Understanding Glazing Properties

A Pacific Energy Center Factsheet

Pacific Gas and Electric Company
Pacific Energy Center

Introduction

Glazing selection is a process that requires balancing various tradeoffs. There is no single perfect glazing for any project; however, a designer can narrow the choices with careful consideration. Thanks to development activity on the part of glazing manufacturers, designers have an increasing range of choices and balancing window criteria is no longer as difficult as it once was.

The energy properties of glazings are usually listed in manufacturer product literature. Examining all of these properties in a glazing decision informs good selection for maximum comfort and energy efficiency while preserving view, amenity and other design intentions for the fenestration.

Important Properties to Evaluate

Visible Transmittance is the percentage of visible light striking the glass that passes through the glazing to the interior. Manufacturers often list visible transmittance as 'daylight transmittance.'

Glazing with a high visible transmittance provides a good sense of connection with the exterior while admitting useful daylight. Daylight can offset the need for electric lighting and save significant energy while creating a pleasant indoor environment.

High visible transmittance glazing can sometimes introduce a glare problem. When the window and the area immediately adjacent are far brighter than surrounding areas, the contrast is difficult for our eyes to handle. Low transmittance glazing, while reducing glare, creates 'gloomy' interiors, diminished view, and little daylight. Visual comfort can be achieved with high transmittance glazing through careful sizing and placement of windows, light colored interior surfaces, movable window coverings, light diffusing deep sills and baffles, among other solutions.

Shading Coefficient indicates heat gain due to solar radiation. A dimensionless number between 0 and 1, it expresses the total transfer of the sun's radiation as compared to a benchmark glazing (1/8' (3mm) clear glass) under identical conditions. The lower the number, the better the glazing prevents solar heat gain. This property is widely used in air-conditioning calculations.

To minimize heat gain and air conditioning load, look for glazings with low shading coefficients. Air-conditioned buildings with large areas of unshaded glass particularly need solar control glazing. Title 24 may dictate a maximum shading coefficient.

Low shading coefficient once meant very dark gray or bronze glass, or highly mirrored reflective glass. This is no longer the case. Today's advanced glazings offer a tremendous range of aesthetic opportunities, without sacrificing solar control.

Solar Heat Gain is the incident solar radiation reduced by the glazing under a specific set of conditions. Part of the sun's energy is transmitted directly through the glass, part is bounced off by reflection, and part is absorbed by the glazing. The absorbed energy warms up the glazing, which then re-radiate this energy, both toward the building interior and the outdoors. Solar heat gain includes both the directly transmitted solar energy and the absorbed portion that is re-radiated inward.

U-Value and R-Value are measures of heat transfer through the glazing due to temperature difference between inside and out. These properties are critical in all building types in colder climates, in residential construction for most climates, in any application where 24-hour comfort is important, and in any application where condensation must be avoided.

Heat transfer through the window occurs due to the difference between indoor and outdoor temperatures; the greater the difference, the faster the heat flow. R-Value measures the resistance to heat flow of the entire window assembly with higher numbers indicating better insulating properties. U-Value measures the rate of heat transfer and is the reciprocal of the total window R-Value. In this case, lower numbers are better.

Title 24 may indicate a maximum U-Value for a project and requires the total window (glazing assembly plus the frame) U-value to be documented. The frame and spacers are often a prime path for heat flow, reducing the overall insulating value of a window assembly. Manufacturers generally quote a U-Value for the 'center of glass,' where insulation is highest. Recently, California began requiring window manufacturers to label their windows with a sticker identifying total window U-Value as measured by a standardized method.

The U-Value or R-Value is most important where heating costs are a concern, since the difference between indoor and outdoor temperatures is usually higher in winter than in summer. It is also critical for occupant comfort. In cold weather, a single pane window with a high U-Value will quickly reach nearly the same low temperature as the outside air. Persons sitting inside near that window will likely feel chilled, even with a warm indoor air temperature, due to the body's heat loss by radiation to that cold glass surface. Additionally, room air is chilled upon contact with the cold glass and falls along the window, creating a cold 'down' draft. Finally, cold surfaces have a higher likelihood for condensation than warm surfaces. The lower the U-Value, the more closely the glass temperature will match room temperature, reducing condensation possibilities.

Visible Reflectance indicates to what degree the glazing appears mirror-like, both inside and out. It measures the percentage of light striking the glazing that is reflected by the glass. Most manufacturers provide both outside (exterior) and inside (interior mirror effect at night) reflectances. While all smooth clear glass is naturally somewhat reflecting (the effect is greatest on the side with higher lighting levels), visible reflectance can be increased through glazing treatments such as metallic coatings. A higher visible reflectance represents a more mirror-like appearance, a darkened view and reduced daylight transmittance. Zoning ordinances may limit the degree of exterior reflection. For example, San Francisco has such a restriction.

Ultraviolet Transmittance indicates the percentage of incident ultraviolet radiation that passes through the glazing. Ultraviolet radiation (UV)is responsible for sunburn (of people and plants) and contributes to fabric fading and artwork damage. Most manufacturers provide the percent of UV transmittance for their glazings. Look for low ultraviolet transmittance when interior finishes or artwork need protection. Note that ultraviolet is not the only factor in fading; for highly sensitive artwork or furnishing, limit all sunlight and control other environmental factors such as humidity and temperature.

Spectral Selectivity refers to the ability of a glazing material to selectively transmit visible light while reducing solar gain. Many glazings achieve a low shading coefficient at the price of low visible transmittance, making the window appear dark. On the other hand, a window that lets in a lot of daylight may also admit too much heat. A spectrally selective glazing brings in the light without the heat, for 'cool' daylight. These glazings are highly transmissive in the visible portion of daylight while blocking the infrared. The result is both an excellent shading coefficient and good visible transmittance.

A glazing is generally considered selective if it has relatively high visible transmittance and a relatively low shading coefficient. The ratio of the visible transmittance to the shading coefficient can be used as a metric for selectivity, with ratios greater than 1.0 indicating that a glazing is selective. Some manufacturers list this number in their literature as a 'coolness index' or use other similar names.

Glazing Color affects the appearance of view (bronze will dull a blue sky, for example) and the appearance of interior finishes. During the design phase, be sure to examine carpet, fabric, and paint samples in daylight that comes through the selected glazing to be sure finishes are not changed undesirably.

Sound Transmission is not related to energy; but an energy-efficient window can also deliver superior acoustic performance. Sound transmission class (STC) is the property used to express sound attenuation characteristics of glazing and window assemblies. The higher the STC rating, the better the unit will insulate against sound. Multilayer assemblies, especially those with a laminated layer, generally have high STC ratings.

Next Steps

Familiarize yourself with product literature. See glazing brochures in section 08810 of Sweets Catalog. Read the manufacturers' tables of properties for each of their products. The Pacific Energy Center has exhibits to aid in understanding glazing properties.

For More Information

Contact your PG&E representative or call 1-800-468-4743 for more information about PG&E's energy efficiency programs and other services.