Bio-Climatic Features of adobe Vernacular Houses of Hamirpur

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ABSTRACT

Vernacular architecture by its very definition responds to vitality of nature. The research paper studies features of adobe structures particularly vernacular buildings of Hamirpur district of Himachal Pradesh which represents the most sustainable building construction practices being followed by our elders. The research work was conducted through exhaustive surveys based on socio-economic and cultural parameters, field measurements of spatial structures. Case studies were conducted highlighting features in relation with material usage and spatial dimensions and generalization regarding the same were made. In the research paper one vernacular house has been discussed as representative of old vernacular residential built masses. Most of structures were built in adobe except few which were constructed in stone. Different planning and designing features like sunspaces, attic spaces, layout of rooms and construction materials used like adobe for walls, wood and bamboo for roof and mud phuska for flooring leads to formation of conducive environment inside which greatly improves indoor environment quality. However, in view of changing lifestyle with usage of more and more electronic equipments and problems of laborious and periodic maintenance, more additions are made either by demolition of original structures or simply by addition of few rooms to the original structure. But in no case these are at par with the original vernacular constructions in terms of conducive indoor environment, energy efficiency, cost reduction and sustainability as presented by vernacular constructions. Therefore acknowledgment of climate responsive features of vernacular architecture and their suggested amalgamation in modern construction practices was put forward as an alternative solution for decreasing dependence on modern energy consuming and less sustainable construction materials and technology.

Keywords: Vernacular; Building; Construction

1. INTRODUCTION

Vernacular architecture is known for its climate responsiveness, with its building and construction features inherited directly from nature by the people and moulded as per the specific needs of

inhabitants to match their lifestyle and culture. Since essentially vernacular architecture is the crude architecture [1, 2], derived directly from the nature therefore its materials and technology resembles nature in its purest form. This theme forms the basis of evolution of adobe houses, rammed earth constructions, cob houses, bamboo and wooden houses or later modifications as stone houses. Noted for their climatic responsive features, these different techniques of house building respond very well to conducive indoor environment at negligible energy costs [3, 4]. Owing to heavy thermal mass, earth is known to keep inside environment warm in case of winter season and cold in time of summer season with precisely no necessity of external energy equipments for maintaining internal comfort[5]. Earth is not only known for good thermal insulation but also a good alternative along with bamboo and wood for maintaining structural strength of the building with minimum damage to life and property in wake of earthquakes. Therefore the very field of adaptation of earth buildings to suit to modern lifestyles and earthquake considerations has fascinated researchers all around the globe from past few decades' for further modifications that can be done in terms of material improvement or construction techniques improvement or otherwise[5, 6]. Many alternative materials have also been developed with the help of government, some semi-government and non-government organizations [7] that could prove useful especially for reducing energy consumption of building industry and at the same time would address the problem of housing shortage especially for mass housing.

2. CLIMATE & LOCATION OF HAMIRPUR

Location: Situated at an altitude of about 765 meters, Hamirpur town has 30°41' 00" North latitude and 76°31' 00" East Longitude. Hamirpur has sub-tropical climate with average yearly rainfall of about 124.8cms. [8,9,10]

Climate: Climatically entire state of Himachal Pradesh has been divided into four bio-climatic zones namely: 1) sub-montane and low hills subtropical, 2) Mid hills sub humid, 3) high hills temperate wet, 4) high hills temperate dry. The area of study Hamirpur falls in first category that is sub-montane and low hills subtropical bio-climatic zone. [8,9,10].This zone is accompanied by warm humid climate.

3. VERNACULAR ARCHITECTURE OF HAMIRPUR

Vernacular architecture of Hamirpur is not governed by a particular type of construction system rather it has three types: 1) prominent adobe construction with wooden sloping roof topped by slates for weather resistance, 2) mix of stone and adobe construction with bamboo sloping roof topped by slates and 3) prominent stone construction with wooden/ bamboo sloping roof topped by slates.

