

A REVIEW ON PRECAST CONCRETE

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Abstract - Most of the construction activities in India take place by conventional cast in situ method of construction. But still there is a huge demand for housing in India. So the construction activity has to take place in a much faster way. This cannot be achieved by conventional method of construction. It can be done possible with precast concrete of construction. Moreover there are more advantages of precast concrete when compared with conventional one. So various literatures are studied and a review of those all has been given in this paper. Also the advantages and disadvantages of precast construction are also discussed here.

Key Words: precast, cast in situ, construction, review, comparison

1. INTRODUCTION

Nowadays the precast concrete has been used extensively in many residential and commercial construction projects. It is because of the property of the precast concrete. It has higher durability, thermal properties and very easy to handle and so on. Also the quality of the precast concrete is higher as it is manufactured under great control. But there is lack of awareness and knowledge regarding the precast concrete in our country. This has to be changed and more study has to be done regarding precast. The connection details of the precast members also should be studied well. In this journal various literatures are studied and the results of various studies have been given here.

2. LITERATURE REVIEW

2.1 Dinesh Kumar et al., (April 2015) conducted a research so as to study the present situation of the precast construction industry in India. In his study two main factors are considered which are cost and time. For this research purpose data collection is done in the form of questionnaire survey and from this survey the present status and scope of precast techniques are known. A residential building is taken as case study and comparison is done. 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. At this stage conventional construction is economical and comfortable when compared to the prefabrication construction.

2.2 Siva Priya et al., (May 2016) carried out this research, as the construction industry replacing its method of implementing conventional methodology by various new innovations in the process of construction and selection of materials. Precast method of construction can increase productivity and quality of work through the use of better construction machinery, equipment, materials, and extensive pre-project planning. This study is essential since there is no organised body. In this research thesis the precast construction and conventional method is compared and it is found that the cost overall cost required for constructing the building using precast concrete method is reduced by 20% when compared to conventional method.

2.3 Akash Lanke et al., (June 2016) carried out a thesis to analyze the design, cost and time of precast and RCC buildings. Apart from these factors various other minor factors such as speed of construction, quality control, environmental conditions, labor resources, durability, connection, size, shape etc are also considered for the analysis. The cost and duration are compared as major factors. one building is chosen as a case study and Design is done for the same building as a precast building and Traditional Cast in-situ building. From this analysis It is remarkably seen that the cost of precast building is significantly reduces & duration of construction is also much lesser than traditional method. From all this study we can be conclude that the precast concrete system is economical than conventional cast in place method but still there are some conditions which we have to take care of while using precast, those are quantity of construction, Distance of site from manufacturing unit, Type of building etc.

2.4 M.J. Gopinath et al., (November 2013) done a thesis on a a two dimensional 3-bay G+5 storeyed prefabricated frame subjected to lateral loading. The joints in beam column junction and joints in beam to beam connection were strengthened by specially designed steel bolts and L-angles by welding and bolting. The frame was subjected to lateral cyclic load until failure. The results are compared with ANSYS model. The efficiency and performance of beam-column joints and beam-beam joints were studied and the behaviour of prefabricated frame is compared with monolithic frame. In this research Joints in beam column junction & Joints in beam to beam connection

were studied experimentally. It is concluded that the precast models performs efficiently than the conventional one.

2.5 Souma Alhaj et al. (2009) carried out a thesis on the productivity improvement of precast concrete. So the production process is investigated using the production delay model. Forty cycle data are used in the analysis. The comparative impact and severity are measured for five delay causes, namely: labour, environmental, management, equipment and material on overall system productivity. It is found via the production delay analysis that material, followed by equipment availability then labour was major contributors to system delay. Secondly, statistical analysis on the installation cycle time of three pre-cast component types is carried out, in order to insure whether the delay observed via the first step is attributed to variation of pre-cast pieces. It has been conclude that future work is to develop a decision model that could be used by production and construction managers in order to improve plant and onsite production.

2.6 Ragavendra Holla et al., (May 2016) reviewed and summarized the role of time, cost, quality and productivity of the precast system in order to compare with the conventional. Precast concrete construction is considered to produce better productivity and reduce completion time, cost and dependency on work force. Compared to cast-in-situ method, the precast method consumes less time because the prepared materials and elements are delivered just in time and placed on site which reduces unnecessary handling and equipment use. Cast-in-situ method of concreting requires lots of time because concrete requires minimum 28 days to achieve 99% strength of its total strength. In this thesis it has been referred that the construction methodology has a direct impact on strength and quality of the structure. It has been concluded that the precast construction provides better productivity, reduce the duration time of the project and cost and also the dependency of work force. Precast is a cost and time saving construction method which assures quality of concrete to its maximum extent. The productivity of the construction is high and wastes are minimum. Even after being very economical, it has its own drawback as the precast system has not been fully implemented in India and there is less knowledge about this method in the construction sector of India.

