

# Impact of Modern Construction Practices as Compare to Traditional Construction for Sustainable Rural Houses in the Northern Eastern Part of Rajasthan

Prateek Sharma  
Research Scholar, Dept. of Civil Engg.,  
NITTTR, Chandigarh, India

Sanjay K. Sharma  
Professo, Dept. of Civil Engg.  
NITTTR, Chandigarh India

Vimal Preet  
Associate Professor, Dept. of Architecture,  
Chandigarh University, Mohali,  
Punjab

**Abstract-** India is a rural dominated country and villages are said to be the heart of this nation. According to 2011 Census, the population of rural areas comprised of 68.84 per cent. Migration of the people from rural areas to urban areas causes some burden on the urban areas. If the vision of the founders of this nation is to be respected and implemented, then we all need to have the responsibility to make our rural houses smart and sustainable.

Rajasthan is the largest state of India. Major population lives in villages. Till 1980's they lived in traditional houses because these traditional houses have performed well during natural hazards, environmental impacts, high temperature and stormy wind. A special type storm activity that is called "Andhi" begins in the month of April and reaches its maximum in June in the Northern Eastern part of Rajasthan. It is responsible for the major losses of life and property, but these traditional houses made of locally available material and with traditional construction techniques, But in the present era new development in techniques and easy availability of building materials has overcome the geographical restrictions faced in the past. But current scenario of houses making in rural Rajasthan has becoming in challenging phase. Traditional techniques, workmanship, materials have become dispensable in the present time. Because of easy availability of modern materials like cement, steel and bricks are get ahead even in extreme remote areas of Rajasthan. But these inappropriate techniques for rural modern houses not good act in the local climate or environmental conditions and there is no surety of their good performance during natural hazards and environmental impacts.

This paper highlights the study or examines the rife traditional and appropriate modern construction techniques in Northern Eastern portion of Rajasthan are analyzed and evaluate for their appropriateness in the modern era. Traditional construction techniques of building houses should be cooperating with modern or innovative materials and latest construction technology for both affordable housing and sustainable development.

**Keywords-** Rural Houses, Traditional Construction Techniques, Affordable, Traditional Architecture

## I. INTRODUCTION

Rajasthan is the bio-diverse state of India. The state can be divided into two major divisions along the Aravali range which divide the state into East Rajasthan and West Rajasthan. Temperature can sometimes reached 54°C in the summer months [19]. A major part of the state is dominated by parched and dry region. The topography includes rocky terrain, rolling sand dunes, wetlands, land filled with thorny scrubs, river-drained plains, plateaus, and wooded regions. Rajasthan has been divided into the following physiographic divisions: 1. Western Sandy Plains 2. Aravali Range and Hilly Region, 3. Eastern Plains, 4. Southeastern Rajasthan Pathar (Hadoti Plateau) [21]. Because of different topography and so much geographical changes, or climatic factors, Rajasthan having different housing typologies. Traditional construction and vernacular construction techniques with locally available material have performed well during natural hazards because the techniques evolved centuries with continuous improvement in resisting natural hazards and environmental impact [19].

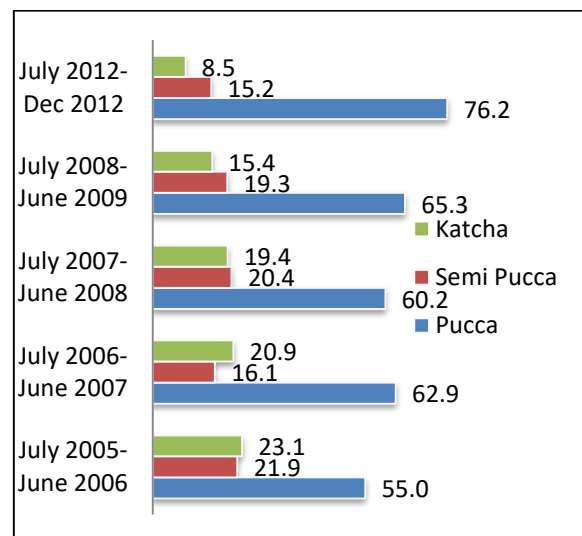


Fig. 1. Percentage distribution of Rural Households living in various types of Houses in Rajasthan (According to census 2011) [19]

According to Census 2011, Construction of *Katcha* houses was only 8.5% in Rajasthan and construction of *pucca* houses reaches in Rajasthan upto 76%. So it shows that traditional housing construction techniques almost dispensable in the present time. There is a drastic increment in percentage of construction of *pucca* houses because of easy availability of modern materials like cement, steel and bricks are get ahead even in extreme remote areas of Rajasthan[13]. *Katcha* houses are made of natural materials and maintenance requirement is more. Its live duration is very short and when we compare with *pucca* houses, *Pucca* houses are more durable, required less maintenance and structure resistant wear also. But these *pucca* houses not fit for local climate. These houses made with modern materials and these materials are not sustainable for particular climate[13]. In Rajasthan some districts like Bikaner, Ganganagar and Churu. There is a climate of tropical hot summer with high speed storm wind, which is warm also and this region also comes under high risk zone for wind hazards. Thus, in this area the basic form and type of houses are influenced by these natural conditions.



