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Precast Concrete Elements- A Review

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Abstract:- Rapid population growth is creating enormous demand for basic services and resources such as housing, infrastructure, and resources. According to various engineering studies, the use of precast technology accounts for about 2% of India's total construction industry. Currently, the application of precast concrete construction (PCC) technology is limited to infrastructure projects such as subways, monorails, and bridges. Researchers suspect that the use of PCC technology is one of them. A sustainable way to achieve high quality with less effort consumption of resources such as cost and time construction. Today, conventional architecture pales in comparison to prefabricated. Precast concrete is a smart choice to build all kinds of buildings safely and economically. Guarantees fast construction times and high cost-effectiveness and excellent quality. Precast concrete elements are industrialized construction. It means moving work from the field to the factory. This improves productivity and quality and shortens the construction period of the building. In summary, the consumption of precast concrete parts significantly reduced overall construction costs. This article describe research on precast technology and its advantages over conventional construction.

Key words:- *Precast, Cast-in-Situ, Construction, Reviews, and Concrete Comparison.*

I. INTRODUCTION

Ready-mixed concrete is a construction product that is produced by pouring concrete into reusable forms, curing it in a controlled environment, and transporting it to a construction site after installation. A leading Indian real estate company is leveraging precast technology in the construction of its latest projects. The main advantages of precast technology are quality and speed structure and cost performance. Designers and builders today rely on precast technology to avoid labor shortages and delays and deliver quality products. Using such technology saves up to 64% of the time required. For a similar project using a regular theme, technology. In other words, standard brick-and-mortar construction would take a year to complete the project, while precast construction would take about four months. Precast technology proves its worth through savings in Europe and the Middle East construction time. The best thing about this technology is that it not only speeds up construction but also improves the quality of the final result.

- *History of Precast Technology*

Ancient Roman architects used concrete and quickly cast the material into molds to build intricate networks of aqueducts, sewers, and tunnels. Modern applications of precast technology cover a wide range of architectural and static applications, from individual parts to complete building systems.

In modern times, prefabricated panel building was introduced in 1905 in Liverpool, England. The inventor of this process is city planner John Alexander Brody, the creative genius who also came up with the idea for the soccer goal. In 1906, they followed Walton's tram stop in Liverpool. The idea was not widely accepted in Britain. However, it is popular all over the world, especially in Eastern Europe and Scandinavia.

Two sub-industries for precast concrete have developed in the United States, each represented by a major association.

The precast concrete industry focuses on utility products, subgrade products, and other non-prestressed products and is primarily represented by the National precast concrete Association (NPCA). The precast concrete industry centers on prestressed concrete components and other precast concrete components. Materials used for ground structures such as buildings, parking lots, and bridges. The industry is primarily represented by the precast/prestressed concrete institute (PCI).

II. LITERATURE REVIEW

- *F. Givssani et al., [August 2006]*

This study deals with precast and in-situ concrete roofing systems for residential use. He has two other types of interesting panels. The first uses a composite support and the second is based on a casting process that behaves like a two-sided thin plate resting on a solid support. The concrete slab on-site lit up with terracotta stones. This study requires careful consideration of crack and deformation limit states

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- *Souma Alhaj et al., [2009]*

Wrote an article about improving the productivity of precast concrete. Therefore, we use the production delay model to analyze the production process. Data from 40 cycles are used for analysis. Impact and severity comparisons are measured for five sources of delay. Labor, environment, management, equipment, and materials affect

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the productivity of the entire system. An analysis of production delays revealed that material, followed by equipment availability, and personnel were the main causes of the system delays. On the other hand, a statistical analysis of the assembly cycle times of the three types of precast elements is performed to confirm that the delay observed in the first step is due to the variability of the precast elements. For this reason, In the future decision-making models must be developed that enable production managers and shop floor managers to improve factory and shop floor production.

- *Tanut Waroonkun [2011]*

Published an article on the analysis of conceptual models considering several factors that affect the efficiency of the deployment process. For this purpose, the factors that have a significant impact on the use of precast concrete systems are determined by a statistical evaluation by 160 experts from the construction industry. For this purpose, a simple regression analysis was performed, and results are achieved.

- *NG Ban Kiong et al., [November 2012]*

A precast concrete framework for building support was examined. The article examines the factor that causes maintenance problem in precast concrete construction. These factors are factors to consider when planning, manufacturing, and designing precast concrete systems. Finally, we offer recommendations for designers, contractors, manufacturers, and researchers working with precast elements. Precast concrete parts are made to indicated measurements and transported to the development location. Building maintenance without proper planning can cause problems. Various factors are considered such as the architectural design stage, structural design stage, construction services, design phase, production phase, construction stage, etc.

