LEARNING FROM PAST: VERNACULAR ARCHITECTURE IN CONTEXT OF SUSTAINABILITY

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Abstract— This paper discusses the specific climatic conditions of BidadaVillage. BidadaVillage is a small village of Kutch. Kutch is one of the hottest areas of Gujarat. The region experiences more than 49°C during summers and in January which is the coldest month of the year, the temperature recorded 2°C. There has been no year of scanty rainfall in 35 years from 198° to 215°. It is one of the extreme climatic zones for human survival. Despite such extreme conditions humans have continuously inhabited the region for centuries. Here, we are discussing, how they people sustain in this climate with their building construction technology and Vernacular Architecture.

Keywords— building construction technology, climatic design, hot and dry climate, vernacular architecture.

I. INTRODUCTION

Bidada is a village near Mandavi, Gujarat State, India. It belongs to Kutch division. "Kutchua" that is what the northwestern part of Gujarat is named as. With a rich treasure of tradition, it is a delight for tourists and pride for the inhabitants. The northwestern Gujarat has its own vernacular architecture which are developed throughout the ages and has been an inhabitants themselves with locally available material, the traditional building are time tested, sustainable and sensitive to the microclimatic conditions and natural calamities, including earthquakes which the northwestern region is prone to.

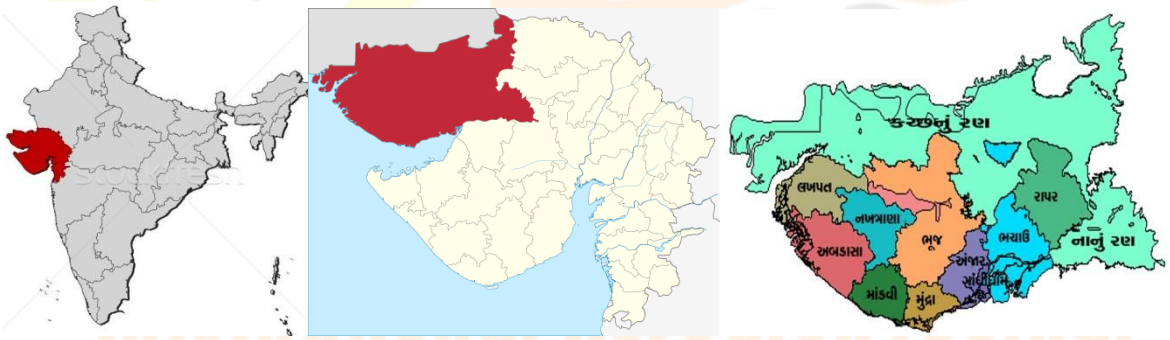

Figure 1: Location of the Bidada Village, Kutch, Gujarat.

II. CLIMATE

Apart from its unique and rich cultural heritage, it is the survival of human beings in the extreme climatic conditions that intrigues any scholar of architecture and settlement studies. It has hot and dry climate and one of the hottest places in Gujarat which is continuously inhabited by the human beings. The summers are extremely hot and the temperature exceed more than 49°C, posing challenges for the survival of humans or for that matter any life forms. However, the nights in Kutch are pretty cool, with the night temperature falling considerably. Summer prevail for almost eight months in a year. As a result sky is clear in most of the months with 345 sunlight days per year. When winter comes, January is the coldest month of the year and the temperature recorded 2°C. It means in winters, days are shiny and the nights are very much cold.

Figure 2: Culture of the Region.

III. SETTLEMENT PATTERN

Bidada Village is in Mandavi Taluka- the southern coastal part of Kutch District. It is a situated near the river and a highway runs perpendicular to it in east-west direction. The river is almost dry except during monsoon. The Village has about 500-550 houses and People are of various castes and communities. The zoning of public and private activities in the village gives refernces and shows resemblance to a typical old indian town. The settlement is based near water source. The major population is of Hindus, Jains and Muslims with a firm hold of caste system.

