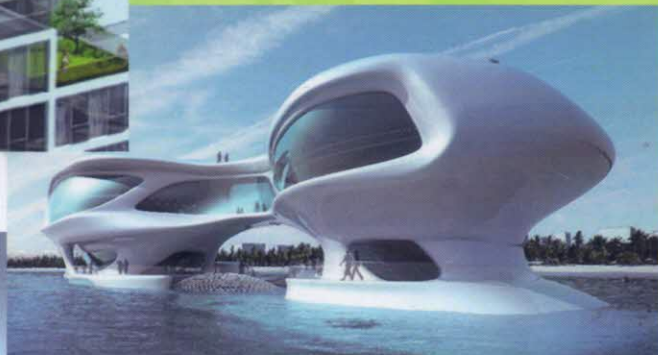




Emerging Trends in Architecture, Design & Urban Studies

(A conscious creation of utilitarian spaces)



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PREFABRICATION TECHNIQUES FOR LOW COST BUILDINGS.

Ar. Safiullah Khan and Ar. Abdur Raoof Khan

ABSTRACT

This paper examines the development and current status of prefabrication techniques and their application in building construction. This paper also means to call attention to the different parts of pre-assembled building approaches for low cost Buildings by highlighting the distinctive construction methods, and the financial favorable circumstances accomplished by its appropriation. In a building the foundation, walls, doors and windows, floors and roofs are the most important components, which can be analyzed individually based on the needs thus, improving the speed of construction and reducing the construction cost. The major current methods of construction systems considered here are namely, structural block walls, mortar less block walls, prefabricated roofing components like precast RC planks, precast hollow concrete panels, precast concrete/Ferro cement panels are considered.

Key words: Prefabrications Sustainability, life cycle, technology, energy efficiency



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INTRODUCTION

"Reasonable Lodging or Affordable housing is a term used to describe dwelling units whose total housing cost are deemed "Affordable" to a group of people within a specified income range."

In India, the technology to be adopted for housing components should be such that the production and erection technology be adjusted to suite the level of skills and handling facilities available under metropolitan, urban and rural conditions. (P.K.Adlakha and H.C.Puri, 2003).

Building Cost:-

The building construction cost can be partitioned into two sections namely:

- Building material cost: 65 to 70 %
- Labour cost: 20 to 30 %

Now in low cost housing, building material cost is less because we make use of the locally available materials and also the labour cost can be reduced by properly making the time schedule of our work. Expense of diminishment is accomplished by choice of more effective material or by an enhanced configuration.

Intelligent methodology for optimizing housing solutions:

There should be an intelligent methodology for giving proper innovation in light of the accessibility of alternatives, thinking of it as' specialized and financial investigation.

1. There should be optimal space in the design considering efficiency of space, minimum circulation space.
2. Economy should be considered in design of individual buildings, layouts, clusters etc.
3. While preparing the specifications it should be kept in mind that, cost effective construction systems are adopted.
4. Energy efficiency has gained considerable importance due to energy crisis especially in developing countries. Orientation, built-form, openings & materials play a vital role besides landscaping / outdoor environment.
5. To develop an effective mechanism for providing appropriate technology based shelter particularly to the vulnerable group and economically weaker section.(R.K.Garg, 2008).

Prefabrication as applied to 'Low Cost Housing:-

Advantages of prefabrication are:

1. In prefabricated construction, as the components are readymade, self-supporting, shuttering and scaffolding is eliminated with a saving in shuttering cost.
2. In conventional methods, the shuttering gets damaged due to its repetitive use because of frequent cutting, nailing etc. On the other hand, the mould for the precast components can be used for large number of repetitions thereby reducing the cost of the mould per unit.
3. In prefabricated housing system, time is saved by the use of precast elements which are casted off-site during the course of foundations being laid. The finishes and

services can be done below the slab immediately. While in the conventional in-situ RCC slabs, due to props and shuttering, the work cannot be done, till they are removed. Thus, saving of time attributes to saving of money.

4. In precast construction, similar types of components are produced repeatedly, resulting in increased productivity and economy in cost too.
5. Since there is repeated production of similar types of components in precast construction, therefore, it results in faster execution, more productivity and economy.
6. In prefabricated construction, the work at site is reduced to minimum, thereby, enhancing the quality of work, reliability and cleanliness.
7. The execution is much faster than the conventional methods, thereby, reducing the time period of construction which can be beneficial in early returns of the investment.

