

Feasibility of Precast Super Structures for Pune Metro Project

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Abstract – Arguably the most spectacular recent development in urban infrastructure has been the introduction of the metro as a public transport system. In addition to being the main means of transportation, the subway has greatly contributed to reducing pollution and improving the quality of life of the people here. Vehicle fleets in urban areas of India are growing rapidly. As cities grow and expand rapidly demanding more urbanization and housing, new residential areas and large commercial establishments are rapidly emerging, all integrated with public transport. need to do that. For civil engineers, metro projects provide an excellent opportunity to develop skills and find creative solutions to difficult problems inherent in large constructions in the environment. urban. Critical design decisions determine project success in terms of speed and quality of construction, impact on the environment and the aesthetics of the structure, as well as cost and economy. This paper describes some of the challenges faced by viaduct structures and how they have been overcome in Indian metro structures through the use of precast concrete construction techniques.

Keywords – Urban, Metro, Viaduct, Stations, Precast Concrete, Feasibility.

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1. 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.

1.1 Problem Statement:

- In recent years, India uses the traditional method of "CAST IN SITU" which has many disadvantages such as taking longer, weather delay, labour, quality assurance less than.
- Today, the world is reaching heights in the use of precast concrete. When comparing with foreign countries, India lacks knowledge about prefab house, its value and its use.
- For this matter, the prefabricated superstructure must also be developed in infrastructure projects.

1.2 Scope of Project:

In the context that most of the labour is scarce and expensive, requiring fast-paced and high-quality projects, the construction industry is gradually shifting to prefabricated construction. Research shows that access to urban prefab technology and related infrastructure in the form of sewers, bridges and pipelines leads to faster and leaner construction with less significantly more labour on site, better site control, higher precision and quality of finish. Prefabricated technology in bridges and overpasses is popular all over the world and hence India. It has

also been applied in the form of building segments for bridges, culverts, deck slabs and viaducts for urban areas.

1.3 Objectives:

- a) To study the need of precast structures in infrastructure projects.
- b) To find out demerits of cast in situ for infrastructure in metro cities.
- c) To study the manufacturing process of precast structural elements and its applications.
- d) By taking suitable case study compared to analysis between cast-in-situ and precast construction in consideration of time, quality and cost.

1.4 Methodology:

Past research through literature review from various journal papers.



Study of cast in situ and precast applications, advantages, disadvantages.



Comparative study between cast in situ and precast structures in terms of cost, quality and time.



Detailed case study of Pune metro precast superstructures.

2. INFRASTRUCTURE:

Infrastructure is an important sector that drives the overall development of the Indian economy. The Planning Committee's Infrastructure Secretariat is involved in launching Policy, which ensures that world-class infrastructure is created in the country for a limited time. This section focuses on the development of electricity, bridges, dams, roads and urban infrastructure. Users are provided with details about projects, organizations, policies, schedules, plans, and costs for the infrastructure.

After consideration of complications for shuttering and reinforcement Pune Metro is using the offsite casting process for elements i.e., Precast concrete method.

2.1 Cast in Situ Construction:

Cast-in-situ is defined as concrete poured into a mold at the site. It offers the designer endless possibilities of any shape with an unlimited selection of surface structures.

Cast-in-situ concrete is a construction technology that drives the walls and ceilings of buildings into formwork on site. This is different from the precast concrete technology where slabs are poured elsewhere and transported to the site for assembly. Instead of brick and wooden panels, we use concrete slabs for the walls and formwork for both the walls and roof.

2.2 Advantages of Cast in Situ:

- 1. With this method, the body is poured where it is needed, without the need to lift or transport heavy objects.
- 2. Great way to build a bridge in an inaccessible place.
- 3. This method is used for low-cost construction of solid, hollow, or ribbed reinforced concrete slab bridges.

2.3 Disadvantages of Cast in Situ:

- 1. It takes longer time than the precast method.
- 2. If the bridge is built over a body of water, it can seriously damage uncured concrete during floods.
- 3. This method requires a large number of workers and requires professional supervision.
- 4. Wastage of concrete is more.

2.4 Precast Construction:

Precast concrete is a construction product manufactured by pouring concrete into a reusable shape or "mold", hardening it in a controlled environment, transporting it to a construction site, and lifting it into place.

On-site casting obstructs traffic flow. Off-site casting and construction processes facilitate the construction of subway stations and allows ease and faster construction.

2.5 Advantages of Precast:

- 1. When concrete the same components, it is advantageous to use the same formwork. Better quality control is possible in factories

and shipyards, so you can produce better quality concrete.

2. You can create a smoother exposed surface that does not require plaster.
3. Precast work can be performed in any weather as long as the concrete holes provide sufficient protection.
4. You can make finished parts into the desired shape without any hassle.
5. When required, they may be dismantled without any breakage.
6. Curing can be done more effectively and economically.
7. Constructions can be erected mostly under all climatic conditions.

2.6 Need of Precast Structures in Infrastructure Project:

To avoid labour shortages, delays and to deliver quality products, promoters and builders are now applying the technology. prefabricated technology. The main advantages of prefabricated technology are quality, speed of construction and an economical product. Using such technology can save up to 64% of the time required for similar projects using conventional construction methods and technologies. In other words, while the conventional brick and mortar method takes a year to complete a building, the prefab method takes about four months.

