

Study of Vernacular Houses of Chanasma Region in Gujarat

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Abstract— Vernacular houses have sustained over generations having added or deducted the non-useful components and are comfortable as they have adapted to specific places and user groups.⁶ With advancement in building technology, there is a rapid increase in the construction of Engineered Buildings, even for residential purposes in rural and semi urban areas. This is due to the misconception that Engineered Buildings are safer as compared to Non Engineered Buildings in resisting Seismic Loads. The downside of this is the huge Environmental Impact caused by materials used for Engineered Buildings, which generally cannot be sourced locally.⁴ Studies are needed to determine the suitability of Vernacular Construction for Seismic Resistance. This Paper presents the findings of a detailed survey of the Vernacular Buildings in Maniyari Village of Chanasma region, Gujarat. The survey was conducted as a part of the study aimed at determining the suitability of Vernacular Buildings to resist Seismic Loads by considering various parameters such as Climatology, Economy, Sustainability and Earthquake resistance.

Key words: Sustainability, Vernacular Buildings, Seismic Resistance

I. INTRODUCTION

Vernacular Architecture, which means native science of building, is the result of collaboration of many people over many generations, as well as collaboration between the maker and user of the building and other artefacts, which is defined by the term "traditional".² The term "vernacular architecture" in general refers to the informal building of structures through traditional building methods by local builders without using the services of a professional architect. The builders of this structure are unschooled in formal architectural design and their work reflects the rich diversity of India's climate, locally available material and the intricate variation in social custom and craftsman.⁵ Climatologic and economic reasoning have always been the foremost apprehension in any housing technology being practiced specifically among those groups of people who have been living in close association with nature for years. It is estimated that one third of world population lives in different types of vernacular houses. Countries like Latin America, Africa, Indian subcontinent, and other parts of Asia, Middle East and Southern Europe use vernacular houses.⁶ According to data from 2001 census, the use of earth for building is very common in India (approximately 32% of dwellings are built with mud)¹. Technology of housing construction and the knowledge about construction materials are not recorded. It is imperative to urgently document this hidden transcript of knowledge before it disappears, because rapid growth of science and technological development has hardly left any space for traditional knowledge though it is highly significant and experimented paradigm that exists over years from generations to generations⁴.

Vernacular architecture is influenced by:

- Localized needs
- Local construction material
- Local traditions

Hence, varies from area to area.

The differences between the types of buildings in different area are result of differences in culture, rituals, ways of life, social organization, climates, and materials and technology available, while the similarities are the evidence not only of areas where some or all of these factors have coincided, but also of some basic constancies in man's needs and desires.

Hence one needs to study in respect to various viewpoints rather than only one constant which helps in understanding the change in culture, expressed in behaviour, relating to changes in the environment, as shown by physical form⁶.

Gujarat has a tribal area, forest area, urban and rural areas having varied climatic conditions with people of different economic and social status.⁵

II. LITERATURE REVIEW

As per Ar. Kaninika Dey Sarkar this paper is a concise discussion on the classical Indian Architecture. The history of architecture in India is defined by the strong and deep rooted history, traditions, religion and culture. A mixture of cultures, dynasties and kingdoms defined the architecture of India. Indian Architecture has evolved into the vast style of architecture it is today. It is important to adopt the vernacular style of architecture for future as it will not only glorify India's rich culture and traditions but also contribute to the environment around us.⁸ As per Leila Mohebbi & Elham Kazemi the way of using the local materials, and corresponding with region and climate where the building is constructed is of paramount importance, but nowadays due to the developments in architectural knowledge, vernacular architecture all over the world that were inspired of the nature and the environment has been forgotten and mostly modern materials, which they have no relevance with climate,

