Analysis of Non Engineered Construction of Houses in Rural Himachal

Robin Mahajan
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- Thoughtless development has adversely affected our environment and the solution to cater these affects is to increase awareness for sustainable development. Buildings construction is a threat to environment due to its higher consumption of energy and waste generation capacity. Therefore proper design and planning when assisted with appropriate technology leads to sustainable development. Traditional buildings have performed well during natural hazards and environmental impacts. Many buildings which have sustained themselves witness the knowledge of people improved from centuries, originated from the needs arising due to local conditions. But in the present era new development in techniques and easy availability of building materials has overcome the geographical restrictions faced in the past. Traditional techniques and materials have become redundant in the present time. Modern building materials like cement, steel and bricks are gaining increased demand due to greater acceptance because of easy availability even in extreme remote hills. But these Non Engineered construction of modern houses do not behave well in the local climatic conditions and there is no surety of their good performance during earthquake. Apart from the safety considerations the current construction practices are costly thus can be concluded that it is neither safe nor economic.

Keywords- Analyzing Sustainability, Construction Materials, Construction Techniques Practiced in Himachal Pradesh.

I. INTRODUCTION

Himachal Pradesh being so vivid in terms of having different housing typologies that results because of different geological factors, climatic factors, Socio - Cultural factors, Topography factors and exposure to natural Hazards. Traditional construction techniques have performed well during natural hazards because the techniques evolved over centuries with continuous improvement in resisting natural hazards and environmental impacts (Sharma, Vinayak, &Marwaha, 2015). However trends in construction in rural areas are similar to those seen in cities due to easy availability of modern materials and better aesthetics. This is also evident from the fact that the construction of Kutcha houses in 2005 was only 3.2 % which has reduced to 0.2 % in 2012 [Fig. 1]. The declining trend in construction of houses using traditional techniques has almost vanished in the present date. Construction industry is highest consumer of energy and modern materials have great impact on environment because of high energy consumption. So the biggest problem is that the houses being build today are not sustainable nor affordable. Also the performance of all these Non Engineered construction of houses in terms of stability against natural hazards is very poor (Thakkar & Morrison, 2009). Aspirations of people cannot be undermined to build modern houses and to provide the solution to the society, an affordable house model has to be given which collaborates the traditional knowledge and modern materials.

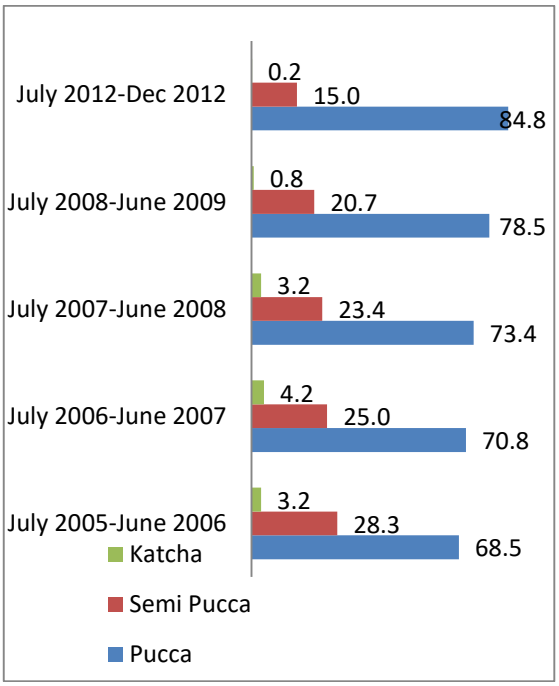

Fig. 1. Percentage distribution of Rural Households living in various types of Houses in Himachal Pradesh[3]

II. ANALYSIS AND DISCUSSION

Lahaul - Spiti and Kinnaur districts [Figure 2] of Himachal Pradesh can be distinctly noticed as the highest altitude region of the state with severe winter and highly prone to avalanche hazard. It has an altitude of 4500m above mean sea level. The climate of this zone is Humid Continental

i.e. severe and dry winter, warm summer. The zone is vulnerable to avalanche. Kinnaur district has high vulnerability to earthquake, landslide and floods. The existing traditional construction techniques involves Kath-Kuni and Rammed earth with mud roofing and wooden under-structure (Kumar & Pushplata, 2013a).[5]

Materials & Technology

Foundation- Random rubble stone masonry in cement mortar.

