competitive, at most differing by only pennies per quart.

New products such as microfiber cloths can reduce the need for unhealthy cleaning solutions

Why

According to the U.S. Department of Interior, a janitor uses an average of 58.2 pounds of chemical cleaning products per year. Many of these cleaning products contain hazardous chemicals that can be harmful to those who are exposed to them. The chemical ingredients can cause severe skin and eye burns, irritate the lungs or cause cancer.

In addition, cleaning chemicals can aggravate asthma. A 1998 Occupational Lung Disease Bulletin issued by the Massachusetts Department of Public Health reported that more than 10 percent of the reported work-related asthma cases in the state listed cleaning products as the suspected asthma agent. These cleaning products included bleach, chlorine and ammonia.

Some chemicals in cleaning products can pose serious safety threats if they are improperly mixed, stored or handled. For example, the mixing of chlorine and ammonia together can produce deadly gasses. Green cleaners contain less hazardous materials and do not react in a dangerous manner when accidentally stored or mixed with other cleaning products. They are often derived from citrus fruit, thereby producing a pleasant odor.

Inappropriate chemical disposal can create concerns for a school and for the environment. Cleaning chemicals can find their way into rivers and streams if they

are poured down the drain, contributing to water and air pollution. Furthermore, the disposal of hazardous chemicals can be quite costly. Green cleaning programs will reduce the number of chemicals used in a school and will reduce the need to store and dispose of hazardous waste.

How

There are a number of policies and practices that school administrators can institute to promote the use of green cleaning practices and products that will minimize potential health and safety risks.

- Learn about the most hazardous ingredients (e.g., sodium hypochlorite, 2-butoxyethanol, phthalates and ethanolamine) and cleaning products (e.g., acid toilet bowl cleaner, disinfectant and floor finish stripper) used at your facility by reading product labels and obtaining Material Safety Data Sheets.
- Establish criteria for the selection of cleaning products, janitorial paper products, equipment, cleaning tools and other supplies. Consider *Green Seal* Standard for general purpose, bathroom and glass cleaners (GS-37) or the standards and requirements for cleaning products and equipment set forth in the U.S. Green Building Council's *LEED for Existing Buildings* rating system.
- Look for cleaning chemicals with the following characteristics: biodegradable; no toxic ingredients; not petroleum based; not in a sealed aerosol spray can; produce minimal or no irritation to skin, eyes or respiratory system; are not corrosive or highly flammable; concentrated; and work optimally in room temperature water.
- Train and educate staff on proper storage, mixing and use of cleaning products. Training elements should include: wearing gloves and goggles for protection; instructing on the proper mixing of cleaning products to reduce over-concentration and waste of chemicals; allowing for sufficient ventilation of work areas; avoiding the mixing of products; and rinsing work buckets after each use.
- Consider including a preference in contracts for suppliers that provide on-site training in the proper use of their products.
- Develop cleaning strategies with the occupants in mind. Use special care when cleaning around vulnerable populations (e.g., young children, teachers who may be pregnant or nursing babies, and those with illnesses or compromised immune systems).
- Consider implementing changes on a limited basis to test products for performance, involving on-site janitorial staff in the decision-making process.
- Develop and practice safety procedures to minimize the potential for chemical spills in your school.
- Develop policies addressing how groups using school facilities before and after normal school hours are responsible for cleaning and maintaining the rooms that they use in a manner consistent with green cleaning recommendations.
- Monitor how your green cleaning program is working, address concerns and make adjustments and updates.

Lockport School

In order to improve indoor air quality, the maintenance department at Lockport Township High School implemented an indoor air quality plan. In the plan, the department recommended the use of green cleaning products whenever possible, required the purchase of vacuums with HEPA filters, implemented high efficiency filters in their HVAC system and they instituted a classroom monitoring system for carbon dioxide levels to ensure adequate ventilation.

For more information:

Lockport Township High School
East Campus
Bill Thompson
1333 E. Seventh Street
Lockport, IL 60441
(815) 588-8116

Impact on Other Systems and Technologies

A janitor uses an average of 58.2 pounds of cleaning products per year, many containing hazardous chemicals

Green cleaning is more than just replacing a traditional cleaning chemical for an environmentally friendly alternative. Many products come in concentrated form and can be used for multiple purposes, allowing for the reduction and consolidation of cleaning products. Some cleaners come in sealed, no-spill cartridges, which snap into a dispensing system that automatically portions the solution into a bottle or bucket. With no chance to incorrectly measure or spill, custodians use the minimum required amount of solution.

A successful cleaning program also begins before new products or equipment are installed and continues with routine vacuuming, maintenance cleaning and periodic restoration efforts. For example, it is important to keep carpets away from situations where water, chemicals or other hard-to-clean materials are used. Locker rooms, kitchens and copy centers are not good places to install carpets. Preventing soil from entering a building in the first place (e.g., large walk-on mats placed in high traffic areas) means the use of carpet cleaning products can be reduced.

Finally, if more harsh cleaning products like floor strippers are necessary, it is important to recognize that some building occupants may be sensitive to the vapors or residues from these products. The floor stripping work should be done at night, on weekends or during holidays. Windows should be opened and fans used to increase the amount of outside air flowing into the work area. Facility staff should flush the building with fresh air prior to reoccupation by students and staff.

Resources

- Greening Schools – a joint project between the Illinois EPA and the Waste Management Research Center with resources on janitorial supply purchasing – www.greeningschools.org/resources/view_cat_admin.cfm?id=14
- Healthy Schools Campaign, Green Cleaning – www.greencleanschools.org
- Janitorial Products Pollution Prevention Project – www.wrppn.org/Janitorial/jp4.cfm
- Green Seal – www.greenseal.org/certproducts.htm#cleaners
- U.S. Green Building Council – www.usgbc.org
- Minnesota Office of Environmental Assistance, Cleaning Supplies – www.moea.state.mn.us/lc/purchasing/cleaners.cfm
- U.S. Environmental Protection Agency, Cleaning Product Pilot Project – www.epa.gov/opptintr/epp/cleaners/select

Clean School Buses

What

While school buses provide children with safe transportation to and from school each day, they may emit diesel emissions that can affect the air quality in and around school buildings. Children are especially sensitive to diesel emissions because their respiratory systems are still developing and they have a faster breathing rate. A healthy, high performing school can take steps to minimize the exposure of children to diesel exhaust by reducing school bus idling, retrofitting existing buses with devices that reduce pollution and/or using cleaner-burning fuel. Reducing school bus idling also saves money on fuel and maintenance costs.

Why

In Illinois, at least 70 percent of the 18,500 school buses in service today are powered by diesel fuel. Thousands of Illinois children ride these school buses, with many of the buses equipped with diesel engines that lack advanced emission controls. Diesel exhaust contains a variety of pollutants, including fine particulate matter. Exposure to diesel exhaust can trigger asthma symptoms and other respiratory ailments.

