

# Cost Effective Housing

M.S. Kalkundri

KLS Gogte Institute of Technology Khanapur Road, Udyambag, Belgaum-590 008, Karnataka  
E-mail: mskalkundri@git.edu

**Abstract**—Housing is a basic need of man, in importance; it is third after food and clothing. The dream of owning a house particularly for low-income and middle-income families is becoming a difficult reality. Hence, it has become a necessity to adopt cost effective, innovative and environment-friendly housing technologies for the construction of houses and buildings for enabling the common people to construct houses at affordable cost. This paper deals with techniques that can help reducing the cost of construction in foundation, walling, roofing and lintel. And it is found that about 22% to 29% of the construction cost can be saved by using low cost housing technologies in comparison with the traditional construction methods. This proves that using low cost housing technologies is a cost effective construction approach for the industry in, to tackle the housing shortage issue for low-income and middle-income families.

## 1. INTRODUCTION

Housing is a basic need of man, in importance; it is third after food and clothing. The importance of housing was universally accepted from the dawn of history. Even the Neolithic man who lived between 10,000 and 2000 B.C. built durable habitation like pit dwellings, lake dwellings and beehive huts. However, its functions increased manifold over the years. With the development of knowledge and the advancement of civilization, people became particular about sanitation, environment, privacy, location of house, etc.

A house is the place where one can take rest, sleep and cook food. A house can also be used partly as a shop, work place, or a place for business for any type of activities. A significant percentage of recreational activities are being brought into the house with the advent of television, radio, computer, recorded music etc. As per the available information man spends a good part of his lifetime in his house. This clearly indicates the fact that a house is a part and parcel of a man's life. Adequate shelter for all people is one of the pressing challenges faced by the developing countries.

Census of India data clearly indicates that the quality of per capita shelter has declined during the last 40 years as measured by indices of crowding. It also indicates that Three fourths of the shortage is in the EWS (Economically Weaker Section- income up to Rs 5000 per month) category and another quarter of the shortage is in LIG (Lower Income Group- Income between Rs 5001- 10,000 per month) category.

In the latter, a significant proportion of shortage is on account of congestion in living conditions.

Sl. No.	Category	Distribution of housing shortage among different economic categories as on 2012	
		No. (in millions)	In %
1	EWS	10.55	56.18
2	LIG	7.41	39.44
3	MIG and above	0.82	4.38
<b>TOTAL</b>		<b>18.78</b>	<b>100.00</b>

It is predicted that by 2020 approximately 40% of India's population will be living in cities, indicating a 12% increase since 2008 (McNeil et al., 2008). Furthermore, the urban population is expected to more than double by 2050. And need to address the challenges faced by low-income populations living in urban areas.

According to UN-HABITAT report 2005 by the year 2030, an additional 3 billion people, about 40 percent of the world's population, will need access to housing. This translates into a demand for 96,150 new affordable units every day and 4,000 every hour. Hence need for affordable housing is a must, especially in EWS and LIG category.

Non-affordability of housing by economically weaker sections of society and low income families in urban areas is directly linked with poverty. The national sample survey organization (NSSO) reports that the number of the urban poor has risen by 4.4 million persons in 2004-2005 One fourth of the country's total urban population, numbering 80.7 million persons is below the poverty line. The urban poor constitute 26.7% of the total poor in the country. The fact that the number of urban poor has risen is in stark contrast with rural poverty, where both the total number of rural poor and its incidence vis-à-vis the rural population has fallen. The urban poor have limited access to basic services.

## 2. OBJECTIVE

The objective of the paper is to deal with techniques that can help reducing the cost of construction in foundation, walling, roofing and lintel. And how these little interventions could

help to provide affordable housing for economically weaker section and low-income families. And could also help to reduce housing shortage problem.

### 3. NEED FOR AFFORDABLE HOUSING

The dream of owning a house particularly for low-income and middle-income families is becoming a difficult reality. Hence, it has become a necessity to adopt cost effective, innovative and environment-friendly housing technologies for the construction of houses and buildings for enabling the common people to construct houses at affordable cost. Hence sustainable low cost housing technologies which could provide houses to masses at affordable cost assumes greater significance. The present strains on Indian economy and the ever-growing demand for housing, call for adoption of appropriate building technology which could achieve utmost economy and speed in construction.

