Ain Shams University
Faculty of Engineering
Department of Architecture

Interactive Walls as an Approach for Enhancing Thermal Performance in Egypt

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

By

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Statement

This thesis is submitted to Ain Shams University for the M.Sc. degree in Architecture.

The work included in this thesis was carried out by the researcher at the Department of Architecture, Faculty of Engineering, Ain Shams University, and During the Period from December 2012 to November 2014.

No Part of this thesis has been submitted for a degree of a qualification at any other university or institute.

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Abstract

Thermal comfort in spaces is one of the most important aspects that architects aim to achieve during the design process of buildings. The building external walls play a main role in transferring heat to the designed spaces, therefore walls were developed to be interactive that have integration with building services such as HVAC, also to respond to the environment efficiently to achieve thermal comfort and to increase the productivity of building users. This thesis aims at defining a guideline for the thermal performance of interactive walls in Egypt through the use of different strategies of mechanically ventilated double skin facades (transparent walls) and automated shading systems (opaque walls).The research addresses the thermal performance of interactive walls in three different climatic regions in Egypt (Alexandria, Cairo and Aswan).

The thesis consists of two parts and ends with conclusions and recommendations. The first part introduces and classifies the interactive walls according to the factors affecting thermal performance of buildings. Transparent interactive walls is introduced in (Chapter 1) and its classifications according to ventilation mode. Chapter 2 illustrates the opaque interactive walls concepts and configurations, analytical case studies of buildings using transparent and opaque interactive walls to analyze the thermal performance. In The second part of the thesis an office space in three climatic regions in Egypt (Alexandria, Cairo and Aswan) was selected as a reference case and its thermal performance was analyzed (Chapter 3). The effect of using transparent and opaque interactive walls on thermal performance is analyzed through thermal simulations applied on the reference case, results were compared to the reference case results (Chapter 4). Conclusion of the thermal performance of transparent and opaque interactive walls is presented in (chapter 5) to be used as a guideline in Egypt.

The studied reference case were modeled using Integrated Environmental Solutions virtual environment IES-VE ,thermal performance was simulated using Apache Sim engine integrated in IES-VE . Outputs were presented as space air temperature, energy use, predicted mean vote PMV and percentage of dissatisfied people PPD, Analysis was carried out during occupancy time in the peak day in the three climatic regions in Egypt.

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