Innovative techniques for low-cost rural housing

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Additional Information:

- This is a conference paper.

Metadata Record: https://dspace.lboro.ac.uk/2134/29716

Version: Published

Publisher: © WEDC, Loughborough University

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ABSTRACT
The need for integrated development of rural areas including the necessary infra-
structure, such as roads, water supply, electricity, primary education, health, etc. in addition to the provision of house
sites was emphasised by the conference of State Ministers of Housing and Urban
Development of their meeting held at Madras. The housing problems need
serious considerations. The housing situation in rural areas is still more
grave because of neglect of rural hous-
ing over a period of years.
Surveys made by the United Nations and the specialized agencies to ascertain prev-
sailing housing conditions in the world show with minor exceptions that they
are so unsatisfactory that extraordinary steps must be taken within reason-
time in order to master the situation. It has been estimated that the present
shortage of housing in the country is 34.7 million. At the present rate of
increase in population of the country as well as the present rate of construc-
tion of housing shortage will swell to 50 million dwellings by the year 2000.
The yearly production of dwellings is presently estimated at 8 million. It
would be possible technically to control the situation if, during the present
decade, the production could be increased to an average of 12 million dwellings
per year and thereafter for each decade be further accelerated so that between
1990 and 2000 the production will be about 25 million dwellings. This gigantic
problem poses a serious challenge to planners and construction engineers to
reduce construction costs and to use the limited resources in the most economi-
cal manner.
In this paper the authors have made an
attempt to discuss the factors influencing building cost and to suggest some appropriate techniques for reducing
building cost for low cost rural housing so as to meet the ever-growing demand.

INTRODUCTION
Now-a-days, low cost housing has become a crying need in almost all developing
countries. Increase in population, industrialisation and urbanization, migration
of more low income people to cities, increase in cost of construction material,
etc. are the factors that contribute to this very situation. Different efforts
are being made by all developing countries to tackle the problem in differ-
ent ways. The planning design research and construction of low cost houses for
developing countries are taking place according to the needs and performance
requirements of the occupants.
Very recently it has been observed by the world bank that poor people are
becoming poorer and their number is increasing day by day. Dwelling facility
even for a very poor man is essential requirement of his life. Especially in
our country cost of basic building material is increasing day by day. There-
fore it is a challenge to every civil Engineer, Architect and Technocrat of
the country to think seriously on this aspect so that utmost desire of common
man having his own house is satisfied in his life period.
It is difficult to generalise the defini-
tion of low cost. The cost of building
depend upon many aspects such as
(i) Cost of land (ii) Basic material used
for construction (iii) Rate of skilled
and unskilled labourer and auxiliary
facilities such as water supply and san-
itation. Low cost can be defined as lower-
ing overall cost as compared to alterna-
tives available of a comparable
quality. Moreover it also depends upon
the optimum utilization of the land and
local material, employment of locally
available skilled and unskilled labourer
and mode of design or design approach.

Philosophy of Low Cost Housing:
Central Building Research Institute has
devoted its almost entire effort over
last about 40 years to solve this
problem. The approach had been mainly
as under.

Materials: The philosophy which is being
adopted by CBRI to reduce the cost is
in savings on materials where they are
not needed particularly in a section of
the roofing and use of alternate material
like lime, flyash, agricultural and
industrial wastes in place of expensive
and vital building materials without
affecting strength and durability of the
finished product.

Speed of Construction: The conventional construction of a horizontal component for shuttering, requires considerable time in erection and curving period while with prefabricated component this time is saved to a large extent. This accelerates the rate of construction considerably.

Standardisation: The design of house are being standardized for different plinth area and for different categories of users with emphasis on modular construction.

BUILDING COST REDUCTION TECHNIQUES
The various techniques contributing the reduction in the cost of a house are (i) Planning and Design, (ii) Selection of materials (iii) Construction Technology (iv) Construction Management & (v) Cost Planning.

Planning & Design:
Apart from the fact that building must be designed according to the functional requirements, several aspects of planning have a direct impact on its cost such as - plan shape, size of building, circulation space, storey height, area of opening and number of storeys. Structural design influences the overall cost of a building considerably. By the use of latest theories of design, the cost of a structure can be brought down.