- *VC Castilho et al., [2012]*

A study was conducted to determine the cost of continuous and span roofs it consists of single-celled and prestressed bars using a genetic algorithm (GA). A comparative examination of the final cost of these two precast components was performed. Prestressed beams are more economical and single-cell beams are emerging on the market to compete with other prefabricated roofing products. A genetic algorithm (GA)is a search and optimization technique that uses concepts from genetics and is based on the mechanism of population evolution. One type of plate called a single alveolar plate, is prefabricated. These panels have a hollow core which makes them lightweight. For this plate, the plate depth is increased as light increases. As a result, it turned out that the prefabricated roof is cheaper. In this study, the usage of GA was explored to find the most economical solution for prestressed and single-beam floors.

- *Muhammad Abedi et al., (2013)*

To explore the possibilities of cloud computing technology as building collaboration tools for supply chain management of prefabricated houses. Poor integration and lack of collaboration are the biggest obstacles in precast construction projects. Effective communication system at the various stages of precast construction, precast supply requires access to up-to-date information to improve collaboration between parties in the chain. The result is inadequate planning and scheduling, high finisher part costs, poor design, lack of architectural creativity, poor production times, large scale and heavy finished parts, poor delivery, on-site coordination and cooperation, poor site conditions, lack of contractor expertise, lack of good communication between parties. It is the main obstacle in the supply chain of finished parts. These obstacles in the precast supply chain stage can negatively impact the delivery performance of precast projects. Therefore, cloud computing technology has great potential to provide an efficient collaborative system in precast construction. Therefore, cloud computing technology has proven to be an efficient collaborative system in managing the supply chain of finished parts. Cloud computing as a critical collaboration tool improves the integration, communication, and collaboration of parties and stakeholders in prefabricated house construction.

- *M.J. Gopinath et al., (November 2013)*

Wrote a thesis on a two-way fabricated frame with 3 compartments, G + 5 floors subjected to lateral loads. The connection in beam-to-column connections and those in beam-to-beam connections have been reinforced with specially designed long steel bolts by welding and bolting. The frame has been sent to cyclic loads until it breaks. Results are compared with the ANSYS model. The efficiency and performance of beam and beam connections were tested, and the performance of the prefabricated frame compared with the monolithic frame was tested. In this study, beam-column joints and beam-beam joints are studied experimentally. It is concluded that the pre-designed model works better than the conventional model.

- *N. Rossley et al., (2014)*

Describe the connections of prefabricated elements under their in-memory shear load. A study is underway on the relationship between exterior and interior elements in precast concrete. The connection between the walls is called the ring bar connection. A crossbar is inserted between the rig bars to ensure that the entire ring bars are connected. The connection creates a gap between the walls, which is then filled with concrete to create a rigid connection. The main goal of this experimental study is to determine the behavior of the ring bars under horizontal loads. The connection exhibits a ductile behavior because it creates a few cracks in the pipeline and is large in size redirects to warn of errors. This ductility is within the acceptable ductility of the structure. Therefore, it is recommended by the construction industry to use this type of connection, which can be used for medium to large-size prefabricated members.

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- *Mar Dewi Jamal et al., (2014)*

Conducted a study to verify the ductility of prefabricated members under cyclic load, then compare them to normal loads. The test is performed using step-type motion control. Research shows that precast concrete structures have higher ductility than monolithic concrete. The ductility of precast concrete members, μ= 4.379, while for monolithic concrete, μ= 2.333. After testing, it turned out to be the ductility properties of prefabricated elements are superior to those of monolithic structures. However, the crack pattern is nearly the same for both types.

- *Prakash Rao et al., (2014)*

Surveying the perception of construction owners and contractors about prefabricated house construction technology. In our country, the concept of ready-made parts is not the strongest. This may be due to inherent reasons of human acceptance characteristics and lack of skill in the production of precast concrete. This perception is based on the respondent's name, experience, knowledge of prefabrication, etc. through a questionnaire survey of senior customers. Workers consider prefabricated elements is dangerous. Repeating volume units is best to select. A few points out that research is required in the field of precast concrete research.

- *Dinesh Kumar et al., (April 2015)*

A survey was conducted to investigate the current state of the precast industry in India. Their study takes into account two main factors: Cost and Time. This study collects data in the form of a questionnaire to understand the current status and scope of precast technology. Let's take housing as an example. A comparison showed that there was a large cost difference between the methods and that this type of procedure was prohibitively expensive. A detached house compared to a conventional prefabricated house. Prefabricated two-story single-family homes cost 13% more than conventional construction. This is the main drawback of prefabricated construction; in this case, it is not economical to build. At the same time, prefabs are simple to handle and reducing the construction time by 63 days compared to traditional methods. At this stage, conventional construction methods are economical and comfortable compared to prefabricated construction.

- *Siva Priya et al., (May 2016)*

The study was conducted at a time when the construction industry was trying to replace traditional construction methods with other construction methods. Innovations in construction processes and material selection. Prefabricated construction can improve productivity and quality of work through the use of better construction machinery, equipment, and materials, and comprehensive pre-project planning. This investigation is essential as there is no organized organization. In this survey, when comparing the precast construction method and the conventional construction method, the total construction cost was precast buildings are 20% cheaper to build than conventional construction methods.

