

Thermal Comfort through Vernacular Architecture for Hamirpur

Vandna Sharma

Department of Architecture, National Institute of Technology Hamirpur
E-mail: vandna@nith.ac.in

Abstract—Vernacular Architecture is known for its thermal comfort benefits and comfortable indoor built environment. It is basically the intelligent use of building materials and amalgamation of climate responsive planning and designing techniques. This interwoven fabric of materials and techniques is so simple in nature that in addition to being energy efficient and eco-friendly, it promotes self-help tendencies among the rural people. This paper presents a study on some energy efficient features of vernacular houses of Hamirpur district of Himachal Pradesh. It also serves as the groundwork for the development of thermal comfort model for the study area.

1. INTRODUCTION

Vernacular architecture is the indigenous and crude architecture, derived from nature directly and moulded as per needs of people (Paul Oliver, 1983, Paul Oliver, 1998). Vernacular architecture therefore comprises of construction methodology that uses locally available resources and essentially corresponds to environmental, cultural and historical background of the area (Mauro Sassu, 2011). This architectural style comprises of mechanisms which take care of climatic, and energy conserving factors providing enhanced thermal comfort at negligible cost. However, today this indigenous architectural style is on the verge of extinction since it has been abandoned by the people for the reasons of switch over to conventional architectural style (Maijakairamo, 2011). In wake of fast urban development and technological innovations such construction practices has started that not only consume more energy, are environment destructing and not eco-friendly. Neither they are able to cover up the bridge between housing shortage and affordable housing nor are they able to stand up to the standards of being environment savvy or energy efficient. This research presents advantages of vernacular architecture in maintaining of comfortable indoor thermal environment.

2. CLIMATE AND TOPOGRAPHY OF HAMIRPUR

Hamirpur is situated at an altitude of about 765 meters and has 30°41' 00" North latitude and 76°31' 00" East Longitude. The study area has sub-tropical climate with average yearly rainfall of about 124.8cms. (Revised development plan Hamirpur). The area of study Hamirpur lies in sub-montane and low hills

subtropical bio-climatic zone. This zone is accompanied by warm humid climate.

3. THERMAL COMFORT STUDY

The thermal comfort survey was conducted for months January, April, July and October (Singh, M. K.et.al, 2010).the field survey was conducted between 11:00 h and 13:00 h, due to limited access to these vernacular house. These are the houses which have original vernacular architectural style with neither additions nor adaptations. The study was conducted for 30 vernacular houses in which only three representative houses have been taken. The respondents were asked to vote on ASHRAE 7 point thermal sensation scale followed by extensive interaction and filling up the questionnaire. Adaptive approach has been used for thermal comfort study based on statistical analysis of large number of 33 comfort field studies. (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), (C. Bouden, N. Ghrab, 2005). Both correlations are used to evaluate the application of adaptive models in predicting comfort temperatures in-built space (Singh, M. K.et.al, 2010) of the four category buildings. Thermal comfort votes were recorded on ASHRAE 7 point sensation scale. In case of naturally ventilated buildings instead of comfort temperature, range of comfort temperature is applied since the range involves physiological, psychological and behavioral adaptations of the residents (Singh, M. K.et.al, 2010).

Table 5. Parameters selected for the study

| S. | Parameter selected | Parameter from literature (Singh, M. K.et.al,2010) |
|----|--------------------------|--|
| 1 | Mean Outdoor temperature | Mean Outdoor temperature |
| 2 | Mean indoor temperature | Mean indoor temperature |
| 3 | Comfort temperature | Comfort temperature |
| 4 | Neutral temperature | Neutral temperature |
| 5 | Thermal sensation votes | Thermal sensation votes |

4. RESULTS AND DISCUSSION

This comfort study gives the range of comfort temperature which is underlining inherent aspect of comfortable indoor environment.

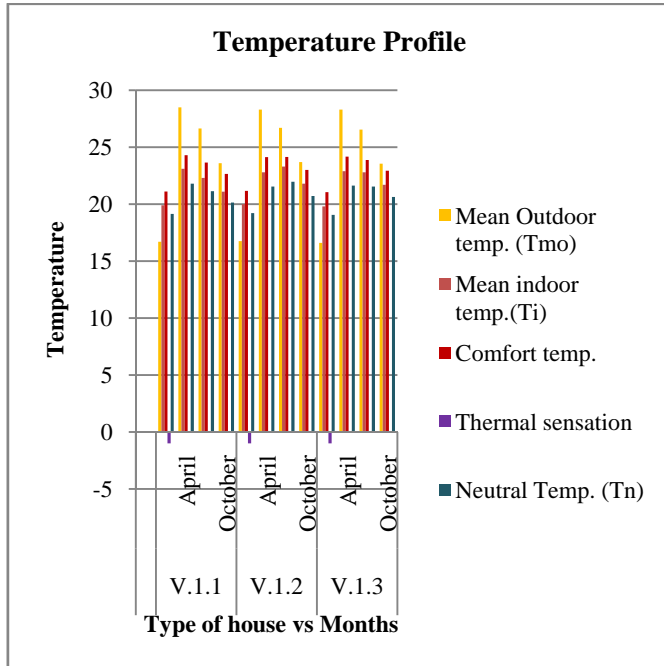


Figure 1 Temperature Profile for four months for vernacular houses

The figure shows that the comfort temperature range is from 22 to 24 degree Celsius for the year round for original vernacular styled houses. Thermal sensation votes (TSV) implies that people feel have to put up some insulation 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).

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. This also showed the involvement of external energy equipment in residences and the extent to which they were used.

For the month of January without putting up of external energy equipment's, for outdoor temperature of 16 °C the corresponding indoor temperature, (Mean indoor temp. (Ti) = 19.9°C and Thermal sensation (TSV) = -1) there is very less need to use external energy for achieving comfortable warmth or desired comfort level.

Temperature profile for April showed that without putting up of external energy equipment's, for outdoor temperature of 29 °C the corresponding indoor temperature, (Mean indoor

temp. (Ti) = 23.2°C and Thermal sensation (TSV) = 0) there is no need to use external energy for achieving desired comfort level.

Temperature profile for July showed that without putting up of external energy equipment's, for outdoor temperature of 26 °C the corresponding indoor temperature, (Mean indoor temp. (Ti) = 24.2°C and Thermal sensation (TSV) = 0) there is no need to use external energy for achieving desired comfort level.

Temperature profile for October showed that without putting up of external energy equipment's, for outdoor temperature of 24 °C the corresponding indoor temperature, (Mean indoor temp. (Ti) = 23.4°C and Thermal sensation (TSV) = 0) there is no need to use external energy for achieving desired comfort level.

5. CONCLUSION

Thermal sensation votes show no requirement of insulation in terms of clothing or external energy equipment people for vernacular houses for desired comfort level. The comfort temperature range is from 22 to 24 degree Celsius for the year round for original vernacular styled houses. This implies that vernacular houses require occasional input of external energy equipment and are quite comfortable in all four seasons. Future scope of work includes study of comparative thermal performance of vernacular houses with modern conventional houses.

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