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A Detail Review of Comparative Study on Estimation & Analysis of Precast and in Situ Bridges

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ABSTRACT

With the advent of high capacity machines, new materials and new management methods, we are now able to manufacture bridge structures and lift them into place. work, and also benefit from trade through faster delivery of goods. The aim of this research is to analyze the replacement of concrete bridges with precast concrete bridges, which can potentially lead to faster construction, thinner slabs and a more sustainable life. Precast concrete bridges also allow for longer construction seasons throughout the year and reduce construction time while roads are being maintained or bridges are being rebuilt. Life cycle cost analysis (LCCA) of precast concrete bridges with the traditional method by comparing the initial cost of precast concrete bridges with the traditional casting method, construction methodology, materials used, environmental impacts, recurring costs, maintenance costs, service life assessment and life expectancy are discussed. In addition, the traditional method is essentially to carry out all work on site, i.e. pour bridges in place, cure bridges and then open them up for use by traffic. All of these traditional methods can be eliminated if precast concrete bridges are used. The expected results of this research will indicate the feasibility of replacing traditional bridge casting with precast concrete bridges in terms of cost, time and life expectancy.

Keyword: Bridge Assemblies, Life cycle Cost Analysis, Maintenance Costs

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I. INTRODUCTION

1.1 General:

ABC is bridge construction that uses innovative planning, design, materials and construction methods in a safe and cost-effective manner to reduce the on-site construction time that occurs when building new bridges or replacing and repairing existing bridges. ABC is a paradigm shift in the approach to project planning and procurement where the need to minimize mobility impacts arising from on-site construction activities is given a higher priority.

A common reason for using ABC is to reduce traffic impacts, as the safety of the traveling public and the flow of the transport network are directly affected by on-site construction-related activities. However, other common and equally viable reasons to use ABC have to do with site constructability issues.

Construction projects today take a lot of time and money to complete the task. Infrastructure projects that are reconstructed using the traditional casting method cause inconvenience to the public during construction. By applying the idea of a precast concrete bridge over a cast-in-place bridge, time and costs can be minimised. In addition, if the precast concrete bridge is prestressed, maintenance throughout its life is minimal. Precast concrete bridge panels are fabricated offsite, transported to site and mounted on the prepared sub-foundation.

Fig. 1.1 Accelerated Bridge Construction

1.2 Aim of the Project:

The goal of the topic is to reduce construction time, minimize traffic dissipations, reduce life cycle costs and improve construction quality and safety

1.3 Objectives:

Following are the objective of the Project work:

- To improve site constructability
- To improve Work-zone safety for the traveling public
- To reduce Traffic Impacts
- To reduce Onsite construction time
- To minimize Impacts to existing roadway alignment

II. LITERATURE REVIEW

[1] Remi Kurania, Yusuf Latief(2018)
This study aims to create WBS Precast Bridge construction standards and identify risk variables on the work packages, activities and resources for the construction of concrete precast bridges for improved project cost performance. This study provides the results that the WBS standard of concrete precast bridge structures consists of 6 levels, with 13 dominant risk variables and 5 risk response recommendation groups against project cost estimates as the development of WBS standards.

[2] Habibullah Sharifi, Sayed Hafiz Sadat (2021)
The aim of this research is to analyze the replacement of concrete bridges with precast concrete bridges, which could potentially lead to faster construction, thinner slabs and a more sustainable life. Precast concrete bridges also allow for longer construction seasons throughout the year and reduce construction time while roads are being maintained or bridges are being rebuilt. Life cycle cost analysis (LCCA) of precast concrete bridges with the traditional method by comparing the initial cost of precast concrete bridges with the traditional casting method, construction methodology, materials used, environmental impacts, recurring costs, maintenance costs, life assessment and life expectancy is discussed

[3] Mohammed Hadi, Wallied Orabi, Jianmin Jin (2016)
According to the 2013 U.S. Department of Transportation status report, 25.9% of the total number of bridges in the United States are considered structurally deficient or functionally obsolete. There is therefore an urgent need for significant bridge repair and replacement efforts (DOT 2013). These bridge projects pose a challenge to State Transportation Agencies (STAs) across the country to minimize the associated traffic disruption in a safe manner, while maintaining quality of work and meeting budget constraints. This tool will make it easier to compare the total costs of bridge repair and replacement under both ABC and conventional methods.

[4] Amin K. Akhnoukh (2016)
This paper presents various ABC technologies adopted by various state DoTs, the optimal site conditions and project constraints associated with each technology, and the benefits achieved for applying ABC technology in various bridge construction projects. Special emphasis is placed on the engineering of prefabricated bridge elements and systems (PBES) as a common ABC approach for various DoT projects. the savings in material, labor and equipment in the construction of bridges.

