ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.6

Climate Responsive Vernacular Architecture of Kutch

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Abstract:
To understand a particular place and its people we have to understand the history, origin, living patterns, geography, visual expressions and the built environment. The culture of a society is manifested in various ways. The traditional architecture of Kutch is the outcome of the prevailing topography, extremes of the climate and other natural forces. Moreover the vernacular architecture merges well with the desert at the backdrop. The traditional architecture forms the backbone of social and cultural set up of the place. It is essential for this architecture to retain its integrity. It commands deep interest and respect as it represents and reveals the many faceted realities of the people living there. In the Traditional architecture, buildings were designed to achieve human comfort by using locally available building materials and construction techniques which were more responsive to their climatic and geographic conditions. Learning from traditional wisdom of previous generations through the lessons of traditional building can be very powerful tool for improving the buildings of the future. The purpose of the research is to design the new housing and so the emphasis is on architecture. This research paper deals with the study of Kutch region and the architecture of housing evolved from the study. The research is focused towards architectural design to learn from the characteristics of the region. The description of Kutch is not complete but an attempt to explain the essence of this wonderful region of India.

Keywords: Climate Responsive Building, Vernacular Architecture, Sustainable Construction, Living Style.

I. INTRODUCTION

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. Many theorists and distinguished architects like Hassan Fathy have promoted the underlying concepts on traditional architecture to form contemporary design. However unlikely in the northwestern region, the traditional building has been replaced by fast growing concrete jungles, which are not sustainable or sensitive towards the natural calamities and microclimatic conditions. The Kutch region can be divided into three parts running more or less horizontally in an east-west direction. The largest of the three is the Rann in the north extending towards the southeast. Of this the larger northern section is known as the Rann of Kutch and the south eastern part is known as Little Rann. The northern area of Kutch is mainly saline desert (great ran).

