Efficient Windows Collaborative

Energy Efficient Windows for New Schools

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Efficient window design for schools is crucial not only for saving energy and money but also to enhance the learning environment. The same window properties that affect a school's heating and cooling needs also affect thermal comfort in the classroom. Daylight improves the quality of the space as perceived by the teachers and students that work in it, while well designed daylit classrooms can replace the use of electric lights and save energy. Several major design considerations are affected by different window properties, as shown in the figure below:Efficient Windows and the Learning Environment

	Visual Comfort	Thermal Comfort	Energy Efficiency
Daylight & Views	✔		✔
Solar Heat & Glare Control	✔	✔	✔
Insulating Properties		✔	✔

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Visit www.efficientwindows.org for more information on the benefits of efficient windows, how windows work, how to select an efficient window, and what manufacturers provide efficient products.

Visual Comfort

The choice of glass along with the orientation and shading of windows affects the amount of daylight in a space and the view to the outside. Additionally, the quality of daylight is dependent on the window design, with the control of glare being a key design feature for visual comfort. A pleasant visual environment is an important factor for the performance of students and teachers.

Thermal Comfort

Windows that stay warm in the winter due to good insulating properties improve winter comfort, particularly for students sitting close them. Likewise, solar control glass and shading mitigate discomfort from solar heat.

> Windows can have both positive and negative impacts on student comfort and performance. Access to natural light and pleasant views are positive factors, but student performance can be negatively impacted by factors such as glare, uncomfortable temperature extremes, stuffy air and noise pollution. Proper window design and operation can help mitigate these issues, creating more comfortable and productive learning environments.
>
> ~(Heschong Mahone Group. 2003. Windows and Classrooms: A Study of Student Performance and Indoor Environment.)

Energy Use and Cost Considerations

Energy Efficiency

Window design that maximizes comfort also improves energy performance. Well insulating window systems can reduce the heating needs of a space. Meanwhile, appropriate solar control can allow solar energy to enter when heat is needed while blocking the sun to lower cooling. Glare-free daylighting reduces the need for electrical lighting while window design for thermal comfort reduces heating and cooling needs.

Cost Considerations

Energy-efficient design does not always mean higher initial cost: Optimum window placement and orientation can save energy at no cost, and improved window design may save up-front cost by allowing for smaller heating and air conditioning systems.

Considerations for Efficient Window Design

1. Start early with considering your options

There are many design options that affect the performance of a window system. Building orientation, window area, shading, window type and the use of daylighting controls are all important factors to consider. Start early in the concept phase to assess the impacts of window design options on energy use, comfort, daylighting potential and peak demand.

2. Pursue a systems approach

To achieve the best building performance, pursue window design that is integrated with lighting system and HVAC design. It is important to assess the impact of each system on the next and use that information to refine your choices. When designing for daylighting with windows, for example, consider strategies to control glare and solar heat gain and ensure lighting design that allows electric lighting to be reduced when daylight is available.

From schematic design to final specification, computer simulation tools can help you analyze how window design can impact demands on lighting and HVAC systems.

3. Select energy-efficient windows

To ensure good energy performance and meet the locally applicable energy code, select windows with efficient energy ratings. The National Fenestration Rating Council (NFRC) provides certified energy ratings for whole (glass plus frame) windows, doors and skylights that are third-party verified and recognized throughout the United States and Canada. Energy ratings for site-built windows are also available through the Component Modeling Approach (CMA). The most prominent window energy ratings are:

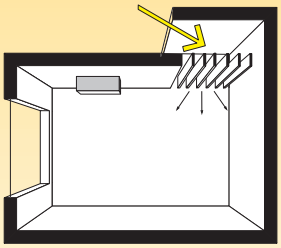
U-factor: Low-E glass and advanced frame designs can significantly reduce a window's U-factor. Aim for a U-factor below 0.45 in mixed and below 0.35 in cold climates.

Solar Heat Gain Coefficient (SHGC): A low SHGC is a priority in cooling-dominated locations. Low-E glass can reduce the SHGC below 0.25 without much impact on visible transmittance. Other low-E options are available that result in high SHGCs above 0.40 to help reduce heating needs.

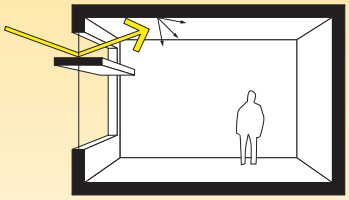
Visible Transmittance (VT): High visible transmittance increases daylight access but also increases the importance of glare control through orientation and shading.

Daylighting

Schools are particularly suited for daylighting for several reasons – they have primarily daytime use, predictable needs for room layout and lighting, and typically have only one or two story construction which is suitable to daylighting strategies such as roof monitors, skylights and light shelves. Such strategies are often needed because typical school classrooms with windows on one wall are too deep to be effectively lit by standard view windows alone. For optimum daylight access, buildings are usually best oriented on an east-west axis.



Toplighting with a roof monitor and diffuser baffles



Sidelighting with a light shelf.

For the amount of light provided, daylighting contributes less heat to a space than electric lights. Daylighting design should, however, prevent an oversupply of daylight that would cause glare and increase cooling needs. In six schools that implemented careful top and sidelighting design, a study by Innovate Design found lighting and HVAC savings resulting in a 10-25% reduction in total energy use (Guide for Daylighting Schools).

Design Guidance

Tools for Schools
Efficient Windows Collaborative
Information on window technologies and selecting energy efficient windows for schools
www.efficientwindows.org/ToolsForSchools.pdf

Guide for Daylighting Schools
Innovative Design
www.innovativedesign.net/pdf/daylightguide_8511.pdf

Design for High Performance Schools
Collaborative for High Performance Schools:
www.chps.net/dev/Drupal/node/31