

Daylight performance of a microstructured prismatic window film in deep open plan offices

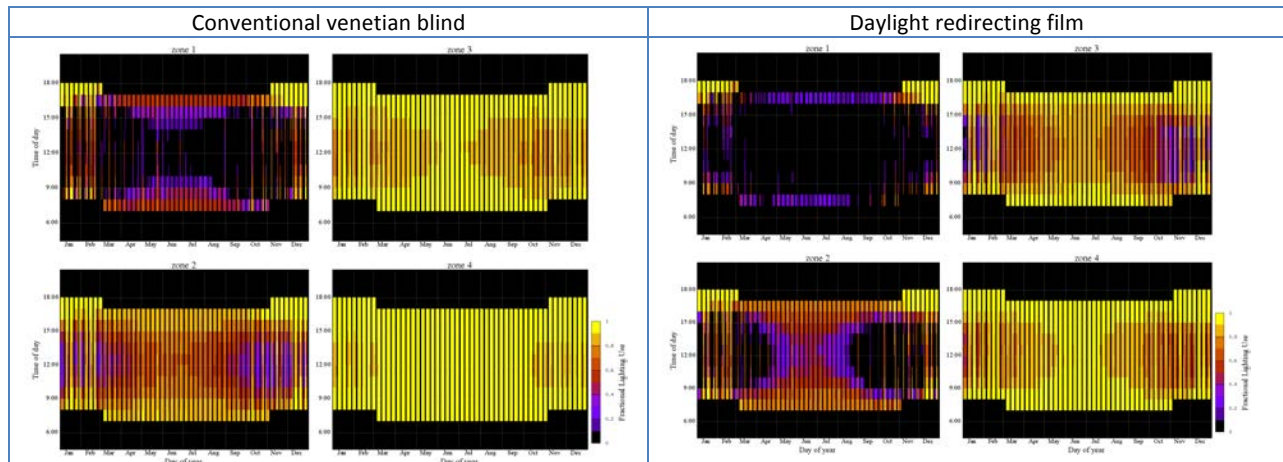
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Summary

Daylight redirecting systems with vertical windows have the potential to offset lighting energy use in deep perimeter zones. A microstructured prismatic film was designed and fabricated by a manufacturer to redirect sunlight to the ceiling plane when the film was installed in the upper portion of a window. Energy simulations based on the ray-tracing program, *Radiance*, were performed to evaluate the annual lighting energy use and discomfort glare in a deep open plan office zone in several climates and for south and east-facing window orientations. These simulations showed that when the prismatic film was combined with a light diffusing film, the system was able to deliver significant energy savings without glare.

Compared to conventional Venetian blinds with daylighting controls, total annual source lighting energy use savings for the dual-film system across a 40 foot deep office zone were 0.99-1.05 kWh/ft²-yr (20-22%) in Chicago, Houston, and Sacramento assuming an installed lighting power density of 0.89 W/ft²*. Source peak electric demand reductions were 0.09-0.21 W/ft² (17-25%). Estimated simple payback ranged from two to six years, assuming an added installed cost of \$20/ft²-window to the consumer. In common cases where there are no lighting controls, annual lighting energy savings would be 39-43% with an even shorter payback period.



Hourly lighting energy use in four 10-foot deep zones from the window. Black indicates no lighting energy use due to sufficient daylight to shut off the lights, yellow indicates 100% lighting energy use. Zone 1 (upper left) is the 10-foot deep zone closest to the window (0-10 ft from the window). Zone 4 (bottom right) is the 10-foot deep zone farthest from the window (30-40 ft from the window). Even in Zone 4, the daylight redirecting film is able to reduce energy use during the day from the equinox to winter solstice, September to March (x-axis is month, y-axis is time of day). The blind was lowered with slats at 45° to block sun.

* California's Title-24 2013 requirement