



Comparative Study of Indian Village Houses and Lowcost Engineered Houses using Earthen Meshed Panels

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ABSTRACT

The scarcity of affordable and easily constructed houses is contributing to the cycle of poverty and under developed status of many people of rural area. It is present need to provide lowcost housing technology for the population staying in the rural areas of our country. Everyone cannot afford therein forced concrete houses in rural areas. So, we have to provide such house that poorest can afford without sacrificing on strength, performance and life of structure. Majority of houses in rural area are earthen or made using straw. These houses present in rural areas has many problems like leakage in rainy season, high maintenance, life of these houses is less, unstable against high wind currents, earthquake resistant capacity is minimum, aesthetic appearance is not good. These problems can be minimized by providing lowcost earthquake resistant housing technology using locally available materials. So, low cost engineered house can be constructed using soil, GI wire mesh as confinement (to increase performance as well) and plaste redusing cement mortar. This study will also focus on different connections between wall to wall panels, slab to wall panel and wall to footing. The lowcost earthquake resistant earthen house can have advantages like more earthquake resistant, pleasant aesthetic appearance, Low maintenance and more life (upto 50 years), fast and easy construction with reliability, use of engineering materials like GI mesh, cement is limited to 10% - 15%. The detail study of different methods of construction of rural houses is done and compared with lowcost engineered houses using earthen meshed panels, to provide full fledge house (400square feet) with best performance in lowcost (within 1 lakh) to rural people.

Keywords: Aesthetic appearance; Affordable; Earthen meshed panels; Earthquake resistant; GI wire mesh.

1. INTRODUCTION

There are different methods for construction of houses in rural areas. Earthen houses with metal sheets at top are mostly observed as earth is locally available material. The houses using straw are also constructed in rural areas. The type of houses depends on the region and locally available materials. In Konkan area (Maharashtra) laterite stones are available at shallow depth, so they are used instead of bricks, soil etc. In recent years serious efforts have been undertaken to develop lowcost housing technology for rural area and number of ideas with different materials and arrangements are brought up throughout the world. This paper discusses the different types of houses, construction methodologies for construction of rural houses, houses using earthen meshed panels and their comparison. Pre-fabricated house is also an option but sometimes transportation limitations are there.

Assembly issues may leads to joint failure and leaks. So, the technology to bead apted for housing should be such that it can suit the level of skills and handling facilities available under rural area.

2. LOWCOST VILLAGE HOUSES

2.1 Houses Using Straw

These type of houses are constructed using stalks of grain (straw) as main building material for wall panels and sometimes for roofing also. For construction of these houses no foundation is required, constructed quickly within a week. Other materials required for construction are wooden stakes used as column supports, door and window frames, and hemp rope for binding the elements together. Flooring is generally earthen and maintained regularly using cow dung.

These houses has some advantages like they are constructed quickly and has good thermal insulation. As most of the materials are locally available it is constructed in lowcost, generally for house of 400ft 2 using straw can be constructed within 50,000 Rs. But has disadvantages like life of these houses is very less (2-3years). Water may enter from roof level directly during heavy rains and height of such houses is limited as it can be blown away by high wind currents.



Fig. 1: Low cost house using straw.



Fig.2: Connection at roof level in straw house.

2.2 Earthen Houses

For construction of these type of houses soil is used as main building material. For this soil should have some cohesion. For this type of houses we can use metal sheets or wooden planks and soil for roofing. Door frames, window frames, wooden stakes these materials are required for construction.

Labour required for construction is more in this case. If soil suitable for construction is not available locally then cost of transportation also added. These houses can be constructed in 1-2 months. These houses look better than straw houses but has different disadvantages. Plaster gets removed regularly hence maintenance required frequently. The leakage is observed in earthen houses as shown in fig. In case of any excessive loading the brittle failure occurs in case of earthen houses. Life of such houses is 25-30 years. For the same area of 400 ft² the earthen house can be

constructed in 60-70 thousand rupees. These houses has low earthquake resistant capacity.



Fig. 3: Earthen house.



Fig.4: Leakage problems in earthen houses.