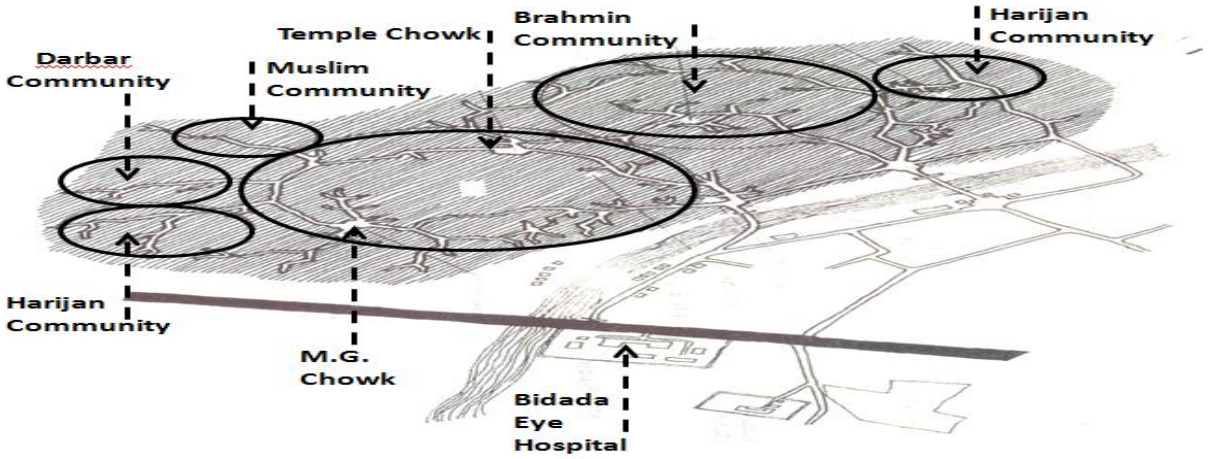

Figure 3: Village Settlement of Bidada.

The Streets of Bidada village have a streetscape of Unique pattern. They constantly turning in curves, never remaining straight, in a particular direction through smallchowks of Y Shape- where it branches out in 2/3 Directions and again keeps turning. The entire village is a mesh of these curvilinear streets which connect the chowks.

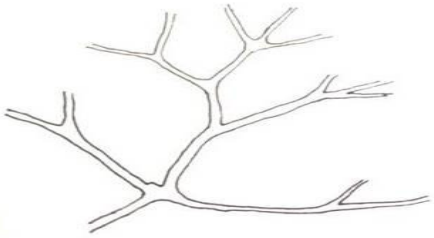

Figure 4: The Street network like a Water stream.

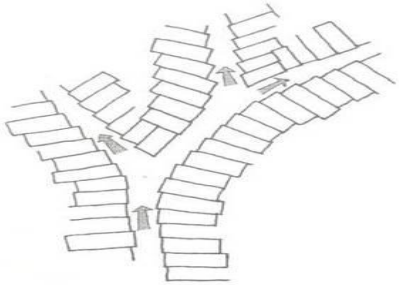

Figure 5: Y shaped branching of Streets Forming small intersection At regular interval

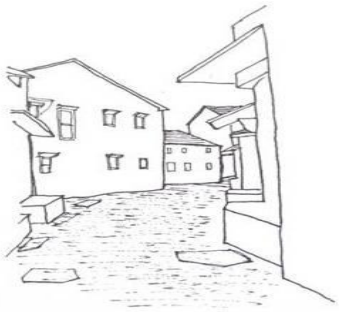

Figure 6: Narrow curvilinear streets for the smooth Flow of breeze.

It is like water stream line flowing smoothly in various direction and as they go ahead the width goes on decreasing, forming alleys. At a large scale the entire village street network has a distinct advantage that the curvilinear Streets behave like channels of winds throughout the village. Breeze can be discreetly felt on any street in the village justifying the curved street pattern. It is amazing that streets are predominantly oriented along the southwest direction, as is the wind directions for most part of the year. It is an incredible organic model of built form like a perfect machine to catch breeze thoughout the day.

