CASE STUDY: CIDCO MASS HOUSING PROJECT USING PRECAST TECHNIQUE.

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ABSTRACT

Pre-Fabrication system, involves processing and assembling of structural components such as beam, columns and slab in a factory or other manufacturing site and transported on site. Precast technology is Adopted to promote the speedy construction. This paper provides a real time case study with focus on the new construction technology and it's implementation. The technology used is pioneered and patented by B.G.SHIRKE CONSTRUCTION TECHNOLOGY PRIVATE LIMITED. The system consists of using precast structural components such as Dense concrete hollow core columns, Dense concrete partially precast beams, lintels, staircase, etc., to achieve strength, safety and speed. The main objective of this paper is to observe and study the current level of utilization of precast technology in the building sector of the construction industry, examine the advantages and limitations of prefabrication technology and formulate construction techniques that will improve the current prefabrication technology.

INTRODUCTION

Migration from rural to urban area has caused unplanned urbanization and poor quality building stock. To overcome these problems mass housing was introduced. The basic concept of mass housing is speedy construction which is a major advantage of precast technology and cost is reduced if similar construction work can be grouped and techniques can be employed in precast at a location where skilled labor is available, while congestion at the assembly site, which wastes time, can be reduced. The method finds application particularly where the structure is composed of repeating units or forms, or where typically same basic structure are being constructed.

SCHEME DETAILS

For promoting fast rate growth, The Building Materials and Technology Promotion Council (BMTC) under the Ministry of Housing and Urban Affairs (MoHUA) has been supporting innovative housing technologies for affordable housing. About 1.2 million houses are being constructed with such innovative technologies in India under PMAY (U) and other state-run schemes. Pradhan Mantri Awaz Yojana (PMAY) is an initiative taken by Government of India in which affordable housing will be provided to the poor with a target of building 20 million affordable houses by 31 March 2022.

Three Phases of PMAY considered starting and completing the house construction work as follows:

- **PMAY Phase-1** from April 2015 to March 2017 to roof 100 cities.
- **PMAY Phase-2** from April 2017 to March 2019 to envelope additional 200 cities.
- **PMAY Phase-3** from April 2019 to March 2022 to cover the remaining cities.

In NAVI MUMBAI, under Pradhan Mantri Awas Yojana (PMAY), The City and Industrial Development Corporation of Maharashtra (CIDCO) has already initiated the construction of residential buildings. It is approved by Maharashtra RERA and built to cover LIG and EWS housing units with all modern amenities. The location of the project is Taloja, spanning across 21.32 Acres with 64 towers, the project offers 4194 housing units.

