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Comparative Study of Labour Cost for Conventional Construction and Precast Construction in Pune

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ABSTRACT

Precast concrete elements are 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 assembly of components on the construction site. The use of precast concrete elements has increased in recent years because these precast concrete elements 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. Numerous researchers have studied the adoption model within their individual fields of study.

This study attempts to model the various factors that influence this industry's effectiveness in adopting precast concrete elements. These factors can be broadly defined as enablers and include the product characteristics, communication channels, management support and environmental impact. The performance and interaction between these enablers influence the degree of adoption achieved. Factor analysis was used to confirm and refine grouping of significant factors. In this research article the labour cost for conventional and precast project is analyzed and shows the man power (Labor) is 26% extra in conventional method.

Keywords: *Precast Construction, Conventional Construction, Building Construction*

1. INTRODUCTION

1.1 General

The concept of precast (also known as "prefabricated") construction includes those buildings, where the majority of structural components are standardized and 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.

1.2 Need for Prefabrication

1. Prefabricated structures are used for sites which are not suitable for normal construction method such as hilly region and also when normal construction materials are not easily available.
2. Prefabrication facilities can also be created at near a site as is done to make concrete blocks used in plane of conventional Knick.
3. Structures which are used repeatedly and can be standardized such as mass housing storage sheds, godowns, shelter, bus stand security cabins, site offices, foot over bridges road bridges. Tubular structures, concrete building blocks etc. are prefabricated structures.

1.3 Advantage of Prefabrication

- Self-supporting readymade components are used so the need for formwork shuttering and scaffolding is greatly reduced.
- Construction time is reduced and buildings are completed sooner allowing on earlier return of the capital invested.
- On-site construction and congestion is minimized.
- Quality control can be easier in a factory assembly line setting than a construction site setting.
- Prefabrication can be located where skilled labor, power materials space and overheads are lower.
- Time spent in bad weather or hazardous environments at the construction site is minimized.

- Availability of precise structure and expect workmanship.
- Work time is reduced.
- Less expansion joints are required.
- Interruptions in connecting can be omitted.
- Work is done with a better technology.
- Fewer workers are needed.
- Members can be used again.

1.4 Disadvantages of Prefabrication

- Careful handling of prefabricated components such as concrete panels or steel and glass panels is required.
- Attention has to be paid to the strength and corrosion-resistance of the joining of prefabricated sections to avoid failure of the joint.
- Similarly leaks can form at joints in prefabricated components.
- Transportation costs may be higher for voluminous prefabricated sections than for the materials of which they are made which can often be packed more efficiently.
- Large prefabricated structures require heavy-duty cranes & precision measurement and handling to place in position.
- Large groups of buildings from the same type of prefabricated elements tend to look drab and monotonous.
- Local Jobs are lost.

2. AIM AND OBJECTIVE

2.1 Aim

"The ultimate aim of this work is, to systematically analyze different aspects of prefabricated construction techniques in panorama of labour cost for multistoried project in Pune city".

2.2 Study Objective

To perform comparative and analytical study of labour cost for precast construction over conventional construction of similar scale project.

3. LITERATURE REVIEW

This literature review is used in support development of the research hypotheses and the methodologies used to test those hypotheses. An extensive literature review provides background information on current knowledge related to the research topic.

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 advantages for prefab construction and also it helps when there is labor shortage. As per the survey carried out by author, the prefab constructions have more advantages and procurement in industrialized, heavy infrastructures. But in individual houses there are lot of constraints and lack of knowledge its get struggling to implement in India. At this stage conventional construction is economical and comfortable when compared to the prefabrication construction. [2]

Vaishali Turai and Ashish Waghmare

Author has analysed the precast practice followed in India with case study. The paper based on 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 factory (i.e. in controlled environment) with required quality, can easily mix, cure with good quantity. Precast concrete is manufactured in factory and transport to site. The precast construction less manpower is required; labours are required only to joint 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. There is no need of curing on site after erection of members because members are cured in factory for desired days. There for the time (in days) is saving in construction which will reduces the

cost of construction. Precast construction reduced the cost of construction required for maintenance of work. The cost on shuttering and de-shuttering is eliminated by using precast will result into saving total cost of construction. The cost of rework due to improper work, faulty construction method, unskilled labour, material quality, onsite environmental problem can be eliminated by using precast members. [3]

B. Raghavendra K. Holla, Siddhant Anant et. 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 minimum. Being a county with a large number of unskilled labours, 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 labour. To implement precast in larger scale in India this percentage should be increased which can help in meeting the huge housing demand using precast. Author expressed its view on site. [4]

