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A Review on Analysis and Design of Prestressed Concrete Bridge by CSiBridge Software

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***Abstract:** The methods for designing, building, and maintaining buildings, especially bridges, have greatly advanced thanks to computer applications and software.*

It has streamlined the design process for all bridge types and opened up opportunities to test out novel theories and concepts for more ambitious undertakings. The lifecycle of a bridge now includes computer software and applications at every stage, from conception to bridge management. This essay focuses in particular on the investigation and CSiBridge a software created by the American Based Company and Structures Inc. The CSI Bridge software is an advanced version of Staad Pro and SAP, CSiBridge software is multidimensional programming software specifically created for bridges. Bridge users are quite accustomed to CSiBridge software.

***Keywords:** CSiBridge Software, Prestressed concrete, Analysis and Design, Bridge Design, Software Analysis, Manual Analysis*

I. INTRODUCTION

Prestressed concrete (PC) technology is being used all over the world in the construction of a wide range of bridge structures. Prestressed concrete is the most recent form of major construction to be introduced to structural engineering. In a relatively short time, it has become a well- established and common method of construction. For bridge engineers, the development has allowed the design of longer spans in concrete bridges, and more economical solutions for smaller bridges. As a result, the use of prestressed concrete for bridge design has become very common worldwide. Reinforced concrete bridge structure early crack of the live load and over the compression but prestressed concrete bridge will be high strength of material used for the structure. Used on high tensile steel and tendon.

There are mainly two ways to prestressing technique as follows

1) *Pre-Tensioning:* A concrete structure made of pre-tensioned tendon is cast around them. This process results in a strong attachment between the tendon and concrete, which prevents corroding of the tendon and permits direct tension transfer. When the tension is released, it is transmitted to the concrete as compression via static friction because the cured concrete sticks and binds to the bars. The tendons are typically in a straight line, but it requires strong anchoring points between each tendon that needs to be stretched. As a result, the majority of pre-tensioned concrete components must be brought to the construction site after being constructed at a factory, which limits the size of these components. Pretension elements can be floor slabs, beams, lintels, balcony elements, or foundation piles.
2) *Post-Tensioning:* A technique for applying compression after concrete has been poured and has had time to cure is known as "bonded post-tensioned concrete" (in situ). To avoid strain where it would otherwise develop in the concrete portion, the concrete is cast around a curved duct made of plastic, steel, or aluminum. The concrete is poured after a set of tendons are pulled through the duct. Once the concrete has cured, hydraulic jacks that respond (push) against the concrete member itself strain the tendons. When the tendons have sufficiently stretched, in accordance with the design, parameters (see Hooke's law); they are jammed in place and continue to maintain tension when the jacks are withdrawn. Transferring pressure to the concrete 'To protect the tendons from corrosion, the duct is next grouted. This technique is frequently utilized to construct monolithic slabs for homes in areas where expansive soils (like adobe clay) make the standard perimeter foundation problematic. The entire tensioned slab absorbs all pressures from the underlying soil's yearly expansion and contraction, supporting the structure without much flexure. Additionally, post-tensioning is employed in the building of various bridges, both after the concrete has dried out following false work support and when assembling prefabricated pieces, as in the case of segmental bridges.

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A. Bridge

A bridge is a building designed to span an obstacle so that traffic can go freely across it. A bridge has played a significant part in the development of a place from ancient times by increasing its connectedness with other places, hence enhancing trade and economy. An obstruction may be a river, stream, canal, valley, ditch, highway, railroad, etc. Bridges come in many different varieties. However, PSC bridges are now the best option for building long span, important bridges. Prestressed concrete bridges are primarily employed because they are quick to build, simple to construct, and competitively priced with alternatives like steel and reinforced concrete. A famous PSC bridge in India is the Ganga Bridge in Patna. It is an example for major PSC Bridge in India (See Fig.1).

Fig -1: Ganga Sethu Bridge Patna

B. CSiBridge Software

One of the best versions for analyzing geometrical figures is CSiBridge. It was created by the American based Company and Structures Inc. Engineers can quickly design complex bridge geometrics, boundary conditions, and load scenarios with CSiBridge. Bridge engineers will be familiar with the words used in the parametric definition of the bridge models. As the parameters for the bridge specification change, the software automatically updates models of spine, shell, or solid objects.