Fig. 2. Small opening used as a Window in Northern Rajasthan [19]

II. ANALYSIS AND DISCUSSION

In the Northern region of Rajasthan covers the district Ganganagar, Hanumangarh, Churu, Bikaner, Jhunjhunun and Sikar. The region irrigated by the Gang canal and the Bhakra canal tributaries resembles the fertile plains of Punjab, but some areas have desert like conditions. This region is characterized by low rainfall and scarce vegetation. Average rainfall received is 30-40cm annually. Maximum temperature in summers goes up to average 40-46°C. Vulnerability to Natural Disaster, The entire region lies in zone II of seismic vulnerability except for Jhunjhunun, Sikar & Bikaner which lie in zone III.[20]

To prevent houses from wind hazards household made small openings as a window, which is basically used for vision and access to fresh air. These small opening or small decorative holes made over the wall, also allow the hot air from inside to blow out.



Fig. 3. Large opening used as a Window in Northern Rajasthan [19]

The size of opening kept small to get rid of hot climate. In cases where normal low level dust swirls within the settlement the interior of house is protect by almost blank walls with very small openings. But due to modernization the household adopting large opening window which is not suitable for such climate and also obsolete the traditional construction practices. It proves that such types of modern construction had no regard for site, climate, topography, geology, culture and way of local life of the people. Traditional techniques should be prevented and new technology must be introduced, but in a minimalist way so we can make sustainable and affordable rural houses build with locally available material [9].



Fig.4. District Map of Northern Region of Rajasthan [20]

Traditional and existing construction practices in this area there are single storeyed houses constructed with sandstone and good quality brick with cement mortar is prevalent in this region. Stone *patti* or brick jack arch roof is usually constructed. These small openings prevent dust to enter in house and also give cool interior by preventing of warm winds to enter in house. This region is characterized by

more dense and urbanized population. It was also observed that many of the male population are engaged in working as daily wagers in stone quarries, thus good building stone is also found in abundance, which can be used in various ways for rural house construction [16].

There are some learnings and drawback in this region, like houses mostly built on the rear end of the plot. Open cooking space in aangan is provided outside the house enclosed by a low height wall. We can use any suitable local material available to build this enclosure. The isolated kitchen keeps the heat generation in a specific location [16].



Fig. 5. Open cooking space provided outside the House [19]

Underground water storage tank with a raised platform provided in open space in front of the house. Their response of shelter towards climate, there are thick walls, which decrease the heat gain from outside but also take up lots of liveable space, minimum openings, mostly in the form of ventilators. Use of clay bricks over stone patti keeps the room cooler and prevents leakage. The houses comprise simple load bearing structure. Flat stone patti roofing system rests on 18" thick dressed stone wall load transferred to random rubble foundation. CGI sheet is also used in verandah. Due to black cotton soil arch foundation with plinth band can be used. Sandstone, kota mines are abundant. Fly ash bricks are available near kota area due to the presence of thermal power plant. Waste sandstone and kota stone pieces are available for flooring [15].

To promote the environmental sustainability the materials used traditionally are procured locally except cement for mortars. Local procurement of materials should be encouraged. Good earth for construction found in abundance; we can use this stone potentially in various ways. Some traditional elements also present in existing houses like Jali wall for openings and Niches (aala) made in external facade for storage and lighting lamps [17].