However out of three, most prominent style of vernacular architecture is of first type constituting approximately 70% of rural vernacular buildings and second style constituting 20% and the last category constituting only 10% of the total vernacular houses in Hamirpur district. Therefore the case studies concentrated exhaustive study on first category of vernacular architecture that is adobe vernacular houses.

4. METHODOLOGY OF RESEARCH

The work undertakes the study of socio-cultural and economic factors in relation with environmental and climatic aspects of the area and its implications on the design and spatial pattern of the area. Data was collected through case studies, field measurements, subjective and objective surveys based on questionnaires.

Whole district was studied with the help of Development Plan Hamirpur [10] and 42 houses were selected representing adobe vernacular construction style. Out of these 42 houses, one house as representative was taken for discussion in paper. However generalizations were made on the basis of these 42 houses under study.

5. STUDY AND ANALYSIS

Houses are made of sun dried mud bricks as adobe finished with mud mortar, given fine coatings of bhusa or husk mixed with either cow dung or mud. Reinforced with heavy wooden beams, the walls are sufficiently weather and earthquake, resistant. Generally rural traditional houses are double storied high and elegantly plastered with mud plaster. The floors are also well plastered with mixture of mud-cow dung bhusa or husk. This makes the floors heat insulating that helps in maintenance of comfortable temperatures inside the areas even in extreme cold and hot months. Heavy wooden beams are also sometimes intricately carved in case of areas of special importance; like living room etc. Walls are finished by cladding with wooden panels for insulation reasons. Staircases in traditional houses are generally of small width of flights (generally of 3') & that is also made up of completely wood with treads plastered in mud or cow dung and husk. Roof top is made up of wooden rafters and battens supporting framework of slates with slope perfectly maintained. Sometimes it is double sloped or somewhere it is single. Design of a typical house comprise of two to three rooms (general size 10'x12') with generally one or two or maximum of three small sized openings that are meticulously placed so that no direct impact on living space is felt. One small sized kitchen in the house with sometimes attached chimney, one bathing space and one small sized detached toilet that is often at some distance outside the house are essential part of a traditional house. Sometimes if the owner has cattle, a separate double stored or even single storied house is made in near vicinity of the residential complex. In the lower storey cattle is kept while in upper storey cattle feed, or husk etc. is kept. Large sun spaces in front acting as verandahs form an integral part of the houses.

Fig 1. Adobe brick walls + Roof made of wooden beams finished with slates

Fig.2 Adobe staircase finished with mud

6. DISCUSSION & RESULTS

Based on the case studies conducted some generalizations were made for the adobe vernacular houses in the form of planning, designing and construction aspects as follows:

Table 1: Features of adobe vernacular houses

Parameter	Features	Remarks
Planning	South oriented /along the contours	Optimum ingress of heat &light
Designing	Rooms on ground floor, kitchen on first floor	Average design owing to changed lifestyle pattern
Materials & techniques	Adobe, wood and bamboo	Highly energy efficient, low cost and sustainable
Openings	Small and lesser openings	Maintains conducive temperature inside
Sunspaces	Long verandahs in front	Helps in maintaining comfort level inside rooms

Vernacular materials not only consume minimal energy as embodied energy during construction phase but also after construction leads to reduced use of energy for running of household chores [5]. Indigenous materials like bamboo, earth have been experimented and tested in this regard

[6,7].This shows vernacular architecture is increasingly gaining momentum for revival and being looked upon as better alternative for achieving sustainability.

7. CONCLUSION

Study of Vernacular architecture is prerequisite for understanding the architecture style and factors shaping it. The very study not only gives understanding of the typical building construction style prevalent in the area but also highlights socio-economic and cultural factors shaping it. The study helps to realize varied climate responsive features of vernacular architecture practiced by people long ago which are not only sustainable but also energy efficient and at the same time maintains conducive indoor environment both in summers and winters. This thus provides an opportunity to realize the potential of vernacular technology to address problems of mass housing which is affordable, low cost and earthquake resistant and most importantly involves very less dependency on active energy inputs.

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