Analysis Of A Precast Segmental Bridge Considering Different Types Of Loading: A Review

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Abstract- *The technology is advantageous over cable stay construction in terms of complexity and time. It is particularly suitable for bridge sites where base shuttering is not practicable and foundation is costly. Because of the various benefits afforded by the construction process and structural structure, concrete cantilever bridges built using the balanced cantilever method have become quite popular. Segmental, cast-in-place concrete cantilever bridges are now routinely used to build long span bridges. Because bridges are subjected to strong internal forces and stresses, prestressing is an essential component. Segmental construction is one of the most used techniques for prestressed concrete bridges. By using the cantilever construction approach, this strategy avoids false work and temporary supports, resulting in no obstruction to traffic or the waterway beneath the bridge. Construction time for multi-span bridges is longer since the structure's statical system, as well as support, loading, and environmental conditions, are constantly changing. Because of these conditions, the deformations and internal forces within a constructed part of the bridge changes. Due to this reason, The method and chronology of building have a significant impact on the end result. Creep and shrinkage, which are time-dependent features of concrete and prestressed steel, have the biggest impact on bridge behaviour during and after construction, among the several parameters that affect the long-term behaviour of bridge structures. Creep and shrinkage of concrete, as well as prestressed steel relaxing, have a significant impact on changes in deflection and stresses.*

The balanced cantilever method of construction is a complicated way of bridge construction in which spans are built cantilever-style and then joined together after completion. As a result of established continuity and other factors, the moments developed in the span and at support during construction, after completion, and during the course of the service life did not remain constant.

Keywords- Creep, shrinkage, prestress, Seismic analysis, Seismic demand, Bridges.

I. INTRODUCTION

Precast buildings are substantially built before they are deployed. A precast construction is made of pre-stressed concrete, and the final form of the structure is placed where it will be used. Precast concrete is made out of fine stone gravels, cement, water, and admixtures. In the factory's batch plant, the concrete mix design provided by the civil is employed to prepare the mixture. A dispensing mechanism with an overhead crane transports the permitted batch of concrete to the moulds. When it comes to bridge construction, there are two methods. All bridges made of CFST or concrete materials are built in one of two ways. The "Single Span Construction Method" is one, while the "Segmental Construction Method" is the other. In a single span bridge, the entire span is built at the same time. The bridge's entire span is consolidated, and no component of the bridge span is isolated from the other. Piers and abutments are not included in the bridge's span. The bridge span is made up of three parts: beams, deck, and parapets. The span of the bridge does not include the abutments, piers, foundations, or arch. As previously stated, a CFST or concrete bridge can be constructed in either a single span or a segmented configuration. There are many spans of the bridge that are put on the piers in a segmented span bridge. Segmented spans are used to connect the piers to each other. To put it another way, the bridge's span has been divided into multiple segments or pieces. It is done because lifting the beams and slabs in sections is more convenient. Lifting a consolidated beam is extremely difficult, even for large machinery. As a result, the beam is pre-cast in parts on the ground before being elevated above the piers' tops.

Fig 1: Precast Segmental Bridge

II. LITERATURE REVIEW

Li Jia et al (2021) research paper presented an experimental evaluation of the flexural behaviour of ultra-high performance concrete (UHPC) beams prestressed with external carbon fiber-reinforced polymer (CFRP) tendons. The effects of the effective prestressing stress, partial prestressing ratio, deviated angle, and loading condition on the flexural behaviour were explored utilizing a total of eight T-shaped beam specimens.
According to the experimental data, the shear capacity of completely prestressed beams was primarily determined by the effective prestressing stress in CFRP tendons and the ultimate tensile strength of UHPC, whereas partially prestressed beams failed in a ductile way. Internal steel reinforcement could significantly improve flexural capacity and deformation ability.

Internal reinforcements in UHPC beams with CFRP tendons should not be ignored. Increased cracking load and flexural capacity were achieved with a higher effective prestressing stress. The deviating angle increased the efficiency with which high-strength CFRP tendons were utilised. The specimens' flexural behaviour was slightly influenced by the loading condition. Furthermore, a method for predicting the flexural capacity of UHPC beams prestressed with external CFRP tendons was presented and tested, taking into account the effect of steel fibres.

