

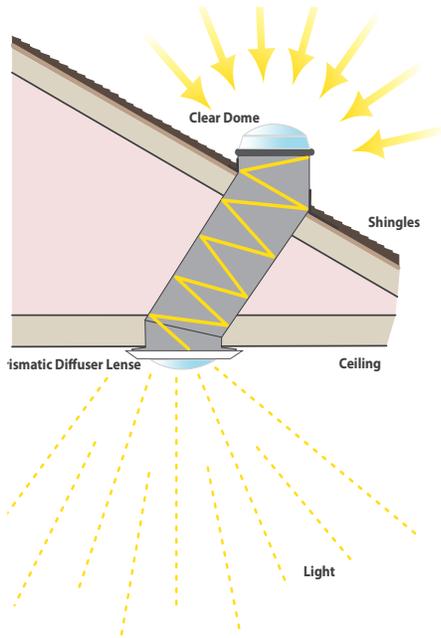
TUBULAR DAYLIGHTING DEVICES

INTRODUCTION

Tubular Daylighting Devices (TDDs) are high-performance skylights that collect sunlight from a rooftop dome, transfer it through a reflective tube, and diffuse it through a prismatic lens (light emitter) into interior space of a building. On first glance, the light output from a TDD may seem counterintuitive because it provides as much illumination as one would expect from a much larger conventional skylight. However the brightness level and consistent quality of light produced by TDDs is enabled by advanced optical technologies which result in optimum daylighting impact, without the shifting light patterns and glare associated with conventional skylights.

TDD DESIGN

The overall performance of any TDD depends on a number of factors, including the size and shape of the light tube, the solar collector's positioning relative to the sun, and the application of optical materials to



affect the quality and quantity of sunlight entering the interior. The concept of reflectivity efficiency is an important performance measure used to rate these devices. For example, a typical TDD loses 0.5% of the captured sunlight each time light "bounces" off the reflective material within the tube. Therefore a 97% reflectivity efficiency signifies that the sunlight has been reflected 6 times before it reaches the indoors.

EXAMPLES OF TDD APPLICATIONS

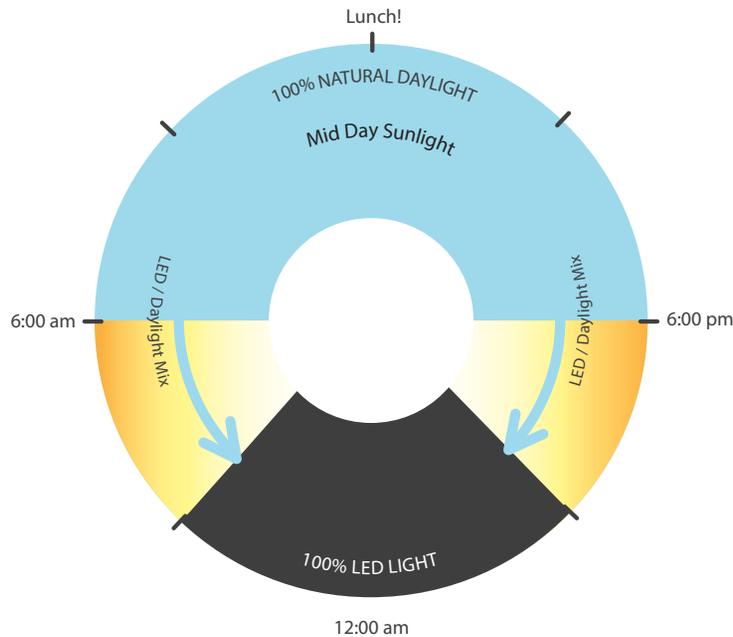
TDDs are a popular skylight choice for learning environments because of the consistent, diffuse quality of the light and their ability to dim for audio visual presentations. The modular design of the skylights are adaptable to most classroom designs, but are most beneficial when combined with efficient lighting systems that feature dimming controls to modulate light output according to available daylighting. It should be emphasized that any daylighting strategy should be part of a carefully designed overall lighting design which works in unison with electric lighting and lighting controls. A poorly integrated daylighting strategy can be worse than no daylighting at all. Poor designs can cause too much sunlight, heat gain, glare, and shifting light patterns which are particularly counterproductive in educational environments.

TDD retrofits are often more affordable compared to other daylighting methods. For example, the Natomas Unified School District in Sacramento, California recently determined that TDDs were the most cost-effective way to install daylighting into 121 portable classrooms which were purchased to accommodate an unprecedented 18% growth rate in student population. As a result, students were packed in 25-foot-by-40-foot container-like classrooms that lacked sufficient natural light. The school district used a \$300,000 school bond to daylight the portables with 267 Solatube skylights. This resulted in much improved learning environments and lower energy costs.

One reason that TDDs are so popular is that they provide high design versatility compared to conventional skylights (baseline). For example, they can be installed in tight interior spaces (without re-framing, drywalling or painting) where other daylighting solutions are not practical. TDDs can even be extended to the interiors of lower floors in multi-story buildings without taking up much interior space. Usually the reflective tubes are run through unobtrusive areas (such as closets or interior walls) and are often surrounded by a chase for added protection.

OTHER ADVANTAGES OF TDDS

- Lower cost and easy installation compared to baseline traditional skylights
- High quality daylighting and minimum solar heat gain compared to baseline
- Consistent light quality without shifting light patterns
- Lower maintenance than baseline
- Ability to dim when sunlight is not wanted



SMART TDDS WITH LEDS

Standard TDDs have been on the market for decades, but recently the Solartube company introduced a hybrid TDD/LED. This skylight incorporates an LED lighting system to not only provide free daylighting, but also to provide efficient lighting when sufficient daylight is not available. The new design is called Smart LED system, which includes daylighting controls to modulate the LED lights according to available natural light levels and occupancy sensors to ensure that LEDs operate only when people are present in the lighting control area. The Smart LED System featuring these advanced lighting controls can produce an energy savings of 67% compared to an LED light fixture alone.



REFERENCES & RESOURCES

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