PRODUCTION OF PRECAST ELEMENTS

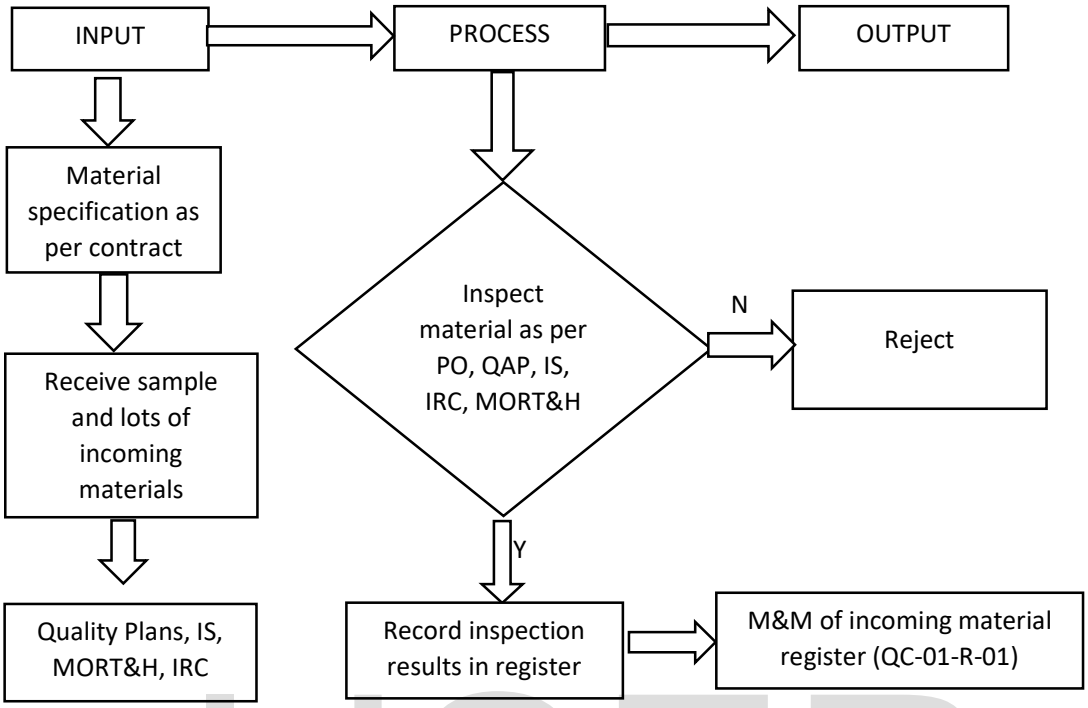
1. Quality of Material

As soon the pre-production materials such as crushed sand, cement, coarse aggregate reaches the factory, these materials are monitored and measured as per the specification of contract. The inspection result is then recorded in the register. The test on these materials are conducted as per Indian Standard Codes. For this purpose a material testing laboratory is provided with the essential and required apparatus given in IS Codes.

Following are the quality control test:

- ✓ Moisture Correction
- ✓ Workability Testing
- ✓ Cube Testing
- ✓ Aggregate Testing
- ✓ Silt Content Test
- ✓ Water Test
- ✓ Temperature Testing
- ✓ Slump Cone Test
- ✓ Fly Ash Testing
- ✓ Cement Testing

Process Flow chart for monitoring and measurement of quality of materials



2. CASTING OF STRUCTURAL COMPONENTS

Each building in this project consists of their own prefabricated components and each has different specifications. The site engineer refers the plan of the required floor and determines the number of components required, this is then sent to the factory for the fabrication of the required component. As per the required specifications the moulds are constructed, these moulds are only allowed to be placed in factory if they are certified. Proper inspection is done. In the factory the engineers are provided with the schedule section and plan of the required component. With the help of these drawings the engineers construct the reinforcements which are then placed in the moulds, after which the concrete is poured with the help of bucket which is moved by gantry or overhead girders. After the component has gained the required strength it is then removed and undergoes proper curing. The partially prefabricated component is then transported to the specified building.

The factory unit consists of manufacturing prefab segments as follows:

a) PRECAST BEAMS

As per the requirement of the building the various types of beam such as chajja beam, roof beam, floor beam, plinth beam, are manufactured in the provided section of the factory. The construction of the beams initiate by arranging the reinforcements as per the designs. After this the cover is attached to the reinforcements and then placed in to the certified moulds. The mould is oiled from inside before the placement of the reinforcements. After placing the reinforcement the concrete is poured in the mould. The slump of the concrete is 70mm. To eliminate the voids which are present in the concrete, compaction is done by vibration either manually or hydraulical arrangement. The period of 15 hours is provided so that the concrete gains it's required strength, after which the mould is dismantled and beam is lifted with the help of gantry cranes, placed on the trailer truck and transported to the stacking yard. For identification purpose marking on side face of the beam is done. In stacking yard, proper curing is done for 15 days and dispatched for erection purpose at site. The total capacity of the beam unit is 287 beams per day.

Figure 1. Hydraulic Mould

Figure 2.Beam Reinforcement

Figure 3.Chajja Beam

Figure 4.Manual Casting

b) PRECAST COLUMNS

The columns are manufactured in the factory as per the requirements includes single core and multi-core columns. The construction of the columns initiated by arranging the reinforcements as per the design. Before placing the reinforcement the pallet should be oiled properly. These columns reinforcement is placed on the pallet along with the plates at the end to provide opening for the notches. After this, the pallet is moved forward with the help of lorry. The core is then inserted hydraulically. This is followed by pouring of concrete in the pallet with the help of bucket. The capacity of bucket is 1.5 cubic meters. The concrete in bucket is poured from the adjacent batching plant. Two buckets are required to fill one single pallet. After pouring, uniform spreading of concrete is done manually. For removing the voids hydraulic vibrators are provided below the pallet. Core is taken out after the setting of the concrete. Proper surface finish is achieved with the help of floater machine. Further, the pallet is moved forward with the help of lorry and the entire pallet is covered with the plastic, so as to use the moisture generated by the heat of concrete is for curing. For identification purpose the columns are marked and then moved further for curing in the stacking yard. Before dispatching the concrete 7 day curing is done. The total capacity of this unit is 40 columns in 24 hours.

