A study in Investigating the Difficulties in Adoption of Precast Concrete Members in Construction Practices

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Abstract - *It is not that conventional concreting is bad but for fast and quality construction output utilization of precast components is a better option. Though conventional concreting has its own benefits, precast has come more to overcome the conventional method with some drawbacks too. This project is concerning the difficulties show up while adopting the precast components for small scale construction. Difficulties during casting of precast members at casting yard, difficulties during transportation, difficulties during erection of a building are studied in the project. It is concluded that precast is good for mass concreting and mass as well as identical construction like a multi-storey building with identical floor plans. Precast is not so suitable in small scale construction work as these buildings has variation in cross-section site to site also no presence of a local precast casting yard which increases cost due to transportation from far places.*

Key Words: Precast concrete, Precast Vs Conventional, Precast beam, Precast column, Precast slabs, etc.

1. INTRODUCTION

Many growing international locations are battling with the housing emergency, many advanced countries have subdued this trouble with precast concrete innovation. Precast concrete development innovation is one of the promising answers for deal with the huge housing demand. The usage of precast concrete frameworks offers a few beneficial circumstances, as an instance, brief and exceptional improvement and upgraded properly-being and safety. Regardless of those beneficial situations, the enterprise has not picked up prominence in India. With ever increasing call for housing, a need to automate and modernize the construction industry changed into deemed. In the existing situation, engineering and architectural innovation & improvisation has enabled the development global to discover the brand new arena of precast technology. Innovation & development isn't growing something new, but redefining the existing aspect in a cutting-edge manner.

1.1 Gap Identification

It is noticed that Precast concrete contributors are not that a great deal well-known and now not utilized in well-known practices though they make paintings less complicated and quicker with out compromising the quality of work as those participants are made in manufacturing unit beneath controlled surroundings. So it's miles vital to look at the reasons why precast contributors are not being used in general production exercise.

1.2 Problem Statement

Precast concrete contributors aren't as well-known as conventional concreting techniques and not used in production practices thinking about residences of precast concrete participants it is necessary to examine the motives and factors affecting in adoption of precast contributors in creation practice.

1.3 Objectives

1. To find area of use of precast concrete members in general construction practice.
2. To find the conventional practices which can be replaced by precast concrete members.
3. To find difficulties in adoption of precast concrete members construction practice.

1.4 Methodology

PHASE 1 : Study of literature review to understand current scenario
PHASE 2 : Data collection to identify problems
PHASE 3 : Data analysis
PHASE 4 : Result and conclusion

2. LITERATURE REVIEW

Papers studied deal with what are precast concrete components, erection methodology of precast concrete components, use of precast concrete construction in multi-storeyed buildings, joints and connections, labour productivity analysis using precast components with respect to time, traditional method of concreting versus installation and erection of precast components and seismic response of connections in precast structures with reference to beam and column joints, analysis and behaviour of precast concrete. None of them give any idea about use of precast in general construction practices

construction industry or why precast concrete is not being used in construction industry.
It can be suggested that, use of precast can result in cost saving with respect to tremendous time saving during precast erection with zero compromise in quality with optimum number of labours.

3. WHAT IS PRECAST

Precast concrete panels are widely used for a variety of applications including agricultural buildings, grain stores, silage clamps, slurry stores, livestock walling and general retaining walls. Panels can be used horizontally and placed either inside the webbings of RSJs (I-beam) or in front of them. Alternatively panels can be cast into a concrete foundation and used as a cantilever retaining wall.

4. REPLACEMENT FOR CONVENTIONAL PRACTICES

Conventional concreting can be replaced by precast components listed and described as below

4.1 Precast Beams

Precast beams required are Internal Beams(IB) and External Beams(EB). Internal beams support the slab from both sides where as external beam supports slab only on one side. Hence two different types of beams are required.

4.2 Precast Columns

Precast columns has 3 types viz. Corner column(CC), Edge column(EC) and Internal column(IC).

Corner column is located at the corner of a building and supports two beams. Edge column is located where two beams need to support in straight line. Internal column is placed at position where 4 beams has to hold up.

4.3 Precast Slabs

Precast slabs has two types viz. hollow core and solid section. These slabs are provided as per requirement of the structure.