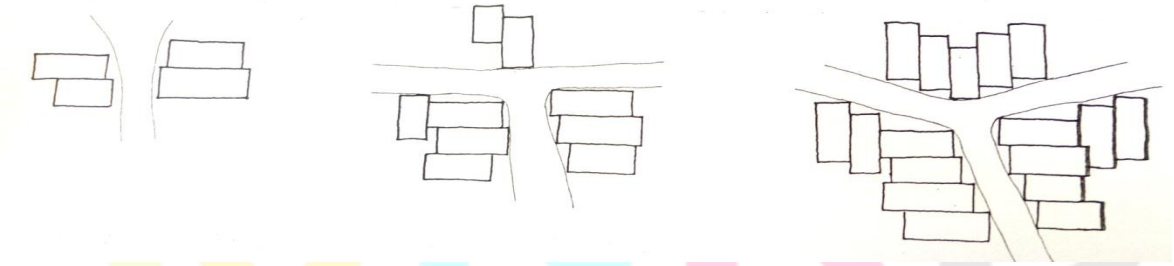

Figure 7: Row Houses with Y shaped chowks which further form the village settlements.

All Houses of the village are row houses on both sides of the streets. Many features like doors and windows, colours, textures,carvings on lintels distinguish a particular house and the group . Row housing pattern reduces the exposure of external wall surfaces to sun as the houses share a commom wall. The movement of warm air around the house too is minimised and helps to keeps the Interiors cool and Comfortable.

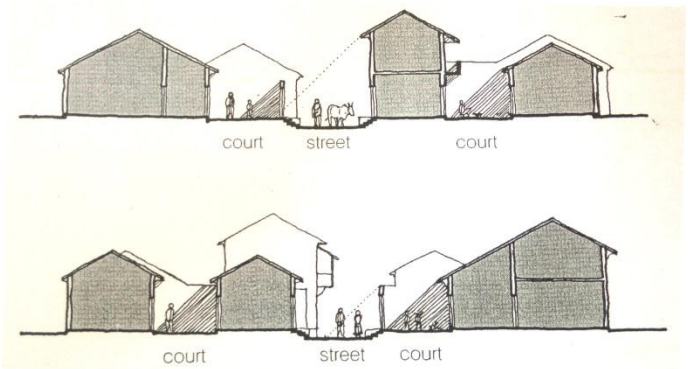

Figure 8: A dense row house typology taking care of light.

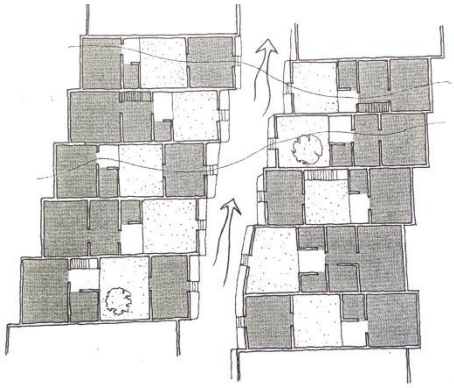

Figure 9: changing heights and with it the Streetscape.

The curvilinear streets are formed by staggering each house by few feet. The Narrow street width varies from 8 to 18ft serving pedestrain, carts and cattle movement. The house have a frontage of 10-15ft width with the height of street façade walls change as per the number of storeys.A typical feature is that if we enter a house on one side of the street the entry is in a roomwhile on the opposite side of the street the entry is into a court of the house.The opposite main entrance never face in straight line avoiding direct sight in the house. The width of Streets and the heights of houses have a proportion such that the curvilinear streets are mostly protected by shades during the day. This makes walking on the streets comfortable in the scorching heat.