Figure 5. Reinforcement with notch plate

Figure 6. Concrete Pouring

Figure 7. Finishing with floater machine

Figure 8. Casted Column

C) PRECAST SLAB

The slabs are also constructed as per the requirement. Before placing the reinforcement the pallet should be oiled properly. The reinforcement of the slab consists of a mesh and lattice girder. The mesh and the lattice girder are manufactured with the help of machines. These are the tied manually. After this the covers are provided and electrical conduits are placed. These reinforcement are placed on the pallet and moved forward with the help of lorry. The concrete is poured with the help of bucket having capacity of 3 cubic meters. The slump of concrete maintained is 55mm. For removing the voids hydraulic vibrators are provided below the pallet. For a single pallet 4 vibrators are provided. After pouring, uniform spreading of concrete is done manually. After the concrete is compacted the pallet is moved forward in the curing chamber for thermal curing for a period of 24 hours. For identification purpose the slabs are marked and then moved further for curing in the stacking yard. Before dispatching the concrete 7 day during is done. The total capacity of this unit is 160 columns in 24 hours. The slab is also casted manually, the only difference is that curing is done conventionally instead of thermal curing. The total capacity this unit is 30 slabs per day.

Figure 9. Reinforcements with electrical conduits

Figure 10. Uniform Spreading

Figure 11. Stacking

d) PRECAST STAIRCASE (RACKERS)

The pre-casted staircase consists two flights which includes floor landing to mid landing and mid landing to floor landing. According to design the reinforcements are arranged and while placing the reinforcements the moulds are oiled. The mould is designed in such a way that 2 flights staircase are casted at a time. The reinforcements are inserted in the mould manually.

After this concrete is poured from the bucket with the help of remote control cranes. After 24 hours the moulds are removed and then lifted with the help of cranes and placed in the stacking yard. Curing is done for 7 days for dispatching the batch for erection to site. The total capacity of this unit is 40 rackers per day. Water leakage problem is eliminated by providing sleeves.

Figure 12. Reinforcements

Figure 13. Moulds

Figure 14. Stacking

SITE EXECUTION

The prefabricated components after the curing are dispatched with proper inspection and registration along with its date and time. These components are then transported to the specified building site for erection purpose. The erection and construction of the buildings are done according to the design.

Construction of foundation is done using conventional cast-in-situ method. Isolated type of foundation is constructed resting on the hard strata. The precasted plinth beam is placed and erection of prefabricated hollow core column is done. The column is lifted with the help of tower cranes and then placed at their precise position according to the design. Small grooves are provided at bottom of the columns so as to make smaller arrangements.

for its perfect erection. In order to get no eccentricity in columns, these are temporarily attached to the slab below with the help of wire rope arrangement as shown. Then the dowel bars are inserted in these columns and grouting is done until the column is half filled with high strength self compacting concrete. Primary beams are then allowed to rest on these columns at the notches as shown below.

In order to check the level of beam, level flushing is done in which, the floor to floor height is measured. If the level of beam is lower by significant amount then steel pads is used. After proper alignment, further four 20mm diameter steel bars are passed through the stirrups of beam with the lap length equal to (46*rod diameter) placed inside the core of the column.

Figure 15. Beam resting over column

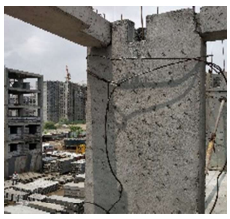


Figure 16. Notch connection

Figure 17. Column to beam connection

Figure 18. Beam to beam connection

Figure 19.slab to slab connection

Secondary beams if present are then placed keeping in view the location of notches. Similarly alignment is checked and then further reinforcements are tied.
Then the prefabricated slabs are allowed to rest on the beams. Props are placed beneath so as to avoid formation of cracks due to self weight. Further, reinforcements are provided which connects slab, beam, and columns together providing a stable and monolithic structure. This is followed by constructing shuttering for the entire floor and screeding is done in which the partially casted component attains there final dimensions.

For the installation or erection of staircase, notches are made in the columns while casting in which the beams are allowed to rest. These beams are provided for supporting the mid-landing of the staircase. The beam should be arranged properly so that the level of mid landing is exactly at a distance equal the half of floor to floor height. After this the mid landing is allowed to rest on these beams and reinforcements are then provided. Then the prefabricated staircase are placed between floor landing to mid landing and then midlanding to floor landing.

Figure 20. Staircase

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