4.4 Connections in Precast

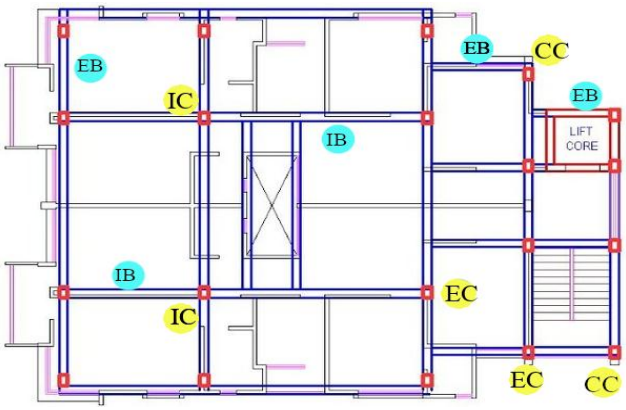


Photo 1: *Types of column and beams*

Precast structures has three connections which are Column to column, Beam to column and slab to beam.

5. CASE STUDY

For better understanding of casting and erection of precast components a housing project site visited being constructed by Shirke group located at Taloja Phase 2, Kharghar, Mumbai. This construction site was consisting of two type of housing for LIG (low income group) and EWS (economic weaker section).

A casting yard is erected near construction site. Daily around 40 m^3 to 50 m^3 concrete is being casted per day. With controlled environment and advanced technology casted components comes in hand for erecting at 8^{th} day from casting. These components then transported at erection site and placed in their desired place using tower cranes and mobile cranes. And this is how 24 story buildings on site visited get shaped using precast components.

6. ANALYSIS OF DIFFICULTIES ARRIVED WHILE CASTING, TRANSPORTATION, ERECTION OF PRECAST COMPONENTS.

1. Difficulties at casting yard
2. Difficulties in transportation
3. Difficulties on site during erection
4. Cost comparison with conventional method

6.1 Difficulties at casting yard

The infrastructural setup required is always sizeable
As precast production has high production rate production faces a lot of economical loss when work stops not only for a single day even for few hours. To avoid condition of out of stock, ample amount of raw material is required to be stored at storage. This storage place required a lot of space with respect to higher production rate.

Precast components are manufactured using proper concrete mix design guidelines. Raw material (like cement, sand and aggregate) requires well-planned shelter to avoid excessive moisture content due to weather change. Large quantity raw materials need to be stocked thus large shelter is required to cover raw material.

Requires heavy machinery as well as heavy canes
Considering physical and mental limitations of humans it becomes hard-bitten to achieve high production rate in same time with required standard quality with manpower. Machines overcome the human limitations here as they deliver the required output without compromising the quality in specific time.

To get more output large scale machine or required number of machines can be installed. Cost of this huge machinery is higher as they deliver the large output in required time. These machines are equipped with computer, hydraulic jacks, rolling belts, vibrators any of component may require special attention and care to be taken.

Not only the one-time instalment cost but time to time maintenance required which again costs. At a time casting of various components is being carried out hence more number of concrete batching and mixing units are required. Not only heavy machines abut also heavy duty cranes are also required at casting yard as well as erection site.

Requires more manpower to run big setup
A commanding person is always essential to guide machines to get work as per requirements. Man power is also required for
●Placing of raw material at storage place using cranes
●Manually loading of raw material in some machinery
●Reinforcement reinforced by machines is needed to place at storing place using cranes.
●To make moulds ready for casting i.e. cleaning and applying oil to the moulds and placing them over concreting machine.
●To place the reinforcement in the mould using crane
●To operate automatic concreting and to place these moulds in curing chamber
●To separate the mould from casting
●Quality check

Requires numerous moulds
All the activities of concreting, right from cleaning of moulds for casting to remove the moulds after casting are done parallelly with number of moulds. It means if there are 200 moulds, 30 moulds will be being cleaned for casting, 30 will be being casted, few are in curing chamber which are already casted on previous days, some of moulds being casted, some may be at maintenance and so on. To achieve high rate of production in minimum time, maximum number of moulds are required so that casting will not stop due to lack of moulds. This means there is huge amount of investment is required to invest in moulds after heavy machinery and cranes.

