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Time and Cost Management in Precast Concrete Constructions

Technology & Innovation

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ABSTRACT

Building design often has a direct implication on various factors leads to success of the project. Proper construction management leads to improve construction processes, ease of construction, reduced dependency on on-site manpower and improved quality of the project taken. Further it is influenced by type of construction carried out. In this aspect precast concrete construction plays a major role in bringing out higher productivity, faster completion time and better builds quality. This paper exposes the role of time and cost in precast concrete construction.

INTRODUCTION

Precast concrete is a construction product produced by casting concrete in a reusable mold or "form" which is then cured in a controlled environment, transported to the construction site and lifted into place. In contrast, standard concrete is poured into site-specific forms and cured on site. Precast stone is distinguished from precast concrete by using a fine aggregate in the mixture, so the final product approaches the appearance of naturally occurring rock or stone. The production process for Precast Concrete is performed on ground level, which helps with safety throughout a project. There is a greater control of the quality of materials and workmanship in a precast plant rather than on a construction site. Financially, the forms used in a precast plant may be reused hundreds to thousands of times before they have to be replaced, which allow cost of formwork per unit to be lower than for site-cast production.

Ancient Roman builders made use of concrete and soon poured the material into moulds to build their complex network of aqueducts, culverts, and tunnels. Modern uses for pre-cast technology include a variety of architectural and structural applications featuring parts of or an entire building system.The New South Wales Government Railways made extensive use of precast concrete construction for its stations and similar buildings. Between 1917 and 1932, they erected 145 such buildings.

METHODOLOGY

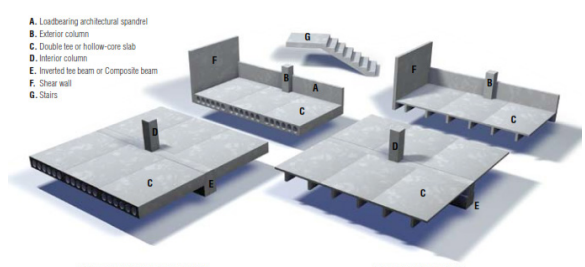
This study outlines the implication of precast concrete construction in construction industry. It encompasses the various issues related directly and indirectly. Issues directly related are elements, connections, systems, production, handling; assembling, Demounting and Issues indirectly related arematerials, technology, structural analysis, building physics and equipment. A building example has been taken and the construction process of the same building follows the precast concrete construction. Various factors affecting the construction process is analyzed and addressed. For the building time taken and cost of the project is calculated and it is compared with conventional to locate the differences, advantages and disadvantages of precast concrete construction.

CHARACTERISTICS OF PRECAST CONCRETE CONSTRUCTION

Bespoke precast concrete products are widely used components of construction projects.These products implement the offsite prefabrication technology that offers a unique opportunity for innovation and cost savings for construction projects. However, the production process from design to manufacturing contains uncertainties due to external factors: multi-disciplinary design, progress on construction site.The outcomes of the research include shortened customer lead-time, in-house repository of production knowledge, and achievement of the optimum factory's resource utilisation.This research initiated an innovation production planning system called AIP that adopted artificial intelligence technologies to alleviate this complexity and improve the efficiency in the bespoke precast concrete production planning.(Benjaoranet.al., (2006))

COMPONENTS AND SYSTEMS

Precast concrete's plasticity allows it to be cast into a wide variety of shapes and sizes. Although precasters routinely produce custom designs and shapes, designers typically take full advantage of speed and economics by using standard components that can be cast and replicated many times with existing forms. To this end, precasters provide a number of typical components that meet the vast majority of traditional design challenges. Below are the components used most often in building applications. Horizontal members that support deck components such as double tees and hollow-cores labs, beams typically are considered structural components. Three types cover the majority of uses: rectangular beams, inverted tee beams, and L-beams.



Designing with Precast Concrete

The precaster can provide significant input on a variety of topics of critical importance to the project's ultimate design. Some of these topics include:

- Mix durabilityandstrength;
- Panelization (sizes and layout);
- Bay sizes;
- Repetition possibilitiesfor reducingform materials andcost;
- Efficient shippingsizes andconfiguration;
- Seismic needsfor joints;
- Finishoptions;
- Connection issues such as prewelding;
- Scheduling,includingproductiontimingandsequencingof cranes
- Cost data,includinghelpingto createa guaranteedmaximum price

ANALYSIS PRECAST FRAMING COMPONENTS

After analyzing the various advantages and limitations of precast concrete construction the institutional building is taken and designed with precast concrete components. In order to

compare the conventional construction methods with precast concrete construction the example taken is designed with both methodologies.

A building having seven storeys is taken and designed with precast concrete components.

Name of the project: School of Education

Total built up area:18800 sq.m

No. of Floors: G+7

RESULTS AND DISCUSSIONS

The multi – storey institutional building is situated in the campus of Periyar Maniammai University, which is designed to satisfy the function of School of Education. It planned with eight floors of area 2670 Sq.m. The buildings precast façade was chosen as a means of integrating this building with the surrounding neighbourhood. The ability to control colour and texture of the finish and the ability to break up the façade into smaller elements with rustication joints, allows the precast concrete to relate comfortably to both the 19th and 21st century buildings that surrounds it. The use of precast concrete provided the ability to create a prefabricated window anchor system throughout the building, which enabled the creation of multiple visual elements.