are used. Nanotechnology makes the monitoring of intrinsic features feasible by developing some structures in nanometer scale. Development of nanotechnology provides new methods of constructing with lower costs and better quality and durability and also results in lower energy consumption.⁹ As per A Madhumathi, J.Vishnupriya, S Vignesh to assess passive solar design techniques and the extent to which they promote high thermal comfort in a vernacular mud houses in the Madurai, Tamilnadu in India. The various parameters which are considered in the study of the existing rural house are – orientation, plan-form, building exposure to sun, surface-volume ratio, openings, shading, building envelope material and ventilation. Mud and Thatch are the locally available materials in Madurai Region.¹⁰ As per Ritu Gulati Mud houses located on the fringes of Lucknow City and the downtown city houses at FarangiMahal in Chowk area are two types of vernacular houses that have existed simultaneously for hundreds of years. Yet both could be called comfortable and sustainable in the real sense of the word. The structural system of the dwelling constitutes timber joists resting on timber beams supported on the walls or the columns. The walls and the columns are made of Lakhori bricks and lime mortar which was locally manufactured. They have been able to respond to the climate of a specific place besides taking the evolution of human civilization.⁶ As per Ar.RupaT.Ganguly this paper talks about one such 14th century settlement located in Pauni, achieving sustainability through planning, orientation, materials and architectural practices evolved from long time due to socio, economic and environmental factors. The study of local vernacular architecture and lessons about climate responsive planning, techniques can be helpful to generate an approach towards green building design. In spite of extreme hot and dry climate, Pauni has its own unique methods of building comfortable dwellings. Simple climate responsive planning principles from vernacular architecture which are tried and tested practices can bring up major changes.¹³ As per Subhash Mishra, Dr. J A Usmani energy saving in Mud house as compared to brick wall building is discussed by selecting a proper insulation material and different wall materials. Buildings made of mud bricks act as environmental friendly. The thermal insulation keeps the indoor temperature constant during summer and winter seasons. The various parameters which are considered in the paper are orientation of walls, building exposed to sun, surface-volume ratio, wall materials, ventilation and shading. In this paper the optimum insulation thickness for mud house and brick wall house was calculated.¹¹ As per Ladakh is one of the extreme climatic zones for human survival. Ladakh illustrates a highly evolved traditional understanding of manipulating the extreme climatic conditions through vernacular architecture; resulting in the survival of human beings for centuries. Indigenous techniques are time-tested and sustainable.¹³

III. STUDY AREA

A. Chanasma

Chanasma is Taluka of Patan District. Patan District is divided into 7 talukas, 272 Pamchayats, 689 Villages.



Fig. 1: Patan Taluka Map³

IV. GEOGRAPHY

Patan is Located at Latitude-23.8, Longitude-72.1. Patan comes into IVth zone. It is Located 102 KM South towards State capital Gandhinagar. Patan District is sharing border with BanasKantha District to the North, Mahesana District to the East. Patan District occupies an area of approximately 5740 square kilometres. It's in the 84 meters to 126 meters elevation range. Patan District population is 1342746. It is 21st Largest District in the State by population. Gujarati is the

Local Language here. Also People Speaks Hindi. Patan District is one among 25 Districts of Gujarat State, India. Patan District Administrative head quarter is Patan. The major Rajput clans of Chavdas (746-942), Solankis (942-1244) and Vaghelas (1244-1304) ruled the Hindu Kingdom of Gujarat from Patan. Patan was the home of the great scholar and author Hemachandra, a Jain Acharya who lived during (1089 -1172).Patan is also a tourist destination with a rich religious and cultural history and landmarks. Patan has numerous Hindu and Jain temples as well as Muslim mosques. It was under the rule of different Rajput clans till the advent of Muslim rule in India. The main occupations of the people are agriculture and weaving. The Patola silk sari made here is quite famous. Patan is well connected to the rest of the country by road and rail links. The places to visit in Patan are the SahastralingaTalav, a water storage unit build 1000 years ago, Rani niVav built by Rani Udaymati of Solanki dynasty and a number of Jain temples.⁷ Now, Chansma is Located at Latitude-23.8, Longitude-72.1.It is located 17 KM towards South from District head quarters Patan. 90 KM from State capital Gandhinagar towards East. Chanasma Taluka is bounded by Patan Taluka towards North, Harij Taluka towards west, Bechraji Taluka towards South and Unjha Taluka towards East. It is in the 67 m elevation (altitude). Total population of Chanasma Taluka is 128,629 living in 26,135 Houses, Spread across total 72 villages and 60 panchayats. Males are 66,484 and Females are 62,145. Total 15,822 person's lives in town and 112,807 lives in Rural. The places to visit near chanasma are Sun Temple, Modhera.⁷ Maniyari is a village in India and it is located in the Chanasma taluka, Patan district in the state of Gujarat. The latitude 23.6043322 and longitude 72.0879235 are the geocoordinate of the Maniyari. Gandhinagar is the state capital for Maniyari village. It is located around 64.8 kilometres away from Maniyari. It is in the 49 m elevation(altitude). The Maniyari village has population of 2090 of which 1067 are males while 1023 are females as per Population Census 2011.⁷

V. CLIMATE

In Chansma Rainfall is about 494 mm per annum; hence the region falls among the semi arid areas. Salinity and humidity are very high. Chanasma has a tropical monsoon Climate, and generally the rainy season stretches from June to September. The temperature ranges from 7 °C in winter to 45 °C in summer.

