

A Review on Comparative Understanding of European and Indian Precast Structure

Aamir Patel¹, Kiran Shinde^{2*}, Atharva Sakpal³, Siddhi Surve⁴, Siddhartha Ray⁵

^{1,2,3,4}B.E. Student, Department of Civil Engineering, New Horizon Institute of Technology and Management, Thane, India

⁵Assistant Professor, Department of Civil Engineering, New Horizon Institute of Technology and Management, Thane, India

Abstract: In India there is a great demand for construction but usually, construction is done in situ, as India is a developing country construction is in great demand to make the process fast precast construction can be adopted hence a study of this process is included in this paper. Conventional cast in situ method of construction is most used construction method in India. But still, there's an enormous demand for housing in India. So, the construction activity has to take place much faster. This can't be accomplished through conventional method of construction. It can be done possible with precast concrete for construction. Moreover, there are greater benefits of precast concrete in comparison with traditional ones. So various literatures are studied and an assessment of these all have been given in this paper. Also, the benefits and negative aspects of precast construction are discussed here. In this paper different structural components are studied and designed according to Indian code as well as Eurocode-2. In this study a comparison between IS CODE and EUROCODE-2 is done while designing loads from one element are transferred to other components, and components are designed accordingly.

Keywords: Construction, precast, IS CODE, EUROCODE.

1. Introduction

The meaning of precast development includes those constructions where structural aspects are produced and standardized in plants that are positioned away from residential areas. It is also regarded as prefabricated construction.

The purpose for adoption of precast construction nowadays for industrial and residential structures is its durability, effortless handling, and lesser time required for construction. As precast concrete is manufactured below high-quality control, it has better quality; however, in our country, precast is rarely adopted because of a lack of knowledge and lack of study on precast to make the development, quick understanding, and use of precast concrete should be increased. The purpose of conducting a study on the precast concrete structure is its merits such as

Onsite casting, safety, and control over material quality and workmanship.

The important aspects of the precast development manner are as follows:

- Human staff is divided and specialized which saves time.
- The use of computerized tools, equipment, and

different equipment offers a rise in the quality of buildings and its standard.

Precast construction can be adopted in various conditions such as underground building and above-ground construction, from the biggest infrastructural tasks to small works. The precast building gives importance to the aesthetics of the structure. Precast concrete can take any structure or size as per the requirements.

A. Objectives of Precast Construction

Following are the objectives of precast concrete construction.

- **Quality:** High levels of quality control as compared to the cast in-situ concreting.
- **Strength:** Precast elements are of higher-grade concrete in contrast to traditional in-situ construction.
- **Durability:** Precast concrete construction improves building quality and for this cause extends the life of the buildings.
- **Weather Resistant:** Precast concrete sincerely gains strength when un-hydrated cement particles in it react with water, consequently making it totally weather-resistant.
- **Corrosion & Fire Resistant:** Precast concrete is one of the few non-combustible constructing substances which does no longer lose its structural potential nearly as rapidly as steel, and performs very well even in accelerated temperatures.

B. Scope of Precast Construction

Precast concrete technology is very famous in housing, factories, and infrastructure projects. In the early 70s, precast concrete technology was first initiated thru premier state laboratories of India to help authorities' programs. Freyssinets invention in 1928 had modified concrete technology into a popular prestressed concrete technology. Prior to this invention concrete was not such a famous building material due to its low tensile strength. By the 1940s prestressed concrete could turn out to be the great alternate construction material having excessive compressive strength with isotropic material properties. The use of high-strength steel, improvement in durability, achieve in high early compressive power in concrete,

*Corresponding author: kiranshinde181@nhitm.ac.in

etc., have helped the precast industries in creating many innovative building products, in particular, for a long-span and large dimensional category. Precast hollow-core slabs, long-span T-beams, planks, roof shells, etc., have popularized precast building construction. L&T- development below the education and pioneering initiatives of Dr. A Ramakrishna had carried out big precast concrete technology developmental works in buildings, industrial factories, bridges, stadium buildings for quite a few years. ICI Handbook important points many such constructing revolutionary tasks built in India in the ultimate quite a few years. So, science adaptation and execution exist but complete building precast concrete works are very scanty in India.