An engineer can conduct the following functions when designing a bridge using CSiBridge:

1) Dynamic and Static Analysis
2) Energy Method, to Drift Control
3) Linear and Nonlinear Analysis
4) Segmental lanes Analysis
5) P-Delta Analysis
6) Parameters Analysis
7) Default analysis

The software includes a feature that for layout lines, spans, abutments, piers, slab decks, load cases (vehicle load, moving load, parapet load, material load, etc.)

C. Problem Identification

1) For the manual design of prestressed bridges, some traditional procedures are employed. However, these procedures are time-consuming and inconvenient. In order to save time and money, simplified methods should be devised. Consequently, it takes longer to obtain data.
2) It takes a lot of time, effort, and effort to perform a manual computation.
3) We desired experienced, skilled individuals to perform manual calculations.
4) There is also the possibility of not receiving Accuracy.

D. Future And Scope

In today's world of cutting-edge research and technology, it is essential to build heavy structures with technologically efficient solutions. At the academic and curriculum levels, economic awareness will promote research in the topic of bridges. Because of the infrastructure and resources that are often available, new design ideas are often lacking; nonetheless, these factors should not be a barrier to a country's progress. In massive and public constructions, it is necessary to use multidimensional sectional design options.

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II. LITRETURE REVIEW

Expert system technology has been utilized successfully to build bridges across various groups of researchers. Many ideas are generated during the design process based on previous experiences, analysis, thumb rules, and other considerations. Furthermore, because design can be done in a variety of methods, expert systems created for bridge design can provide the most appropriate strategy for these structures

P R Bhivgade [1] in this paper SAP 2000 Bridge wizard was used to analyse a concrete box girder. Precast concrete Prestressed two-lane bridge that was taken and examined in accordance with IRC 6, IRC 18, and IS 1343 specifications. In order to satisfy the stress criterion and deflection criteria different span-depth ratios were taken into consideration. Better resistance to the torsion of the superstructure was demonstrated by box girders. Deflection and stress requirements were met within accepted limits during the various L/d ratio trials for Box Girder Bridges. As the depth grows, so does the prestressing force and the number of wires. Because of prestressing, more and more concrete strength is utilized.

Viqar Nazir and Mr. Sameer Malhotra [2] in the software they analyzed, the shear forces and bending results are substantially higher. This might be because of various forces and allied effects that manual approaches are unable to account with. The analysis of the deck slab is the primary focus of the software results. The substructure-related results are simply presented as numerical numbers, with no graphical representations and the values of displacement are within the prescribed range, they find that not many variations between the outcomes of the Morice-Little approach and those produced by software. But the software provided a thorough analysis at every section, giving much more insight into the bridge's design

Kumar, Ghorpade and Rao [3] In this paper CSiBRIDGE software was used to carry out the analysis and design of the stress ribbon bridge. The fundamental aim of the work was to investigate the bridge model employing "manual design and the software analysis", A bridge with a 60-meter span and lanes that are 4.2678 meters wide was chosen. They came to the realization that manual results are less harsh than software solutions. Because of software's boundary condition constraints, the disparities developed. Additionally, the deck slab was the primary emphasis of the software.

Kruthi A [4] This paper takes into account every action, including applied induced loads, accidental loads, and it should be able to endure the loads generated by seismic action without producing any damage to property or causative events. The parameters that determine the performance of the bridge are safety, serviceability, durability, and affordability, that project based on national highway standards has been completed taking this into consideration. Pre-stressed concrete's features and building methods are compared to reinforced concrete design in the research. STAAD software has also been used to simulate, analyses, and design a per-cast post-tensioned continuous beam and slab bridge deck for a national highway crossing with an 80-meter span. She researches design strategies, numerous design elements are grasped, such as how crucial the section's modulus is to the construction of prestressed concrete bridges. One of the most crucial factors that determine the design is the section's depth. Despite appearing to be a minor consideration, fiber tensions need to be carefully considered. The edge beams appear to not support the live load, even though they are supposed to support the dead load moments of the cantilever slab. Consequently, the edge girder needs to have the same pre-stressing force as the central girder.