Difficulties due to varying cross-sections
As per requirements of user, design and plan of each building varies from the another; exception for row bungalows or multi storey apartment like structure. In general small scale construction practice has very less chances of having same structural cross sections in two or more buildings. To meet this varying cross-sections, moulds required to cast the required section may not be same for all the requirements. So it becomes essential to alter or modify mould size for each project. Material used for moulds is solid iron. The reason behind using the solid iron is to sustain weight of fresh concrete which will be poured in the mould. The mould should be firm enough to use again and again to reduce manufacturing cost.

Hence it is not quite economical to alter and modify moulds like steel or timber shuttering being used generally for casting or structural members on site in small scale construction practice. Shuttering/formwork can be easily and quickly modified or altered as per site requirements as compared to solid iron moulds. Thus it can be concluded that timber shuttering/formwork is better in general small scale construction practice. Precast is salutary for prototype planning

6.2 Difficulties in transportation

Heavy trailers and transportation medium is required to convey precast components from casting yard to erection site. Which carry very less number of components per trip. While loading the components in vehicle handling problems may rise like, unexpected failure of section at lifting point.

Considering the density of concrete around 2,500kg/m 3, weight of each precast components with volume 5 m3 -10 m3 goes around (2,500X5 = 12,500 kg) 12.5ton.

To lift such heavy load heavy vehicles are required. And transportation of components by these heavy vehicles becomes hectic in crowded city areas as well as rural areas where there is no proper roads.

6.3 Difficulties on site during erection

Storage and Handling on site
As erection of precast components is very fast as compared to conventional method of concreting, it becomes essential that the components must be available on site; to avoid idle conditions. It requires more space to store these components, as these members are large in size. A spacer is required

between adjacent components while stacking, to avoid damage to the lifting hooks of components.

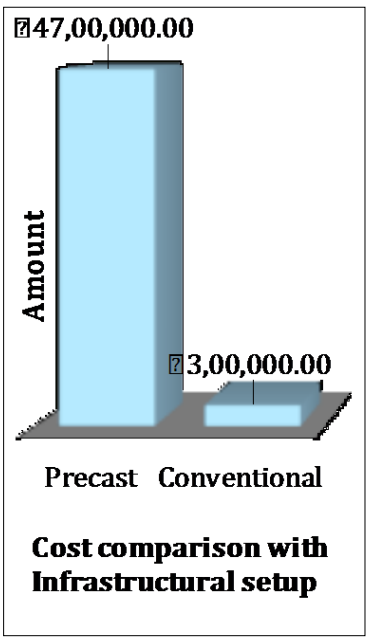
Area required to store precast concrete components is always more as compared to loose fine and coarse aggregate. Members need to be placed carefully to avoid accidents. Because these members are so much heavy that if placing operation fails there are very high chance of causalities.

6.4 Costing comparison with conventional method

Cost comparison with Infrastructural setup

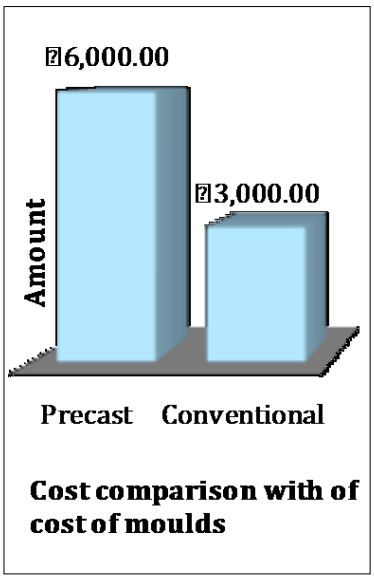
Cost in case of Precast
Tower cranes required for lifting and placing members at required position cost around 50-60 lakh. Huge capacity concrete mixers required which cost upto 20-30 lakh. Gantry cranes required with lifting capacity upto 20-30 tons cost upto 7-8 lakh. Weigh batching plant with capacity 25 ton costs upto 10-11 lakh to increase production rate, equipment listed above are required in multiple numbers.

Cost in case of Conventional method
There is requirement of one concrete mixer and weigh batcher which costs around 1 to 2 lakh and 40,000 to 50,000 respectively. And these equipments can be mounted used on multiple sites in consecutive manner. No gantry cranes required.

