# Review On Comparative Study Of International Codal Provision For Precast Construction

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***Abstract-*** Construction is in high demand in India, however most construction is done in cast in situ because India is a developing country. To speed up the process, precast construction can be used. Construction operations in India are carried out using the traditional cast in situ technique of construction. In India, however, there is still a high demand for housing. So. The construction work must proceed at a considerably faster pace**.**

National building codes have been formulated in different countries to lay down guidelines for the design and construction of structures. These codes are periodically revised to bring them in line with current research and often current trends. They render tasks to the designer relatively easy and simple; results are often formulated in formulas or charts. The aim of this project is to compare the practical and theoretical approaches of AMERICAN ACI 318 & EUROCODE 2. The broad design criteria like L/d ratio, Load Combinations, formulas are compared along with the area of steel for the major structural components like beams, slabs, columns to get an overview of how the codes are fair in comparison with each other. The significance has been tabulated and graphical representation so as to get better clarity and comparative analysis.

***Index Terms-*** Precast, Eurocode, construction, review, comparison, American code, recast construction.

## I. INTRODUCTION

Precast is a construction method in which structural elements are prepared in a factory and then put on the job site. Beams, slabs, columns, walls, and other structural elements are built and placed on the job site. The rise of this sector is the result of the foresight and boldness of a few famous individuals. Precast concrete has recently become popular in a variety of residential and commercial construction projects. It's because of the precast concrete's property. It is more durable, has better thermal qualities, and is very easy to handle, among other things. Precast concrete also has a superior quality because it is manufactured under strict guidelines. With the advent of a new construction method and new technologies, the construction sector has grown at a rapid pace. Many countries throughout the world use precast concrete technology, which is one of the most cost-effective and quality-controlled technologies available. The global construction boom is growing at a rapid pace, thanks to advances in technology. It covers a wide range of possibilities for incorporating precast concrete building technologies into our construction process. Fast track construction is currently a rapidly increasing approach, and the time saved in building will more than offset the overall construction cost, making prefab technology generally recognized around the world. The main advantage of precast versus cast-in-place is the reduction in project completion time. Precast building saves 30-40% of the time, resulting in indirect cost savings owing to inflation. Furthermore, when using a precast structure, the percentage of time lost due to external influences can be reduced. We analyzed precast structure productivity, quality, cost, and time in this study. On the basis of a selected scenario, we have also made a comparison of both precast and traditional cast in situ construction methods. We evaluated the following factors in our analysis.

• Manufacturing costs • Equipment utilized • Materials used • Machinery required • Storage costs • Labor costs • Transportation costs • Worker efficiency

## II. LITERATURE SURVEY

2.1 **R. A. J. (June 2020)** According to the report, the construction industry contributes over 15% to the global

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economy and is one of the most important sectors. The biggest benefit is that precast construction saves over 50% on labour costs, but there is a cost increase as well. This study is based on manual estimation and scheduling using Primavera Software for both precast and convention procedures. We can also learn about construction approaches that are ideal for high-rise buildings from this publication. This can be accomplished by determining the cost and time required to complete the project under construction. The project should be completed efficiently, and the overall cost should be reduced. In addition, the project's duration should be kept to a minimum. According to the preceding paper, a project completed using the precast approach takes 244 days to complete, whereas a project completed using the conventional way takes 544 days. For the difference in total cost, the difference in cost per house, and the difference in cost per sq. ft., the % difference in the overall cost is determined. So, the main conclusion of this study is that while the initial amount of precast concrete is large, it also has an edge over cast-in-situ in terms of time consumption, which is a significant benefit.

