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"ANALYSIS OF A PRECAST SEGMENTAL BRIDGE WITH RCC BRIDGE USING CSI BRIDGE SOFTWARE: A REVIEW"

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ABSTRACT

Bridges are those structures which built to span physical obstructions without closing the way underneath such as a water body, valley, or roads the purpose is to provide passage over obstructions. Precast bridges with segmental structure are commonly used for long span, due to researchers increasing interest in bridge modeling by using various span condition to check deflection of segmental bridge and RCC bridge, segmental bridge shows better results in comparison to RCC bridge, which is economical for longer spans, as the span increases then the most important factor dead load also increases.

In This Paper We Are Conduction A Research On "Analysis Of A Precast Segmental Bridge With Rcc Bridge Using Csi Bridge Software".

INTRODUCTION

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.

LITERATURE REVIEW

Francesca Turchetti et.al (2023) in the research paper, risk-targeted design approach was developed for circular reinforced concrete bridge piers, based on a probabilistic optimization procedure aimed at minimizing the design resisting moment at the pier base. In particular, the proposed procedure addresses the design problem for RC piers in multi-span bridges. The only variables considered as free

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design parameters are the pier diameter and the longitudinal reinforcement ratio, which are the most important parameters that control the performance of a bridge pier designed according to capacity design principles. In order to reduce the computational effort, a meta model is built to describe the changes in the bridge dynamic behaviour and seismic fragility with these two design parameters. The optimal values of the design parameters are found as the solution of a simplified reliability-based optimization problem aimed at minimizing the pier resisting moment, without the need to resort to complex and time-consuming optimization strategies.

Conclusion stated that the design resisting moment at the base of the pier exhibits a significant inverse correlation with the target MAF of failure and can be used to define the objective (cost) function to be minimized, as its value also affects the design of the transverse reinforcement of the pier, the design of the foundations, as well as the forces transmitted to thesuperstructure. If both the pier diameter and the longitudinal reinforcement ratio are assumed as design parameters, non-smooth variations of the optimal values across adjacent sites could be obtained. This issue can be avoided by considering only a single design parameter and fixing the other. The site classification can influence the design results, especially in regions of high seismicity. Design maps should be built for different soil types to better estimate the effect of the site classification.

J. P´erez-Sala and A. Ruiz-Teran (2023) research paper proposed a new Finite Element model for Precast Concrete Segmental Bridge decks capable of reproducing the main characteristics of their behaviour at a reduced computational cost. The model accounts for the opening of the joints, the friction of external tendons at the deviators, and the combination of internal and external tendons. Moreover, the effect of the epoxy layer at the joints was analysed.

The model proposed has shown very good agreement with experimental results existing in the literature. After calibration, the influence of different modelling choices has been analysed. The results point out to a high impact of the modelling strategy adopted for the joints in the compression areas, requiring an adequate estimation of the point of contact between the segments. Additionally, consideration of friction of external tendons at the deviators showed limited relevance in the global behaviour of the model but was important for the correct estimation of stress increments in the tendons. The use of shell elements combined with the modelling strategy adopted for the joints offers better accuracy than existing models with a significantly lower computational time.

M Jagandatta et.al (2022) research paper presented the analysis and design of the Composite Single

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Span PSC-I Girder Bridge under IRC loadings using MIDAS. The analysis was carried out to get various outputs such as bending moment, shear force, and time-dependent characteristics like creep and shrinkage. At the construction stage, the PSC (prestressed) design of the span was carried out according to IRC standards to get output parameters such as principal stresses for prestressing tendon. The design involves calculation of the section properties, primary and secondary moments, magnitude and location of the prestressing force, profile of the tendons, losses due to prestressing and shear stresses on the section. The structure was designed in accordance with IRC guidelines.

Results stated that assigning on tendon materials and profile in the girder is safe as the tendon stresses are safe. Midas civil is the one step solution for the analysis and design of any model of structures and especially bridges. The prestressing tendon profile and forces in the girders can be easily assigned using Midas civil.

