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ROLE OF VERNACULAR ARCHITECTURE IN THERMAL COMFORT OF LUCKNOW

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ABSTRACT
Vernacular architecture is known to have mechanisms that enhance indoor thermal comfort of interiors at negligible costs. Therefore, it is often termed as sustainable energy efficient architecture. In modern context when energy saving aspects are very much sought-after aspects, present research work deals with study of traditional vernacular architecture of Lucknow to explore similar aspects. Present study deals with study of nearly 30 traditional vernacular houses in season of winter. The study was conducted in the form of spatial survey accompanied by thermal measurements. During the survey responses of the occupants were carefully recorded on ASHRE and Nicole scale which also gave an idea about the satisfaction level of the occupants. The research involved the study of physical environmental and personal parameters which gave an insight into behavioral adaptations made by occupants for achieving state of thermal comfort. The results showed that planning and designing strategies along with use of local building materials helped in maintaining of indoor thermal comfort even at extreme outdoor environmental parameters along with behavioral adaptive measure by occupants.

Keywords: Thermal Comfort, Vernacular Architecture, Indoor Environment.

INTRODUCTION
Over ages, people living in different climatic zones in different parts of the world have contributed towards the development of vernacular architecture in one way or the other [1]. It involves meticulous amalgamation of bio-climatic features along with the requirements of built environment in terms of planning and constructing methods [2]. Therefore, this architectural style considers climatic factors and actually deals with energy efficient and energy saving strategies in order to provide improved thermal comfort to the inhabitants [3].

Across the globe many international research studies have been conducted so far which clearly defines the and correlates the bio-climatic features of vernacular architecture with the thermal comfort aspects with reduced energy consumption patterns. In India also, notable work in the very field has been done by Singh et al.[4], Dhaka et. al[5], Indraganti et al.[6], Dili and Naseer [7], Praseeda et.al.[8], Priya et.al[9] etc. and many more. In similar context, present research study was carried to understand the role of vernacular architecture elements in shaping up of indoor thermal comfort in buildings in Lucknow.

The study was carried out in months of winter season and included study of environmental parameters and socio-cultural parameters to understand correlation between elements of built environment and socio-cultural aspects that effect indoor thermal comfort of a building and can contribute towards possible energy savings.

Case Study
Lucknow, which is located in the Gangetic plains in northern India, has composite climate [NBC10]. The area is rich in traditional vernacular architecture. The methodology included case study of nearly 30 vernacular houses using method of questionnaire-based surveys, and thermal measurements and visual recording of the data. The study showed that traditional vernacular houses are typically in courtyard planning with construction done in lahori bricks and surkhi lime along with frequent use of mud phuska as outer coating cover. Roofs are generally high in these houses with construction of timber joists or jack arches.

Houses had rooms aligned along with courtyards which allowed more natural light and ventilation inside the houses. Ingress of sunlight was seen in almost all the traditional vernacular houses. Figure 1 represents typical vernacular house profile.

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Figure 1: Typical vernacular house profile

Data Collection

The research study included collection of data in terms of environmental parameters and personal parameters as discussed below.

Environmental Parameters

For field study time period, the indoor air temperature of the living room and the outdoor temperature of the houses were recorded as shown in Table 1.

Table 1: Typical environmental parameters profile of vernacular houses

Housing Typology		Month	Mean Outdoor Temp, To (°C)	Mean Indoor Temp, Ti (°C)	Mean outdoor humidity (%)	Mean outdoor air velocity (m/s)
Traditional Vernacular House	TVH	Dec	17	21	59	2.65
		Jan	15	22	51	2.65
		Feb	21	26	53	7.45

It can be interpreted from the table that in traditional vernacular houses, the mean indoor temperature in winter season is higher than the mean outdoor temperature, which make them warm from inside as compared to the outdoors. This further adds to optimum comfort which inhabitant achieve through use of warm woolen clothes in months of winter season.

Similarly study of relative humidity of the area, showed that there was no or negligible difference between mean outdoor and mean indoor humidity levels in winter season in these houses within some cases the humidity level was more inside the house than outside. this showed that at given low outdoor temperatures and low humidity level outside, the internal temperatures were more and same was with humidity levels which gives the interpretation that indoor environment of traditional houses was more comfortable at given extreme outdoor climatic conditions. Further, presence of courtyards accentuated the comfort levels inside these houses.

