



# Passive control methods of Kerala traditional architecture for a comfortable indoor environment: A comparative investigation during winter and summer

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## ABSTRACT

Kerala is a strip of land on the southwest coast of India lying between Arabian Sea on the west and Western Ghats on the east. The traditional architecture of Kerala is known for its use of natural and passive methods for a comfortable indoor environment. However, it has not been proved by a detailed and quantitative evaluation method so far. A field study was thus conducted in the winter and summer periods to investigate the indoor environmental condition of a typical Kerala traditional residential building. The objective of the investigation was to understand the passive environment control system of Kerala traditional architecture by quantitative analysis of various thermal comfort parameters. It was done by continuously monitoring the indoor and outdoor conditions using a custom made instrument called "Architectural Evaluation System". The results show that the natural and passive control system of Kerala traditional architecture provides comfortable indoor environment irrespective of the outdoor climatic conditions.

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## 1. Introduction

Sustainable development recommends that architects and engineers must seek solutions from traditional buildings for design of low energy consumption, environmental friendly and localized identities while utilizing modern materials and techniques [1].

There is a close connection between energy use in buildings and the resulted environmental damage. This is because of energy intensive solutions that are employed in buildings to attain comfort conditions in terms of mechanical cooling, forced ventilation and artificial lighting. This has caused severe depletion of non-renewable energy resources and environmental degradation. The utilization of passive methods and techniques in modern buildings to achieve thermal comfort allows the possibility of decreasing the dependence on fossil energy as much as possible and realizes sustainability [2].

Investigations on natural and passive ventilation systems in buildings providing thermal comfort are underway in the form of continuous evaluation of thermal comfort parameters of traditional buildings, in various part of the world [3–6].

A clear understanding of various design principles, methods and techniques of construction employed and materials used in traditional architecture would be useful in contemporary architecture by judiciously adopting them even while using suitable modern

materials and modern technology. Of late, there is an increase in concern among architects and engineers in providing energy efficient and sustainable solutions in designing modern buildings.

Kerala traditional architecture, evolved on the principle of climate responsive architecture, has emerged as a novel area among the researchers in this field. Majority of these studies focus on qualitative analysis of the relationship between the building types, materials, construction techniques and the local climate and lacks field tests and quantitative analysis [7–11]. It is difficult to establish the real performance of traditional buildings in providing a comfortable indoor environment without quantifying and monitoring the actual comfort parameters over a period of time.

Extending from 7° N to 13° N latitude, Kerala is a strip of land on the southwest coast of India lying between Arabian Sea on the West and Western Ghats on the East. Kerala has a characteristic Warm-Humid climate because of its geographic settings. The presence of high amount of moisture in the atmosphere for major part of the year causes physiological and psychological discomfort as there is less scope for evaporation.

Climate of a region has a direct influence on the settlement pattern and in its built form. Any good building should relate and respond to the climate it is situated in. A built form is designed for the beneficial aspects of the climate and to reduce the impact of unfavorable conditions. The layout, orientation and scale of buildings and settlements should therefore be controlled in relation to the climatic zones [12]. The influence of climate in the evolution of form is evident from various styles of architecture that we see today.

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Traditional buildings of Kerala are built according to the principles of *Vaastushastra*, the Indian discipline on architecture [13]. The basic house module of a traditional Kerala house is *nalukettu* with four blocks built around an open courtyard. The blocks are topped with a sloping roof. The buildings are generally rectangular or square in plan and the courtyard is open to the sky for letting air and light inside. There is an internal verandah around the courtyard for protection from rain and sun. Depending on the size and importance of the household, the buildings may have upper storeys or additional modules with enclosed courtyards. In the case of repeated modules, the *nalukettu* becomes *ettukettu* (eight blocks building) or with further groups of such courtyards. The courtyard also functions as a major functional element in the house with most of the internal movement and circulation of people defined by the verandahs around the courtyard providing entry to rooms from the court. The common building materials used for traditional construction in Kerala are mud, laterite, granite stone and lime mortar for walls, wood and bamboo for roofing, and coconut palm leaves and clay tiles for roof covering.

This climate responsive design of Kerala traditional architecture demands a comprehensive and quantitative study to understand better its efficiency in terms of energy efficient and sustainable design. The authors have conducted a detailed investigation of a typical Kerala traditional building by continuously monitoring the comfort parameters during the winter and summer of 2008–2009.

