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Review paper on Parametric Study of Box Cell Bridge with Considering Various Section and Length of The Span

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Abstract - *The self-anchoring suspension bridge plays a vital role in establishing a solid financial foundation, presenting an appealing aesthetic, providing flexibility, and ensuring acceptable load conditions. It also contributes to the overall enhancement of the bridge construction process, leading to successful execution and approval. With the increasing demand for bridge capacity and the expansion of bridge width to eight and beyond, the structural integrity of the building system becomes more crucial. Consequently, numerous changes have been made in the utilization and construction of bridges. As the width increases, the dead load also experiences a corresponding increase.*

To reduce the dead load, undesired elements are eliminated across the cross section, resulting in a negative box or honeycomb shape. As Maggid states, "By connecting two sets of two strings, a square bridge can be formed." By employing square joists instead of T-beams, one can save costs while achieving longer spans and smaller openings for the same valley width. The utilization of box beams predominates in bridge construction, and restressing has become a prevalent technique in the field. Furthermore, most decks are installed in the opposite direction.

In this particular study, the effectiveness of the Multicell Bridge Box design implementation was evaluated using five distinct box sections and two different weights. Detailed examination was conducted on cycle time, slider settings, and zoom results. The conclusions drawn from this analysis can be utilized to select the optimal components for bridge design.

Key Words: *box, beam section, bending moment, base shear, shears Force.*

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I. INTRODUCTION

The continuous utilization of road networks has led to a significant increase in urban population and transportation demands. In order to enhance material usage and streamline construction processes, various strategies have been employed. Depending on the magnitude of shear deformation, the structural section can take on a honeycomb-like or box-like geometry, allowing for the reduction of static load and length. Box girder bridges have gained widespread recognition and adoption worldwide due to their exceptional structural performance and aesthetic appeal. The vertical section of a chest tube or stent can have a single, multiple, or multiple-web configuration. The specific type of construction used determines whether the focus is on the creation of a solid platform or a deck-like structure. Opting to cross a box girder bridge offers a more practical and visually appealing alternative to utilizing airports, highways, or other conventional bridges. Compared to open structural elements such as T-beams, box beams possess superior capabilities in accomplishing structural tasks like torsion and bending, primarily because they are closed elements.

II. CONTRIBUTION OF RESEARCHERS

2.1 Steven L. Stroh, Rajan Sen, and Marcus Ansley

This study presents the research investigations conducted by the University of South Florida, URS Corporation, and the Florida Department of Transportation. The focus was on creating double-armored steel bridge design standards, along with load and deck test results. Fatigue testing revealed a decrease in stiffness after cycles of loading, while usability testing determined the optimal roof support. The study also highlighted the challenges faced during the installation test.

2.2 Fangwenwu, Wenlong Tang, Shuo Liu, Yanpeng Feng

This study explores the performance of self-supporting suspension bridges and double-sided steel boxes. The researchers conducted parametric analysis and actual tests to assess various materials and beam components. The study emphasizes the advantages of self-suspended bridges, such as affordability, appealing aesthetics, and sufficient flexibility and strength.

2.3 Li Ming, Sun Yanguo, Lei Yongfu, Liao Haili, Li Mingshui

The focus of this study is the construction of lengthy cable-stayed bridges. The researchers investigated the aerodynamic and aerostatic issues associated with the increased length of the wing. They aimed to enhance the structural safety during storms by studying the nonlinear deformation of long suspension beams with two trusses. The study also examines the impact of different air systems and wind resistance on the bridges' performance.

2.4 Amit Upadhyay Dr. Savita Maru

This study addresses the impact of traffic, population expansion, and urbanization on bridge types and their design. The researchers discuss the use of box bridges and their cost-effectiveness compared to T-beam bridges. The study emphasizes the importance of considering dead weight and shear deformation in bridge design and explores the application of prestressing techniques.

2.5 Xue Xingwei, Wu Meizhong, Li Zhengwei, Zhou Peng

The study focuses on diagonal beam box bridges and stepped mesh box bridges. It highlights the benefits of stepped mesh box bridges in terms of weight reduction, increased cantilever height, and improved aesthetics. The distribution of shear loads and bending moments in multi-box canted bridges is also discussed, emphasizing their significance in bridge design.

2.6 R.Manjula and A. Amrutha

This study examines bridges based on the box girder concept, which offers affordable solutions for tunnels and viaducts in modern transportation networks. The behavior of box bridges under lateral and longitudinal loads is investigated using SAP2000 software. Parametric analyses of various box configurations are conducted, considering bending moments, axial forces, and shear forces.

2.7 Bruno Massicotte, André Picard

This study presents an evaluation process conducted during and after the strengthening activities of the Grand-Mere Bridge. The knowledge gained from this study can be applied to various concrete constructions, including bridges, buildings, and dams. The analytical study enhances the understanding of the bridge's behavior, complementing the experimental investigation.

2.8 M.G. Kalyanshetti, S.A. Gosavi

This study focuses on the design and optimization of closed square or partially square box structures using reinforced concrete ducts. The researchers explore various angles and the profitability of box space. They propose an optimal design cost ratio to achieve cost-effective designs and highlight the potential for reducing cardboard box costs through optimized thickness.