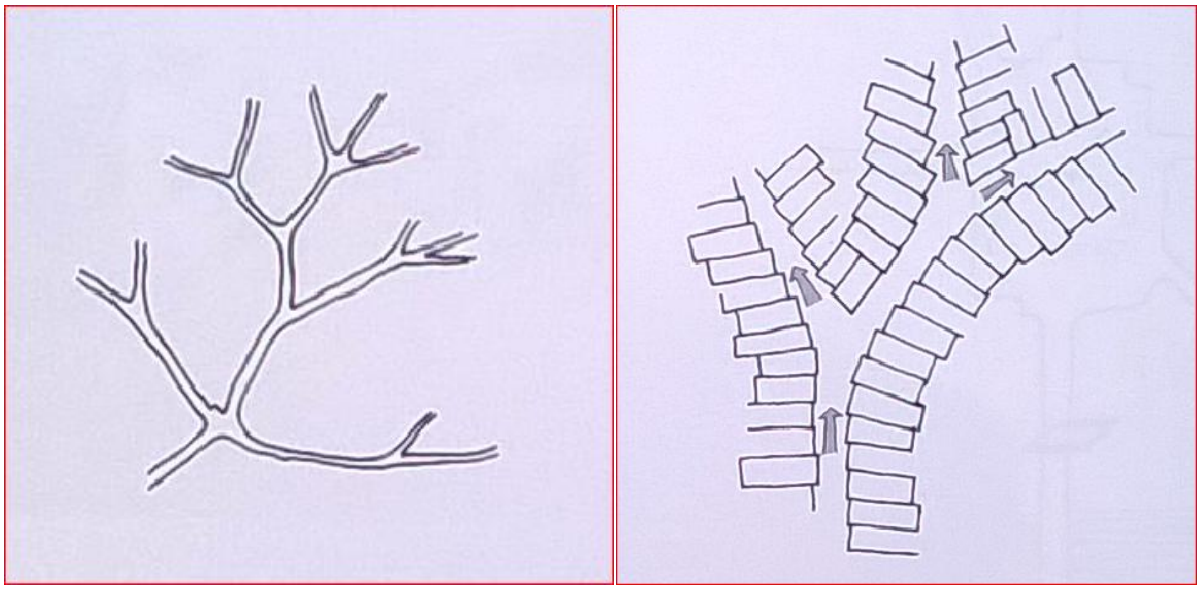
1. CLIMATE AND VEGETATION

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. Instead a mix of dry lands with green farms and occasionally coconut orchards will make vivid that Kutch has a diverse landscape. Architecture documents built form and spatial organizations and analyses regional indigenous architecture- its evolution, structure, public and private spaces, the form and spaces of the typical houses to the whole village extending to the basic form of town and finally the city of Kutch. The central belt is banni grassland, an arid tableland with thorny trees-ganda babal (prosopis juliflora) – a semi desert stretching east to west as low rocky hills scattered by the riverbeds and streams, which are perennially dry. The southern coastal part where water availability is good and has almost all types of flora and fauna with khajur and neem trees thrown in large numbers.

2. SETTLEMENT PATTERN

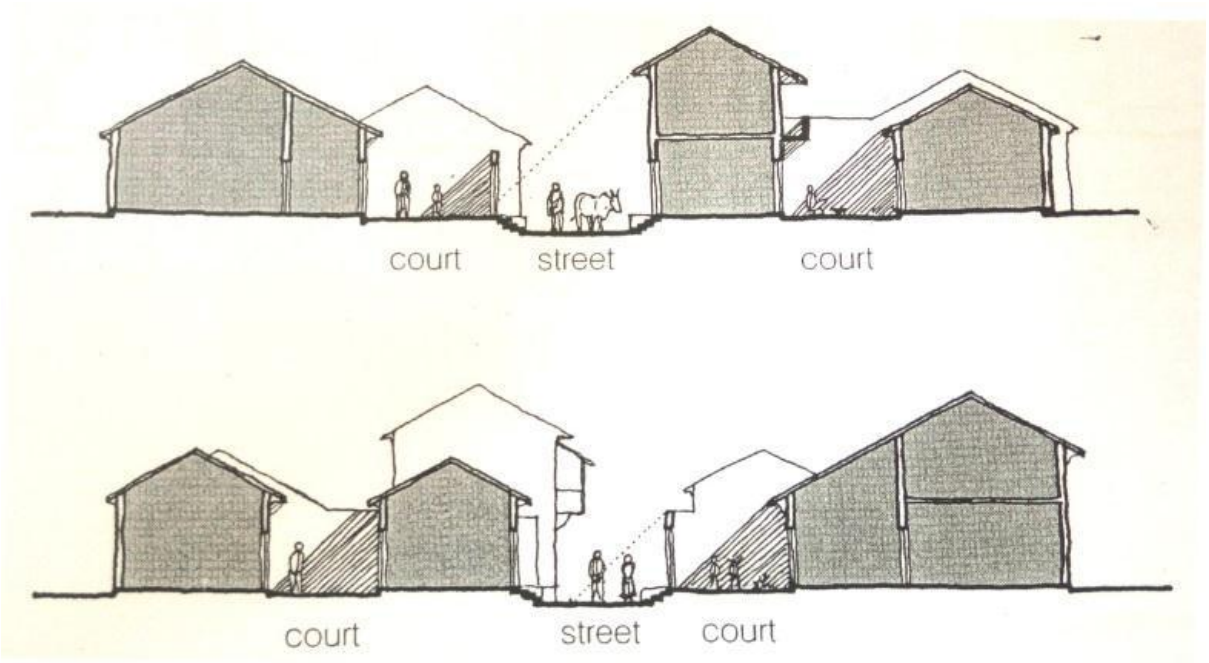
A habitat in a tropical climatic region is a composition of open, semi open and enclosed spaces interwoven together forming the public and private realm- collectively called 'built form' or 'built environment'. The beliefs, religion, climate, materials, social structures, and economy of the people of that place shape the living pattern and the habitat. Conversely the habitat and lifestyle reflects the behaviour, social set up, economy as also the deep-rooted traditions and the aspirations of the people. It also has numerous public buildings, houses, palaces, temples, mosques, memorial chattris and step wells, built in stone displaying the crafts skill as graceful as wood work. The carved sandstone **gadkhi** (lamp niche near the door and window head), door and window lintels are elaborately adorned giving a strong consistent character to the house facades and to the street wall – forming a seamless streetscape. In Kutch region two distinct architectural typologies (type of

