

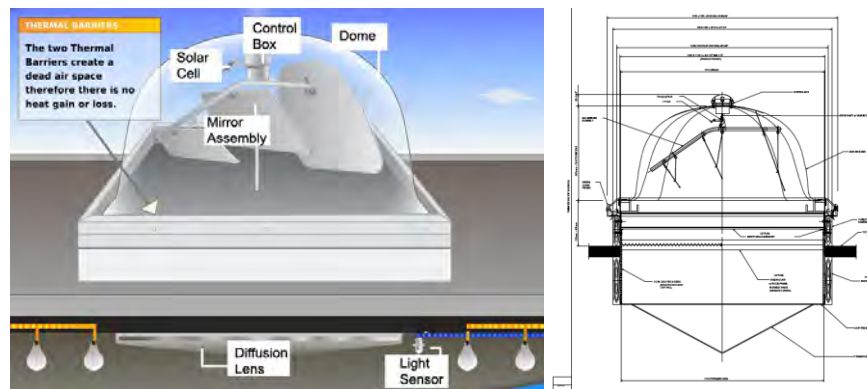
BRIEF DESCRIPTION

Sunlight tracking is an active daylighting system, which collects sunlight using a mechanical device to increase the efficiency of light collection. Mirrors within the system rotate based on the direction of the sun or time of day to collect the most possible sunlight, which is directed down to a diffuser box located within the occupied space.

Applications

Core spaces

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



(Sources: <http://www.ciralightglobal.com/flash/ciralightDemo.htm>;
<http://www.solar-track.com/architects.html>)

- Actively collect sunlight via tracking mirrors.
- Transmitting light to interior space via a straight shaft.
- Requires a large opening in the roof (This may require modifications to existing roof joists.)

Design Notes

Straight light path

- Sunlight tracking systems require a straight light shaft into the occupied space; therefore, there cannot be any air duct or other obstacles in the way.
- The distance from the roof to ceiling below is limited to a certain height.

Related Technologies

Hybrid Solar Lighting

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.

[2] A new strategy for EUCLIDES subdegree solar tracking. Available at <http://www.inspira.es/newsroom/981130.html>

Energy Savings

Lighting Energy

- Sun tracking system provides two or more times the amount of light compared to conventional skylights. So Solar Tracking Skylights can provide the same light levels and duration as conventional with a fraction of the units or square feet of coverage.

Cooling Energy

- The biggest shortcoming of any skylight is heat loss and gain. Even with an optimal design, up to 45 percent of the electrical lighting savings produced from skylights is lost in additional HVAC expense. Comparing to choosing skylights, sun tracking system lowers HVAC requirements by reducing the number of openings on the roof. Sun tracking system 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

- Sun tracking systems can yield to a substantial reduction in monthly demand charges due to reduced lighting energy during peak hours and possible reduced cooling requirements in warmer months.

Guiding Principles¹

Optimize Energy Performance (Energy Efficiency)

- Reduce the energy use by 30% 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% 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)²

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 75percent of regularly occupied spaces.

¹ Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings www.wbdg.org/pdfs/hpsb_guidance.pdf

² USGBC LEED Reference Guide for Green Building Design and Construction, 2009 Edition

Product Images



- Work in low bay (eight to twenty feet ceilings).
- One 24” roof penetration per Sundolier.
- Light 1,000 to 2,500 sf with single fixture.

Components **Top dome, Flashing, Thermal barrier, Ceiling diffuser, Light sensor**

Cost Range

Components	Cost	Unit
Solar tracking system	\$5,900	Per system

Product types

Closed loop solar tracking

- Closed loop systems track the sun by relying on a set of lenses or sensors with a limited field of view, directed at the sun, and are fully illuminated by sunlight at all times. As the sun moves, it begins to shade one or more sensors, which is detected by the system resulting in the activation of motors or actuators to move the device back into a position where all sensors are once again equally illuminated.

Open loop solar tracking

- Open loop systems typically employ electronic logic, which controls device motors or actuators to follow the sun based on a mathematical formula. This formula is typically a pre-programmed sun path chart, detailing where the sun will be at a given latitude and at a given date and time for each day.

Vendors

Sunflower Corporation, Sundolier™

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

Natural Lighting Co., Inc. Active Daylighting™ System

<http://www.daylighting.com/index.asp>

Sunlight Tracking

[PRODUCT AND ECONOMICS]

Ciralight SunTracker

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

Solar Tracking Skylight, Inc

<http://www.solar-track.com/>

Warranty Info

Unknown

Code

None

Restrictions

Sunlight Tracking

[SPECIFICATIONS]

SYSTEM DESCRIPTION and WARRANTY³

The skylight system shall be UV-stabilized, shatter proof and energy efficient. The plastics used in the manufacture of the skylights shall be light transmitting plastics for daylighting applications.

- A. Light transmission and color of the panels shall not change after [exposure to heat of 149°C 300 °F for 25 minutes] [5-year exposure at a low angle of 5 degrees in South Florida].
- B. There is no delamination of the panel affecting appearance, performance, weatherability or structural integrity of the panels or the completed system.
- C. There is no fiberbloom on the panel face.
- D. Change in light transmission of no more than 6 percent in accordance with ASTM D 1003, and in color (yellowing index) no more than 10 points in comparison to the original specified value over a 10 year period.

