VARIOUS COST REDUCTION TECHNIQUES EMPLOYED IN HOUSING CONSTRUCTION

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The main thrust of building research has been to improve upon the conventional practices and develop new prefabricated and cast-in-situ construction methods, mechanical aids, modern management techniques to achieve appreciable reduction in cost and time of construction and to effect maximum possible saving in the consumption of costly and scarce materials like cement and steel as well as improving quality in construction. Techniques for construction of walls and roofs were developed with a view to make an optimum use of local materials such as soil, bricks, lime and timber.

The Central and State Construction Departments, Housing Boards, Development Authorities and other construction agencies either on charitable or voluntary basis have come forward for promoting the innovative techniques in their large scale housing programmes. Some important innovative techniques are used by these agencies for the construction of walls, roofs and building services (eg: drainage) which consume over 50 % of building cost.

Premier R& D institutions engaged in the field of building technology

like central Building Research Institute (CBRI), Roorkee, structural Engineering Research Centre (SERC), Chennai, National for cement and Building materials (NCB) Ballabgarh and the Regional Research Laboratories etc. have played an important role in the development of cost effective construction techniques and materials.

On the other hand, organisations like National Building Organisation (NBO) New Delhi, Building Materials and Technology Promotion Council (BMPTC) New Delhi, Housing and Urban Development Corporation (HUDCO), New Delhi and Housing Development Finance Corporation (HDFC), the National Network of Nirmithikendras under the aegis of HUDCO and COSTFORD centres throughout the state have been playing useful role in the promotion of innovative construction techniques evolved by the afforesaid research institutions in the country. NBO had experimented with 60 innovative cost reducing techniques in as many experimental projects.

Amongst 60 types of construction techniques only two dozzen techniques found wider application in large scale housing programmes. Emphasis was laid on partial prefabrication instead of total prefabrication in the construction of NBO experimental buildings. Such a system leads to saving in cost and speed in construction.

Out of these precast components successfully employed in the experimental buildings precast roofing units viz, reinforced concrete (RC) channel units, precast RC solid plants and joists, precast- RCC lintels, stone block masonry are note worthy. Other popular technologies emerging out of successful field trial of the innovative techniques include the concept of construction of 4-5 storeyed buildings having single-brick (23 cm) load bearing walls, in all the storeys, double storeyed construction with 19 cm load bearing masonry walls use of 11 cm (half brick) thick load bearing masonry construction having Z-shape in cross section for the urban poor and single slack system of plumbing.

The adoption of chemical specification for mortars and plasters, as tried out in several experimental projects, is by now a routine affair in the construction of buildings under the large scale housing programmes taken up by several housing agencies across the country for the Economically Weaker Sections (EWS) and Low Income Group (LIG), categories of the population.

Several alternative building materials like secondary species of timber, dry-hydrated lime, flyash and plastics had been successfully tried out under several NBO experimental projects. Flyash, an industrial waste from thermal plants, has been experimented in a bigway under several such NBO projects sponsored by the Neyveli Lignite Corporation (NLC) Military Engineering

service (MES), Haryana Housing Board and Tamilnadu Housing Board etc. It was tried out as partial replacement of cement in plaster and mortar and in the production of bricks and blocks. The results of such experimentation have been quite encouraging.

The Building Materials Technology Promotion Council (BMTPC) under the ministry of Urban Affairs and Employment has undertaken identification of potential technologies which could help in larger utilisation of industrial wastes like flyash, phosphogypsum and blast furnace slag in construction industry. The council has prepared technical profiles in respect of clay-flyash burnt bricks, fly-ash-sand-lime bricks, cellularconcrete components, alumina red mud bricks and phosphogypsum based building components for their larger exploitation in building acivities.

The popular cost-effective construction techniques promoted by Nirmithi Kendra and COSTFORD include Rat-Trap Bond, Filler Slab, Brick Arches and Waffle Shell system for roofing. Now, burnt clay bricks are being replaced by factory - produced concrete blocks. Similarly, newer construction techniques are also being used.

In the private sector, shirke - siporex consortium, pune has relied on the concept of total prefabrication for mass housing programmes. The firm manufactures pre-cast hollow columns and beams, lightweight concrete

slabs and blocks and wall panels with swedish know-how which has been extensively used in construction of over 100,000 dwelling units of all categories both in India and abroad.

