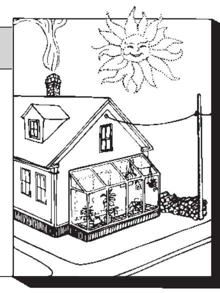


Can Skylights Save Energy?

by Chuck Silver and Terry Brennan

A couple of years ago, I added a skylight while remodeling a bathroom. The major reason for the skylight was to keep the room daylit, since I was removing the only window in the room. (The window was in the tiled tub enclosure—you know, the type of window that grows slime mold but makes the tub a bright place to take a shower.)

Since skylights have a bad reputation as energy losers, I figured the best I could do energywise was damage control, even though the unit faced south at about a 30-degree slope. I purchased a 4x4-foot Velux double-glazed unit with low-e glass and a 1/2-inch air gap. At that time, this was about the highest R-value skylight I could get.

I didn't bother to do an energy analysis at the time since this was my own house. But I discovered later that skylights can perform pretty well thermally if selected and sized right.

Computer Games

Using a computer simulation, I discovered some surprising things about skylight energy performance. I analyzed two glazing options: double glass and double glass with low-e and argon fill. Essentially, there are R-2 and R-4 units, and are the two most common options today. This is a big change from two years ago, when I had to special order low-e, and argon wasn't even an option.

I compared skylights facing south, east, west, and north, and looked at two slopes—3:12 and 8:12. The skylight area varied from 0 to 100 square feet, and all calculations were based on an 1,800-square-foot ranch house located in Albany and insulated to meet New York's state energy code for electrically heated houses.

The house's annual heating load with no skylights would have been about 41 million Btus (around 400 gallons of oil, 550 therms gas, or 12,000 kWh electricity). The computer simulation takes into account heat loss and solar gain.

Of all the skylight options, the best performance was with 75 square feet of south-facing low-e glass with argon, on an 8:12 pitch. This cut the home's heat load by about 7 percent (about 30 gallons of oil a year). The poorest performer was 100 square feet of regular double glass, facing north on the same pitch. This increased the heating bill by 12 percent.

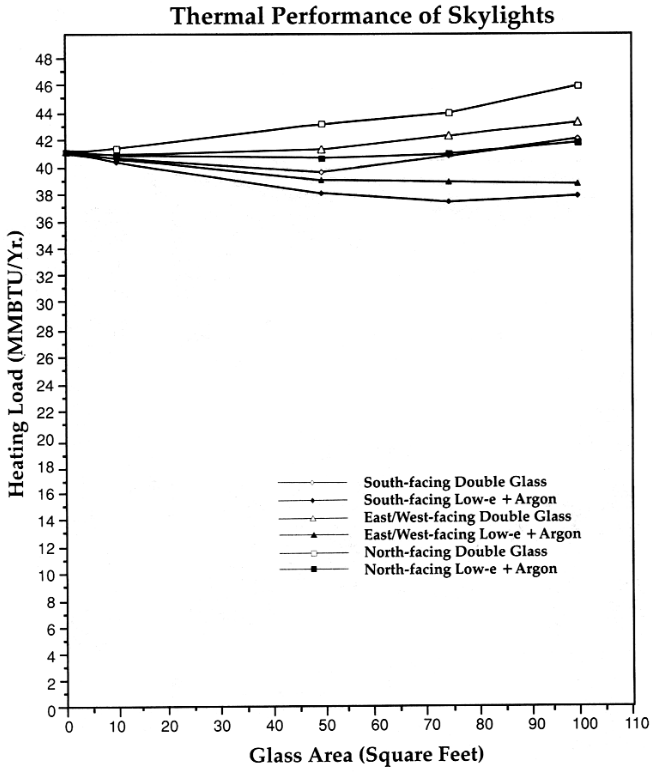
These two figures give you the total range. In general, the slope of the skylight made little difference. However, for south-facing skylights the steeper-pitched skylights did slightly better; at the other orientations, the shallow-sloped units did slightly better.

