



Pharos University in Alexandria
Faculty of Engineering
Department of Architectural Engineering

Guidelines for Facades to Optimize Energy Efficiency

A Thesis submitted in partial fulfillment of requirements for the degree of Masters of Science

IN

Architectural Engineering

Submitted by

Israa Samir Fathy Aly El Dallal

B.Sc. in Architectural Engineering
Faculty of Engineering, Pharos University in Alexandria

2024

ABSTRACT

The increasing worldwide reliance on air conditioning systems to cool buildings has resulted in a significant rise in energy consumption, leading to an energy crisis, especially in hot arid climate regions during the summer season. This escalating energy demand not only puts a strain on existing energy resources, but also has detrimental environmental impacts. In this context, building facades emerge as a critical component in addressing these challenges and improving the indoor thermal comfort

To face these issues, the adoption of passive solutions in wall construction techniques within building facades presents a promising approach. By incorporating passive design principles, such as effective insulation, shading devices, natural ventilation and thermal mass, buildings can significantly reduce their reliance on mechanical cooling systems. Passive solutions leverage natural elements and design strategies to regulate indoor temperature, enhancing occupant comfort while minimizing energy consumption.

This research focuses specifically on the limited existing particularly that examines the challenges and opportunities associated with building facades in educational buildings situated in hot arid climates. Educational buildings have unique requirements due to their specific functions and occupancy patterns, making it crucial to tailor facade strategies to meet their specific needs. By conducting an in-depth exploration of materiality, techniques and design considerations, this research offers valuable insights into effective strategies for improving energy efficiency and thermal comfort in educational building facades.

The novelty of this research lies in its comprehensive analysis of the specific context of educational buildings within hot arid climates. By considering factors such as solar radiation, prevailing winds and local climate conditions, the study provides a deeper understanding of how to optimize facade design and material choices to maximize energy efficiency. The research outcomes encompass actionable recommendations and guidelines tailored to educational buildings, enabling architects, designers and stakeholders to implement sustainable and energy-efficient building facade systems effectively.

These recommendations and guidelines serve as practical tools for decision-making during the design and construction phases of educational buildings. They encompass aspects such as facade material selection, thermal insulation techniques, shading strategies and natural ventilation approaches. By integrating these recommendations into design practices, educational buildings can achieve improvement in energy performance and reduce environmental impact.