2.7 V.C. Castilho et al., (2012) made a research on cost minimization of continuous and simply supported slabs, formed by unialveolar beams and pre stressed joist, using Genetic Algorithms (GAs). Comparative analyses of the final costs were made for these two precast elements. although the pre stressed joist is more economical, unialveolar beam reaches the market to compete with the other precast elements for slabs. Genetic Algorithm (GA) is a search and optimization method that uses concepts of Genetics and is based on the mechanisms of population evolution. A kind of slab called unialveolar slab are pre casted. These slabs have a

hollow core thus making the slabs lighter. In this slab the depth of the slab will get increase with increase in the length of the span. The results are concluded that the precast slabs are more economical. This study investigated the use of GAs to find the lowest cost solution for slabs made of pre stressed joists and unialveolar beams.

2.8 Kyuman Cho et al., (July 2017) thesis research is about the comparison of traditional slab system with half precast concrete slab system. A half-precast concrete slab system (HPCSS) is reported to exhibit excellent structural performance when compared with traditional slab systems. However, there is a lack of extent research examining the construction issues of an HPCSS. The results indicate that (i) the construction productivity of HPCSS is 1.7 times that of a traditional slab system, (ii) the cost per productivity unit of HPCSS exceeds that of a traditional slab system. The results of this study suggest that it is possible to develop an optimal construction plan of a construction site in which an HPCSS is installed, and that the HPCSS can be actively applied in the future.

2.9 H.N. Nurjaman et al., research thesis is about the use of precast in low cost housing. The paper deals with the research and the application of precast concrete structural systems in Indonesia. The paper also describes the vast development already achieved to date in the applications of the precast concrete structural systems in the constructions of low-cost apartments in Indonesia. The research and applications of precast concrete structural systems are intended to support accelerated construction of one thousand low-cost apartment towers throughout large cities in Indonesia. Much low cost housing construction has been done by using precast construction and they had survived even stronger earthquake. It has been concluded that the precast construction can be implemented for an accelerated progress in development of public housing facilities particularly low cost rental and owned apartments.

2.10 N. Rossley et al., (2014) described about the connections of precast element when subjected to shear loads through his thesis. A study is done on the connection between the exterior and interior precast concrete walls. The connection between the walls is called loop bars connection. Between the looping bars, one transverse bar is inserted as to ensure connectivity of all the looping bars. This connection produces a gap between the walls, which would then be filled with concrete to produce rigid connection. The main objective of these experimental studies is to determine behaviour of loop bars connection under shear loading. The connection shows a ductile behaviour by producing a few line cracks and having a large deflection to give a warning before failure. This ductility is within the acceptable ductility of a structure. Therefore, it is recommended to the construction industry to adopt this kind connection design which can be used for medium rise precast building.

2.11 Mar Dewi Jamal et al., (2014) done a research is to check the ductility of precast elements under cyclic loading and then compare it with conventional elements. Testing was conducted using displacement control, with the gradual type. The study reveals that precast concrete has higher ductility compared with monolith concrete. Ductility of PC, $\mu = 4,379$, while the MC, $\mu = 2,333$. After the test has been conducted it has been noted that the ductility properties of precast is greater than the monolith construction. But the crack patterns are almost same in both the type.

2.12 Tanut Waroonkun (2011) presented a paper about analyses of a conceptual model that accommodates the numerous factors impacting the effectiveness of the adoption process. For this purpose a survey conducted to 160 construction industry professionals and the significant factors which impact the adoption of precast concrete systems are determined through statistical analysis. For this purpose single regression analysis is carried out and results are obtained.

2.13 Muhammad Abedi et al., (2013) through his research aimed to explore the potential of the cloud computing technology as the construction collaboration tools for precast supply chain management. Poor integrations and lack of collaboration are the major obstacles within the precast construction projects. In order to improve collaboration among precast supply chain stakeholders on the various phases of precast construction a system are needed for an effective communication and accessing to up to date information. Findings shows that the poor planning and scheduling, high cost of precast concrete components, the poor design, lack of architectural creativities, the poor production timing, large size and heavy precast components, wrong deliveries, poor on site coordination and collaboration, poor specialised contactors and lack of good communication among parties are the main barriers within the precast supply chain. These barriers within the precast supply chain phases may result to adverse consequences on the performance of precast project delivery. Hence, the cloud computing technology was found to have huge potential to provide efficient collaboration systems within the precast construction. So cloud computing technology was found to provide efficient collaboration system in precast supply chain management. Cloud computing as a significant collaborative tool will improve the integration, communication and collaboration for the parties and stakeholders within precast construction.

