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A Simple Heliodon System for Horizontal Placed Models

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ABSTRACT

Most probably, all our buildings are affected by sunlight. Hence, the ignorance of the sun's impact results in overheating, glare, and missed opportunities for the positive use of daylight, leading to wasted energy. Heliodon is considered to be a powerful tool that can aid students, professionals, building developers and users to better understand the relationship between the sun's path and its effects on the architectural model(s). Most of the heliodons are relatively expensive and complex in operation. Thus, the need to design and build a simple and relatively inexpensive one emerged. It was proposed to work on this heliodon as a team project in the environmental control class "fall-2016". The authors put the design concept and introduced a mathematical calculations table to be used with the physical heliodon, while nine students participated in the manufacturing process. The design concept is based on determining the sun's position by converting the Altitude and Azimuth angels to their corresponding measurements on the (X, Y & Z) coordinates (in relation to the observer's location). One light source can be moved on a set of graded tubes assembled in the shape of a wire frame box (thus the X, Y & Z distances could be measured) to simulate the sun's position and its lighting conditions for any latitude, at any time for any chosen day.

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1. Introduction

1. Nearly, 40% of the energy produced worldwide is consumed by buildings; this is equivalent to 2500 Mtoe "*million ton oil equivalents*" per one year (Attmann, 2010). In Egypt, 52% of the produced electricity is consumed only by the residential buildings, while 90% of the electric power plants depend on non-renewable energy resources to operate (URL4)(www.moee.gov.eg). Thus, buildings are considered to be one of the main causes of climate change.

Studying the sun's impact on buildings is the first step on the long way of solar-responsive design, where the most important goals are:

- The maximum harvesting of winter sun
- The optimum control of summer sun
- The benefits of the natural daylighting "The natural daylight that a 0.9m × 1.5m window can provide is equivalent to 100 – 60W incandescent lamps" (Lechner, 2008).

Hence, the comprehensive understanding of solar geometry and its consequences is necessary for a successful architectural design.

Starting from the very early model made by Dufton-Bachett in 1931, passing by that one

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