

Analytical study of the size of solar tubes for interior spaces for Cairo, Egypt

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Abstract

Indoor thermal and visual comfort are core issues in designing sustainable buildings. Natural daylight and ventilation are proved to improve the occupants' performance and productivity levels. The buildings sector in Egypt and specifically the residential sector is responsible for 42 % of the total energy consumption. Utilizing natural daylight in buildings plays a great role in reducing the energy used for artificial lighting and especially in a country like Egypt with high solar exposure rates.

This research paper proposes an evaluation of solar tubes configurations in a space located in Cairo, Egypt (semi desert climatic zone). This evaluation is conducted using a simulation study that has been held to determine the optimum size of the solar tunnel as well as the optimum placement of them, and to optimize their performance in the case study investigated space. Twenty-four configurations of solar tunnels have been studied and twelve combinations of skylight have undergone evaluation. The analytical study provides the optimum size of the light tubes that is able to provide the highest level of daylight factor in the case study space.

The selected space is located in Cairo, Egypt in a building. The coordinates are 30.0444° N, 31.2357° E and 23m elevation above sea level. The size of the room is 4.20 m length, 3.60 m width and 3.00 m height, oriented to the north, the main feature of the room is that it has no windows in order to accurately analyze the effect of the light tubes.

The building envelope of the selected case study is as follows, the wall finishing is plaster and flooring tiles both have the following characteristics 0.90% reflectance, 0.03% rugosity and 0.0% specularity. The reference plane where the light properties have been calculated is a wooden table centered in the room, and has the following characteristics, 0.66% reflectance, 0.02% rugosity, 0.05% specularity.

Keywords:

natural light, daylight, solar tubes, visual comfort