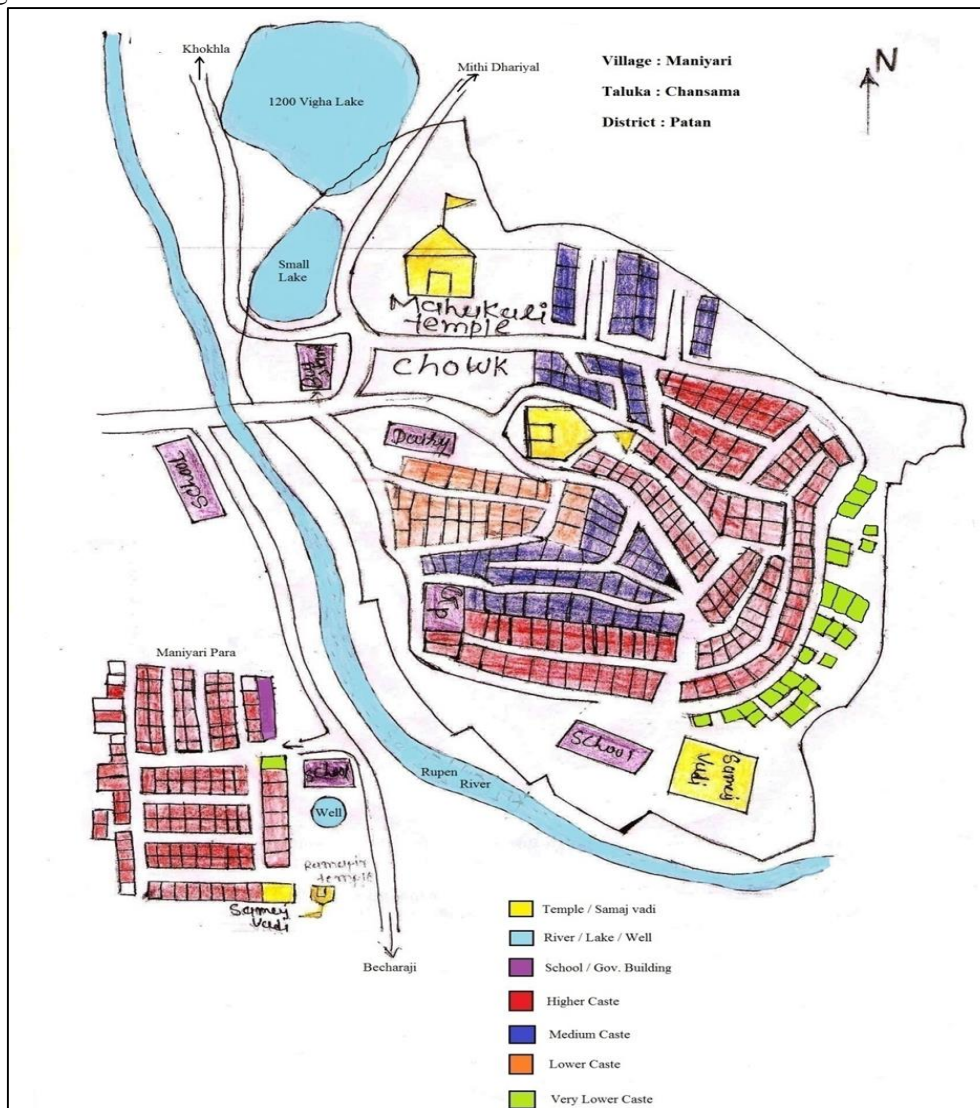


Fig. 2: Maniyari Layout

VI. CASE STUDY

Case study of six houses was conducted, where information regarding materials and methods used were collected. The details of one such house is mentioned here:

