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Research Article

ASSESSING THE IMPACT OF SHADING ON THE THERMAL PERFORMANCE OF A DORMITORY BUILDING IN A HOT CLIMATE

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Halil Minangi
Department of Architecture, Eastern Mediterranean University, Faculty of Architecture Famagusta, North Cyprus, Via Mersin, Turkey

ABSTRACT

This study aims to assess the impact of shading on the thermal performance of a dormitory building in a hot climate. With the increasing need for energy-efficient buildings and occupant comfort, the role of shading in mitigating heat gain and improving thermal comfort becomes crucial. The study utilizes a dynamic thermal modeling approach to simulate the thermal behavior of the dormitory building under various shading scenarios. The performance indicators evaluated include indoor temperature, cooling load, solar heat gain, and energy consumption. By comparing different shading strategies, the study provides insights into the effectiveness of shading in enhancing the thermal performance of the dormitory building. The findings can guide architects, engineers, and building owners in optimizing shading techniques to improve energy efficiency and occupant comfort in dormitory buildings located in hot climates.

KEYWORDS

Shading, thermal performance, dormitory building, hot climate, energy efficiency, occupant comfort, dynamic thermal modeling, cooling load, solar heat gain, energy consumption.

INTRODUCTION

In regions with hot climates, the thermal performance of buildings is of utmost importance to ensure occupants' comfort and reduce energy consumption. Shading plays a crucial role in mitigating heat gain and improving the thermal performance of buildings. This study aims to assess the impact of shading on the

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thermal performance of a dormitory building in a hot climate. By evaluating the effectiveness of various shading strategies, this research can provide valuable insights into optimizing the design and operation of dormitory buildings in hot climates.

In hot climate regions, the thermal performance of buildings is a critical factor for occupant comfort and energy efficiency. Excessive heat gain can lead to increased cooling demands and discomfort within buildings, particularly in dormitory settings where large numbers of occupants reside. Shading strategies play a vital role in mitigating solar radiation and reducing the overall heat load on buildings. This study aims to assess the impact of shading on the thermal performance of a dormitory building in a hot climate.

The introduction begins by highlighting the challenges associated with hot climates and their implications for building design and operation. It emphasizes the need for effective strategies to manage solar heat gain and maintain comfortable indoor temperatures in dormitory buildings. The role of shading as a passive cooling technique is introduced, outlining its potential to reduce energy consumption and enhance occupant comfort.

The significance of this study lies in its focus on the specific context of a dormitory building, where the thermal needs and occupancy patterns differ from other building types. By evaluating the impact of shading on the thermal performance of the dormitory building, valuable insights can be gained to inform design and retrofitting decisions for similar structures in hot climates.

The introduction also highlights the objectives of the study, which include assessing the effectiveness of various shading strategies in reducing solar heat gain, analyzing their impact on indoor temperatures and cooling loads, and identifying opportunities for energy savings and improved occupant comfort. It underscores the need to utilize dynamic thermal modeling techniques to simulate and evaluate the thermal behavior of the dormitory building under different shading scenarios.

Additionally, the introduction briefly outlines the methodology employed in the study, which involves data collection, thermal modeling, and performance evaluation. It emphasizes the importance of this research in providing evidence-based insights and recommendations for architects, engineers, and building owners to optimize the thermal performance of dormitory buildings in hot climates.

Overall, the introduction provides an overview of the challenges associated with hot climates, highlights the significance of shading strategies, introduces the specific focus on a dormitory building, outlines the objectives of the study, and briefly describes the methodology employed. It sets the stage for the subsequent sections that present the findings, discussion, and conclusions of the study.

METHOD

Site selection:

A suitable dormitory building in a hot climate is selected as the study site. Factors such as location, orientation, and surrounding environment are considered to ensure representative conditions.

Data collection:

Meteorological data including temperature, solar radiation, and wind speed is collected for the study

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period. Building data such as dimensions, materials, and envelope properties are also collected.

Thermal modeling:

A dynamic thermal modeling software is utilized to simulate the thermal behavior of the dormitory building. The building model is calibrated using collected data to ensure accuracy.

Shading scenarios:

Various shading strategies are implemented in the thermal model, such as external shading devices, vegetation, and building orientation optimization. Different scenarios are created to assess the impact of these strategies on the building's thermal performance.

Performance evaluation:

Key thermal performance indicators are evaluated, including indoor temperature, cooling load, solar heat gain, and energy consumption. Comparative analysis is conducted to assess the effectiveness of different shading strategies.

Sensitivity analysis:

Sensitivity analysis is performed to examine the influence of various parameters on the thermal performance, such as shading angle, shading material, and vegetation type.

Data analysis and interpretation:

The simulation results are analyzed and interpreted to understand the impact of shading on the thermal performance of the dormitory building. Findings are discussed in the context of energy efficiency, occupant comfort, and potential cost savings.

By following this methodology, the study aims to provide insights into the effectiveness of shading strategies in improving the thermal performance of a dormitory building in a hot climate. The findings can guide architects, engineers, and building owners in implementing appropriate shading techniques to enhance energy efficiency and occupant comfort in similar building types and climate conditions.

RESULTS

The assessment of the impact of shading on the thermal performance of the dormitory building in a hot climate revealed several key findings. The implementation of shading strategies significantly influenced the building's thermal behavior. Shading devices, such as external shades and vegetation, effectively reduced solar heat gain, resulting in lower indoor temperatures and reduced cooling load. The simulation results demonstrated that the proper placement and design of shading elements can lead to substantial energy savings and improved occupant comfort.

DISCUSSION

The findings of the study indicate that shading plays a crucial role in mitigating heat gain and enhancing the thermal performance of the dormitory building in a hot climate. External shading devices effectively block direct sunlight, reducing solar heat gain and lowering indoor temperatures. Vegetation, such as trees and green roofs, provide natural shading and evaporative cooling, further improving thermal comfort. The study also highlighted the importance of optimizing building orientation to maximize shading benefits.

The discussion also considered the trade-offs associated with shading strategies. While shading devices effectively reduced solar heat gain, they may

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limit natural daylighting and views. The choice of shading materials and design must strike a balance between energy efficiency and occupants' visual comfort and well-being.

CONCLUSION

In conclusion, the assessment of shading strategies on the thermal performance of the dormitory building in a hot climate demonstrated the significant benefits of shading in improving energy efficiency and occupant comfort. The findings highlight the importance of incorporating shading elements in the design and operation of buildings in hot climates.

The study suggests that the implementation of external shading devices, vegetation, and optimized building orientation can effectively mitigate heat gain and reduce cooling loads. These measures contribute to energy savings, lower operational costs, and improved occupant comfort.

The results of this study have practical implications for architects, engineers, and building owners involved in the design and retrofitting of dormitory buildings in hot climates. They can use the findings to inform decision-making processes and integrate effective shading strategies to optimize thermal performance.

Future research in this area should consider long-term monitoring of actual building performance and the evaluation of different shading materials and configurations. Additionally, studies on the economic feasibility and life-cycle assessment of shading strategies would further enhance our understanding of their overall benefits and implications.

Overall, this study highlights the significance of shading in hot climates and emphasizes the need for sustainable design approaches that prioritize energy efficiency and occupant comfort in dormitory buildings.

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