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Michigan State University
Cooperative Extension Service
Margaret Boschetti., Extension Specialist, Human Environment and Design
Brenda Long, Graduate Assistant, Family Ecology

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Window Treatments for Thermal Comfort

By Margaret Boschetti
Extension Specialist, Human Environment and Design

and Brenda Long
Graduate Assistant, Family Ecology

The word **window** comes from an Old Norse word meaning "wind's eye." It referred originally to narrow slit-like openings in the wall which were there for the purpose of letting smoke out, letting in a little fresh air and sunlight, and allowing persons inside the building to catch a glimpse of the world outside.

Through centuries of changes in window design, the **function** of windows has remained the same: to allow transmission of light, air and view between the interior and exterior of the structure. Window **treatments** provide some degree of control over window **functions**, so that the home dweller can select a balance between opened and closed conditions.

As costs of energy required to heat homes in winter and cool them in summer continue to increase, the loss or gain of heat (either mechanical or solar) through windows grows in importance. This bulletin will focus on the role of various window and treatment factors in controlling heat transmission through windows in order to find a balance between conserving energy and maintaining a comfort level inside the home.

Heat Transmission and Windows

Uncovered windows provide minimal resistance to the transmission of heated air. During the winter months, loss of heated air from a home through windows can be costly as well as uncomfortable, particularly at night. However, during hours of sunlight, uncovered windows can provide a source of passive solar (sun) heat into the home. The amount of heat being transferred through windows depends upon a number of factors:

- Number, size and location of windows in the house
- Type of glass in windows
- Operating versus nonoperating sashes
- Leaks and cracks around windows
- Interior and exterior window treatments (hard and soft)
- Shading trees and plants

Table 1 shows the relative proportion of reduced heat loss for various window and treatment factors.

Though the home dweller has more control over some of these factors when buying or building a house,(✓) there are ways to improve the energy efficiency of windows in existing houses, also.

✓ **Number, size and location** of windows are important because of two outside elements: sun and wind. Window area is usually 10 to 20 percent of the

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Table 1 — Relationship Between Selected Window Types and Treatments and Reducing Heat Loss (1, 5, 12).

	Relative Proportion of Reduced Heat Loss
Single glass, bare	0.00*
Single glass, pull shade	.10†
Single glass, unlined drapery	.20†
Single glass, unlined drapery and pull shade	.25†
Single glass, lined drapery	.30†
Single glass, lined drapery and pull shade	.35†
Storm windows, 1-4 inch air space	.50
Double glass	.51
Double glass, loose drapery	.53
Double glass, drapery touches floor and closed-top cornice	.57
Triple glass	.68
Double glass, insulated shutters	.91
Wall, 3½-inch fiberglass	.94
Wall, 6-inch fiberglass	.96

**The values in this table represent relative heat-loss reduction of various window types and treatments as compared to that of single glass. The figures in the second column mean that for whatever the amount of heat lost through a bare single glass window, there would be 10% less heat lost through a single glass with pull shade; 20% less heat lost through single glass with unlined drapery; etc.*

†These values assume window is covered 12 hours per day in winter (5).

