EDITORIAL

Daylighting:

Bringing Daylight Deeper into Buildings

Before
Sun-Tek Tube

AFTER
Sun-Tek Tube

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Imagine a device that sits on the roof of a building and focuses sunlight into cables the size of electrical wire. These cables are run through walls and ceiling plenums into light fixtures that beam natural, full spectrum daylight deep into a building's interior.

Sound like science fiction? It's not. One such product, the HimawariÔ has been commercially available for nearly 15 years, and more than 1,000 of these (expensive) fiber-optic daylighting systems have been installed in Japan and Western Europe. In the U.S., research on cost-effective fiber-optic daylight distribution is still in its infancy, though many of the components and technologies, including optical fibers used for electric lighting, are well developed and already finding widespread use for specialized lighting applications. The idea of using special devices to distribute daylight or light from a remote source has been around for a while. Ships in the 1800s were sometimes fitted with special prisms that channeled daylight down into the ship's hold. In 1880, William Wheeler patented a mechanism for distributing light throughout a building using a network of pipes-though he did not succeed with implementing the concept.

This article takes a look at strategies for bringing daylight deeper into buildings. Last month we addressed daylighting with windows and conventional skylights-strategies that have been shown to boost worker performance in offices, increase test performance in schools, and increase sales in retail establishments. (The two studies described last month on daylighting's impact on student performance and retail sales are now available in full text-to download the files, go to the EBN Web site: 222.ebuild.com/Current/Past-sites.html.) This month, we'll look at strategies for increasing the penetration of daylight. In addition to high-tech fiber-optic systems, we'll examine tubular skylights, which are finding widespread use in the residential market, as well as some high-performance commercial skylights that rely on highly reflective light wells or sun-tracking mirrors to boost performance.

Tubular Skylights

Used primarily in residential buildings, tubular skylights are devices that channel daylight from an aperture on the roof down through an unheated attic to a ceiling mounted diffuser, which looks much like a conventional ceiling-mounted light fixture. The light is transmitted through a cylindrical tube 8" to 24" (200 mm to 600 mm) in diameter with a highly reflective interior surface. Tubular skylights were developed in 1989 by the Australian Steve Sutton, who founded Solatube, Inc. In the U.S., they were first developed and introduced by Greg Miller, who founded The Sun Pipe Co., Inc.

Today there are at least a dozen companies producing tubular skylights in the U.S. and Canada. The design of these systems is pretty straightforward, though there are some significant differences among the various products. Most have acrylic domes that mount on or

above the roof; a few use polycarbonate for the domes to meet special hurricane design standards in effect in parts of Florida (where tubular skylights are especially popular). Polycarbonate has roughly 10% lower light transmission than acrylic, but it is much stronger. At least one product is available with a special reflective scoop to capture more sunlight. Several products include a prismatic or collimation lens beneath the dome, which improves the capture and downward channeling of low-angle sunlight in the morning and afternoon. Special flashing kits are available from most manufacturers to adapt the units to various roof types.

As for the tube, most products use a highly reflective silver film on the interior to minimize light loss as the daylight is channeled downward. Both 3M and Alcoa produce silver film used in these products. A few manufacturers use highly polished anodized aluminum. Either approach appears to have advantages and disadvantages. Reflective silver films have the highest reflectivity, but some have been known to delaminate; the polished aluminum can't delaminate, but the surface may oxidize over time, reducing its reflectivity. One manufacturer, Sun Tunnel Skylights, has a flexible tube that simplifies installation, but reflectivity is significantly lower and light output suffers.

Most ceiling diffusers are simply white acrylic, which spreads the light fairly evenly. A few products have prismatic diffusers, which increase the lateral distribution of light, and one manufacturer (HUVCO) has recently introduced a unique holographic strip above the diffuser (at the bottom of the tube) to improve lateral lighting-through details on how this works were not available.

Most residential tubular skylights cost $300 to $500, not including installation. The least expensive we found were about $200 for 8" diameter (200 mm) models. Tubular skylights can be installed fairly quickly, and many products are targeted toward a do-it-yourself market. Light delivery varies according to the tubular skylight diameter, the transmissivity of the dome, the reflectivity of the tube inner wall, the transmissivity of the ceiling diffuser, and the outside sunlight conditions. The best selling 10", 14" and 16" (250 mm, 360 mm, and 405 mm) Solatube units provide up to 3,760, 6,300 and 8,200 lumens, respectively, under ideal, full-sun conditions.