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Review Paper on Precast and Cast in Situ for Metro Project

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Abstract: Arguably the most dramatic recent development of urban infrastructure is the introduction ofthe subway as a public transport system. In addition to being the main means of transportation, thesubway has contributed significantly to reducing pollution and improving the quality of life of itscitizens. The vehicle population in urban areas of India is rapidly increasing by While rapidly growingand expanding cities demand more urbanization and housing, new residential colonies and largecommercial facilities are rapidly emerging, all integrated with public transport. need to do it. For civilengineers, metro projects have provided a great opportunity to develop skills and seek innovativesolutions to the difficult problems inherent in large structures in the urban environment. Key designdecisions determine the success of the project in terms of construction speed and quality,environmental impact and structural aesthetic appeal, and cost and economics. This paper describessome of the challenges faced by viaduct structures and how they were overcome in Indian metrostructures through the use of precast concrete construction techniques.

Keywords: Urban, Metro, Viaduct, Stations, Precast Concrete, feasibility

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INTRODUCTION

Concrete is the maximum critical a part of the present-day shape. Concrete offers compressive energy to the shape which facilitates shape to resist compressive forces. There are distinctive strategies of concreting one in all that is traditional technique of concreting known as cast-in-situ that is normally used for production in construction. This is the oldest technique of concreting and getting used for decades in production of construction industry. Even if this technique is an oldest technique, its drawbacks can't be neglected as exceptional of structure or shape is depending on great quality of concreting. The maximum critical downside of cast-in-situ technique is high-satisfactory quality of concrete can't be reliable and extra time required for production of construction.

Whereas now a days Precast is in boom and it requires less amount of time to execute on site. Hence In precast concrete technique excellent concrete may be confident as concrete is ready in controlled environment. Speed of creation is simply speedy as compared to cast-in-situ creation.

Here is feasibility of precast superstructures for Pune Metro Project.

LITERATURE REVIEW

Paper 1:

Vaishali Turai, Ashish Waghmare (2016), *"A study of cost comparison of precast concrete vs cast in place concrete"* International Journal of advanced Engineering Research and applications – Volume 2, Pages 11.

Findings:

1. The author concluded that, the transportation and shifting cost of precast members considerably affective on total cost of construction which help to assist decision makers and engineers to compare both concrete construction methods early in the construction planning phase of a project.
2. By using Payback period method, the cast in place concrete system takes more time for pay back the invested cash as compare to Precast concrete system.

Paper 2:

P. Karthigai Priya, M. Neamitha (2018), *"A review on precast concrete"* International Research Journal of engineering and technology - Volume 5, Pages 5.

Findings:

1. The author stated that, precast is been adopted worldwide and it has many properties such as it can withstand under seismic loads, cyclic loads etc.
2. It has good quality control.
3. The speed of construction can be increased with precast construction.
4. The labour requirement in precast construction is very less.
5. The installation and connection of precast construction is also very easy.
6. 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.
7. It may also be due to poor knowledge about precast in our country.

Paper 3:

Suraj Kumar (2019), *"A comparative study on Precast / Prefabricated structures and cast in situ structures"*, International Research Journal of engineering and technology - Volume 8, Pages 3.

Findings:

1. Author stated the concept of prefabrication/ partial prefabrication which are adopted for speedy construction, better quality components and saving in material quantities and costs are to be

studied.

2. The major emphasis is to be given on the cost comparison between precast/ prefabricated structures and cast in-situ structures.

3. Thereafter, it will represent the present housing approach in India and its extension to prefabricated housing.

4. This project will also highlight the sustainability of prefabricated housing units and the implementation of prefabricated housing units in major disaster-prone areas.

5. Futuristic housing techniques using precast units and their advantages related to time and economy will also be discussed using certain case studies of major precast structures.

6. The reduction of waste due to use of precast structural units and utilization of energy using prefab structures will be studied and represented.