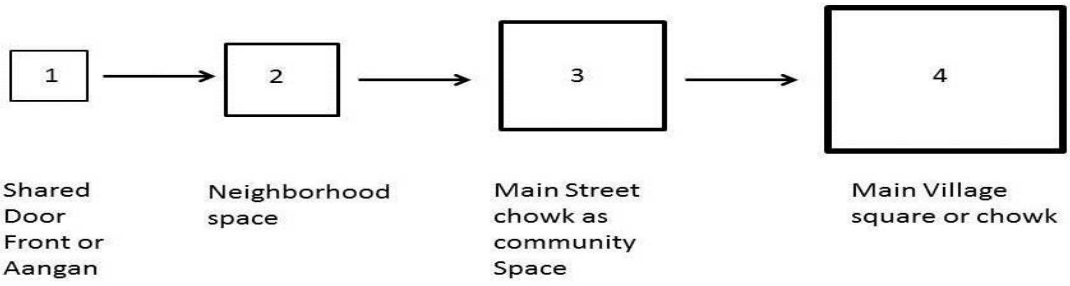

Figure 10: Hierarchy of space at Village level.

IV. ARCHITECTURE- SPATIAL LAYOUT

The row house is located near Darbari chowk, north of village darbar chowk. It belongs to a darbar family of six persons and is entered from streets by small steps called delly with Platform. The Guests or the visitors are entertained at the steps and as per the familiarity is welcomed inside the courtyard or living room or Osari.

The Basic form of house is tube row house, an elongated rectangular space with central courtyard and single story have sloping Mangalore tile roofs supported on wooden members. All the space and Most of Daily activity are concentrated around the courtyard and organized in a system from public space to most Private spaces.

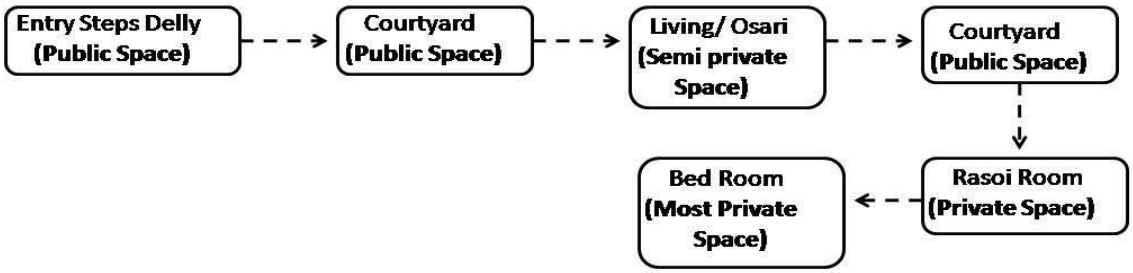

Figure 11: The Sequence of Spaces in House.

