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شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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Biophilic Design as an Approach for Enhancing Thermal Performance in Office Spaces by Using Green Walls

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

By

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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 included in this thesis was carried out by the author and no part of it has been submitted for a degree or qualification at any other scientific entity. The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

Office spaces are considered one of the most important places that have to be integrated with nature; as work environment affects workers' behavior, performance and productivity. Workplace requirements are stated in many publications as; thermal, visual, acoustic comfort, and indoor air quality, in addition to the psychological factor. All these factors should be provided for the sake of work productivity and creativity. Hence, the application of plants was suggested; as it meets many of workplace needs. It is a Biophilic Design element that also contributes to improving indoor environmental quality and thermal conditions in particular.

This research work contributed to enhancing thermal conditions in office spaces, for the aim of increasing users' satisfaction and productivity in turn. It studied the effect of green walls, especially Double Skin Green Facade (a pattern of Biophilic Design) on enhancing thermal performance in the workplace. The research aims at establishing guidelines for applying Double Skin Green Façade through analyzing its impact on enhancing thermal conditions in workplace, in three climatic zones in Egypt (Cairo Alexandria and Aswan).

The research consisted of four chapters then ended with conclusion and recommendations. The first chapter mentioned the benefits of applying Biophilic Design in workplace, and its role in enhancing thermal performance. It came up with choosing plants (especially green walls) to study its effect in workplace. Then green walls technique was studied in detail, in chapters two and three; to select the green wall type used for investigation (Double Skin Green Façade) and to find factors affecting green walls performance. The methodology adopted in studying the first three chapters was theoretical study.

Then, simulation and comparative analysis was done to study the effect of Double Skin Green Façade on indoor thermal conditions in 3 cities in Egypt (Cairo, Alexandria, and Aswan). In each city, parameters as (green wall orientation, plant coverage percentage) were examined to find the best setup for maximizing the benefit resulted from green wall application. This case study was presented in chapter 4. The simulation software used in this study was Design Builder for modelling, and Energy Plus as an engine for

thermal analysis. The duration of the experiment was chosen as the working hours of the day having maximum indoor air temperature.

The scope of the research was limited to studying only one type of green walls (Double Skin Green Façade). The impact of green wall was examined only in working hours of the peak summer day. It did not cover the four seasons with different weather conditions.

The results proved that climatic zones and orientation are parameters having a significant impact on green wall performance. Moreover, it was observed that DSGF was efficient in all cases, even if plant density was low.

Finally, the research concluded that Double Skin Green Facade has proved its successful application in local climate of Egypt. The research provided guidelines for efficient use of DSGF and recommended the best setup for applying it in each city.

Keywords

Biophilic Design; Green Walls; Double Skin Green Façade; Office Spaces Thermal Performance; Design Builder; Energy Plus.

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