There are various research and development bodies in the country which conducts research on appropriate building technology, play stellar roles in evolving and promoting low cost housing technology which has helped to solve the problem of housing to masses through provision of house at affordable prices by adopting appropriate and cost effective technologies namely;

1. Central Building Research Institute (CBRI),
2. Structural Engineering Research Centre (SERC),
3. Centre for Application of Science and Technology to Rural Areas (CASTR),
4. Regional Research Laboratories (RRL),
5. National Environmental Engineering Research,
6. Building Materials & Technology Promotion Council (BMTPC).

As a result of a number innovations have been made in the field of low cost housing technology, it is now possible to achieve an overall saving to the extent of 10% to 30% in the total cost of construction compared to the cost of traditional houses.

### 4. LOW COST CONSTRUCTION TECHNOLOGIES

The design of the house may vary from single storied to multi storied but the main components of a house will be foundation, walls, roof, flooring, door and windows depending upon the location and the context. So

### 5. FOUNDATION

Normally the foundation cost comes to about 10 to 15% of the total building it is recommended to adopt a foundation depth of 2 ft (0.6m) for normal soil like gravely soil, red soil etc. it is also suggested to use arch foundation in ordinary soils and in case of black cotton soil and soft soil it is recommended to use

under ream pile foundation which saves about 20 to 25% in cost over the conventional method of construction.

This type of foundation was used in olden times where in spread foundation is replaced by inverted arch reduces the construction cost up to 40% Advantage of this is-In soft soils that the depth of foundation can be greatly reduced; disadvantage is that the end piers have to be specially strengthened by buttresses so as to avoid the thrust to arch action tending to rapture the piers junction.

It is recommended to adopt 1 ft. height above ground level for the plinth and may be constructed with a cement mortar of 1:6. The plinth slab of 4 to 6" which is normally adopted can be avoided and in its place brick on edge can be used for reducing the cost. By adopting this procedure the cost of plinth foundation can be reduced by about 35 to 50%.

### 6. WALLS

The rat trap bond is a masonry technique, where the bricks are used in a way which creates a cavity within the wall, while maintaining the same wall thickness as for a conventional brick masonry wall. While in a conventional English bond or Flemish bond, bricks are laid flat, in a Rat trap bond, they are placed on edge forming the inner and outer face of the wall, with cross bricks bridging the two faces. The main advantage of Rat-trap bond is reduction in the number of bricks and mortar required as compared to English/Flemish bond because of the cavity formed in the wall.

This technology has about 25% overall-saving on cost of a building of traditional 9" construction. The structure has proven its strength to go up to three floors with the support of brick columns. With this technique there is reduction in cost of the wall by 25% as with conventional English bond (9"thk wall) 350 bricks are required per cu. m whereas in Rat-trap bond only 280 bricks are required and also the reduced number of joints reduces the mortar consumption.

Gypsum Area Separation Wall Gypsum panel products shall not be used where there will be direct exposure to water or continuous high humidity conditions. Such areas include but are not limited to saunas, steam rooms, gang shower rooms, and indoor pools. Gypsum panel products shall not be used where they will be exposed to sustained temperatures of more than 125°F (52°C) for extended periods of time. In single layer gypsum panel product systems, end joints parallel to and on the same side of framing members shall be staggered between alternate courses of gypsum panel products and from joints on the opposite side of the framing.

Aluform Technology Mivan is an aluminum formwork system developed by one of the construction company from Europe. Mivan is an upcoming technology which has empowered and motivated the mass construction projects throughout the

world. The technology has been used extensively in other countries such as Europe, Gulf Countries, Asia and all other parts of the world. As Wall Panel It forms the face of the wall. It is an Aluminum sheet properly cut to fit the exact size of the wall.

## 7. ROOF

By providing an economic solution to RCC slab 30 to 40% cost reduction on floor/roof over RCC slabs without compromising the strength. These being precast, construction is speedy, economical due to avoidance of shuttering and facilitates quality control. They are easy to construct, save on cement and steel, are more appropriate in hot climates. These can be constructed using compressed earth blocks also as alternative to bricks for further economy.

Therefore in a conventional RCC slab lot of concrete is wasted and it needs extra reinforcement due to added load of the concrete which can otherwise be replaced by low-cost and light weight filler materials, which will reduce the dead weight as well as the cost of the slab to 25% (as 40% less steel is used and 30% less concrete). The filler slab is based on the principle that for roofs which are simply supported, the upper part of the slab is subjected to compressive forces and the lower part of the slab experience tensile forces. Concrete is very good in withstanding compressive forces and steel bears the load due to tensile forces. Thus the lower tensile region of the slab does not need any concrete except for holding the steel reinforcements together.