Prajwal Raj and Mr.Vasantha [5] in this paper, they used recently developed software named "CSI Bridge" version 2015 to analyse the behavior of the structure of a post-tensioned box-girder bridge. In order to determine which code of practise is better by comparing the results, post tensioned box girder bridges of the single cell and four cell types were analysed using the software for the specific design. This was done in order to learn about the modelling pattern of the software as well as to gain knowledge of the structural behavior of single cell and four cell box girders under IRC and AASHTO loading. For the analysis of beam bridges, several span-to-depth quantitative relationships are used, and in each case, the permissible limits for deflection and stresses are at intervals. Pre-stressing force and the number of cables decrease as beam depth lowers. Because of the prestressing, more concrete with greater strength is utilised, and its utility is well governed. Four cell and single cell pre-stressed concrete beam cross sections have been compared in this study. This study demonstrates that for two-lane Indian national road bridges, the one cell pre-stressed concrete beam is the most suitable and cost-effective approach. Finally, this comparative analysis has proven that AASHTO code is more cost-effective than IRC

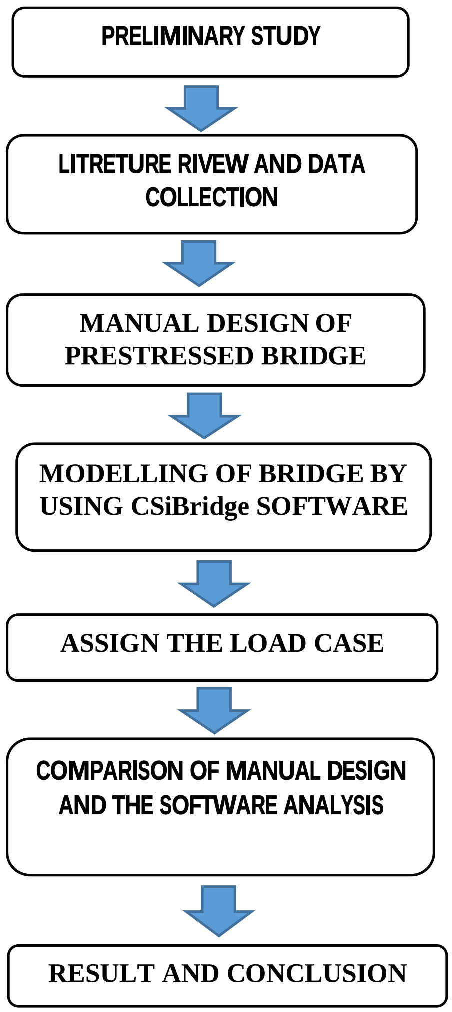
Rohit M and Dr. J. Jegan [6] In this paper they cross-dividing lines to bring people, communities, and countries closer together. They reduce travel times, speed up transit, and ease business. The usage of prestress box girder bridges is growing in popularity among bridge engineers due to their improved stability, serviceability, economy, aesthetic appeal, and structural efficiency. In this project, a Prestressed concrete box girder bridge is examined for the movement of loads in accordance with guidelines from the Indian Road Congress (IRC: 6) and the code of practice for concrete bridges (IRC: 112) standards. The CSI Bridge Wizard will be used to analyse the box girder.

The different response types are plotted, described, and the findings are tabulated. They discovered that Finite Element Analysis of Box Girder from CSI Bridge modeller software is more efficient. According to the live load analysis, one IRC 70 R and Class A lane is considered more important than three Class A lanes. The deflection resulting from various loading circumstances

III. METHODOLOGY

A flow chart is produced as the overarching research methodology for this project (see Fig.2).

Fig -2: Schematic Diagram of Methodology



IV. CONCLUSION

1) Different kinds of software and methodologies are used for bridge design and analysis in the above papers that have been reviewed and Bridge designs are compared with design codes from various nations, and in the aforementioned publications that have been studied. many types of software and methodology are used for bridge design and analysis.
2) The study displays the distribution of loads using various combinations of loads and girder sections. The use of sections subjected to circumstantial loading is to be implemented and concluded utilizing CSi bridge software.
3) The manual design method is discussed in the various above work. The values were afterwards displayed in different design software. Finally, the manual design and software analysis results are compared
4) Comparing the manual results with those of software analysis, it is observed that the manual results are less than those of analysis with software.
5) The structure is analyzed using CSI Bridge software. It is particularly good in analysing the structure under various loads. The outcomes produced by this software are quite precise.

