

Light Tube

[STRATEGY]

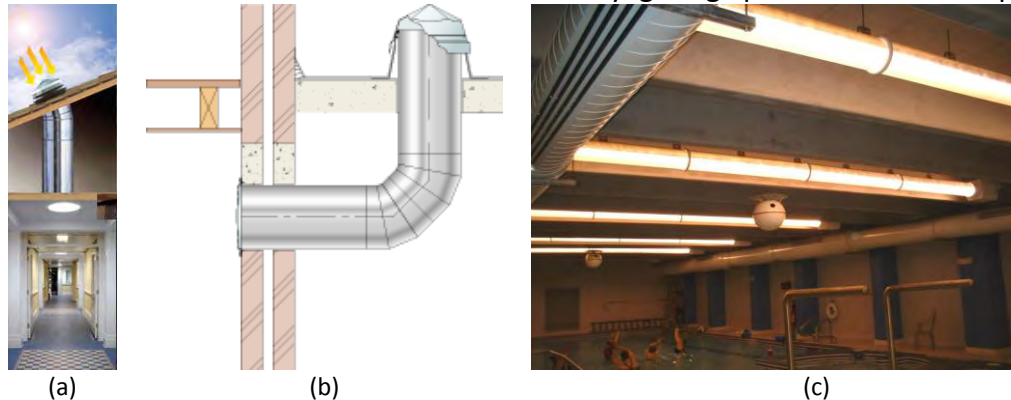
BRIEF DESCRIPTION

Light tubes, also called sun/solar pipes, solar light, or tubular skylights, are tubes/pipes used for transport and/or distribution of natural light to another location. A light tube uses highly reflective material or plastic optical fiber to lead the light rays through a building. It can also be a prism light guide distributing light uniformly over its length.

Applications

Core spaces

- Core spaces of multistory buildings.
- Spaces distant from the building envelope.
- Locations where more conventional daylighting apertures cannot be placed.



(a) Solar light (vertical) (Source: <http://www.cellars.co.uk/cellar-conversion.php>)

(b) Solar light (Horizontal) (Source: <http://www.ebuild.com/articles/474908.hwx>)

(c) Prism light guide (Source: <http://www.visualimpactlighting.com/VisualImpactRecent1.htm>)

- Passively collects daylight using a light-bending reflector mechanism.
- Transmits light through a roof opening via a mirrored tube.
- A 9 to 21-inch circular opening in the roof is required for each tube¹.

Design Notes

Programming

- Proprietary control system hardware and software needs to be installed.
- On-site or remote programming, control, and monitoring are required.

Blast Resistance

- If the dome is made of glass, blast resistance should be considered.

Related

Technologies

Sun pipe can be combined with natural ventilation systems.

References/Useful Resources:

[1] Commercialization of technologies to lower defense costs (CT/LDC): Draft demonstration/validation and cost benefit analysis report for cost effective and worker beneficial lighting technologies. National Defense Center for Energy and Environment. June 2008.

¹ Larger solar tube (>21 inch diameter) is applicable for higher ceiling (>16 feet) and product may need to be imported.

Energy Savings

Lighting Energy

- Light tubes save a significant amount of electricity by turning off electric lights during the daytime hours.

Cooling Energy

- When combined with proper lighting controls, light tubes can help save cooling energy by reducing the need to remove heat from electric lighting. The actual savings depend on the local climate condition.

Demand Charges

- Light tubes can yield to a substantial reduction in monthly demand charges by reducing lighting energy during peak hours and also reducing cooling requirements during warmer months.

Guiding Principles

Optimize Energy Performance (Energy Efficiency)

- Reduce the energy use by 30 percent compared to the baseline building performance rating per ASHRAE Standard 90.1-2007.

Enhance Indoor Environmental Quality (Daylighting)

- Achieve a minimum daylight factor of 2 % in 75 percent of all space occupied for critical visual tasks.
- Provide automatic dimming controls or accessible manual lighting controls, and appropriate glare control.

Associated LEED Credits (NC 2009)

EAc1: Optimize Energy Performance (1-19 points)

- Demonstrate a percentage improvement in energy performance compared to a baseline performance per ASHRAE/IESNA Standard 90.1-2007.

IEQc8.1: Daylight and Views—Daylight (1 point)

- Achieve daylighting in 75% of regularly occupied spaces.

Product Images



(Source: <http://www.monodraught.com/assets/flash/commercial-galleryFINAL/commercial-galleryFINAL.html>)

Components

Top dome, Flashing, Pipe, Ceiling diffuser, Daylight dimmer

Cost Range

| Components | Cost | Unit |
|--|-------------------|----------|
| Solatube (10", 14", 21" diameter) | \$300 – \$1,000 | per pipe |
| Monodraught SunPipe (29", 39", 59" diameter) | \$1,000 – \$5,000 | per tube |

Product types

10" Tube Diameter (Solatube®)

- Covering 150-200 ft² per tube

14" Tube Diameter (Solatube®)

- Covering 250-300 ft² per tube

21" Tube Diameter (Solatube®)

- Up to 500 ft² per tube

29" Tube Diameter* (Monodrought SunPipe)

- Suitable for Sports Halls and similar areas where the floor to ceiling height is 16' – 23' (5m – 7m).