**2. Experimental investigation**

*2.1. Building description*

The residential building selected for the study is located at Nilambur in the Malappuram district of the northern part of Kerala. The building (*Puthiya Kovilakam*) is nearly 300 years old. It has three rectangular courtyards in which one courtyard is surrounded by a double storeyed structure while the other two courtyards are surrounded by single storeyed structures. The internal space taken for the investigation is around the courtyard of 6 ft × 12 ft surrounded by double storeyed structures. The courtyard has an

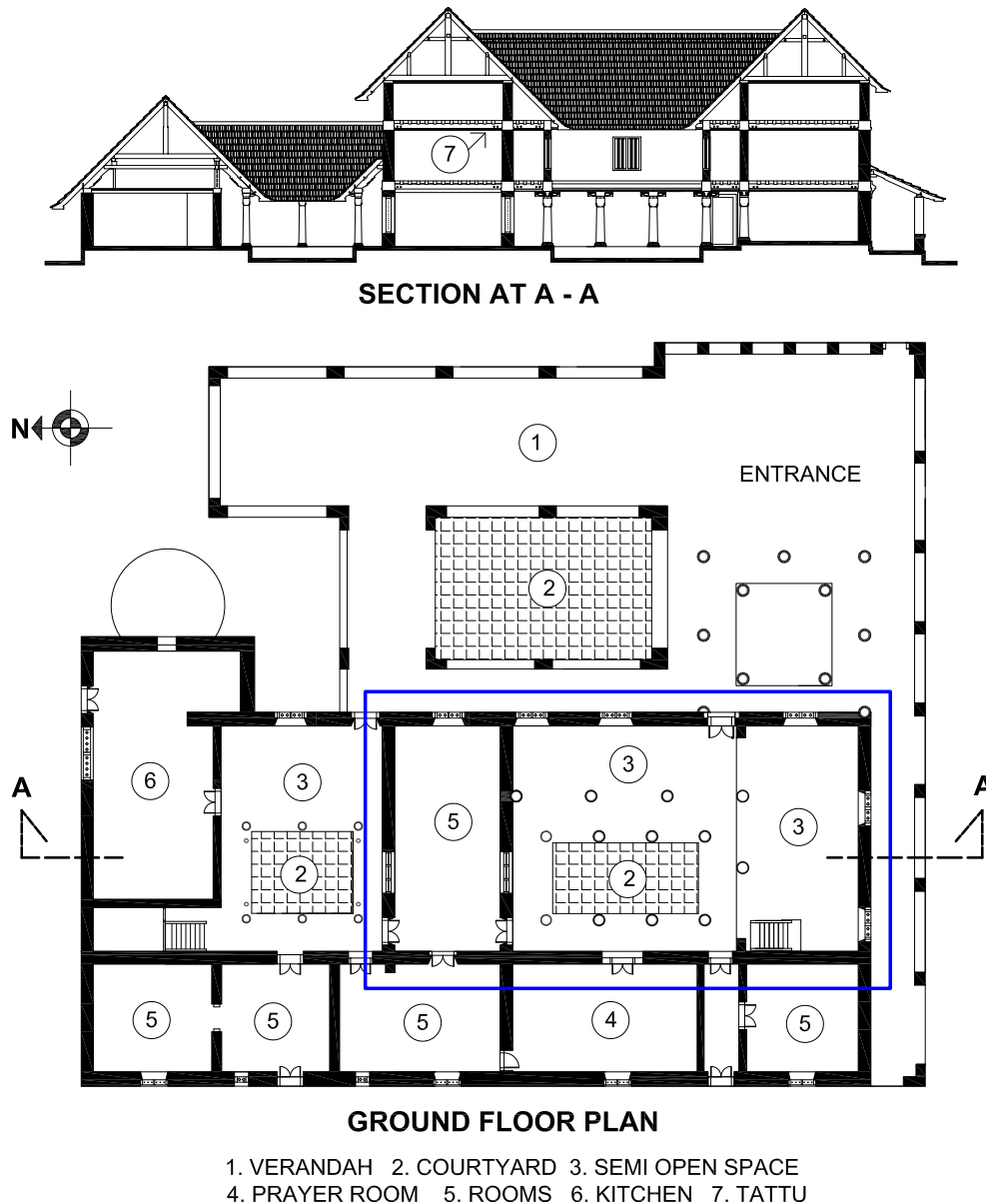


Fig. 1. Plan and section of Nilambur Kovilakam – selected area for the study marked in rectangle.

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