

# Rejuvenating the Vernacular Architecture of South India as the representative of Sustainable Architecture: a case study of Hubli, Karnataka

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**Abstract**— Every region has its unique identity with climate base responsive building designs and its knowledge in the form of Vernacular Architecture. It is the growing awareness of energy efficiency and sustainable architectural design, which pushes vernacular architecture to the forefront, to have a design which impacts or correlates with environmental issues of the region. Thus vernacular architecture provides a basic and a simple solution with regard to sustainability issues. That is why, sustainable architecture which features sustainability through environmental friendly resources like low energy techniques, and approaches that are integral to the form, orientation and materials obtained from local resources. This paper talks about one such vernacular settlement located in Hubli, Karnataka, achieving sustainability through planning, orientation, materials and architectural practices evolved from long time due to the socioeconomic, climatic and environmental factors of that place. The study of local vernacular architecture and lessons can be helpful to generate an approach towards the sustainable architecture, which the trained designers of modern era have mostly ignored.

**Keywords**—Vernacular Architecture, Climate responsive design, Sustainable Architecture, Energy Efficiency techniques, Hubli.

## 1 INTRODUCTION

VERNACULAR Architecture is “the local or regional dialect, the common speech of the building. As such it comprises a range of building traditions as wide as that of the linguistic traditions” [1]. According to Lawrence [2], vernacular architecture of the particular region are designed by the human and the development of relationships among social factors, economic, material, and ecological. So it reveals the combination of culture, tradition, climatic condition, social life, the technology of the region. Vernacular architecture has evolved as the result of trial-and-error methods. At face, these methods seem trivial but in fact, they are quite complex and effective as they are tested over the period of time.

Building industry consumes more than 40% of energy use and this is increasing rapidly. The built environment has a significant impact on the natural environment, human health and economy. The concept of sustainability gives the environmental friendly approaches to deal with the issues like depletion of energy resources, thermal comfort, atmospheric emissions, use of renewable energy, indoor environmental quality, water consumption etc. Sustainable design involves integrating environmental, social and economic objectives.

Since the beginning of 21st century, the globalization has had a major impact on the human lives. We, humans, are behind bringing the more and more comfort and convenience into our daily life style, this is leading to reduce the meaning of art, architecture, culture and interrelationship with the natural environment. The theory behind the architecture encompasses the factors like an art of building, the influence of socie-

ty and tradition.

Vernacular architecture gives simplest solutions for the sustainable issues. Vernacular architecture has significant environmentally features which respond to the concept of sustainability such as low-energy techniques, approaches that are integral to the form, orientation, and materials that are obtained from local resources, to give comfort to the human being. In the recent years, professionals have begun to incorporate vernacular architectural features into their design to provide a sustainable built environment. Dayaratne [3] conducted the study on learning from tradition for an environmentally responsive architecture exhibits that the vernacular architecture has been naturally sustainable. The study on climatically responsive indigenous buildings and settlements in two desert conditions of India conducted by Krishnan et al. [4] presents that these buildings possess high thermal performance compared to the current contemporary buildings.

When we look back to our history, it is evident that all the human settlements were built out of sustainable techniques. All those settlements were defined by firmly unified buildings and land use pattern. People had adapted the art of living in harmony with nature.

In the energy efficiency and sustainability context, understanding the sustainable features of vernacular architecture will provide significant lessons and ideas to develop a sustainable built environment. This study of vernacular architecture is focused on the knowledge and the experiences related to sustainable features and considerations practiced from the past. Also to understand and designing a space in harmony with the nature and the environment to achieve balance between man and nature through most efficient and sustainable ways and techniques.

## 2 VERNACULAR ARCHITECTURE

Vernacular architecture can teach some lessons and principles

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which can be an inspiration and which have to be integrated into the design to solve the problems which we are facing in the building construction industry.

## 2.1 Participatory paradigm

In the 21st century, it is very challenging to provide shelters for the rapidly growing population. Here the process of self-help and participatory mechanism plays a most economical and affordable way. The flexible and adoptable design is another factor in vernacular architecture. So houses should provide flexibility and opportunity to use the spaces as per the choices and interests of multi-generational users. Also, building should put less impact on the ecosystem and energy resources.

