Association of
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Continuing Education

The Benefits of Daylighting

By Cara Clinton

Learning Objectives:

After taking this course, the reader will:

1. Understand the many benefits of incorporating daylighting in commercial projects.
2. Learn how daylighting in commercial buildings can specifically lead to energy savings, increased employee productivity, higher retail sales, increased property values and increased student performance (schools).
3. Discover how daylighting can help projects gain green certification credits under the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED™) program.
4. Learn how Tubular Daylighting Devices (TDDs) in particular are being used to incorporate daylighting in both new and retrofit building projects.

The U.S. Department of Energy states that electric lighting can account for as much as 40 to 50 percent of energy consumption in today's commercial buildings. This is an area where daylighting can have a major beneficial impact. By incorporating smart daylighting strategies, including such measures as automated or pre-set lighting control systems, the need for energy-consuming electric lights is cut dramatically.

However, using daylight offers several positive benefits beyond just decreased electric bills. Those benefits, as well as daylighting guidelines, are outlined below.

Why Use Daylighting?

Energy Savings

According to the U.S. Green Building Council's Sustainable Building Technical Manual, well-designed daylighting solutions can reduce lighting energy use by 50 to 80 percent. A sufficient daylighting design can greatly reduce energy consumption and the overall carbon footprint of a building.

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The latest technique in the industry is "cool daylighting," which filters out unwanted wavelengths of light, such as heat and ultraviolet rays, without negatively affecting lighting levels. Adding cool daylighting minimizes upfront installation costs for mechanical cooling systems and reduces the overall cooling load costs.

Increased Employee Productivity

Energy savings is not the only reason architects and business owners should consider daylighting their facilities. In fact, it may very well be just a small part of the overall picture. A Harris poll found lighting as the number one contributor to worker productivity.

Since companies spend an average of 70 times as much money (per square foot, per year) on employee salaries as on energy, an increase of just one percent in productivity can result in savings that exceed the company's entire energy bill. According to the Rocky Mountain Institute, productivity gains of six to 16 percent, stemming from decreased absenteeism and improved quality of work, have been reported from energy-efficient building design.

Higher Sales

Larger gains in retail sales have also resulted for many building tenants that occupy spaces that are lit by daylight. Natural light makes interiors appear larger and more spacious. In addition, the colors of the merchandise, displays and walls look truer, creating better product visibility. While most customers say they do not notice when buildings feature daylighting, it has been proven that naturally lit environments increase long-term customer loyalty. Customers prefer naturally lit environments without being able to pinpoint why.

In fact, profits from sales in buildings that use daylighting "may be worth 45 to 100 times more than the energy savings," according to a two-year study sponsored by the California Energy Commission.

Property Value and Marketability

Green projects typically sell or lease faster and retain tenants longer because they combine superior amenities and comfort with lower operating costs and more competitive terms. The resulting gains in occupancies, rents and residuals all enhance financial returns.

According to the Electric Power Research Institute, daylit

buildings can result in 10 to 20 percent higher rental income than those that use only artificial light. Daylit properties are likely to rent faster and for higher rates. Additionally, when the owner is ready to sell the building, the investment in energy efficiency should bring added resale value.

Improved Student Performance in Schools

The use of natural lighting for interior illumination in school buildings has resulted in greater productivity, enhanced student test scores, improved health and wellbeing, increased safety and reduced environmental pollution.

For example, a study by the National Clearinghouse for Education entitled "Do School Facilities Affect Academic Outcomes?" reports proper lighting reduces poor behavior and daylighting fosters higher student achievement. Classrooms with effectively incorporated daylight yield lighter electric loads, reduced heating and cooling costs and are more popular with students and teachers.

"Larger gains in retail sales have also resulted for many building tenants that occupy spaces that are lit by daylight."

Achievement of LEED Credits

Aside from the major benefits above, daylighting also plays a pivotal role for those looking to gain green certification credits for their projects through the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED™) program, which is increasingly used as a building standard by all types of governing bodies. The efficient use of daylighting can contribute to the achievement of LEED credits for energy savings and innovative performance, among other potential qualifications.

Daylighting with TDDs

In addition to traditional methods, such as windows and skylights, Tubular Daylighting Devices (TDDs) are becoming increasingly popular as a highly effective way to incorporate daylighting in both new and retrofit building projects. Often selected for their compact size, technological features and design flexibility, TDDs are passive systems that capture daylight on the rooftop, transfer it down a reflective tube and deliver it into a building's interior. More advanced TDDs offer superior performance and additional features that take appearance, style and functionality into consideration.

In late 2007, the TDD earned its own section in the Construction Specifications Institute's MasterFormat 2004 number system, representing a coming-of-age for the product category, which had previously been included in the unit skylight section since the 1980s.

Today, TDDs are being specified into all types of commercial structures, from schools to supermarkets, as an effective and affordable lighting strategy. The product earned international acclaim as hundreds of TDDs were installed in a major sports arena for the world's first green Olympics in Beijing.

TDDs, however, are not for commercial use only. There are residential products on the market that provide exceptional lighting for all interior spaces, including hallways, bathrooms, kitchens and home offices.

Specifying TDDs*

The role of the specification in TDD design is extremely important and can greatly affect the outcome of the space itself. A specifier must take into account the varying components of the Tubular Daylighting Device and the differences in the technologies of those components to understand how to achieve the required results. Three attributes are particularly critical: Capture, Transfer and Delivery.

Although the differences in these components may seem inconsequential, subtle variances can make the difference between a poorly lit space and an award-winning, environmentally conscious design.

Capture

In order for the TDD to bring daylight into interior spaces effectively, sunlight capture must begin at the roof level. With various technologies being used to harness daylight in TDDs, the differences begin at the dome. Products can range in technology from simple thermally formed, clear plastic domes to more advanced systems that utilize optics to maximize light collection.