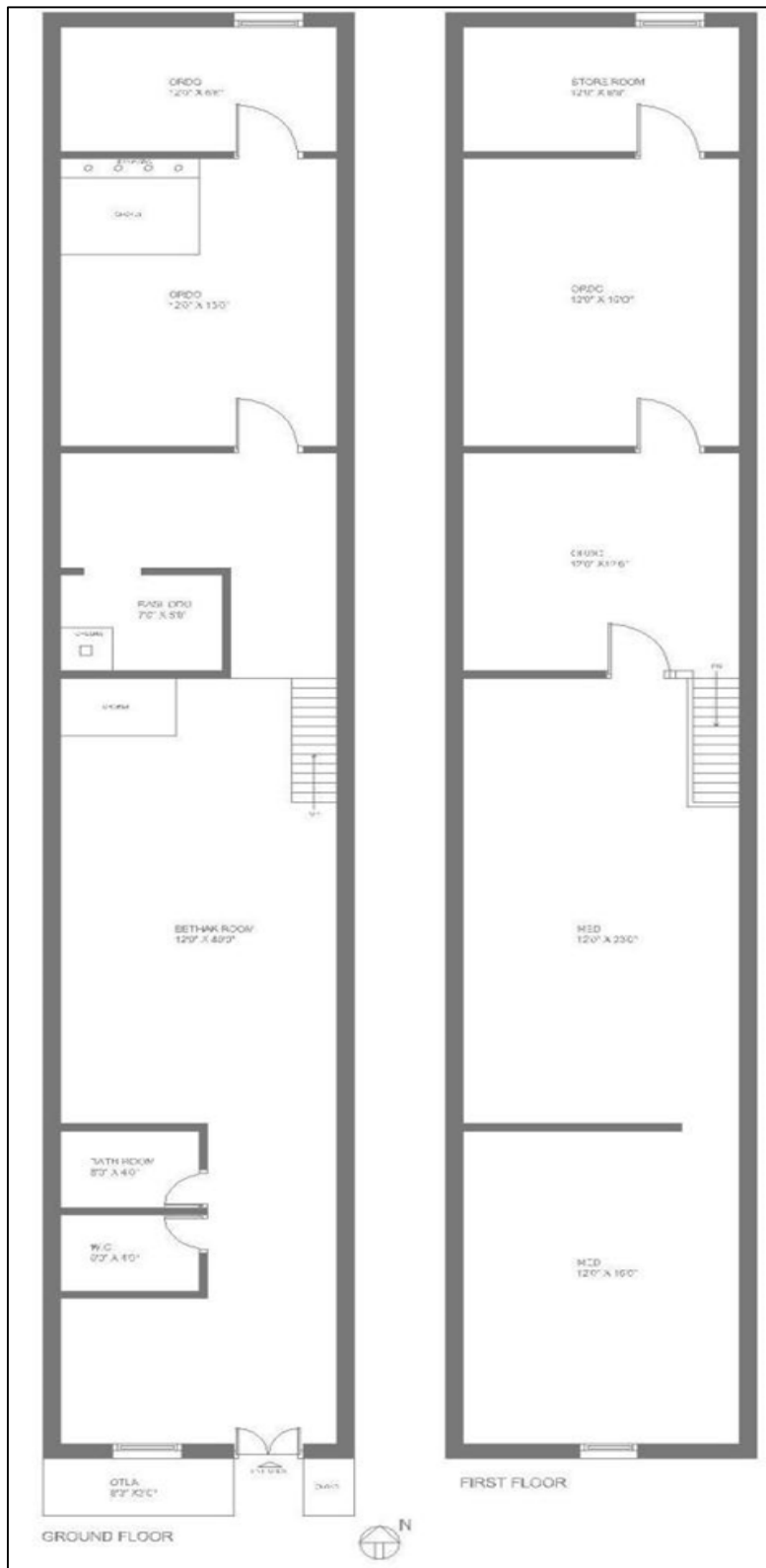


Fig. 3: Plan of Case Study 1

Owner: Patel kantibhai B
Village: Maniyari
No. Of family members: 7
Age of building: approx. 300years
Use: Residential

Occupation: Farmer
Floors: 2



Fig. 4: Elevation of Case study 1



Fig. 5: Bethak Room



Fig. 6: Chulha



Fig. 7: Paniyara



Fig. 8: ORDO



Fig. 9: MEDI

A. *House Components:*

- 1) Bethak Room
- 2) Rasodu
- 3) Paniyara
- 4) Ordo
- 5) Medi

B. *Distribution of Space:*

1) *Bethak Room:*

Used for seating and sleeping purpose. It consist bathroom and W.C at the starting of the room.

2) *Rasodu*

Used for cooking purpose. It consist CHULHA with chimney and space used for storage of fuel.

3) *Paniyara:*

Used for storage of drinking water.

4) *Ordo:*

Used for storage and sometimes sleeping purpose.

5) *Medi:*

It is an upper floor of house. It is used for storage of waste materials. temporary stair case is provide.