2. Types of Precast Construction

A. Large Panel Systems

It is a structural system that consists of planar walls and slab elements, which shape an enclosed space. In massive panel system column factors are now not used solely wall and slab elements are used for forming the structure. When desirable joined together, the horizontal elements act as diaphragms that can transfer the lateral loads to the walls.

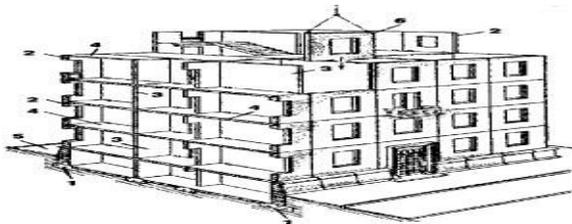


Fig. 1. Large panel system

B. Frame Systems

Precast concrete frames are developed earlier than actual construction begins and is transported to the site for erection. There are a variety of types of precast concrete frames such as skeletal frame, H frame, and portal frame. Precast concrete frames are usually used for single-storey and low-rise structures. The concrete individuals are transported to the site where a crane then lifts and place them into position to assemble the frame. The beam-column joints executed in this way are hinged. However, inflexible beam-column connections are used in some cases, when the continuity of longitudinal reinforcement through the beam-column joint wishes to be ensured.

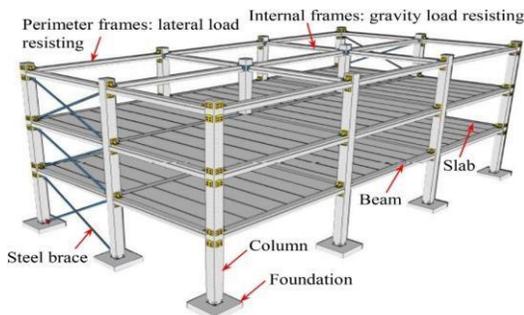


Fig. 2. Frame system

C. Column Slab Systems with Wall

In this system, gravity masses are supported through slab column shape whereas shear walls stand up to lateral loads. There are two sorts of column-slab structures with shear wall.

- Lift slab system with walls: Reinforced concrete slabs are poured on the floor in forms, one on top of the other. Precast concrete flooring slabs are lifted from the ground up to the ultimate top through lifting cranes. The slab panels are lifted to the top of the column then moved downwards to the final position.
- Pre-stressed column-slab system: The prestressed slab column system makes use of horizontal prestressing in two orthogonal directions to gather continuity. After erecting the slabs and columns of a story, the columns and ground slabs are prestressed via potential of prestressing tendons that pass-through ducts in the columns at the ground degree and along the gaps left between adjoining slabs.

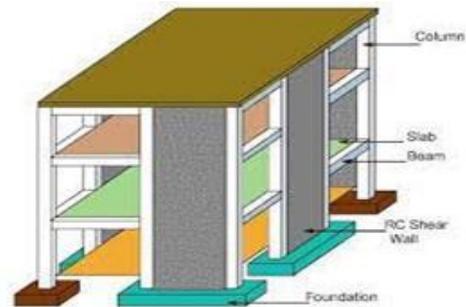


Fig. 3. Slab column system

3. Literature Survey

Ahmed A. et. al, (2016) They Revealed and concluded through their research that to improve the normal weight concrete properties can be achieved by saving time and cost in the project. In this research it is mentioned that by improving three properties of precast panels such as heat capacity, thermal resistance and fire resistance saving in cost and time can be achieved. [1]

Rao P. et al., (2014) They studied in this research about the understanding between client and contractors toward their approach for precast construction and technology. In India, the outlook about precast is not very positive. This can be attributed to intrinsic motive of acceptability quantities of men and women and it have very low potential to produce precast concrete elements. Through the questionnaire survey carried by high profile builders the understanding about precast is based on respondent job profile, information about precast, and experience. Precast construction is considered unsafe by the labours. For mass Repetitive units precast is considered as one of the best choices and according to the survey some people recommended that there is need to look up in precast construction [2].

