

Comparative Study on Prefabrication Construction with Cast In-Situ Construction of Residential Buildings

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Abstract

The main objective of the present work is to study the present situation of the precast construction industry in India. Suggestions for improvement of the industry and study on cost effectiveness of precast concrete construction for single and multi-story residential buildings are to be given. A literature survey was carried out in order to obtain the comparison between the conventional buildings with precast concrete buildings in India and some field visits are conducted to collect data to investigate the current situation regarding precast industry in India. In order to compare the cost of precast and in-situ construction, double storey residential buildings is considered.

Keywords: *the comparison between the conventional buildings with precast concrete buildings in India*

1. Introduction

The construction boom in India is developing at a fast rate of growth. It provides wide opportunity in India for a new entrant in prefab sector. At present precast concrete buildings are the advanced construction techniques available over worldwide. Being its wide applicability, the total precast concrete buildings systems are becoming a popular choice for many construction. Precast concrete available in many shape, sizes, including structural elements and unreinforced pieces. The prefab industry is the backbone for the development of new ideas in construction business of any country; 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.

1.1 Importance of Precast Construction

The precast construction has the following benefits:

1.1.1 Precast concrete is comfortable

The material has intrinsic properties of thermal inertia (allowing a more constant temperature both in cold and hot regions) and acoustic insulation.

1.1.2 Precast concrete is safe

Everybody knows that concrete does not burn! Not only is the structural stability maintained for longer periods, but concrete construction prevents the spread of the fire from one building to another. It is sufficiently

strong to resist impacts, blasts and natural catastrophes like earthquakes, tornadoes and floods.

1.1.3 Precast concrete is versatile

Factory production allows a wide choice of surface finishing, color range and special shapes. Precast concrete has another advantage: its mould ability which entails designers to copy classical details like keystones and capitals or match the finish of materials like weathered stones. The precast concrete industry can source a wide range of aggregates locally and offer a tremendous variety of colors and visual effects.

1.1.4 Precast concrete is healthy

Indoor air quality is a concern for all of us. Precast concrete is stable throughout its life and does not need chemical treatment to protect it against rot and insect attack: this means that there are no emissions in the internal environment.

1.1.5 Precast concrete is optimized

Advanced technologies used in the pre-casting plants create an improved quality product (i.e. reduced tolerances, thinner sections, engineered solutions) compared with cast-on-site concrete. Additionally this quality can be checked before a unit is inserted into the structure or site work!

1.1.6 Precast concrete is durable

Egyptian and Chinese people used an ancient form of concrete for buildings and structures that still exist today. Concrete is used where the structural stability has to be maintained for long periods.

Effective design detailing helps to lengthen the life of a concrete building; precast manufacturers can offer guidance on designing for durability.

2. Data Collection

This chapter describes the data collected from the survey. Data collection should be done in different companies to get the rate details about the precast construction and as well as conventional construction. In the data collection we can also know the procedures of the construction work and also find out the difficulties of the work. This collection is helpful to find out cost of the project for the both constructions. We also find the project duration of the construction by using these enquiries.

2.1 Questionnaire Survey

Questionnaire survey is made from different companies. From this we had known about the advantages and disadvantages of both conventional and prefabrication construction. And also from this we had known the present status and scope of the precast techniques. Survey respondents used a 5 point Likert scale to quantify their impact and ranking the score. The average amount of construction experience for all the respondents is 18 years. The low is 6 and the high is 60. Most of the respondents have focused on Commercial and Residential construction in their careers. This chapter explores the data provided by the surveys in an in-depth manner. Each question is broken down and analyzed independently of the others. Then for each topic, the group of corresponding questions and their analyses are summarized. As a reminder, a blank survey for reference is provided in Appendix A.

3. Methodology of the Study

3.1 General

This chapter presents the method of the study on comparison of prefabrication construction with conventional construction. A residential building is taken for comparing and it includes the preparation of plan, data collection from precast industry, estimation of quantities, and determination of project duration.