Exposure to diesel exhaust can trigger asthma and other respiratory ailments

Diesel exhaust also can potentially affect children by entering school buildings through air intakes, doors and open windows when school buses are idling.

Federal standards to reduce emissions from heavy-duty trucks and buses will take effect in 2006. At that time, new heavy-duty vehicles will be up to 95 percent cleaner than today's vehicles. Major engine manufacturers and fuel suppliers are already marketing cleaner engines and fuels that meet the new standards. However, diesel engines are durable and long-lasting, and many existing school buses will remain in service well beyond the effective date of the new standards.

How

There are a number of policies and practices that school administrators can institute to reduce school bus emissions and minimize the exposure of children to diesel exhaust.

- Adopt policies to eliminate unnecessary idling, such as limiting idling time during early morning warm-up to what the manufacturer recommends (generally no more than five minutes) and turning off engines as soon as possible after arriving at loading or unloading areas. Policies can include advising parents to turn off their cars when waiting for their children and prohibiting delivery trucks from idling on school grounds.

- Replace the oldest buses in the fleet (manufactured prior to 1990) with new, less-polluting buses.
- Upgrade or retrofit buses in the fleet with better emission control technologies (e.g., oxidation catalysts or particulate matter filters) and/or fuel them with cleaner fuels (e.g., biodiesel blended fuel and ultra low-sulfur diesel fuel).
- Investigate the availability of state and federal grants to help offset the cost of retrofitting older school buses to make them cleaner.
- Design your parking facility so that the exhaust from buses idling cannot enter school buildings through air intakes, doors and open windows.

The chart on this page summarizes the benefits of some of these techniques.

Summary of Clean Fuel/Clean Technology Options for School Buses

Clean Fuel/Clean Technology Options	Type of Engine	Effect on Particulate Matter	Effect on Nitrogen Oxides	Approximate Cost of Technology
Ultra-Low Sulfur Diesel (ULSD)	New or Used Engine	10%—Enables the particulate matter filter technology to work	N/A	8 to 25 cents per gallon more than regular diesel (In June 2006, when ULSD will be required nationwide for new buses, cost differential will be much less)
Particulate Matter Filter	New or Used Diesel Engine—1995 or newer models	80% to 90% reduction	N/A	$5,000 to $10,000 one-time cost per bus, and requires ULSD
Oxidation Catalyst	New or Used Diesel Engine	20% to 30% reduction	N/A	$1,000 to $2,000 one-time cost per bus, and can be used with regular diesel
Biodiesel Fuel	New or Used Diesel Engine			
B20: 20% biodiesel 80% regular diesel		B20 – 10% reduction	B20 – 2% increase	B20 – 15 to 30 cents per gallon more than regular diesel
B100: 100%biodiesel		B100 – 40% reduction	B100 – 10% increase	B100 – 75 cents to $1.50 per gallon more than regular diesel (B-100 may not be an option for cold climates)

Source: U.S. EPA and Illinois EPA

Impact on Other Systems and Technologies

Reducing school bus emissions also can impact engine maintenance procedures and fleet operational plans. For example, it is important that proper maintenance procedures be followed for all bus fleets to ensure that engines run as cleanly as possible. Fleet managers can assign the cleanest buses to run the longest routes, and arrange bus departure times so that buses do not queue up for lengthy periods in front of buildings.

Resources

- Illinois EPA, *Clean School Bus Program* – www.epa.state.il.us/air/cleanbus
- American Lung Association of Metropolitan Chicago *Clean School Bus Initiative* – www.lungchicago.org/site/epage/23887_487.htm
- U.S. EPA, *Clean School Bus USA* – www.epa.gov/cleanschoolbus/

McLean County Unit District No. 5

The McLean County School District, which serves over 11,000 children in the Bloomington-Normal area, was one of the first participants in the Illinois Clean School Bus Program. Illinois EPA provided a grant to the district to retrofit 93 school buses with diesel oxidation catalysts that reduce emissions of particulate matter. In addition, the entire bus fleet is using biodiesel fuel, a blend of 20 percent soy oil mixed with 80 percent petroleum diesel. The use of pollution control devices and cleaner fuel can cut particulate emissions by almost one-half.

For more information:

McClean County Unit District No. 5
Steve Simpson, Fleet Manager
1809 West Hovey Avenue
Normal, IL 61761-4339
(309) 452-0509
www.unit5.org

Integrated Pest Management Programs

What

Integrated Pest Management (IPM) is a proven, safer method of pest control that reduces exposure to pesticides while controlling pest problems. IPM emphasizes simple, inexpensive prevention practices, such as improving sanitation and maintenance and sealing access points so that pests cannot enter the building. Existing pest problems are handled with least-hazardous strategies to minimize exposure to toxic chemicals.

According to the U.S. EPA, "preliminary indications from IPM programs in school systems suggest that long-term costs of IPM may be less than a conventional pest control program."

Why

Pests, such as mice and cockroaches, can be harmful to children's health by exacerbating asthma or spreading disease. However, some of the chemicals traditionally used to control pests also are dangerous to student and staff health. Studies show that pesticide exposure is linked with cancer and asthma, as well as certain behavioral and reproductive disorders.

All Illinois public schools are required by law to use IPM. PA91-0525 requires schools to implement IPM indoors, if economically feasible. The law also requires the notification of parents/guardians and school employees at least two days prior to indoor or outdoor pesticide application. A school may be exempt from the requirement if it demonstrates to the Illinois Department of Public Health (IDPH) that IPM will cost the school more than it is currently paying for pest control. A waiver must be obtained in writing and submitted to the IDPH.

How

By focusing on preventative measures, IPM uses fewer pesticides to solve pest problems. Schools need to communicate with the pest management professional about IPM expectations and follow through on their recommendations to improve maintenance and sanitation. IPM is a collaborative effort between school staff, administration and a district's pest management professional.

There are five steps to IPM:

1) *Keep Pests Out.*
If a pest can't get inside your schools, then it won't be a problem.

Caulk, seal or cement all cracks and holes on the outside of the building. Focus on gaps around pipes, ducts, baseboards and window frames. Install door sweeps on outside doors and avoid propping doors open. Place dumpsters as far away from outside doors as possible.

2) *Remove Pests' Food and Water.*
Sanitation is an important component of pest management.

Sweep and mop daily and clean up spills immediately. Do not leave full garbage cans or dirty dishes overnight. Periodically move equipment or shelves to clean hard-to-reach spaces. Store food in pest-proof containers. Repair leaky pipes and periodically clean evaporation trays under refrigerators and HVAC systems to eliminate water for pests. Look for water infiltration and repair as necessary.