[5] Mostava Tazarv & M.Saiid Saiidi (2015)
In this paper, seismic performance of a new column-to-footing connection was experimentally investigated by cyclic testing of a half-scale precast reinforced concrete bridge column connected to the footing incorporating an ultra-high performance concrete (UHPC) filled duct connection. The test results showed that the UHPC-filled duct connections were emulative of the conventional connection.

[6] M. Marshal, S. White & A Palermo (2012)
The application of Accelerated Bridge Construction (ABC) in areas of moderate to high seismicity is a challenge that is being addressed in current research. This document provides an overview of the research being conducted. This includes a description of the prototype structures under investigation, an overview of experimental tests that will take place as part of the programme, and finally the results of numerical modeling aimed at predicting the behavior of the structures during testing.

III. METHODOLOGY

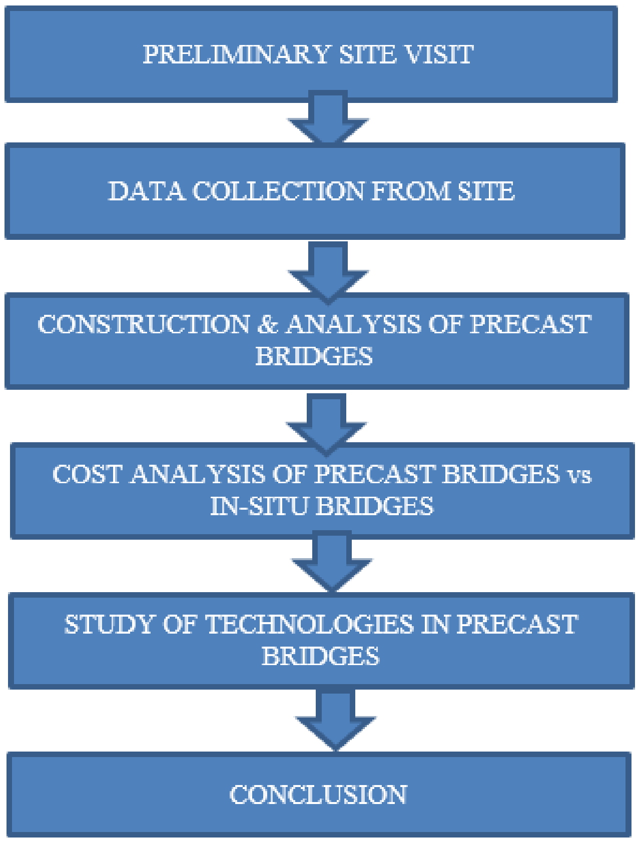

Fig 2. Process Steps

3.1 Construction of Precast Concrete Bridges:

For the construction of precast concrete bridges or Accelerated Bridges, the complete replacement of the panels or maintenance and construction of the new bridge can be performed on heavily cracked panels, punched panels, damaged joints and prepared base boxes. In addition, the detailed construction method for the construction of unpaved roads and the maintenance of a paved road is listed below. Repairs and repairs are usually carried out across the full width of the track. Several important measures to be taken before opening are temporarily re-tensioning, filling or covering the tension pockets and ensuring a smooth transition from the end of the mounted panel to the current bridge. The study focuses on finding ways to incorporate and improve road infrastructure with precast concrete bridges, taking into account the construction time, design, cost and life expectancy of this technique.

3.3 Condition of Cost Estimate:

The construction costs are estimated under the following conditions:
The constructive excavation for the substructure is carried out by means of open excavation without temporary diversion of traffic and vehicles.

- Prestressed concrete piles are driven by pre-auger methods
- Ready mixed concrete is available.
- Remanufactured post-tensioning beams on the approach road.
- Prestressed beams and post-tensioned beams are treated and launched with a truck crane.
- Electricity and water are available on site.
- Costs of diversions, demolition of existing structures, temporary bridge and land acquisition are not included.
- The provisional costs are assumed to amount to 15% of the direct costs.
- The contractor's overheads and profits are assumed to be 25% of direct costs.

3.4 COST ANALYSIS OF PRECAST SEGMENTED BRIDGES

Segmented precast bridges compete with other types of prestressed concrete bridges that typically require a smaller investment for specialized equipment. The construction costs of a bridge deck can be schematically divided into three main components: building materials, labor and technology. What makes one solution more cost effective than others, especially within design-build procurement, is minimizing the combined cost of labor and technology.
The rationale of segmented prefab technology is to invest capital to set up a prefab facility and purchase special transportation and assembly equipment to save labor costs and speed up project construction. Analyzing the construction cost of a prefabricated segment bridge is a complex task that involves hundreds of cost items and requires careful planning so as not to become overwhelming.

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