Fig. 5: House using metal sheets.

2.3 Houses Using Metal Sheets

In this type of houses only metal sheets are used as wall panel and roofing material also. The wooden stakes are used as beam and column. For the connections between metal sheets and sheets-wooden Stake connection hooks, screws and washers are used. These are lowcost structures but having less life. These structures are not stable during high winds. Water may enter from flooring level during rainy season. The sound and thermal insulation is not good in these houses.

These are some types of houses adapted in rural areas, they are low cost but has less life, can't resist earthquake aesthetic appearance is not good. It may cause image problem because they look like houses of inferior quality. Hence we should think about the technique for construction of lowcost house with long life, having high earthquake resisting capacity and can stand stable in all weathers. Brick houses and house using RCC are having high strength and long life but every one can't afford such type of house. Hence Low cost engineered house using earthen meshed panel can be used. This will give house with pleasing appearance in lowcost without sacrificing strength and stability.

2.4 Low Cost Engineered Houses Using Earthen Meshed Panels

In this type of houses soil is used as building material with confinement using wire mesh. Locally available soil is taken and its suitability is checked for construction by using tests in laboratory. The foundation is required for this type of house. The foundation can be one using stones and no room is filled up to basement level. For construction of wall panels we are using wire mesh as shown in fig. We have to decide the thickness of wire used for making of mesh and spacing of mesh. The mould should be made for casting of wall panels using plywood sheets. Then place the mesh in the mould and open it from one side (from top). Cover should be left from bottom to plaster the panel, firstly apply the plaster at bottom and then compact the soil in mesh. Add water during its compaction to achieve maximum density. Topside of mesh is then fixed and all panel is plastered using cement mortar.

We can add some admixtures to stabilize the soil and some light weight materials like straw, thermocol balls to reduce the dead weight of the panel. This idea of reducing weight by adding light weight materials is more useful in case of slab panels as in wall panels we require more dead weight for stability. Proper care of joints should be taken by proper anchoring of the reinforcement. The openings should be provided in the house so, the mesh should be cut properly for placing of window. We can use door frame and window frames of wood or concrete. Cost of concrete frames is less hence

it can be preferred. We can use Mangalore tiles over the slab panel. The flooring of this type of house can be earthen or we can use tiles.



Fig. 6: Connection details of metal sheet house.



Fig. 7: Wire mesh for wall / slab panels.



Fig. 8: Mould forcasting of wall/ slab panels.

To increase the performance of panels we can make alterations in the structure of mesh by introducing folded mesh in the inner part. Care should be taken while doing compaction, it should attain maximum density without disturbing the alignment of the mesh.

The advantages of such houses are:

- More Earthquake Resistant
- Pleasant aesthetic appearance
- Low maintenance and more life (upto 50years)
- Lowcost (poorest can afford)
- Use of resources without harming the environment (soil).
- Fast and easy construction with reliability.
- Use of engineering materials like GI mesh, cement is limited to 10%-15%.
- We can construct full fledge house of 400 square feet, with porch in 1 lakh rupees.

For example:

Consider the house of 400 ft 2 area for our case study about its cost required aesthetic appearance. The full fledge house with toilet and bath, veranda should be taken. The plan of proposed house using earthen meshed panels is as shown in figure.

This type of house is constructed at a lowcost (within 1 lakh) and can have longer life compared to other existing low cost houses. This house will look aesthetically pleasant as shown in fig. this will improve the standard of living of rural people. This project will also be useful for third world and under developed earthquake prone countries such as Nepal, Sri Lanka and some of African countries by providing a low-cost earthquake resistant houses. Thus this will help in improving social and economic status of people on global level.

