

# Analytical Comparison between Conventional Construction Technique and Precast Concrete Construction System

Ar. Ravi P. Mishra, Prof. Chidambar S. Dudgekar

Shri Prince Shivaji Maratha Boarding House's College of Architecture, Kolhapur, Maharashtra, India

## ABSTRACT

Precast concrete construction system - 3D volumetric is one of the most remarkable developments in the construction of concrete structures. In recent decades, precast concrete elements have been widely used for architectural and structural buildings. The construction method is mainly divided into two stages: manufacture of mass-produced components in a permanent construction facility, and erection of units on the construction site. The use of precast concrete construction systems has increased in recent years particularly in developed countries because these systems provide the advantages of construction effectiveness, high levels of quality control, saving construction time, minimization of skilled labor, reduced manpower requirements on site and savings in formwork requirements. As the adaptation of this system is at a very early stage in India, so very little study has been carried out in the context of the Indian construction industry. This research paper attempts to analyze the model in comparison with Light House project at Jagarnath in Ranchi and with Xrbia Project Lohegaon and get that Precast concrete construction system is 18% less cost as compared to conventional system on the other hand the cost equipment and machinery is on higher side about 46.5% more but still the overall cost is less as the system reduces the time by almost 50%.

**KEYWORDS:** Precast construction system, Conventional Construction system, Precast Concrete

## 1. INTRODUCTION

The concept of Precast concrete construction system - 3D volumetric (also known as "modular") construction includes those buildings, where the majority of structural components are standardized and typical which are produced in plants in a location away from the building, and then transported to the site for assembly. These components are manufactured by industrial methods based on mass production in order to build a large number of buildings in a short time at low cost. Modular construction methods are often compared to building with blocks, because each building section is constructed to fit perfectly with the next one. This results in a high-quality product that's constructed in a safe, effective work environment.

Ultimately, modular prioritizes efficiency, durability, and quality control. There are various types of modules used in modular construction as follows:

- 4-sided modules.

- Partially open-sided modules.
- Open-sided (corner-supported) modules.
- Modules supported by a primary structural frame.
- Non-load bearing modules.
- Mixed modules and planar floor cassettes.
- Special stair or lift modules.

## 2. AIM AND OBJECTIVE

### Aim:

The ultimate aim of this research paper is to carry out the comparative analytical study of the Precast concrete construction system and conventional construction system in the terms of labor, machinery & equipment, curing cost requirement in site,

### Objective:

1. To study the precast concrete construction system - 3D volumetric in prospect of indian construction industry.
2. To systematically study the comparative analysis of the Precast concrete construction system and

**How to cite this paper:** Ar. Ravi P. Mishra | Prof. Chidambar S. Dudgekar "Analytical Comparison between Conventional Construction Technique and Precast Concrete Construction System" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-2, February 2022, pp.141-145, URL: www.ijtsrd.com/papers/ijtsrd49183.pdf



Copyright © 2022 by author(s) and International Journal of Trend in Scientific Research and Development Journal. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0>)



conventional construction system for live projects of similar scale and size.

### 3. LITERATURE REVIEW

#### **Krish R. Villaitramani and Dhruv P. Hirani**

In this paper the author has studied the feasibility of Prefabricated Construction for Mass Housing in Mumbai. Prefabrication of houses, an innovation that has potential to address environmental and sustainability concerns at a rapid pace, mechanizes the construction process, enabling mass manufacture of affordable houses. This paper discusses the case of Mumbai, the city of maximum slum population density in the world, where prefabrication can be a promising solution to housing scarcity. [6]

Author has reviewed in this paper to plan, analyze and design residential buildings using prefabricated techniques in Mumbai, bearing in mind, the cost of total construction and planning of the building are done in such a way that the maximum area utilization is achieved for minimum space and cost. Prefabrication has the capability to make a difference within the Indian construction industry in economic, social and environmental terms. It is essential that the potential benefits of this innovation are yielded so that required development can take place. [6]