2.2 **P Siva.et.al., (May 2016)** According to the report, the precast construction industry has replaced its traditional technique with a variety of innovative advances in the construction process and material choices. The goal of this study is to compare traditional methods with precast concrete construction. The goal of this study is to show how precast concrete products affect the construction sector and to compare them to traditional methods. The mould size in this academic paper is determined by the size, intricacy, and materials employed. Individual castings do not have to be the same color or texture when using the master mould. Cutting into the mould surface for projecting details is more expensive than using bulkheads, blackouts, or reveals placed on top of the mould surface. Furthermore, price is more dependent on the long term. A project with 100 large panels can be more expensive per square foot than a one with 1000 smaller panels. In addition to cost savings during erection, larger panels have the added benefit of decreasing project timelines, lowering the number of joints that must be sealed, and eliminating the need for fever connection. Larger units are usually preferred unless they lack sufficient repetition or have considerable transportation and constructing costs. By utilizing the precast concrete components to their best potential, the total cost of an architectural precast concrete wall can be reduced.

**2.3 Lanke A. et al., (June 2016)** A real endeavor is made here to follow the standards, having created a 12-story skyscraper. Because of the regularity of the building grids, the building is termed cast-in-situ construction. Hollow core slabs, beams, columns, and stair flights are among the precast components. It is built on two prestressed concrete constructions with at least two hours of fire retention for hollow-core slabs. From this report, precast beams utilized in the office space are 540mm deep. The column size for precast columns is 500mm x 700mm, with a base plate connection every alternate story. As a result, these structural elements can be included in this research review. As a result of this, the population continues to rise rapidly, necessitating the necessity for rapid or quick development in future generations. The fundamental advantage of precast construction is that it saves time and money in terms of waste management and construction. We deliver stability, flexibility, sound durability, and adaptation with cost-efficiency using precast concrete. Precast concrete construction necessitated fewer steps, saving money on finance costs. In addition, labour policies that reduce costs, skills, staff growth, and training are all important aspects. We can decide the economic features of this study based on this general estimating, which seeks to find out the nearest cost of building and correspondingly. The biggest disadvantage of precast is transportation from the factory to the location where it will be installed. The most crucial thing to note is that with precast construction, time is of the essence. It takes less time to construct in this way. It necessitates the use of competent labour and qualified contractors, as well as a cheaper starting cost, particularly for major projects. We can also improve concrete quality control and make lighter concrete modules.

**2.4 D. Kumar.et al., (April 2015)** The major goal of the effort is to investigate the precast condition in India's precast construction industry. Precast concrete is comfortable as a result of its inherent thermal inertia (which allows for a more consistent temperature in both cold and hot climates) and acoustic insulation capabilities. Precast concrete is also safe, versatile, healthful, optimized, and long-lasting. In this case, data gathering should be done in several companies to obtain rate details for both precast and traditional construction. This collection can be used to determine the cost of a project for both new and existing constructions, as well as the length of time it will take to complete the project. We learn about the comparison of a cost analysis from this literature. This literature review accomplished the work's key objectives. For both constructions, the total cost and length of the double-story residential building have been determined. The analysis revealed that there is a significant cost difference between two technologies, with precast being significantly more expensive than conventional on this type of individual dwelling. Individual double-story residential buildings constructed using precast concrete cost 13% more than conventional construction. At the same time, it is simple to use and reduces project duration by 63 days when compared to traditional approaches. Its key benefit is that it aids in the event of a labour shortage. We learned from this literature review that building has more advantages than procurement. However, there are several limits and a lack of information in individual homes, making it difficult to execute in our country. When compared to precast construction, conventional construction is more cost-effective at current time.

**2.5 M. Gopinath et al., (November 2013)** Precast concrete has been widely employed in residential and commercial construction projects, according to the illustration. Precast concrete also has a superior quality because it is manufactured under strict guidelines. As a result, the thesis was based on a two-dimensional three-bay G+5-story prefabricated frame that was subjected to lateral loading. Specially designed bolts and L-angles were used to strengthen the joints in the beam-column junction and the beam-to-beam connection. A lateral cyclic load unit failure occurred on the frame. The results are then compared to the ANSYS model. The efficiency and performance of beam-column and beam-beam joints were investigated, and the