VII. OBSERVATION

A. *Construction Materials*

As per study conducted the building materials are concerned, these can be grouped under two categories⁷ :

- Building material used for walls
- Building material used for roofs

1) *Building Materials used for Walls:*

In India, building materials used for walls can broadly be grouped under these categories.

These are (i) mud, (ii) brick

- Mud is the most common material, available from all types of soils, varying in texture and colour . It is also the wide spread oldest material used in houses of old civilization. These vernacular buildings, involving family labour and neighbour's co-operation and are available almost all parts of the country.



Fig. 10: Mud and Brick

- Brick walls are now covering the country side with the increased use of coal as baking material. Today brick kilns are commonly found in rural areas and bake bricks are freely available. Its role in construction cost, durability, space saving and manner-variability is obvious. The oldest evidences of houses are available from the excavation of various sites of Indus valley civilization.

2) Building Materials used for Roofs:

These materials can broadly be grouped under seven categories.

These are (i) tiles, (ii) thatch, (iii) mud and other material, (iv) brick and others.

- Tiles roofs are common throughout Maniyari. Two types of tiles-semi-cylindrical and flat are used for covering houses with varied sizes and forms.
- Thatching is original shelter making skill, still prevalent in most of the poor class people. All sorts of walls are covered by thatch. Whether it is stone, timber or mud walled houses.
- Mud thatching often mixed with cow dung, is common in northern part of Gujarat. Its occasional plastering is enough to provide safety from rains.
- Bricks make flat and smooth roof in the form lintel mixed with iron rods and cement, a practice in vogue, in modern type rural house particularly in rural market centres and commonly found in the houses of rural rich.

The use of traditional building material is decreasing and it is being replaced by building material like, iron, tin sheets, cement, etc.

B. Construction Method

1) Excavation of Soil:

The first stage of the construction of vernacular houses is the excavation of soil.

2) Construction of Foundation:

Then, in second stage foundation are made. The materials used for foundation are bricks and mud mortar.

The foundation is made by step footing. Three steps are made up to ground level.

The length of steps is 27 inch, 24 inch, 18 inch and 14 inch respectively and the width of steps are 6 inch, 8 inch and 9 inch respectively.

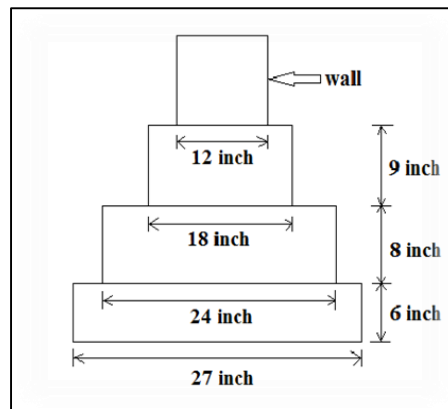


Fig. 11: Foundation

3) Compaction of Soil:

In the third stage, the compaction of the top surface of the soil is done by watering and by tamping using wooden tamper.

Above the surface of soil one layer of KANKAR and mud mortar about 6 to 9 inches are made.

4) Masonry work:

In next stage masonry work has started using material bricks and mud mortar up to lintel level.

At lintel level wooden beam is provided. Sometimes vertical bricks are also provided.

The doors and windows are provided as per requirement during masonry work, which is made of available wood nearby areas.



Fig. 12: Masonry Work

C. Roofing:

The next stage of construction is providing roof. If one storey house is constructed, then roof is made by using G.I sheets or country tiles.

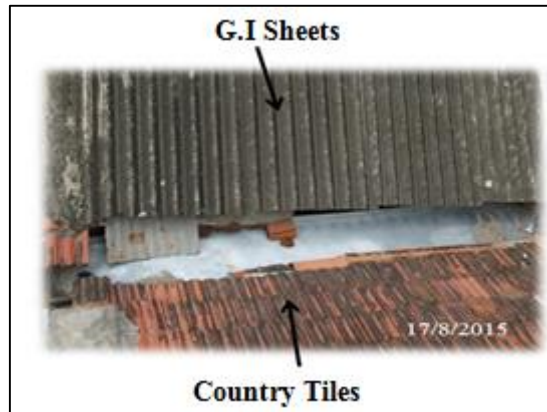


Fig. 13: Different Roof

If two storey houses are constructed, then the roof is made by as described below :

First of all long wooden blocks are provided at space of about 2 feet to 2.5 feet, this wooden blocks are called rafters. Above rafters long wooden planks are provided to cover roof of the house. Large wooden beams are provided to support the rafters.

