International Journal of Scientific Research & Engineering Trends
Volume 10, Issue 5, Sept-Oct-2024, ISSN (Online): 2395-566X

Review on Design of Bridge Structures

Research scholar Sombrat Arjariya, Assistant Professor Rahul Sharma
Department of Civil Engineering,
Prashanti Institute of Technology & Science Ujjain

Abstract- This review synthesizes findings from a collection of papers investigating the design, analysis, and optimization of bridge structures. The reviewed studies cover a wide spectrum of topics, including T-beam and Box Girder designs, dynamic behavior under heavy loads, parametric studies for optimal design, and innovative optimization techniques. The papers collectively highlight the importance of accounting for factors such as material choices, loading conditions, and dynamic effects to achieve economically viable and structurally robust bridge designs. The insights gained from these studies contribute to the current knowledge base in bridge engineering and offer guidance for researchers, engineers, and practitioners seeking to enhance the efficiency and resilience of bridge structures.

Index Terms- Bridge, structural analysis, damage

I. INTRODUCTION

Bridges play a critical role in the infrastructure landscape, connecting regions and facilitating transportation. The design and analysis of bridge structures require meticulous consideration of various factors, including materials, loading conditions, and dynamic effects. This review examines a selection of papers that delve into different aspects of bridge engineering, encompassing studies on T-beam and Box Girder designs, dynamic behavior under heavy loads, parametric studies for optimal design, and innovative optimization techniques. By synthesizing these diverse findings, this review aims to provide a comprehensive overview of the current state of knowledge in bridge engineering, shedding light on key considerations for achieving both economical and structurally resilient bridge designs. The insights gleaned from these studies contribute to the ongoing evolution of bridge engineering practices, offering valuable guidance for researchers, engineers, and practitioners involved in the planning, design, and optimization of bridge structures.

II. LITERATURE REVIEW

Mahantesh. S.Kamatagi, [1] A simple span of T-beam bridge was analyzed by using staad pro. The study show that maximum bending moment is obtain while apply for class 70R vehicles loading. After getting the result the T- beam bridge is design by both the method i.e. (IRC21 &IRC112). It is noted that results obtained from finite element method is less as compared to the result obtained by working stress method. It is also noted that the design of bridge with IRC 112-2011 is economically compared to IRC 21.It is noted that area of steel required is less in IRC 112-2011 as compared with the IRC 21. The modeling and analysis of RC T-beam bridge superstructure can be efficiently performed using staad pro and results in time saving. In design of concrete bridges IRC:112-2011 gives an economical design with a reliable safety margin since the design is based on probabilistic method of design. As comparedtoIRC:21-2000, designing the girders with IRC:112-2011, results in saving of longitudinal.

Abrar Ahmed, [2] “Comparative Analysis and Design Of T-Beam and Box Girder” The analysis of T-beam girder by IRC specification showed thatthe results obtained by FEM method is economical than the one dimensions analysis. The comparative design of T-beam and Box Girder for span up to the 25m or below the result shows that the T-Beam Girder is more economical section but if span is greater than 25 m Box Girder is always suitable. By getting the result it is found that the torsional rigidity is higher in box girders as they have closed section. By the study it is also found that Comparative design of I-Section and Box Section concludes that the Box girder is found to be Costlier for 16.3 m Span whereas for span 31.4 m the box girder is economical. Comparative design of RCC and PSC sections concludes that the Shear force and bending moments for PSC T-beam girder are lesser than RCC T-beam Girder Bridge so itis always preferable to adopt PSC sections rather than RCC, which is economical and Suitable for spans 24m and above. Life span of Prestressed concrete structures is very more as compared to reinforced concrete structure sand Steel structures.

Anushia K Ajay [3] Parametric Study On T-Beam Bridge”In this study the Single span two lane bridge is subjected to IRC class AA tracked loading by varying the span is analyzed using software. In this project parametric studies are conducted on various bridge super structural elements. The study is mainly focused on the economical depth of a longitudinal girder for different span of bridge. Graphs and

© 2024 IJSRET

diagrams are also developed which can be used as a handy tool in the design of T- Beam Bridge. The optimal of effective length to the effective depth (I/D) ratio for the economical design of longitudinal girder using LSM is obtained as 14. Cost of girder will be increases if there is increase in grade of concrete and decreases when it is increase in thickness of deck slab so It is preferable to keep the thickness in between 170 mm and 200 mm.

