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Methodology Used In Low Cost Housing

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ABSTRACT: This reports aims to designate the various feature of prefabricated building methodologies for affordable housing by highlighting the different prefabrication techniques, and the economic advantages achieved by its application. The work was executed with cost effective technologies foe walling, roofing and other pre-cast elements. The work comprised of rcc framed structure with walls 200mm thick with mechanized fly ash bricks. The foundations, columns and beams were casted-in-situ. The slabs were pre-casted with RCC plank and joist technology and rcc planks and joists are casted with m-25cement concrete.

Keywords: Prefabrication; Precast R.C.C., precast joist, Ferro cement products, Fly Ash, Precast R.C.C. Joists and Planks.

INTRODUCTION

Housing is one of the basic need of an individual and not all of them do have a shelter for their survival. In India alone 27 million units of housing has been traced to be in shortage. In depth maximum of population who lack housing are the *economically weaker section* and the *middle class.* There is a dire need for the country to patch up this large population. If we fail to manage with housing and shelter within this population, the shortage is sure to increase to 38 million units by 2030. A radical change is need of an hour. Though providing shelter to millions is a pretty tough and a huge task, there has to be a remedy for this problem [4,5].

Problem Statement: Ramky Infrastructures Ltd. has been handling Engineering, Procurement and Construction assignments for the past few decades, and has been acquired its status as one of India's top Infrastructure Firm due to the excellent construction management and Cost-Reducing practices that it follows. *The author felt it worthwhile to undertake a detailed study of these practices, the rationale behind these practices and a real-life instance of their implementation in an on-going construction project, namely the Construction of Low-Cost Houses for Urban Slum Rehabilitation in Sector-3, Bawana undertaken by D.S.I.I.DC and overseen by Ramky Infrastructure Limited*in which the company is tackling India's affordable housing crisis with construction technologies that bend the cost curve and make quality homes attainable to low income families in the EWS segments.

Literature Review: Low Cost Housing is a new concept which deals with effective budgeting and following of techniques which help in reducing the cost of construction through the use of locally available materials along with improved skills and technology without sacrificing the strength, performance and life of the structure. There is a huge misconception that Low Cost housing is suitable for substandard works and they are constructed by utilizing cheap building materials of cheap quality. The fact is that Low Cost housing is done by proper management of resources. Economy is also achieved by postponing finishing works or implementing them in phases.

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.

There should be a logical approach for providing appropriate technology based on the availability of options, considering its technical and economic analysis.

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.

Building Cost can be divided in three parts namely:Building Material Cost= 65 to 70%, Labor Cost= 20%, andOthers= 10%

Now in Low Cost housing, building material cost is less because we make use of the locally available materials and also the labor cost can be reduced by properly making the time schedule of the work. Cost of reduction is achieved by selection of more efficient material or improved design [4,6].

II. RESEARCH METHODOLOGY

Project Profile

Name of the Agency: Ramky Infrastructure Limited
Location of site : Bawana-III, Delhi
No. of Units : 6480 EWS Houses (G+4)
Built-up area of a unit: 132.56 sqm.
Unit consist of: 1 LR, 1 Bedroom, 1 Kitchen, 1 Bathroom, 1WC, 1 Balcony
Nodal State Agency: D.S.I.I.D.C.

Particular Specifications for Alternative Technologies for Housing

Building Work:-The work was executed with cost effective technologies foe walling, roofing and other pre-cast elements. The work comprised of RCC framed structure with walls 200mm thick with Mechanized fly ash bricks. The foundations, columns and beams were casted-in-situ. The slabs were pre-casted with RCC plank and joist technology and RCC planks and joists are casted with M-25cement concrete. The roofing and intermediate slabs compromise of pre-cast RCC planks 75mm thick placed on partially pre-cast RC joists. The shelves are in pre-cast Ferro cement elements. The sunshades are pre-cast RCC [5].

III. PROPOSED MECHANISM

Technology and Specifications

The Specifications of the work are mentioned in the following table consisting of all the activities adopted by Ramky Infrastructure Limited during the construction mentioned in Column 3 and the respective DSR clauses in Column 2 [1,2].

S. No.	DSR Clauses	Activity Involved
		I. EARTH WORK
.1	2.8.1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.
	2.8.1	All kinds of soil
.2	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth: consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m
.3	1.1.2	Carriage of earth by mechanical transport including loading unloading and stacking up to 5 km lead
.4	2.27	Supplying and filling in plinth with Jamuna sand under floors including, watering, ramming consolidating and dressing complete.
		II. CONCRETE WORKS
.1	(4.1.10)	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level.
	4.1.2	1:1½:3 (1 Cement: 1½ coarse sand: 3 graded stone aggregate 20 mm nominal size).
	4.1.10	1:5:10 (1cement : 5 coarse sand: 10 stone aggregate 40mm nominal size)
.2	A.R. (4.2.7 - 4.1.7)	Extra for concrete work in super structure above plinth level up to floor V level
		III. R.C.C WORKS
.1	5.33A	Providing and laying in position machine batched, machine mixed and machine vibrated design mix cement concrete of specified grade for reinforced cement concrete work including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing, and reinforcement. Including Admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. M-25grade reinforced cement concrete by using 380kg. of cement per cum of concrete. All work above plinth level up to floor V level.