SKYLIGHT SYSTEMS

Provide skylight systems meeting the following requirements:

- A. Integral perimeter framing system assembly shall be by the manufacturer.
- B. Air infiltration at 300 Pa 6.24 psf shall be less than [0.5] [_____] L/s/m² [0.1] [_____] cfm/ft² in accordance with ASTM E 283.
- C. Water penetration at test pressure of 73 kg/m² 15 psf shall be zero in accordance with ASTM E 331.
- D. Manufacturer shall be responsible for maximum system deflection, in accordance with the applicable building code, and without damage to system performance. Deflection shall be calculated in accordance with engineering principles.
- E. Proper weepage elements shall be incorporated within the perimeter framework of the glazing system for drainage of any condensation or water penetration.
- F. System shall accommodate movement within the system; movement between the system and perimeter framing components; dynamic loading and release of loads; and deflection of supporting members. This shall be achieved without damage to system or components, deterioration of weather seals and fenestration properties specified.
- G. The exterior panel face shall repel an impact of 81 N-m 60 foot-pounds without fracture or

³ Specification language modified from the Whole Building Design Guide's Federal Green Construction Guide for Specifiers, Section 22 40 00 (15400) Plumbing Fixtures. Accessed August 2010 at http://www.wbdg.org/ccb/browse_org.php?o=84 (last updated January 2010).

Sunlight Tracking

[SPECIFICATIONS]

tear when impacted by a 89 mm diameter, 2.9 kg 3.5 inch diameter, 6.37 pound free falling ball. Impact strength shall be measured by the Society of Plastics Industries (SPI) method.

- H. The system shall require no scheduled recoating to maintain its performance or for UV resistance.

Additional specification language recommended by a vendor includes:⁴

Dome: Extruded sheet of high impact, optically clear, acrylic with UV protection. Light Transmissions: ASTM D-1003, 91percent at 0.125 thickness.

Mirror: A single aluminum reflector coated with a super reflective Oxide-layer system on one side to reflect light. Reflection to ASTM: E-1651 (95 percent).

Light Well: < 3' - Regal White with sealed corners; > 3' - .039 polished aluminum with sealed corners

Controller: Polycarbonate / ABS blend controller has the ability to accurately calculate the sun's position regardless of weather and maintains accurate time within one second per year.

Performance:

U Value = .35

SHGC = .3196

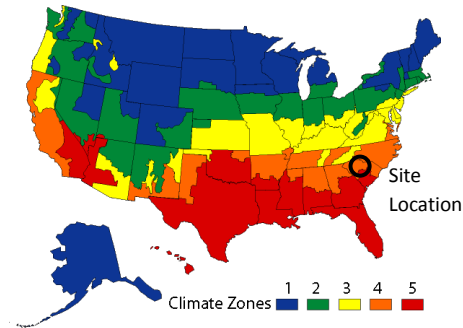
VLT = 91%

Meets OSHA fall protection

⁴ Specification language modified from Ciralight SunTracker Spec Sheet.

<http://ciralight.com/documents/SpecSheetST2.pdf>

Fort Bragg, – Building 3-1631 Cumberland, North Carolina



Facility

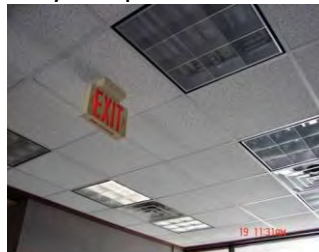
- The Directorate of Public Works serves as the “City Engineer and Public Works Department” for Fort Bragg North Carolina.

Approach

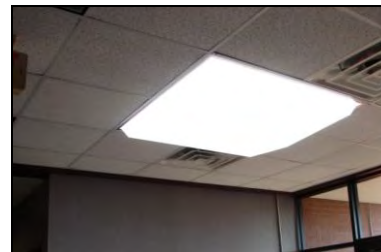
- SunTrackerOne from Ciralight Inc. was installed in the lobby of Directorate of Public Works (Building 3-1631). There were four lighting fixtures in the lobby. After installation of SunTracker, the electric lights were turned off via a photo-sensor, and occupancy sensor, and a power back relay.
- The lobby is a highly visible location to many high-ranking individuals. The use of daylight in this space may encourage others to consider the technology for both new construction and retrofit.

Results

- The illuminance was about at the same level before and after installing the SunTracker.
- The initial cost of the technology was significant; there also were significant energy reductions. No economic payback was calculated.
- Surveys conducted before and after the installation showed workers’ satisfaction with the natural light. Their remarks expressed pleasantries with the overall system and the amount of light created.
- Easy to operate.



(before installation)



(after installation)

Additional examples of DOD applications of sunlight tracking systems include:⁵

1. Dyess AFB Abilene Texas: over 700 units including hangars, maintenance, and warehouse facilities, including a 100,000 sq/ft B-1 Bomber phase hangar.
2. Luke AFB Glendale Arizona: over 400 units including all hangars, engine repair, warehouses and gyms.
3. Fort Huachuca Sierra Vista Arizona: over 500 units including all hangars, maintenance facilities and warehouses.
4. Davis Monthan AFB Tucson Arizona: warehousing, gyms, recreation center.
5. 29 Palms Army Base, 29 Palms California: over 200 units in warehouses.
6. Marine Air Station Yuma Arizona: over 400 units including all hangars, gym, and warehouses.
7. Camp Pendleton California: over 400 units in mixed facilities.
8. Seymour Johnson AFB Goldsboro, North Carolina: new and retrofit hangar and classroom facilities.
9. Barksdale AFB: B-52 corrosion control hangar.
10. Arizona National Guard: 2 sites including helicopter repair hangars, warehouses, and administration.

⁵ List of DOD projects was found at: <http://www.daylighting.com/projects.asp>