Rossley N. et al., (2014) They studied about the connections of precast construction and described about the connections

when subjected to the shear force through their research. The study is done on this research paper which includes the connection between the interior and exterior precast concrete wall. The loop bar connection is known as the connection between distribution. The connectivity of all the looping bar is made certain by inserting transverse bar between the looping bar. The gap is produced between the wall because of the connections, then that gap is filled with concrete in order to produce unbending connections. The main objective behind this research is to study and decide the behaviour of loop bars connection when subjected to shear loading. By studying the behaviour of loop Bar connection, it specifies ductile behaviour because it has produced few cracks and undergoes huge deflection. For medium rise precast building construction, it is highly recommended to use these types of connection. [3]

Chandiwala A. et al., (2013) They concluded and published through the research that in the public construction as well as in private construction project prefabricated (precast) construction is largely adopted. Prefabrication together with standardization and modernization has introduced an important substitute in the development of the construction business used worldwide for some decades. Precast building analysis. Precast elements are designed by taking forces into consideration and by dealing with the additional forces due to lateral load and gravitational loading. Excel sheets are used for format of precast elements. Comparison of precast construction for cost and time with cast in situ construction is done. In this report precast material cost, construction price and handling are mentioned. [4]

Bindurani P. et al., (December 2013) They concluded through their research that for executing construction project, precast construction is considered as one of the environments friendly choices for construction. Precast machine behaviour totally depends on connections, for evaluation and design it should be properly modelled in the computational models. Connections in wall type precast construction can be learned through this type of modelling. In this research a 23 storeyed building is considered which is made up of precast slabs and wall panel, in this 23 storeyed building vertical joint modelling is done in terms of shear transfer. In order to seek out the effect on the drift the vertical joints between the wall panel has been investigated by using two computation models and therefore the forces has been generated within the walls. For the model which is no longer considering any shear switch through the vertical joints has the tendency to provide conservative effects for metal requirement. [5]

Kiong N. et al., (November 2012) Their research was about maintenance of precast elements. In this paper, the factors that will lead to troubles during renovation for structures using the precast concrete structures are discussed. At the design and manufacturing stage these are the precast elements that need to be shown for the precast concrete construction. Lastly, suggestions or ideas are proposed that can be used by designers, contractors and manufacturers who are worried in a precast concrete system. The precast concrete elements are manufactured as per the desired size and dimensions and is then transported to site. Further no planning is available, issues may arise related to maintenance. Various stages such as design

stage, planning stage, constructing design stage, manufacturing stage, etc. are considered. [6]

Abedi M. et al., (2013) Through their research aimed to discover the attainable of cloud computing science as the development collaboration tool for the precast grant chain management. Fewer integrations and very few collaborations are the main barriers within the precast construction projects. A system is needed for effective conversation and with up-to-date information. Findings show that the poor planning, high prices of precast concrete elements, improper design, less architectural creativities, wrong manufacturing timing, large dimensions and precast components with high weights, improper deliveries, worst on-site manufacturing and collaboration, un-specialized contractors, and lack of proper communication among stages and events are the major limitations within the precast supply process. These limitations within the supply process can also have damaging consequences on the process of precast project delivery. Hence, the technology of cloud computing was observed to have a big advantage to provide proper coordination inside the precast construction. So, cloud computing technological was discovered to provide a proper coordination machine in precast furnish chain management. [7]