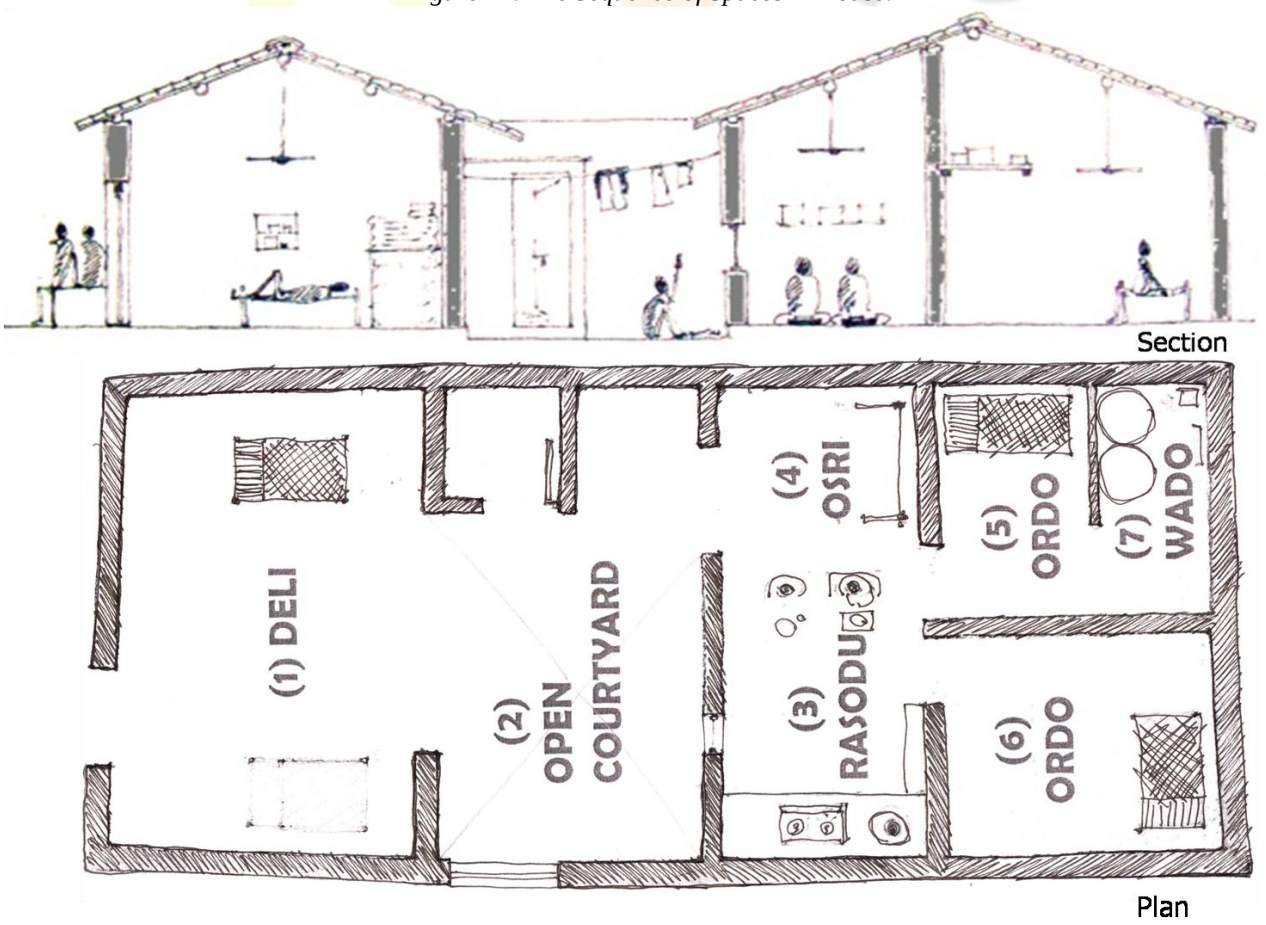

Figure 12: Plan and Section of the Bidada Village (house)

Courtyard

The Court lights and helps ventilation for all the rooms of the house and by its proportions it is in proportions it is in shade for most part of the day. The open to sky courts brings nature inside the house and create an inner microcosm of the family. In the evening time family members sits together and sleeping in summer time and throughout day most active space.

Store Area

It is usually attached with a room for and there is no ventilation. It is used for storage purpose.

Kitchen

There are mostly open kitchen connected to Courtyard because of ventilation. All other rooms are usually 3 to 4 m in sizes perhaps due to the limitations of the building materials and also helping in maintaining a climate comfort inside. In this houses, windows are not provided on south face and window is kept closed most of the times and never opened during summers in order to trap the solar radiation.