#### **N. Dineshkumar and P. Kathirvel**

The main objective of the research paper is to study the present situation of the precast construction industry in India. Author has Proposals for improvement of the industry and study on cost effectiveness of precast concrete construction for single and multi-story residential buildings. The prefab construction for individual double story residential building cost is 13% more than the conventional construction. Prefab construction is easy to work and reduces the project duration of similar magnitude of project, reduced by 63 days when compared to the conventional. It's the main advantage for prefab construction and also it helps when there is labor shortage. As per the survey carried out by the author, the prefab constructions have more advantages and procurement in industrialized, heavy infrastructures. But in individual houses there are a lot of constraints and lack of knowledge that is struggling to be implemented in India. At this stage conventional construction is economical and comfortable when compared to the prefabrication construction. [2]

#### **VaishaliTurai and Ashish Waghmare**

Author has analyzed the precast practice followed in India with a case study. The paper is based on a cost comparison of precast concrete vs. cast-in-place concrete. Cost of any construction is directly varied with time of construction. Precast is manufactured in

a factory (i.e. in a controlled environment) with required quality, can easily mix, and cure with good quantity. Precast concrete is manufactured in factories and transported to site. The precast construction requires less manpower; laborers are required only to join precast members. That means indirectly saving cost on labours. [3]

In precast concrete construction wastage of materials is negligible as compared with cast-in-place concrete. Precast construction reduced the cost of construction required for maintenance of work. The cost of shuttering and deshuttering is eliminated by using precast and will result in saving total cost of construction. The cost of rework due to improper work, faulty construction method, unskilled labor, material quality, onsite environmental problems can be eliminated by using precast members. [3]

#### **B. Raghavendra K. Holla, SiddhantAnantet. Al**

This paper reviews and summarizes the role of time, cost, quality and productivity of the precast system in order to compare with the conventional. The productivity of the construction is high and wastes are minimal. Being a county with a large number of unskilled laborers, it gets difficult to work with heavy machinery without experience and the cost of transportation of structural elements from the factory to various sites is variable.

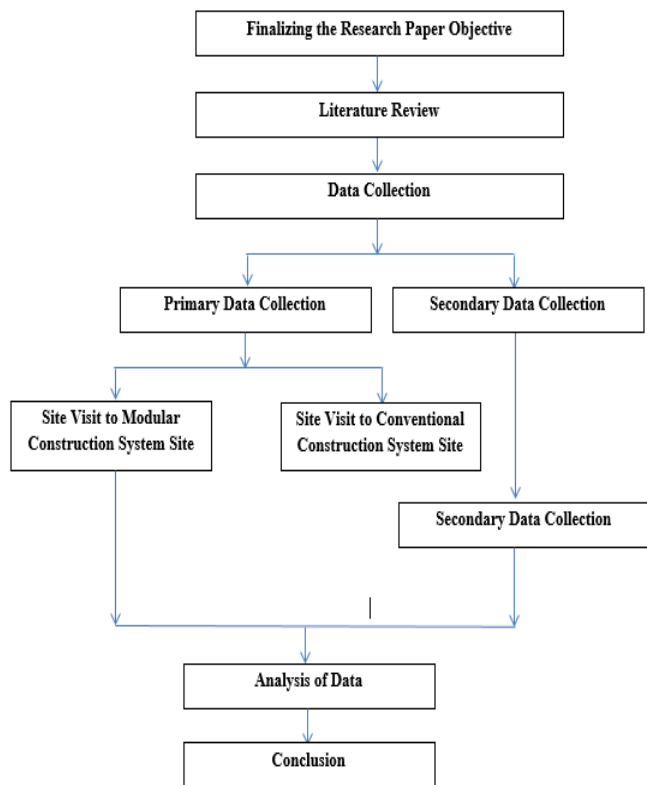
At present India has only 2% of skilled labor. To implement precast on a larger scale in India this percentage should be increased which can help in meeting the huge housing demand using precast. [4]

#### **AkashLanke and Dr. D. Venkateswarlu**

In this research paper the author has taken one building as a case & designed the same building as a precast building & Traditional Cast in-situ building. Author has made a cost analysis as well as feasibility check on the basis of costing & duration. Author analysis resembles the cost of precast building is significantly reduced & duration of construction is also much lesser than traditional methods. From all this study it has been concluded that the precast concrete system is more economical than conventional cast in place method but still there are some conditions which we have to take care of while using precast, those are quantity of construction, distance of site from manufacturing unit, type of building etc. [5]

### 4. METHODOLOGY

The primary data will be collected on site from concerned competent persons. All data analysis and reporting will be done on the basis of data obtained from site investigation.



