Energy-conserving window treatments—shutters, shades, blinds

Craig Birdsong 1/

Table 1: Insulating values of various insulating panel materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Resistance for 1&quot; (2.5 cm) thickness</th>
<th>U-value of window with 1&quot; (2.5 cm) panel</th>
<th>U-value of window with 2&quot; (5 cm) panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded polystyrene, extruded, plain</td>
<td>4.00</td>
<td>0.20</td>
<td>0.11</td>
</tr>
<tr>
<td>Expanded polystyrene, molded beads</td>
<td>3.57</td>
<td>0.22</td>
<td>0.12</td>
</tr>
<tr>
<td>Expanded polyurethane</td>
<td>6.25</td>
<td>0.14</td>
<td>0.07</td>
</tr>
<tr>
<td>Cork (¼&quot; or 1.9 cm)</td>
<td>1.68</td>
<td>0.39</td>
<td>-</td>
</tr>
<tr>
<td>Cork/paper bd/cork (¼&quot; or 1.9 cm)</td>
<td>2.56</td>
<td>0.29</td>
<td>-</td>
</tr>
<tr>
<td>Plywood (¼&quot; or 1.9 cm)</td>
<td>0.93</td>
<td>0.55</td>
<td>-</td>
</tr>
</tbody>
</table>

An energy-conserving insulating panel.

Insulating shutters when closed have the advantages of reducing winter heat loss and thereby improving comfort near windows, reducing sound transmission and granting privacy. However, they are bulky to store during the summer and during the day if demountable panels are used, easily crushed in the case of polystyrene or polyurethane necessitating periodic replacement, and polystyrenes and polyurethanes are flammable and give off highly toxic gases in the event of fire, thereby making a protective cladding of metal essential.

Rigid insulating panels can be covered with decorator fabrics to enhance the character of the window. Cork or other insulating materials are attractive in their natural condition in many interior design schemes. In deep window openings.

1/Craig Birdsong, CSU assistant professor, family housing (4/1/78)

Quick Facts

An energy-conserving window treatment must trap air between itself and the window.

Winter heat loss through a window can be reduced by covering the window with an insulating panel in contact with the glass.

Insulating panels are, however, bulky to store and easily crushed and flammable, in the case of polystyrenes and polyurethanes.

Installation of an opaque or translucent roll shade reflects sunlight back out the window in summer and, if the shade has a dark side and is reversible, absorbs solar energy in the winter.

Disadvantages of roll shades include maintenance, ventilation impediment and blocking of view.

Venetian blinds have advantages, such as needing minimal space for storage in the window, can be selectively tilted to direct daylight to the ceiling or directly onto the work surface and can be partially lowered to eliminate sunlight from only a portion of a room.

Blinds are tedious to clean and they offer decreased effectiveness in reducing winter heat loss compared to shades or tight-fitting draperies due to slits between each slat.

The unprecedented rise in fuel costs is forcing many consumers to be on the continual search for energy efficient methods of heating and cooling their homes. Though somewhat limited in scope and seldom thought of as energy conserving, window treatments are one method of maximizing a home’s heat gain and minimizing loss.

Window treatments can be as diverse and distinctive as desired, some treatments are more energy efficient than others. Why? Because an energy conserving window treatment must trap and hold air between itself and the window.

The winter heat loss through a window can be reduced by covering the window with an insulating panel in contact with the glass. The heat loss is reduced in proportion to the insulating value of the panel measured as resistance to heat flow per inch (2.5 centimeters) thickness of material. The U-value for a window with a one-inch (2.5-cm) insulating panel against it can be approximated as follows:

\[ U_{\text{total}} = \frac{1}{U_{\text{glass alone}}} + R_{\text{panel}} - 1 \]

This assumes equivalent values for the air film at the surface of the panel and at the interior surface of the glass, or an R-value of 0.68 in both cases.

Table 1 lists several common rigid insulating materials, their resistances and the winter U-value of a single glazed window with the panel in contact with the glass. All values are for one-inch (2.5-cm) thick panels.