P.S. Jaiswal (2021) research paper presented the comparative study of RCC girder and prestressed girder of roadway bridge forth span of 30 m. The analysis and design of girder for 30 m span was subjected to IRC Class AA Tracked Vehicle loading as per IRC 6. The distribution of live load among the longitudinal girders determined using the Courbon's Method was adopted because of its simplicity. The prestressed sections were thinner and lighter than the RCC sections as a result of high strength concrete and high strength steel are utilized in prestressed sections.

Conclusion stated that more quantity of steel and concrete needed for RCC girder as compared to prestressed girder. Clearly, Prestressed girders are economical than RCC girders for higher spans. In case of the design of prestressed girders, for 30 m span the quantity of concrete can be saved up to 46.52% which of steel up to 167.67%.

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 Necati Catbas (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

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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.

Rajesh B. Jadhav and Ashok B. More (2017) in the research paper, two superstructure types (RCC/PSC) was investigated to review its suitability for bridge having span length of 21.50m. The cost and time component for both types are evaluated to work out the economical option for superstructure.

Results stated that the RCC T beam type superstructure is economical among two. But the superstructure type, PSC I Girder (In –situ) can be considered based on important aspects like durability, aesthetic point, etc. The rate of deck area for RCC T Beam superstructure type is worked out as Rs. 8332/- per sqm while the rate per sqm of PSC I Girder is Rs. 9671/- for In-situ type and Rs. 10795/- for precast type PSC I Girder superstructure. The RCC type superstructure is susceptible for corrosion, tensile cracks, etc. Due to heavy reinforcement steel at tensile zone there are chances of honeycombing during concrete. Placing of concrete gets more difficult in RCC T beam type while in PSC I Girder type, concrete placing is more easier as congestion of reinforcement steel is avoided. The segregation of aggregates does not occur and chances of honeycombing are less in PSC I Girder type.

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

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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.

P. Selvachandran et al (2016) To investigate the deflection behaviour of FRP tendon prestressed beams and provide design guidelines, an experimental and numerical analysis was conducted. In order to conduct a numerical investigation, four beam specimens were cast and tested in the laboratory, and 51 experimental results were collected from research articles. By softening the effective moment of inertia curve and introducing the effect of shift of neutral axis after the member surpasses concrete cracking stress, the ACI (2011) recommended generalized deflection calculation for beams.

The deflection behaviour of a FRP tendon beam is determined by the material's deformability, prestressing degree, and bond strength, according to the findings. With respect to the deformability index, a design chart is presented for calculating the effective moment of inertia and the effective neutral axis distance. According to ACI 2011, the error percentage of deflection values has been decreased to less than 5% using the recommended method.

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Mohamed Husain et al (2015) The influence of some structural factors on the behaviour of prestressed concrete bridges with FRP prestressing tendons were investigated in this study. The approach employed was the three- dimensional nonlinear finite element method (3D-NL-FEM). On a commercial finite element analysis programme, different models of prestressed concrete bridges tensioned with FRP cables and subjected to a four-point load system were modelled and structurally examined (ANSYS, 2013). The impacts of prestressing reinforcement ratio, concrete compressive strength, and initial prestressing level on behaviour were investigated using a parametric research. Three types of FRP cables was used: carbon fiber (CFRP), aramid fiber (AFRP), and glass fiber (GFRP).

Results stated that flexural prestressing reinforcement ratio ρ, concrete compressive strength fcu, and initial prestressing force P% affects the flexural behavior and failure modes of the concrete beam models. The increase of flexural prestressing reinforcement ratio ρ for all types of FRP tendons increases load carrying capacity, due to vital role of the tension prestressing reinforcement in reducing crack width and prevent crack from developing at low load levels. For CFRP, and AFRP tendons, the optimum flexural behavior attained at ρ =0.494 % for best characteristics in both strength and ductility, while for GFRP tendons, the high strength and ductility achieved at ρ = 0.633%.

