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Editorial

Passive Daylighting Systems

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Passive daylighting approaches stimulate the quantity and even distribution of daylight throughout a building by collecting natural light and reflecting it into darker areas of the building. What makes this a "passive" approach is that the design elements do not require any special mechanical equipment.

Natural light is a powerful architectural tool. As the significance of sustainable design develops, passive strategies like daylighting have become critical in reducing the effect of the built environment. Additionally, research in the last decade has shown daylighting to have significant health and wellness benefits for users [1]. Nowadays, there are more tools than ever to harness daylight. From innovative reflective materials to advanced computer modeling, architects are using modern technology to light buildings more efficiently.

Recently, Solatube is considered as one of the key renewable energy source commodity used in passive daylight systems and modern daylighting technology [2,3]. This device was a substitute for traditional skylights. Solatube daylighting systems (also known as Sun Tunnels, Light Tubes, or Sun Pipes) gather natural light at roof level then transfer it via highly reflective tubing to a ceiling fitting which diffuses the beautiful, natural light into the room below. This is considered as an innovative device and technology able to transport and distribute natural sunlight without heat transfer. Figure 01 shows the new Integrated LED Light Kit that allows the integration of natural light and traditional electric light from a single fixture for a cleaner ceiling appearance and nighttime illumination.

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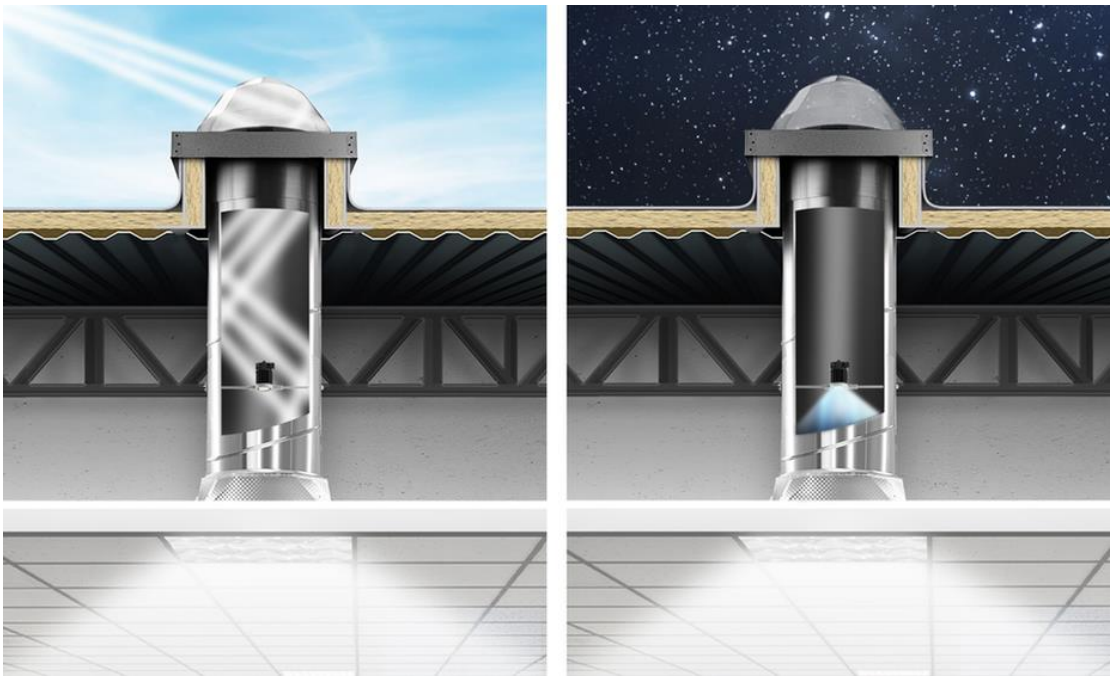

Figure 1: Integrated LED light kit [4]

The Solatube technology started in the 1980s when an Australian inventor created a product known as a tubular daylighting device (TDD) that can bring daylight into a building. This invention revolutionized the way daylight was brought into a building and was the catalyst to the daylighting industry.