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behavior of prefabricated and monolithic frames were compared. Joints in beam-column junctions and joints in beam-to-beam connections were investigated experimentally in this study. The components utilized in this Ordinary Portland Cement of Grade 53, which meets IS-12269 standards. The aggregate utilized was a maximum of 12.5mm and met BIS 383-1970 specifications. The concrete is cast with potable water, and the steel is of the Fe 415 grade. Two types of concrete mixes, M20 and M60, were used in this project. Concrete proportioning is a term that refers to the process of putting together a This literature study covers the dimensions of the model prefabricated frame, the reinforcement features of the control frame, the types of joints used in the prefabricated frame, casting of the precast multi-story precast frame, and assembling the test set up. The initial cracking and ultimate load of frames, load-deflection behavior of the frames, and load-deflection behavior based on the type of connection are all obtained as a result of this. Based on the experimental results, the following conclusion was reached from the above literature for prefabricated frame specimens subjected to lateral cyclic loading. The ultimate base shear for the conventional frame was 189.9 KN in the 14th load cycle, but the prefabricated frame specimen attained 210 KN in the 14th load cycle. The conventional frame had a story deflection of 33m in the 16th cycle of loading, while the prefabricated frame specimen had a story deflection of 42.5mm in the 16th cycle of loading. And, based on the aforementioned findings, it can be stated that, of the two frames, PS-1 closely approaches the control frame's ultimate load, and the variation in deflection is also modest. As a result, the premade model functions reasonably well.

**2.6 J. M. D.et al., (2014)** investigated this, comparing the ductility of precast elements to that of conventional elements under cyclic loading. The tests were carried out utilizing the gradual kind of displacement control. Precast concrete has higher ductility than Monolithic Concrete Ductility of PC, mue=4,379, while MC, mule=2,333, according to the study. The ductility qualities of precast are greater than those of monolithic construction, according to the results of the test. However, the crack patterns are nearly identical in both varieties. An experimental investigation was carried out to assess the behavior of the connections when they were subjected to cyclic loading. According to the test results, the precast connection can meet or exceed the performance of the monolithic connection, resulting in moment-resisting performance. The performance of the connection is measured in terms of ductility, energy dissipation capacity, connection strength, and drift capacity. In traditional precast concrete (PC), the walls are subjected to cyclic loads, and the gap opening and shear slip at the panel junction reduce ductility and energy dissipation capacity. Two alternative strategies were investigated in this study to improve the earthquake resilience of the emulative PC walls. At the plastic hinge zone, bonded or unbounded Longitudinal rebars with a partially reduced cross-sectional area were utilized first. The PC panel at the bottom of the wall was weakened by the reduced rebars area, resulting in the development of a plastic hinge zone in the PC panel rather than at the panel joints. Second, a cast-in-place RC-PC hybrid wall is considered. The proposed approaches avoided gap opening and shear slide at the panel joints, according to the test results. As a consequence, the suggested PC (Precast Concrete) wall's ductility and energy dissipation were comparable to those of the existing wall. It was also determined that the precast construction's overall performance was comparable to that of a monolithic specimen, and that the precast specimens' ultimate displacement ductility was slightly higher than that of monolithic specimens.

**2.7 J. Anupam et al.,** (2014) In India, the technology of precast concrete was stated. The rapid growth of the urban population created a great need for housing, infrastructural development, and commercial zones, among other things. Tilts & hollow core is the method of construction in this example, with tilts encompassing columns, beams, canopy, wall panels, cladding, balcony, staircase, and landing, and hollow core encompassing a slab. This literature paper explains what those phrases mean and defines them. The major goal was to discover that precast construction barely accounted for 2% of the USD 500 million Indian construction industry. As a result, the Indian government has taken steps to support the precast construction industry. They proposed employing precast concrete technology to give houses to everyone by 2022. This case study examines the occupants of the G+1 structure's building in terms of cost, time, and schedule. The project is broken down into three key stages: substructure, superstructure, and finishing works.