3.2 Plan Preparation

Plan preparation is done for residential building to estimate the quantities of conventional and precast constructions. Double storey building is taken to estimate the quantities. The plan of the building is shown in fig 3.

3.3 Estimation Of Quantities

Estimation is used to find out the requirement of the materials for both the constructions. The details of the materials which are used in the construction from the companies were collected. By getting these details we can estimate the quantities of the materials. The estimation of quantities for the double storey building is presented in table 4.1 and 4.2.

3.4 Project Duration

Project duration of the each construction was collected from the similar companies and compares the time of completion period by using Critical Path method with Primavera P6. Table 4.3 and 4.4 gives the project

duration of precast and conventional construction of the building

3.5 Cost Analysis

This is the main factor which is considered in the project is to find out the comparison of cost analysis of double storey building for the prefab construction and conventional construction. In this analysis we want to consider the resources of labor, material and machineries.

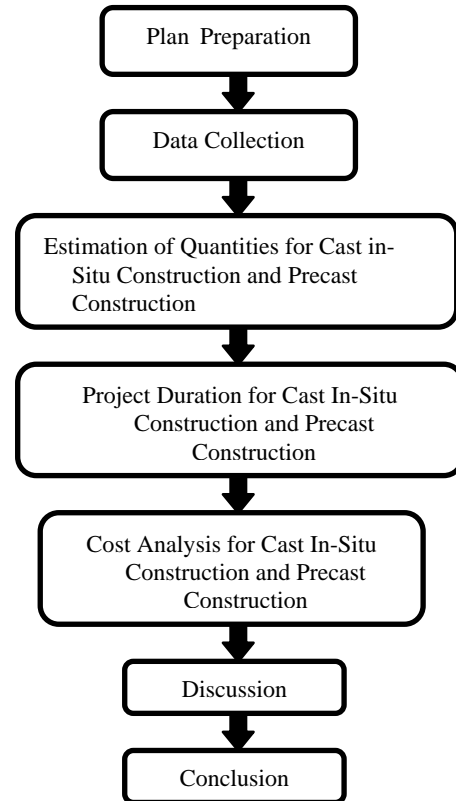
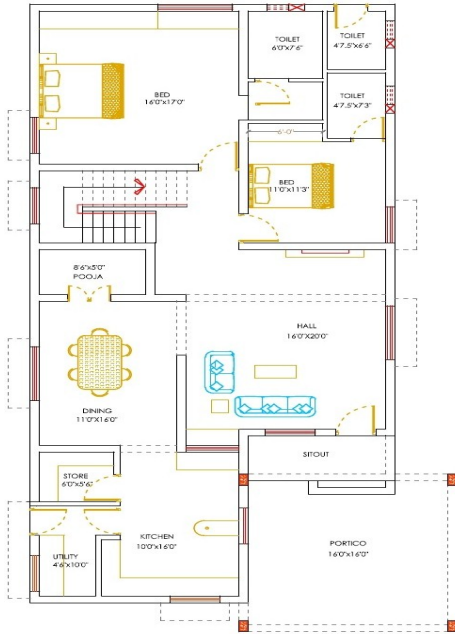
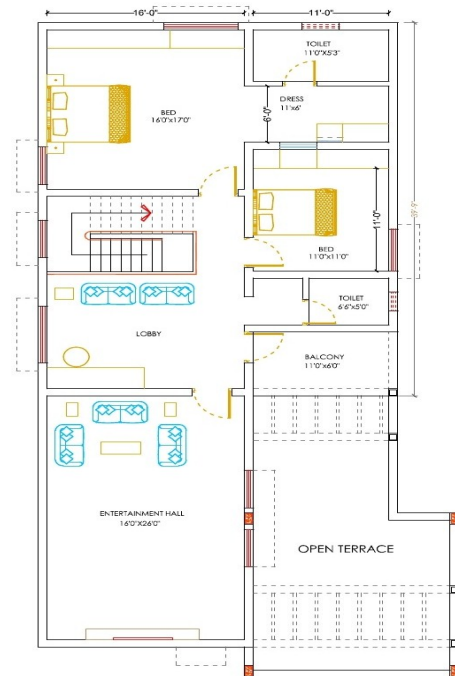