Wall- Random rubble stone masonry with cement concrete.

Roof- Dried biomass with wooden understructure.

Double glazing windows- as solar passive technique to keep the house warm

Vertical bars grouted to the lintel band to tie the roof understructure structure to prevent damages in case of wind hazards.

Potential

Stone easily available and can be used extensively.

Dried biomass locally available doesn't add much to the cost of house.

Potential for coursed rubble masonry and

Rammed earth technique due to local availability and good insulation properties.

Local procurement of materials such as stone and dried biomass for construction.

Issues/Concern

Cost of material is exorbitant due to transportation

Extreme climate conditions.

Timber is not available for under structure.

Avoid re-entrant corners as they are not seismically stable.

Roof anchorage.

The practice of Kath-Kuni structures has reduced over a period of time.

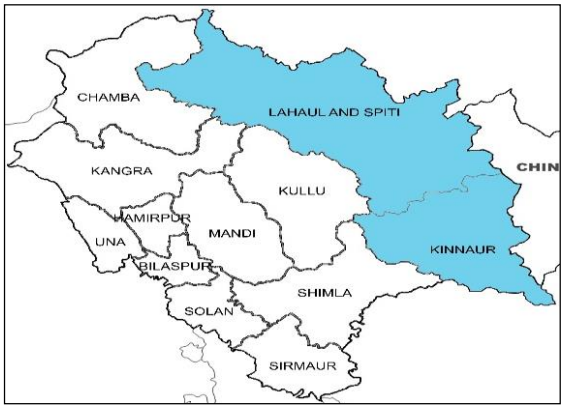

Fig.2. District Map of Himachal Pradesh[3]

Chamba, Kangra, Kullu, Shimla and Mandi districts [Figure 3] is prone to multi hazards such as earthquake, landslide and flash floods. Most of the districts in the zone lie in seismic zone V. The climate varies over the region from hot summer, moderate hot summer and mild dry winter. The altitude ranges between 1500m to 4500m above mean sea level. There are issues of landslides and heavy rainfall in these area due to which wall, roof and plinth are affected. There is prominent use of stone in construction in the region. The traditional practices such as kath-kuni, rubble stone with mud mortar and slate roofing with timber and bamboo understructure defines the structure in the region (Rahul & Ahuja, 2014). Most of the houses are rectangular and have aangans and verandahs but over the time with shift in materials and the need of future extension, the shape of the house are becoming irregular. Dry stone walls are cost effective and reduce heat loss. Stone can be easily accessed but this construction technique seems to be disappearing.

Materials & Technology

Foundation- Random Rubble Stepped foundation with cement mortar.

Wall- Bricks with cement mortar.

Roof- RCC slab

Potential

Bamboo availability.

Use of bamboo for roof under structure.

18" thick walling of sun dried mud block has good insulation properties.

CSEB could be encouraged because the mud quality is good.

Can be used with slate, RCC and CGI sheet.

Issues/Concern

No seismic bands are used.

Improper anchorage.

Roof insulation for sloping roofs.

Thick walls reduce the carpet area.

Fig.3. District Map of Himachal Pradesh[3]

Una, Bilaspur, Solan, Hamirpur and SirmaurDistricts [Fig. 4] is the lowest altitude and portrays features similar to plains. The climate of tropical monsoon with hot summer, mild and dry winter is constant over the region. It also comes under high risk zone for wind hazard.The altitude ranges between 350m to 1500m above mean sea level. The zone is vulnerable to earthquakes & forest fires. District Hamirpur, part of Bilaspur&Una lies in seismic Zone V where as the rest of the zone lies in Zone IV.Sun dried mud block with slate roofing or thatch roof with bamboo under-structure is the traditional construction practice of the region. The technique of making sun dried mud blocks is still in practice. Most of the houses in the zone have sun dried mud block walls.