Paper 4:

Azharuddin Ahmed; Dr. Anup Kumar Mandal (2020), *"Benefits and Challenges of Precast Construction in India – A Review"*, SSRG International Journal of civil engineering – Volume 7, pages 4.

Findings:

1. Author stated that the precast construction technology offers advantages such as cost-saving, Time savings, Quality enhancement, less labour required, Enhanced safety, Reduced wastage. But the implementation of Precast technology in the Indian construction industry has some challenges as discussed in the results above.

2. The proper measures should be adopted to promote precast technology in India. The government should take initiative in this regard.

3. Despite having the advantages mentioned above companies are not following the technique as several precast concrete elements manufacturing units or industries are very few in India, so dependability on the supply of precast elements is very high and they find it very risky.

4. The setup of a precast yard requires a very high initial investment, so in India, investors should promote this technology.

5. Precast engineering although has certain criteria for its execution that include proper roads and transportations to carry the constructions from the factory to the site without any damage or hazard.

Paper 5:

Manbhawan Singh, Jatin Mehta, Kapil Soni (2019),*"Study on Comparison of Pre-cast & Cast in Situ Construction of the Structure based on Economic Category"*, International Research Journal of engineering and technology - Volume 6, Pages5.

Findings:

1. Author had studied and analysed the both methods cast in-situ construction and precast construction. The initial cost of precast construction is more than Cast-in-situ construction because in India cost of precast labour (skilled) is more than normal labour. And lack of knowledge about the precast construction.

2. The cost of maintenance (repair cost) is more in cast in-situ construction as compare to precast construction. But after 15-20-year precast construction is economical. And Time saving in precast construction is 40-50% of the Cast in-situ construction. At the end value of cast in-situ construction is 2% but at the end value of precast construction is 50% because it can be easily recyclable.

3. More significant advantages, such as improved quality control, reduction of construction time, construction waste, dust and noise on-site, and less labour requirement on-site.

Paper 6:

Akash Lanke, Dr. D. Venkateswarlu (2016), *"Design, Cost & Time analysis of Precast & RCC building"*, International Research Journal of engineering and technology - Volume 3, Pages 8.

Findings:

1. Here the author has studied the various methods of precast, design, case studies of precast & it founded that, the design comes out as economical if proper care while designing is taken. They have designed the same building by traditional & precast method & notice the cost & completion duration. It is remarkably seen that the cost of precast building is significantly reduces & duration of construction is also much lesser than traditional method.

2. 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. we have identified that for standard & Repetitive work precast is the best option to choose.

3. In observation the most important thing is to be observed project is in precast construction technique is the time effective it requires less time to construct.

4. It requires skilled worker and qualified contractor, Lower initial cost especially for large project.

5. We can achieve better concrete quality control and lighter concrete unite. The main limitation of precast is transportation from place of manufacturing to place of site where it is to be fixed.

Paper 7:

Sayali A. More, Aishwarya V. Patil (2017), *"Time, Cost, Productivity and Quality Analysis of Precast Building"*, International Research Journal of engineering and technology - Volume 4, Pages 4.

Findings:

1. Author studied the precast Technique and have been Working in Precast India Infrastructure Pvt. Ltd. at Pune for 6 months in Planning, purchase, quality department as management trainee. By Reviewing all Planning, Production Cycle, Quality Checks we have done analysis of time, cost, quality and productivity.

2. He had concluded that 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.

3. He also had identified that for standard & Repetitive work precast is the best option to choose. In observation the most important thing is to be observed project is in precast construction technique is the time effective it requires less time to construct.

Paper 8:

Noor Azim Mohd Radzi, Roszilah Hamid, Azrul A. Mutalib, & A. B. M. Amrul Kaish (2020), *"A Review of Precast Concrete Beam-to-Column Connections Subjected to Severe Fire Conditions"*, Hindawi - Volume 2020, Pages 23.

Findings:

1. Precast concrete beam-to-column connections are classified (rigid, semirigid, and pinned) using the moment-rotation relationship beam-line method and connection classification system.