S. No.	DSR Clauses	Activity Involved
		III. R.C.C WORKS
.2	5.38	Extra for R.C.C./ B.M.C/ R.M.C. work above floor V level for each four floors or part thereof.
.3	5.9	Centering and shuttering including strutting, propping etc. and removal of form for :
	5.9.1	Foundations, footings, bases of columns, etc. for mass concrete.
	5.9.5	Lintels, beams, plinth beams, girders, bressumers and cantilevers.
	5.9.6	Columns, Pillars, Piers, Abutments, Posts and Struts.
	5.9.7	Stairs, (excluding landings) except spiral-staircases.
	5.9.16	Edges of slabs and breaks in floors and walls.
	5.9.16.1	Under 20 cm wide
.4	5.22	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete at all level.
	5.22.1	Mild steel and medium tensile steel bars
	5.22.6	Thermo-Mechanically Treated bars 500/500D
		as per design & drawing
.5	AR DSR based	Providing, hoisting and fixing up to floor five level precast reinforced cement concrete in lintels, beams and bressumers including setting in cement mortar 1:3 (1 cement : 3 coarse sand), cost of required centering and shuttering but excluding the cost of reinforcement using M 25 design mix concrete with minimum cement 380 kg per cum of concrete.
.6	AR DSR based	Providing, hoisting and fixing up to floor five level precast reinforced cement concrete in Planks including setting in cement mortar 1:3 (1 cement : 3 coarse sand), cost of required centering, shuttering but excluding the cost of reinforcement with M 25 design mix concrete with minimum cement 380 kg per cum of concrete.
.1	6.1.2	Brick work with F.P.S. bricks of class designation 75 in foundation and plinth in cement mortar1:6 (1 cement : 6 coarse sand)
.2	6.4	Brick work with F.P.S. bricks of class designation 75 in superstructure above plinth level up to floor V level in all shapes and sizes in :
	6.4.1	Cement mortar 1:4 (1 cement : 4 coarse sand)
.3	6.34	Brick work with modular fly ash lime bricks (FALG Bricks with 5% cement content) conforming to IS:12894-2002, class designation 100 average compressive strength in super structure above plinth level up to floor V level in:
	6.34.2	Cement mortar 1:6 (1 Cement : 6 coarse sand)
.4	6.5	Extra for brick work in superstructure above floor V level for each four floors or part thereof by mechanical means by lifting material using mobile crane.
.5	AR DSR Based	Half brick masonry with modular (FALG Bricks with 5% cement content) in superstructure above plinth level up to floor V level.
	6.13.2	Cement mortar 1:4 (1 Cement : 4 coarse sand)
.6	6.14	Extra for half masonry in superstructure above floor V level for every four floors or part thereof by mechanical means by lifting material using mobile crane.
.7	6.15	Extra for providing and placing in position 2 Nos. 6mm dia. M.S. bars at every third course of half brick masonry (with F.P.S. bricks)
.8	5.18	Providing, precast cement concrete Jali 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6mm nominal size) reinforced with 1.6 mm dia mild steel wire including centering and shuttering, roughening cleaning, fixing and finishing in cement mortar 1:3 (1 cement : 3 fine sand) etc. complete excluding plastering of the jambs, sills and soffits.
	Note:	(Partially in veranda/staircase landing railing)
	5.18.2	40 mm thick
		IV Flooring Work
.1	11.3	Cement concrete flooring 1:2:4(1 cement: 2 coarse sand :4 graded stone aggregate) finished with a floating coat of neat cement including cement slurry but excluding the cost of nosing of steps etc. complete

