Energy-Efficient Window Treatments

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Abstract: Energy-Efficient Window Treatments:

Most building owners spend billions of dollars to outfit windows with drapes, shades, or blinds. Only a small fraction of this expenditure is ever targeted towards energy-efficient systems. Increased numbers of pleated, cellular shades with R-values presented in the R-3+ range are now in the marketplace. Foam plugs have been successfully used in many regions for low-cost, high R capability. The following elements shall be compared with respect to economic, utilitarian, thermal, and moisture issues:

Exterior systems
Interior systems
Traditional coverings
Glazings, films, coatings
Foam plugs
Cellular shades
Current research

There is an increasing interest in energy-efficient fenestration systems. For many existing property owners, new or replacement windows are not an option. Energy-efficient window treatments, or coverings, offer this class an opportunity to address the system efficiency often as a byproduct of an aesthetic refurbishment.

Windows may be outfitted on the exterior, interior, and even between glazings with devices that will modify the apertures thermal effect on the building. Different climates, not unusually, require different strategies.

The following approaches are the ones most often discussed by staff of the US Department of Energy's Energy Efficiency and Renewable Energy Clearinghouse (EREC).

Solar Screen:

Solar screen material is used in hot, sunny climes to cut the amount of solar radiation reaching the window itself. Any insect screen associated with a window tends to reduce the amount of solar gain by about 10%; solar screening is capable of reducing that by up to 90+%. It generally takes the form of a mini-louvered metal or vinyl-coated fiberglass textile. The textile patterns tend to predominate in the marketplace.

All window screens should be utilized/removed in concert with the general weather patterns. In much of the United States, the winter provides lower light levels with associated cloudy, overcast conditions for many days on end. This has been found to be a factor in a malady termed Seasonal Affective Disorder (SAD). Actively removing the window screens once a year at the onset of winter conditions and then reinstalling them in the Spring can promote better indoor daylighting access for inhabitants.

Textile-type solar screens are commonly employed on the interior of commercial buildings. Skylights, greenhouses, and lobbies are places they may often be spotted. They provide diminished illumination while still providing better view to the outside than offered with many other materials. Unfortunately, much of the solar spectrum has already passed through the glazing and heated the building's interior somewhat by the time the screen intercepts the light.

Solar Control Films:

These are typically employed when the owner requires a non-obstructed view and may not wish to employ other shading devices. They may be attached using electrostatic or bonding agent elements. These films are capable of employing beneficial low-emissivity coatings, tinting, or safety characteristics.

Research is even underway on photovoltaic-powered and operated 'smart' film-a retrofit approach that could substantially improve the thermal efficacy of glazing systems. If affordable, it would have dramatic effects on the thermal characteristics of commercial structures. It may even provide building systems with additional electric power directly generated from the Sun.

Insulation Plugs:

"Insulation plugs," or "window plugs," typically are rigid or semi-rigid panels that fit snuggly inside or around the fenestration opening. While they may be designed to work on the exterior as a shutter-like assembly, most people contacting EREC are interested in interior applications.

These panels may be constructed of multiple layers of corrugated cardboard or one or more layers of rigid insulation board. While insulation board of expanded polystyrene, extruded polystyrene, and polyisocyanurate is readily available, the flame-spread characteristic of these materials is often left unconsidered. Perhaps the best option is to use foil-faced polyisocyanurate board sealed about its edges with foil-tape. The foil imparts both fire resistance and reflective insulation characteristics to the plug.

To be effective, the plugs must be well sealed to reduce the potential for moisture condensation on the glazing. Plugs inserted inside the window opening typically have soft, flexible edging about its perimeter. These elements are often the first to fail or ware out. Remember to install a handle or pull-strip to assist removal of the plug. Surface-mounted plugs may use magnetic tape, hooks, hook-and-loop strips, or an assortment of other mechanisms to create a good seal.

The plugs are generally bulky and difficult to store effectively. While perhaps one of the lowest-cost, simple do-it-yourself options, very few households utilize this option over more conventional options.