Selection of Materials:
In any dwelling unit, the cost of building materials is between 50% to 70% of the total cost. It is therefore quite clear that the reduction in cost of any dwelling unit would largely depend on economy in use of materials and use of locally available materials in preference to scarce and costly materials. In the name of durability, the relatively affluent section of the rural population has of late started using to a great extent cement and steel, many times out of proportion. As a nation starving for its development it should be our policy to see that use of cement and steel where it can be substituted should be discouraged. For example the use of clay with good binding property and lime can be tried in place of cement for reducing constructing cost of building. Another area where economy can be achieved is in the services, the cost of which can vary from 10% to 20% of the cost of a building.

Construction Technology:
Application of appropriate technology in construction works is an area where planners can play an effective role in reducing the cost of a building. Obsolete technology though often liked by some of the planners prove costly and it is time consuming, this may be due to lack of faith and lack of fair trial of the new technologies developed in the country. Another factor which is more important while selecting any specification/material or construction technique is that the cost should be seen both in short as well as in long term perspective. A technique or specification economical in the first cost but consuming more maintenance cost may prove costly in long run.

Public works are generally executed on contract basis by open competitive tendering. There are different types of contract e.g., measurement contract, lump sum contract and cost plus fee type of contract. It is also felt by the builders, architects and engineers in the field that there is a prime necessity to formulate a need based contract term with equitable conditions of contract for smooth running of a project which will ultimately result in savings in time and reduction in cost.

Construction Management:
To deal successfully with many difficult and complex management problems, the management is required to ensure judicious allocation and efficient use of resources i.e., the management aims at making the best use of all the resource. Modern management techniques like CPM and PERT are vital tools for timely and economical completion of projects.

Cost Planning:
Adequate control of expenditure is a prerequisite for successful completion of any project, which requires for accurate forecasting of construction estimates and comprehensive planning in the early stages of a project in order to avoid variations, deviations etc. which play havoc during execution. For this computer aided estimating for accurate and rational forecasting of the project cost is necessary. The problem of cost over-runs can also be effectively checked by monitoring the progress of work along with frequent cost checks on the pre-allocated cost to each element through a process technically known as cost-planning technique.

RECENT DEVELOPMENTS IN CONSTRUCTION TECHNIQUES FOR RURAL HOUSE
In rural areas, the vast majority of houses are made of mud walls and thatch roof. A number of such houses collapse during rainy season due to erosion of the walls. To protect the walls from
moisture penetration, and prolong their life, CBRI, Roorkee has developed a technique called 'Plinth Protection of Mud Walls' where burnt clay brick wall is built around the mud wall for a height of 60-75 cm. above ground level. The joints in the brick work are pointed with cement:sand mortar 1:4.

To protect mudwalls from weathering, non-erodible mud plaster, prepared by mixing bitumen cutback to ordinary mud-mortar can be used. The treatment is non-erodable, water repellent and durable. It provides safety against the collapse of walls in rainy season. The fire-resistance of existing thatch roof can be improved by applying a layer of non-erodable mud plaster over its top surface, after suitable strengthening measures of the supporting structure to carry the extra loads are taken.

Thatch is the most commonly used roof in rural areas. However, being of organic origin, it is susceptible to natural weathering, vulnerable to insect attack and fire. CBRI has developed a new method of laying thatch roof by using manually pressed thatch panels and making it water-proof and fire retardant by applying non-erodable mud plaster over it.

Due to absence of any drainage system in rural areas, the water from the house is generally discharged in the streets making them unserviceable and creating unhygienic conditions. CBRI has developed a system to dispose off waste water coming from kitchen and bath. The waste water is first passed through silt and ash trap chamber, where the heavy particles are settled down and floating particles are trapped in the next chamber filled with brick ballast. The clean water is disposed off in a bore hole.

Disposal of night soil through underground sewerage or in septic tank is not feasible in rural areas due to their high initial and maintenance cost. Pit type latrines with hand flush type seat is found most appropriate and economical for rural areas. CBRI has developed a suitable design for low-cost latrines.

RURAL HOUSE SPECIFICATIONS:
To minimise the overall cost of a rural house, the general specifications of the common type of rural house may be as follows:

Foundation Concrete:
It may be 15 cm. thick and of any one of the following:
(a) Mud concrete with kankar of brick ballast. (b) Simply well compacted kankar or brick ballast in the presence of required quantity of water. (c) Weak cement concrete of 1:6:12 with brick ballast. (d) stabilised soil with about 33% brick ballast of 40mm nominal size well graded with 1% cement or other stabilised soil. (e) Lime concrete 1:3:2:100 with brick ballast.

