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Review on Design and Analysis of Bridge Structures

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Abstract- Bridge is the structure which is used for carrying the traffic over the valley or river by connecting highways or railways. The current research reviews the existing work conducted in the field of design and analysis of bridge structure. The study presents the study of bridge structures using both experimental and numerical techniques. The formulation of different output parameters associated with strength and deformation of bridge structure is presented.

Keywords- Bridge, Design, Highways, Railways, Imperialist competitive Algorithm (ICA) Back tracking search Algorithm (BSA) Search group Algorithm (SGA).

I. INTRODUCTION

A bridge is a construction built to span physical obstacles such as a body of water, valley, or road, for the purpose of providing passage over the obstacle. Designs of bridges vary depending on the function of the bridge, the nature of the terrain where the bridge is constructed, the material used for construction and the funds available to build it. A bridge has three main elements. First, the substructure (foundation) transfers the loaded weight of the bridge to the ground; it consists of components such as columns (also called piers) and abutments.

An abutment is the connection between the end of the bridge and the road carried by the earth; it provides support for the end sections of the bridge. Second, the superstructure of the bridge is the horizontal platform that spans the space between columns.

Finally, the deck of the bridge. The guidelines for Non-linear analysis for bridge structure presents a collection of general recommendations for the modeling and analysis of highway bridges and overpasses subjected to earthquake ground motions, required for the design or evaluation of the capacity and ductility of critical bridge components and systems.

II. LITERATURE REVIEW

Jerome F. Hajjar et al [1] In this paper give a brief statement of the main points of measured versus computed results from field test with heavy live load conducted on a multi-span, horizontally curved composited steel I-girder bridge in Duluth, Minnesota. In this paper total eight trucks 320KN are placed on the bridge which have 43 static and 13 dynamic loading configurations after that the final result were compared to the linear elastic grillage analysis. In the give a summary of a comparison of final results from the grillage computational model to field tests due to live loading of the bridge. A twogirder five span continuous horizontally curved composite steel and 13 dynamic tests has been conducted with eight trucks 320KN with measured axle weight as soon as dynamic impact factors which have obtained in the field study that is slightly higher and more than the code specified values A. Ghani Razaqpur et al [2] In the paper determined distribution factor experimentally for the model total bridge, and compare with Canadian highway bridge based calculated values. The code values as per design standard is found to overestimate the maximum moment in the interior loaded girder about 22% and 33% at the elastic and inelastic states, respectively Conclusion of the study in this paper. Slightly higher deformation of the time if loaded girder than all the stage of loading exceptclose to the ultimate load when the time of unloaded girder.

The three girders at any section along the bridge become nearly equal which indicated the formation of plastic hinge at mid-span in all three girders at the time of near the ultimate had. The calculation moment by the loaded girder based on the CSA standards. In the observation that the CSA S6 standard give values and caution about charge or innovation estimate of the moment carried by the loaded girder. Prajwal Raj and Mr. Vasantha.D [3] Design and Analysis of post tensioned look girder bridges of single cell and four cell type is compared IRC and AASHTO Loading using the software CSi bridge design.

In this software structural behaviour decide which code of practice is better by comparing the results and also know about the modelling pattern of the software and the detail study about the single cell and four cell box girders under IRC & AASHTO loading. As per the result of CSi bridge software the depth of beam decreased the prestressing force decrease and number of cables decreases. Results shows that the single cell prestressed concrete beam is most fitted and economical crosswise for double lane Indian national IRC is not more safety as compared to AASHTO code safety. In the comparative study between IRC and AASHTO code clear that the AASHTO code economical. R.L. Pedro et al [4] The design of steel

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concrete I-girder bridges tow stage optimization approach. To refine and improve the optimization in finite element model. Five well know metaheuristic algorithms is used to conduct the first stage optimization. Imperialist competitive Algorithm (ICA) Back tracking search Algorithm (BSA) Search group Algorithm (SGA). In the final conclusion is that another contribution was the estimation of five modern optimization algorithms addition information to properly select the best algorithm for the study. Rohit M and Dr. J. Jegan [5] In this paper Made up of prestressed concrete box girder which is analyzed for moving loads by wing of Indian road congress (IRC:6) and code of practice for concrete bridges (IRC:1/2) specifications. Using CSi bridge wizard analysis of box girder bridge. Found the result the dead load, shear force and bending moment is higher as compared to other loading One lone of IRC 70R and class A under the live load analysis is found to be more critical than 3 lane of class A. After the testing deflection obtained due to various loading conditions (Different loading conditions) is well within permissible limits as per IRC. It is found that near mid-span of the girder vertical deflection is maximum. Radek Wooziness et al [6] In this paper inspect in detail to determine their nature and the effect of various parameters on the free vibration response of curved composite-steel girder bridges.