Kumar D. et al., (April 2015) Through their research they found out about the existing affairs of the precast construction industry in India. In their study, two of the most important factors are considered which are price and time. For this research, the information is in the form of a questionnaire survey, and from the survey, the present scope of precast construction in India is known. A residential construction is taken as a case to learn about and a survey is done. The analysis confirmed that there is a huge cost difference between different methods, which the precast is very high as compared to conventional on-site construction on. The precast building for double-story residential constructing expenses is 13% extra when compared to traditional on-site construction. This is the main disadvantage for precast construction. At the same time, the precast construction is easy to work and reduces the time duration, is reduced by 62 days when compared to the conventional on-site construction. At this stage, conventional on-site construction is economical when compared to precast construction. [8]

Gopinath M. et al., (November 2013) This research is completely based on a two-dimensional G+4 storeyed prefabricated frame subjected to lateral loading. The joints of beam to column and joints of beam-to-beam connection were connected by using designed metal bolts and (L)-angles by using bolting and welding. The structure was under lateral cyclic loading till the time it comes to failure. The consequences are in relation with the (ANSYS) model. The effectiveness and performance of beam-column joints and beam-beam joints were studied and the behaviour of the prefabricated frames is in relation with the monolithic frames. Joints in beam-column junction & Joints in beam-to-beam connection were studied experimentally. It is understood that the precast elements functions properly as compared the traditional on-site construction. [9]

Siva P. et al., (May 2016) They carried out this research, As the traditional method of construction is exchanged with precast

construction with number of improvements in the method of construction and specifications of materials. The precast techniques of construction can highly increase productivity and perfection of work. This is necessary because there is no organized body. In this research, the precast construction and conventional on-site construction are in contrast and it is known that the overall cost required for setting up the building using the precast concrete technology is decreased by 22% when compared to the traditional on-site method. [10]

Lanke A. et al., (June 2016) They succeeded and achieved this theory to study the design, cost and time of precast and RCC buildings. Excluding these components, a span of other small elements such as speed of construction, pleasant control, meteorological conditions, employment supplies, longevity, connection, size, structure etc. are also considered for the research. The price and period are differentiated as primary factors. One building is selected as a case learn about and design is done for the same building as a precast constructing and a conventional cast in-situ building. From this study, it is extraordinarily observed that the fee of precast constructing is considerably decreased & the span of building is also a good deal lesser than the normal method. From all this they have come to the conclusion that the precast concrete machine is extra money saving than the standard cast in place technique but still, there are some prerequisites which we have to take care of while the usage of precast, these are quantity of construction, distance of site from manufacturing unit, type of building, etc. [11]

Souma M. et al., (2009) They examined the effectiveness improvement of precast concrete. So, the manufacturing manner is inspected the utilization of the manufacturing lengthen model. Forty cycle documents are used in the analysis. The comparative study has an effect on and severity are measured for 5 prolong causes, namely: labour, environmental, management, equipment and material on fundamental computing device productivity. It is placed by means of way of the manufacturing delay evaluation that material, observed through the usage of equipment availability then labour used to be major contributors to system delay. Secondly, statistical assessment on the set-up cycle time of three pre-cast issue types is carried out, to make sure whether or not the length found through means of the first step is attributed to the version of pre-cast pieces. It has been concluded that future work is to improve a decision model that might also prefer to be used by means of manufacturing and building managers to enhance plant and onsite production. [12]

Jamal D. et al., (2014) This investigation is to see the ductility of precast factors beneath the effect of cyclic load then calculate them with forged in situ elements. Testing was once conducted for the utilization of displacement control, with the gradual type. The study exhibits that precast concrete has higher ductility in distinction with monolith concrete. Ductility of PC, $\mu = 4,379$, while the MC, $\mu = 2,333$. After the observations that are been carried out it has been concluded that the ductility of precast construction is greater than the monolith construction. But the crack patterns are almost the equal in each precast and forged in situ construction. [13]