The Bottom Line

My conclusions from the computer analysis are:

- If you use skylights with low-e and argon fill, it doesn't really matter which way you face a skylight. If you face it south, east, or west you get a few percent savings in the house's heating bill. If you face it north, the heating load stays about the same—unless the skylight area is over 75 square feet.
- With regular double glass, you'll lose energy with nearly all orientations and all glass sizes. The one exception here is small south-facing skylights (under 50 square feet total glazing).
- You can't lose much energy with double-glazed skylights. And with the right orientation and glass type, you can actually reduce heating bills.

Thermal Performance of Skylights



Why the Bad Rap?

If this is the case, then why have skylights gotten such a bad reputation for heat loss? I think it has to do with a number of factors that aren't taken into account by heat-load analysis.

First, there are many problems in framing, air sealing, and insulating the skylight chase. There are lots of jogs, angles, and corners to maneuver around with the drywall, vapor barrier, and insulation. This is an area where foamed-in-place polyurethane works well if you can get it installed cheaply enough in such small quantities.

Air leakage around a skylight will be more of an energy problem than a comfort problem. Ordinarily, customers won't feel drafts near skylights because the warm air would be leaking up out of the building, rather than in. It would only feel drafty when the wind blows against the skylight.

Second, even if the chase is well sealed and insulated, the interior surface temperature of double glass is cool—around 45°F when it is 0°F outside—and this can cause a discomfort problem (due to low radiant temperature) right under the skylight. The colder interior glass temperature also increases the likelihood of moisture condensing on the skylight interior. You can reduce both problems by using low-e units with argon. With it's 0°F outside, these units will be about 58°F inside.

Third, many older skylights were not very well weatherstripped or sealed against rain penetration. Many of these were virtually manufactured on site, and quality varied greatly. Modern manufactured units are a great improvement over their predecessors. But it has only been within the last few years that industry standards for skylights have developed.

Other Concerns

Energy is only one of a number of important issues you should consider when using skylights. Three other key issues are durability, aesthetics of placement, and daylighting.

For the most part, you can judge the quality of a skylight unit by the materials and methods used in manufacturing, the quality of the finishes, and the installation details. Will it easily install in an airtight and watertight fashion?

For aesthetics, skylights can serve to break up large expanses of roofing or ceiling in new construction or remodeling. In planning where and how many to use, you need to consider their visual impact from both inside and outside, which will differ during the day and night. At night, skylights combine with other windows to form the pattern of light visible from outdoors. During the day, they add daylighting to the interior.

The daylighting effect can be dramatic. In my own remodel, the bathroom was so bright—even on overcast days—that I kept walking in to turn the light off. When this brightness becomes the glare of direct sunlight, it can create discomfort for the occupants. But in this instance, it wasn't a problem for three reasons.

First, the skylight was located in a vaulted ceiling so that direct sunlight hit a high Sheetrocked wall and then reflected down into the room. No direct sun was anywhere near eye level. Second, the skylight is immediately north of a 70-foot tall sugar maple, which blocks a great deal of direct sunlight during the summer. Finally, this particular skylight is located in central New York in the rain shadow of the Great Lakes. On the rare occasion that it is not overcast, no one is in the bathroom—they're all outdoors.

If you're not fortunate enough to be building in a cloudy climate or have a giant tree outside the building, you'll need to resort to other methods of shading: shades, louvers, lightshelves, or placing the skylight where glare will not be a problem.

Conclusions

Start with a well-made unit with high R-value—preferably low-e with argon. Look for a good fit and quality weatherstripping with operable units. Beyond that, you can put skylights pretty much where you like. Even north-facing skylights don't have to be energy wasters in the Northeast, as long as you keep the total area under 100 square feet.

This gives the designer a great deal of flexibility in taking advantage of the aesthetics and daylighting value of skylights. One caution: If you live in areas that have a substantial cooling load, be wary of using large areas of sloped glass that let summer sun into the building. In these situations, make sure skylights have adequate provisions for sun control. ■

Terry Brennan used to build houses, and Chuck Silver designs them. They currently run training seminars on energy-efficient construction for the New York State Energy Office.