Akash Lanke and Dr. D. Venkateswarlu

In this research paper author has taken one building as a case & design the same building as a precast building & Traditional Cast in-situ building. Author has made a cost analysis as well as feasibility check on basis of costing & duration. Author analysis resembles the cost of precast building is significantly reduces & duration of construction is also much lesser than traditional method. From all this study it has been conclude that the precast concrete system is 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]

Krish R. Villaitramani and Dhruv P. Hirani

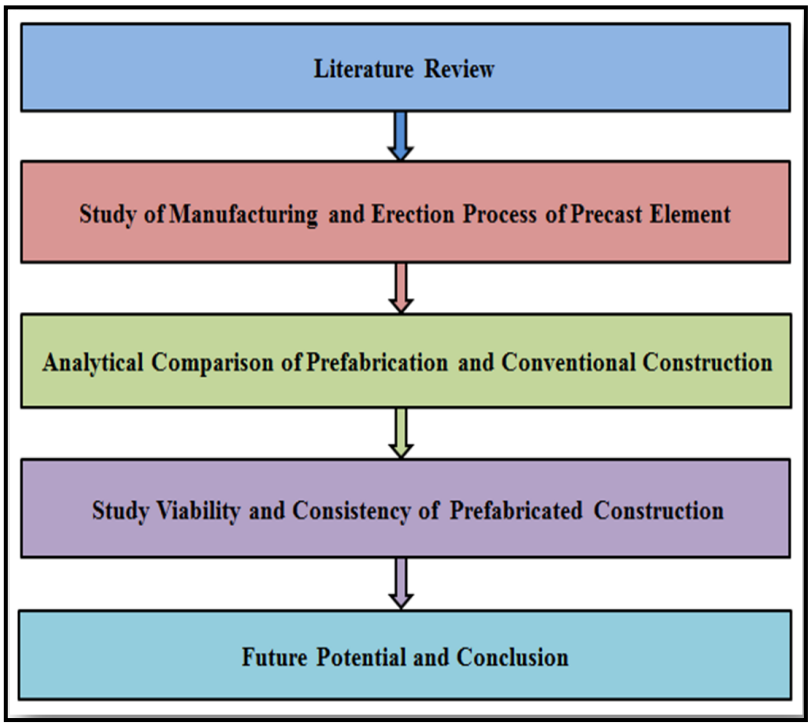
In this paper author has studied the feasibility of Prefabricated Construction for Mass Housing in Mumbai. Prefabrication of houses, an innovation that has potential to address environmental and sustainability concerns at a rapid pace, mechanizes the construction process, enabling mass manufacture of 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 review in this paper to plan, analyse and design residential building 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]

4. METHODOLOGY

The Primary data will be obtained from the case study of AG Tech Park and Schmersal Project. The data analysis and article will be done on the bases of data obtained and investigation.

Fig No 1: Overall Methodology Process



5. DATA COLLECTION AND ANALYSIS

5.1 Case Study Brief

Project	AG Tech Park, Aundh, Pune
Type of Building	Commercial Project, (G+8 story)
Element for Analysis	Footing and Column (Up to 4.5 m height)
	Total Concreting Work = 341 cum
	Total Shuttering Work = 917 sqm
Contractor	AG Construction

Project	Schmersal India Pvt. Ltd , Ranjangaon, MIDC, Pune
Type of Project	Extension of Schmersal plant, Ranjangaon. Production plant and warehouse space which manufactures safety switchgear and lift switching devices.
Element for Analysis	Footing and Column (Up to 20 m height)
	Total Concreting Work = 778 cum
	Total Shuttering Work = 2205 sq. m
Contractor	Bhate Raje construction Pvt.Ltd.

5.2 Data Collection

In this section labour required for Conventional project as well as Precast project has been illustrated in tabular form with analysis.