Concept of prefabrication / partial prefabrication has been adopted for speedier construction, better quality components & saving in material quantities & costs. Some of these construction techniques & Materials for walls, roof & floor slab, doors & windows are as follows:

Cost Reduction Techniques:-

- 1) Reduce plinth area by using thinner wall concept (150 MM) thick solid concrete block wall.
- 2) Use locally available material in an innovative form like soil cement blocks in place of burnt brick.
- 3) Use energy efficiency materials which consumes less energy like concrete block in place of burnt brick.
- 4) Use environmentally friendly materials which are substitute for conventional building components like use R.C.C. Door and window frames in place of wooden frames.
- 5) Preplan every component of a house and rationalize the design procedure for reducing the size of the component in the building.
- 6) By planning each and every component of a house the wastage of materials due to demolition of the unplanned component of the house can be avoided.
- 7) Each component of the house shall be checked whether if it's necessary, if it is not necessary, then that component should not be used. Cost reduction through adhoc methods.

FOUNDATION

Normally the foundation cost comes to about 10 to 15% of the total building and usually foundation depth of 3 to 4 ft. is adopted for single or double story buildings and also the concrete bed of 6 Inches is used for the foundation which could be avoided.

It is recommended to adopt a foundation depth of 2 feet for normal soil like gravely soil, red soils etc., and use the un-coursed rubble masonry with the bond stones and good packing. Similarly the foundation width is rationalized to 2 ft.(0.6m). To avoid cracks formation in foundation the masonry shall be thoroughly packed with cement mortar of 1:8 boulders and bond stones at regular intervals.

It is further suggested adopt arch foundation in ordinary soil for effecting reduction in construction cost up to 40%. This kind of foundation will help in bridging the loose pockets of soil which occurs along the foundation.

In the case black cotton and other soft soils it is recommend to use under ream pile foundation which saves about 20 to 25% in cost over the conventional method of construction. Under reams piles are of two types.

1. Pre cast under Reams Piles
2. In Situ cast Under Reams Piles.

Plinth:-

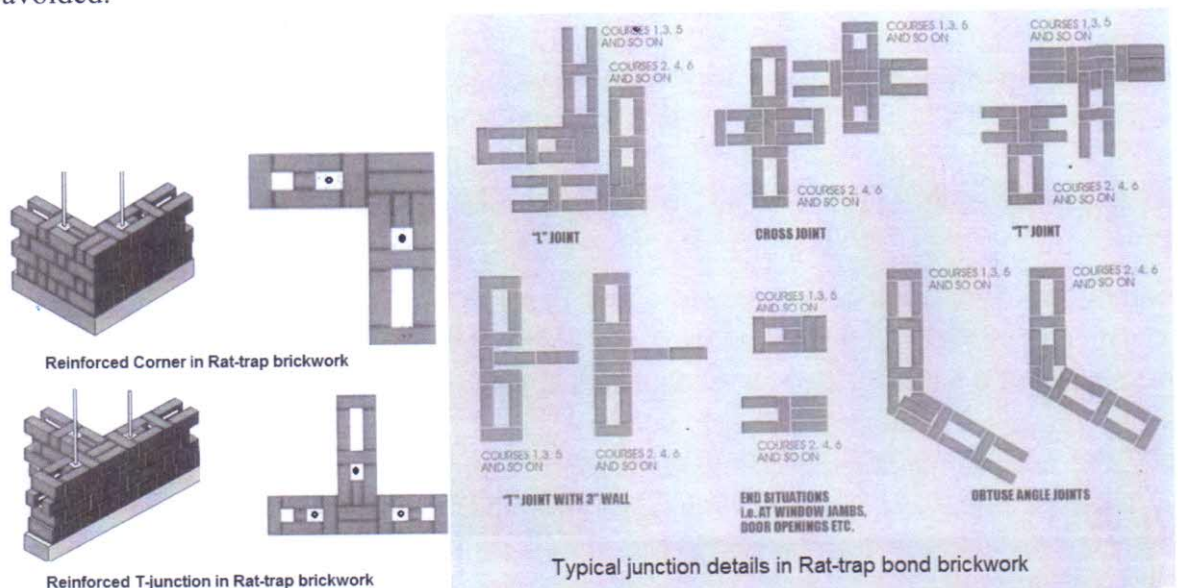
It is suggested to adopt 1 ft. height above ground level for the plinth and may be constructed with a cement mortar of 1:6. The plinth slab of 4 to 6" which is normally adopted can be avoided and in its place brick on edge can be used for reducing the cost. By adopting this procedure the cost of plinth foundation can be reduced by about 35 to 50%. It is necessary to take precaution of providing impervious blanket like concrete slabs or stone slabs all-round the building for enabling to reduce erosion of soil and thereby avoiding exposure of foundation surface and crack formation.