David A.M. Jawad [4] Study On "Analysis of The Dynamic Behavior Of T-Beam Bridge Decks Due to Heavyweight Vehicles" The study concluded the dynamic behavior of bridges due to vehicle loading has been the subject of considerable experimental and analytical research. The first important report on the matter was published in 1931 by a special committee of the ASCE. The recommendations of this committee, which were based on data obtained from a series of field tests, constitute the basis of American design specifications. In particular, it was recommended that the live load due to vehicles should be increased by an Impact Fraction (I0/ given by in which L is the loaded length in feet, and the maximum value of I is 0.25). The American Association of State Highway Officials conceived and sponsored a major experimental investigation in 1962 to determine the dynamic effects of moving vehicles on short span highway bridges. The standard specifications for highway bridges of AASHO. cite a variation on the impact fraction given by equation, whereby the maximum value ofI should not exceed 0.3. In 1981, the ASCE committee on loads and forces. confirmed current AASHTO practice concerning live load impact, except that the term impact be replaced wherever appropriate in current design specifications by the more descriptive term dynamic allowance for traffic loading.

P.Veerabhadra Rao [5] Study On "Analysis Of Girder Bridge With IRC And IRS Loadings - AComparative Study" The study conduct on simply supported RC T-beam Bridge by rational method and finite element method using staad Pro. This study concluded that when itis compared with the Guyon Masssonet method Courbon's Method gives the average result with respect to Bending Moment values in the longitudinal girder.The study also conclude that the bridge deck is analysis by both method grillage analogy as well as by finite element method. This study concluded that grillage analysis is easy to use and comprehend but analysis by finite element method, it is found that as compared to IRC the load per meter run of IRS loadings was increased by 210%, The Bending Moment due to IRS 25t Loading-2008 load combinations increased on an average of 4.6 times to the Bending Moment due to the IRC loading and Shear force and due to the IRS 25t Loading-2008 load combinations increased on an average of 3.2 times to the Shear force due to IRC load

Nieuwsma et. al. [6] Discrete swarm intelligence optimization algorithms applied to steel–concrete composite bridges: Composite bridge optimization might be challenging because of the significant number of variables involved in the problem. The optimization of a box-girder steel–concrete composite bridge was done in this study with cost and CO2 emissions as objective functions. Given this challenge, this study proposes a hybrid algorithm that integrates the unsupervised learning technique of k-means with continuous swarm intelligence metaheuristics to strengthen the latter's performance. In particular, the metaheuristics sine-cosine and cuckoo search are discretized. The contribution of the k-means operator regarding the quality of the solutions obtained is studied. First, random operators are designed to use transfer functions later to evaluate and compare the performances. Additionally, to have another point of comparison, a version of simulated annealing was adapted, which has solved related optimization problems efficiently. The results show that our hybrid proposal outperforms the different algorithms designed.

Faber et. al. [7] Experimental investigation on the vortex-induced vibration of an arch steel bridge tower: This paper reports the wind tunnel study of the vortex-induced vibration (VIV) of a free-standing steel arch bridge tower with pentagon cross-section. The tests were carried out at different yaw angles β (0°–90°) of wind flow by employing a 1:50 scaled aeroelastic model. A series of aerodynamic measures were studied to mitigate the VIV of the tower at the most unfavorable yaw angle. Effects of turbulence intensity and structural damping on the VIV performance of the tower were evaluated. A sleeve-type eddy current damper (ECD) for increasing the structural damping of aeroelastic model was designed for reserved emergency measures. Experimental results indicate that the VIV occurs for a few yaw angles at wind velocity of 15–18 m/s and the maximum VIV amplitude happens for β = 35°. The aerodynamic measures are effective for some yaw angles but become invalid for other yaw angles. Compared to those in smooth flow, the VIV amplitude drops by 65% for a turbulence intensity of 8.5%. The VIV of the tower can be effectively suppressed by the eddy current damper which provides additional damping to the aeroelastic model. The sleeve-type eddy current damper is shown to be a convenient device to adjust the damping for aeroelastic models

Fernando et. al. [8] Effect of the soil cover depth on the seismic response in a large-span thin-walled corrugated steel plate bridge: The common use of corrugated steel plate (CSP) bridges and culverts has been increasing in recent years. Despite the growing popularity of these objects, there is very scarce research concerned with the response of such structures to seismic excitation. Therefore, the aim of the study is to determine the effect of seismic excitation on a CSP bridge with span exceeding 17 m and a variable depth of the soil cover above the steel shell (from 1.0 to 5.0 m). The obtained

© 2024 IJSRET

results demonstrate that the depth of the soil cover has a significant impact on the response of the bridge.

Jong et. al. [9] Thermal transfer analysis method for judging the best time of removing the steel bridge deck asphalt pavement by induction heating: The application of induction heating technology to remove the steel bridge deck asphalt pavement (SBDP) is a green, efficient and non-destructive bridge deck pavement removal method.