39" Tube Diameter* (Monodrought SunPipe)

- Suitable for factories and similar, where the floor to ceiling height is up to 30' (9m).

59" Tube Diameter* (Monodrought SunPipe)

- Suitable for larger applications.

***Note:** The diameter of Monodrought SunPipe is marketed in mm. The product sizes 750mm, 1000mm, and 1500mm, which equals to 29", 39", and 59", respectively.

Vendors

Monodraught SunPipe (UK)

<http://www.monodraught.com/sunpipe/index.php>

Sun Pipe Co., Inc SunPipe®

<http://www.sunpipe.com/>

Solatube® Daylighting Systems

<http://www.solatube.com/>

Light Tube

[PRODUCT AND ECONOMICS]

Carlisle SynTec DryLight Tubular Skylight

<http://www.carlisle-syntec.com/index.cfm?act=skylight>

(Products are available in 13-inch and 21-inch diameters and can illuminate approximately 150sf to 300sf of floor space respectively.)

Warranty Info **Majority of manufacturers offer 10 year warranty**

Code Restrictions **None**

PERFORMANCE RELATED SPECIFICATIONS²

- A. Completed tubular daylighting device assemblies shall be capable of meeting the following performance requirements:
1. Air Infiltration Test: Air infiltration will not exceed 0.30 cubic feet per minute (cfm) per square foot aperture with a pressure delta of 1.57 pounds per square foot (psf) across the tube when tested in accordance with ASTM E 283.
 2. Water Resistance Test: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E 547.
 3. Fire Testing:
 - a. When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the 2006 International Building Code.
 - b. Self-Ignition Temperature - Greater than 650 degrees F Per: U.B.C. Standard 26-6. See ASTM D-1929.
 - c. Smoke Density - Rating no greater than 450 Per U.B.C. 8-1 (See ASTM Standard E 84) in way intended for use. Classification C.
 - d. Rate of Burn and/or Extent - Maximum Burning Rate: 2.5 inches/min (62 mm/min) Classification CC-2: U.B.C. Standard 26-7. See ASTM D 635.
 - e. Rate of Burn and/or Extent - Maximum Burn Extent: 1 inch (25 mm) Classification CC-1: U.B.C. Standard 26-7. See ASTM D 635.

TUBULAR DAYLIGHTING DEVICES

- B. Tubular Daylighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICBO/ICC AC-16.
- C. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
- D. LightTracker Reflector (optional): Made of aluminum with Spectralight Infinity. Positioned in the dome to capture low angle sunlight.
- E. Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome

² Specification language modified from Solatube® CSI Specifications <http://www.solatube.com/commercial/technical-resources/index.php>

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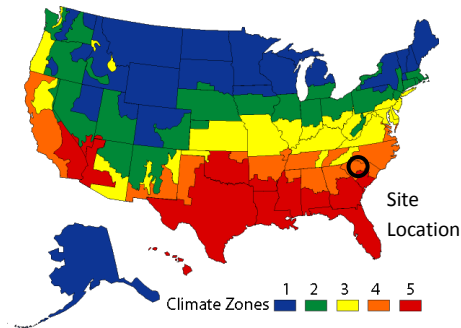
[SPECIFICATIONS]

and top of tube.

- F. Tube Ring: Attached to top of base section to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
- G. Reflective Adjustable Tube Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface Visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum (400 nm to 2500 nm) less than 93 percent.

Fort Bragg – Building 3-1634

Cumberland, North Carolina



Facility

- The Directorate of Public Works serves as the “City Engineer and Public Works Department” for Fort Bragg North Carolina.

Approach

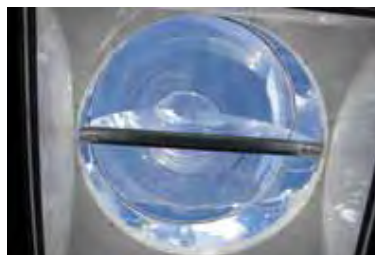
- Light tubes were installed in the Customer Service conference room of Directorate of Public Works (Building 3-1634). There were six lighting fixtures in the room.
- A complete control package and electronic dimming ballasts were provided and retrofitted into existing luminaries. The control panel was coupled to a photo-sensor, an occupancy sensor, a variable slider switch, and a multi-function digital control station. The controls were also coupled to variable position motors that open and close butterfly dampers in the tube to increase or decrease amounts of available sunlight.

Results

- Illuminance levels were approximately the same before and after installation.
- Initial cost of the technology was considered significant; with significant energy reductions. No economic payback was calculated.
- Surveys conducted before and after the installation showed workers preferred the daylight systems. Occupants commented that the new fixtures provided extra light and natural light.
- Room temperature was not affected by the added skylight.
- The control system is complex, not very easy to operate.



Before installation



Before the diffuser was installed



After installation

(Source: http://www.ndcee.ctc.com/fact_sheets/lighting.pdf)