

# Evaluating the Thermal Comfort Performance of Vernacular Houses with Modern Conventional Houses

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**Abstract**—*Vernacular architecture is indigenous in nature that has evolved as a response to the human need for shelter and is very much in harmony with climate, topography and local availability of the materials. Various research studies have always elaborated the benefits of vernacular architecture in terms of energy efficiency in comparison to modern conventional architecture. The present paper shows a comparative thermal performance evaluation of vernacular houses with modern conventional houses and identifies the reasons behind the same and further, the guidelines have been developed.*

## 1. INTRODUCTION

Vernacular architecture is the indigenous architecture, which is derived from nature and moulded as per needs of people according to Paul Oliver (Paul Oliver, 1983, Paul Oliver, 1998). This presents vernacular architecture in its most pure and crude form. It comprises of methods of construction and use of materials which are indigenous that is locally available and does not involve mathematical calculations technical inputs. It essentially comprise of simplest methods of construction which can be used and adopted by rural people with very little knowledge or absolutely no literary knowledge, that is why vernacular architecture is also common man's architecture. This architecture has inbuilt climate responsive features like planning and designing as per climate, sun and wind direction, orientation as per contoured topography to ease access and reduce grading of fragile hills and therefore it corresponds to environmental, cultural and historical aspects of the area (Mauro Sassu, 2011). Due to these many features it is energy conserving architecture providing enhanced thermal comfort at negligible cost.

However, research studies show that today vernacular architectural style is on the verge of extinction due to abandonment by the people for switch over to modern architectural style (Maijakairamo, 2011). Report show that today building construction industry based on modern architecture style involves very high input of energy resources (Shukla, 2009). These construction practices not only are high energy consuming but also are environment destructing and not eco-friendly. Concern therefore comes to highlight the

advantages of vernacular architecture especially the thermal benefits of vernacular houses over modern houses which can help in energy conservation and can become ground work for further research work for improvement in energy sector. Present study focuses on evaluation of vernacular architecture comparative with modern conventional houses in terms of indoor thermal environment.

## 2. THERMAL COMFORT STUDY

Study area Hamirpur is located in western Himalayas in an Indian state of Himachal Pradesh. Situated at an altitude of 765 meters, the area has sub-montane warm humid climate. The study involved analysis of 30 original vernacular, 30 adapted vernacular and 30 modern conventional house selected with the help of development plan Hamirpur through random sampling. From each category three house were selected for the purpose of discussion.

The thermal comfort survey was conducted for months January, April, July and October (Singh, M. K.et.al, 2010) representing four seasons of winter, summer, monsoons and pre -autumn. The field survey was conducted between 11:00 h and 13:00 h. ASHRAE 7point thermal sensation scale was used to gauge thermal sensation of the respondents followed by filling up of the questionnaire. Adaptive approach has been used for thermal comfort study based on statistical analysis (Singh, M. K.et.al, 2010), (J.D. Richard, Brager, G, 1998). Humphreys and Auliciems have given correlation between observed comfort temperature and the mean temperature in indoor and outdoor temperatures during field studies (Singh, M. K.et.al, 2010) which was to calculate the comfort temperature required for analysis and predictions. In case of naturally ventilated buildings including both vernacular category and modern conventional houses category range of comfort temperature is used since the range involves wider aspects of physiological, psychological and behavioral adaptations of the residents (Singh, M. K.et.al, 2010). Parameters selected for the study included mean outdoor

temperature, mean indoor temperature, comfort temperature and thermal sensation votes (Singh, M. K.et.al, 2010).

**3. RESULTS AND DISCUSSION**

**3.1 Vernacular V houses**

These are the houses which have original vernacular architectural style with neither additions nor adaptations. The comfort temperature range varies from 22 - 24 °C for the year round for original vernacular styled houses. Thermal sensation votes show that people increase their insulation level in terms of clothing and external energy equipment to feel comfortably warm in month of Jan (corresponding TSV =-1 ), however for months of April, July & Oct temperature falls between comfortable temperature range (corresponding TSV =0 ).

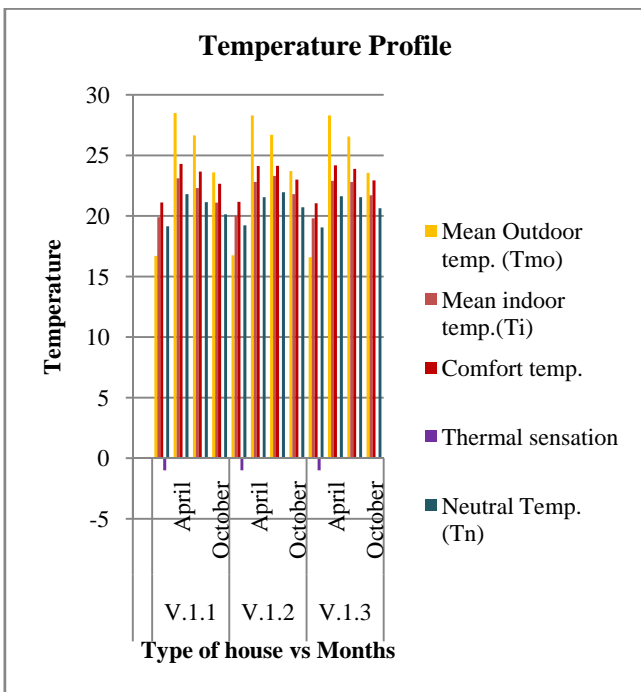


Figure 1 Temperature Profile for four months for V houses

**3.2 Conventional modern C houses**

These are the modern houses with typical features and use of R.C.C, burnt bricks, aluminium or steel frames for doors/windows, floors of Cement Concrete, Tiles etc.