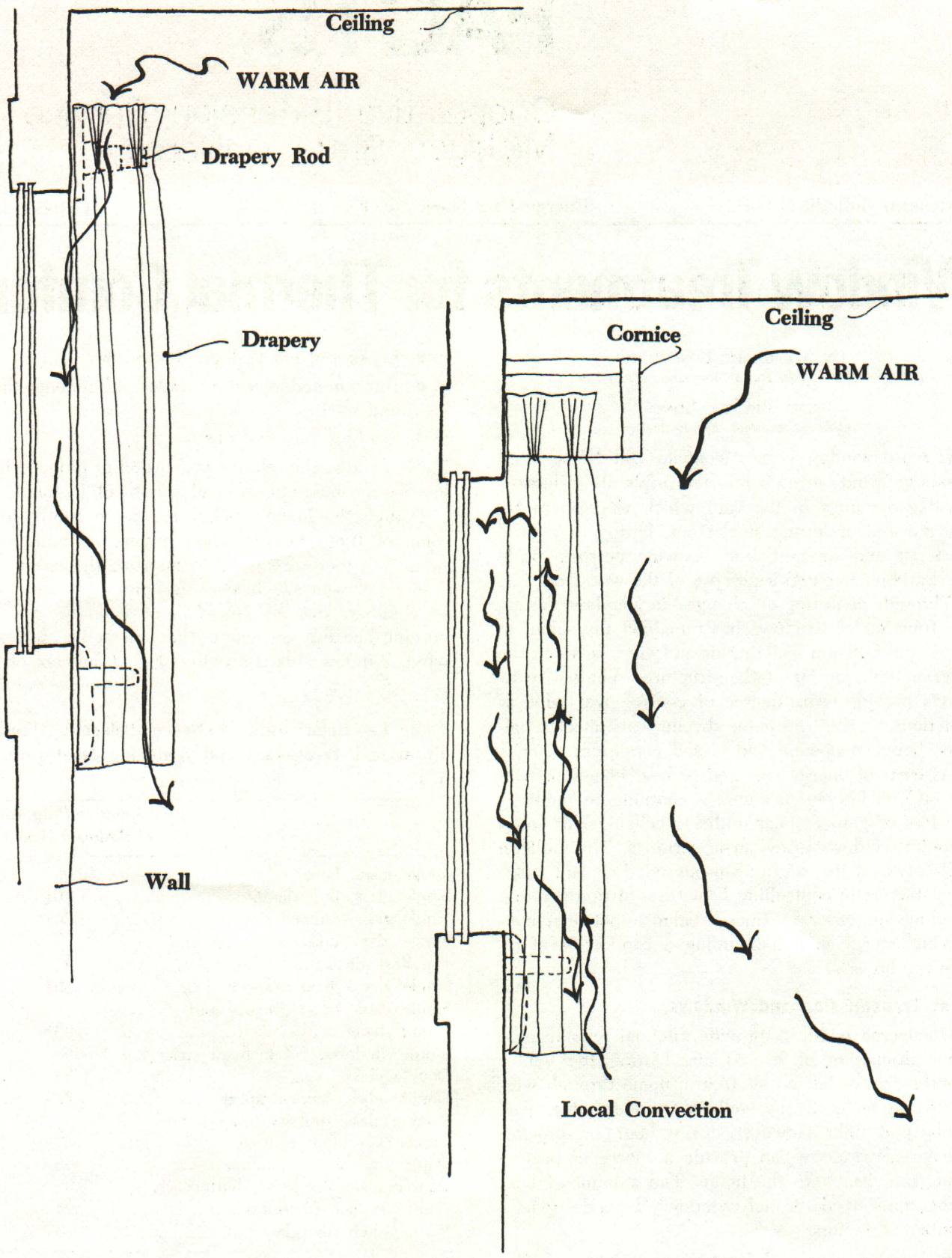

Fig. 1 — Tightly fitted interior treatments stop movement of heated air through enclosed window space.

total floor area. In Michigan it is best to have maximum window area with a southern exposure to take advantage of the warming rays of sunlight during winter months, when the sun is low in the southern sky, and a minimum of window area with northern exposure to protect against the cold of prevailing northern and northwesterly winds during the winter months.

Double- or triple-pane glass will substantially reduce the transmission of heat through window areas. Dead air spaces between layers of glass serve as the insulating factor. Homeowners who already have single-pane windows can install **storm windows** and substantially reduce heat losses or gains. **Plastic sheet** (4 to 6 mil) attached to the inside or outside of windows, completely masking the area, is an acceptable substitute for the more costly storm windows, although view to the outside may be somewhat distorted.

Nonoperating sashes may minimize the potential for leaks and cracks, but they also eliminate the opportunity for ventilation during months of milder weather. **Weather stripping** and **caulking** windows that do open and close will cut air leakage.

Properly selected and placed deciduous **trees and shrubs** can encourage cooling breezes into the home in summer, shade out hot summer sun, and not interfere with warming winter sun rays. Strategically located evergreens will protect the house from the chill of winter winds (3).[1]

In recent years less consideration has been given to **exterior window treatments** as a means of controlling inside temperatures because of the widespread use of mechanical air systems for homes. However, the lack of cheap energy in the future may increase the popularity of awnings, light-filtering screens, fixed vertical or horizontal louvers, and other devices for attaching to the outside of windows — all of which are available now. Manually operated canvas awnings (light color for reflection) with ventilating slots do the most to reduce demand for internal cooling mechanisms during warm weather. The amount of maintenance required and the degree of flexibility allowed should be considered.

Interior Window Treatments

It is important to recognize that controlling heat transmission in order to stabilize inside temperature at a desired comfort level is not a one-way operation. In the winter, while it is desirable to keep mechanically heated air inside the house (which means windows must be insulated to prevent heat loss during the coldest hours of the night), it may be equally desirable and economically advantageous to encourage admission of solar heat during the day (which requires uncovered windows). And there are seasonal fluctuations to consider as well as the daily changes in outside temperature (from day to night) in all seasons.