The temperature between the steel bridge deck and the asphalt pavement is the key to the removal efficiency and effect. In order to analyze the distribution law of the temperature field, a heat transfer analysis method considering various factors is proposed, in which the thermal contact resistance (TCR) is an important factor. At the same time, this paper analyzes the influence of interlayer delamination disease on thermal resistance. Besides, by simplifying the SBDP, this study built an induction heating experimental platform to verify the effectiveness of the above method. Through this method, the distribution of the interlayer temperature field in the process of induction heating the SBDP can be accurately analyzed, so as to determine the best removal occasion of SBDP.

Groenendijk et. al. [10] Fatigue behaviour of joint-free bridges with steel and GFRP-reinforced ECC link slabs: Engineered Cementitious Composite (ECC) link slabs provide a feasible alternative to leaking expansion joints for improving long-term durability of slab-on-girder bridges. The use of Glass Fiber Reinforced Polymer (GFRP) rebars have become increasingly common for inducing superior chemical resistance in bridge decks in salt-prone locations. Existing literature lacks experimental research on effects of fatigue load on joint-free bridges with ECC link slabs reinforced with GFRP bars. This paper presents results of experimental testing of joint-free bridges with GFRP or steel-reinforced ECC link slabs subjected to static and fatigue (up to 1 million cycles at 4 Hz) loadings.

Comparative performance between GFRP and steel-reinforced ECC link slab bridges is described based on load–deflection or moment-rotation behaviour, strain characteristics and crack development in pre-fatigue, fatigue and post-fatigue stages. After 1 million fatigue cycles, the GFRP-reinforced ECC link slab exhibited smaller crack widths and higher deformation capacity while its incorporation provided superior ductility and deformation capability of the full bridge.

A finite element (FE) model was also developed using experimental results to simulate load–deflection behaviour of composite deck-steel girder joint-free bridge with ECC link slab subjected to fatigue loading. Parametric FE study showed that increasing mean stress level caused increased composite deck-steel girder deflection while link slab

III. CONCLUSION

The collection of reviewed papers offers a multifaceted exploration into the design, analysis, and optimization of bridge structures, encompassing diverse topics such as T-beam and Box Girder designs, dynamic behavior under heavy loads, parametric studies for optimal design, and innovative optimization techniques. The findings underscore the importance of considering various factors, including material choices, loading conditions, and dynamic effects, in achieving economical and structurally sound bridge designs. The studies contribute valuable insights that can inform both current engineering practices and future advancements in bridge engineering, emphasizing the need for a holistic approach that considers the intricacies of different bridge types and their responses to varying environmental and loading conditions.

REFERENCES

1. Mahantesh.S. Kamatagi, (Sep 2015), Worked On “Comparative Study of Design of Longitudinal Girder Of T-Beam Bridge” Volume: 02 Issue: 06| Sep-2015 (IRJET)
2. Abrar Ahmed, (Jul 2017), ‘’Comparative Analysis and Design Of T-Beam and Box Girders” Volume 6, Issue 8, August-2015 IRJET
3. Anushia K Ajay (June 2017), ‘’Parametric Study On T-Beam Bridge” Volume 8, Issue 6, June 2017, pp. 234–240, Article ID: IJCIET_08_06_027
4. David A.M. Jawad (2010), Study On ‘’Analysis ofThe Dynamic Behavior of T-Beam Bridge Decks Due to Heavyweight Vehicles’’ Emirates Journal for Engineering Research, 15 (2), 29-39 (2010)
5. P.Veerabhadra Rao(Aug 2017), Study On “Analysis Of Girder Bridge With IRC And IRS Loadings – A Comparative Study’ Vol. 6, Issue 8, August 2017 IRJET.
6. Nieuwsma R. Inventory of wheel loading and tyre inflation pressure in practice – measurements within framework of COST-334. Tech. rep., European Commission; 1999.
7. Faber A, Hahn WD. Effects of wide single tyres and dual tyres–A technical and economic approach–report on cost 334. Eng Trans 2000;48(3):261–72.
8. Fernando EG, Musani D, Park D-W, Liu W. Evaluation of effects of tire size and inflation pressure on tire contact stresses and pavement response. No. FHWA/TX-06/0-4361-1. Tech. rep., Texas Transportation Institute; 2006.
9. De Jong F. Renovation techniques for fa-tigue cracked orthotropic steel bridge decks [Ph.D. thesis], Delft University of Technology; 2007.
10. Groenendijk J. Accelerated testing and surface cracking of asphaltic concrete pavements [Ph.D. thesis], Delft University of Technology; 1998

© 2024 IJSRET