International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 10 | Oct 2020 www.irjet.net p-ISSN: 2395-0072

Comparative Study of Precast Technique and Conventional Technique for Construction of Rehabilitated Villages in India

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ABSTRACT - *To meet the huge demand of affordable and sustainable housing, the construction industry must use advanced technique. Conventional construction technique will not be able to meet the need of mass housing and in the current scenario, it is clear that new construction technologies should be utilized to deliver homes fast with minimum labor and zero wastage of materials. But selection of the most appropriate one among the emerging technologies is a complex process and depends upon many factors like cost and time certainty, speed of construction, effectiveness in the use of materials etc. Precast technology is recognized worldwide as offering significant advantages. It include easier and quicker erection of the building structure. It helps to lower project cost, achieving tighter control over quality and less material waste as compared to conventional technique. In the recent years, enormous advancement of construction technology take place, from conventional site-based methods to a more dynamic combination of methods, has given new possibilities for construction industry. Also large number of innovative alternate building materials and low cost construction techniques have been developed through intensive research and development efforts during last four decades. This paper highlights comparative study of precast technique and conventional technique for construction of rehabilitated villages in India.*

Key Words: Conventional construction, Precast technology, Affordable, Rehabilitated

1. INTRODUCTION

In India, a large population base, rising income level and rapid urbanization has made housing industry a booming sector Indian Economy. According to the Ministry of Housing and Urban Poverty Alleviation (MHUPA) in 2012 "there were 18.78 million housing units short in urban India; nearly 95% of this shortfall was in the economically weaker sections (EWS) and low income group (LIG) housing". To meet the huge demand of affordable and sustainable housing, the sector must use advanced technique. Under the Pradhan Mantri Awas Yojana (PMAY) scheme, affordable housing scheme is being taken up by the state Government's adopting the modern technologies of construction. Conventional construction is also continued by the state Government's in the rural sector, as the contractors are not available for construction using the modern Technologies. One of the technologies being adopted by the State Govt. are Monolithic construction technology and is also called as shear wall technology. This paper presents the possibility of using the precast technology also for the affordable houses and for construction of rehabilitated villages in India.

2. METHODOLOGY

Methodology adopted for "Comparative study of precast technique and conventional technique for construction of rehabilitated villages in India" is as follows:

2.1 Collect data about the rehabilitated villages in Maharashtra

Katavadi Khurd is a rehabilitated village of Urmodi dam located in Khatav Taluka, in Satara district of Maharashtra state, India. Karad is nearest town to Katavadi Khurd. Karad is 30 KM from Katavadi Khurd. Road connectivity is there from Karad to Katavadi Khurd. Katavadi Khurd is a rehabilitated village having 124 plots each having around 185 sq.m area. Out of 124 plots 70 plots are empty and 54 housing units are present in Katavadi Khurd village.

Government have provided almost all basic amenities like safe drinking water, waste water drainage system, sanitation, housing, all weather road to village, electrification, fuel, connectivity, Healthcare Centre, school, playground and many more but houses were built by owners by using cast-in-situ technique and then government provided them money used for construction of houses as a compensation amount.

