Credit crunch—Daylighting and LEED®

By Mark Mitchell, Major Industries, Inc.

Daylighting systems are an important part of sustainable design, and affect the way a building interacts with its environment. Well-planned systems contribute to a variety of LEED categories and improve both occupant well-being and the bottom line.

Let’s examine how daylighting fits into specific credit opportunities in LEED v3 - New Construction (some strategies will cross over into other rating systems).

Sustainable Sites
The annual mean air temperature of a large city can be 1.8–5.4°F (1–3°C) warmer than its surroundings (and higher during evening hours) as a result of the heat island effect.1 Reducing heat islands (SS 7.2) is a key goal in sustainable design. Effective solutions to reduce the heat island effect include: cool and reflective roofs, light colored, reflective glazing materials like translucent fiberglass reinforced polymer (FRP) panels, as well as light colored and reflective framing finishes.

Translucent daylighting systems can also reduce light pollution during evening hours (SS 8), as they diffuse direct interior light sources and minimize the impact on nocturnal environments.

Energy and Atmosphere
According to the U.S. Department of Energy, roughly 50 percent of a typical commercial building’s energy use comes from cooling and artificial lighting. Utilizing daylighting systems with enhanced thermal properties both reduces artificial lighting during peak energy use hours and stabilizes HVAC loads.

Glazing materials such as translucent FRP panels also offer insulation options that bring center of glazing U-factors to 0.08 for 2.75-inch FRP panels and 0.06 for 4-inch panels. Compare these values to typical insulated glass which falls in the range of 0.40 to 0.30 and triple insulated glass at 0.20 to 0.10.

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**Materials and Resources**
MR Credit 4 encourages the use of waste-reducing recycled materials, and aluminum is highly recyclable and can be found in the structural members of most daylighting systems. Check with your supplier for recycled content percentages for the system you’re specifying.

Local/Regional Materials Credit (MR 5) may also apply to the specified daylighting system if its materials have been extracted, harvested/recovered and manufactured within 500 miles of the project site. Contact your daylighting system supplier for details specific to your system.

**Indoor Environmental Quality**
LEED doesn’t just relate to the building and its environment—it is also intended to have an impact on occupant health and well-being. IEQ Credits 2 and 6.2 cover increased ventilation and control of systems, and daylighting systems can contribute in both areas. Mixed-glazed systems, like translucent FRP panels and operable glass window combinations, allow for light and ventilation control.

IEQ 8.1 and IEQ 8.2 are a natural fit for daylighting systems. IEQ 8.1 requires a minimum glazing factor of 2 percent in at least 75 percent of occupied areas and IEQ 8.2 stipulates views to the outdoors for 90 percent of spaces. Again, translucent FRP/glass mixed glazed systems work well as they provide views while enhancing thermal performance and sun control.

**Innovation in Design**
Skylights and curtainwalls are versatile design components. Innovative use of these high-performance daylighting systems may contribute to LEED credit for innovation in design.

**Beyond LEED**
No matter what your overall goals are—even if they’re as simple as saving on energy costs—daylighting systems are a cost-effective way to create a beneficial and welcoming environment for building occupants. If you’re not sure where to start, contact a daylighting system supplier today to find out more about the options available for your specific projects and needs.

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Daylighting analysis
By Scott Schuetter, Energy Center of Wisconsin

Daylight design touches many aspects of the design process, from building massing to glazing properties to electrical lighting control and layout, and even the interior designer’s selection of finishes and partitions. With many factors affecting the design, how are you to know that a particular design is effective? Daylighting analysis provides this feedback by showing you how a given design will perform. A wide range of daylighting analyses exist, from simple and quick to complex and time-intensive, each of which has its strengths and weaknesses.

Simple Tools and Calculators
Two types of simple daylighting tools include sunpath diagrams and daylight factor calculations. Sun path diagrams illustrate the position of the sun at different times of the day and different days of the year for a specific latitude. When they are coupled with architectural drawings, they illustrate portions of the building that will receive direct sunlight at a given time.

Daylight factor is the ratio of illuminance attributable to daylight inside a space to the illuminance level outside at the same time. There are several different methods for estimating daylight factor, each of which takes into account the window area and total floor area of the space. Both of these tools are simple enough to provide an understanding of the available daylight in a space. However, their results are relatively inaccurate compared to other methods.

Physical Modeling
Physical modeling involves creating a scale model or actual-scale mock-up of the space and analyzing its illuminance levels under different conditions. A heliodon is one device used to simulate the sun and its relationship (solar declination, time of day, and latitude) with a scale model. Pacific Gas and Electric Company maintain a heliodon that may be reserved for this type of analysis. Physical models have the advantage of allowing you to use actual natural light. Additionally, they provide a wealth of quantitative and qualitative information for analysis, and they can represent any geometry. However, physical models take time to build and cannot easily be adjusted. A further drawback is limited access to a heliodon or other sky simulator.

Computer Modeling
There is a growing trend in using computer simulation to provide daylighting design guidance. In the past, these tools were sufficiently complex that only researchers and the most skilled practitioners could use them. Today, software tools exist that are relatively simple to use and sophisticated enough to provide accurate results. The main advantage of computer simulation is that it is parametric in nature, allowing you to quickly understand how a change to the design will affect the daylighting performance. Computer simulation provides both quantitative information (in the form of illuminance levels at different locations) as well as qualitative information (such as graphical renderings of a space). There are two main types of calculation methods:
1. Radiosity: compute how photons emitted from a source are absorbed or reflected by surfaces
   a. Software tools include AGi32, AutoDesk VIZ, LumenDesigner

2. Raytracing: a rendering technique based on simulating the path that light rays travel within a space
   a. Software tools include Radiance, Ecotect, DAYSIM, SPOT

Each technique and each tool has its strengths and weaknesses. Several are free and easy to learn, while others may be costly and time-intensive. However, the free software is often limited to simple geometries or unable to analyze more sophisticated shading methods. Your choice of which software to use should be guided by the project itself. If the project is small with a limited budget or time frame, then a simpler approach is warranted. If the project is larger with more sophisticated technologies and higher performance goals, then a more sophisticated approach is necessary.

For more information about these techniques, see the tools available from the Daylighting Collaborative and the Advanced Lighting Guidelines.