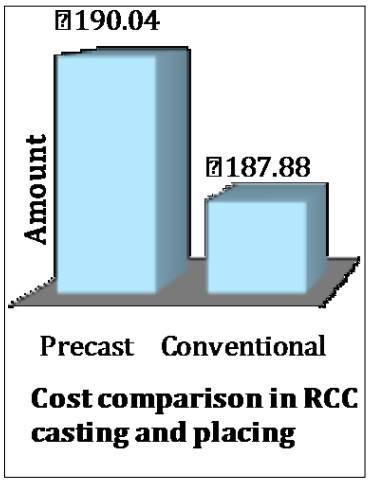


Cost comparison of moulds
Cost in case of Precast
Mould costs upto ₹ 5,000 to ₹ 6,000 Per mould.

Cost in case of Conventional method
Plywood or timber formwork costs upto 30 to 50 ₹/sq. ft. i.e. 2,500 to 3,000 ₹/mould approximately.



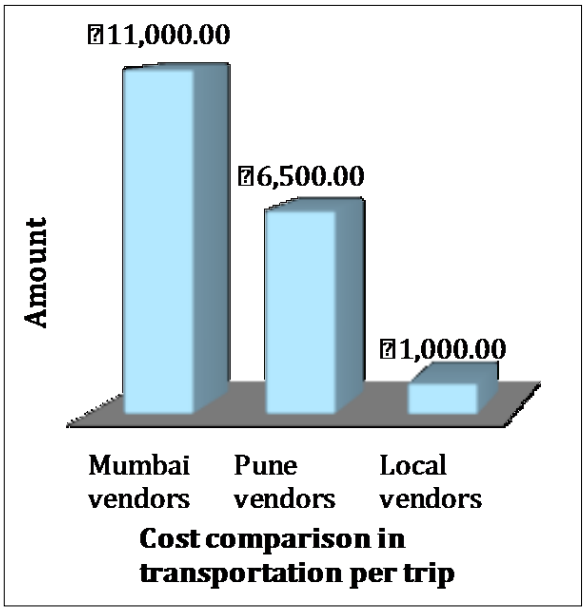
Cost comparison in RCC casting and placing
Cost in case of Precast
Per sq. ft. Rate of precast calculated as, 190.04 ₹/sq. ft.
Cost in case of Conventional method
Per sq. ft. Rate of conventional concreting calculated as, 187.88 ₹/sq. ft.



Cost comparison in transportation per trip
As per market survey, there are no precast components seller industries nearby Kolhapur area. So it is required to transport components from Pune (around 240 km away from Kolhapur) or Mumbai (around 340 km away from Kolhapur). Transportation charges from Mumbai to Kolhapur ranges from 10,000 to 15,000 per trip. Charges vary depending on load capacity and distance per trip.
Same considering about transportation charges for conveyance of material from local market to site is around

500 to 1,000. Charges vary depending on load capacity and distance per trip.

It seems that charges required in conventional method are around 90% lesser than required to convey precast components.



7. RESULT AND CONCLUSION

7.1 Result

1. Costing comparison with conventional method
Precast costs upto ₹ 47,00,000 where as Conventional method costs upto ₹ 3,00,000 Which is about 16 times more investment than precast.

2. Cost comparison of moulds
Precast mould costs upto 6,000 and conventional type mould i.e. formwork costs upto 3000 per mould.
Which is around 50% of the precast.

3. Cost comparison in RCC casting and placing
Per sq. ft. Rate of precast can be calculated as, 190.04 ₹/ sq. ft.
Per sq. ft. Rate of conventional concreting can be calculated as, 187.88 ₹/sq. ft.
Comparing the rates of precast and conventional method it can be seen that precast has higher rates than conventional method. The difference between rate is 2.16 ₹/sq. ft. In other words precast costs 1.14% more than conventional concreting.

4. Cost comparison in transportation per trip
Transportation of heavy precast components from Pune or Mumbai costs around 5,000 to 10,000 per trip where as cost of transportation locally costs upto 500-1000 ₹/trip.
This indicated precast costs 5 times more than conventional method.

7.2 Conclusions

Considering the results it can be said that, precast components are feasible only for mas production of identical housing project and it is not so economical for general small scale construction practices.

To make the precast feasible for small scale construction industry following possibilities may work

1. Moulds could be telescopic in all the three dimension so that a component of any possible length, width and height can be casted in it.
2. A group of some engineers or contactors can take initiative to built up small scale casting yard for their project which will work on average scale machinery and investment will not be high.
3. Such plant must be locally available to reduce transportation cost.

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