Fig 3.1 Flow Chart of Work Methodology



ground floor



first floor

Fig 3.2 Plan of Double Storey Building

4. Results and Discussion

4.1 Project Duration

S. No	DESCRIPTION	DURATION
1.	Sub Structure - (Site cleaning, Earthwork, Foundation, Basement, Soil filling & Consolidation.)	22 Days
2.	Super Structure – (Wall panels framing and Roofing slabs.)	12 Days
3.	Finishing Works – (Electrical, Plumbing, Painting, Tiling, and Windows, Extra items.)	31 Days

Table 4.1 Total Duration for Prefabrication Construction

The duration of the prefab construction was calculated through the data collected from precast company, which help to find the duration of erection for the super structure of prefabrication construction. The duration of the project is shown in three different stages. The duration of sub-structure was the same as conventional construction because of same method is used to construct in the prefab. But the super-structures in the prefab were completed earlier when compared to conventional construction. The project duration of super-structure has a huge variation and it's an advantage of prefab construction. The walls and slabs are manufactured in factory and installed in site, which reduces the duration of the super-structure. The prefab construction takes less time duration in finishing works when compared to conventional construction, because of the electrical piping work was fitted already in precast walls and slabs. The plastering work is no need for precast elements, which is good in appearance and finishing. The total duration of the double storey residential building for prefabrication construction is 65 days which is shown in table 4.1.

Sl. NO	Description	Duration
1.	Sub Structure - (Site cleaning, Earth work, Foundation, Basement, Soilfilling&Consolidation.)	22 Days
2.	Super Structure (Columns, Lintel& sunshade, Beams, Roof slabs, Brick work, Plastering.)	52 Days
3.	Finishing Works – (Electrical, Plumbing Painting, Tiling, and Installation of doors & Windows, Extra items.)	54 Days

Table 4.2 Total Duration for Conventional Construction

The duration of the conventional construction was calculated through the data collected from conventional company and CPWD engineering data, which help to find the duration for the conventional construction. The duration of the project is shown in three different stages. The duration of sub-structure was same for both constructions which used same method to construct. But the super-structures in the conventional takes long time to complete when compared to prefab construction. The project duration of super-structure has a huge variation and it is a main delay to the project in conventional construction. And finishing work also the conventional construction takes more time duration when compared to prefab construction, because of the electrical and plastering work is done only in site condition. The total duration of the double storey residential building for conventional construction is 128 days which is shown in table 4.2

In this analysis, we had known about the total project duration of both prefab and conventional constructions. The figure (5.1) shows the comparison of project duration for the both prefab and conventional construction in three different stages. As in the figure the sub-structure has taken the same duration for complete the project for both construction of double storey residential building, because of the sub- structure was done by the traditional method.

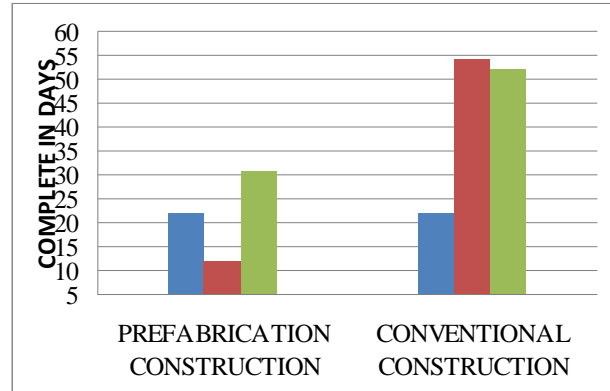


Figure 4.1 Comparison cost for prefab and conventional in three different stages

But the category of super-structure has more variations, which the prefabrication construction is completed soon when compare to the conventional construction, because of the super-structure for the prefab was manufactured in factory and installed in site, which reduce the working time. The finishing works also the prefab construction is taken less time duration when compared to conventional.