2. moment-rotation-temperature relationships for precast concrete beam-to-column connection are influenced by the effects of fire on the reinforced concrete structure, including deflection, cracking, spalling, loss of stiffness and strength, and rein- forcement strength loss.

3. change in the properties of concrete structure as a result of exposure to high temperatures affects the moment capacity, rotational capacity, rotational stiffness, and fixity factor of the semirigid connections.

4. case studies of fire effect on precast structures showed that the beam-to-column connections sustained severe damage. Some of the main structural members were not able to carry the applied load and collapsed. (Eir load-bearing capacity was considerably compromised, making them unusable. (Ese studies explored the possibility of rehabilitating the structures by repairing or demolishing and re-building the main structures.

5. Several studies investigated the effect of fire on precast concrete beam-to-column connections. different sources of heat used in large-scale fire tests are natural fire, large-scale furnace, small-scale furnace, gas burner, and FCP. (e tests were con-ducted on the cantilever and simply supported beams. Among the investigated parameters are the first crack, displacement, toughness of the joints, and fire protection.

6. fire resistance of connection elements (bearing pad, grout, bolt, and weld) is a critical parameter in

the design of precast connections. (e tensile properties of half-grouted sleeve connections were directly affected by temperature. (e quality of metal-to-metal contact determines the strength of the welded connections.

Paper 9:

Josef Novak, Alena Kohoutkova, Vladimir Kristek and Jan Vodicka (2017), *"Precast concrete pavement – systems and performance review"*, IOP Publishing, Pages 9

Findings:

1. Better concrete curing conditions and quality concrete, minimal weather restrictions on precast element placement, shorter delay before opening to traffic and elimination of construction related early age failures represent decisive aspects because the PCP systems are used over cast-in-place concrete pavements for the repairs and rehabilitation of existing damaged pavements.

2. Most of the current PCP systems have been developed in USA; namely it concerns Fort Miller Super Slab System, Michigan system and Uretek Stitch system.

3. Their wider utilization is limited by production costs which are estimated 1.6 to 4 times higher than the cast-in-place repair methods. On the contrary, cost savings. associated with shorter time required for repairs and traffic restrictions increase significantly when PCP systems used and consequently slightly compensate the high production costs.

Paper 10:

Nagaraju Kaja, Anupam Jauswal (2021), *"Review of Precast Concrete Technology in India"*, International Research Journal of engineering and technology - Volume 10, Pages 6.

Findings:

1. Author finded the application of Precast Construction technology is very effective and efficient in terms of executing large scale construction projects like housing, commercial, institutional buildings etc.

2. It is also very efficient with respect to saving time, requirement of manpower, providing better construction quality, less wastage of materials, flexible in executing all sets of design requirements like façade, repetitive module blocks.

3. The initial investment for establishing a precast yard in very high but it also provides the benefit of speedy construction which can contributes towards mitigating delays in large scale construction projects.

4. All these advantages can only be achieved with the help of adequate planning and designing.

5. The case study reflects that the application of precast concrete technology can provide a superior quality in lesser time duration.

6. The adaptation of precast concrete technology is a smarter and sustainable way to fulfil the housing demands in India. The major issues are a smaller number of precast concrete manufactures in India which resists the adoption of the technology.

7. Another concern is the standardization of various components of precast concrete and its joinery details needed to be elaborated by IS codes.

8. This paper concludes that the application of precast concrete technology can fulfil the need of housing in India within the defined time duration.

Paper 11:

Vikas Kumar Patel. V. V. Singh (2017), *"A Review on Precast Cement Concrete Paver Blocks Using Fly Ash"*, International Journal of Advance Research, Ideas and Innovations in Technology – Volume 3, Pages 5.

Findings:

1. Author states that, there are various types of waste material like stone crusher dust, Recycled plastic or plastic waste, fly ash, Copper slug, marble waste, coal waste, foundry sand, brick kiln is used to replaced material aggregate or cement in the manufacture of paver block for reduction of cost.