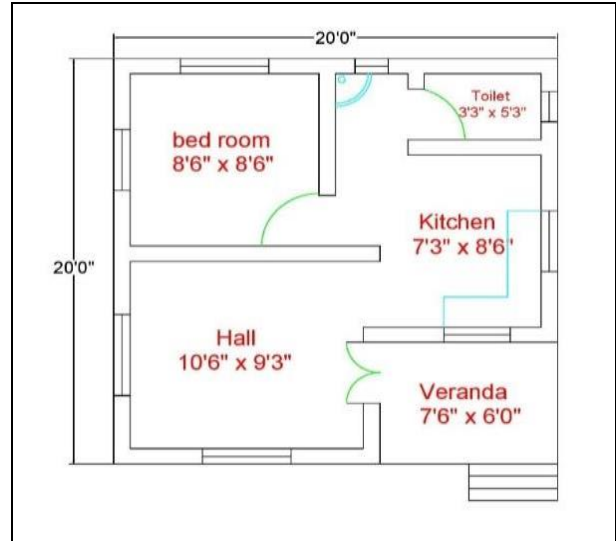


Fig. 9: Plan of proposed house.



Fig. 10: House using earthen meshed panels with better aesthetic appearance.

Table 1. The cost required for construction of this house is estimated as follows.

Item no.	Description	Quantity	Unit Rate (Rs)	Total Amount (Rs)	
1	Foundation	Excavation	480ft3	350/ labour	1400
		Stone masonry	3brass	1200/brass	3600
		cement	6bag	280/bag	1680
		sand	1brass	1500/brass	1500
		Labour	8labours	500/labour	4000
		murum	2brass	1000/brass	2000
				14180	

2	Walls	GI mesh	2000sqft	18/ft ²	36000	
		Soil	8brass	Locally available		
		Labour	10labours	400/labour	4000	40000
3	Slabs	GI mesh	450sqft	18/ft ²	8100	
		Soil	2brass	Locally available		
		Labour	3labours	400/labour	1200	9300
4	Plastering	Cement	10bags	280/bag	2800	
		Sand	0.6brass	1500/brass	900	
		Labour	5labours	400/labour	2000	5700
5	Floor finish	Tiles	320ft ²	22/ft ²	7040	
		Cement	3bag	280/bag	840	
		Sand	0.5brass	1500/brass	750	
		Labour	4labours	500/labour	2000	10630
6	Doors and windows	Doors	3doors	1500/	4500	
		windows	6 windows	600/	3600	
		Labour	2labours	500/labour	1000	9100
7	Paint	Paint	80litre	60/lit	4800	
		Labour	9labours	400/labour	3600	8400
Total					97310	

Table 2. Comparison between Indian village houses and houses using earthen meshed panels.

Indian village houses	Lowcost earthquake resistant house using earthen Meshed panels
Life of these houses is less.	Life of the house can be upto 50years.
Generally, no foundation is required.	Foundation is required.
Earthen flooring is adapted in these houses.	Tiles are used for flooring.
Construction time is less.	Construction time may be slightly more butreliable.
These houses should be repaired frequently	Less maintenance is required as compared to other village houses
There may be problems in rainy season and can't resist earthquake	Can stand stable in all climates and strong enough to Resist earthquake
Roofing is generally done using metal sheets, straw.	Roofing is done using earthen meshed panels and Mangalore tiles over it.
This type of houses does not look good.	This house have pleasing a esthetic appearance.
In village houses, full fledge house with all amenities is not provided.	In this house, we can provide house with all amenities like toilet, bath and veranda.
Constructed using locally available and non-engineering materials.	This house is also constructed using locally available materials(Soil), use of engineering materials mlike wire mesh Cement is limited 15% -20%.
Thermal insulation of these houses is good but they are not Good at sound insulation	This house can be good at thermal as well as sound insulation

3. CONCLUSION

Above discussion throws light on the fact that presently rural housing is in bad condition, there is need for permanent and durable houses which can be constructed at low cost. Present study shows low cost house using earthen meshed panels is better solution over current Indian village houses in terms of durability, aesthetics and performance. This will help poor rural people to construct good quality houses at affordable cost, which will solve the current problems of rural housing.

It is also intended to study the structural behavior of the earthen mesh wall panel house under seismic load. It is expected that due to the wire mesh the seismic behavior will be considerably improved. Different configurations of wire mesh are to be tested so that wall panel of better performance can be designed. This will considerably improve the rural housing standard.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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