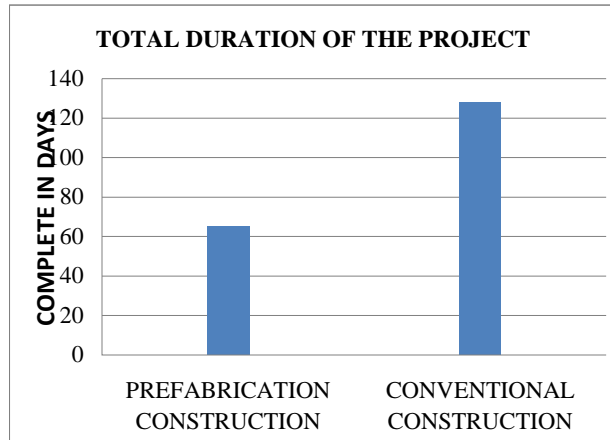


Figure 4.2 Comparison of total project duration for both prefab and conventional construction of double storey building

The total project duration were calculated for both construction and shown in the Figure (5.2). The figure represents the duration of the prefabrication construction is lower than the conventional construction. The time duration of the project difference is 63 days between the prefabrication and conventional construction. This contains very low time duration compared to the conventional method for the individual double storey building.

4.2 Cost Analysis

SI NO	DESCRIPTION	COSTS
1.	Sub Structure - (Site cleaning, Earth work, Foundation, Basement, Soil filling & Consolidation.)	5,26,000.00
2.	Super Structure- (Wall panels framing and Roofing slabs.)	24,23,000.00
3.	Finishing Works – (Electrical, lumbing Painting, Tiling, and Installation of doors & Windows, Extra items.)	43,51,000.00

Table 4.3 Total cost for prefabrication construction

The cost of the prefab construction was calculated through the data collected from precast company, which help to find the cost of the super structure of prefabrication construction. The sub-structure and finishing work cost was the same as conventional construction because of same method is used to construct in the prefab. The cost of the project is shown in three different stages. The total cost of the double storey residential building for prefabrication construction is 73, 00,000.00 (Sixty nine lakes and nineteen thousand rupees only).

SI NO	DESCRIPTION	COSTS
1.	Sub Structure – (Site cleaning, Earth work, Foundation, Basement, Soil filling & Consolidation.)	5,26,000.00
2.	Super Structure – (Columns, Lintel & sunshade, Beams, Roof slabs, Brick work, Plastering.)	1024000.00
3.	Finishing Works – (Electrical, Plumbing, Painting, Tiling, and Installation of doors & Windows, Stair case, Extra items.)	44,69,000.00

Table 4.4 Total cost for conventional construction
Material and labor cost for total project

The cost of the conventional construction was calculated through the data collected from conventional construction company, which help to find the cost of the total project. The sub-structure and finishing work cost was taken to the prefab construction from the conventional. So there are no cost variations in both constructions for these stages. But the cost variation was in the super-structure and which is low when compared to the prefab construction for double storey residential building. Total cost of the double storey residential building for conventional construction is 60, 19,000.00 (Sixty lakes and nineteen thousand rupees only).

