A Review Literature on Performance of Closure joints in Accelerated Bridge Construction

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Abstract - - *Accelerated Bridge Construction (ABC) uses prefabricated components which are joined at site. Decks of bridge are joined by joints known as "Closure joints". As these joints are made at site joining two prefabricated decks and experiences dynamic load, there durability and serviceability are of great concern. These joints consist of reinforcing bars and enclosures of various shapes that they may create congestions within the joints. In-situ casting, material incompatibility and steel reinforcement congestion results in the chances of leaving defects and anomalies in the closure joints. Several studies have been done to examine the behaviour of these joints under the action of loads. This paper includes comprehensive literature review on the analysis applicable to monitor the performance of closure joints.*

Key Words**:** Accelerated Bridge Construction, Closure joints, durability and serviceability

1. INTRODUCTION

Accelerated Bridge Construction (ABC) is used to reduce on-site construction activities and traffic congestions during new bridge construction and as well as repairing or replacement of the existing bridges. It also helps in cost saving during the service life of the bridge. Generally, ABC uses precast elements of the bridge fabricated on site or away, moved to the bridge location and installed in place. The prefabricated elements are then made continuous using casting-place joints. Deck joints are, normally, referred to as "Closure Joints." The quality of the joints, expected to quickly become serviceable, depends on the concrete mix design, reinforcement and enclosure details, and is affected by placement and curing procedure. Normally, ABC joints contain reinforcing bars and enclosures of various shapes that in some cases create congestion within the joints.

Being cast-in-situ nature of closure joints they are expected to go into service rapidly, there have been always concerns about probability of leaving some defects in the closure joints. Thus, results in a higher potential for exposure and other degrading effects with possible degradation in time, and therefore reducing the strength and serviceability of the joint and the structure.

1.1 Accelerated bridge construction (ABC)

Accelerated Bridge Construction is a method to design, planning and construction of new bridges and for repairs, replacement, and rehabilitations of existing bridges in order to reduce the traffic congestions, onsite construction duration, and to make it economic, at the same time increasing the safety and quality.

1.2 Closure joints for accelerated bridge construction

Closure joints are joints for connecting the bridge deck elements to each other and to the substructure. Application of the ABC using prefabricated elements and assemblies necessitates the use of joints for connecting and integrating the bridge structure. Different types of ABC connections and evaluation of the available connections have been experimentally and analytically studied.

Fig -1: ABC Closure Joint

2. LITERATURE REVIEW

A bridge database stored with several parameters extracted from bridges part of the National Highway Inventory was studied to identify the key parameters. Using mean values from the database, a hypothetical bridge was created for each bridge type. Finite-element or grillage analysis was carried out to assist in the development of the LLDF formulas. Important parameters considered in the analyses included different bridge types, span lengths, edge-to-edge widths, skew angles, number of girders, girder depths, slab thickness, overhangs, curb to curb widths, year of construction, girder eccentricity, girder moment of inertia, and girder area. A sensitivity study was performed to identify the key parameters for live-load distribution (Zokaie 2000).

Barr et al. (2001) evaluated the accuracy of finite-element modeling techniques and code equations for determining flexural live load distribution factors for prestressed concrete girder bridges. The study also investigated the effects of lifts, IDs, EDs, continuity, skew angle, and load type. The evaluation was based on the response of a live-load test on a bridge as per earlier studies. The experiment was used to ensure that moment obtained from finite element model corresponded to the observe behaviour of the prototype bridge.

Cai et al. (2002) examined the effect of diaphragms on live load distribution factors and maximum strain through numerical predictions and comparisons with load testing for six prestressed concrete bridges. The bridges included different AASHTO girder types, skew angles, span lengths, diaphragm layouts, and number of lanes. These bridges were analysed using slab-on-grid finite element technique with four different cases. In each case, the bridges were analysed differently to consider effects of end and intermediate diaphragms. In all the cases, EDs were modelled integral with the beam ends and assuming stiffness based on uncracked sections. For IDs, full composite action with the beam was not assumed since reinforcing bars are discontinuous at the interface of the two members. Different stiffness levels were used in modelling the IDs as a result of cracking assumed to develop in the concrete. Composite behaviour between IDs and the slab was also assumed in some of the models.

Sengupta and Breen (1973) investigated the influence of IDs in prestressed concrete bridges using four 1/5.5 scale microconcrete simply supported models. Physical models of the bridges were tested under static and dynamic loads. Variables included in the tests were span lengths, skew angles, stiffness, number and location of diaphragms. Experimental results were used to validate a computer program for analysis of the bridge which was then used to study, the general effect of diaphragms in load distribution of a variety of bridge models.

3. SCOPE OF THE WORK

Further the work can be focused on precast, prestressed girder bridges with concrete closure pours and diaphragms. A typical cross-section of Tee Girder Bridge shall be taken for analysis. The study is limited to simply supported straight bridges. Analysis of the bridges can be carried out using three-dimensional finite element modelling. The model shall be defined with the girder's material and section properties generally taken in the construction drawings.

4. CONCLUSION

Accelerated Bridge Construction constitutes precast elements of the bridge fabricated on site or away, moved to the bridge location and installed in place as per the design. The prefabricated elements are then made continuous using cast-in-place joints. In all, the specific nature of the joint application, in-situ casting, curing, material incompatibility, cavities and reinforcement congestion results in leaving defects and anomalies in the these joints. Concerns have been raised regarding long-term durability of these joints. It is therefore important to first ensure the closure joints are in good health immediately after the construction, and then to remain healthy during their service life.

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