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# Thermal Performance of Structural Lightweight Concrete Composites for Potential Energy Saving

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**Abstract:** Residential consumption dominates the energy expenditure of heating and cooling systems, especially in tropical climates where building envelopes play an important role in energy efficiency. The thermal properties of concrete that are commonly employed as the building envelope material affect directly human comfort in a building. In addressing both the concrete thermal performance and industrial waste issues, this paper experimentally studies the concrete compressive strength and thermal properties used later for comparative energy analysis for human comfort. Four design mixes and a conventional concrete as control specimen are considered utilizing industrial wastes; palm oil fly ash (POFA), lightweight expanded clay aggregate (LECA), oil palm shell (OPS), and quarry dust, as constituents. These mixes are cast for cube compressive strength (to ensure the achievement of structural concrete requirement) and small-scaled wall tests. The measurement of surface temperatures of scaled wall tests is conducted in a polystyrene box to determine the concrete time lag and decrement factor. It is found that the density of concrete governs the compressive strength and that air pockets in the concrete matrix play an essential role as far as the thermal properties are concerned. From the energy analysis, structural lightweight concrete may save approximately 50% of the residential energy consumption.

**Keywords:** thermal behavior; time lag; decrement factor; energy consumption; concrete

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## 1. Introduction

The rapid growth and diversification of various appealing economic developments by urbanization are symbiotically accelerated by the massive migration towards city or metropolitan areas for a better lifestyle, in which there is an increased trend of the human population. This pattern of population agglomeration is often synonymous with intensified utilization of energy that results in heavy heat release. The use of impermeable surfaces as construction materials within the urban areas promote, more so the trapping of the generated heat creating the urban heat island (UHI) phenomenon with an ambient temperature greater than the surrounding sites, the situation of which demands more energy to achieve indoor human comfort. Furthermore, the tendency of commonly employed