Table No. 1: Work done for Construction of footing and Column for cast in situ

CONSTRUCTION OF FOTTING & COLUMN					
Work done up to 4.5m height (Avg. column ht.4.5m)					
Particular	**No. of Groups**	**Manpower per group**	**Avg. Daily Salary**	**Duration (Days)**	**Amount Rs.**
Welders	0	0	0	0	0
Carpenters & Labor	5	4	500	25	250000
Steel fixers	3	5	500	25	187500
Mason & Labor	3	5	500	25	187500
Laborers (mazdoor)	1	12	300	25	90000
Supervisor	1	1	500	25	12500
Steel Fixer Foreman	1	1	500	25	12500
Concreting In-Charge	1	1	500	25	12500
Electrician	1	1	500	25	12500
QC Inspector	1	1	550	25	13750
Total Amount (Direct Labor Cost) Rs.					**7,78,750**

Table No. 2: Man power required for cast-in-situ project

Srl. No.	**Resources**	**Numbers**
1.	Supervisor	1
2.	Steel Fixer Foreman	1
3.	Concreting In-Charge	1
4.	Welder	0
5.	Carpenter & Carpenter Labor	20
6.	Mason & Mason Labor	15
7.	Steel fixer	15
8.	Electrician	1
9.	Labor (mazdoor)	12
10.	QC Inspector	1
Total Manpower		**67**

Labour Cost per sq. m of shuttering $= \frac{Total\ Amount\ (Direct\ Labor\ Cost)}{\text{Total shuttering work}}$

$= \frac{7,78,750}{917} = 849.24 \approx$ Rs 850 /-

Labour Cost per sq. m of shuttering for conventional construction Rs. 850 /-

Table No. 3: Man power required for precast project

Srl. No.	**Resources**	**Numbers**
1.	Supervisor	1
2.	Steel Fixer Foreman	1
3.	Concreting In-Charge	1
4.	Welder	16
5.	Carpenter & Carpenter Labor	8
6.	Mason & Mason Labor	6
7.	Steel fixer	8
8.	Electrician	1
9.	Labor (mazdoor)	10
10.	QC Inspector	1
Total Manpower		**53**

Elements to cast simultaneously;

1. Footing (Weight = 18ton to 30ton) - Molds will be fabricated here in the factory (existing plant) and to be delivered to site.

2. Columns (Weight = 25 ton to 36ton)

- All columns will be cast at site.

- Location of casting beds was located under the tower crane during our site visit (30 -40) m from actual location of column).

- All data is collected from site

Table No. 4: Work done for Construction of footing and Column for Precast Project

Work Done	**Quantity**	**Unit**
Total shuttering work	**2205**	sq. m
Total concreting work	**778**	cum
Work done only up to 20 m height (column up to Roof truss bottom)		

Table No. 5: Construction of Column and Footing

CONSTRUCTION OF FOTTING & COLUMN					
Work done up to 20 m height (Avg. column ht.20 m)					
Particular	**No. of Groups**	**Manpower per group**	**Avg. Daily Salary**	**Duration (Days)**	**Amount Rs.**
Welders	4	4	550	55	484,000.00
Carpenters & Labor	4	2	550	55	242,000.00
Steel fixers	1	8	550	55	242,000.00
Mason & Labor	1	6	550	55	181,500.00
Laborers (mazdoor)	1	10	300	55	165,000.00
Supervisor	1	1	550	55	30,250.00
Steel Fixer Foreman	1	1	550	55	30,250.00
Concreting In-Charge	1	1	550	55	30,250.00
Electrician	1	1	550	55	30,250.00
QC Inspector	1	1	600	55	33,000.00
Total Amount (Direct Labor Cost) Rs.					**14,68,500.00**

Labour Cost per sq. m of shuttering $= \frac{Total\ Amount\ (Direct\ Labor\ Cost)}{\text{Total shuttering work}}$

$= \frac{14,68,500.00}{2205} = 665.98 \cong$ Rs. 666 /-

Labour Cost per sq. m of shuttering for precast construction Rs. 666 /-

From above comparative study we get,

- Cast in situ per sq. m (shuttering) = Rs.850.

- Precast per sq. m (shuttering) = Rs.666

Man Power (Labor cost) for shuttering work 183 Rs/sq. m additional in conventional method.

2) MAN POWER (Labour)

- **Cast in situ manpower (No's) = 67**
- **Precast manpower (No's) = 53**

All data are collected from site and analysis shows Man Power (Labor) 26% extra in conventional method.

6. CONCLUSION

As the population continuously growing rapidly, so the need of rapid or fast construction is requirement of current and future generation. Precast concrete construction methods are become feasible and alternatives method or solution in such applications likes buildings and bridges. In this research article the labour cost for conventional and precast project is analyzed and shows the man power (Labor) is 26% extra in conventional method.

The primary benefit of precast construction is the speed of construction (i.e. reduction in time of construction), waste management, and high-quality construction. Precast elements can be cast in controlled environment conditions at a pre casting yard in advance of when they will be required, stocked, and transported to the construction site carefully as required.

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