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## **Benefits of Decorative Glass in Daylighting Applications**

### **Role of Glass in Daylighting Design**

For as long as building construction has existed, architects and designers have recognized the power of the sun to provide natural light. In today's modern world, the architectural and design community continue to incorporate techniques that harness natural light to create comfortable, energy-efficient and aesthetically pleasing interiors.

Over the years, the number of decorative glazing daylighting solutions has significantly increased, providing a number of significant benefits, such as:

- Enhanced light diffusion
- Glare control
- Light redirection
- Maximized light transmittance
- Increased light scattering

Decorative glass may also contribute toward LEED credits in the categories of Energy and Atmosphere, Environmental Quality and Innovation.

### **Benefits of Daylighting**

Decorative glazing in a daylighting strategy can bring about obvious ecological advantages as it is one of the most environmentally responsible lighting strategies available. By harnessing the power of the sun, buildings can reduce the amount of energy needed for lighting and climate control, while effectively controlling thermal transmission.

An integrated approach to daylighting can lower costs by properly directing natural light and managing heat generation to reduce overall heating and air conditioning needs. Technological advances in glass, including decorative glazing, contribute to good daylighting which proves efficient and economical.

In addition to energy savings, countless studies cite the advantages of daylighting in terms of increased productivity, reduced absenteeism, enhanced employee retention and improved academic performance. Specific studies show a 6% increase in retail sales after adding daylighting<sup>3</sup>, a 15% reduction in absenteeism among office workers in a well-lit environment<sup>4</sup>, a 21% increase in student test scores when students have good access to daylight<sup>5</sup>, 39 additional work hours per year in office worker productivity<sup>4</sup> and 6% to 12% improvement in office worker performance<sup>5</sup>.

Daylighting can have health benefits to people who suffer from seasonal affective disorder. In addition, studies show that daylighting can help reduce depression and improve sleep<sup>1</sup>, reduce the development of surgical post-op delirium by as much as 55%<sup>2</sup>, reduce the length of the average hospital stay by 2.6 days<sup>1</sup> and lower pain medication in post-spinal surgery patients by 22%<sup>1</sup>.

## **Decorative Glazing Solutions Meeting Daylighting Challenges**

### Reduce Energy Consumption

Combining decorative glass with low-e can allow as much useful light as possible while optimizing energy consumption.

Decorative glass can reduce heat gain enabling downsizing of HVAC systems and use of electricity. In addition, decorative glass filters can decrease the harshness of direct sunlight. By controlling how and where daylight penetration exists, decorative glass can reduce the likelihood of excessive brightness in vision areas.

Windows have two essential functions in day-lit buildings. First, daylight delivery/admittance requiring a high visible transmittance; and second, provision of view to occupants requiring low visible transmittance to prevent glare. Decorative glass can easily accommodate these two functional components.

### Improve Light Level Control

We have all seen how intense a beam of light streaming through a simple window can be. In this case, only one small area of the room will get a concentrated amount of light, while the rest of the room only gets the redirected/reflected light and remains in the dark. This is especially true with a skylight in high structure, like in a mall or museum. Ideally, we would like to transform this intense beam of light into a more diffuse light source and use it to light up the whole room or transport sunlight into areas without a direct line of sight to the exterior.

- Light reflection or redirection – The level of daylight can be enhanced in darker areas such as the basement or in the center of the building. Decorative glazing can be used to replace opaque walls so that light can pass through, while mirrors can be used to redirect light further into the rooms.
- Light scattering - Just as for glare control, some types of decorative glazing can be used to diffuse direct sunlight and spread out the beam, thereby maximizing the area lit up by a window.

### Enhance Comfort Level

Trends in building design show an increasing interest in bringing sunlight into interior spaces to both enhance occupant experience as well as increase energy performance and sustainability. Just as we use sunglasses and sunscreen to guard against sunlight over-exposure when outside, thoughtful building and glazing design must be deployed to maximize interior daylighting benefits while minimizing the potential negatives.

Daylighting must be managed to avoid light levels or conditions that lead to excessive glare. Equally important is the need to account for and control the heating that occurs when interior surfaces absorb sunlight and convert it to heat. The heating felt at any given position relates to the light intensity at that spot, while the overall amount of daylighting heats the interior environment and must be considered in balancing the HVAC needs of the building. Managing the amount and distribution of this heat is required to ensure a comfortable environment for each individual and room, and for the entire building. Decorative glazing methods can be used to manage glare and light-induced heating.

- Light Scattering –Some decorative glazing products are designed to scatter light, transforming intense sunlight into a softer array of diffuse light. Textured films, rolled-patterned glass or surface treatments, like ceramic frit or acid etching, turn ordinary float glass into a light diffuser which spreads the light out, reducing glare and localized heating.

- Glare-Control Glazing - Designed to absorb or redirect part of the sunlight, these products control the total amount of light entering a building. Low-e or reflective coatings, tinted glass, electrochromic glass, acid-etched glass or a decorative pattern can be used to decrease light transmission or absorb light through the glazing. Particularly in areas where people will be stationary for significant amounts of time, for example an office, work station or cafeteria, it is important to control daylighting levels to maintain occupant comfort.
- Dynamic Light Control – It is usually important to maintain consistent lighting levels even when the amount of daylight available can vary, such as cloudy versus sunny days or at noon versus 6pm. Most decorative glazing products have a fixed effect on the amount of light they block or absorb. One exception is dynamic glass, where the light transmission can be adjusted dynamically to the light level entering the building. Designers often use static decorative glazing products in combination with complimentary and variable methods to adjust area lighting levels. Such variable methods include movable blinds and light level sensors to adjust artificial lighting levels in response to the amount of daylighting available.

Daylighting is becoming increasingly important and popular, particularly with the emphasis on reducing the use of artificial lighting to reduce energy costs while simultaneously increasing occupant comfort and wellbeing. Decorative glazing products can and should be an integral part of the design strategies used to ensure occupant comfort while seeking to maximize daylighting benefits.

#### Greater Privacy with Maximum Daylight

Decorative glass is instrumental in maximizing daylight while achieving an appropriate measure of privacy in both residential and commercial applications.

Certain types of glass with a translucent surface offer excellent light transmittance with limited or no line of sight. In residential applications, they are typically found in bathrooms and kitchens, but they are also used creatively as room enclosures or dividers, creating more illuminated spaces while providing a sense of openness and grandeur.

In commercial applications, such as health care facilities, research laboratories, corporate buildings with meeting rooms and offices, the need for appropriate privacy is high but the desire to restrict light flow is as important.

In both cases, the privacy/light flow combination can be achieved with various types of decorative glass products.

Options such as rolled patterned glass, stained glass, cast glass, acid-etched glass or thermoformed glass can provide privacy, light flow and an element of design. Somewhat dense designs on glass, through ceramic frit, acid etching or sandblast may also meet the desired objectives.

Another option is diffusing light through glass. This can be done with a number of surface finishes such as acid etch or sandblast or through a laminate assembly with somewhat translucent interlayers. Post installation solutions also include films and decals on glass.

The challenge is finding the right glazing where privacy is paramount but vision is still required, and must also consider factors other than glass. Daytime and night time outdoor conditions as well as interior lighting may have an impact on the actual level of privacy achieved. Appropriate testing of glazing solutions considered should always be performed.

#### **Conclusion**

The correlation between indoor environmental conditions and the wellbeing of building occupants is strong and the impact of daylight on worker performance, health and recovery of patients and student learning is undeniable.

A wide variety of interior and exterior decorative glazing solutions is available to help the architectural community create building designs that provide an appropriate balance between aesthetics, solar performance and daylighting.

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