4.4 Construction and performance-analysis of a 'Solar-light" for efficient use of daylight

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ABSTRACT

A pleasant and appealing environment, excellent color rendering, natural interior, and significant energy saving are the major advantages of using the daylight compared to the artificial lighting. Glare and heat radiation are the main drawbacks of utilizing direct sunlight for building illumination.

This 'solar-light', a newly designed unit, can be used only during the day time and is operated from natural solar radiation with no additional power being required at all. It acts as a light guide which transfers the filtered visible spectrum of solar radiation from outside into the interior of the building.

Solar-light that illuminates building interiors more efficiently with natural daylight, has been constructed and tested for its performance. The unit has been designed to reduce substantially the heat component of solar radiation with an IR-filter so that the building interior does not get heated up by increased cooling load due to lighting. This would considerably reduce the air-condition load of the building. The UV component of the solar spectrum is eliminated with a UV-filter installed inside the unit, thus only the filtered harmless visible spectrum is taken into the interior of the building.

The Solar-light has a cylindrical shape (to minimize the internal reflection losses) with a height of 80 cm and a diameter of 26 cm. The transparent window at the top of the unit has a hemispherical shape in order to increase the effective area of the solar radiation input into the interior of the building. The small air gap between outer cylinder and reflective cylinder creates a convection path for heated air. A light-reflective coating is applied at the interior surface of the cylinder to minimize the loss of illumination. The filtered radiation finally is sent through a light diffuser also with the same diameter at the bottom of the unit before the light is finally delivered into the building.

The performance of the unit has been tested in real environment and a maximum of 170 Lux was measured at the desktop height inside the building with the daylight. Diameter of the illuminated area is about 5-6 m of which the intensity variation is minimal within the inner region.

A series of these solar-light units can be installed on the roofs of large buildings (ex: garments factories, ware houses etc.) to illuminate the interiors in place of fluorescent bulbs to save energy substantially reducing the electricity bill.