The Tunnel Form System of Prefabrication for mass housing programmes promoted by ECC construction Group of L & T (Larson and Tubro), Bangalore, is yet another construction techniques which deserves mention in the context of technological options for housing for the masses. Under this system, the walls and floor slabs are cast in a continuous pour of concrete using room - size structural steel framework called "Tunnel Form". This technique of construction has been successfully employed in construction of 1,500 dwelling units measuring 75 m^2 each for the employees of Tata Iron and Steel Company Ltd. (TISCO) at Jamshadpur. The entire construction, which was based on the knowhow acquired from a French Firm "SPECTRA" was completed within a period of only 32 months.

Very recently the largest cement manufacturer in the country "The Associated Cement Companies Ltd" has also acquired "Tunnel Form" construction techniques from a Danish Firm "Scan Form Building System Ltd". The company is contemplating in the use of this system for mass-housing constructions.

Thus, there is enormous potential in terms of technical capabilities

available in the country which could be Judiciously exploited for providing affordable housing to the masses. Thus, before embarking upon a particular technology it is important to work out the "Cost Effectiveness". In case of thin precast flooring/roofing units, due attention should be given to the proper detailing of Joints and for ensuring diaphragm action of such roof/ floor.

Therefore, while undertaking any mass housing programme, due consideration is required to be given to the holistic approach to the various issues related to it such as financial resources, land availability, provision of necessary infrastructural services, selection of suitable cost effective construction techniques and materials etc.

4.1 SOME COST REDUCTION TECHNIQUES NOW IN PRACTICE

For cutting down the construction cost various cost reducing devices have been introduced by Nirmithi at National level and COSTFORD Centres in the state for their large scale housing construction. Some of them are the following.

4.1.1 Thinner walls or single brick thick walls

Using thinner walls in construction and single brick thick walls, enhance the structural safety of buildings.

4.1.2 Load bearing brick work

It is now possible to construct 4-5 storey buildings in load bearing brick-work. By the adoption of this technique 5 - 15 percent saving in cost is achieved depending upon the structural requirements, type and strength of bricks etc. Over 1,60,000 houses have so far been constructed with this technique by the major construction agencies like central PWD (CPWD). Delhi Development Authority (DDA), Military Engineering Service (MES), Tamil Nadu Housing Board, Tamil Nadu Slum Clearance Board, PWD West Bengal and Uttarpradesh etc.

It is recommended by CBRI that due to the adoption of thinner section of wall and newer type of bonding, the load carrying capacity of walls subjected to axil and eccentric loads should be reduced by 15 percent. By the adoption of 19 cm thick walls 17 percent saving in construction of bricks and mortar is achieved. As both the faces of the walls are even, only 10 mm thick plaster is required. An additional advantage by the use of this technique is the increase in floor area for the same plinth area. Using this techniques several LIG and EWS houses were completed at Ludhiana under NBO Experimental Housing Scheme. Some houses were constructed in Tamil Nadu also.

4.1.3 Brick-on-Edge Cavity Wall

The Central Building Research Institute (CBRI) Roorkee has

developed a technique of construction of brick-on-edge 20 cm thick cavity wall (CBRI Data Sheet 1972) which consists of two masonry leaves each of 7.5 cm thickness with a continuous air gap of 5 cm between them. The leaves are tied together either by corrosion proof metal ties or brick or concrete blocks. Two storey residential builddings could be constructed with such cavity of bricks having crushing strength not less than 100 N/mm^2 and mortar not leaner than 1 : 3 in cement or 1 : 1 : 6 in cement and lime.

The adoption of brick cavity walls result in a saving of upto 30 percent in bricks and mortars, 15 percent in overall cost as compared to 23 cm thick brick walls and the inner leaves remains dry. This technique was used for the construction of middle school buildings in shantinagar, Roorkee and by University of Roorkee for lecturer's residences. It was also used under NBO Experimental Housing Scheme for Assistant Professor quarters at Thapar Institute of Technology, Patiala and Several double storey quarters in Gandhi Nagar Township, Gujarat, and a large number of both institutional and residential buildings in Tamil Nadu and Kerala.