2.14 Ng Ban Kiong et al., (November 2012) thesis is about the precast concrete system for building maintenance. In this paper the factors that will lead to maintenance issues for building using precast concrete system are discussed. These factors will be those that need to be considered at the design, manufacturing and construction stage for the precast concrete system. Lastly, recommendations are proposed to be used by designers, contractors, manufacturers and researchers who are involved in precast concrete system.

The precast concrete are manufactured to specified dimensions and then they are transported to the site. If proper planning is not available, it may leads to building maintenance issues. Various factors such as architectural design stage, structural design stage, building services design stage, manufacturing stage, construction stage etc. are considered.

2.15 Prakash Rao et al., (2014) studied the perception of clients, contractors towards precast construction technology. In our country the perceptions about precast is not most responsive. This can be attributed to inherent reasons of acceptability traits of individuals and lack of skills to produce precast concrete elements. This perception is done based on the respondent's designation, experience, their knowledge about precast etc. through questionnaire survey taken from top level builders. Labors consider precast to be unsafe. It is better option for mass repetitive units. Some suggests that there is a need of research in precast.

2.16 Rinkesh Patel et al., thesis is regarding the prefabrication in India. Prefabrication first emerged with the Hindustan Housing factory. It was developed by our first prime minister of India, Pandit Jawaharlal Nehru as a solution to the housing crisis. The prefabrication is light weight and has a thermal insulation property, easy workability, and economy in cost, easy availability. He concluded that the cost of prefabrication is high compared to conventional but it helps when there is labor shortage.

2.17 B. Anvari et al., (August 2016) through his research suggested that a multi-objective Genetic Algorithm-based (GA-based) searching technique is proposed to solve unified resource scheduling problems (which are equivalent to extended Flexible Job Shop Scheduling Problems). To the best of the authors' knowledge, this is the first time that a GA-based optimization approach is applied to a holistic problem with the aim of minimizing time and cost while maximizing safety. The model is evaluated and compared to other exact and non-exact models using instances from the literature and scenarios inspired from real precast constructions.

2.18 F.Givssani et al., (August 2006) thesis is about precast and cast in situ slab systems for residential buildings. Two other interesting types of slabs, the first adopting composite truss beams and the second based on a cast in situ construction process, behaving as a two-way thin plate resting on fixed supports are then discussed. The cast in situ slabs are lightened by introducing terra cotta bricks. The cracking and deformation limit states are to be considered carefully in this study.

2.19 A L Kulabi Ahmed (2016) revealed through his research that the only way to save time and cost in a project is to improve the properties of normal weight concrete. In this research thesis it has been found that the saving in cost,

time can be achieved by improving the three properties of precast panels such as thermal resistance, fire resistance and heat capacity.

3. ADVANTAGES OF PRECAST

- The total time of construction can be saved up to a minimal of 20% when compared with conventional method of construction.
- Quality is assured more in precast construction.
- The dependency of work force is less in precast concrete construction.
- The speed of construction is higher.
- The ductility of precast concrete is higher when compared with monolith concrete.
- The precast concrete is light in weight and has a higher thermal insulating property.
- The topping slab in precast improves the cracking moment.

4. DISADVANTAGES OF PRECAST

- The precast method of construction becomes uneconomical for small residential construction.
- While transportation of the precast units to larger distance it may subject to get damage.
- The precast is not been fully implemented in India as there is lack of knowledge about this method.
- The crack pattern in both precast and conventional method of construction is almost same.
- Poor integration and lack of collaboration among stakeholders.
- If planning is not proper then it may lead to maintenance issues in later period.
- The cost is higher when compared to conventional method.

5. CONCLUSION

From the analysis done from various literatures it has been found that

- The precast is been adopted worldwide and it has many properties such as it can withstand under seismic loads, cyclic loads etc.
- It has good quality control.
- The speed of construction can be increased with precast construction

- The labor requirement in precast construction is very less.
- The installation and connection of precast construction is also very easy.
- Even though there are many advantages in precast construction there is still non responsive in countries like India. They still opt for the conventional construction and consider that to be safe as the cost of precast is slightly higher than that of the conventional construction.
- It may also be due to poor knowledge about precast in our country.

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