buildings) are evolved due to different climatic, social and economical conditions within the religion. The centre, western and southern coastal area with hot and humid climate has long row type houses with narrow streets network and dense population. These are traditional villages and people are involved in trading, handicrafts and agriculture. The other settlements in northern desert of banni area with hot and dry climate and some parts in the southern coastal desert are resided by the nomadic and semi nomadic pastoral communities in a humane habitat of stunningly beautiful circular mud and thatch houses. It has evolved by the social conditions and the scarcity of building materials in the desert area. All houses of the village are row houses on both sides of the street. Many features like doors and windows, colours, textures and carvings on lintels distinguish a particular house and group. Row housing pattern reduces the exposure of external wall surfaces to sun as the houses share a common wall. The movement of warm air around the house too is minimised and helps to keep the interiors cool and comfortable. The street width further goes on marginally decreasing and at their intersection are the neighbourhood spaces. Narrow streets and lanes continue to terminate in formation of space around 5-6 houses which are intimate shared door fronts or aangans.



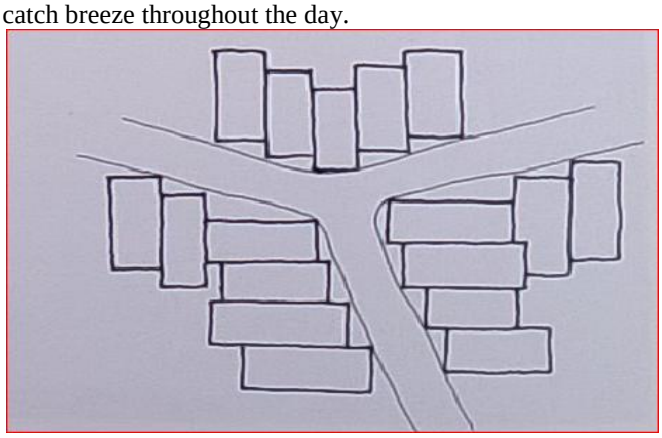
CURVILINEAR STREETS

The haria chowk is the formal entry point as well as the main and the largest of all the chowks in south eastern part of the village. A number of streets radiate from one main street in different directions. While walking towards the village interiors the streets become quite narrow and finely carved entrance of row houses with the repetitive main entrance door with two small niches and two long windows on both side are seen. Streets take angular turns at intervals and all houses have mangalore tile sloping roofs. Though once in 3-4 years, the initial rainfall here is high. Though a desert region, kutch gets rainfall in southern coastal area unlike other desert regions where low rainfall area implies flat roof buildings. The absence of flat terraces confirms this point.



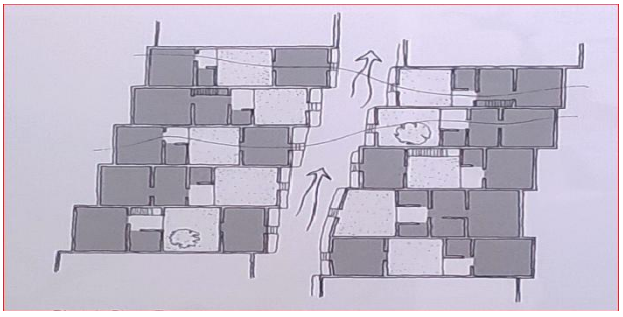
The streets of bidada village have a streetscape of a unique pattern. They are constantly turning in curves, never remaining straight, in a particular direction through small chowks of Y-shape – where it branches out in 2/3 directions and again keeps turning. The entire village is a mesh of these curvilinear streets which connect the chowks. It is like water stream line flowing

smoothly in various directions and as they go ahead the width goes on decresing, forming alleys. At a larger scale the entire village street network has a distinct advantage that the curvilinear streets behave like channels of wind 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 direction for most part of the year. It is an incredible ingenious organic model of built form like a perfect machine to catch breeze throughout the day.