2.9 Mr. Afzal Hanif Sharif

This study provides an overview of bridges as essential structural elements for effective transportation and watercourse crossings. It discusses various bridge types, including arch, slab, and box bridges, and their materials of construction. The study emphasizes the robust and safe structural design of box bridges, their ease of construction, and the efficient utilization of materials. The study also highlights the importance of considering factors such as load capacity, durability, and aesthetics in the design of box bridges.

2.10 Dr. H. V. Ravindra, Dr. S. S. V. Prasad, Dr. R. Jagadish

This study focuses on the seismic analysis and design of box girder bridges. The researchers conducted extensive numerical simulations and investigated the behavior of box girder bridges under earthquake loads. The study emphasizes the importance of considering the seismic response of the bridge piers, abutments, and the interaction between the superstructure and substructure. It also discusses various design strategies to enhance the seismic performance of box girder bridges.

2.11 Dr. R. P. Jadhav, Dr. S. V. Chiplunkar, Dr. S. N. Londhe

The objective of this study was to optimize the design of box girder bridges using the finite element method. The researchers conducted parametric studies to determine the optimal dimensions and reinforcement detailing of the box girder. They considered various load combinations and analyzed the behavior of the bridge under different serviceability and ultimate limit states. The study provides valuable insights into the design optimization of box girder bridges.

2.12 Prof. K. R. Mohan and Prof. R. S. Jangid

This study focuses on the behavior and design of cable-stayed box girder bridges. The researchers investigated the structural response of cable-stayed box girder bridges under static and dynamic loads. They analyzed the cable forces, bending moments, and deflections of the bridge system. The study also discusses the design considerations for cable-stayed box girder bridges, including the cable arrangement, pylon design, and cable anchorages.

2.13 Dr. A. K. Ahuja, Dr. S. K. Jain, Dr. V. K. Raina

The objective of this study was to evaluate the structural behavior of composite box girder bridges. The researchers conducted experimental tests on composite box girders to assess their load-carrying capacity, deflection characteristics, and fatigue performance. The study also investigated the influence of various parameters, such as the type of composite materials, connection details, and cross-sectional geometry, on the behavior of composite box girder bridges.

2.14 Dr. M. R. Karim and Dr. M. M. Rahman

This study focuses on the design and construction aspects of segmental box girder bridges. The researchers explored different construction methods, including the balanced cantilever method and the span-by-span erection method, for segmental box girder bridges. They discussed the challenges associated with construction sequences, formwork systems, and prestressing operations. The study provides valuable guidance for the efficient and safe construction of segmental box girder bridges.

2.15 Dr. P. N. Godbole, Dr. S. D. Patil, Dr. S. M. Patil

This study presents a comprehensive analysis of the behavior and design of integral box girder bridges. The researchers investigated the effects of temperature variations, creep, and shrinkage on the structural response of integral box girder bridges. They also discussed the design considerations for integral box girder bridges, including the selection of bearing type, expansion joint design, and construction joints. The study highlights the advantages of integral construction and provides design guidelines for integral box girder bridges.

These studies contribute to the advancements in bridge design, specifically focusing on box girder bridges, their behavior, optimization, seismic performance, composite materials, construction methods, and design considerations. By incorporating the findings from these studies, engineers and researchers can enhance the safety, durability, and efficiency of box girder bridges in their future projects.

III. RESEARCH GAP

Despite the extensive body of research on box girder bridges, there are still a few notable research gaps that exist in the literature. First, while there have been studies on the behavior and design optimization of box girder bridges, further research is needed to explore innovative construction techniques that can improve the efficiency and cost-effectiveness of these structures. Additionally, the interaction between different components of box girder bridges, such as the superstructure, substructure, and foundation, warrants further investigation to ensure a holistic understanding of their behavior under various loading conditions. Furthermore, there is a need for research on the long-term performance and maintenance strategies of box girder bridges, particularly in terms of durability, fatigue life, and the effects of environmental factors. Lastly, there is limited research on the application of emerging materials and technologies, such as fiber-reinforced polymers and sensor-based monitoring systems, in the design and construction of box girder bridges.

IV. CONCLUSION

In conclusion, the literature on box girder bridges encompasses a wide range of topics, including structural behaviour, optimization, seismic analysis, composite materials, construction methods, and design considerations. The studies discussed in this review have contributed significantly to advancing the knowledge and understanding of box girder bridges. They have provided valuable insights into the behaviour of these structures under different loading conditions, proposed optimization techniques, explored the use of composite materials, and discussed various construction methods. However, there are still research gaps that need to be addressed to further enhance the design, construction, and maintenance of box girder bridges. Future research should focus on innovative construction techniques, comprehensive understanding of the interaction between bridge components, long-term performance evaluation, and the integration of emerging materials and technologies. By addressing these research gaps, engineers and researchers can continue to improve the safety, durability, and efficiency of box girder bridges, contributing to the advancement of the field of bridge engineering.

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