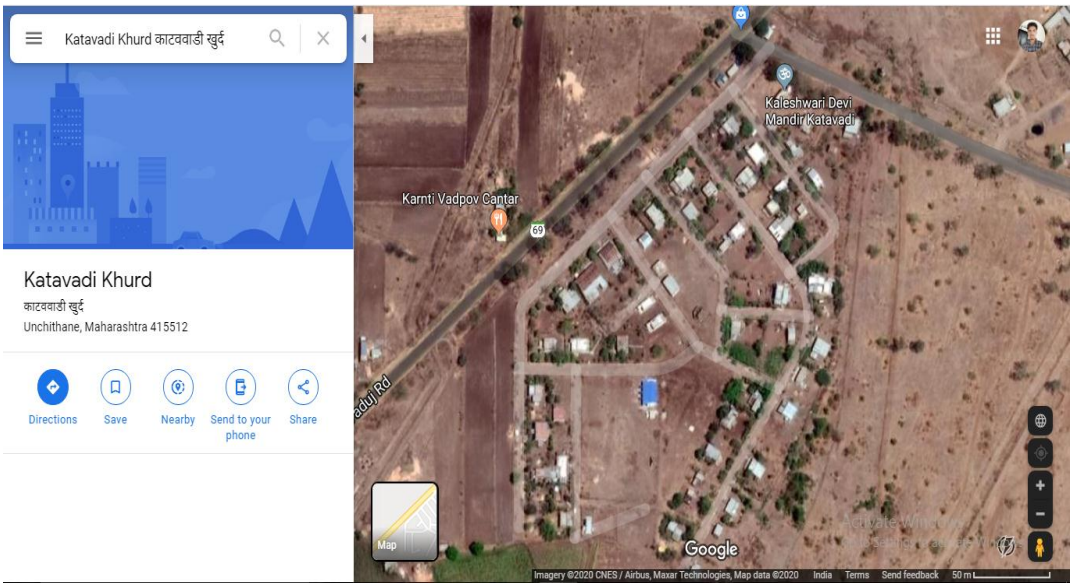


Fig- 2.1: Katevadi Khurd village map

(Ref. Google map**)**

Cast-in-situ is the conventional method of concreting. In this Method concrete is prepared on the site and poured in formwork and then cured. It often requires more labours and even takes longer time.

2.2 Conventional construction site

Construction site of staff quarters of primary health center (PHC) Pusegaon, Satara is visited several times to collect data about the project and then study all available estimates of construction site which is constructed by using conventional construction technique.

2.3 Identify the reasons how precast concrete is more essential for construction:

There are many drawbacks of this method like less quality, lesser speed of construction, high labour requirement etc. To overcome these drawbacks a new method of concreting can be adopted called as precast concrete method. Precast concrete method is accepted worldwide for its advantages over conventional concrete method.

2.3.1 Visit to precast plant

BG Shirke Kiwale precast unit plant, Pune is visited to collect data about the precast construction technique. Information collected at precast plant is then used to calculate estimate of rehabilitated village constructed by using precast technique.

3. RESULTS AND DISCUSSION

3.1 Model plan used for comparison

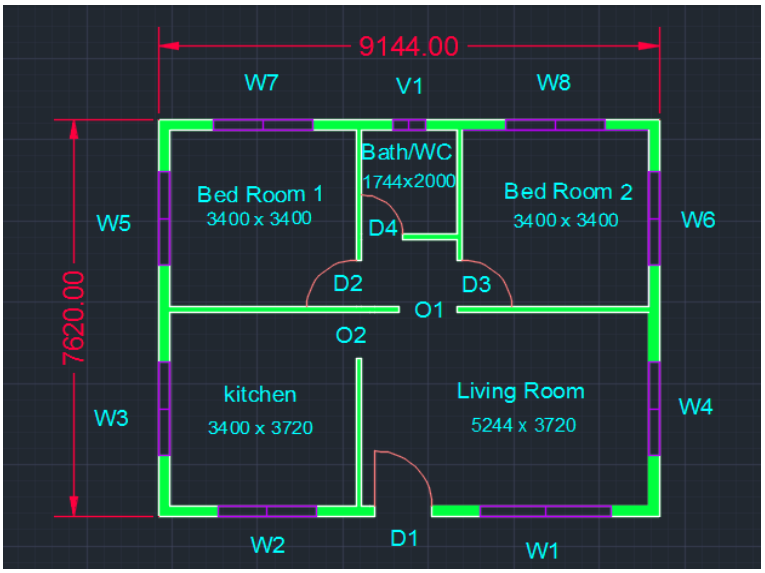


Fig - 3.1: Flore Plan

3.2 Conventional Technique

Element: Column

No.	Material	Unit	Quantity	Rate ₹	Cost ₹	
1	Concrete M20	(cum)	3.50	6000.00	20976	
	Sub Total		3.50			20,976
2	Rebar T8 (Fe500)	(kg)	146.17	54.00	7893	
3	Rebar T12 (Fe500)	(kg)	345.00	54.00	18630	
4	Rebar T16 (Fe500)	(kg)	163.00	54.00	8802	
	Sub Total		654.17			35,325
5	Shuttering	(sqm)	45.07	600.00	27044	
	Sub Total					27,044
	Grand Total					**83,345**