**2.8 A.L Venkatesh et al., (2013)** developed a resource for precast construction that uses the lean manufacturing technique to eliminate waste and optimize production operations. Many building strategies in the lean manufacturing system were employed in this literature paper, however the Kaizen method was applied in this study. The major goal of this article is to improve labour productivity by implementing lean production techniques (kaizen method) in a precast factory. This case study is done at Devanagari, Bangalore, where the project of 130 acres of land is termed the first smart city in Bangalore. The precast elements were cast at the factory and can be delivered to the election site after 7 days from the date of casting. The first steps essentially document the present process, such as mould mending, reinforcement laying, and so on. They identify all types of waste in the second stage, build lean in the third step by fixing window molds outside the table, marking on the table, and so on, and document the changes in the fourth step. They also present a graph comparing performance before and after training, showing that value-added activities improved by 13% from 84 to 97 percent, and non-value-added activities decreased by 13% from 16 to 3 percent.

**2.9 M. Sayali et al., (2013**) Precast building time, cost, productivity, and quality analysis were summarized. They had been working as management trainees at Precast India Infrastructure Pvt.Ltd. in Pune for 6 months in planning, buying, and analysis on time, cost, quality, and productivity with the help of reviewing entire planning, production cycle. They use the Pune Metro office project as an example of a time analysis because it was built with precast parts such as arches, plinth walls, precast box walls, beams, and so on. This is broken down into three stages: substructure, foundation, superstructure, and finishing works. For prefabrication construction, the substructure takes 15 days, the foundation takes 8 days, the superstructure

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takes 30 days, and the finishing work takes 35 days; for conventional construction, the substructure takes 15 days, the foundation takes 8 days, the superstructure takes 30 days, and the finishing work takes 35 days. The substructure will take 15 days, the foundation will take 21 days, the superstructure will take 50 days, and the finishing work will take 45 days. As a result, when compared to the cast-in-situ approach, precast construction takes less time to finish (conventional method). Thus, the entire construction time for a single-story building using the precast approach was 88 days, compared to 131 days using the conventional method. In a cost analysis, the cost of precast increases for a small project due to the lack of bulk manufacturing of pieces, while the cost may fall dramatically for larger projects. Construction costs are lower in larger batches, but transportation costs can be greater depending on the distance between the precast facility and the construction site.

**2.10 J. Sandeep. et al., (2013)** investigated the use of precast concrete technology in high-rise building construction. They looked at the many aspects of precast elements such as columns, beams, slabs, panels, and staircases. Precast concrete construction design philosophy is based on buildability, economy, and standardization of precast elements in this case. Horizontal and vertical joints are the two types of connections. They completed a project on Dream Valley in Greater Noida in their literature article (Delhi). There are 47 high-rise residential towers, 379 villas, commercial and institutional buildings, and other projects in this residential township. This project has a total built-up area of more than 10 million square feet. Each floor has 12 apartments with a carpet space of around 430 sq.ft. for 1 BHK. Because this project is in seismic zone IV, the appropriate design was chosen. As a result, if 2B+G+18 floors were built in 18 months thanks to precast technology, the project resulted in 7 buildings. For a slab area of 7000 sq.ft., they obtained a slab cycle of 10-12 days.
Precast building, if conceived and constructed with meticulous planning, has a significant potential to meet new market demands, according to the findings of the study. Non-destructive testing (NDT) is simple to execute if the need arises, and it is also simple to mitigate. Precast technology allows for additional flexibility in design and longer clear spans in non-tower areas such as parking, and it is also a sensible choice.

2.11 **Benjamin Abensour (April - September 2017)** The present research compares the Chinese code GB 50010, the European code Eurocode 2, and the American code ACI 318 in the design of reinforced concrete beams. The design of rebars of reinforced concrete beams is made according to the three design codes from a concrete construction constituted of a slab and many beams. The comparison is based on the ratios calculated between the various values of reinforcement areas. Using the same number for steel yield strength, we determine which code is the most cautious in this study. The results of rebar regions in flexure design are nearly same. Eurocode 2 appears to be the most conservative code. The codes are mostly comparable, and the changes between them are just about 10% to 20%. We see larger disparities in shear design than in flexure design, although the stirrups ratios of two comparable codes stay in a range of 1 to 2 worldwide. In most circumstances, ACI 318 is the most conservative code. Then, using trend-lines to characterize the distribution of all the collected data, a relationship is established between the codes using all of the calculated ratios. The following is a summary of the paper. First, we'll go over the project's presentation and calculating approach. The comparison's findings are then displayed. Finally, a proposal for a global design code is presented.

