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Developing a Tool for Automation of Casting Various Concrete Elements for Precast Residential Towers

S.Balamurali¹, G. Gangha²

Faculty of Engineering and Technology, Department of Civil Engineering, SRM University, Kattankulathur,
Kanchipuram, Tamil Nadu, India¹

Assistant Professor (O.G), Department of Civil Engineering, SRM University, Kattankulathur, Kanchipuram,
Tamil Nadu, India²

ABSTRACT: It is always been a challenge in Indian Construction scenario in adapting or transferring to a state of art technology and methodology, one such methodology is Precast Construction. From the past decade it is been noticed that this methodology of construction is taking a lateral penetration into the Indian construction sector, which is a positive note that this methodology reduces time, cost and wastage involved during a construction project. However, successful implementation of precast technology is aconfront as the entire planning, establishing and implementation procedure has to be changed in order to smooth the adaption of precast technique. This Project is an initiation to simplify and automate the process, calculations, algorithms and logics involved in precast construction and make the planning and establishment work like setting precast plant and assigning the precast mould size automatically with the help of Visual Basics in MS Excel

KEYWORDS: Precast construction, Precast technology, algorithms.

I. INTRODUCTION

Prefabrication is the practice of assembling components of a structure in a factory or other manufacturing site and transporting the complete assemblies or sub-assemblies to the construction site where the structure is to be located. For example to illustrate the process of prefabrication, the conventional method of building a house is to transport building materials to the site and to construct the house on site from these materials. In prefabricated construction, only the foundations are constructed in this way, while sections of walls, floors and roof are prefabricated or assembled in a factory -possibly with window and door frames included- then transported to the site, lifted into place by a crane and bolted together. In order to build in remote locations, deliver buildings more quickly, or to build in mass quantity, society has used prefabrication, taking the construction activities that traditionally occur on a site to a factory where frames, modules, or panels are fabricated. Prefabricated buildings is completely assembled and erected of which the structural part of building consist of prefabricated individuals units or assemblies using ordinary or controlled materials. Prefabricated buildings are used for sites which are not suitable for normal construction method, and also when normal construction materials are not easily available, or when there is difficulty to provide enough workers. Prefabrication is usually applied in structures which are used repeatedly and can be standardized such as mass housing, sheds, bus stands, security cabins, site offices, and road bridges. Prefabrication allows for year-round construction and work is not affected by weather delays (related to excessive cold, heat, rain, snow, etc.). The mechanization used in prefabricated construction ensures precise conformity to building code

The main objective of this study is

- To study the various elements such as wall panels, slabs, beams of precast residential towers for a selected plan.
- To create an Effective Framework for Precast Construction.

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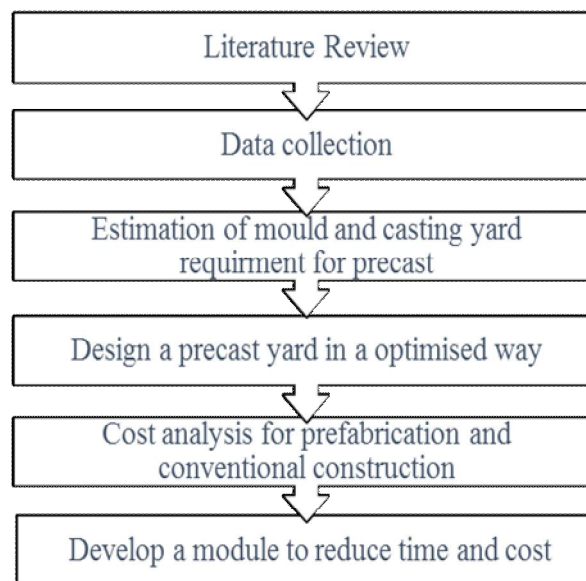
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- To develop an algorithm for elements used in residential tower construction using precast methodology.
To validate the algorithm by developing a tool to automate the precast construction process.