Element: Beam

No.	Material	Unit	Quantity	Rate ₹	Cost ₹	
1	Concrete M20	(cum)	3.46	6000.00	20770	
	Sub Total		3.46			20,770
2	Rebar T8 (Fe500)	(kg)	234.48	54.00	12662	
3	Rebar T10 (Fe500)	(kg)	39.96	54.00	2158	
4	Rebar T12 (Fe500)	(kg)	3.64	54.00	197	
5	Rebar T16 (Fe500)	(kg)	104.58	54.00	5647	
6	Rebar T20 (Fe500)	(kg)	24.51	54.00	1324	
	Sub Total		407.17			21,987

7	Shuttering	(sq.M)	31.61	600.00	18964	
	Sub Total					18,964
	Grand Total					**61,721**

Element: Slab

No.	Material	Unit	Quantity	Rate ₹	Cost ₹	
1	Concrete M20	(cum)	7.29	6000.00	43759	
	Sub Total		7.29			43,759
2	Rebar T8 (Fe500)	(kg)	664.83	54.00	35901	
	Sub Total		664.83			35,901
3	Shuttering	(sq.M)	58.35	600.00	35008	
	Sub Total					35,007
	Grand Total					**1,14,667**

Element: Wall

Brick wall construction

Brick size- 9 x 9 x19 (without mortar)
10 x 10 x 20 (with mortar)
Quantity required- 6500 (external wall)
2100 (internal wall)

Total no. of bricks required = External wall bricks + Internal wall bricks
= 6500 + 2100
= 8600
Price of brick with mortar = 11.95 Rs
Total cost required = 8600 x 11.95 = **102770 Rs**

3.3 Precast Technique

Element: Column

Precast column for M25 Grade
Column Size = 0.35 x 0.35 x 2.820 M
Total volume = 0.35 m3
Steel required = 46 kg
R.M.C rate for 1m3 concrete = 5531 Rs.
For 0.35 m3 concrete cost = (5531 x 0.3) = 1936 Rs
Labour cost for 1 column = 125 Rs
Erection cost for 1 column = 46 Rs
Total cost required for 1 column
Concrete = 1936 Rs
Steel cost = 46 x 54(Rate/KG) = 2484 Rs
Labour cost = 125 Rs
Erection cost = 46 Rs
Total column cost = 4591 Rs
Total no of column required for 1 floor 10 No's
Total cost = 4591 x 10 **= 45910 Rs**
1m3 Rate for column = 13117 Rs

Element: Beam 3m

Precast Beam for M25 Grade
Total volume of Beam = 4.92 m3
Steel required 407.17 kg
R.M.C rate for 1m3 concrete = 5531 Rs.
For 4.92 m3 concrete cost 27213 Rs
Labour cost for 15 beam = 42 x 15 = 630 Rs.
Erection cost for 1 beam = 22 Rs.
Total 15 no's of Beam = 22 x 15 = 330 Rs.
Total cost required for 15 no's of beam
Concrete = 27213 Rs
Steel cost = 21987 Rs
Labour cost = 630 Rs
Erection cost = 330 Rs
Total beam cost = **50160 Rs**
1m3 Rate for Beam = 10195 Rs

Element: Slab

Siporex Slab Panels

Siporex is produced by a highly advanced factory process under the control of chemists and engineers, Siporex products are made either as steel reinforced (panels) or as unreinforced blocks. Panel size is 2 to 3 meters wide, breadth 600mm and thickness 125mm. The basic raw materials are sand and cement.

Sr. No.	Size	Reqd. No's per floor	Cost per panel (Rs)	Total cost (Rs)
1	3000 X 600 X 125	20	2190	43800
2	2500 X 600 X 125	20	1825	36500
3	2000 X 600 X 125	16	1460	23360
45				**103660**

Table - 3.1: Cost and no. of siporex slab panels required for single floor slab of project

Total cost required for 45 panels = 103660 Rs
Erection cost for 1 panel = 15 Rs.
Total 45 no's of panels = 15 x 45 = 675 Rs.
Total cost required for 45 no's of panels
Cost for slab panels = 103660 Rs
Erection cost = 675 Rs
Total slab panel cost = **104335** Rs
The dowel bars for beam, column and reinforcement steel for floor screed is laid on complete floor. The screed of 40 mm thickness is laid on the top of panels with a nominal reinforcement of 8 mm diameter @ 230 mm c/c having concrete M25 grade.

