Journal of Civil, Construction and Environmental Engineering
2023; 8(1): 1-14
http://www.sciencepublishinggroup.com/j/jccee
doi: 10.11648/j.jccee.20230801.11
ISSN: 2637-3882 (Print); ISSN: 2637-3890 (Online)

Thermal Comfort in a Residential House in Kampala

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To cite this article:

Simon Peter Wafula, Obed Kamulegeya, Andrew Kasumba Buyondo, Solomon Mutebi, Isaac Ogwang, Michael Mutambo, James Kateu. Thermal Comfort in a Residential House in Kampala. *Journal of Civil, Construction and Environmental Engineering*. Vol. 8, No. 1, 2023, pp. 1-14. doi: 10.11648/j.jccee.20230801.11

Received: August 16, 2022; **Accepted**: August 30, 2022; **Published**: January 9, 2023

Abstract: Global warming and climate change has been a challenge in the last decades. Buildings are major contributors to energy consumption. This is due to the rise in human comfort needs and services. The residential sector consumes a significant amount of energy worldwide. A NZEB strategy emphasizes closing the gap between energy demand and renewable energy supply. Despite some of the roles that NZEBs significantly contribute to smart cities on the energy efficiency, the potential contribution of NZEB to the residential sector of Uganda has not been documented in literature. The objective of this study was to develop a thermal comfort model in a residential house through an envelope design. CBE tool was used and results indicate; PMV with elevated air speed of residential houses during resting hours in Kampala; at night: -0.75. DBT as 24.1°C, PPD as 17%, the Cooling effect as 2.7°C and SET = 26.3°C. The study realized factors to be considered while building like; air temperature, average radiant temperature, air speed, air humidity. The model developed in this study enables a building to heat up during cold hours and cool down during hot hours by the help of the water pool collected during rainy days. This water cools down the house during the day time while absorbing heat that can be released during the night hours that are somehow cold in Kampala. However, if this isn't considered, then heat pumps have to be employed to pump heat into rooms to reduce heating in rooms. Recommendations should be put in raising thick walls and ceilings to maintain building temperatures.

Keywords: Net Zero, Energy, Buildings, Predicted Mean Vote

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1. Introduction

Global warming and climate change are increasing issues since the last decades. Commercial and residential buildings are major contributors to energy consumption [42]. Energy consumption significantly increases on a yearly basis due to the rise in human comfort needs and services [56]. The residential sector therefore, consumes a significant amount of energy worldwide. By the year 2030, the energy demand in buildings is expected to increase up to 50% [54]. There is need to use net zero energy strategies for the residential sector in order to close the gap between energy demand and renewable energy supply [46]. Net Zero Energy entails that the total amount of energy used by a building is equal to or less than the amount of renewable energy created on-site. Net zero energy does not increase the amount of greenhouse gases in the atmosphere [44]. The wording "Net" emphasizes the energy exchange between the building and the energy infrastructure [47]. By the building-grid interaction, the National Nearly Zero-Energy Buildings (NZEBs) become an active part of the renewable energy infrastructure. According to the US department of education 2015, the main advantages of Nearly Zero Energy living (NZE) at

Abbreviations and Acronyms

ASHRAE – American Society of Heating Refrigeration, Air-Conditioning Engineers, HVAC - Heating Ventilation and Air Conditioning, IREA - International Renewable Energy Agency, NZE - Net Zero Energy, NZEB - Net Zero Energy Building, REC - Renewable Energy Credits, RES - Renewable Energy Supply, DBT - Dry Bulb Temperature, MRT - Mean Radiant Temperature, and SET - Standard Effective temperature.

Acknowledgements

I wish to acknowledge the contribution made by the following in preparing this paper; my wife Awori Esther, parents, my brothers and sisters for the support rendered to me in the process of collecting and writing this paper.

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