3) *Remove Pests' Shelter.*
Clutter, cardboard and holes in walls provide places for pests to hide, nest and reproduce. Clutter also hides evidence of pest infestation.

Organize storage and janitorial closets and clean periodically. Use wire shelves with the bottom shelf at least 2 inches above the floor, so you can clean under it. Throw away or recycle corrugated cardboard—it is a favorite living space for cockroaches.

4) *Monitor for Pest Problems.*
Monitoring for pest problems is an essential part of IPM.

Keep a simple log of pest sightings—when and where they occur. Look for small spaces where pests can hide and use sticky traps and glue boards to detect problems in these areas. These include under sinks, along walls, under shelves, in furnace rooms, storage rooms, janitorial closets and kitchens. These traps are inexpensive and non-toxic. Work with your pest control professional or assign maintenance staff to check traps periodically.

5) *Treat Existing Pest Problems.*
Many pests, such as spiders, ants and crickets, pose no threat to children's health and can be eliminated by vacuuming. For more dangerous pests, first use non-chemical control methods, such as traps and vacuums. For persistent pest problems, work with a pest control professional to select the least-toxic pesticides—generally those formulated as baits or gels. If other pesticides are required, consult a professional. Schools are required by law to notify parents at least two days before pesticides are sprayed (containerized and gel baits are exempt from notification).

IPM vs. Borer Beetles

For more than five years, an Illinois school stuggled with an infestation of wharf borer beetles. By the spring/summer of 2005 the problem had grown out of control, and the school began investigating control strategies. After the district's pest management company proposed spraying and fogging more than 900 gallons of pesticides throughout the school, the school district contacted the Safer Pest Control Project (SPCP) for safer alternatives.

SPCP developed an Integrated Pest Management (IPM) strategy for the school that focused on three main tactics: keeping pests out of the school; managing the problem with the least toxic options available; and monitoring the situation.

1. Keeping pests out
Using high-quality silicon caulk, the school staff filled cracks and crevices in the basement and first floor, including above and below baseboards and around electrical outlets, loose tiles and wall cracks, to provide a barrier against future wharf borer problems.

2. Using the least toxic option
A borate-based product called Tim-Bor was applied by drilling through the masonry walls. Borates/boric acid is a less-toxic form of pesticide because of its low mammalian toxicity. However, Tim-Bor is a dust and can act as an asthma trigger, so its application requires notification to all parents, students and staff before use. By applying Tim-Bor directly on the source of the infestation, rather than a general fogging/spraying, the school was able to reduce exposure to students and staff without compromising effectiveness.

3. Monitoring the problem
Wharf borers are persistent and can be expected to make incursions in the future. Light traps were used to signal if such a problem occured and helped determine if additional applications of Tim-Bor were required.

The new strategy did not use any pesticide fogs or other spray chemicals that aerosolize. Aerosols can remain in the air and settle onto surfaces in the classroom and kitchen. Avoiding aerosols and using less-toxic borate dust reduces pesticide exposure.

For more information:

Safer Pest Control Project
Rachel Rosenberg
25 E. Washington, Suite 1515
Chicago, IL 60602-1849
(312) 641-5575
www.spcpweb.org/schools

Impact on Other Systems and Technologies

A successful IPM program relies on effective communication between school administrators, building engineers, teachers and students. IPM contributes to a clean, sanitary, high performing school. Using IPM also results in fewer pest emergencies. The EPA's Tools for Schools provides excellent documentation on integrating IPM into an overall IAQ management plan. For more information, see Indoor Air Quality Management Plans chapter.

Resources

- Safer Pest Control Project (SPCP) – www.spcpweb.org
- IPM Technical Resource Center – www.entm.purdue.edu/entomology/outreach/schoolipm/
- Illinois Department of Public Health (IDPH) A Practical Guide to Management of Common Pests in Schools – www.idph.state.il.us/envhealth/pdf/schoolpests.pdf
- IDPH Integrated Management of Structural Pests in Schools – www.idph.state.il.us/envhealth/pdf/imsps.pdf
- Illinois State Board of Education Integrated Pest Management and Notification Handbook – www.isbe.net/construction/PDF/IPM.pdf
- Environmental Protection Agency – Tools for Schools, IPM Checklist – www.epa.gov/iaq/schools/tfs/checklists/ipmcklst.pdf

The Safer Pest Control Project is the only organization in Illinois dedicated to protecting children and their families from the serious health consequences of pesticides

Learning Activities to Support Healthy, High Performing School Buildings

What

Healthy, high performing school buildings not only reduce energy costs, operating costs and air pollution, but also are dynamic, hands-on learning laboratories. For example, many of the healthy, high performing building design elements provide students, teachers and the surrounding community with interactive tools to teach and learn about energy, resource and water conservation, indoor air quality and more. A number of materials exist that teachers and administrators can incorporate into school curriculums, for any grade level, that can help meet many of the Illinois Learning Standards. Educational resources, technological support and financial assistance are available for schools to begin making energy efficiency, renewable energy and green building design components a part of the classroom learning environment.

Why

Every aspect of healthy, high performing schools can be incorporated directly into a school's curriculum. Learning activities can be used in a variety of subjects, such as science, math and social studies. These activities help students understand how they, and their building, affect resource use and the environment. This implementation is truly a win-win strategy for Illinois schools.

How

Healthy, high performing schools are unique teaching and learning opportunities for their inhabitants. Successful schools will involve teachers in the building and design phases to ensure that green design features are incorporated in a way that optimizes the learning experience. Students can be involved in the process as well. For example, activities exist that help students measure energy savings from different technology choices (such as lighting design); Students can present their calculations and recommendations to the design team or school board. Collaboration is also a key component. Schools can partner with local environmental organizations, municipal and state agencies as well as regional and national organizations for assistance in making their school a dynamic learning tool.

- Consider using solar electric systems (photovoltaics).
- Improve the educational environment by integrating effective indoor-outdoor relationships between the building, encouraging energy efficient practices/ activities and the site in the design of outdoor educational venues.

- Develop interpretive nature trails through preserved wildlife habitats and ecosystems, identifying plants and trees to maximize their educational value.
- Integrate recycling and waste reduction into the classroom. Students can make use of mathematical, communication and investigative skills in implementing programs. One program reduced the waste generated in the cafeteria by 70 percent—through students weighing and monitoring waste daily.
- Allocate space in each classroom and administrative area for white and mixed paper recycling. Place receptacles for aluminum and plastic in areas where waste is generated, including public areas, gymnasiums and hallways.
- Coordinate with a local recycling agency or waste hauler for preferences with recycling bins. Monitor savings from recycling and reuse.
- Install a demonstration windmill that is hooked up to the outlets in a technology lab. Students can monitor and meter the electrical output.
- Integrate curriculum into the design of the building. The use of timelines in history, the solar system or the color spectrum in floor, wall or ceiling designs can be effective tools. Quotes can be etched into surfaces to encourage creativity in students.