Screeding of 40 mm
Total volume of screeding = 2.67 m3
For M25 grade rate of 1 m3 of concrete = 5531 Rs
Steel required = 225.89 kg
Total Screeding cost
Concrete cost = 2.67 x 5531 = 14768 Rs.
Steel cost = 225.89 x 53.9 = 12198 Rs
Total cost = 26966 Rs
Total cost for slab = 104335 + 26966 = **131301 Rs**

Element: Wall

AAC Block wall construction

AAC block size- 200 x 200 x 600 (external wall)
100 x 200 x 600 (internal wall)
Quantity required- 540 (external wall)
350 (internal wall)

Total no. of AAC blocks required = External wall AAC blocks + Internal wall AAC blocks
= 540 + 350
Price of AAC block:
External wall AAC blocks (size: 200 x 200 x 600 mm) = 72 Rs
Internal wall AAC blocks (size: 100 x 200 x 600 mm) = 48 Rs
Total cost required = (540 x 72) + (350 x 48) = **55680 Rs**

Sr. No.	Components	Conventional Cost in (Rs)	Precast Cost in (Rs)	Differences in Cost (Rs)
1.	Column	83345	45910	37435
2.	Beam	61721	50160	11561
3.	Slab	114667	131301	-16634
4.	Wall	102770	55680	47090
Total		362503	283051	**79452**

Table – 3.2: Cost comparison Housing Structure

Other structures present at katavadi khurd

1. School building
2. Sabha mandap
3. Water tank
4. Bus stop

These structures are constructed by using conventional technique. As for sub-structure and finishing work total cost and time required is considered same. So, cost and time required for column, beam, slab and wall is calculated for these structures.

Sr. No.	Components	Reqd.no. per floor	Conventional cost in Rs	Precast cost in Rs	Difference
1	Column	22	183370	101002	82368
2	Beam	27	169123	125238	43885
3	Slab panels	110	250614	287028	-36414
4	bricks/AAC	29895/2853	343792	205416	138376
			946899	718684	**228215**

Table - 3.3: Cost comparison School Building

Sr. No.	Components	Reqd.no. per floor	Conventional cost in Rs	Precast cost in Rs	Difference
1	Column	4	33340	18364	14976
2	Beam	4	29736	22020	7716
3	Slab panels	20	58968	67536	-8568
			122044	107920	**14124**

Table – 3.4: Cost comparison Sabha Mandap

Sr. No.	Components	Reqd.no. per floor	Conventional cost in Rs	Precast cost in Rs	Difference
1	Column	8	66680	36728	29952
2	Beam	8	19824	14680	5144
3	Slab panels	6	6552	7504	-952
			93056	58912	**34144**

Table – 3.5: Cost comparison Water tank

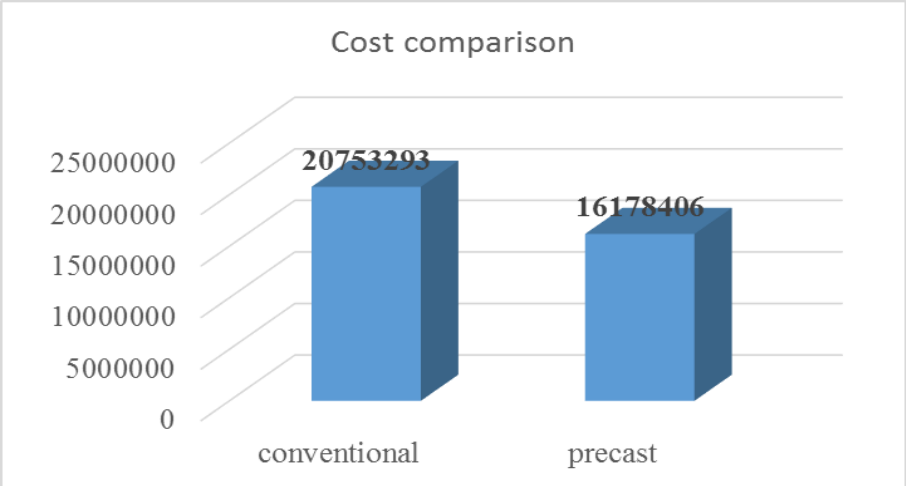
Sr. No.	Components	Reqd.no. per floor	Conventional cost in Rs	Precast cost in Rs	Difference
1	brick/AAC	1350/113	16132	8136	7996
			16132	8136	**7996**