The principle of the Solatube design is light propagation from the outdoor to indoor by multi reflections on high reflective internal surfaces. Solatube consists mainly of three components: receiving part (capture zone), reflecting tube (transfer zone), and emitter part (delivery zone) as shown in Figure 2. The receiving part (hemispherical dome) collects the sunlight in the top part of the hemispherical-shaped dome. It is transparent and commonly UV resistant. Some domes equipped with a light tracker-reflector made of aluminum so that it can capture low-angle sunlight. The reflecting tube has an inner surface coated with a highly reflective aluminum film that enables the received light to go multiple internal reflections through the reflecting tube. The emitting part (diffuser) is responsible for uniform light distribution throughout the interior space area. Usually, the diffuser is connected to a light controller, controlling the output light intensity.

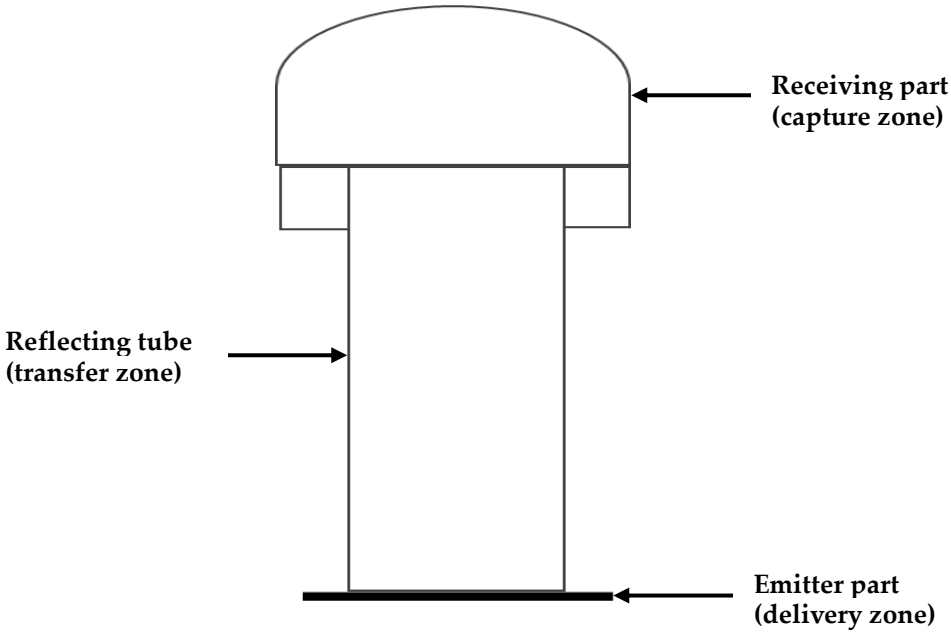

Fig 02 : Main components of Solatube

Solatube can be utilized alongside the lighting controls that react according to the sunshine accessible. A wide range of investigations has been performed to develop the Solatube technology with recent and new models. However, like every new technology, Solatube technology also has its pros and cons. Most of the investigations, either numerical or experimental, aimed to enhance the Solatube performance and to overcome the associated problems and limitations. Moreover, some accessories have been developed to include more operation functions under different operating conditions.

The shift of the lighting load from conventional electrical lamps to modern daylighting technology is key contribution towards energy sustainability in new sustainable buildings especially in new smart cities [5]. Moreover, daylighting technology is considered as one of the important strategies for energy retrofit programs applied for existing buildings and help reduce electrical consumption and decrease harmful carbon emissions [6]. Therefore, the first important aspect related to the prior design of sustainable buildings is the inclusion of daylighting technology. In general, most of the energy conservation building codes have recommended employing intelligent daylight integrated lighting systems.

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