4.1.4 Precast stone masonry block

Stone masonry wall is 15-20 percent cheaper in cost as compared to random rubble masonry where bricks are costly. A large number of houses have been costructed with stone masonry blocks in different parts of the country by different construction organisations. In the Northern districts

of Kerala, majority of the houses are constructing by using precast stone masonry block. In Andrapradesh and west Bengal Prefab factories have come up which supply these blocks.

4.1.5 Modular Brick Masonry Walls

To introduce and achieve the benefits of modular planning in building construction it is necessary to produce bricks in a module of 10 cm. The nominal size of modular brick is 20 cm x 10 cm and so it has some advantages over the conventional bricks viz, (i) it gives more floor area (ii) results in upto 10% saving in the quantity of bricks and 24% in the consumption of mortar and (iii) consumes less clay and coal.

4.1.6 Hollow Clay Blocks For Shell Type Houses

Hollow clay blocks are arranged in a category profile and supported over a foundation of random rubble or brick masonry. The shell serves both as wall and roof for the house. There is considerable saving in cement and no steel is used. About 15% saving in cost could be achieved. A large number of houses have been constructed with hollow clay blocks in the states of Kerala and Tamil nadu.

4.1.7 Sundried Brickwalls with Waterproof Treatment

The use of mud walls is still a predominant feature in villages. Such walls require continuous attention and repair every year as the rain erode

them. CBRI Roorkee has developed a non-erodable mud plaster which makes the walls water repellent. When the mud plasteris partially dry a leaping of cowdung and soil (1:1) is applied. When it is dry, the surface can be white or colour washed if desired.

4.1.8 Precast Hyperbolicshell for roofing

By adoption of Hyperbolic shell roofing system (NBO 1980) beams and columns could be avoided and long spans such as stores, halls, etc. could be covered in an economical way. The use of such type of shells require less maintenance and are aesthetically pleasing.

Anyway, the proper handling of man-power and materials requirement is very necessary to reduce the construction cost. An estimate of man power and materials is generally required prior to the start of actual construction for seeking technical and other administrative sanction, calculating the requirement of various materials and labour, planning and budgeting purposes, calling and Justification of tenders etc.

4.2 TYPE OF CONSTRUCTIONS IN KERALA

There are various types of building constructions generally applied by the low-cost housing agencies in Kerala. Some of them are viz, (i) modular constructions (ii) Wood - Frame Modular Constructions (iii) Masonry Modular Constructions, (iv) Plant and Beam Constructions, etc... A brief description about each of them is given below.

4.2.1 Modular constructions

Modular construction is a method of designing and building a house in which the component parts sized according to some agreed upon basic unit of length or module.

4.2.2 Wood-Frame Modular Construction

The National Forest Products Association has developed what it calls the Unicom method of house construction that seeks to fit traditional lumber sizes and building products into the 4 - in-module. The object is to maximise the use of modular components and minimise the cost of construction.

4.2.3 Masonry Modular Construction

Modular masonry construction is also in the 4-in-module, although the individual bricks and concrete blocks are not. A masonry wall, is ofcourse, constructed with mortar joints between the masonry units and in modular construction the thickness of these mortar joints is considered part of the modular dimension.

4.2.4 Plank-and-Beam construction

Also known as "post and beam construction". It is a method of building the framework of a house in which fewer but much heavier timbers are used instead of the light or and more closely spaced joists, studs and rafters of more traditional wood frame construction.

However, innovations and their application keep society growing, dynamic and competitive and help in improving peoples welfare overtime, We need to train our manpower resources in such a way that we can reach international levels of technology and quality in some fields and gain a reputation and self- reliance at international level. In every major fields today, machine tools, electronics, chemicals, technology and so on we are dependent on foreign collaboration. This is not to say we must not have foreign collaboration but to stress that we must learn from it and build on it on the basis of a clearly understood strategy.

Further, in areas where we have no access to foreign scientific and technological knowledge and we decide that the ends are important enough, there are proven instances of success. Nuclear energy and space applications are outstanding examples where although we are not fully self-sufficient we have made phenominal progress (Vinod Vyasulu 1993).