Table – 3.6: Cost comparison Bus stop

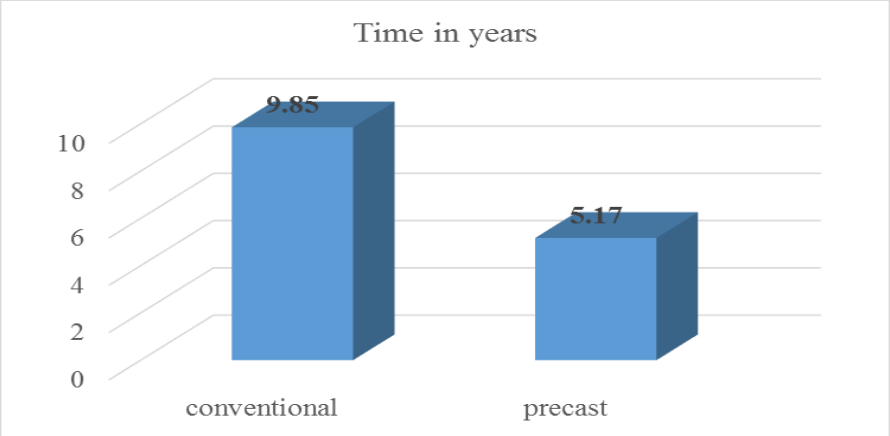
Sr. No.	Structures	Conventional cost in Rs	Precast cost in Rs	Difference in cost
1	54 houses	19575162	15284754	4290408
2	School Building	946899	718684	228215
3	Sabha Mandap	122044	107920	14124
4	Water tank	93056	58912	34144
5	Bus stop	16132	8136	7996
Total		20753293	16178406	**4574887**

Table – 3.7: Cost comparison of total project

For total project we can save **4574887 Rs** if we use precast technique instead of conventional technique.



Time calculated by using MS Project.
For conventional technique total time required is 9 years 10 months.
And by using precast technique total time required is 5 years 2 months.
Total time we can save is 4 years 8 months.



4. CONCLUSIONS

Precast technique more essential for construction of rehabilitated villages in India. Cost and time required to complete the project by conventional technique is more than precast technique. Precast method help to reduce on-site waste. The precast technology can used for the affordable houses also. Conventional construction technique will not be able to meet the need of mass housing and in the current scenario, it is clear that new construction technologies should be utilized to deliver homes fast with minimum labour and zero wastage of materials. If precast technique is used over conventional technique in India it can be very useful and advantageous to solve housing problem. Maximum number of homes with greater quality and in minimum time can be provided by using precast technique than using conventional technique.

REFERENCES

[1] N. Nanyam, R. Basu, A. Sawhney and J. K. Prasad, "Selection framework for evaluating housing technologies," (ELSEVIER)-Creative Construction Conference, vol. 10, no. 44, pp. 333-341, 2015.

[2] A. Baldwin , C.-S. Poon, L.-Y. Shen, S. Austin and I. Wong, "Designing out waste in high rise residential building: Analysis of precasting methods and traditional construction," (ELSEVIER)-Renewable Energy, vol. 2, no. 08, pp. 2067-2073, 2009.

[3] S. K. Lachimpadi, J. J. Pereira, M. R. Taha and M. Mokhtar, "Construction waste minimisation comparing conventional and precast," (Elsevier)-Resources, Conservation and Recycling, vol. 68, no. 1, pp. 96-103, 2012.

[4] G. Polat, "Factors Affecting the Use of Precast Concrete Systems in the United States," (ASCE)-Journal of Construction Engineering and Management, vol. 134, no. 3, pp. 169-178, 2008.