Above the planks the layer of mud mortar about 1.5 inches to 3 inch are made. This layer is called Lipan.

In last roof are constructed using G.I sheets or country tiles. Finally, house is ready.

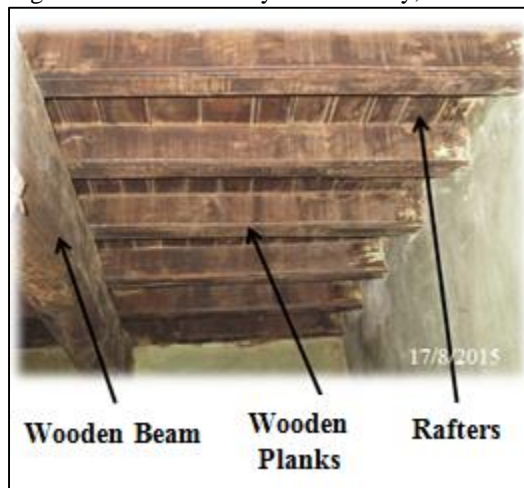


Fig. 14: Wooden Roof

VIII. CONCLUSION

From the study of villages in Chanasma Taluk, and the detailed survey of Maniyari Village, we can infer that Most houses in the region are constructed as row houses. The structure of row houses is such that one wall is common between two adjacent houses. The outskirts of the village consisted of individual houses as can be seen from Fig.13. The houses followed rectangular form. The Upper Floor is used mainly for storage of light weight materials, and not for residential purpose. Materials used for construction were mostly locally sourced. The primary materials used were soil, wood, and bricks. Houses where recent innovation was undertaken used Cement Mortar as plaster material. Roofing material consisted of Country Tiles and / or GI Sheets.

ACKNOWLEDGEMENT

The Authors owe a special word of gratitude to guide Mrs. Lokapavana H M (SVBIT) and external guide Dr. V. M. Patel (AIIE) for their valuable suggestions and constant support. Thanks are also due to villagers for their moral support without which, the paper on vernacular houses could not have been possible.

REFERENCES

- [1] Earthen habitat in rural development of Western India: experiences in post-earthquake rehabilitation in Kutch district of Gujarat by Chiara Chiodero2006 (Post-graduate school Habitat, Technology and Development Politecnico do Torino, Italy).
- [2] Understanding the factor affecting the house form by zaveri pratik.
- [3] Determination of the optimum composition of adobe brick for a school in Cuba-Materials de Construction Vol. 56, 282, 53-62 April-June 2006.
- [4] Indian journal of traditional knowledge volume 07(3) July 2008, pp.494- 500 by nasir uddin (department of anthropology, faculty of social sciences, university of Chittagong 4331, Bangladesh).
- [5] www.slideshare.com
- [6] International Journal of Technical Research and Applications e-ISSN: 2320-8163, www.ijtra.com Volume 1, Issue 4 (sept-oct 2013), “vernacular houses of lucknow: customized comfort within” by RituGulati
- [7] www.onefivenine.com
- [8] Civil Engineering and Urban Planning:An International Journal(CiVEJ) Vol.2,No.1, March 2015“ Indian vernacular planning”byAr. Kaninika Dey Sarkar
- [9] The SIJ Transactions on Advances in Space Research & Earth Exploration (ASREE), Vol. 2, No. 4, July 2014“Explaining the Role of Material in Vernacular Architecture and its Comparison with Modern Materials Architecture and Utilizing Nanotechnology” by Leila Mohebbi & Elham Kazemi.
- [10] Journal of Multidisciplinary Engineering Science and Technology (JMEST) ISSN: 3159-0040 Vol. 1 Issue 5, December - 2014 “Sustainability of traditional rural mud houses in Tamilnadu, India: An analysis related to thermal comfort” by A Madhumathi, J.Vishnupriya, S Vignesh
- [11] International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974 “energy conservation in mud house as compared to brick wall building in India” by Subhash Mishra, Dr. J A Usmani.
- [12] National conference on Advancements in Sustainable Practices and Innovations in Renewable Energy ASPIRE-2013 “vernacular architecture and climatic control in the extreme conditions of ladakh” by Nisar Khan
- [13] International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 (130-135) Volume: 3 Issue: 2 “Role of Vernacular Architecture of India In Green Building Design – A Case Study of Pauni” by Ar.Rupa T.Ganguly.