Shutters:

Shutters are also seldom employed today. Exterior shutters are very effective in diminishing solar gain on the fenestration. They must be designed with climate-resistant elements however. Interior shutters may be made from many materials, but begin to fall into the same category as the insulation plugs.

Roller shades:

The common pull-down shade, using a roller to store the material, is easily fabricated out of materials that offer higher energy savings potential. Using reflective insulation, magnetic edge seals, and a heavy bottom bar begin to yield improved thermal characteristics of these systems.

Commercially manufactured and homemade window quilts function similarly to standard roller shades except for the edge seal and quilted characteristics. Window Quilt"! is one of the few energy-efficient window coverings available in the early 1980s that are still available today. The homemade variety is a good option for energy efficiency if one has some sewing skills.

Roman shades:

Roman shades offer an easy to install conventional system using tightly woven materials. Efficiency appears to be optimized when installed inside the window frame. Aesthetically, this system is very effective for overhead glazings such as attached greenhouse windows, since the folds hang tightly together. It is a good option for energy efficiency if one has some sewing skills.

Mini-blinds:

The efficacy of mini-blinds in a hot climate is often overlooked. They can operate effectively as a daylighting device in redirecting sunlight to deeper areas within the building. They also demonstrate a thermal resistance that varies with the degree of opening between the vanes.

Vertical blinds:

These provide similar, although slightly less effective, characteristics to mini-blinds. The vertical nature of the product seams and that of convection currents most likely combine to yield the reduced efficacy.

Pleated shades:

Shading devices with horizontal pleats, or pleated shades, offer one of the highest thermal characteristics available in window coverings. These are commercially available, but few utilize edge tracks to minimize edge losses. As typically purchased, pleated shades are not sealed.

Cellular shades:

Cellular shades are similar to pleated shades except they provide complete cells between the folds. Like pleated devices, they accordion allowing the devices to store in a very small volume. As they open, the horizontal cells fill with air. The heavy bottom bar and cellular composition provides the thermal effectiveness. Some include low-emissivity coatings on cell fabric. They are one of the most thermally effective thermal coverings.

These devices occasionally employ reflective insulation within the matrix of fabrics. Commercially produced materials may not be easily cleaned however. Ultrasonic cleaning is recommended for some materials. Cellular shades may be purchased at a dramatic discount through groups on the Internet.

R-value tests for these products can be quite high; the tests do not guarantee, however, how it will perform in your house. Unbiased, independent third party testing using summer conditions confirms their position as one of the highest R-value window covering types available. Nonetheless, the third party R-values achieved fell short of that described in manufacturer's promotional material.

Insulating Drapes:

The efficiency of draperies to thermally control an inefficient window are generally rather poor. If, however, the drapery is fitted with a cornice, edge seals, and an effective sill or floor seal-usually by means of a weighted edge-their effectiveness is significantly improved.

As with the other strategies, seals are important. Reflective insulation and vapor diffusion retarders are also important in the fabrication of the draperies to improve effectiveness.

The National Solar Data Network (NSDN) was a mechanism by which solar and energy-efficient techniques were analyzed during the solar heydays, roughly 1975-1985. Several projects employing energy-efficient window treatments were analyzed. Generally, the efficacy of the window coverings tended to be about half that of their true R-value. The ultimate outcome of the current R-value analysis of window coverings will likely reconfirm the findings of the NSDN.

The high cost of commercially fabricated energy-efficient window coverings has often proven to be a handicap to them in the marketplace. Unlike window coverings designed expressly to address the owner's aesthetic tastes, the energy-efficient variety is put to task to prove their payback, or cost efficacy. In truth, the cost of such coverings is very high.

Those effecting a measure of energy efficiency are at least offering some payback-not the exorbitant ineffectiveness of the typical faire. For this aspect alone, the energy-efficient options are a good choice for the conscientious owner.

Homemade window coverings are not too difficult to fabricate. They may also be quite tasteful and effective if one chooses an appropriate style. Reflective insulated roller shades, quilted roller shades, Roman shades, and appropriately designed draperies offer a variety of aesthetic options to the hands-on homeowner.

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