S. No.	DSR Clauses	Activity Involved
		IV Flooring Work
	11.3.1	40 mm thick with 20 mm nominal size stone aggregate
.2	11.6	Cement plaster skirting (up to 30 cm height) with cement mortar 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement.
	11.6.1	18 mm thick
.3	11.26.1	Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab including rubbing and polishing complete with base of cement mortar 1:4 (1 cement : 4 coarse sand) :
	11.26.1	25mm thick
.4	11.36	Providing and fixing 1st quality white ceramic glazed wall tiles conforming to IS: 15622 (thickness to be specified by the manufacturer) of approved make in as approved by Engineer - in- charge in skirting, risers of steps, and dados over 12 mm thick bed of Cement Mortar 1:3 (1 cement: 3 coarse sand) and jointing with grey cement slurry @ 3.3 kg per sqm including pointing in white cement mixed with pigment of matching shade complete.
.5	11.13	Providing & fixing glass strips in joints of terrazzo / cement concrete floors.
	11.13.1	40 mm wide and 4 mm thick
.6	11.31	Extra for pre finished nosing in treads of steps of Kota stone/ sand stone slab (for Kitchen slab).
.7	11.35	Providing and fixing M.S. angle 25x25x3 mm to act as nosing with lugs of M.S. bar 6mm dia 20 cm long forked at end 60cm apart (minimum three lugs to be provided) including necessary welding and applying a priming coat of approved primer on exposed surface etc. complete.
		V. FINISHING WORK
.1	13.1	12 mm cement plaster mix :
	13.1.2	1:6 (1 cement: 6 fine sand)
.2	13.7	12mm cement plaster finished with a floating coat of neat cement of mix:
	13.7.2	1:4 (1 cement: 4 fine sand)
.3	13.4	12 mm cement plaster mix :
	13.4.1	1:4 (1 cement : 4 coarse sand)
.4	13.22	Extra over Item No.6.3 for height above 10m.from ground level for external plaster.
.5	13.37	White washing with lime to give an even shade :
	13.37.1	New Work (three or more coats)
.6	13.5	Applying priming coat :
	13.50.1	With ready mixed pink or grey primer of approved brand and manufacture on wood work (hard and soft wood)
	13.50.3	With ready mixed red oxide zinc chromate primer of approved brand and manufacture on steel galvanized iron / steel works.
.7	13.61	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade :
	13.61.1	Two or more coats on new work
.8	13.46	Finishing walls with Acrylic Smooth exterior paint of required shade :
	13.46.1	New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including base coat of water proofing cement paint applied @ 2.20 kg/ 10 sqm).
		VI. ROOFING WORKS
.1	22.7	Providing and laying integral cement based waterproofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc. consisting of following operations.

S. No.	DSR Clauses	Activity Involved
		VI. ROOFING WORKS
	a)	Applying a slurry coat of neat cement using 2.75 kg. / sqm of cement admixed with waterproofing compound conforming to IS:2645 and approved by Engineer-in-charge over the R.C.C. slab including adjoining walls up to 300mm height including cleaning the surface before treatment.
	b)	Laying brick bats with mortar using broken bricks/brick bats 25mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with waterproofing compound conforming to IS:2645 and approved by Engineer-in-charge over 20mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with waterproofing compound conforming to IS:2645 and approved by Engineer-in-Charge over 20mm thick layer of cement mortar of mix 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.
	c)	After two days of proper curing applying a second coat of cement slurry using 2.75 Kg/Sqm of cement admixed with waterproofing compound conforming to IS:2645 and approved by Engineer-in-charge.
	d)	Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement : 4 coarse sand) admixed with waterproofing compound conforming to IS : 2645 and approved by Engineer-in-charge laying glass fiber cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making of 300x300 mm square 3mm deep.
	e)	The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed & specified by the Engineer-in-charge.
	22.7.1	With average thickness of 120 mm and minimum thickness at Khurra as 65 mm
.2	22.5	Water Proofing treatment with tape Crete/armourerete as per CPWD specifications on 12mm bed of plaster, treatment again protected by 12mm cement plaster 1:3 finished with a coat of neat cement
.3	12.41	Providing and fixing on wall face unplasticised-Rigid PVC rain water pipes conforming to IS :13592 Type A including jointing with seal ring conforming to IS:5382 leaving 10 mm gap for thermal expansion.
	(i)	Single Socketed Pipes
	12.41.2	110 mm diameter
.4	12.42	Providing and fixing on wall face unplasterised - PVC molded fittings / accessories for unplasticised Rigid PVC rain water pipes conforming to IS:13592 Type A including jointing with seal ring conforming to IS:5382 leaving 10 mm gap for thermal expansion.
	12.42.5	Bend 87.5°
	12.42.5.2	110 mm bend
	12.42.6	Shoe (Plain)
	12.42.6.2	110 mm shoe
.5	12.43	Providing and fixing unplasticised -PVC pipe clips of approved design to unplasticised - PVC rain water pipes by means of 50x50x50mm hard wood plugs, screwed with M.S. screws of required length including cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand) and making good the wall etc. complete.
	12.43.2	110 mm
.6	12.46	Providing and fixing to the inlet mouth of rain water pipe PTMT (an Engineering thermoplastic) grating square (Slit) 150 mm square with a height of 8 mm and weighing not less than 100 gms.

CONCLUSION

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. The methodology for low cost housing has to be of intermediate type- less sophisticated involving less capital investment.

All the specifications given by the D.S.I.I.D.C. were followed properly and again Ramky Infrastructure Limited has proved its worth in the field of Engineering, Procuring and Construction.

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