## 2.2 Density and Sense of Place

Vernacular houses are characterized by their efficient utilization of space, compact form, building science and ecology with respect to the environment, economy, and society [5]. The land is an important resource which has to be regulated and used in a crucial manner. Usually, vernacular settlements are defined by high degree of complexity and cohesiveness. This high-density design has advantages of ease of services such as transportation, water supply, sanitation, electricity etc. This will lead to cost efficiency and energy efficiency. Also, higher density housing design must be associated with the life style, traditional values, privacy and security of the families.

## 2.3 Local Materials

Vernacular architecture represents the style and construction method of the particular region. Material selection is a crucial and complex process because it plays a major role in reducing cost and energy consumption [6]. Vernacular buildings are constructed out of locally available materials and technologies, which makes building more green and sustainable. In today's scenario, new building practices must adapt the use of local materials and technologies to minimize the embodied energy of the building. For example, adobe brick has low embodied energy compared to RCC. Local material cuts down the energy used for transportation and manufacturing. Also, these are having less impact on the environment.

## 2.4 Energy Conservation

Since building industry utilizes more energy it is essential to take steps towards energy conservation measurements. Vernacular buildings are good examples for optimization of energy use. Utilization of natural resources from micro level to building level will help to conserve more energy. Energy conserving design strategies will include the following factors: Orientation of building with respect to sun path and wind flow direction, spatial organization, passive solar techniques, materiality, building envelope, courtyards, landscape elements etc. The main aim of green building or sustainable building is to provide comfort and healthy environment to the occupant with less impact on the ecosystem. Vernacular architecture is better way to achieve sustainability. A comparative study done by Mohammadzadeh E. Akhavan farshchi M, Ford A. [7] on energy use in vernacular building and modern building shows that, energy consumption in the modern building is

higher than the vernacular building.

## 3 HUBLI, A VERNACULAR SETTLEMENT IN KARNATAKA



Fig. 1. Location of Hubli in Karnataka

### 3.1 Location and Climate

Karnataka has got different regions because of its diversified climatic zones like, hot and dry, warm and humid and moderate climate. Each zone is characterized by its own socio-economical-cultural pattern and architectural style. The city of Hubli, situated in south-east of Dharwad district, is the commercial center and business hub of North Karnataka region (Fig.1). The city is situated at coordinates of 15°21'42"N, 75°05'06"E and 671 m from mean sea level [8]. Hubli has a tropical hot and dry climate, where summers are hot and dry, lasting from late February to early June. Then monsoon season with moderate temperature and average rain fall of 830mm. When we look into the architecture style, one can see the influence of Maratha dynasty.

### 3.2 Vernacular House in the Rural Region of Hubli

In rural area houses were built as per the social class and the wealth of the people. Most of the families are depending on agriculture for their livelihood, also we can see houses of weavers, merchants, carpenters etc. Here study has been done on a house typology called Wada. Basically, Wadas' are houses of landlords and sarpanch (head of a village). Bigger the Wada wealthier the family. Typical Wada house will have a central courtyard with separate public and private zones. Planning and organization of spaces will showcase the climatic requirements and different levels of privacy issues. This study is focused on vernacular principles which are climate responsive and sustainable approach for the region. This particular Wada was built around 200 years back, which has a glorified history.

### 3.3 Data Collection

In this case study, the existing vernacular houses in Hubli, Karnataka was selected. The survey of Wada houses across the

rural areas of Hubli was carried out. The study provides a detailed examination of the current condition of the vernacular houses. The main focus was to finding out the vernacular techniques and sustainable considerations such as solar passive features, building plan and orientation, materials and technology used in the particular region with respect to climate, culture and social life.

#### 4 EVALUATION OF THE VERNACULAR HOUSES IN HUBLI

An investigation of the vernacular houses in terms of sustainable architecture criteria consisting of thermal comfort and natural ventilation as the effective matter, which includes the natural lighting also. The following characteristic features of the vernacular houses has been analyzed and the sustainable architecture criteria have been discussed.