- *Akash Lanke at al., (June 2016)*

Authored articles on precast construction and RCC design, cost and time analysis. Apart from these factors, the analysis also considers several other minor factors such as speed of construction, quality control, environmental conditions, labor resources, durability, connectivity, size, shapes, etc. cost, and duration are compared as the required causes. A building is selected as an example, and the same building as a prefabricated or traditional cast iron building is designed on-site. This analysis shows that the cost of prefabrication has been significantly reduced and the construction time has also been greatly reduced in the traditional way. From all this research we can conclude that precast concrete systems are cheaper than that. However, when using precast elements, there are some conditions that must be considered, such as construction scale, distance from the location of the production unit, type of building, etc.

- *Ragavendra Holla et al., (May 2016)*

The time, cost, quality, and productivity roles of precast systems were examined and summarized in comparison with conventional systems. Precast concrete construction is believed to be highly productive, reducing time to completion, cost, and reliance on labor. In comparison with the on-site casting method, the precast process saves time and reduces unnecessary handling and equipment use as materials and prepared parts are delivered just in time and placed on site. The process of pouring concrete is slow as it takes at least 28 days for the concrete to reach 99% of its total strength.

The study noted that construction methods have a direct impact on the strength and quality of structures. The precast design increases productivity, shortens project duration, reduces costs, and reduces reliance on labor. Precast elements are a construction method that saves time and money and guarantees the highest level of concrete quality. Construction is highly productive and waste is minimized, and very cheap, but there are some drawbacks. The precast system has not yet been fully implemented in India and the process is relatively unknown in the Indian construction sector.

- *B. Anvari et al., (August 2016)*

It has been pointed out that multi-objective genetic algorithm-based (GA-based) approaches have been proposed to solve joint resource scheduling problems (such as the long-running flexible workshop scheduling problem). According to our findings, this is the first time a GA-based holistic optimization approach has been comprehensively implemented with the aim of minimizing time and cost while maximizing security. Versions are evaluated using time since and compared to various specific and non-specific models. Literature and contingencies inspired by real-world prefabricated designs.

➢ *A L Kulabi Ahmed (2016)*

Through research, we have shown that the only way to save time and money on your project is to improve your normal weight characteristics concrete. The study found that time and cost savings can be achieved by improving the three properties of the finished part.: heat resistance, fire resistance, and heat resistance capacity.

➢ *Kyuman Cho et al., (July 2017)*

Discussed in their thesis about comparing the traditional roof system with the semi-finished concrete slab system. A half precast concrete slab system (HPCSS), It is reported to have excellent structural performance compared to conventional panel systems. However, there is a lack of research on the design issues of HPCSS. As a result (1) the development efficiency of HPCSS is 1.7 times higher than that of the conventional panel method. (2) the unit cost of HPCSS productivity far exceeds that of conventional panel systems. As a result of this examination, it was found that optimal plans can be created for construction sites where HPCSS has already been introduced and HPCSS will be actively used in the future.

III. ADVANTAGES OF PRECAST CONCRETE

- Quality is more assured when producing precast components.
- Low dependency on labor for precast concrete construction.
- Build speed is faster. Overall construction time can be reduced by up to 20% compared to conventional construction.
- Fewer laborers are required and these laborers may be less talented.
- The ductility of precast concrete components is greater than that of solid concrete.
- Precast concrete parts are lightweight and have good thermal insulation.
- Precast cover plate improves cracking moment.
- Precast parts are created in a controlled casting environment, which facilitates controlled mixing, placement, and curing.
- Precast operators can purchase materials for multiple projects, reducing costs through quality discounts.
- Controlling and monitoring quality is much easier with precast concrete.

IV. DISADVANTAGES OF PRECAST CONCRETE

- The precast development strategy isn't temperate for little private buildings.
- Long-distance transportation of finished parts can cause damage.
- Crack patterns in precast and conventional construction are almost the same.
- Poor integration and need for cooperation between parties.
- If planning is incorrect, it can lead to maintenance problems later on.
- Higher cost than the traditional method.

V. CONCLUSION

The use of precast concrete support systems in the construction of low-cost housing has made great strides around the world. Precast concrete systems offer the following advantages over traditional in-situ concrete systems:

- It has been found that replacing conventional structures with precast concrete elements
- typically achieves a profitability of around 5-10% of the structure.
- Prefabricated construction has many advantages, but the cost of prefab is slightly higher than
- conventional construction, so conventional construction is chosen and considered safer.
- The precast parts are used all over the world and have many characteristics such as it can
- withstand seismic loads, cyclic loads, etc.
- Assembling and connecting prefabricated houses is also very easy.
- Precast elements have a less lifetime cost than other construction solutions.
- It also showed that construction speed could be significantly increased in the process of
- achieving higher quality work and greener construction projects.
- Personnel requirements in precast construction are very low.
- Precast parts minimize maintenance needs for many years.
- The use of precast concrete elements as load-bearing components will certainly increase in the
- future.
- Construction speed can be improved by prefabricated construction.
- Precast concrete technology has come to India due to large-scale projects, the need for high-
- quality construction work at high speeds, and reduced manpower.
- All of these benefits are best exploited through careful planning and design.

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