In the Eastern region of Rajasthan, districts in this region are Alwar, Bharatpur, Dausa, Jaipur, Dhaulpur, Karauli, Sawai Madhopur, Tonk, Bundi, Kota, Baran and Jhalawar. This region lies under Southern Rajasthan Pathar (Hadoti Plateau) and Eastern Plains. However, Alwar district and parts of Jaipur falls under North eastern Hilly Region. River Chambal drains a large part of this area. The Deccan Lava Plateau, a wide stony upland falls in this region which includes Kota-Bundi plateau. Black cotton soil is abundant

in this region making it very fertile for crop cultivation. But such types of soil not good for construction because of its swelling and shrinkage properties due to presence of moisture. The summer temperature is high in most of the region. It is also characterized by humid region where deciduous trees dominate the region. Kota, Jhalawar and Baran has wet summers and dry winters with monsoon savanna type of vegetation. Rainfall received is between 80 cm to 150 cm, which is mostly during the rainy season. Vulnerability to Natural Disaster, Drought prone areas and Flood Prone areas are found in this region. The entire region lies in zone II of seismic vulnerability except for Alwar and Bharatpur which lie in zone IV & III respectively. Traditional and Existing construction practices in this area, there are sandstone walls and stone patti roofs are prevalent in this region. Kota stones are used extensively for construction as well. Fly ash blocks made from waste ash collected from thermal power plants are recently being used in this zone [21].

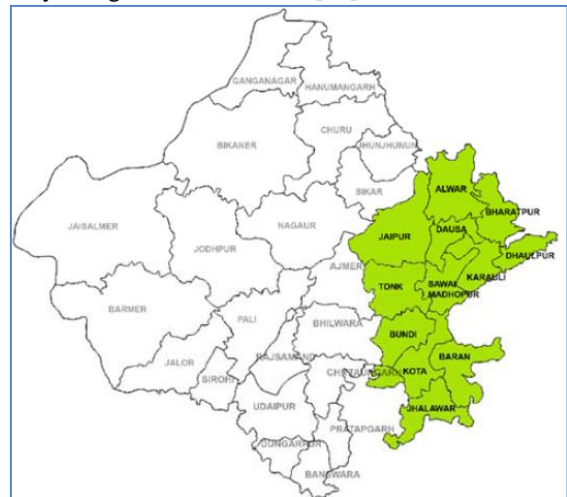


Fig. 6. District Map of Eastern Region of Rajasthan [20]

There are some learnings and drawback in this area, like houses share common walls. Verandah in front acts as buffer space between rooms and aangan. Hierarchy of spaces is evident. The low height wall in verandah is proposed to have jali for effective ventilation of the cooking space and to provide a sense of enclosure. Jali in parapet wall enhances the aesthetics of the house. Other aesthetic features which are incorporated in the type design are coping stone on top of parapet and verandah enclosure wall.



Fig. 7. Jali for effective ventilation[19]

Ventilators are provided above the door openings for effective cross ventilation. Aala, a traditional feature observed as being widely used, is provided on both sides of the door. The semi-covered space in front, before entering *aangan*, acting as false façade is observed in many traditional houses. While recognizing this space an integral part of the homestead to maintain the hierarchy of spaces,



Fig. 8. Ventilator above the door openings[19]

Their response of Shelter towards climate, there are thick walls, minimum openings, mostly in the form of ventilators. Use of clay bricks over stone *patti* keeps the room cooler and prevents leakage. The houses comprise a simple load bearing structure. Flat stone *patti* roofing system rests on 18” thick dressed stone wall. Load transferred to random rubble foundation [11]. CGI sheet is also used in verandah. Due to black cotton soil- arch foundation with plinth band can be used. Sandstone, *kota* mines are abundant. Fly ash bricks are available near *kota* area due to the presence of thermal power plant. Waste sandstone and *kota* stone pieces are available for flooring. To preserve environmental sustainability materials used traditionally are procured locally except cement and mortars. Local procurement of materials to be encouraged, there is good earth for construction found in abundance, we can use this earth potentially in various ways. Some traditional elements also present in existing houses like niches made in external facade for storage and lighting lamps [17].

A. Development of Core House

The type designs developed for Northern Eastern part of Rajasthan state. Suggestive and users can modify this Core House according to their functional requirements. Materials and techniques are suggested such that they can be procured locally.