##### 4.1 Orientation and Planning

Usually, vernacular buildings will be in square or rectangle in plan and oriented towards the cardinal points. The reason is, it will help to control the climatic factors like wind, solar radiation etc., with the passive solar techniques. This particular Wada is having the introvert plan with the central open courtyard. Corridors around the courtyard act as a transition space between the open and closed spaces (Fig.2). These spaces are broadly divided into private space and public space with the consideration of security and privacy. Wada also has secondary courtyard where the cattle's shed is kept.

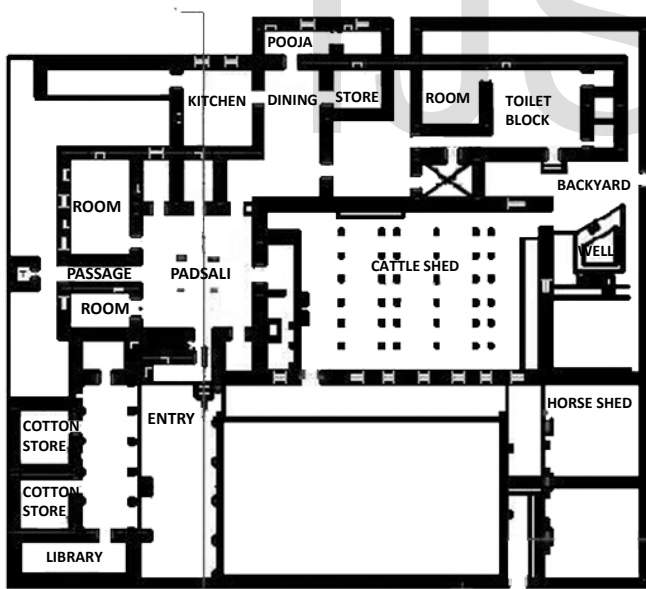


Fig. 2. A Typical Layout of Wada

##### 4.2 Spatial Organization

Spaces are organized in such a way that it should fulfil both privacy and climatic requirements. Semi open space in the form of corridor and varandah around the open courtyard reduces the direct exposure of inner rooms to the solar radiation and keeps interior thermally comfort. Public space is close to entrance so that privacy is maintained. Since this family

grow cotton, storage space for that also kept next to courtyard. Toilets are placed at backyard of the house, which is in the North-West direction (prevailing wind direction). This keeps interior odorless and hygiene. Main entry is from south direction (Fig.3).



Fig. 3. Main Entrance of Wada

##### 4.3. Building Envelop and Openings

In hot and dry climate main design criteria is to resisting heat gain by increasing thermal capacity, providing shading, reducing exposed areas, controlling and scheduling the ventilation. In this Wada all these criteria's are taken into account and achieved by some design intervention. Both interior and exterior walls are of heavy mass (Fig.4). Thickness of the walls are around 80cm to 100cm. These thick walls acts as a thermal barrier, which reduces the heat penetration inside the building.

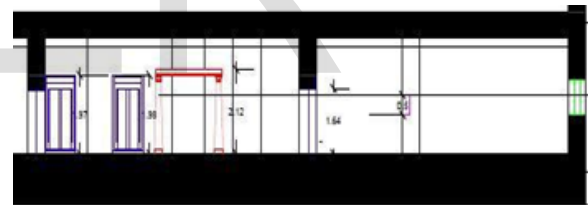


Fig. 4. Section of the Wada House

Window covers area of about 10% of the floor area. Exterior windows are relatively smaller and have high sill level compare to interior windows, those are facing courtyard (Fig.5). This kind of arrangement of openings helps to enhance the cross ventilation and keeps the interior cool by venture effect. Jaalis are used in the exterior walls, which cut down the solar radiation into inside space, at the same time it allows light and ventilation. There are double height spaces with clerestory windows which enhances the venturi effect where hot air rises up and passes through upper level windows (Fig.6). This will keeps interior cool.