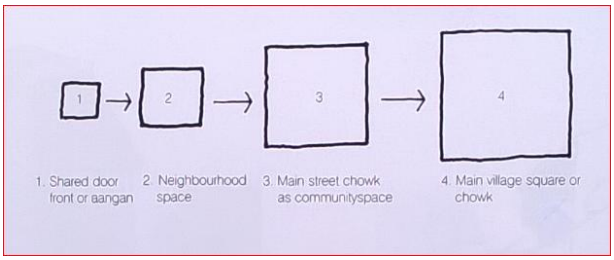


Y-SHAPED STREET

The curvilinear streets are formed by staggering each house by few feet. The narrow street width varies from 8 feet to 18 feet serving pedestrian, carts and cattle movement. The houses have a frontage of 10-15 feet width with the height of street facade walls change as per the number of stories. A typical feature is that if we enter a house on one side of the street the entry is in a room while on the opposite site of the street the entry is in the room while on the opposite side of the street the entry is into the court of the house. This repeats alternately resulting in a section making the curvilinear streets dynamic and visually interesting. Together with alternating court and rooms, the shifting of door axis help to achieve privacy and multidirectional flow of breeze. The opposite main entrances never face in straight line avoiding direct sight in the house. The width of streets and the height of houses have a proportion such that the curvilinear streets are mostly protected by shade during the day. This makes walking ont he streets comfortable in the scorching heat.



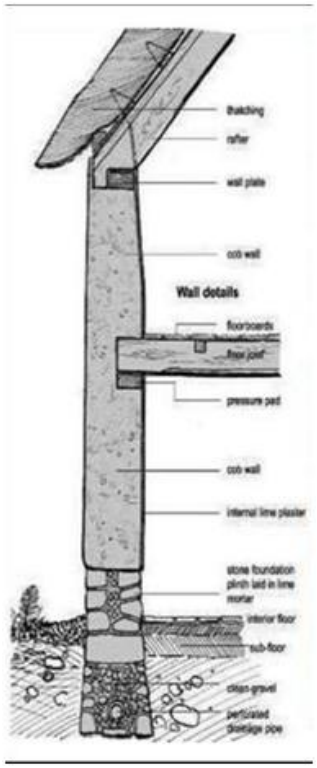
AIR CIRCULATION



3. BUILDING MATERIALS AND CONSTRUCTION TECHNIQUES

Architectural Typologies have developed in the Kutch region as Factor of Tradition, Climate and Functionality. The materials used are locally available materials like Mud, Bamboo, cane leaves, of late Bricks, stone etc. Bhungas are traditional houses unique to the Kutch region in Gujarat. The houses are circular walled with thatched roof. According to the limitation of material and construction techniques. These houses essentially made from organic renewable resources such as mud, grass, cow dung cane etc. The plinth and the foundation consists of consolidated earth with stone and bamboo posts, the walls consists of mud wall, split grass, earth, cane etc., and the roof is thatched, made of wheat or maize straws. The Structural System consists of mud load bearing wall and the wooden nuts truss which supports the roof. The wooden columns are in house in the mud wall. Much of the behaviors of the structure depend on the load bearing mud walls. The structure Integrity is dependent upon Monolithic wall of mud. The corner Junction are woods Sticks and the Foundation are simply filled with earth with the depth 2-3feet. The wood in the house is locally available from nearby. The major Structure failure in the region is due to reaction and erosion of walls due to salinity. The Salinity erodes the bottom part of the wall in the outward side, so the cross section decreases due to erosion so the whole structure is pulled in the opposite. So this reaction due to salinity causes the structure to distort and eventually fail.

Kutchha Houses



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existed for several hundred years. This type of house is quite durable and appropriate for prevalent desert conditions. Due to its robustness against natural hazards as well as its pleasant aesthetics, this housing is also known as "Architecture without Architects." These types of houses are mostly circular in shape with mostly one multipurpose room. The plans and sizes of typical kutchha houses same as per limitations of Material and Construction Techniques. Typical layout of a house consists of Aangan, Room, Cooking area, otta, Verandah, Backyard. The Aangan or Front yard is a public space for gathering, or meeting relatives or visitors. The house unit is typically defined by the platform- otla – that is always raised above the ground , from a few centimeters up to one meter. The otla define the domain of the home and the place for outdoor activities. On this platform rest various structures composing the household one or more Bhungas (Generally up to three), circular houses with diameter ranging between 3 to 6 meters, covered by a conical thatched roof. A Typical Bhungas has a door and three or four small and low windows symmetrically arranged around the door. In front of the door and against the wall, lies a low platform, called pedlo, on which traditional furniture placed. Construction Techniques generally used "COB". In these methods a large Lump is roughly molded into the shape of a huge elongated egg.