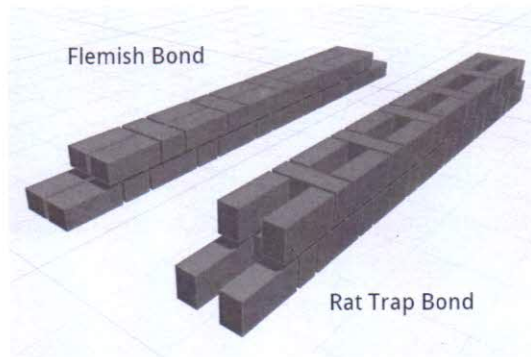
Walling:-

Wall thickness of 6 to 9 Inches is recommended for adoption in the construction of walls all-round the building and 4 1/2" for inside walls. It is suggested to use burnt bricks which are immersed in water for 24 hours and then shall be used for the walls.

Rat – trap bond wall:-

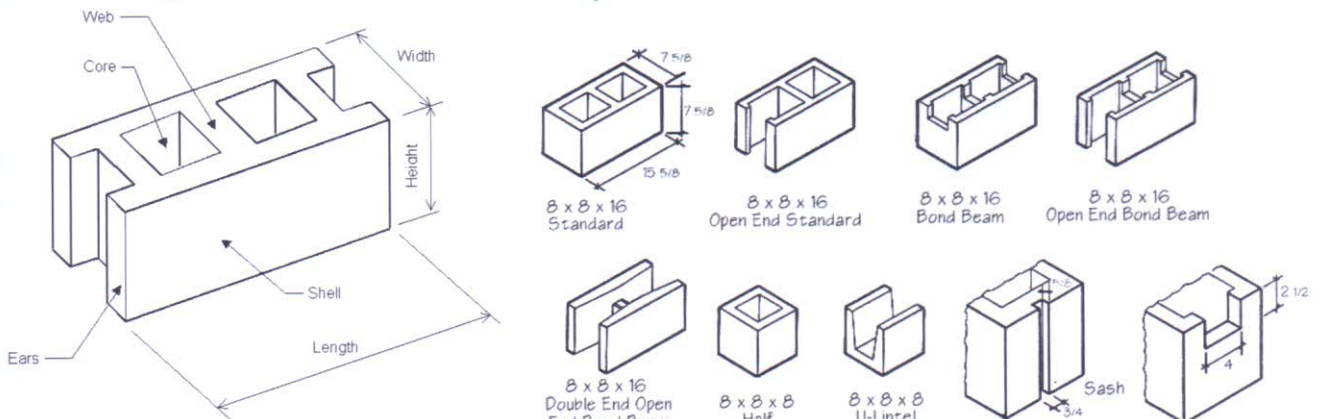
It is a cavity wall construction with added advantage of thermal comfort and reduction in the quantity of bricks required for masonry work. By adopting this method of bonding of brick masonry compared to traditional English or Flemish bond masonry, it is possible to reduce in the material cost of bricks by 25% and about 10 to 15% in the masonry cost. By adopting rat-trap bond method one can create aesthetically pleasing wall surface and plastering can be avoided.





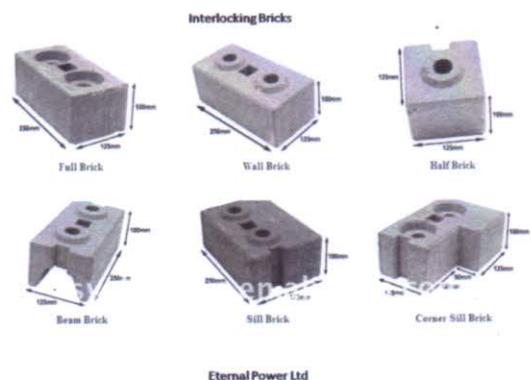
Concrete block walling:-

In view of high energy consumption by burnt brick it is suggested to use concrete block (block hollow and solid) which consumes about only 1/3 of the energy of the burnt bricks in its production. By using concrete block masonry the wall thickness can be reduced from 20 Centimeters to 15 Centimeters Concrete block masonry saves mortar consumption, speedy construction of wall resulting in higher output of labour, plastering can be avoided thereby an overall saving of 10 to 25% can be achieved.



SOIL CEMENT BLOCK TECHNOLOGY

It is an alternative method of construction of walls using soil cement blocks in place of burnt bricks masonry. It is an energy efficient method of construction where soil mixed with 5% and above cement and pressed in hand operated machine and cured well and then used in the masonry. This masonry doesn't require plastering on both sides of the wall. The overall economy that could be achieved with the soil cement technology is about 15 to 20% compared to conventional method of construction.



