ENERGY EFFICIENCY AND THERMAL COMFORT IN ANCIENT BUILDINGS OF SRI LANKA

H.T. Ravishka [1], C. Jayasinghe [1, *], I.E. Ariyaratne [1]

[1] Department of Civil Engineering, University of Moratuwa, Moratuwa

Ancient buildings stand as timeless witnesses to human architectural prowess, and their adaptability to local climate conditions is a testament to sustainable design principles. This research paper investigates energy efficiency techniques in ancient buildings in Sri Lanka by focusing on maintaining optimal thermal comfort. By examining historical structures in Sri Lanka, this study unveils the ingenious strategies employed by our ancestors to achieve optimal indoor comfort naturally without an external power source such as electricity. A comprehensive literature review was conducted as the first step to examine the scientific behaviour of the design intervention and strategies used in ancient and vernacular architecture. Then, various energy-efficient techniques ingeniously integrated into building design were meticulously examined. This exploration was conducted through a comprehensive analysis of four case studies, namely, ancient mansions - Ehelapola walawwa, Ekneligoda walawwa, Warawala walawwa, and Maduwanwela walawwa, representing architectural achievements of ancient Sri Lankan civilisations. The focus of this investigation encompasses passive cooling strategies, such as natural ventilation, shading devices, thermal mass utilisation, and orientation optimisation. Furthermore, incorporating traditional materials such as wattle and daub, clay, and cow dung, which possess inherent thermal properties contributing to heightened comfort, was investigated.

Research findings highlight the seamless integration of architecture and lifestyle, where courtyards, windcatchers, and underground spaces serve both functional and climatic purposes. Also, the paper offers insights into the adaptability of historical solutions in modern sustainable design. The findings underscore the potential for incorporating traditional techniques into current architectural discourse, fostering a more harmonious relationship between occupants, built environment, and energy consumption. To enhance thermal comfort in modern building designs, incorporating ancient features such as thick brick walls, high plinth levels, and natural ventilation can be considered. Ancient natural ventilation features encompass strategically placed windows, vents, and airflow paths, all contributing to improved indoor air circulation. Wall materials such as clay, stone, wattle and daub, and cow dung reduce heat transfer to the inside. Additionally, the veranda was an essential element in ancient mansions. This natural ventilation mechanism helps to maintain indoor air quality and remove pollutants, thus reducing energy consumption in buildings. Furthermore, integrating internal courtyards or atriums into modern building designs can improve natural lighting, airflow, and ventilation.

In conclusion, this research contributes to a comprehensive understanding of energy efficiency strategies embedded in ancient buildings of Sri Lanka, revealing valuable insights that can guide contemporary architectural practices. By recognising the invaluable lessons imparted by our architectural heritage, architects and designers can navigate modern sustainability challenges while celebrating our predecessors' ingenious achievements.

Keywords: Energy efficiency, Thermal comfort, Passive design, Ancient architecture, Vernacular architecture

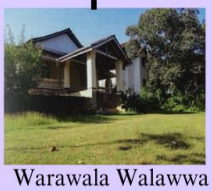
[*] Correspondence: chintha@uom.lk

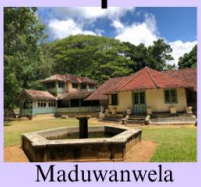
Energy Efficiency & Thermal Comfort in Ancient Buildings of Sri Lanka

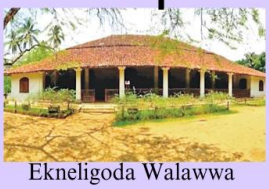
What are the special features in ancient buildings to maintain thermal comfort?

Case Studies

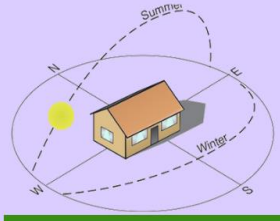

Ehelapola Walawwa


Warawala Walawwa

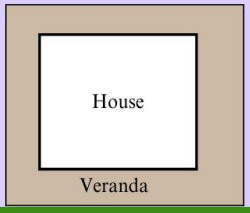

Maduwanwela Walawwa


Ekneligoda Walawwa

Findings



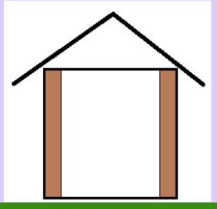
North South orientation reduces heat gain



Veranda all around the house act as a thermal buffer

Roof with ventilation holes reduces excess heat

Central courtyard promotes cross ventilation



30 cm thick brick walls reduce heat transfer to the inside by acting as a thermal mass

30 cm high plinth reduces heat conductivity

Conclusion: These findings can be used in modern building design to maintain optimal thermal comfort in indoor environment. It will reduce energy costs for the mechanical ventilation systems.