II. METHODOLOGY

This project deals with the time and cost related factors of the prefabricated elements and so the various literatures has been studied to know about the prefabrication elements and its usage in construction projects. A detailed study was made about the production of precast elements whether the prefabrication is done offsite or onsite based on the need and location of the project. The data related to the specifications of the prefabricated elements used in the selected projects were collected and the difference between the prefabricated elements construction and the conventional construction is also studied. Estimating the quantities has to be done for precast construction in comparison to conventional construction. The project duration of selected precast construction with conventional type of construction has to be compared. Cost analysis also has to be done for selected precast project with conventional construction. So, the methodology is mainly based on the comparison of planning, networking and estimation of selected precast projects with conventional method of construction and developing a module to reduce time and cost by conducting detailed investigation on the effective usages of prefabricated elements in construction projects. The methodology of the project is shown in figure,



III. PLANNING

SITE LOGISTIC PLAN

Site logistic plan includes the details of various site infrastructure facilities that are planned based on the requirement of the project. It shows the location of various facilities like site office, precast production yard, labour colony, site batching plant and proposed temporary roads.

PRECAST PLANNING

Detailed planning at the pre-production stage is very essential to ensure successful production, supply and erection of precast elements. The production program and the resources are synchronized with the project schedule so that rate of production of precast elements matches with the rate of demand from the construction site including the buffer stock. Precast planning involves the detailed working on the following parameters,

- Element layout

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- Precast yard planning
- Production planning
- Stacking area for precast elements
- Transportation of precast elements
- Erection of precast elements

PRECAST YARD PLANNING

Precast yard planning is one of the most important tasks in precast planning. All the precast elements required for the erection are produced and supplied from a strategically located precast production yard. Production schedule is planned to supply the required elements at the right time to site without hindering the progress of work. Precast yard is planned in 6 acres with three casting yards. The concrete required for the production of elements is supplied from the site batching plant. The details of various set of moulds in each yard are given below.

IV. PRODUCTION AND ERECTION OF PRECAST ELEMENTS

PRODUCTION STRATEGY

Precast production planning is made based on the quantity of work to be done. Monthly casting schedule is prepared based on the scope of elements to be produced for construction.

$$\text{Number of Moulds} = \frac{\text{Total Plan Area of the Element considered} \times \text{Respective Cycle Time}}{\text{Total Duration available for the Project} \times \text{Respective Element's Individual Mould Area} \times \text{Percentage Mould Area lost due to side shutters (0.8)}}$$

$$= \frac{A \times \text{Number of handlings} \times \text{Cycle time per element (2.5)} \times \text{per handling (15 mins)}}{\text{Crane Functioning per day (15 hours)}}$$

STACKING OF PRECAST ELEMENTS

Precast elements after demoulding/curing activity shall be stacked at the planned stacking area. It is planned to accommodate 15 days production of precast elements as a buffer stock to maintain uninterrupted supply of precast elements. Stacking area is calculated based on the element detailing and method of stacking.

TRANSPORTATION OF PRECAST ELEMENTS

Precast elements are transported to the site on flat bed or low bed trailers. The delivery of precast elements is planned according to erection sequence to avoid or minimize unnecessary handling or storage at site. The elements are loaded using gantry crane and delivered to the site with proper supports, frames and cushioning to prevent transit damages.

$$\text{Number of element to be handled by a gantry per day A,}$$

$$= \frac{\text{Total number of elements to be casted in that yard} \times \text{Cycle time}}{\text{Total Project Duration}}$$

Number of Gantry Required,

V. CONCLUSION

The systematic methodology of planning the establishment work which includes yard setup and logistics of gantry of a precast construction was discussed in detail, As a way forward these formulae shall be expanded as an algorithm thereby software shall be created to automate and make in more easier to achieve effective establishment work which forms as a strong base for productive precast construction.

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