Fig. 5. Small Windows and Jaali on the exterior wall

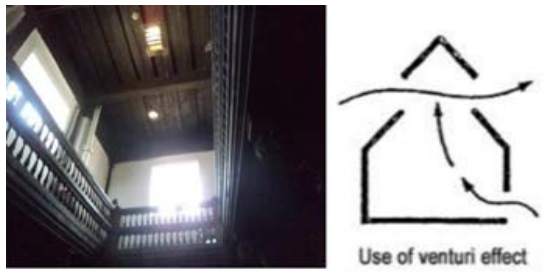


Fig. 6. Double Height Space and Clerestory windows

#### 4.4 Courtyard

The central courtyard is rectangle in shape and open to sky (Fig.7). Courtyard is sunken about 45cm deep. Courtyard will play major role in passive solar design. Size and proportion of the courtyard will decide the wind flow pattern. Here ratio between heights of the building to width of the courtyard is about 1:1. Studies showed that, courtyard increases the air movement through principles of stack effect. As air passes through the interiors it heats up and starts rising. The courtyard allows this hot air to escape (Fig.8).



Fig. 7. Central Courtyard and Verandah

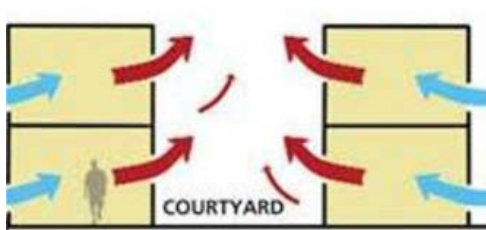


Fig. 8. Air Circulation by Stack Effect

#### 4.5 Materials and Technology

Wada is a load bearing structure, combination of stone, brick, mud and wooden components. Walls are about 1m thick taking the load of the super structure made of stone and brick

masonry with mud and lime plaster on it which acts as good thermal insulation. Thickness of the wall and material used for plastering plays a major role in reducing the heat transfer through wall. There are 2 types of flooring we can see in the wada. 1) Red oxide flooring 2) Patikallu (type of stone) flooring. Patikallu is a good thermal insulator. Upper level floors are made of timber with mud flooring and stone slab placed on it, along with the layers of gunny bags and dry Neem tree leaves as a pest control. All together thickness of the floor is about 60cm, which provides thermal insulation (See Fig.9).

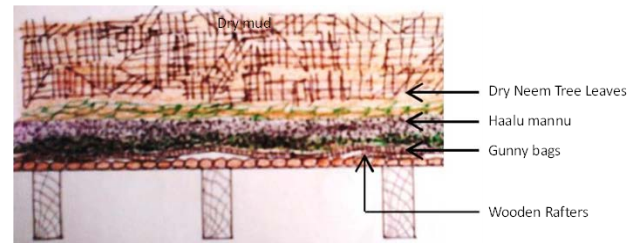


Fig. 9. Upper Level Floor Detail

Wooden columns, beams and rafters were adopted to support the upper floors. Attic place was created to store the household things (Fig.10). Doors and windows are also made out of wood. Door height is relatively less compared to today's design. Door frame has rich carvings. Both doors and windows are supported by wooden lintels. In this Wada all the materials adopted were locally available, thus it makes more sustainable and cost effective design. Embodied energy of the building is very less due the technology and material it has adopted, which is more efficient and environmental friendly.



Fig. 10. Wooden Columns and Rafter

## 5 CONCLUSION

Vernacular architecture is not just a style, it was a way of life. Vernacular architecture not just talks about the form, shape of the buildings, it showcases the culture, social and economic life of the region. This particular study has proved that vernacular architecture is sustainable and energy efficient in nature. It shows the harmony between the built form and nature. Clever use of natural elements like wind, sun, topography etc. to deal with the issues like climatic variation, comfort, protection etc, makes vernacular building more efficient and sustainable. The vernacular house of Hubli, Wada is

found to be more sustainable and environmental friendly in nature. The design has been executed with the factors like energy efficiency, climate responsiveness, and indoor comfort through a sustainable approach. Local materials and natural resources were used very smartly and efficiently in order to achieve the comfort. Use of natural ventilation and natural lighting has made the house more energy efficient. Thermal comfort is achieved by the orientation, spatial organization, shading devices and materials used. Easy and practical solutions to the issues like privacy, security and comfort. Cost effectiveness has also achieved. Today's scenario, from region level to global level, concept of sustainability have become necessity. Instead of searching here and there for the inspiration and lessons, it is better to look back to our roots and learn. It will be more sensible and reasonable

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