Resources

- Greening Schools - a joint project between the Illinois EPA and the Waste Management Research Center with ideas on green curricula – www.greeningschools.org/resources/curricula.cfm
- Illinois Sustainable Education Project – www.istep.org
- Illinois Department of Commerce & Economic Opportunity – www.illinoisrecycles.com
- Illinois EPA, Environmental Pathways: Youth Investigating Pollution Issues in Illinois – www.epa.state.il.us/kids/teachers
- Ambient Project – Environmental health science modules with a problem-solving-based learning approach. Modules are on the topics of air, water soil and food – www.rsmas.miami.edu/groups/niehs/ambient/learnmore/more.html
- Energy Quest – Energy related science projects from the California Commission – www.energyquest.ca.gov/projects/index.html
- Renewable energy lesson plans from the Texas State Energy Conservation Office – www.infinitepower.org/lessonplans.htm

Cuba Middle–Senior High School

The Cuba Middle-Senior High School, in Cuba, Illinois, is a new healthy, high performing school. The building serves as a teaching tool in the school's curriculum, and is used in classes such as science, agriculture and physics.

The building's features, including photo-voltaic and geothermal renewable energy systems, superior daylighting, use of recycled materials, and energy efficiency features, provide hands-on learning opportunities about sustainability and resource conservation. Also, signage throughout the building educates visitors and students about the important connections between building design and environmental stewardship.

For more information:

Cuba Middle–Senior High School
Dr. Janice Spears
20325 N. IL 97 Hwy.
Cuba, IL 61427
(309) 785-5023
http://cuba.fulton.k12.il.us

- Energy Kid's Page from the U.S. Department of Energy – www.eia.doe.gov/kids/
- Integrated pest management curricula ideas from Michigan State University – www.pested.msu.edu/CommunitySchoolIpm/curriculum.htm
- Outdoor education ideas from the National Wildlife Federation – www.nwf.org/schoolyardhabitats/educatorresources.cfm
- School program to reduce waste in the lunchroom – www.wastefreelunches.org
- U.S. EPA curriculum, ideas and activities for students of all ages – www.epa.gov/epaoswer/education/teach_curric.htm

Rain Gardens

Rain gardens are blossoming across Illinois as a low-cost method of improving water quality while preventing flooding and drainage problems. They make good use of rainwater runoff, native perennial flowers and grasses, and create a habitat for wildlife such as native birds and butterflies.

Rain gardens are landscaped areas planted with wild flowers and other native vegetation to replace areas of lawn. These are alternatives to expensive projects aimed at thwarting annual flooding. Rain gardens are a colorful way for schools to help reduce storm water runoff.

The Lieutenant Governor's Rain Garden Initiative helps schools develop student-led rain gardens. These projects can enhance the beauty of your school yard, reduce the quality of storm water runoff while serving as an educational tool for science, math, history and environmental classes.

For more information:

Office of Lt. Governor Pat Quinn
Ryan Mouw
James R. Thompson Center
100 W. Randolph
Chicago, IL 60601
(312) 814-4121
www.raingarden.il.gov

Section 6

Glossary of Terms

ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), founded in 1894, is an international organization of 55,000 persons. Its sole objective is to advance through research, standards writing, publishing and continuing education the arts and sciences of heating, ventilation, air conditioning and refrigeration to serve the evolving needs of the public.

Basis of Design

A document that records the concepts, calculations, decisions and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards and guidelines.

Black Water

Water containing liquid and solid human body waste generated through toilet use.

Building Shell

The roofing, flooring, wall, window and exterior door systems that separate the interior of a building from outside elements.

Chillers

A heat exchanger using air, refrigerant, water and evaporation to transfer heat (BTUs) to produce air conditioning (measured in tons). A chiller is comprised of an evaporator, condenser and compressor system.

Clerestory

An upper portion of a wall containing windows for supplying natural light to a building.

Cogeneration

The simultaneous generation of electrical and thermal energy for on-site use.

Commissioning Plan

A document that outlines the organization, schedule, allocation of resources and documentation requirements of the Commissioning Process.

Commissioning Process

A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the Owner's Project Requirements.

Economizers

A ducting arrangement and automatic control system that allows a cooling supply fan system to supply outside air to reduce or eliminate the need for mechanical refrigeration during mild or cold weather.

ENERGY STAR

ENERGY STAR is a U.S. Environmental Protection Agency program designed to help businesses and individuals protect the environment through superior energy efficiency.

Geothermal

Thermal energy contained underground. Geothermal systems convert the thermal heat stored in the ground into useful heating and cooling energy for use in buildings.

Glazing

Light transmitting materials used in windows and doors. Dual-pane and triple-pane glazing systems reduce the amount of thermal energy that passes through a window. Glazing can also be tinted or reflective in order to reduce solar heat gain, as measured through the solar heat gain coefficient.

Gray water / Grey water	Any water that has been used in a building, except water from toilets, is called grey water. Gray water may be reused for other purposes, especially landscape irrigation.
Green Power	Electricity generated by renewable systems that is available for purchase and delivered through the traditional electric grid.
Green Seal	Green Seal is an independent, non-profit organization that identifies products and services that cause less pollution and waste, conserve resources and habitats, and minimize global warming and ozone depletion. www.greenseal.org
Heat Islands	Developed areas, such as parking lots, that retain solar energy more than surrounding, undeveloped areas and are therefore much hotter.
Insulation	Any material high in resistance to heat transmission that, when placed in the walls, ceiling or floors of a structure, will reduce the rate of heat flow.
Integrated Pest Management	Integrated Pest Management (IPM) is a proven method of pest control that emphasizes simple, inexpensive prevention practices that cause the least harm to people and the environment. IPM focuses on eliminating the cause of pest presence by minimizing access to food, water and hiding places.
LEED	The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. LEED was developed by the U.S. Green Building Council. While LEED does not specifically apply to school facilities, as of September 2005 the USGBC is developing guidelines for LEED school construction.
Light Shelves	Solid horizontal elements placed above eye level, but below the top of the windows that permit daylight to enter deep into a building.
Low-E Glass	Low-emission glass (Low-E) is a clear glass with a microscopically-thin coating of metal oxide. This allows the sun's heat and light to pass through the glass into the building. At the same time, it blocks heat from leaving the room, reducing heat loss considerably.
Owner's Project Requirements	A written document that details the functional requirements of a project and the expectations of how a building will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria and supporting information.
Passive Solar	The capture and use of the sun's energy for heating and cooling purposes. Passive designs such as south facing windows and thermal mass are simple, have few moving parts, require minimal maintenance and require no mechanical systems.
Photovoltaic	Silicon cells that convert visible light into direct current. Photovoltaic cells are joined together in panel systems designed to generate electricity for immediate or later use.

