SUSTAINABILITY OF TRADITIONAL RURAL MUD HOUSES IN KANAKAPURA VILLAGE: A STUDY RELATED TO THERMAL COMFORT

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Introduction:

Before the advent of the industrial age, and the invention of mechanical heating and cooling, bio-climatic means were exclusively used to achieve moderately comfortable climates inside buildings. Today, active heating and cooling devices ensure interior comfort, but require major energy inputs. However, given the dual challenge of a growing fuel crisis and concerns of global warming, the amount of energy used to provide thermal comfort levels will become unsustainable. Sustainable, ecological, and climate-adaptable architecture offers possible solutions to these challenges. Many architectural publications advocate that traditional and vernacular homes form the basis of environmentally conscious design. Design lessons learned from traditional and vernacular architecture can help in designing an eco-friendly future. Ancient Indian buildings use the environment, climate responsive design, and local and sustainable materials in their design and construction. Once built, these buildings form embodied an important strategy of environmentally friendly homes: minimal use of energy.

According to Census of India's 2011 provisional population, a total of 70% of its population lives in rural areas, with very low economic status and it is in this context that the development of proper rural architecture is important. With the energy crisis deepening, the role of the built environment becomes more significant. The main aim of this work is to evaluate the vernacular settlement of Kanakapura village, in terms of its climate appropriateness of various features of the building and the settlement. The evaluation of the settlement and houses shall be carried out keeping in mind the environmental elements such as heat, humidity, air movement and light and the general activity pattern of residents. Design strategies for improving thermal comfort levels will also be suggested. The present

study will also explore the ways in which traditional construction techniques can be used in modern constructions.

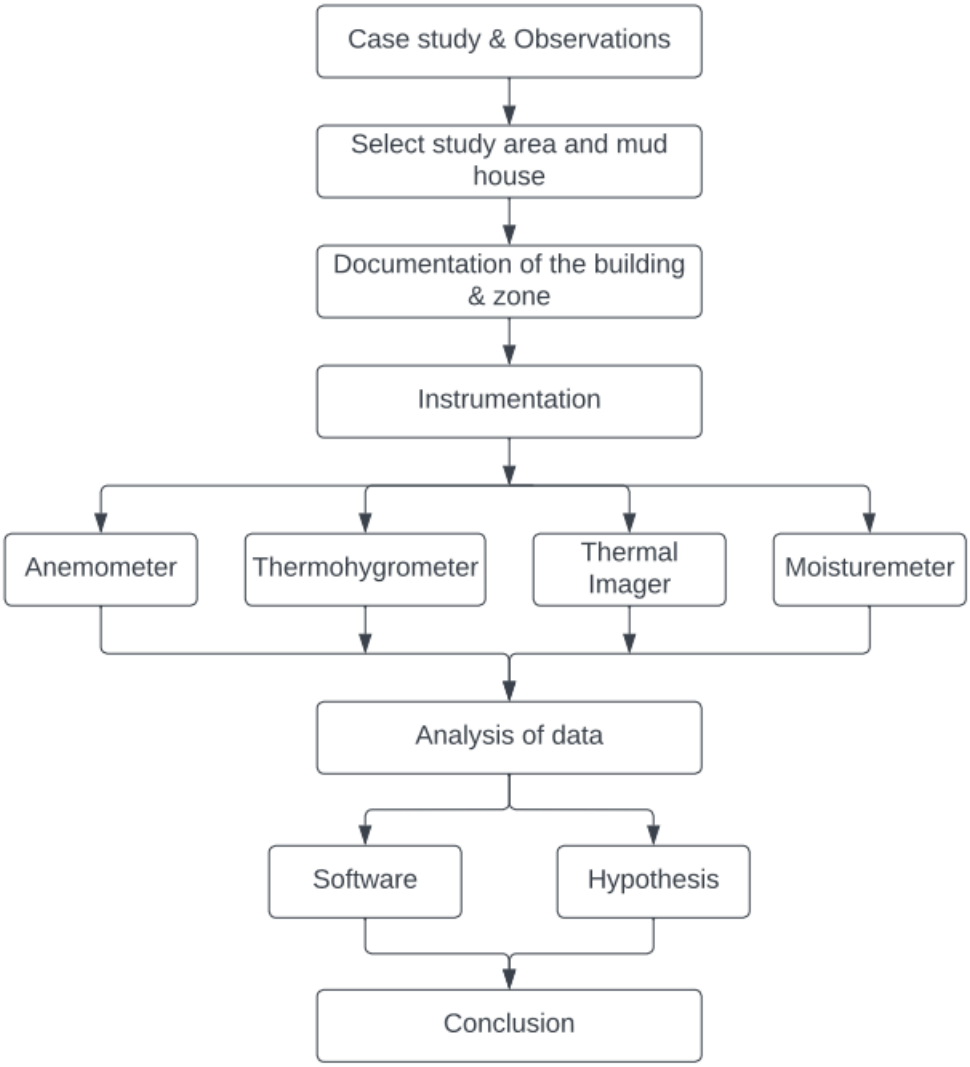
Objectives:

1. To study vernacular buildings through literature review and case studies.
2. Identify the building and analyze the climatic features and zone of the study area.
3. The selected building is documented by listing the materials used, roof type, location of openings, etc.
4. To analyze the thermal comfort of the mud house.
5. To justify that rationalized traditional technologies would help in improving sustainability of heritage architecture in modern construction.

Methodology:

1. Vernacular buildings are studied through literature review and case studies. Findings of various papers are closely observed, and the research gap is identified.
2. Mud house location shall be identified. Features of the zone of study area will be studied along which yearly climatic data of that area will be taken from Indian Meteorological Department.
3. The building properties such as materials used, type of supports, foundation type, roof type and height, orientation of building and number of openings with their locations will be documented.
4. The measurement of bio-climatic parameters will be carried out using instruments. Anemometer will be used for measurement of wind speed and direction, a thermohygrometer will be used for will be used for measuring relative humidity and temperature, thermal imager will be used to produce an instant thermogram and a final check of moisture content present in the materials will be measured by testo moisture meter. Thermal comfort will be assessed based on results.

5. Justifying that principles of vernacular architecture can be applied to modern architecture and offer improved adaptations to a particular climate. The benefits of local or regional construction using traditional materials and regionally available resources will be assessed based on thermal comfort and material properties. Probable applications of local building techniques in modern architecture will be studied.



Results and conclusions:

The air velocities inside the house were measured at different time of the day using a handheld anemometer. The indoor air velocities were between 0.5 and 1 m/s. Poor ventilation was found at the north and south interior windows as a result of low clearance space between surrounding buildings and obstruction of air flow.

The average interior temperatures during the morning (9:00 am) was found to be 23.3 °C. At evening (5:00 pm) 28.1 °C and at night (8:30 pm) 21.8 °C.

While the afternoon and evening temperature were found to be hotter compared to the rest of the day, the insulating properties of the roofing material and the mud walls was observed through the thermal imager. The roof had an average temperature of 32 °C, and exterior wall temperature was 30 °C while interior remained cool having a temperature lower than 27 °C, this can be attributed to thermal time-lag of heat-conductivity of mud.

The bamboo frame roofing with clay tiles and the 530 mm thick main walls displayed a great thermal insulating property. When compared to concrete-built structures, the mud house was found to be cooler having better insulating property.
The moisture content in the mud walls, was found to be between 11-12 %. Whereas in the conventionally made building displayed a moisture content of 9-10 %.

1. The mud stores the heat gained during daytime and dissipates it gradually after 8 PM at night, after getting heated from 7 AM to 5 PM. Inside Temperature is less than the outside temperature from 8 AM in the morning to 7 PM, during the night hours the inside temperature is almost equal to outside temperature.
2. Mean air temperature inside the hut during hottest time of the day over the course of 30 days remained at constant between 28.1 to 30.2 degrees Celsius.
3. The thermal comfort when calculated for a conventional building of the same size with a brick wall and concrete roof is only about 55%, which proves the traditional huts in Kanakapura are more efficient in thermal comfort.

Scope for future work:
The following could be some of the areas for future work:

1. Analysis may be carried out considering best possible orientation and ventilation conditions.
2. Durability tests of the materials used in construction of the selected mud house may be carried out and compared to conventional building materials. (The owner has reported problems of leakage during rain, and failure of wooden columns supporting the roof)
3. Material properties can be changed to more durable bio-degradable material and thermal analysis may be conducted to find the best possible eco-friendly way to build a thermal efficient building.