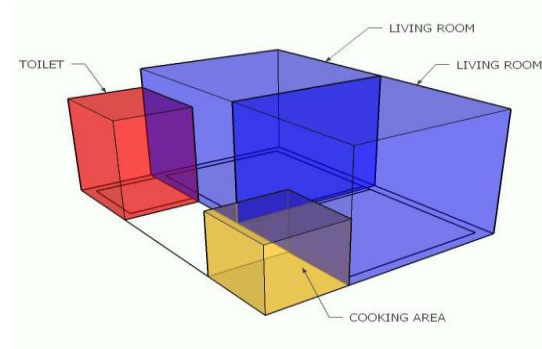


Fig. 9. Design of Core House

**For Northern Part of Rajasthan-** Module when cooking space is outside the house in open with a low height enclosure.

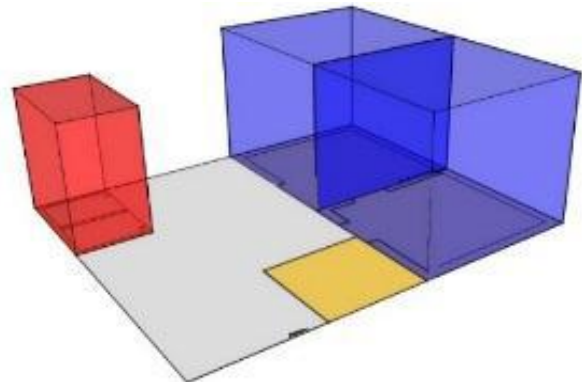


Fig. 10. Design of Core House for Northern Rajasthan

B. Material and Technology

**Roof** – Stone *Patti* with Cement-Sand pointing.

**Wall**- Precast stone filler block wall in Cement /cement-lime-sand mortar

**Foundation**- Coursed rubble masonry in cement mortar

For Eastern Part of Rajasthan- Module when the spaces are compact and attached with the core. Cooking space is provided in the semi-covered verandah.

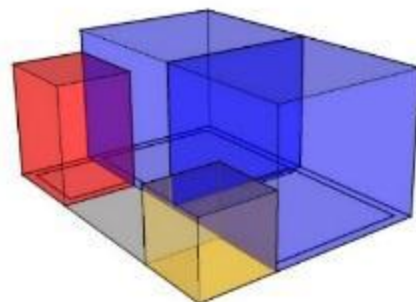


Fig. 11. Design of Core House for Eastern Rajasthan

### C. Material and Technology

**Roof** – RCC Filler slab with fly ash brick as filler material.

**Wall**- Fly ash rat trap wall in Cement

**Foundation**- Coursed rubble foundation in cement-sand/cement-lime-sand mortar

### III. CONCLUSION

The villages of Rajasthan are moving towards modernization where traditional construction techniques are fast replaced by new buildings using modern techniques in a fashion of using modern building materials. This is also validated from the reduced percentage of construction of *kuccha* houses. Traditional practices results in sustainable development because the use of locally available materials use less embodied energy. Climate control only influenced the design adopted. Like a central courtyard surrounded by construction of high walls with a balcony and small wind apertures to allow air circulation as well as preventing dust blow-ins during sandstorms. Traditional house construction has replicated a cost effective housing typology based on using upgraded construction material, while retaining the design fundamentals.

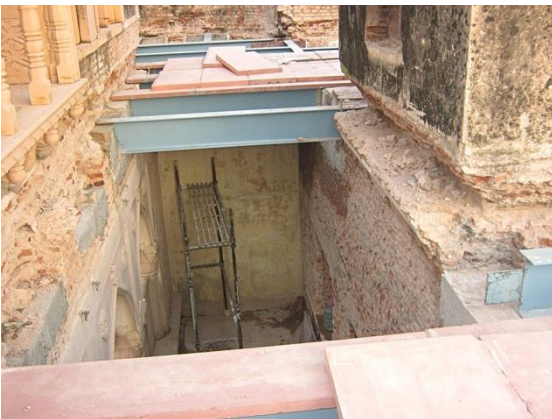


Fig. 12. Stone patti slab instead of R.C.C. slab[19]

Natural stones is locally available abundant in Northern-Eastern part of Rajasthan. Thus we can use stone *patti* slab instead of R.C.C. slab which is flat and no steel and cantering and shuttering required for the construction and less energy consumption. It is cheaper than R.C.C. roofing as in Rajasthan the stone slabs are available at a very low cost and can be used. It is also a faster process as the stone slabs are simply to be lifted to the roof and placed on the beams.



Fig. 13. Stone patti Lintel instead of R.C.C. Lintel[19]

By using stone masonry wall, it provides better climate control due to thick walls. The thickness of wall is more, so it gives more thermal comfort. The process of wall construction is labour intensive and promotes local economy. Dressed stone masonry does not required plaster on wall. It is also a traditional method of construction in Rajasthan. Small stone slabs are also fixed as stone lintels instead of using of R.C.C.; there is no requirement of steel or concrete for the lintels or for the slab. To save the usage of cement, big size stones are inserted into the concrete in a rectangular mould and after remolding; the blocks are cured for two weeks and used for construction process in masonry wall.

The material should be environment friendly, cheap and locally available. In construction each dwelling unit must have sufficient openings so circulation and bulk change of air mass possible inside. Use locally available materials should be encouraged. Use the local traditional construction techniques in a scientific manner, because every district has its own construction knowledge, traditions, vernacular architecture or cultural patterns.

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