Renewable Energy	Any energy resource that is rapidly replaced by natural processes. Some examples of renewable energy resources are sunlight, wind, hydropower and geothermal.
Roof Monitor	A continuous section of roof raised to admit light on a vertical plane.
R-values	A measure of the capacity of a material, such as insulation, to impede heat flow, with increasing values indicating a greater capacity.
Shading	Barriers to sunlight that reduce the amount of solar energy allowed to enter a building. Architectural shading can be achieved through overhangs or fins around windows. Natural shading can be achieved through site planning and landscaping.
Solar Energy	Radiant energy from the sun that can be captured, concentrated and converted into useful applications such as space heating and electricity generation.
Solar Heat Gain Coefficient	Solar Heat Gain Coefficient (SHGC) measures how well a product blocks heat caused by sunlight. The SHGC is the fraction of solar radiation admitted through a window, both directly transmitted and absorbed, then subsequently released inward. SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits.
Systems Manuals	A system-focused composite document that includes the operation manual, maintenance manual and additional information of use to the owner during the occupancy and operations phase.

Case Studies

Mater Dei High School

With the help of the Illinois Clean Energy Community Foundation, Mater Dei High School built a new band room, gymnasium and weight room using energy-efficient techniques. By using sustainable materials, integrating daylighting techniques and including a ground source geothermal HVAC system, the school was able to cut energy costs, as well as improve the indoor environment and average daily attendance.

One of the main goals of this project was to bring natural daylight into the building to reduce energy needs and to provide a well-lit and comfortable environment. A study of daylighting options was conducted using computer modeling to simulate the impact of window size, type, location and time of day and year.

As a result of the study, many steps were taken to provide natural, efficient lighting.

- Daylighting in the gym is provided by glass block openings in the wall between the gym and band room.
- Light from the band room lightwell is used to provide natural daylighting on the south side of the gym.
- The north side of the gym has a continuous run of clerestory windows to light the north side of the gym.
- Metal halide light fixtures provide supplemental lighting in the gym when needed.
- A white roof was used to help reflect additional light into band room lightwell and the north gym clerestory.
- The weight room has a continuous row of clerestory windows on the north side.

The final design incorporated large windows with masonry dividers and a four-foot roof overhang for shading at the south side of the band room. The northern third of the band room contains a large lightwell with translucent glazing to diffuse the incoming light. Daylight is further diffused with baffles in the lightwell, which also absorb sound within the space. High-efficiency indirect fixtures with T-5 lamps supplement the natural daylighting.

The Ground Source Geothermal HVAC system was selected for its low utility consumption and efficiency of operation. The availability of a good location for a geothermal well field and favorable soil characteristics were two additional factors that lead to use of this HVAC system

Benefits:

- Electricity cost decreased by 40 percent in the first year.
- Improved daily average attendance and reduced staff absenteeism.

For more information:

Mater Dei High School
Dennis Litteken
900 Mater Dei Drive
Breese, IL 62230
(618) 526-7216

Cuba Middle–Senior High School

Saving energy was a huge priority for the Cuba School District when the Fulton County School Board began planning the new school facility in 1999. The superintendent, Dr. Janice Spears, led a design team with the goal of having the “greenest” school possible. A 60kw photovoltaic system now allows Cuba to sell power back to the electric company, while geothermal heat pumps keep the building warm with little negative effect on the bottom line. Daylighting is extensively used throughout the building, while highly efficient lighting in the classrooms and gymnasium supplements the natural light. Also, additional insulation in the ceiling and exterior walls and low-e windows keep energy from escaping from the building.

Cuba Middle–Senior School used recycled materials extensively throughout the building. The bleachers are made from milk jugs, the carpet is recycled and the soil for the sports fields is amended with crumbed tire rubber, allowing for better drainage and a safer field.

The HVAC system is designed to provide the highest thermal comfort for the staff and students. Teachers are allowed to control the temperatures in their classrooms within a set range. For meetings or events in particular classrooms, the system has the capability to heat or cool specific spaces without having to do so for the entire building.

For Dr. Janice Spears, Superintendent of Fulton County CUSD #3, building a Healthy, High Performing School was an easy decision. “We envision our school as a living laboratory, and we are integrating energy savings, monitoring and other green design concepts into our operations and curriculum.”

Benefits:

- 50 percent savings in operation cost.
- More comfortable classroom environments.

For more information:

Cuba Middle–Senior High School
Dr. Janice Spears
20325 N. IL 97 Hwy.
Cuba, IL 61427
(309) 785-5023
http://cuba.fulton.k12.il.us

Bolingbrook High School

In 2001, Valley View district officials began planning their new Healthy, High Performing School with their design team, community members and students. Their process allowed them to create one of the “greenest” schools in Illinois.

Bolingbrook High School is equipped with several features that will save the school and community money over the life of the building. The building has computerized temperature controls in each room allowing teachers to control temperature levels within a specified range. A solar-sensor system that automatically adjusts lighting in the building based on the quantity of natural daylight keeps a constant and comfortable lighting level for students and staff while reducing energy use. A system that collects and reuses condensation from the building’s HVAC system reduces water usage. Additionally, natural landscaping absorbs and filters runoff from the school’s parking lots.

The new school features a video system that, among other things, links classrooms with the principal’s office and allows administrators to keep tabs on what happens throughout the school.

Additionally, Bolingbrook High School has amenities that promote a healthy lifestyle for students, including lounges where students can study or relax between classes, a spacious cafeteria with restaurant-style booths as well as conventional tables and chairs, an athletic center with six courts and an indoor track, and an auditorium comparable to professional theaters found in Chicago.

The school design received an award from the Illinois Association of School Boards and is registered with the U.S. Green Building Council–the first school in Illinois to receive LEED certification.

Benefits:

- Energy consumption was reduced by 25 percent.

For more information:

Bolingbrook High School
Dennis Renner
365 Raider Way
Bolingbrook, IL 60440
(630) 759-6400

Lockport Township High School

In October 1999 Lockport Township High School (LTHS) made a commitment to control energy costs and improve the indoor environment by developing an Energy Conservation Plan (ECP). The goals of the ECP were to reduce long-term operating costs and improve indoor air quality in the school. Since its inception, LTHS East Campus has reduced its electrical usage nearly 20 percent and saves more than $80,000 in electricity costs annually.