There continue to be industry advances in low-angled light collection, which is especially important for the winter months, in high latitudes and in climates with frequent overcast skies. Knowing and understanding the differences in the qualities of the domes can help projects properly specify the system that meets the most stringent daylighting and energy efficiency requirements.

Transfer

From the dome level, daylight is captured and then transferred through optical tubing, which systematically affects the daylight transport from the rooftop aperture to the ceiling diffuser. The system uses reflective tubing to duct daylight into the building's interior spaces. With an assortment of qualities in today's tubing

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materials, this is yet another important specification component that must be clearly called out during the building's design and specification process.

When looking at tubing performance, the differences tend to be in the material used and this material's reflectivity. There are two major components of reflectivity that collaborate together within a TDD: 1) Specular reflection, and 2) Spectral reflectance. Tubing types can include corrugated/flexible tubing, enhanced anodized aluminum, metalized surfaces and the more advanced non-metalized film technologies.

The goal, essentially, is to maximize the ability of the light to travel down the tube while minimizing the amount of light lost and color shift during the transport.

Delivery

All the components that work together to obtain the highest quality of daylight in the interior are only as good as the diffuser's final performance. Optical diffusers provide controlled daylight distribution in very precise ways. Light spread, color temperature and glare can all be greatly affected by the diffuser's design and specification.

More advanced TDDs offer optical modulation systems, allowing users to control light output, much like they would with some electric light fixtures. These modern systems do not negatively affect the light distribution pattern of the unit, but can offer designers the ability to integrate daylight into their unique lighting designs and tune daylight levels to meet changing space functions and visual requirements.

Some devices can be integrated into lighting controls systems, while others can offer a wall-mounted rocker switch, allowing building inhabitants to modulate the daylight themselves or set scene level controls for demanding multi-use environments, such as classrooms and boardrooms.

Depending on the design intent, the proper specification of such systems can be crucial to obtaining the energy efficiencies sought, as well as helping to clearly define the appropriate commissioning of the building's energy efficient systems. The ability to modulate daylight makes it possible for TDDs to be used in spaces that have previously been considered "off limits."

Varying lens technologies are available for TDDs, from basic prismatic designs to highly engineered Fresnel lenses. The choice of diffusion can be based simply on aesthetics or on precise lighting calculations that consider light spread and photometry.

Daylighting Resources

Incorporating daylighting strategies into a building plan has become less time consuming and complicated thanks to several industry resources. Tools such as Building Information Modeling (BIM) allow the design community to visualize all building components, including daylighting, before physical construction begins.

The result is a growing body of evidence that daylighting can help businesses retain employees longer, provide a healthier and happier workplace, and stay more competitive through higher productivity and lower operating costs. Daylighting and energy-efficient building design are also added bonuses for building owners looking to increase the value and marketability of an investment property.

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This relatively young field has yet to reach its full potential, and the coming years are bound to present new daylighting tools that were previously unimaginable. In many ways, we have come full circle, back to the original light source, which just so happened to be the best.

** Source: The Construction Specifier, April 2008; "Daylighting Goes Tubular"*

About Solatube International Inc.

Solatube International Inc., based in Vista, Calif. (northern San Diego County), is the worldwide leading manufacturer and marketer of Tubular Daylighting Devices (TDDs). The company's flagship product, the Solatube Daylighting System, provides a revolutionary natural lighting solution for all types of residential and commercial applications. The maxim "Innovation in Daylighting™" reflects the company's commitment to the development of breakthrough daylighting technologies, which has resulted in numerous patents dating back to the mid-1980s. Widely recognized as the industry innovator, Solatube International has earned acclaim around the globe for its unrivaled ability to transform interior spaces with the power of daylight. For more information on the Solatube Daylighting System or other products manufactured and marketed by Solatube International, including solar-powered attic ventilation fans, please visit the Solatube Web site at http://www.solatube.com or call 888-SOLATUBE (888-765-2882).

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ALA Continuing Education Questionnaire -

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QUIZ QUESTIONS

1. According to the USGBC, well-designed daylighting solutions can reduce lighting energy in a building by how much?
   A. 30-50%
   B. 50-80%
   C. 80-100%
   D. 10-20%

2. Which is NOT an advantage of cool daylighting?
   A. Filters out unwanted wavelengths of light
   B. Minimizes upfront installation costs
   C. Reduces the overall cooling load costs
   D. None of the above

3. Since customers prefer naturally lit environments, retail profits from sales in buildings that use daylighting may be worth more than the energy savings themselves. How much more?
   A. 100 times more
   B. 50 times more
   C. 45 to 100 times more
   D. 25-50 times more

4. What is the primary reason TDDs, rather than traditional skylights, are used to daylight a building?
   A. Compact size
   B. Technological features
   C. Flexible design
   D. All of the above

5. In order to most effectively bring daylight into an interior space, where should sunlight capture first occur?
   A. The side of the building
   B. The center of the building
   C. The roof of the building
   D. None of the above

6. True or False: Daylit buildings can result in 10 to 20 percent higher rental income than those that use only artificial light.
   A. True
   B. False

7. True or False: TDDs are only able to be installed in new construction due to the fact that the roof of the building is already in place.
   A. True
   B. False

8. Which of the following are typically found only in the most advanced, modern TDDs?
   A. Corrugated/flexible tubing
   B. Optical modulation systems
   C. Optical Diffusers
   D. None of the above

9. Which can be greatly affected by the design and specification of a TDD's diffuser?
   A. Light spread
   B. Color temperature
   C. Glare
   D. All of the above

10. True or False: The choice of diffusion must be based on precise lighting calculations that consider light spread and photometry.
    A. True
    B. False

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