Vishal v Patil and MD. Ismail (2019) A comparative examination of two separate post tensioned slabs, one flat slab with drop and the other flat plate slab, was reported in this research work. Initially, the analysis was carried out using British code in manual slab design, and later, modelling was done using FEM software. All of the material and section parameters are defined first in the model, and then the frame with slab model is created using the grid. During modelling main tendons are laid with zero width spacing and auto resisting the selfweight of slab and in parabolic pattern.

Mehrdad Aghagholizadeh and NecatiCatbas (2019) research paper presented comparative analysis of two bridges constructed with the most commonly used girder types in Florida. The analysis used the AASHTO Type III (American Association of State Highway and Transportation Officials) and Florida I-Beam girder types of bridges. Under baseline state and distinct prestress loss cases, two bridges with identical specifications but different girder types were examined. Bridges were modelled using finite element software, and the FE models were put through two types of virtual load testing, employing C5 and SU4 Florida legal loads.

The AASHTO interior bridge girder's failure probability is nearly 6 times that of the FIB bridge girder, according to the findings. It's also worth noting that the AASHTO bridges' system-level reliability should be higher as a result of the parallel placement of additional girders.

Shixin Wang and ZhenlingQiu (2015) The research report examined the strength of healed tendons using two different peripheral suture procedures. The biomechanical effects of continuous running peripheral suture (CRPS) and continuous locking peripheral suture (CLPS) on tendon healing were explored using pig flexor digitorumprofundus tendons in biomechanical trials, with stitch lengths ranging from 1mm to 5mm. The maximum load and breaking force in CRPS were 1.57 times higher in the 1mm stitch length group than in the 2mm stitch length group.

The maximum load and breaking force in CRPS were 1.57 times higher in the 1mm stitch length group than in the 2mm stitch length group. The stitch lengths of 1 and 2mm were statistically different from the stitch lengths of 3, 4, and 5mm, although the difference was not statistically significant. The 1mm group consistently had the highest maximum load strength and breaking force, which was twice that of the 2mm group, when it came to CLPS.

Sang-Hyun Kim et al (2021) in the research paper, the effect of the strengthening was validated by conducting a series of material property tests and four-point loading tests on a real bridge that had been in use for almost 45 years before and after it was strengthened. The material parameters of 45-year-old PSC girder bridges were studied, and the external prestressing method's strengthening impact was experimentally proven. The degraded bridge's concrete and tendon material qualities, as well as effective tension evaluation, were assessed, and the bridge's load carrying capacity was evaluated using four-point loading tests before and after strengthening.

After exposing the internal tendon of the deteriorated bridge, the tendon was pulled in the transverse direction to evaluate the effective tension of the existing tendon. The effective tension is 25.1~32.7 KN and assuming the maximum introduced tension, the effective tension of 40~53% is measured; it is conceivable that about 50% of the prestressing force is lost during its service period. Before and after strengthening, a four-point loading test was performed, and the strengthening effect was determined by the increase in the measured crack load. Furthermore, by using the effective moment of inertia, the bridge's behaviour could be anticipated fairly well. Furthermore, determining the strengthening effect before to breaking was challenging due to the external tensioning method's little contribution to stiffness prior to cracking.

Lei Wang et al (2020) Through a series of experimental testing and theoretical studies, a comparison of carbon fibre reinforced polymer (CFRP) bar and steel–carbon fibre composite bar (SCFCB) reinforced coral concrete beams was made in the research paper. The flexural capacity, fracture development, and failure modes of CFRP and SCFCB-reinforced coral concrete have all been thoroughly researched. They were also put up against regular steel-reinforced coral concrete beams.

The results reveal that SCFCB-reinforced beams perform better than CFRP-reinforced beams under the same reinforcement ratios, and their stiffness is slightly lower than steel-reinforced beams. The crack width of SCFCB beams was comparable to that of steel-reinforced beams and CFRP bar-reinforced beams under the same stress conditions. The fracture growth rate of SCFCB beams is comparable to steel-reinforced beams before the steel core yields. SCFCB has a greater strength usage rate, with 70–85 percent of its maximum strength being used. Based on the test results, current design guidelines was also analysed. The present design criteria for FRP-reinforced normal concrete were discovered to be incompatible with SCFCB-reinforced coral concrete structures.

III. CONCLUSION

Reviewed paper suggest that stresses induced by other structural loads are effectively countered when a larger amount of tendons is concentrated rather than spread. In terms of defections, the configuration with all tendons concentrated produces the best results.

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