In 2002, LTHS also developed strategies to reduce natural gas consumption. Occupancy sensors that regulated the heat and cooling system were installed. This system reduces the need for heating or cooling unoccupied spaces and as a result, natural gas expenses were reduced by 23 percent.

In order to improve the indoor air quality, the maintenance department implemented an indoor air quality plan. In the plan, the department recommended the use of green cleaning products whenever possible, required the purchase of vacuums with HEPA filters and instituted a classroom monitoring system for carbon dioxide levels to ensure adequate ventilation.

LTHS' efforts earned the school the Energy Star Labeled School Award. It is one of only four schools in Illinois that has received this distinction.

Benefits:

- Reduced electricity usage by nearly 20 percent.
- Reduced natural usage by 23 percent.
- Annual savings of $80,000 in energy costs.

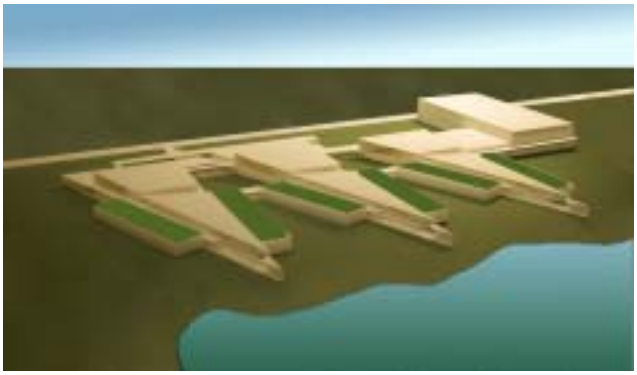
For more information:

Lockport Township High School East Campus
Bill Thompson
1333 E. Seventh Street
Lockport, IL 60441
(815) 588-8116

Matteson Elementary School District 159

Elementary School District #159 Grade Center in Matteson was designed with functional sustainability in mind. All indoor and outdoor spaces were designed to allow multi-purpose use, as well as seamless additions of future classrooms and community-use areas. The school construction is expected to be completed by August 2006.

Daylighting is implemented in 90 percent of school areas. Occupancy sensors are combined with exterior sun shades and light shelves in classrooms to provide efficient natural lighting whenever possible.



One of the largest geothermal pond systems in Illinois will heat and cool the building. This will reduce energy cost by an estimated $70,000 a year. The design also includes roofs that can accommodate a green roof or a photovoltaic array installation in the future.

An added benefit of this healthy, high performing school building is that the building floor plan is strategically intersected with wide, glass-walled courtyards and corridors that create clear lines of vision between the school's interior, classroom wings, main entrances and outdoor space. This use of passive security can decrease maintenance costs and increase security of occupants.

Benefits:

- Projected utility savings are $80,000 annually.
- More productive learning environment.
- Daylight harvesting and exterior views.
- Passive security.
- Commercial grade food service for healthier nutrition.

For more information:

Matteson Elementary School District 159
Eric Hage
20600 Matteson Avenue
Matteson, IL 60443
(708)720-1300
www.sd162.org/

Lake Zurich Elementary/Middle School

Students nicknamed the new Lake Zurich Elementary/Middle School (EMS) "the green spaceship." They were inspired by the green copper panels on the school's sloping, oval-shaped entry. The school's sustainable features make the nickname even more fitting.

The EMS combines two schools in one building to increase energy efficiency and reduce materials used. Natural light touches every major space in the building to create a more stimulating environment and reduce lighting costs. Features such as low-e window coating, solar shades and light shelves reduce glare and solar heat during warmer months, and increase heat gain during winter, while maximizing daylight year round.

Acoustics were carefully considered. Carpet tile flooring, special panels and acoustic plaster sprayed onto ceilings promote speech clarity and reduce ambient noise within classrooms. Large wood panels suspended from the cafetorium/auditorium ceiling enable sound to be reflected, yet contained within the room.

Operable windows bring fresh air to classrooms. On days when the outdoor temperature is comfortable, economizer cycles on air handling units fill classrooms with 100 percent outdoor air.

The building uses low-emitting materials, such as: low-voc paint and adhesive, formaldehyde/CFC/HCFC-free insulation and chemical-free firestopping. Corrugated metal panels line the gymnasium, providing a higher insulation value over the alternative precast concrete, leading to reduced energy demands.

High efficiency filters in the air-handling units are more than twice as efficient as those in the average building. Whereas conventional chillers toil during the day to create cool air, the EMS has an ice storage system that creates ice at night when utility rates are lowest. During those sweltering northern Illinois afternoons, cold air is available immediately and smaller chillers are used more efficiently. An energy recovery mechanical system extracts heat (or colder air) from return air to warm (or cool) and humidifiy incoming air, depending on the season. Also, high efficiency boilers are 10 percent more efficient than standard boilers.

The building's placement on a 31.5-acre site, consisting mainly of vacant farmland, avoids disturbance of two large wetlands areas. "Xeriscape" vegetation, including 40 different types of native seeds, helped bring the site back to its Midwestern prairie origins. Prairie areas do not require watering or cutting.

Benefits:

- 20 percent reduction in energy consumption.
- Reduced maintenance expenses due to copper panels and native plant based landscaping.
- High performance classrooms created with built-in acoustic systems, daylighting, and high-efficiency HVAC systems.
- Reduced construction costs attributable to combining two schools in one facility and using local materials.

For more information:

Lake Zurich Elementary/Middle School
Grant Seaholm
1 Hubbard Lane
Hawthorne Woods, IL 60047
(847) 719-3300
www.lz95.org

Tarkington Elementary School

The Chicago Board of Education has embraced healthy, high-performing building practices in order to create healthy learning and working environments and to reduce costs associated with long-term operations and maintenance. Tarkington Elementary School is soon to become the Chicago Board of Education's first LEED certified building. Located at the southern end of Marquette Park on Chicago's southwest side, Tarkington opened its doors to students in the fall of 2005. The school was designed from ground up using an integrated and green design process. Some of the school's features include:

- Certified wood products from sustainable forests.
- Classroom and office spaces which were designed to reduce external noise.
- Storm water management practices that reduce and control water runoff.
- High efficient lighting and HVAC systems which reduce building energy use by up to 30% as compared to standard buildings.
- Use of low-toxic paint, glues, and caulking.
- 90% percent of the structural steel is from recycled metal.
- 82% of the construction waste from the building was recycled.

The Chicago Board of Education also employed a Commissioning agent before, during and after construction. By doing so, the Board of Education was able to ensure that the school was planned, constructed and now operates in a manner that meets all of its healthy, high performing goals.

