بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

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التوثيق الإلكتروني والميكروفيلم

قسم

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Impact of Intelligent Skin Façade on Daylighting Performance in Educational Spaces by Using Sun-Tracking System

A Thesis Presented in Partial Fulfillment of the Requirements for
Master of Science Degree in Architecture Engineering

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This Thesis is submitted as partial fulfillment of M.Sc. degree in Architecture, Faculty of Engineering, Ain Shams University.
The work include in this thesis is carried out by the author at the Department of Architecture, Faculty of Engineering, Ain Shams University, and During the period from March 2015 to April 2020.

No Part of this thesis has been submitted for a degree of a qualification at any other scientific entity.

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Building skin plays the main role in delivering daylighting inside the building. Meanwhile, sun-tracking system is one of the efficient daylighting systems that achieves good daylighting & glare protection. PV panels are one of the sun-tracking systems in the field of solar energy application. Thus, this thesis identifies the parameters of integrating IPSF (Intelligent Photovoltaic Skin Façade) as tracking system as well as intelligent skin facade to achieve efficient design to improve the efficiency of daylighting performance in a lecture hall. This thesis is evaluated a typical lecture hall space under the desert climate of the city of Cairo, Egypt that is characterized by sunny clear skies through simulation process and computational methods.

The thesis consists of five chapters. Chapter One studied theoretically the intelligent systems and building envelopes types, characteristics, and the ability to be applied in hot arid climates. Chapter Two studied analytically the parameters of daylighting systems as sun-tracking systems. Chapter Three studied analytically the effect of daylighting performance in educational spaces through reviewing examples of BIPV applied in educational spaces to set design guidelines. In Chapter Four, a generic lecture hall (base case) is modeled and tested under the climate conditions of Cairo's weather and its daylighting performance is analyzed. The tested cases are modeled using Grasshopper and Rhinoceros 3D modeling software. In Chapter Five, integrated PV panels as intelligent skin façade of case studies and its effect on daylighting performance are investigated and analyzed.

The simulation is conducted by using Diva-for-Rhino to interface Radiance and Daysim for dynamic daylighting simulation and illuminance level calculations. Dynamic Daylighting Performance Metrics (DDPM) is used to evaluate the daylighting adequacy level by using Point in Time (PT) metric, while visual comfort assessment is calculated and evaluated through (DGP) Daylight Glare Probability. The results provide expanded data of the performance assessment of the IPSF according to the different parameters as orientations, module arrangement and shading areas, which serves as a basis of the integrated PV module and how it affects the efficiency of daylighting needed in designing shading system.

Keywords

Building-integrated photovoltaics, Intelligent skin, Daylighting performance, Shading devices, Sun-tracking systems, Daylight Availability, Daylight Glare Probability