2. There are various types of mix design with different material like Geo polymer concrete is used instead of OPC, iron ore tailing from the mining industry, rubber pad is used for improving the compressive strength of Paver Block.

3. There are various types of fibre used in The Paver Block like nylon Fibre, polypropylene fibber, coconut fibre, polyester fibre for improving compressive strength, abrasion resistance and flexural strength of Paver block.

4. Different size, different shape and different strength Paver block used in different area.

5. Compressive strength of Paver block depends on a water cement ration of mix proportions.

6. There are various waste material used in the manufacture of Paver block like ceramic waste, rice husk ash, fly ash, glass powder for improving the strength of Paver block.

Paper 12:

Dr. Sachin Admane, Prof. Y R Suryawanshi, Mr. Ajit Dhumal (2015), *"Literature work study of precast concrete connections in seismic"*, International Journal of Civil Engineering and Technology – Volume 6, Pages 11

Findings:

1. Authors finded Precast system is not yet well used in India, due to the connections for precast structures, which are the most important part of any structure. The seismic behaviour has to be

study in detail and to develop the best suitable connection for Indian construction industry. Precast structure is an assembly of precast elements which is connected together, form a 3D framework capable of resisting gravitation and wind, earthquake loads.

2. This framework are suited to buildings such as industrial buildings, offices, retail units, car parks, schools, stadium, etc. At present, many buildings of reinforced concrete frame structures have been constructed using precast element. The construction members consist of beams, columns, slabs and walls, etc. Connection should be well planned at the less stressed locations; it is the need and must to take into account the capacities of precast installation.

3. Precast concrete has accepted as a safe construction, durable, reliable, high quality, and cost-effective. In high seismic areas, there is less quantum of designing and construction of precast structures, mainly due to lack of design provisions for seismic resistant of beam-column connections. Gaining confidence to use of precast concrete in several appropriate methods for connecting elements is a need.

Paper 13:

Stephan Johann Fasching, Tobias Huber, Michael Rath and Johann Kollegger (2021), *"Semi-Precast Segmental Bridge Construction Method Experimental Investigation on the Shear Transfer in Longitudinal and Transverse Direction"*, Applied Sciences – Pages 23

Findings:

1. In this paper, Author had stated that shear tests on different connecting elements for unfilled double walls (lattice girders with Ø5 mm and Ø9 mm diagonals and KAP-steel-connectors) as well as thin panels with attached steel girders with corrugated webs were presented.

2. The load bearing behaviour and the failure modes were analysed as such elements will be utilized for the creation of cross-frames in bridge segments made from thin-walled pre-fabricated elements.

3. Further, different joint designs for thin-walled pre-fabricated elements for the application in segmental bridge construction were discussed.

4. The load-bearing behaviour of those joints was analysed by push-off tests with a constant lateral force. The main parameters are the joint type (wet joints: plain, grooved, keyed; dry joints), the grout type and the level of lateral force.

SUMMARY

From the above papers we concluded with below points:

Table 1 Research Paper Summary

SR. NO.	BENEFITS	PRECAST	CAST IN SITU
1.	Time saving	YES	NO
2.	Quality Control	YES	NO
3.	Weather affect	NO	YES
4.	Long Spans	YES	NO
5.	Formwork	NO	YES
6.	Design Flexibility	YES	NO
7.	Finishing	YES	NO
8.	Cost efficient	YES	NO
9.	Reusable	YES	NO
10.	Easy installation	YES	NO
11.	Dismantling	YES	NO
12.	Storage on site	NO	YES
13.	Material Requirement	LESS	MORE
14.	Wastage	LESS	YES
15.	Labours on site	LESS	MORE
16.	Plaster requirement	LESS	MORE
17.	Dimensional accuracy	MORE	LESS

CONCLUSION

After going through of all the above published papers, we conclude that none of the author has spoken or published any paper on the feasibility of Precast superstructures for Pune Metro project.

Hence in this paper we have discussed the need and benefits of Precast over Cast in Situ.

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