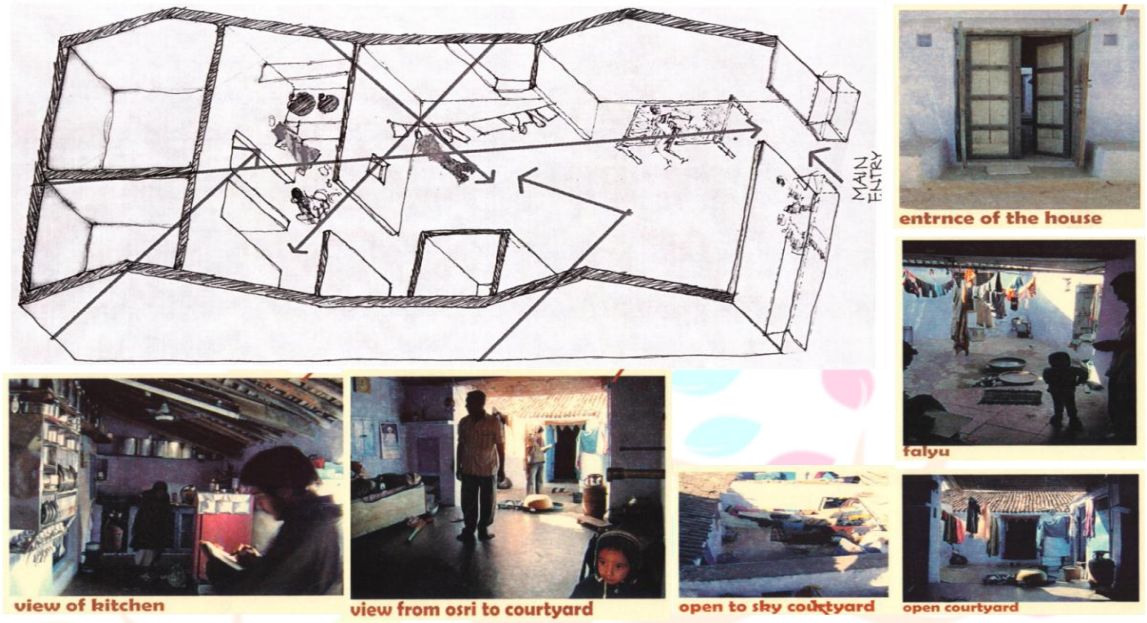

Figure 13: Axonometric view & Photograph of house.

V. AS PER SZOKOLAY (2004), SUSTAINABILITY OF A DWELLING IS USUALLY CONSIDERED UNDER FOUR HEADS: SITE,ENERGY, MATERIALS AND WASTES.

Site:

All Building activity disturbs the land, or the site. Lesser this disturbance, better it is. Undisturbed land, supporting an intact ecology, is particularly valuable. Avoiding the use of undisturbed land is a step in the direction of preserving biodiversity. The use of already disturbed barren land is preferable. Building should fit their environment. Large scale earth works should be avoided. All possible steps should be taken to prevent soil erosion and promote soil conservation.

Usually, human settlement are formed by building houses next to each other but in these hostile semi-arid areas the houses are located at the furthest possible distance from each other. This fact can be attributed to the scarcity of water and other resources, wherein, sharing of resources is avoided. Most of the daily activities of the Bhungas happen in the open space outside the built structure, so constructing the houses at a distance from each other provides privacy. Also, the lands on which these Bhungas are constructed are arid barren stretches of land, with no agricultural value.

Energy

Energy is used in buildings at two levels: Operational, energy annually used for heating, cooling, ventilation and servicing the building and capital energy or energy embodied in the materials and Building processes.

Mud and thatch both have very low energies. Further, the operational energy used for heating the building in winter and cooling it in summer is sizably less in case of mud huts. Material selection must be Influenced by embodied energy, and also by a number of other issue affecting sustainability and renewability.

The Thick mud walled house utilizes the high thermal capacity of the walls. It is known facts that mud house are cooler in summer and relatively more comfortable in winter. The thick mud wall and small openings allow the inside of the house to remain cooler during the day time in summer and comparatively warmer during the evening in winter. This is because the daytime heat is stored in its mud walls possessing high thermal capacity.

Houses have small openings which keep out the hot winds. Thatch, which has good insulating properties, adds to the climate responsiveness of the house.