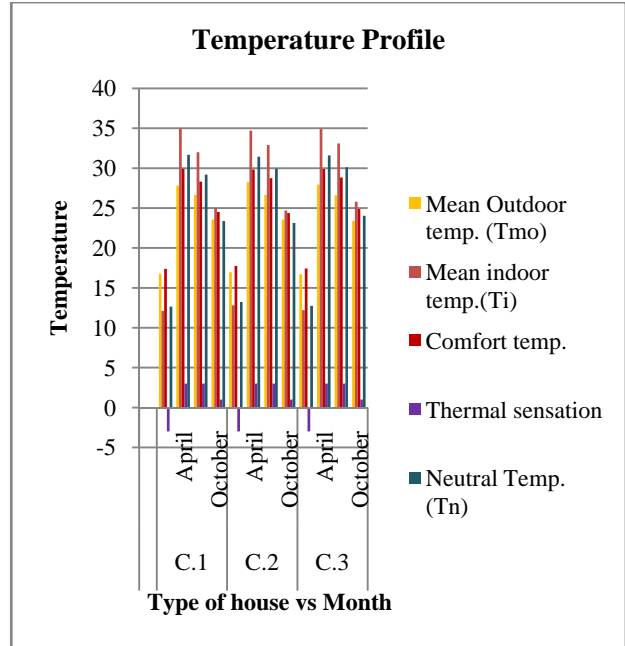


Figure 2 Temperature Profile for four months for C styled houses

The comfort temperature range shows great variation in range from 17 to 30 °C for the year round for conventional styled houses. Thermal sensation votes (TSV) also implies that people feel have to put up lot of insulation in terms of clothing and external energy equipment to feel comfortably warm in month of Jan (corresponding TSV =-3 )and comfortably cool in months of April & July (corresponding TSV =+3,+2 ),however for month of Oct people tend to slightly use external energy equipment to feel comfortably cool(corresponding TSV =+1 ). Months of Jan, April, and July require regular inputs of external energy equipment with October requiring slightly less inputs of energy. This implies that conventional styled houses require regular use of external energy equipment inputs and are not comfortable without them in all the four seasons.

**4. MONTH WISE ANALYSIS OF THERMAL COMFORT OF VERNACULAR AND MODERN HOUSES**

After calculation of temperature profile for different months for different type of houses a comparative analysis of all houses with reference to each month was done to gauge different temperature range for the two categories. This also showed the involvement of external energy equipment in residences and the extent to which they were used.

**January**

Thermal sensation votes show less requirement of insulation in terms of clothing or external energy equipment people for V houses while residents of C styled houses show more requirement for insulation for desired comfort level. Comfort

temperature range for the month of January for V houses is 23-25°C degree and for C styled houses is 20-21°C. Therefore the overall comfort range for the month of January is 20-23 degree Celsius.

#### April

Thermal sensation votes show no requirement of insulation in terms of clothing or external energy equipment people for V houses while residents of C styled houses show requirement for insulation for desired comfort level. Comfort temperature range for the month of April for V, houses is 24-25 °C and for C styled houses 30°C. Therefore the overall comfort range for the month of April is 24-30 °C

#### July

Thermal sensation votes show no requirement of insulation in terms of clothing or external energy equipment people for V houses while residents of C styled houses show comparatively larger requirement for insulation for desired comfort level. Comfort temperature range for the month of July for V houses is 25- 27°C degree Celsius and for C styled houses is 30-31 °C. Therefore the overall comfort range for the month of July is 25-30 °C

#### October

Thermal sensation votes show no requirement of insulation in terms of clothing or external energy equipment people for V houses while residents of C styled houses show slight requirement for insulation for desired comfort level. Comfort temperature range for the month of October for V houses is 21- 23 °C and for C styled houses is 24-25 °C. Therefore the overall comfort range for the month of October is 21-25 °C

### 5. CONCLUSION

Thermal sensation votes show no requirement of insulation in terms of clothing or external energy equipment people for V houses while residents of C styled houses show slight requirement for insulation for desired comfort level. Comfort temperature range for the month of

Jan: 20-23°C

April: 24-30°C

July: 25-30°C

Oct.: 21-25°C

Therefore overall comfort temperature range for the year round is 20-30°C with difference of 10 °C. This proves that vernacular houses have better indoor thermal environment which is established by both indoor temperatures and thermal sensation votes by the people. The study shows that since vernacular houses maintain better thermal comfort than modern conventional houses therefore energy efficient features of vernacular house shall be considered while planning and designing of modern conventional houses.

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