V. ACKNOWLEDGMENT

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Analysis and design of a bridge structure are presented in this review of the literature. Bridge design and analysis have been the subject of a great deal of research, but relatively little of it has addressed the question of combining human design and software analysis. This project requires references from several completed research, which are succinctly described below:

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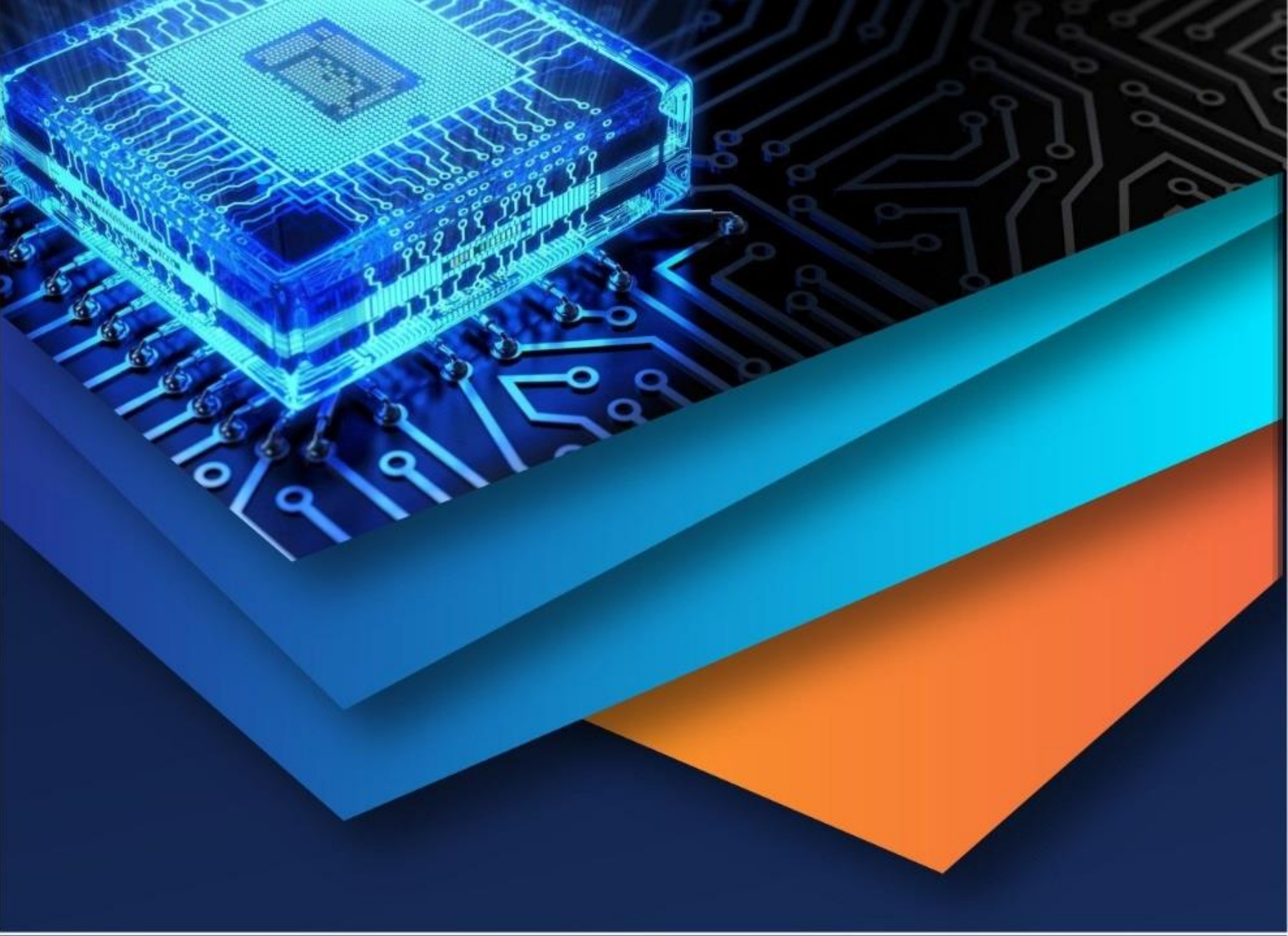

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