Greening With Daylighting

JIM LARUE

Jim LaRue created a "Greening Your Home" series for the Cleveland Green Building Coalition.

Daylighting: A method of illuminating building interiors with natural light so that the use of artificial lighting is reduced in the daytime. Common daylighting strategies include the proper orientation and placement of windows, use of light wells, light shafts or tubes, skylights, clerestory windows, light shelves, reflective surfaces and shading, and the use of interior glazing to allow light into adjacent spaces.

Most of us who cut our eye teeth in building performance matters while on the weatherization route regularly approach the issue of windows as if it is a necessary evil. In even the most energy-efficient exterior wall or roof, windows and skylights are the biggest source of energy loss. For years, we struggled to find ways to install them so that they don't leak moisture. In older homes they are a constant maintenance headache. We relented a little when we learned that air sealing all the places where air can leak through the top ceiling planes could reduce air leakage through the windows, but the discomforts and challenges that they present still keep builders suspicious.

Ironically, skylights can be the most effective window for daylighting, but builders are especially suspicious of anything that will put another hole in the roof. The new flashing details included with these windows should mean they are no more likely to leak than a window in the side walls if installed properly. Builders should be more concerned with how much heat loss or gain occurs because of them. Skylights lose more heat via convective air movement over them than windows in vertical side walls. Also, how the skylight is oriented in reference to direct sunlight at different times of day requires carefully siting them so there is light gain without unnecessary heat gain in the summer, which will increase cooling costs. A plus is their capacity to provide effective natural ventilation possibilities. Also, by using either windows placed high on a wall or clerestory windows, you can introduce light at a higher level, where it can be reflected off of ceilings and walls without shading to protect residents from too much direct light.

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Tubular skylights have made it easier and less costly to bring natural light into a building.

It is not uncommon for us old weatherization types to gradually find ourselves drifting into what is now known as green building. One thing my new green building consciousness has done for me is to make me more sympathetic to windows and their importance in the living spaces we maintain, repair, improve, or build.

One of my first lessons has been that natural light has been clearly demonstrated to be best for our physical and mental health. And that is not new news. The emergence of electric lighting has caused us to lose touch with important experiences of the past. In the old homestead where my wife's grandmother lived in mid-Pennsylvania, built more than 120 years ago, all the windows in the front on the first floor start near the floor and almost reach the ceiling. On the cloudiest day you did not need artificial light. When two of these windows, off the first-floor porch, were cracked open a bit at night after a hot summer day, they would bring in enough air to cool the house when a few second-floor windows were open. Grandma's winter drapes, set in a wood valance at the top, would reduce heat loss in the winter (little air circulated between the drapes and the window with the valance in place), and her summer curtains, often made of lace, would allow summer breezes to pass through. Except in the manure-spreading season (!), windows played a primary role in homes built during this period, and we still essentially need what they delivered.

A second lesson learned is that if we create a truly energy-efficient building envelope (superinsulated and air sealed), though windows still cause the most significant heat loss, the loss is not so significant that it is necessary to sacrifice the health benefits they provide. When Greenbuilt Homes built our first green home, we created an effective building envelope and our heat loss calculations supported our decision to install more than one window per room. In our first winter (four years ago) the house heated for $379 for six months (October–March)—and this included the cost of heating water, since we used the hot water tank to heat the house. The people who live there now love the light and the windows that we included in the design of the home.

When you study older home designs, you learn that the kinds of window you use and how you orient them significantly affects the quality of light and ventilation you receive. Grandma's porch faced south and the porch roof served as an overhang, which meant you

got the benefit of the light without the direct heat of the sun in the summer, and you got the benefit of the heat of a winter sun during the day when the drapes were open. There was one small window in the kitchen at the rear of the house on the side where the hot afternoon sun would set. The old wood cookstove generated enough heat; the kitchen needed no more. But two larger windows on the rear of the kitchen, facing north, provided effective ventilation during the early evening in the summer, as air moved through the house from front to back. And a north-facing window during any season provides the most constant light (artists often like the primary light in their studios to be from the north).

Grandma's house incorporated another green concept: All of the bedrooms on the second floor had an awning-type window over each entrance doorway into the common hallway. The light from outside would travel through the room, through these windows and into the hallways, along with the fresh air. In another green home done recently in the Cleveland area, the architect suggested putting a lovely stained glass window the family owned into an interior wall between the living room and the master bedroom. The light coming through the large living room windows transferred through the stained glass window (above privacy levels) and provided not only more natural light in the bedroom space, but light with some color tones that pleased the residents (see photo).

The invention of light tubes or tubular skylights has made it much easier and less costly to get natural lighting into a building. In my first green rehab, we were able to illuminate a dark interior stairwell from the first to the second floor, and the hallway on the second-floor level, with a light tube inserted through the roof, through the attic space, and into the ceiling. It worked so well that we had to install a diffuser on the opening at the ceiling to keep it from glaring directly into your eyes if you looked directly at it.

These tubes are also much more energy efficient because there is so little exposure of surface to the exterior. The energy penalty from use of tubular skylights is minimal. The direct exposure to the exterior is considerably smaller than a conventional skylight, the unit is sealed where it enters the ceiling of the living space, and the duct that passes through the unconditioned space can be insulated as you would any other duct. While the light tube is a dramatic reduction in heat gain compared to a conventional skylight, a downside is that it is not useable as a potential ventilation opening, which could be used for cooling. Dust in the air traveling through such a tube would soon cloud the reflective interior surfaces that bring light from the exterior to interior.

While they are committed to seeing windows as an effective source of natural light, green builders never give up looking for a more energy efficient, durable, and environmentally friendly window product. The creation of the Natural Fenestration Rating Council (NARC) is bringing more high-quality window products to the marketplace. From a green building perspective, my own choice right now is the fiberglass window, and I am pleased that some of the major manufacturers are now including these windows in their inventory. Fiberglass does not have the same life cycle assessment deficiencies as vinyl, and while failure of glazing has diminished greatly over the past few years, there remains a tension between the framing of windows and the glazing. Wood and vinyl framing expands and contracts at a different rate than the glazing and there is a risk of glazing failure from this stress. Fiberglass windows have the same coefficient of expansion as glass, which nearly eliminates this risk.

I keep hoping for a product like the once-touted aerogel as a glazing, with an R-value nearly as high as that of an effectively insulated wall. The aerogel—or a similar alternative—has not made it yet, but when that occurs, we will have even more tools to help incorporate natural lighting more effectively into our homes and buildings.

We would make Grandma proud!

JIM LARUE

Stained glass windows can provide natural light with color tones that please residents.

FOR MORE INFORMATION:

For more information on daylighting techniques, see Carmody, John, et al. *Residential Windows: A Guide To New Technologies and Energy Performance*, 2nd ed. New York, W.W. Norton, 2000.

And go to www.toolbase.org/techinv/techDetails.aspx?technologyID=116, and

www.daylighting.org/why.htm.