• The usual size is anything between 12 to 18inches. 30-40cm long and 6 inches in diameter.

• A row of these cobs of mud are laid nearly side by side. Preferably somewhat pressed together. Then another row of cobs is laid on top.

• When three or four courses have been laid, one above the other, the sides are smoothened over so that the holes and cracks disappear.

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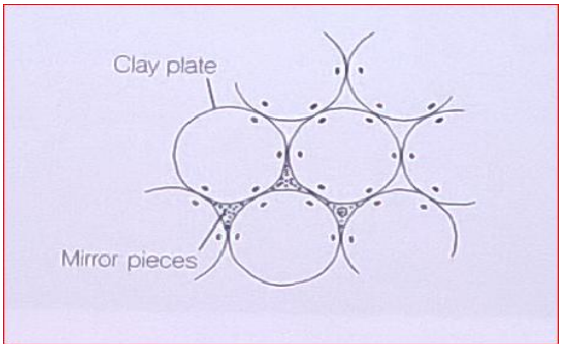
Pucca House

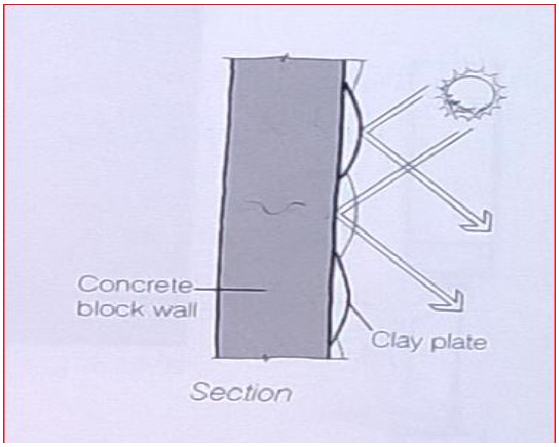
These houses are made with stabilized compressed earthen blocks. In Stabilized blocks cements is added (7-8%) to soil in order to produce the blocks in a manual press. The mixture of soil and cement (92-93%) of soil, composed of 75% sand, 15% clays and slit for the remaining portion, to which 7-8% cement is added), is mixed and with this compound the blocks are produced in the press. They have found place as an advancement of the traditional kutchha houses. According to materials used architectural forms, Pucca houses can be further classified as modified kutchha house. Modified kutchha houses bear close resemblance with the traditional kutchha houses and are mostly being built in the rural areas these days. They are modified for usage of modern materials in construction. The traditional thatch roof is replaced by wooden understructure with Mangalore tiles cover thereby reducing the maintenance of the roof during rainy days. The construction technique is similar with stabilized compressed earthen blocks with steel rods as vertical reinforcement and horizontal reinforced concrete bands at various levels as seismic safety measures.

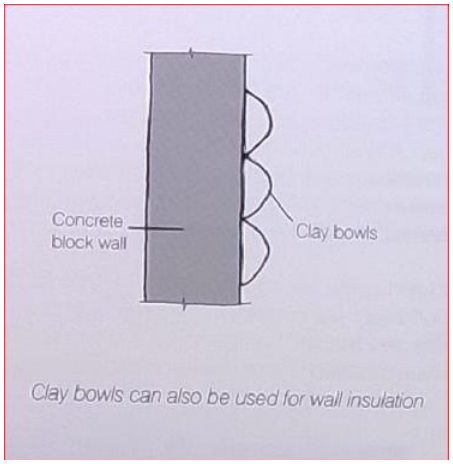
Pottery for Insulation

Pottery is developed craft of kutch. To use clay items for construction was to find new ways of building methods. The clay plates and bowls are used for wall and roof insulation and pots as visual objects for design.