Nethravathi S.M and Darshan prasad (2017) The SAFE software was used to simulate and analyse a post-tensioned flat plate in this research article. According to the tendon layout, equivalent loads based on cable profiles were applied to the flat plate. Design moments, service moments, hyper- static moments, short term deflection, long term deflection, and punching shear were compared for the various tendon architectures at service and ultimate limit state.

Results stated that moment distributions across the slab panels may vary significantly between different tendon layouts, resulting in different signs at critical sections at service limit states. Moment distributions across the slab panels are almost similar between different tendon layouts, at ultimate limit states.

Rahul Singh et al (2018) the research paper emphasized to design a post tensioned building using ETABS and SAFE. The purpose of the study was to provide earthquake and wind resistance structures. C500*500 and B300*500 were the smallest column and beam sizes available. ETABS software was used to do the seismic study. All of the members passed thedesign and construction tests, and the post tensioned one proved to be the most cost-effective.

Shivani Ranje et.al (2018) in the research paper, Balanced cantilever method was used for model generation of precast segmental box girder bridge using MIDAS CIVIL2019. Parametric study was carried out considering different span to depth ratio (at support and at mid-section) and different span length. construction stage analysis has also been carried out. Span to depth ratios for support section are taken as 16,15,14 and that for mid-section are 50,40,30 was considered. Different span length was considered as 60,70,80 different grade of concrete M50, M55, M60 considered. Different type of tendon bonded and unbonded are also considered.

Analysis results showed that shear force and bending moment increases with increase in length of the span of the bridge. S.F. and B.M. increases on the support segment with increase in depth at support section while depth at midsegment keeping constant, while the same decrease at mid-segment. Bonded tendon gives less bending moment, shear force and deflection as compared to bonded tendon, so bonded tendon is more suitable than unbonded tendon. M50 grade of concrete does not satisfy combined shear and torsion criteria which is satisfied by M55 and M60 grade of concrete, so grade of concrete above M50 was require. Span to depth ration at support and mid segment 16,15,14 and 50,40,30 respectively satisfy all ultimate limit state and serviceability criteria and therefore this ranges of span to depth ratio suitable for safe design.

Olga G. Markogiannaki and Ioannis S. Tegos (2015) research paper presented an alternative retrofit system that follows the indirect retrofit approach that involves the use of unbonded tendons. The research work performed focuses on evaluating the effectiveness of the application of the proposed retrofit system on R/C multi-span bridges while dealing with in- service issues, as well. The retrofitted bridges were properly modeled with nonlinear elements. The demand of the structural systems was computedusing time-history analysis. The time history analyses were performed using a suite of representative ground motions and multiple parameters regarding bridge and the proposed system characteristics were investigated.

The proposed system presented high efficiency in limiting longitudinal bridge movements and pier seismic actions for all seismic intensity levels up to 30%. Since the bridge was designed for seismic level I it was taken into account as an indicator of the efficiency of the system. The possible upgrade of the Reference Bridge was more evident for the next two seismic levels. Especially for seismic level III, the seismic demand at the reference bridge exceeded pier capacity, while the installation of the

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mechanism lowered the seismic demand on the piers to the level of their capacity. The efficiency in reducing longitudinal movements and in seismic retrofit, the long lifetime of the tendons and the simplicity of the application contribute to the high reliability of the proposed system, as an alternative indirect retrofit method.

Thanushree H et.al (2016) author analyzed the effect of various span on single-span reinforced concrete bridges and PSC bridges using the finite- element method. Investigations was carried out on RC slab bridge decks and PSC bridge decks to inveastigate the influence of aspect ratio, span and type of load. The finite-element analysis results for bridges were compared to the reference analytical solution for dead load, IRC Class AA loading.

Results stated that the maximum moments for dead load, wheel load and combination of loads for deck slabs reduces for PSC deck compared with that of RCC deck this is because by Prestressing the slab the deck becomes stiff and thus the moments are reduced. But stresses for RCC deck decreases compared with that of PSC deck. The benefit of prestressing reflected a more significant increase in longitudinal bending moment and longitudinal stresses.

CONCLUSION

In this paper, we have examined a few writers who have attempted to study various bridge types using various analytical techniques and tools.

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