Materials

Materials used to create dwelling have to be such that they are locally available and capable of being recycled or renewed, as sustainable building norms. Construction materials used in houses are cob for walls, and thatch and wood for roofs.

18-20 different varieties of locally available reed and grasses are used, namely, khip, shaniyo, Ikal and akado are mostly used for construction of the thatched roof. Wooden posts and beams to support the roof are also made from locally grown Lai, Pilu, Desi Baval, Kher, Khijdo, kerad, Gando baval. The walls, which use cob and hence embodied energy is very less. The house are constructed with locally available technology and labour. Mud and Thatch are inexpensive materials with very little resource cost.

Waste:

The manner in which waste are disposed is crucial to the sustainability of a building. Attempt should be made to retain as much of any storm water on the site as possible- collection and storage of roof water, using soft surfaces rather than paving to promote percolation and soaking of water into the soil. Reducing runoff also helps soil conservation by preventing erosion.

The mud used in the Bhungas can always go back to the soil or be reused for constructing other mud house. The thatch used for the roof used as offer for cattle later.

Table 1: Comparison with modern Sustainability criteria.

Parameter of Assessment	**IGBC LEED**	**GRIHA**	**SITUATION AS COMPARED TO TRADITIONAL HOUSE.**
Sustainable site selection	Proper site selection	Brownfield development, i.e. utilizing barren sites or reclaiming contaminated sites.	Houses are Built on barren soil, keeping the essence of utilizing brownfield undevelopable site selection in mind. - A Cluster of House is known as "Vaas""
Site Planning	Protecting or restoring habitat & Reducing site disturbance, Reducing development footprint	Including existing site features: Preserving and Protecting landscape during construction	The mud House reduce site disturbance, protect the natural ecology and protect the natural landscape of the desert area.
Water efficiency	Reducing water use	Reducing water use in construction	Water use is kept a minimum in mud House.
Energy performance	Optimising energy performance	Optimizing building design to reduce conventional energy demand Optimizing energy performance of Building within specified comfort	The use of mud and thatch as materials along with a lower surface to volume ratio help in thermal comfort.
Material use	Using recycled and regional materials	Using low-embodied energy material	Mud and thatch both have low energy. Mud used in construction is locally available and can be recycled numerous times. - Since this region lacks natural stones and aggregates, but has mud in abundance, common construction material is adobe and wattle daub construction. - All material are locally sourced, within the limited radius, with locally available masons, and traditional construction technology. - 18-20 types of grasses grow here, which are used for constructing thatched roofs, or reinforcing the adobe bricks/ wattle and daub. - Beams and rafter to support the roof are made of locally available wood. - Limestone is amply available, used for construction of foundations and plinth structure.
Indoor environmental	Thermal comfort, Day lighting, ventilation, Low volatile organic compound emitting material use.	Using low VOC materials	Thermal comfort is achieved in summer and winter to a reasonable extent. Mud has no VOC emitting property. - Size of opening is very less. Hence, it prevents the dusty air whole region. - Number of window is usually one or two per house. - Reducing number of windows reduces heat gain.

VI. CONCLUSIONS

The architecture of Kutch region relates to the socio-economic setup, the cultural identities and a good climatic responsiveness. A good number of climate responsive design features are revealed during the study of the traditional architecture including temperature control, enhancing natural ventilation, protection from natural calamities such as flood, earthquake etc. However certain features that lack in the traditional housing are mostly fire proneness and termite infestation due to usage of non- treated material and lack of damp proofing and use of non- stabilized soil for construction too pose problems like dampness of walls and washouts during rainfall.

The notion of energy efficiency in architecture cannot be implemented from outside but by incorporating the indigenous techniques. Indigenous techniques are time-tested and sustainable. Thus, greater emphasis should be laid upon the documentation and research of indigenous techniques to generate a repository of knowledge. This knowledge base will help in formulating the best practices in the Architecture in conjunction with the traditional practices.

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