Insulating shutters when closed have the advantages of reducing winter heat loss and thereby improving comfort near windows, reducing sound transmission and granting privacy. However, they are bulky to store during the summer and during the day if demountable panels are used, easily crushed in the case of polystyrene or polyurethane necessitating periodic replacement, and polystyrenes and polyurethanes are flammable and give off highly toxic gases in the event of fire, thereby making a protective cladding of metal essential.

Rigid insulating panels can be covered with decorator fabrics to enhance the character of the window. Cork or other insulating materials are attractive in their natural condition in many interior design schemes. In deep window openings.
the window may be sufficiently recessed to accommodate half the width of the window, in which case, thermal panels can be pivoted at either side without projecting out into the room. In new construction a pocket can be detailed in the wall adjacent to the window into which sliding insulating panels can be stored out of sight.

Foam panels should be clad with sheet metal. The metal skin would eliminate the problem of panels becoming unsightly due to the vulnerability of unprotected foam. The skin also must provide protection from the toxic fumes given off by certain types of foam insulation during fire.

### Opaque Roll Shades

Another treatment for reducing heat flow through windows both in winter and summer are roll shades. Installation of an opaque or translucent roll shade reflects sunlight back out the window in the summer and, if the shade has a dark side and is reversible, absorbs solar energy in the winter.

Summer solar heat gain through windows can be reduced by lowering an opaque, white roll shade to reflect much of the incoming solar energy back out through the glass. The color of the shade and its opacity greatly affect performance as can be seen in Table 2.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Transmitted</th>
<th>Reflected</th>
<th>Absorbed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light-color, translucent</td>
<td>25%</td>
<td>60%</td>
<td>15%</td>
</tr>
<tr>
<td>White, opaque</td>
<td>0%</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>Dark, opaque</td>
<td>0%</td>
<td>12%</td>
<td>88%</td>
</tr>
</tbody>
</table>

As Table 2 indicates, the shade's ability to reflect sunlight is badly impaired if it is a dark color. The light absorbed by the shade raises the shade temperature. Heat is then dissipated into the room by radiation to room surfaces and by convection of room air in contact with the warm shade surface.

A roll shade can have a dark color on one side, which effectively absorbs sunlight, and a white surface on the reverse side, which effectively reflects sunlight. By simply reversing the shade from dark side facing out in winter to reflective side facing out in summer, the shade can perform as a solar collector or shading device varying with the season.

According to a University of Illinois study, maximum effectiveness is obtained by mounting the roller within the window frame. In summer, energy required for cooling a home can be reduced up to 80 percent, while in winter, heat loss can be reduced by approximately 8 percent.

The advantages of roll shades are reduced solar heat gain in summer, reduced conducted heat loss during winter nights, privacy, glare control, and they are self-storing. The disadvantages include maintenance, the spring mechanism will fatigue or jam with time and need replacement, ventilation is impeded from the top opening of a double-hung windows when the shade is lowered, and shading and view out at the same time are impossible.

### Venetian Blinds

Venetian blinds are regaining popularity as window treatments. As well as an option of vertical or horizontal, today's venetian blinds offer another option—either wide slats, usually two inches (5 cm) wide per slat, or narrow slats, only one inch (2.5 cm) wide per slat, or the conventional 1 1/4 inch (3.8 cm) slot. A variety of colors also is available.

Either slatted horizontal or vertical blinds can be tilted to provide maximum reflection of sunlight back out the window in the summer, reducing direct solar heat by 25 to 50 percent, depending on the color and angle of the slats. The slats can be adjusted to block all direct sunlight while admitting diffuse daylight.

With a light-colored ceiling, the slats can even be tilted to reflect part of the direct sunlight up to the ceiling where it can be reflected back down to work surfaces. The amount of light transmitted to the work surface is greatly diminished in the process, but glare is eliminated.

Venetian blinds have the following advantages: minimal space is used to store them when open and they stack with a minimal obstruction of the window, they can be selectively tilted to direct daylight to the ceiling or directly onto the work surface, and they can be partially lowered to eliminate sunlight from only a portion of a room.

However, venetian blinds are tedious to clean, lifting and tilting hardware and cords require replacement, and they offer decreased effectiveness in reducing winter heat loss compared to shades or tight-fitting draperies because of the slits between each slat.

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**References**