Foundation and Plinth:
The foundation and plinth may be any one of the following:
(a) Stabilised soil rammed mud wall with 3% to 5% cement laid in situ. (b) Stabilized soil with cut back asphalt. (c) Second class brickwork with 1:3 lime mortar. (d) Second class brickwork with 1:8 cement mortar. (e) Cement concrete hollow blocks with 1:1:10 (cement:lime:sand) mortar. (f) Burnt brick or stone in mud mortar.

Damp-proof course (D.P.C.):
It may be one of the following:
(a) Two coats of asphalt painting. (b) 2 cm. thick 1:2 mix cement mortar with required water-proofing compound. (c) 2.5 cm. thick 1:2:4 cement concrete with required water-proofing compound.

Superstructure:
It may be one of the following:
(a) Stabilized soil rammed mud wall with 3% to 5% cement. (b) Burnt brick or stone in mud mortar. (c) Second class bricks in lime mortar. (d) First class bricks in lime mortar. (e) First class bricks in 1:6 cement mortar. (f) Cement Concrete Hollow block masonry in 1:1:10 (cement:lime:sand) mortar. (g) Stabilized soil brick with premoulded stabilized soil bricks laid in stabilized soil mud mortar. (h) Precast concrete solid blocks in lime flyash mortar. (i) Precast concrete wall units.

Door, Window Frames:
It may be any of the following materials:
(a) First class brick work laid in 1:4, Cement: Sand mix, (b) Precast cement concrete. (c) Locally available timber. (d) Stone. (e) Steel rolled sections.

Lintels:
It may be one of the following materials:
(a) Stone. (b) R.B.Work. (c) Precast R.C.C. (d) Locally available timber.

Roof:
It may be one of the following:
(a) Slapy roof with A.C. sheets over wooden structure. (b) Slapy roof with Mangalore tile, Allahabad tiles, or similar other tiles laid over wooden structure. (c) Country tiles laid over
bamboo jafr and ballies. (d) Slate roofing supported over wooden structure. (e) Stone slabs laid over wooden structure. (f) Brick tiles laid over wooden structure. (g) Jack arch roofing. (h) R.B. roofing.

Flooring:
It may be one of the following: (a) Mud flooring with gobri lepping. (b) Moorum Flooring with gobri lepping. (c) Flag stone flooring. (d) Flat Brick flooring. (e) Brick on edge flooring. (f) Lime concrete flooring. (g) Cement concrete flooring. (h) Soil cement stabilized flooring with gobri lepping.

Plastering and finishing:
It can be any of the following types, depending upon the type of walls and roof: (a) Stabilized soil rammed walls Stabilized soil brick walls, shall be plastered with 12mm. thick water proof mud plaster or with soil cement plaster. (b) No further treatment shall be required over precast concrete solid blocks, cement concrete hollow blocks, precast concrete wall units. (c) All types of brick masonry walls shall be plastered with 1:6 (cement:mortar). (d) Walls of kitchen bath, latrine and cattle shed should be plastered with 10 to 16mm thick 1:6 cement, sand, mortar up to 60cm. to 100cm. height from floor level.

Doors and Windows Shutters:
These shall be made with local timber with ordinary steel fittings. The shutters may be of battened or panelled type.

Sanitary Fittings:
P.R.A.I. type or pit latrine fitted with glazed stone ware soil pipe, water traps etc. shall be provided. Pucca open drains shall be constructed in the courtyards, and all other places as per requirements.

CONCLUSION
Low cost construction does not necessarily mean low quality. It only means pruned specifications as against conventional specifications. Considerable R & D work has been done and a large number of economical and efficient building materials and construction techniques have been developed by various research organisations, their application in the building industry has not been to the desired extent. Engineers and builders have a great role to play in popularising the new techniques developed by research organisations. By the use of traditional materials and construction methods alone, it will not be possible to construct houses and other buildings at a pace to match with the ever increasing demand.

In fact low cost housing is a challenge to high calibre engineering. Search for new innovations and materials and development of simple processes for their utilisation should be our constant endeavour.

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