Noorhidana et al., (2016) A unique kind of precast concrete exterior beam-to-column connection is mentioned in this paper. The connection consists of a pre-casted U-beam, a precast column along with corbel, and inter-locking bars to be part of the precast column and beam; these bars, act as the flexural reinforcement to stand up to the hogging and sagging 2nd subjected for the measurement of testing. The beam-column joint used to be designed in accordance to the sturdy column-weak beam Principle. In this test, two specimens are tested. The measurement of the individuals used to be once determined through way of the contra-flexure factors ensuing from a computer evaluation The take a appear setup used in this discover out about is described as follows; the column ends have been restrained with the useful resource of the use of steel plates which have been bolted onto the check rig, at the identical time as the beam cease is free. The static-monotonic loading used to be as soon as utilized to the first specimen (P1) to soak up the preliminary crack, closing failure, and Deflection at top load. whilst a quasistatic loading based totally without a doubt on displacement manage used to be as quickly as utilized on the 2nd specimen (P2). Tip deflection and specimen cracking had been monitored at some stage in the tests. [14]

Magura D. et al., (1966) This examination is in the primary investigated on power and deformation traits of base plate connections between precast columns and their footings. The column base-plate connections consist of a rectangular metal plate welded to the column reinforcement and had been linked with the beneficial aid of bolts embedded in the foundation. They considered three specimens of one-of-a-kind thicknesses of the plate. Each column used to be associated to a rectangular concrete footing slab that was once supported above the laboratory floor. The hydraulic rams have been used to furnish eccentricity load to the column. The eccentricity elevated due to specimen deformation when the column load used to be utilized and the corresponding 2d will be calculated. The moment-rotation curve was once once plotted and this curve will be non-linear. Under the equal eccentricity load, it used to be placed that the stiffness of prolonged base plate connections depends upon the thickness of the plate. Connections incorporating base plates flush with the column on all factors show off up to be greater remarkable as in contrast with base plates extended past the column. [15]

Nurjaman H. et al., An advance theory is about the use of precast in economical housing. The paper makes available search and the benefit of precast concrete structural systems in Indonesia. The paper also expresses the huge growth and has already structural structures in the building of cheap residences in Indonesia. The testing and roles of precast concrete structural systems are suggested to detailed the accelerated development of one thousand inexpensive discharge to date in the functions of the precast concrete condo towers in towns in Indonesia. Much inexpensive accommodation has been completed via using precast constructions and they had remained alive with even better earthquakes. It has been come to an end that the precast building can be carried out for quickened progress in the improvement of public sector housing facilities, mainly inexpensive apartment and owned apartments. [16]

Ragavendra H. *et al.*, surveyed and summarized the characteristic of time, cost, best, and fertility of the precast machine to inspect it with the usual casting. Compared to the usual casting on-site construction procedure of precast technique preoccupy much for a moment because the material is already arranged and the arranged materials and elements are conveyed simply in time and just registered on-site which lessen pointless coping with and gear use. Cast-in-situ point of view of concreting requires an abundance of time due to the truth concrete requires a nominal of 28 days to gain 99% strength of its whole advantage. In this theory, it has been mentioned that the growth of strategy has a straight effect on the strength of the structure. Precast is a effective building approach which satisfy the excellent quality of concrete to its most area. The fertility of the construction is immoderate and wastes are low. Even after being very low-budget, it has its own disadvantage as the precast computer has now not been used in India and there is a dreadful and has less information about this point of view in the improvement area of India. [17]

4. Conclusion

- In this research it is concluded that the IS456 and Eurocode are almost equivalent, there are minimal differences.
- The plan of structural elements by way of Indian code is slightly less expensive as compared to European code whereas European code has established to be safer in design as compared to Indian code.
- Precast is tested to be extra feasible as compared to in-situ construction. Precast has a decrease lifetime value as in contrast to in-situ construction.
- Variation in price of precast is due to transportation, storage, and assembling of elements.
- The precast is been adopted throughout the world and it has many properties like it can stand up to seismic and cyclic loads, etc.
- Precast has decreased lifetime charges than any different building solution. Precast minimizes structural maintenance needs for years.
- It used to be observed that structural construction value efficiency of round 5-10% used to be generally received by way of changing a common structural system with precast concrete.

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