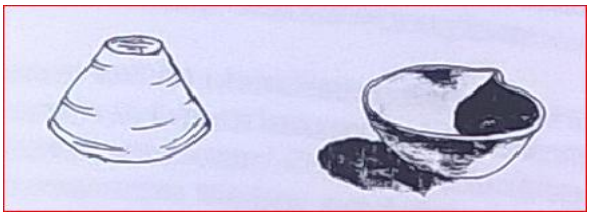


The local convex circular clay plates called tavdi are used for preparing rotis. These clay plates are claded on the external wall for insulation. Small holes are made in plates for ventilation and arranged in different designs and patterns. The triangular spaces between them are filled with small mirrors for reflection of heat. Thus, the entire surface of wall is taken care of heat insulation.

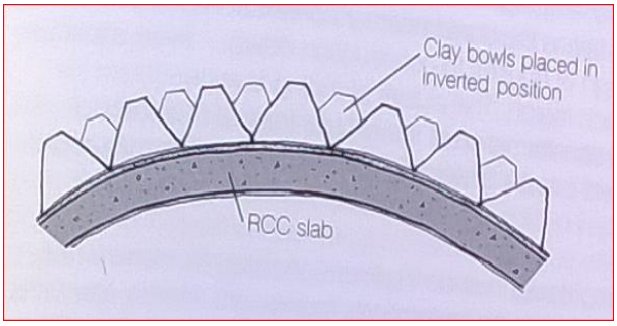




This wall cladding and insulation work proceeds fast as the surface coverage of each plate is about 25cm diameter. Since it is a local material the cost of plate is low and the total item coasts much less than conventional cladding methods. At the same time, it provides work for the potter who has to make about 5000 plates for one house. This compares well with the requirement of the mere 300 plates a month he produces for the entire village. After few days it was realised that this insulation method and weak adhesion with cement to the wall is unworkable due to the poor quality of baking of clay plates.

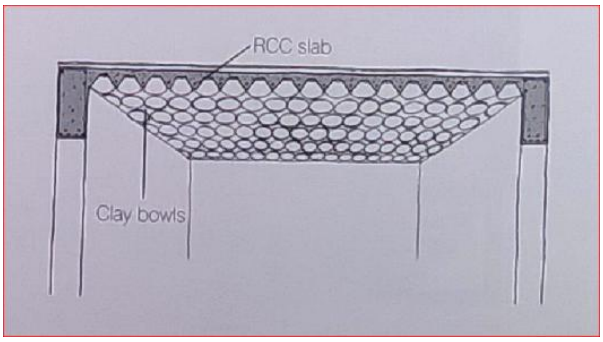


CLAY BOWL



Clay Bowls Cladded on Roof

The conical roof slab of houses is covered for insulation by clay bowls locally called as vatkas. These 15 cm diameter bowls are fixed in invert position on roof surface forming a pattern in itself. The entire roof surface after laying the bowls acquires the terra-cotta rough textured surface. The clay bowls help to insulate the roof by trapping air inside them and decrease roof area under direct incident heat by casting shadows on the roof itself.



Clay Bowls Cladded on Ceiling

The geometry of roof being a spiral cone, the incident sun never covers the entire surface of the roof except when overhead. The bowls themselves are truncated cones and almost half roof surface area is always under shade. This shade goes on increasing as the angle of sun lowers during second half of the day reducing heat intake of the roof. This work does not require specialised labour, so local skilled labour is able to easily learn it. Similar to clay plates this item of clay bowls is inexpensive and provides efficient roof insulation.

4. CONCLUSION

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 tr5aditional 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. Once the construction and design community of Kutch region are aware of the pros and cons of the traditional typologies, the advanced construction techniques can be meticulously clubbed alongside to nullify the problems and enhance the advantage, a modern yet sustainable architecture for the Kutch region can effectively created. In view of the varied advantages of the Traditional housing in the various Gujarat states, the Government need to the frame local byelaws that support the traditional houses of Kutch region, and promote incentives to the inhabitants of these houses. 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.

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