MOLD COSTS

Mold cost depends on size, complexity and materials used. The

S.NO.	NUMBER OF USES	PANEL SIZE (SQ.FT)	MOLD COST(Rs.)	MOLD COST PER SQ.FT.(Rs.)
1.	1	200	2,25000	1125
2.	10	200	2,25000	112.5
3.	20	200	2,25000	56.25
4.	30	200	2,25000	37.35

Table 1: Showing variation in the mold cost due to increase in number of uses.

mold material selected and number of molds depends on a project's schedule. A project with a long precast concrete production period should permit fewer molds to be built.

PANEL SIZE AND PANELIZATION

Precast concrete pricing is determined primarily by the size of the pieces and repetition. Pricing is more dependent on large project. For example, a 100 – piece project of large panels can be less expensive per square foot (sq.m) than a 1000 – piece project using much smaller panels. The reason piece size is so important is because most labor functions performed by an architectural precaster and erector are required because of the existence of a piece. The more pieces the project has, the more labor hours it will take to engineer, cast, strip, finish, load, deliver and install the panels. Therefore, it is more economical to enclose a larger portion of the building's exterior with fewer precast concrete panels.

For maximum economy, minimize the number of pieces making

S.NO	PANEL SIZE(Sq.Ft.)	ERECTION COST PER PIECE PER SQ.FT			
		500 (Rs.)	1000(Rs.)	1500(Rs.)	2000(Rs.)
1.	50	10.00	20.00	30.00	40.00
2.	100	5.00	10.00	15.00	20.00
3.	150	3.33	6.67	10.00	13.33
4.	200	2.50	5.00	7.50	10.00
5.	250	2.00	4.00	6.00	8.00
6.	300	1.67	3.33	5.00	6.67

Table 2: Showing the Erection cost with respect to Panel size.

them as large as possible within normal manufacturing and shipping limitations. Handling and erecting precast concrete components constitutes a significant portion of the total precast concrete expense. The cost difference in handling and erecting a large rather than a small unit is insignificant compared to the increased square footage of a large unit. To be economical, a project's average piece size should be at least 100 to 150 Sq.Ft (9 to 14 sq.m) and ideally, larger than that.

TOTAL WALL ANALYSIS

4.7. SOLID WALL PANELS

Solid wall panels use finish, shape, size and repetition as the major design and cost considerations. The high level of design flexibility possible with custom wall panels allows for a wide variety of architectural appearances the building at each floor interrupted at the middle by the four – storey entry. Duration and cost of the project using precast concrete components is estimated.