[5] M. GREENE, C. GODAVITARNE, F. KRIMGOLD, S. NIKOLIC-BRZEV and J. PANTELIC, "OVERVIEW OF THE MAHARASHTRA, INDIA EMERGENCY EARTHQUAKE REHABILITATION PROGRAM," World Conferences on Earthquake Engineering (WCEE), pp. 1-8, 2000.

[6] S. S. Murari and A. M. Joshi, "PRECAST CONSTRUCTION METHODOLOGY IN CONSTRUCTION INDUSTRY," Elsevier, pp. 1-8, 2017.

[7] P. P. Thorat, D. Gore, K. Kalapure and S. Chavan, "REHABILITATION OF MALIN VILLAGE," International conferance, pp. 1-5, 2017.

[8] L. Ropelewski and R. D. Neufeld, "THERMAL INERTIA PROPERTIES OF AUTOCLAVED AERATED CONCRETE," (ASCE) JOURNAL OF ENERGY ENGINEERING, pp. 59-75, 1999.

[9] E. Briihwiler, W. Jia and F. H. Wittmann, "FRACTURE OF AAC AS INFLUENCED BY SPECIMEN DIMENSION AND MOISTURE," (ASCE) Journal of Materials in Civil Engineering,, vol. 2, no. 3, pp. 136-146, 1990.

[10] D. Getz and A. M. Memari, "Static and Cyclic Racking Performance of Autoclaved Aerated Concrete Cladding Panels," (ASCE) JOURNAL OF ARCHITECTURAL ENGINEERING, vol. 12, no. 1, pp. 12-23, 2006.

[11] A. Bhosale, N. P. Zade, R. Davis and P. Sarkar, "Experimental Investigation of Autoclaved Aerated Concrete Masonry," Journal of Materials in Civil Engineering, vol. 31, no. 7, pp. 1-11, 2019.

[12] J. H. Matthys and R. E. Barnett, "New Masonry Product for the US Designer Emerges –Autoclaved Aerated Concrete," (ASCE), pp. 1-11, 2004.

[13] M. Kalpana and S. Mohith, "Study on autoclaved aerated concrete: Review," (ELSEVIER) Materials Today: Proceedings, pp. 1-3, 2019.

[14] B. Baris , E. Canbaya, A. Aldemirb, I. O. Demirela, U. Uzganc, Z. Eryurtluc, K. Bulbulc and A. Yakuta, "Seismic behavior and improvement of autoclaved aerated concrete infill walls," (ELSEVIER) Engineering Structures, pp. 68-81, 2019.

[15] A. Bhosale, N. P. Zade, R. Davis and P. Sarkar, "Experimental Investigation of Autoclaved Aerated Concrete Masonry," ASCE, pp. 1-11, 2019.

[16] L. S. Pheng and C. J. Chuan, "JUST-IN-TIME MANAGEMENT OF PRECAST CONCRETE COMPONENTS," (ASCE), vol. 127, no. 6, pp. 494-501, 2001.

[17] B. Wang, Q. Li, F. Liu, S. Xu, H. Zhou and K. Tan, "Comparison of Cast-In-Situ and Prefabricated UHTCC Repair Systems under Bending," (ASCE), pp. 1-11, 2017.

[18] A. Warszawski, M. Avraham and D. Carmel, "UTILIZATION OF PRECAST CONCRETE ELEMENTS IN BUILDING," (ASCE), vol. 110, no. 4, pp. 476-485, 1984.

[19] Z. Zhou and Y. Wang, "Study on the Interactive Relationship between Prefabricated Buildings and Sustainable Affordable Housing Construction," (ASCE), pp. 1-6, 2018.

[20] M. GREENE, C. GODAVITARNE, F. KRIMGOLD, S. NIKOLIC-BRZEV and J. PANTELIC, "OVERVIEW OF THE MAHARASHTRA, INDIA EMERGENCY EARTHQUAKE REHABILITATION PROGRAM," (WCEE), pp. 1-8, 2000.

[21] N. Nanyam, R. Basu, A. Sawhney, H. Vikram and G. Lodha, "Implementation of Precast Technology in India Opportunities and Challenges," (ELSEVIER), pp. 144-151, 2017.