For analytical comparison the case study taken into consideration for the Precast concrete construction system is India’s first large scale site Light House project, Rachi and for conventional construction system Xrbia Lohegaon project, Pune.

The study has been carried out in the form of the total cost of the construction system in live case studies varying the cost on site in cast in situ method and modular construction method for first floor. For cost analysis labor cost, machinery and equipment cost and water charges are considered into analysis. In this analysis one unit has been considered for analysis.

### A. Unit Cost Analysis for Conventional Construction

In this section the per unit cost analysis has been carried out in the form of manpower requirement and its cost in site, equipment and machinery costing as well as water requirement for both the methods. The data has been collected from respective site and from competent professionals used only for comparative research purpose.

## 5. CASE STUDY & ANALYSIS

**Table I Man power required for Conventional Construction System**

Srl. No.	Resources	Nos.
1.	Welders	2
2.	Carpenters & Labor	1
3.	Steel fixers	1
4.	Mason & Labor	0
5.	Laborers (mazdoor)	15
6.	Siling Operator	12
7.	Supervisor	18
8.	Steel Fixer Foreman	1
9.	Concreting In-Charge	9
10.	Electrician	1
11.	QC Inspector	1
<b>Total Manpower</b>		<b>61</b>

**Table II Labor Charges for Construction of One Unit for Cast In Situ**

Particular	Total Manpower	Avg. Daily Salary	Duration (Days)	Amount (Rs.)
Supervisor	2	800	40	64000
Steel Fixer Foreman	1	600	29	17400
Concreting In-Charge	1	600	26	15600
Welder	0	600	0	0
Carpenter & Carpenter Labor	15	400	14	84000
Mason & Mason Labor	12	600	8	57600
Steel fixer	18	700	40	504000
Electrician	1	700	26	18200
Labor (mazdoor)	9	750	12	81000
Siling Operator	1	650	18	11700
QC Inspector	1	700	25	17500
<b>Total Amount (Direct Labor Cost) ₹</b>				<b>871000</b>

**Table III Equipment & Machinery Charges for Construction of One Unit for Cast in Situ**

Description	Qty	Rent/Day or Hour	work in (Days)	Amount (₹)
Concrete mixture machine	1	1000/ Day	Approximately	15000
Lift for lifting the concrete	1	1200 /Day	40	48000
Concrete Boom Placer	1	1800/ Hour	15	15000
Other expenses		app.		10000
<b>Total Amount (₹)</b>				<b>88,000</b>

**Table IV Manpower required for Modular Construction System**

Srl. No.	Resources	Nos.
1.	Welders	2
2.	Carpenters & Labor	1
3.	Steel fixers	0
4.	Mason & Labor	1
5.	Laborers (mazdoor)	6
6.	Siling Operator	2
7.	Supervisor	6
8.	Steel Fixer Foreman	2
9.	Concreting In-Charge	5
10.	Electrician	8
11.	QC Inspector	2
<b>Total Manpower</b>		<b>35</b>

**Table V Labor Charges for Construction of One Unit for Modular Construction**

Particular	Total Manpower	Avg. Daily Salary	Duration (Days)	Amount (₹)
Supervisor	2	1200	6	14400
Steel Fixer Foreman	1	800	6	4800
Concreting In-Charge	0	800	4	0
Welder	1	600	2	1200
Carpenter & Carpenter Labor	6	600	4	14400
Mason & Mason Labor	2	700	6	8400
Steel fixer	6	1200	6	43200
Electrician	2	800	6	9600
Labor (mazdoor)	5	750	6	22500
Siling Operator	6	800	6	28800
QC Inspector	2	800	6	9600
<b>Total Amount (Direct Labor Cost) ₹</b>				<b>156900</b>

**Table VI Equipment & Machinery Charges for Construction of One Unit for Modular Construction**

Description	Qty	Rent/day	Work in days	Amount
40 T heavy mobile crane	2	10000	8	160000
4-5 T mobile crane	1	3050	8	24400
Miscellaneous	Approx.		Lumpsum	5000
<b>Total Amount (₹)</b>				<b>189400</b>

**Table VII Water Charges for Construction of One Unit for Modular Construction**

Type of Construction Project	Water Req / Unit (ltrs)	Rate (5.38 for 100 liter)
Cast in Situ	8,500	457.69
Modular	600	32.31

## 6. CONCLUSION

The construction industry in India has been hampered badly in a pandemic situation but after lockdown it has taken its growth grip and is escalating towards its boom. The pandemic situation has shown the mirror to the construction industry needing to be mechanized

and particularly the pinch of labor and material shortage in site has been felt.

