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Thermal Mechanical and Acoustic T of an Innovative Hollow Block Based on Local Material used in Insulation of Building

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ABSTRACT

The contemporary environmental challenges stemming from substantial energy loss in Algerian buildings have prompted a critical examination of resource utilization. The increasing popularity of hollow blocks, attributed to their eco-friendly features, such as reduced heat dissipation and minimized raw material usage, holds significant promise, particularly in developing countries facing resource-intensive challenges in construction and maintaining indoor comfort. This study delves into the thermal, mechanical, and acoustics properties of fired hollow blocks employed for building insulation. The results derived from the analysis of thermal, acoustic, and mechanical properties affirm that selecting this construction system is advantageous. Integrating it into the national housing program is recommended to fulfill the objectives outlined for the national contribution. This integration aims to significantly reduce energy consumption in the building sector.

Keywords: hollow blocks, thermal resistance, mechanical strength, acoustic insulation.

1. Introduction

Nowadays, energy loss from buildings in Algeria has led to severe environmental problems, resulting in the overuse of resources. Hollow blocks or bricks are gaining popularity due to their environmentally friendly features, such as low heat dissipation and reduced raw material usage facilitated by the presence of cavities. These attributes are particularly advantageous for developing countries, where significant resources are required for constructing buildings and maintaining a comfortable indoor temperature [1]. The study aimed to demonstrate that shale and waste materials can be effectively utilized in the production of high-quality hollow blocks. These blocks are intended to exhibit dependable mechanical performance and thermal properties, making them suitable for practical application in real construction projects [1]. In the experiment conducted by Wentao et al. [2], the researchers simulated the operational conditions of different self-insulation hollow block models in cold climates and intermittent air-conditioning usage. This simulation was carried out using a cold and hot test box. The findings indicate that certain conclusions from prior research remain valid in cold climates and scenarios involving intermittent use of air-conditioning. In instances where insulation materials were placed in the center of the holes, the experimental group demonstrated improved thermal performance, particularly at a 25% filling rate. Additionally, when insulation materials were applied to both sides of the holes, the experimental group exhibited superior thermal properties, especially with a 50% filling rate [2].

This study focuses on investigating the thermal, mechanical, and acoustics properties of fired hollow blocks used in building insulation. Hollow blocks, gaining popularity for their environmentally friendly features, are recognized for reduced heat dissipation and minimized raw material usage through cavities. These attributes are crucial for developing countries requiring substantial resources for construction and maintaining habitable indoor temperatures.

2. Experimental

The tests were conducted at our center, the National Center of Building Integrated Studies and Research. Our approach emphasizes utilizing local materials in the production of high-performance fired hollow blocks. A comprehensive examination of the mechanical performances of walls constructed with these

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blocks was carried out. Furthermore, the thermal properties of the blocks underwent evaluation through testing using a heat flux apparatus. Additionally, the acoustics properties of the hollow block walls were assessed using the BK 2270 apparatus loop.

3. Results and Discussion

The results obtained from tests conducted on hollow bricks reveal significant findings. The thermal performance, as indicated by thermal resistance, falls within the range of 0.58-1.39 $m^2 \cdot K$ /W. The mechanical strength of the bricks demonstrates robustness, with values in the range of 7 MPa. In terms of acoustic insulation, the hollow bricks exhibit effectiveness within the range of 34 dB. The thermal, mechanical, and acoustics results satisfied the relevant Algerian Standard, showcasing the fired hollow block's high compressive strength and reliable insulation performance compared to traditional bricks or other hollow blocks. Due to their excellent self-insulation characteristics, these blocks could be directly used as wall materials without the need for special insulation measures in masonry structures. This potential could significantly reduce the cost of housing construction and broaden the application prospects in various masonry structures.

4. Conclusions

The obtained results reveal significant findings, emphasizing the favorable characteristics of the hollow bricks, including notable thermal resistance, structural strength, and acoustic insulation properties. This material can enhance the thermal rehabilitation of buildings and contribute to strengthening the national housing program in Algeria. This work aligns with sustainable construction practices and supports the imperative of enhancing energy efficiency outlined in the National Determined Contribution (NDC).

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