Materials & Technology

Foundation- Random rubble stepped foundation with mud mortar.

Wall- Country timber frame structure with infill of dry stone.

Roof- CGI and slates resting with anchorage on country timber understructure.

Potential

Easily available stone.

Bamboo is cheaper, lighter and more sustainable material for under-structure considering the restriction on timber usage.

Issues/Concern

Slates make the roof heavy which is seismically unstable.

Roof insulation for sloping roof.

Avoiding re-entrant corners as they are not seismically stable.

Anchorage of roof.

Restriction on timber usage.

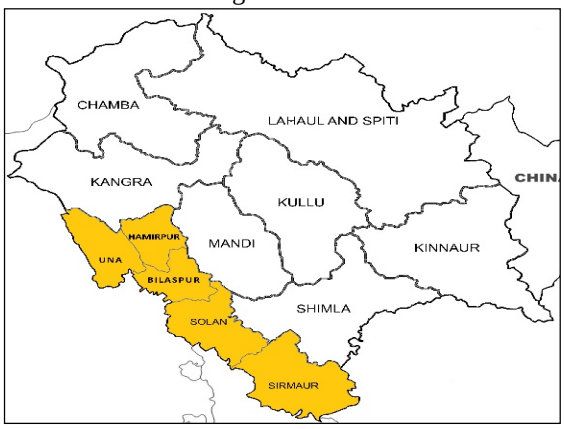

Fig.4. District Map of Himachal Pradesh[3]

The shift of trend to build modern houses without proper knowledge of modern day materials result in tremendous amount of rise in construction cost. There is no manual provided for cost cuts for strong acceptable Housing which emphases on working out effective, inexpensive, low-cost affordable houses according to rural scenario. There is no guideline given relevant to different parts of Himachal Pradesh according to their Topography, Geology, Climate, Natural Multi Hazards and Socio-Cultural profile. The modern rural houses is built of costly, energy intensive material, and no regard for site, climate, topography, culture or religion and way of local life of the people of village is given any emphasis. Mud Houses and Thatch roof gives a cool interior but it needs annual repair and replacement. Also due topoor aesthetics people are not adopting it. There are many ways to prevent this. But it takes more time, resources and energy. A slate and Tile roof can also be easily extended but it requires more costly timber for it. Modern Ferro Cement Shell, R.C.C. structure and new Concrete system of roofing absorb and retain lot of heat from the sun and there are many ways to prevent this. But it requires more time resources and energy, which may reduce affordability of Rural House. The houses are not designed properly and when extension are to be added, Roofs, Doors, Windows etc. are not in the right places. Also houses are not carefully placed on the plot, so there is no space for extension. The construction techniques given for the rural scenario are not being utilized by the people of villages because of the less acceptance of the society to build low cost *kutcha* house.[2] As these houses require more maintenance and are aesthetically not accepted. The problem society is facing is that the people want to build modern houses and all the available research is on old construction techniques. As a result the techniques so developed are not being used by the people and has only made its place in books and manuals. Ultimately the people are forced to build houses with modern materials and the first cost cutting involved is not hiring an Architect or an Engineer and finally results in a Non Engineered construction which is least safe and costly. The cost of construction is more due to lack of proper planning and overdesigning of structures.[3]

III. CONCLUSION

The villages of Himachal Pradesh 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*kutcha* houses. Traditional practices results in sustainabledevelopment because the use of locally available materials use less embodied energy. Although *Dhajji* wall construction has performed well in earthquake prone areas. But the construction Practices followed today are adopted from the plains, irrespective of the fact that these practices are not sustainable. Materials being used today are transported from larger distances and poor workmanship makes use of these materials inappropriately giving less importance to appropriate construction techniques. Also the traditional construction practices are getting obsolete due to unavailability of local materials like slate,wood etc and depleting traditional workmanship.

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