

More than Skin Deep: Window Decisions

A Pacific Energy Center Factsheet



Introduction

Windows are among the most critical parts of a building. They provide light and view for a pleasing visual connection to the outdoors. When they are operable, windows bring in fresh breezes. They give the building facade character, serving an expressive function inside and out. Because windows are also a significant factor in the work that the building's mechanical and electrical systems must do, it is important to design them with care and knowledge. Intelligent window design offers many energy saving benefits.

- ?? Good window design reduces heating and cooling equipment costs and operating costs.
- ?? Good window design reduces lighting costs through daylighting.
- ?? Well lighted spaces can increase the value of a building.

How Window Design Can Fail

Poor fenestration design can both waste energy and cause discomfort. For example, dark gray glass used for solar control is usually disadvantageous overall.

Although the glass is dark, it does only a fair job of keeping out solar heat. It also warms up in the direct sun, reaching temperatures of up to 120 deg. F and turning the window into a virtual furnace. Heat is radiated from the glass to those in the room, making them overheat on a sunny day. If a window is single pane the problem is exacerbated during cold weather.

Single-pane glass is highly conductive, so the entire exterior edge of a building fluctuates widely with changes in outdoor conditions and the HVAC system may be unable to keep up. In cold weather, the surface temperature of the glass is nearly the same as the outdoor temperature. A person sitting near the window feels chilled, no matter the indoor air temperature, since his or her body radiates heat to the cold glass. Making matters worse, a chilly downdraft results as room air touches the glass, cools, and flows down along the window pane towards that person's ankles.

Well-Integrated Window Design

Good fenestration design saves energy, increases comfort, and makes a better indoor environment. An integrated design yields appropriately sized windows with exterior shading and advanced glazing for both daylight admission and solar control. The higher

first costs of advanced glazing, exterior shading, and insulating windows, if not offset by lower mechanical system first-costs, are usually quickly recovered in reduced operating costs and higher occupant productivity due to improved comfort.

Properly sizing a window balances light, view, comfort and energy use. Floor-to-ceiling glazing is not necessary for a good view or sense of openness.

Today's advanced glazings provide good solar control and maintain visible transmittance - the best of both worlds. These glazings are spectrally selective, admitting the beneficial visible light wavelengths, while reflecting the infrared (heat) wavelengths, which otherwise would add to air conditioning load. With the addition of a light tint, also spectrally selective, the window reduces glare while still admitting plenty of useful light. An ideal glazing choice for a high performance window combines a spectrally selective tint with a spectrally selective coating, probably in an insulating unit (see below). This combination provides better solar control than the outdated dark tint describe above and looks clearer as well. Exterior shading saves even more by reducing air conditioning energy. See "Understanding Glazing Properties" factsheet.

Insulating units provide a tremendous improvement over single-pane glazings. Depending on the application, these windows can use various combinations of double- triple-pane glass, an insulating gals fill (argon or krypton), and framing materials chosen to reduce conductive heat losses around the window edges. For even better performance in all construction types, add low-emissivity coatings, which reflect long-wave radiant energy (heat), to further enhance energy performance and comfort. Comfortable occupants are generally more productive and less likely to bring in energy-consuming fans and heaters.

Finally, a well-integrated design incorporates electric lighting systems that take advantage of the additional daylight provided by a window with high visible transmittance. Such a lighting system uses bi-level switching, dimming, and/or photocell controls to turn lights off or down when daylight is available. The potential energy savings are substantial, since up to 50% of electricity use in a commercial building goes to lighting and the air conditioning required to remove the heat from lights.

Details

- ?? Size windows to provide adequate light without burdening the mechanical system. Windows are oversized far more often that undersized. Use a mechanical engineer to assess the thermal impact of your windows and reduce glazing areas where possible.
- ?? Evaluate the concept of view. An all-glass wall may not be the best way to celebrate a grand view. Consider viewing angles from various positions in the space plan. If windows are not providing light or view to the occupants, then their only influence is a negative one on the mechanical system.
- ?? Select a glazing that best balances all aesthetic, performance, and comfort needs.

- ?? Don't forget that sill depth and color affect incoming daylight. A deeper sill provides a diffusing surface for daylight and helps reduce glare. Light colors reflect daylight better than dark colors.
- ?? Consider incorporating an exterior shading strategy, which can be anything from self-shading via thick walls, to a simple overhang, to a complex, operable louver system. Exterior shading is the best way to keep the sun's heat out of a building.
- ?? Interior window treatments are an important part of the fenestration system. If the shades, drapes, or blinds are light colored, they have a beneficial impact on cooling, as they will reflect some solar energy back out the window. If the interior coverings are dark, there is little or no reduction in heat gain. Interior treatments are also a way for occupants to adjust window brightness to suit their own visual comfort needs. Window glare reflected in computer screens can be a serious problem. Provide personal control of the glare for each occupant rather than universally treating the entire building with very dark glass.
- ?? Consider the potential for glare due to brightness of windows or incoming direct solar beams. Bright windows create serious discomfort when the eye tries to balance bright surfaces with the relatively dim surfaces elsewhere in the room. Brightness glare is more difficult to combat than that from a lighting fixture, as the window is directly in the field of view rather than in the ceiling plane. The solution for brightness glare combines glazing treatment, shading, window coverings, and space planning. Select a glazing with a reduced visual transmittance (although not too low to preserve daylight), use exterior shading to prevent sunlight from directly striking the glass, use interior window coverings to provide occupant control, and position work stations to best shield light-sensitive activities from a direct view of the window.
- ?? Work with a lighting or electrical designer to consider daylighting the building. When windows are used properly electric lighting can be offset during daylight hours. A lighting designer understands how to integrate daylighting, lighting systems, and photocell controls to automatically adjust the lighting when daylight is present.

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.

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