To take advantage of passive solar heat, window coverings must completely clear the window glass during sunny hours. Naturally, this practice increases the potential for fading of carpeting and furnishings by sunlight. Improvements in the sun-resistance of furnishings may be prompted by concern for passive solar heating of homes.

While less is known about the insulative factor of conventional window treatments, they do provide the most **flexibility** in controlling transmission of light and air, and, in addition, can substantially affect the comfort of people in a room without increasing mechanical heating or cooling operations. A covering across a chilled window glass will reduce the radiant heat loss of people sitting nearby enough to improve their thermal comfort appreciably. However, to reduce winter heat losses of a house, tightly fitted interior treatments are necessary to stop the convection of heated air into and out of the space enclosed by the treatment. (See Figure 1.) When this is accomplished, however, the reduced surface temperature of the glass may cause an increase in the formation of moisture condensation and frosting (2, 11).

Draperies over floor registers should stop several inches short of the floor to allow for adequate air circulation from the heat register. Draperies across

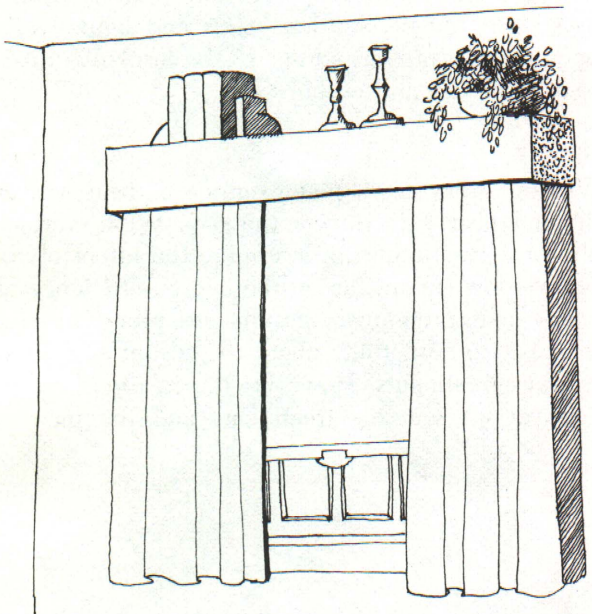

Fig. 2 — Closed-top cornice traps air.

[1] *Numbers in parentheses refer to the list of references on page 4.*

wall registers are not recommended; they should terminate at the windowsill or apron.

A closed-top **cornice** across the top of the window will create a pocket to trap heated or cooled air (Figure 2). Fabric treatments that rest against the wall and touch the floor further insulate the window. Freely hanging curtains and draperies can be attached to the wall at the sides and bottom with velcro tape, hooks, snaps or other fasteners. One research study indicated that installing draperies with tight closures at the center opening and around the entire periphery of the window would reduce heat loss through the window by 20 percent (10).

Tightly fitted shutters, either louvered wooden ones you purchase, or those you construct yourself from 1½-inch rigid foam sandwiched between two layers of masonite or plywood, do form effective barriers to heat transmission (4, 8).

Roller shades and blinds are most effective when they are mounted inside the window frame and when used in combination with other treatments.

Fabric treatments, such as curtains and draperies, that are lined either with fabric or foam will have added insulative properties. The additional cost of making separate insulative liners of synthetic fiberfill encased in muslin would have to be weighed against anticipated energy savings (8). However, separate liners (either of normal weight or otherwise) would increase the flexibility in control of window functions and would permit more choice of fabric structures for the outer drapery. Heavy, tightly woven fabrics resist the penetration of air and light, while napped fabrics trap air, adding to the insulative qualities of draperies and curtains.

Summary

Window areas are a major source of heat loss at night and heat gain during the day. While various studies are attempting to determine the effect of interior window treatments on the energy efficiency of houses — and preliminary results are promising — it is too early to be definite about the cost-effectiveness of various treatments. However, the relationship between various window treatments and the maintenance of a comfortable interior temperature is recognized.

A combination of window treatments will improve thermal comfort of individuals, just as a combination of factors involved in the transmission of heat affects the energy efficiency of windows. In addition, interior window treatments offer the most flexibility in controlling window functions, permitting the home dweller to make desired adjustments to outside temperature conditions.

In conclusion, your selection of window treatments should reflect a balance between control of window functions, improved energy efficiency, and esthetic qualities that meet your satisfaction and your budget.

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