**2.12 Mar Dewi Jamal et al., (2014)** The purpose of this study is to compare the ductility of precast elements to that of conventional elements under cyclic loading. The progressive kind of displacement control was used in the testing. Precast concrete has a higher ductility than monolith concrete, according to the study. The PC has a ductility of 4,379, while the MC has a ductility of 2,333. The ductility qualities of precast are greater than those of monolithic construction, according to the results of the test. However, the crack patterns are nearly identical in both varieties.

**2.13 Muhammad Abedi et al., (2013)** His research aims to look at the possibilities of cloud computing technology as a tool for precast supply chain management in the construction industry. The main challenges in precast construction projects are poor integration and a lack of teamwork. A system for effective communication and access to up-to-date information is required to facilitate collaboration among precast supply chain stakeholders on the various phases of precast construction. Poor planning and scheduling, high precast concrete component costs, poor design, lack of architectural creativity, poor production timing, large size and heavy precast components, incorrect deliveries, poor on-site coordination and collaboration, poor specialized contactors, and lack of good communication among parties are the main barriers within the industry, according to the findings. These roadblocks in the precast supply chain phases may have a negative impact on precast project delivery performance. As a result, cloud computing technology was shown to have a lot of potential in terms of providing effective collaboration solutions for precast construction. As a result, cloud computing technology was discovered to be an effective collaboration solution in the precast supply chain management. Cloud computing, as a crucial collaborative tool, will increase precast construction's integration, communication, and collaboration for all parties and stakeholders.

**2.14 Ng Ban Kiong et al., (November 2012)** The precast concrete system for building maintenance is the subject of this thesis.
The aspects that will contribute to maintenance concerns for buildings constructed with a precast concrete system are explored in this study.
These are the issues that must be considered during the precast concrete system's design, production, and construction stages. Finally, designers, contractors, manufacturers, and researchers involved in the precast concrete system are encouraged to use the guidelines.
The precast concrete is made to certain dimensions before being brought to the job site. If suitable planning is not available, building maintenance concerns may arise. Architectural design stage, structural design stage, building services design stage,

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manufacturing stage, construction stage, and so on are all taken into account.

## III. ADVANTAGES

- When compared to traditional construction methods, total construction time can be reduced by up to 20%.
- In precast construction, quality is more ensured.
- In precast concrete construction, the work force is less reliant.
- Construction is moving at a faster pace.
- When compared to monolith concrete, precast concrete has a higher ductility.
- Precast concrete is lighter in weight and provides better thermal insulation.

## IV. DISADVANTGES

- 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.

## V. CONCLUSION

Finally, we can state the research's overall conclusion. The findings of rebar areas in flexure design are essentially identical, and the mean value of the calculated ratios is a highly good approximation in a particular comparison. Eurocode 2 is a slightly more conservative design code than the others. The computed ratios in shear design are about between 1 and 2. Furthermore, the value of the estimated ratio varies greatly depending on the value of the ratio span/spacing between beams for a given comparison. The most conservative design code is ACI 318.

Then, using the comparisons, we may determine how to achieve code equality. The results are fairly similar in flexure design. Then, using the comparisons, we may determine how to achieve code equality. The results are fairly similar in flexure design. As a result, the equivalency is defined as the average of the outcomes. The results of the calculated ratios in shear design are not near to the same value. However, we have demonstrated that the equivalence between the codes may be expressed as a function, with the function representing the calculated ratios and the variable representing the span/spacing between beams ratio. Expanding this type of research by looking at more structural elements, types of structures, or design regulations, for example, could lead to the creation of an international database that calculates the equivalency ratio for a given scenario. This international code isn't unique, although it is widely used. The necessities of each country define the uniqueness.

- The European code places a greater emphasis on safety considerations.
- In comparison to the Euro Code, the American Code takes a more practical approach.
- As a result, in ACI cost of an element is higher than the EC2 cost.

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