Doors and windows:-

It is suggested not to use wood for doors and windows and in its place concrete or steel section frames shall be used for achieving saving in cost up to 30 to 40%. Similarly for shutters commercially available block boards, fiber or wooden practical boards etc., shall be used for reducing the cost by about 25%. By adopting brick jelly work and precast components effective ventilation could be provided to the building and also the construction cost could be saved up to 50% over the window components.

Lintels and Chajjas:-

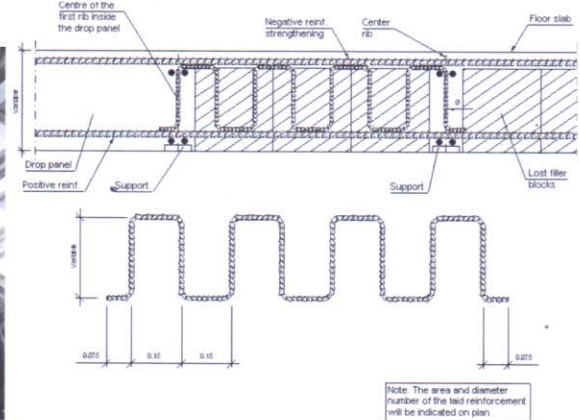
The traditional R.C.C. lintels which are costly can be replaced by brick arches for small spans and save construction cost up to 30 to 40% over the traditional method of construction. By adopting arches of different shapes a good architectural pleasing appearance can be given to the external wall surfaces of the brick masonry.

Roofing:-

Normally 5 Inches (12.5 Centimeters) thick R.C.C. slabs is used for roofing of residential buildings. By adopting rationally designed in situ construction practices like filler slab and precast elements the construction cost of roofing can be reduced by about 20 to 25%.

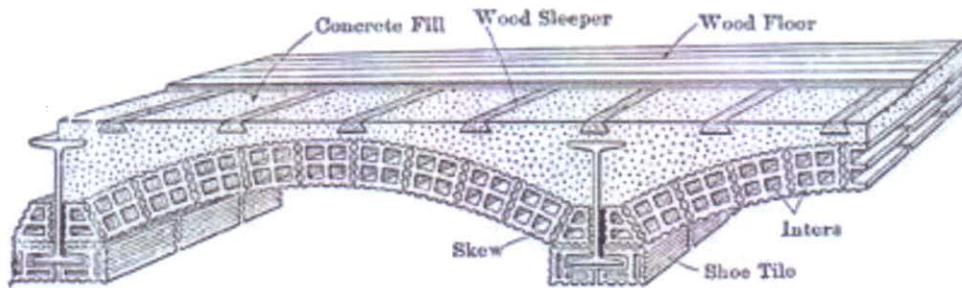
Filler slabs:-

They are normal RCC slabs where bottom half (tension) concrete portions are replaced by filler materials such as bricks, tiles, cellular concrete blocks, etc. These filler materials are so placed as not to compromise structural strength, result in replacing unwanted and nonfunctional tension concrete, thus resulting in economy. These are safe, sound and provide aesthetically pleasing pattern ceilings and also need no plaster.



Jack arch roof/floor:-

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.



Ferro cement channel/shell unit:-

Provide an economic solution to RCC slab by providing 30 to 40% cost reduction on floor/roof unit over RCC slabs without compromising the strength. These being precast, construction is speedy, economical due to avoidance of shuttering and facilitate quality control.

Finishing Work:-

The cost of finishing items like sanitary, electricity, painting etc., varies depending upon the type and quality of products used in the building and its cost reduction is left to the individual choice and liking.

CONCLUSIONS

Mass housing targets can be achieved by replacing the conventional methods of planning and executing building operation based on special and individual needs and accepting common denominator based on surveys, population needs and rational use of materials and resources. Adoption of any alternative technology on large scale needs a guaranteed market to function and this cannot be established unless the product is effective and economical. Partial prefabrication is an approach towards the above operation under controlled conditions. The essence lies in the systematic approach in building methodology and not necessarily particular construction type or design.

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About Amity School of Architecture & Planning

Amity University Madhya Pradesh (AUMP) is established by the Ritnand Balved Education Foundation (RBEF), New Delhi to promote professional, industry-oriented education in the state of Madhya Pradesh. Amity University Gwalior, located on 100 acres of land opposite Gwalior Airport, conducts modern, practical and research-based courses, leading to the development of manpower which is employable and industry ready. Amity School of Architecture & Planning (ASAP) in AUMP was established in 2012. The main focus of ASAP is to cater for the demands of professionals like architects & interior designer in the market. Development of cutting edge technologies, imparting high quality education and conducting research in the emerging trends are the main features of the Institute.

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