The top benefits due to precast concrete strength and uniformity are as follows:

1. Structurally safe and effective.
2. Pre-built and pre-installed.
3. Weather and large precast concrete elements.
4. Thermal friendly.
5. Safety and large-scale infrastructure demands.

3. MANUFACTURING PROCESS OF PRECAST STRUCTURAL ELEMENTS:

3.1 Main Process:

The activities of the main process are as follows.

1. Mold preparation and assembly.

2. Install a reinforcing cage on the reinforced concrete structure to tension the wires of the prestressed concrete component.
3. Install pipes and inserts as needed.
4. Place the concrete in the formwork.
5. Vibration and finishing of concrete.
6. Remove the mold from the mold, remove the unit and stack the products for curing.
7. Curing is complete. It is preferable to use steam curing.

4. COST, DURABILITY, CASTING AND QUALITY:

4.1 COST:

The price of the product depends on the size and quantity of the product. The initial cost of precast concrete is higher than cast-in-place, but later proves to be effective.

Table No. 4.4 (a & b) Cost comparison between Cast in Situ & Precast concrete Elements:

Source: - Tender no. P1C-06/2017 (Pune Mahametro BOQ)

a) Cast in situ:

Item no. & Description	For 7 stations			
	Unit	Qty.	Rate	Amount
2.2 IN-SITU Providing M 40/20 concrete (cement as per technical specification) for structural elements at all levels like slabs, beams, columns, pits, shafts, walls, staircase etc., including centring, steel shuttering, scaffolding and all related operations as required to complete the work as specified in drawings.	cum	4,428.11	Rs.16,040.00	Rs.7,10,26,884.40/-
Total:				Rs.7,10,26,884.40/-

b) Precast Concrete:

Item no. & Description	For 7 stations			
	Unit	Qty.	Rate	Amount
2.2(a) PRECAST Providing M 40/20 concrete (cement as per technical specification) for structural elements at all levels like slabs, beams, columns, pits, shafts, walls, staircase etc., including centring, steel shuttering, scaffolding and all related operations as required to complete the work as specified in drawings.	cum	15,156.62	Rs.15,032.00	Rs.22,78,34,311.84/-
2.2 (b) Transportation, Castin Yard, Stacking Yard, etc.	cum	38,146.50	3161.00	Rs.120581086.50/-
Total:				Rs. 34,84,15,398.34/-

4.2 Time:

To achieve a productive work pace, it is important to have a well-planned approach to work. If we can't get the Construction moving along faster, it will be harder to make any further progress. Precast products can be cast before the work is started, if proper time scheduling is done. This will help to speed up the work progress. Where Cast in situ is slower than traditional methods, where elements can't be casted before the execution, these delays work and scheduling.

Precast construction:

Total construction time is less as compared to cast-in-situ.

Speedy construction is possible.

Cast-in-situ Construction:

Total construction time is more as compared to precast.

Speed is less as elements are casted at site.

4.3 Quality:

Precast products provide a higher level of quality assurance because the production of the elements can be monitored carefully and under controlled conditions in a lab. The object is inspected and tested by experts and technicians. Cast in situ can't provide quality products because of improper scaffoldings. The segregation of the honey, the bleeding of the bee, and the combing process reduce the quality of the product.

Precast construction:

Quality can be controlled and maintained easily.

Cast-in-Situ construction:

Quality control and maintenance is difficult.

4.4 Durability:

Precast concrete products need to be durable in order to meet the requirements of the user. Products that are used above or below ground may be exposed to harsh environmental conditions. Without durability, a concrete product can deteriorate much faster than the expected lifespan of 50 to 100 years.

Precast construction:

It is durable because of high grade of concrete and well compaction.

Precast elements are of good quality and are more durable compared to cast-in-situ.

Cast in Situ construction:

It is less durable because of less quality assurance.

Improper casting affects the durability of the product.

4.5 Requirement of Worker & Machinery:

To successfully complete a construction project on time and with high quality, it is essential to have skilled workers and machinery in good working order. Prefabricated construction requires less labor compared to monolithic construction. Precast is a good choice for large construction projects, because it is affordable. Cast in situ is a good choice for small construction projects, because it is affordable and can be done quickly.

Precast Concrete:

Less labours are required.

Skilled labours are required at construction site.

Cast-in-situ Concrete:

More labours are required.

Skilled labours are required at construction site.

Local contractors can also build the structure.

Cast-in-situ concrete does not require such handling equipment.

5. RESULT:

Hence feasibility of precast construction is more in terms of time, quality, durability, workers and machinery.

6. CONCLUSION:

We have reviewed both in-situ construction and precast construction methods, and have come to a conclusion about each. Precast concrete solutions can help reduce the waste generated on site by up to 50% compared to traditional construction sites. The initial cost of precast construction is more than cast-in-situ construction because the cost of skilled labor in India is higher than the cost of unskilled labor. There is a lack of knowledge about precast construction among potential homebuyers. Because the pouring of the prefabricated arm can be carried out at the same time as the pouring of the piers in the station area, it is a method with low cost, high efficiency and high safety, which not only shortens the completion time of the project, but also reduces the complex structure pouring. - Live casting on moving traffic These recent successes have shown that this cost-effective option is very effective. Further research will be focused on the

development of structural framing, jointing system, moulding, and erection methods.

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