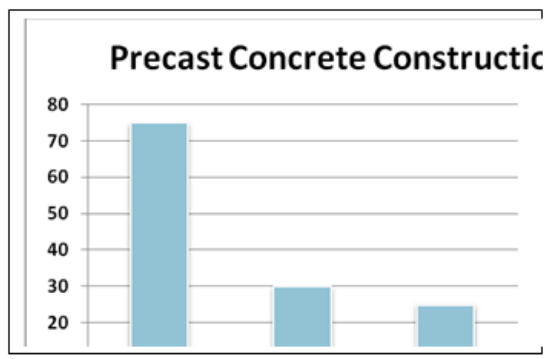


Figure 3: Project Cost

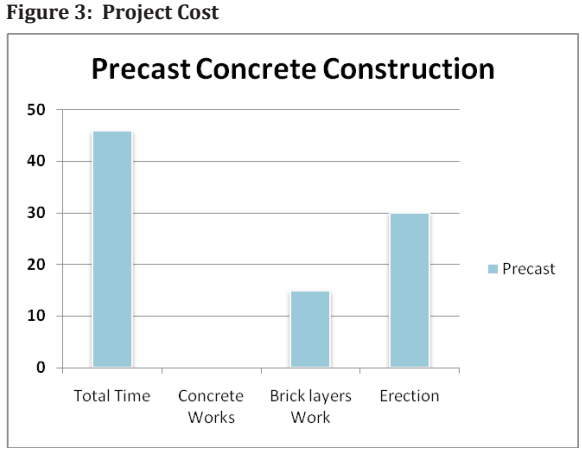


Figure 4: Overall Duratio

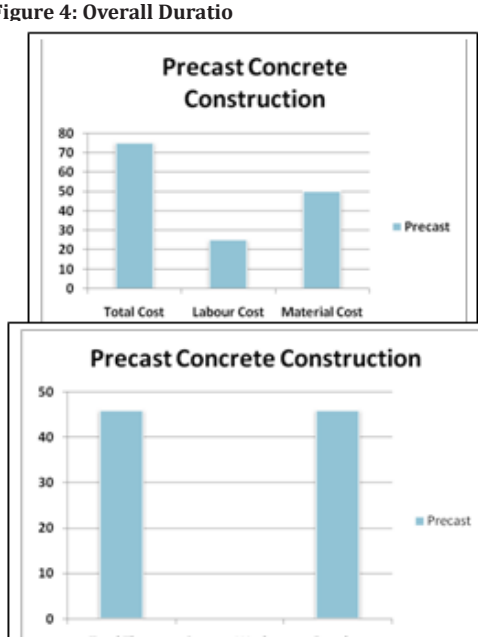


Figure 5: Duration - Internal walls

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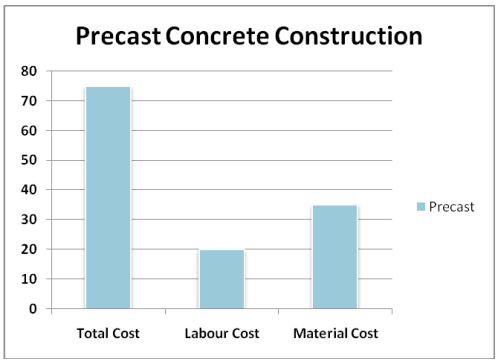

Figure 6: Duration - Internal walls

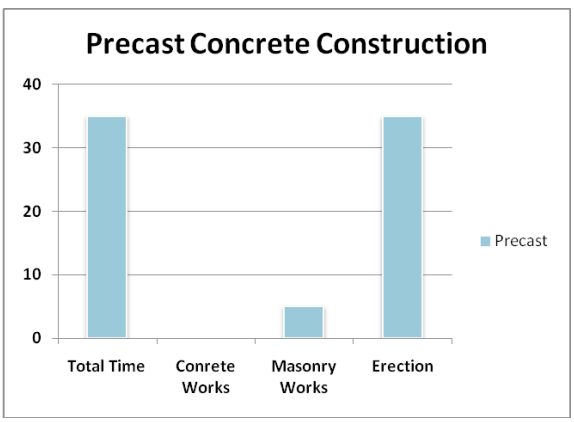

Figure 7: Duration - External Wall

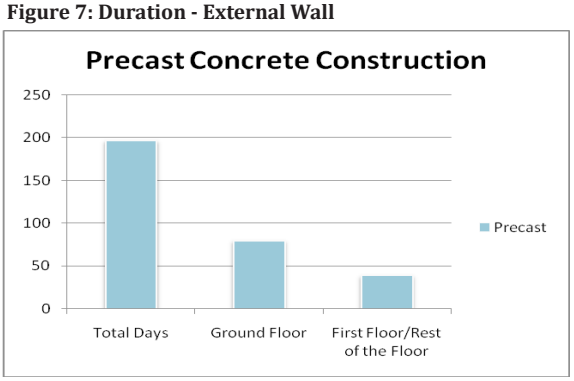

Figure 8: Duration - External Wall

	PCC METHOD	COMPARISONS
OVERALL CONSTRUCTION PERIOD	06months and 5 days	Savings up to 223 days or 53% of overall completion period
SUPER STRUCTURE	150 days	
SUB - STRUCTURE	47 days	

Table3: The summary for the comparisons of overall construction period for precast PCC method

No.	Details	Approximate Duration (minutes)
1	Precast Concrete Column	30 to 45
2	Precast Concrete Beam	15 to 20
3	Precast Concrete Slab	15 to 20
4	Precast ConcreteWall Panel	15 to 20

Table 4: The approximate duration for the installation for each component.

CONCLUSIONS

This study aims at studying the various process included in the precast concrete construction. Some of the factors like time, cost, labour and equipments are taken. To compare the durations required for PCC method scheduling is created using FAST TRACK SCHEDULE 10. By preparing the cost estimation the cost is compared. Through the data collected from the site regarding labour requirement labour productivity, project cost and durations estimated. Thus at the completion of study various factors are analyzed and the following is coined as the recommendations and benefits of PCC method.

RECOMMENDATIONS

Speed of construction and buildability:

Speed of construction and tight construction programmes are primary considerations in most building projects and this is where precast concrete excels. To maximise the advantage of precast, two critical factors should be taken into considerations:

a. Design the building layout to maximize repetition of precast units.(Master mould concept)

b. Design construction details to maximize the number of standardized components

2. Choosing a construction method – comparative costs.

a. In making cost comparisons between alternative systems, it is imperative that total like for like cost are considered. There are substantial savings to be made using precast construction which are not evident when a direct elemental cost comparison is made with alternative construction methods.

b. Savings through factors such as earlier completion dates, in-built fireproofing, reduced formwork, scaffolding, reduced wet trades and increased budget control can be significant.

c. Also, fast – track procurement and construction may minimise capital costs by reducing financing costs and securing earlier rental income.

d. The precast frame package typically includes columns, beams, floors, wall panels, stairs, landings, balconies etc., all of which have an in built minimum one hour fire protection.

e. Specialist precast frame producers will assist design teams in evaluating the scope for standardized precast components for a particular project.

Budget costing and erection programmes can be prepared by the precaster on receipt of outline drawings and a list of performance criteria.

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