Personal Factors: Adaptive Measures

Study of personal factors, such as activity (metabolism) and clothing, were also studied during the field research. It was found that people increased the thermal insulation in terms of clothing levels. They wore more woolen winter clothes during winter season and opted for adaptive behavioral patterns like more consumption of hot beverages like tea, coffee, and closing of doors, windows and shutting down of fans etc. level of clothing insulation is closely related with thermal comfort [11].

Regarding activity levels, people tend to decline physical activity during winter season to minimize the loss of energy from their bodies as body heat which is also related with their metabolic state which was accounted as 1.0 during the study [12].

RESULTS AND DISCUSSION

Vernacular houses were studied in detail with its layout, construction materials, views, and the data of various factors (physical and personal) recorded during the survey. The analysis was done using regression analysis and

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comparison was drawn with the previous studies done by ASHRAE and Humphrey. The analysis also yielded overall satisfaction of occupants which gives an idea of thermal comfort state of occupants as is shown in Figure 2.

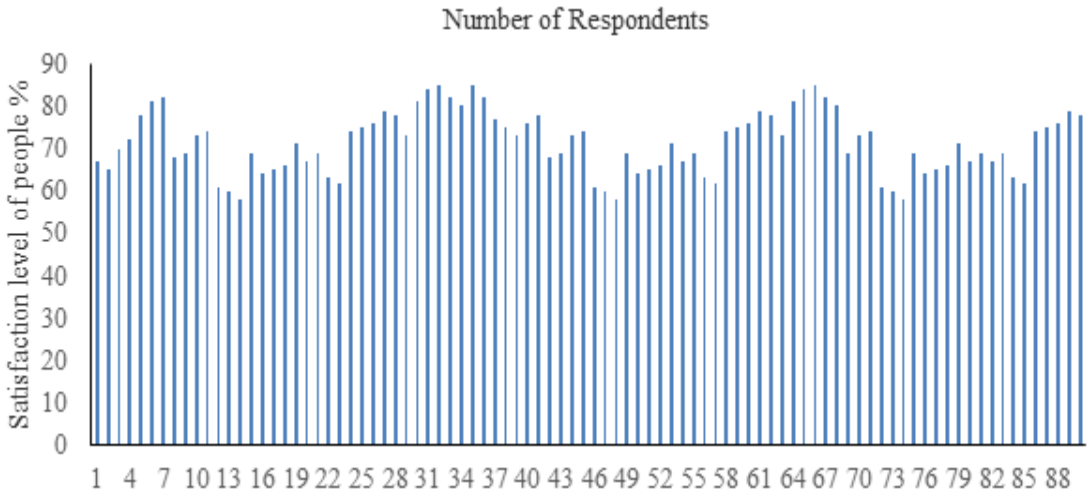

Figure 2: Satisfaction level of respondents: traditional vernacular houses

The study showed that occupant's adaptation is in the form of their attire choice which is further related with environmental parameters like temperature, wind and humidity levels. Inhabitants of vernacular houses used preferably sweaters and warm clothes in winters and were quite comfortable even without the use of energy equipment to make them thermally comfortable.

The outdoor temperature of winter season in Lucknow varied from 17°C to 26°C with indoor temperatures ranging from 21°C to 26°C for traditional vernacular houses. This showed prevalence of higher temperatures inside linked with more comfortable indoor environment as is also evident from the satisfaction level of occupants.

Since in vernacular houses, the sunlight was available in all the rooms and large windows were present which opened in the courtyard , the interiors of all traditional vernacular houses had proper air ventilation which kept the thermal environment comfortable for the occupants.

CONCLUSION

The study showed that vernacular houses had unique layout and building construction features which not only give an idea of bio-climatic planning and designing aspects but also adds to energy saving aspects in interiors of these houses. Aspects like courtyard planning, presence of large windows, opening towards courtyards allowing for optimum natural light and ventilation, high roofs all are different bio-climatic strategies which can be seen as lessons from the study and can be used in modern conventional houses as strategy to save energy and propagate sustainable modern housing in present context.

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