Conventional tests by different institutions and laboratories has proved the load bearing capacity of filler slab and found it no less in performance from the conventional R.C.C. slab. Since filler roof tiles are firmly bonded to and covered by concrete, it does not collapse under the impact of say, a coconut falling on the roof. The filler slab is a mechanism to replace the concrete in the tension zone. The filler material, thus, is not a structural part of the slab. By reducing the quantity and weight of material, the roof become less expensive, yet retains the strength of the conventional slab. The most popular filler material is the roofing tile. Mangalore tiles are placed between steel ribs and concrete is poured into the gap to make a filler slab. The structure requires less steel and cement and it is also a good heat insulator.

The air pocket formed by the contours of the tiles makes an excellent thermal insulation layer. The design integrity of a filler slab involves careful planning taking into account the negative zones and reinforcement areas. The savings on cost can be from 15% to 25%. But designing a filler slab requires a structural engineer to determine the spacing between the reinforcement bars. Filler slabs provide aesthetically pleasing patterned ceilings. In most houses, the filler material is left open without plastering to form aesthetic design symmetry but

some residents prefer to cover the space with Plaster of Paris coating.

## 8. DOORS AND WINDOWS

As door and window frames are responsible for almost half the cost of timber used, avoiding frames can considerably reduce timber cost. Door planks are screwed together with strap iron hinges to form doors, and this can be carried by 'holdfast' carried into the wall. The simplest and cost effective door can be made of vertical planks held together with horizontal or diagonal battens. A simplest frameless window consists of a vertical plank of about 9" wide set into two holes, one at the top and one at the bottom. This forms a simple pivotal window. Wide span windows can be partially framed and fixed to walls or can have rows of pivotal planks

Sl.	Parameter	
1	Concrete	M20+fly Ash (25%)
2	Sand	Natural Sand < Crush sand
3	Aggregate	Light Weight Aggregate
4	Plaster- Internal	Gypsum
	External	Crush Sand
5	Tiles	Ceramic Tiles
6	Flooring	Vitrified Flooring
7	Doors	Teak Wood
8	Windows	M S Fabrication
9	Drainage Pipes	RCC
10	Partition Wall Thickness	150mm
11	Slab Thickness	130mm
12	Paint	ODP/Dry Distemper

The other Key aspects of Affordable Housing are Location of the project, Property specifications, Amenities provided & price identified, Ticket Size of the project. Even if there are so many there are a few Hindrances that are faced for affordable housing by developers and housing authorities and they are, High Land Cost, External & Internal development, Charges payable to the Govt., Permissible Ground Coverage and Restrictive Density Norms

## 9. CONCLUSION

It was also found that about 22% to 29% of the construction cost can be saved by using low cost housing technologies in comparison with the traditional construction methods. This proves that using low cost housing technologies is a cost effective construction approach for the industry in to tackle the housing shortage issue for economically weaker section and low-income families.

## REFERENCES

- [1] Adoption of Appropriate and Cost Effective Technologies in Housing: Indian Experience, A. K. Jain, M. C. Paliwal World Academy of Science, Engineering and Technology, Vol: 6 2012-03-26.

- 
- [2] Cost Effectiveness of using Low Cost Housing Technologies in Construction. Vivian W. Y. Tam, Twelfth East Asia-Pacific Conference on Structural Engineering and Construction
  - [3] Industrial & Economic Planning Division of TCPO, chapter 4
  - [4] Kumar A. Sustainable building technology for mass application, Development Alternatives Newsletter. 9(11).
  - [5] Cost Effective House by Using Various Construction Techniques and Materials Prof. U. J. Phatak, Prof.C.S.Chavan Vishwas L. Nachare and Atul.B.Suryawanshi, Indian Journal Of Applied Research, Volume : 4 | Issue : 4 | Apr 2014 | Issn - 2249-555x.
  - [6] Affordable Housing in India: Building a New Paradigm, Indian Habitat Summit – 25th Sep'09 Rahul Todi Bengal Shrachi Housing Development Ltd.
  - [7] Use of cost-effective construction technologies
  - [8] in India to mitigate climate change, Nilanjan Sengupta, Current Science, Vol. 94, No. 1, 10 January 2008