On the basis of investigation the concluding performance of the modular construction system as



compared to conventional system is considered an excellent model for the rapidly changing construction industry.

1. Modular construction was found to be labor cost efficient and required around 18% cost only as compared to conventional structural systems of similar scale and size.
2. The equipment cost is on a higher scale as compared to conventional way of about 46.5% but still it's a saving and efficient due to the saving in terms of less duration of project.
3. The water requirement in modular construction is about 7% as compared to conventional system as maximum manufacturing has been done in manufacturing plant only. Requirement of less water in construction may be very influencing factor particularly in the area where water is scarce.

At present modular construction are the advanced construction techniques available over India and worldwide. Being its wide applicability, the total system is becoming a popular choice for many developed countries. The modular construction is the backbone for the development of new ideas in construction business; factory buildings, residential buildings and the industrial township are needed practically by all the sectors, either to support the manufacturing or services of any industry.

## References

### Paper

- [1] Greg Rice, Chairman Rapid Building Systems "Turning dreams into reality" The best solution for affordable mass housing in developing economies. Presentation to 2009 UN — Habitat Business Forum: Innovative Cities — New Delhi - 7 to 9 July, 2009, pp. 2 — 23.
- [2] Towards adoption of prefabrication in construction by Vivian W.Y. Tama, C.M. Tam, S.X. Zeng, William C.Y. Ng published in science direct, Building and Environment 42 (2007) 3642–3654 on Feb 2006.
- [3] State Of The Art: Research and Application of Precast / Pre-stressed Concrete Systems in Indonesia by SugengWijanto and TakimAndriono, published in The 14<sup>th</sup> World Conference on Earthquake Engineering, Beijing, China on Oct 2008.
- [4] Modelling of Factors Impacting Adoption of Precast Concrete Systems by Assistant Professor Dr. TanutWaroonkun and

ASSOCIATE PROFESSOR Dr. RawipornKoojaroenpaisan, published in Management and Innovation for a Sustainable Built Environment ISBN: 97890526939580 – 23 June 2011, Amsterdam, The Netherlands.

- [5] Erection of Building Construction Easy To Made by Mohak Patel, JayeshkumarPitroda and J.J.Bhavsar, published in International Conference on: "Engineering: Issues, opportunities and Challenges for Development" on April 2015, ISBN: 978-81-929339-1-7.
  - [6] A Case Study On Use Of Precast Technology For Construction Of High-Rise Buildings by Mr. Ram Kumar, Mr. Manoj Patterson and Mr. Sandeep Jain, Published at GETS 2016.
  - [7] Comparative Study on Prefabrication Construction with Cast In-Situ Construction of Residential Buildings by N.Dineshkumar and P.Kathirvel, published in IJISSET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 4, April 2015.
  - [8] A Study of Cost comparison of precast concrete vs. Cast-in-Place by VaishaliTurai and Prof. Ashish Waghmare, published in International Journal on Recent and Innovation Trends in Computing and Communication, Volume: 3 Issue: 11, ISSN: 2321-81696235 – 6238.
  - [9] Time, Cost, Productivity and Quality analysis of Precast Concrete System by B. Raghavendra K. Holla, SiddhantAnant, Muzzammil Ali Mohammad, AakashPeriwal, Aakash Kapoor, Published in IJISSET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 5, May 2016, ISSN 2348 – 7968.
  - [10] Design, Cost & Time analysis of Precast & RCC building by AkashLanke, Dr. D. Venkateswarlu, Published in International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 06 June-2016, e-ISSN: 2395 -0056, p-ISSN: 2395-0072.
- ### Books & Handbooks
- [1] "Hand book of RCC precast element."
  - [2] Public information published by Construction Industry Development Council, Planning Commission of India, "structural precast concrete handbook" buildable solution for high rise residential development