For more information:

Erin Lavin Cabonargi
Chicago Public Schools
125 S. Clark Street, 17th Floor
Chicago, IL 60603
(773) 553-3158
www.cps.k12.il.us

Sample School Board Resolution

Resolution on Sustainability
and the Design and Construction of Healthy,
High Performing School Buildings

_____School District
Board of Education

Adopted _____
Date

WHEREAS, Students and staff are entitled to a safe and healthy school environment, and studies have indicated that student achievement is greater and attendance is higher, and teacher and staff retention is improved, when the learning environment is naturally lit, comfortable and well maintained;

WHEREAS, Schools should employ design, construction and operation strategies that minimize operating costs, in particular for energy and water use as studies show that new facility energy costs, for example, can be reduced by 25 percent or more;

WHEREAS, Schools that follow sustainable design principals can contribute to our community's environment by minimizing waste as well as air and water pollution;

WHEREAS, the District's program to build new schools and renovate existing ones provides a unique opportunity to move beyond standard designs;

WHEREAS, Schools designed to be Healthy, High Performing Schools incorporate environmental features that provide a context for learning; now, therefore, be it:

RESOLVED, That the _____ School District Board of Education recognizes the progress already made by the District's staff and design teams to incorporate sustainable design criteria into the District's school construction program; and,

RESOLVED further, That the Board directs staff to expand this effort to ensure that every new school and modernization project, from the beginning of the design process, incorporates healthy, high performing design recommendations to the extent feasible; and that the focus be on criteria in the following priority areas:

(Select priorities that meet your district's needs and location. Examples include:
1) Student performance and staff health through measures such as daylighting, the use of non toxic-emitting materials and sound insulation or isolation to minimize noise and enhance classroom acoustical quality; 2) Operating cost minimization, through resource efficiency; 3) Minimizing the impact of District operations on the environment 4) Taking advantage of financial incentive programs; and,

RESOLVED further, That the Board of Education directs staff to follow recommendations in the Illinois Resource Guide for Healthy High Performing Schools Buildings; and,

RESOLVED further, That the Board of Education endorses District participation in and directs staff to pursue partnerships that further the goal of high performance schools, including Federal, State and utility programs that provide sustainable design financial incentives; and,

RESOLVED further**,** That the Board of Education directs staff, during the design phase of the remaining projects in the current construction and modernization program and all such future projects, to require architects and staff to verify that their District project(s) have striven to achieve energy efficiency and healthy construction objectives; and,

RESOLVED further**,** That the Board of Education directs staff to report to the Board, within ____ days of the passage of this resolution, on the District's plan to comply with this Resolution; and,

RESOLVED, That the Board of Education directs staff to report to the Board annually on the progress of this program, and provide quarterly summary statistics on the number of new schools and modernization projects designed and the percentage which have incorporated Healthy, High Performing design criteria, and other statistics useful in assessing the progress of this effort.

For a downloadable version of this resolution, visit www.healthyhighperformingschools.org.

Financial and Informational Resources

Monetary Assistance Programs

Healthy, High Performing School Construction Resources

Illinois Clean Energy Community Foundation

Summary:
The Illinois Clean Energy Community Foundation's mission is to invest in clean energy development and land preservation efforts. To promote healthy, high performing K-12 schools, the foundation offers the following programs:

- Energy efficient K-12 School Lighting Upgrade Grant Program.
- Energy efficient green building design program (Up to $100,000 would be provided for incremental design costs, to include energy efficient and renewable measures above local codes. The program also provides up to $35,000 for building commissioning.)
- Geothermal heating and cooling
- Renewable energy (Solar photovoltaic, solar thermal and small scale wind power generation).
- Policy initiatives.

For additional information: www.illinoiscleanenergy.org
Illinois Clean Energy Community Foundation, 2 North LaSalle, Suite 950, Chicago, IL 60602; (312) 372-5191;
Program Contact: Bob Romo

U.S. Department of Energy: Ongoing Grant Programs for Energy Efficiency, Renewable Energy, and Indoor Air Quality.

Summary:
U.S. DOE actively maintains a list of grants from the Federal Government for energy, indoor air quality and environmental programs. DOE consolidates various energy efficiency, renewable energy and EPA IAQ solicitations, and updates a website and sends out regular e-mail notifications of new opportunities to subscribers.
For additional information: http://doe-iips.pr.doe.gov

U.S. Department of Energy: Ongoing Grant Programs Sustainability Projects under the "Smart Communities" Network

Summary:
U.S. DOE maintains a website that lists current Requests for Proposals (RFPs) from various sources for sustainability projects. Schools are directly eligible for some grants; other RFPs are looking for places that may be willing to be a demonstration site for a new technology.
For additional information: www.sustainable.doe.gov/management/financl.shtml

Bureau Valley School District - Wind Turbine

The Bureau Valley School District, in Manilus, Illinois, installed a wind turbine, which is the first school-owned utility-scale wind turbine project in Illinois. Located at the Bureau Valley High School, the 660-kilowatt system saves an average of $90,000 in energy costs annually. To fund the project, the district received grants from the Illinois Clean Energy Community Foundation and the Illinois Department of Commerce and Economic Opportunity and financed the remainder of the cost through loans.

For more information:

Bureau Valley School District
Mr. Gutshall
9154-2125 N. Avenue
P.O. Box 329
Manlius, IL 61338
(815) 445-4004
www.bhsroe.k12.il.us/bureauvalley/

Renewable Energy Resources

Illinois Department of Commerce and Economic Opportunity (DCEO)
Summary:
The Illinois Department of Commerce and Economic Opportunity offers a variety of programs in the areas of energy efficiency, renewable energy and renewable fuels. In addition, the Department offers educational resources through its Illinois Sustainable Education Project (ISTEP).
For additional information: www.illinoisenergy.org

Alternative Financing Mechanisms

Illinois Finance Authority (IFA)
Summary:
IFA is a self-financed, state authority principally engaged in issuing taxable and tax-exempt bonds, making loans and investing capital for businesses, non-profit corporations, and local government units statewide. From pre-school to post-grad, IFA can help schools by offering lower-cost borrowing options for new facilities, renovations and expansions, and to help school districts better manage cash flows and reduce operating costs.
Contact one of the four offices across the state, Chicago office: (312) 651.1300, Springfield office: (217) 782.5792, Peoria office: (309) 495.5959 or Carbondale office: (618) 453.5566. Or visit the IFA website, www.il-fa.com

Technical Assistance Programs

U.S. Department of Energy: Rebuild America Program
Summary:
U.S. DOE provides school districts, free of charge, technical assistance from their network of experts to support the building of high-performing schools and retrofitting buildings for energy efficiency. Assistance includes design best practices, answers to technical questions and identifying financial resources. School districts must join the program through a "partnership" to receive detailed assistance.
For additional information: www.rebuild.org/aboutus/aboutus.asp
For comprehensive school information, visit: www.energysmartschools.gov