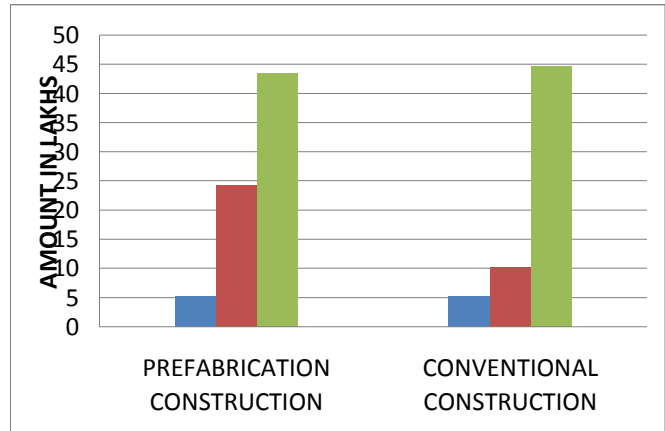


Figure 4.3 Comparison cost for prefab and conventional in three different stages

In this analysis, we had known about the cost of both prefab and conventional constructions. And also the comparison cost for different stages as sub-structure, super-structure and finishing works. The figure (5.3) shows the cost difference for the both prefab and conventional construction in three different stages. As in the figure the sub-structure and finishing works has the similar cost for both construction of double storey residential building, because of the sub- structure and the finishing works was done by the traditional method. But the category of super-structure has more variations, which the prefabrication construction is very high cost compare to the conventional construction, because of the super-structure was done in two different methods as prefab and conventional. The total project cost were calculated for both construction and shown in the Figure (5.4). The figure represents the cost of the prefabrication construction is higher than the conventional construction. The cost difference is 12, 91,000.00 rupees between the prefabrication and conventional construction.

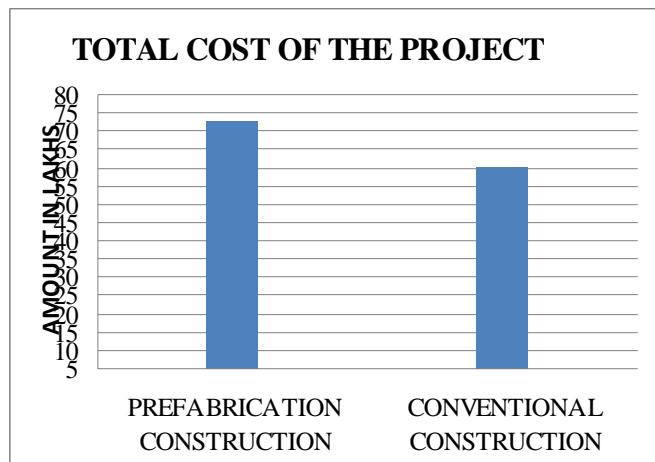


Figure 4.4 Comparison of total project cost for both prefab and conventional construction of double storey building

4.3 Recent Trends

The first aim of the survey was to find out, what are the recent trends of prefabrication in the construction industry. Question 1 of the survey states, “What is the average use of prefabrication for projects you are familiar with today, in terms of % of overall project work?” Respondents reported that they use prefabrication for 5% of overall project work.

4.3.1 Use of Prefabrication

Understanding that many of the reasons for performing prefabrication are well known, it was of interest to determine if one factor dominates the others, or if new technology drivers were beginning to emerge. Question #2 states, “Of all the factors that are currently driving the use of prefabrication, what single factor is the most important?” When forced to choose a single driving factor in prefabrication, the respondents collectively chose cost and schedule as the most critical factors (Figure 5.1). A number of respondents also indicated that shop labor is cheaper. Additionally, productivity was indicated to be higher in shop work than field work. The third driving factor is workforce, in terms of prefabrication as a way to deal with the shortage of skilled construction workers. The fourth and fifth most important factors chosen are safety and quality, respectively.

5. Conclusion

The main goals of the work have been achieved. The total cost and total duration for the double storey residential building have been determined for both prefab and conventional construction. And also we had known about the advantages and disadvantages of both prefabrication and conventional construction by the survey conducted in similar companies. The comparison showed there is enormous cost difference between the methods, which the prefab is very high when compared to conventional on this type of individual houses.

The prefab construction for individual double storey residential building cost is 13% more than the conventional construction. This is main drawback for prefab construction which is not economical to construct in this case. At the same time the prefab construction is easy to work and reduces the project duration, is reduced by 63 days when compared to the conventional. It's the main advantages for prefab construction and also it helps when there is labour shortage. As a result of survey we had known that the prefab construction 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 our country. At this stage conventional

construction is economical and comfortable when compared to the prefabrication construction.

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