U.S. Department of Energy's Midwest CHP Application Center (MAC)
Summary:
Established by the U.S. Department of Energy (DOE) in March of 2001, the CHP Midwest Application Center (MAC) provides education, outreach support and technical assistance in the commercialization and deployment of cooling, heating and power (CHP) technologies in the eight-state Midwest region. The MAC is funded to provide technical assistance and support, such as current energy usage assessment, site analysis and technology evaluation regarding the best distributed generation/CHP technology for a school.
For additional information: contact the Energy Resources Center at UIC 312-413-5448 or visit www.chpcentermw.org

Informational Resources

Greening Illinois Schools
Summary:
Greening Illinois Schools is a joint project of the Illinois EPA and the Illinois Waste Management and Research Center. It helps schools provide a safe and healthy environment that can save money, improve learning conditions, and increase efficiency. The program addresses waste prevention, water conservation, indoor environmental conditions and energy efficiency. Greening

Illinois Schools offers free on-site technical assistance, workshops for teachers, administrators and facility managers, funding opportunities and on-line resources.
For additional information: www.greeningschools.org

U.S. Environmental Protection Agency: Healthy School Environments

Summary:

The U.S. EPA's Web site includes school design and construction resources (including the free "Indoor Air Quality: Design Tools for Schools"), as well as material selection, and water, waste and environmental education resources. The site provides links to on-line training information and upcoming conferences. The site also has several fact sheets, including indoor air quality and mold.
For additional information: http://cfpub.epa.gov/schools/index.cfm

U.S. Department of Energy: High Performance Design Guidelines and Education Activities

Summary:

Information and resources for school officials and design professionals that are building high performance schools, including U.S. DOE's "National Best Practices Manual," are available. U.S. DOE also provides a CD-ROM of education activities. This Web site also includes step-by-step guidelines for school officials involved in the design and construction process, and provides specific information about school maintenance best practices to promote health and save money.
For additional information: www.energysmartschools.gov. For an overview of DOE's school information, click on the "overview" link.

U.S. Green Building Council: LEED Green Building Rating System®

Summary:

The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. LEED was developed by members of the U.S. Green Building Council and these members continue to contribute to its evolution.
For additional information: www.usgbc.org/leed/leed_main.asp

National Clearinghouse for Educational Facilities: Safe, Healthy, High Performance Schools

Summary:

An on-line clearinghouse for educational materials related to healthy, high performance school construction. The Clearinghouse includes a wide variety of material, including design suggestions and school construction related research.
For additional information: www.edfacilities.org

Sustainable Building Industry Council (SBIC): Healthy, High Performance Design Resources Including On-line Video Training Seminars

Summary:

SBIC, in conjunction with the U.S. Department of Energy, developed an on-line video series for healthy, high performance schools. The video series covers information about how High-Performance School Buildings boost student health and productivity, conserve energy, water and other natural resources, and save communities money.
For additional information: www.buildingmedia.com/sbic/
Or visit the SBIC website at: www.sbicouncil.org/

U.S. Environmental Protection Agency: Energy STAR Information for Schools

Summary:

Energy STAR energy-saving equipment purchasing guidelines, indoor air quality recommendations and resources for school districts.
For additional information: www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12

Environmental Education Links

Department of Commerce and Economic Opportunity (DCEO): Sustainability Education

Summary:

The Bureau of Energy and Recycling has developed a new integrated approach to its once separate energy and recycling education programs. New efforts in education will now fall under one program—the Illinois Sustainable Education Project (ISTEP). The program will continue to emphasize the link between energy, recycling, the economy and the environment and will provide Illinois students and teachers with the necessary information to make informed decisions. ISTEP offers educational resources, including hands-on inquiry kits, bookmarks, curriculum and posters, in addition to providing teacher workshops and presentations. ISTEP materials incorporate energy efficiency and recycling into a variety of subjects including literacy, math, social science and fine art.

For additional information: www.istep.org

Illinois Environmental Protection Agency (IEPA): Environmental Education

Summary:

IEPA provides resources for environmental education, focusing on one concept: why is the environment important? Resources provided include Educators' Tools, internship announcements, "Envirofun" activities for youth, and poster and poetry pages, including information about annual exhibits and contests.

For additional information: www.epa.state.il.us/education.html

IEPA also recently unveiled a new "Greening Schools" program, with a Web site featuring both green building information for schools and tips for teacher lesson plans.

For additional information: www.greeningschools.org/

U.S. Environmental Protection Agency: Environmental Education Grants

Summary:

The Grant Program sponsored by EPA's Office of Environmental Education supports environmental education projects that enhance the public's awareness, knowledge and ability to make informed decisions that affect environmental quality. Since 1992, EPA has received $2 million to $3 million for grant funding per year and has awarded over 2,500 grants.

The EPA suggests schools visit its Web site in late Summer or early Fall for information about grant availability.

For additional information: www.epa.gov/enviroed/grants.html. To view past grants awarded in EPA Region 5 (includes Illinois), visit: www.epa.gov/region5/enved/grants.html#currentawards

Acknowledgements

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About the Healthy Schools Campaign

Our Mission

To advocate for policies and model programs that allow students and staff members to learn and work in a healthy school environment.

Our Partners

We work with a broad network of individuals and organizations that includes parents, teachers, school administrators, students, public health and education advocates, policymakers and community leaders. Our task forces and committees engage hundreds of individuals representing a wide variety of organizations in HSC-led activities.

Our Work

Recognizing the connection between a clean environment, healthy children and better education, HSC addresses the problems of asthma and obesity by promoting school-based programs, practices and policies such as green cleaning, healthy school design, healthy school food choices and nutrition education.

clean environment, healthy children, better education

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The Healthy Schools Campaign acknowledges the numerous organizations and individuals who served on the taskforce to develop and review this guide. We thank the following for their time, effort, valuable comments and expertise:

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Disclaimer

The *Illinois Resource Guide for Healthy, High Performing School Buildings* is designed to serve as educational material for school administrators, school board members and design teams who are interested in designing healthy and energy efficient facilities.

While the content presented in this resource guide has been reviewed by an extensive review committee with broad-based expertise in construction issues, no warranties, either expressed or implied, are made in connection with the accuracy or completeness of the information contained herein, and no responsibility can be assumed by the Healthy Schools Campaign, the Illinois Capital Development Board, the Illinois State Board of Education or any other of the taskforce members or their organizations.

Readers needing specific construction advice should seek the advice of a design or construction professional.

Please contact the Healthy Schools Campaign at 312.419.1810 with comments, criticisms, clarifications or suggestions regarding the format and content of this guide.

At the time of publication, all URLs for Web sites were accurate. A current list is maintained at www.healthyhighperformingschools.org.

healthy schools campaign

clean environment, healthy children, better education

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