Determine corresponding mode shapes, an extensive parametric their fundamental frequency all study is conducted on 336 straight and curved bridges. The numerical simulation for the considered bridges in order to obtain the fundamental frequencies by the use of ABAQUS software. If increase in curvature ratio or with an increase in span length the fundamental frequency decreases. In the fundamental frequency the girder spacing and the number of girders have a less pronounced effect. But in general increase in spacing and number of girders the fundamental frequency decreases. A point is reached where increase in number of girder results in increase in fundamental frequency with an increase in span and curvature ratio.

Md Tautened Riyaz and Syed Nikhat Fathima [7] In the paper study and analysis of compare between two standards specifically AASHTO and IRC followed in the construction of super structure of bridge and applying serious load for 2 sorts of examples specifically beam with single cell and four cell and comparison bet them. IRC category AA loading in load combination is followed in style of box girder superstructures. And the AASHTO code is applied. And the AASHTO code is applied because of its safety then IRC. The prestressing force decrease and number of cables decrease as the depth of beam decreases. It is clear that the AASHTO code is more economical than the IRC. Jun Shi and Weitao Li [8] In this paper study of a large curvature continuous steel box-girder bridge model to viewers it's behaviour characteristics and noticed failure mechanism based on the theory and conducts the experimental investigation into the whole working process of the bridge.

Ghafur H. Ahmad and Omar Q. Aziz [9] In this paper study series of the series of specimens with epoxied joints, were tested to evaluate shear behaviour of box girder segmental bridges, under direct shear loading. To the study confining stress level, concrete compressive strength and prestressing eccentricity. As well as we investigated shear behaviour, crack pattern of joints and shear capacity. The AASHTO formula estimate that value shear capacity values for epoxied keyed joints 11.3% is the average value. The Inexperienced shear capacity is more compared to estimate shear capacity by 4.6%, 15.7% and 26.9% for confining stress levels of 1MPa, 3MPa and 5MP respectively. Underestimated by the ultimate shear strength of a joint is 14.4% and 0.1% respectively for a concrete with 40MPa, 80MPa and 120MPa of compression strength. Quang-Viet Vuet al [10] In this paper an investigation open steel box section into the toad carrying capacity of a steelconcrete composite box girder bridge. In the paper study analyzed threedimensional finite element model of steelconcrete composite box girder by using software ABAQUS. The intermediate diaphragms significantly affect the load carrying capacity of the girder under the strength load combination, but not the strength load combination 3. For steel concrete structure 30 to 60m in length for the box girder, it is advisable to place an intermediate membrane in the diddle of the crossbar to prevent loss of bearing capacity.

N. Loaiza et al [11] In-steel bridge girders, longitudinal reinforcement is mainly used to increase flexural and shear strength. The purpose of this article is to investigate the behaviour of longitudinal steel beams with long reinforcement: one-fifth of the beam depth in the patch load. A nonlinear elemental analysis is performed. Examine the interactions between geometric parameters that affect the resistance of the load patch. Finally, design recommendations for strict longitudinal beams are presented. In practice, long-term reinforcement is mainly used at b1 = 0.2 h to increase resistance to bending and shear. Cameron D. Murraya and Mauricio Diaz Arancibiab [12] A limited amount of published information on previously stressed concrete bridge failures is collected by cutting and timing. A concrete bridge was built to investigate the behaviour of the final bridges with particular attention to the capacity of the structure after cracks and full depth. When the filled beam failed, the diaphragm beam connection broke. They were seen to cause cracks in the outer rays and were eroding the end diaphragm platforms that had turned off the bridge. In addition to the test bridge, 2D and 3D computer models were constructed to determine the elastic embroidery distribution (DF) factors and to compare them with the factors obtained during the bridge test. Some guidance is provided on developing a bridge model to find DF. The computer model presented here provided a better

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resolution than the other and compared the results of the test scale bridge. Grid models were relatively simple compared to 2D and 3D FEM, and appeared to be almost accurate. Although the grid method is at least computationally demanding of all modelling methods, it requires experience, judgment, assumptions, and modelling time when converting stage elements into frame elements. 2D models are comparatively efficient and give similar results to 3D models. The computer model presented here provided a better resolution than the other and compared the results of the test scale bridge. Grid models were relatively simple compared to 2D and 3D FEM, and appeared to be almost accurate. Iqra Zaffar and Priyanka Singh [13] Bridges are advocates of improvisation of lifelines and road networks. Bridges not only assist in the flow of traffic without interruption, but also maintain the safety of the roads.

For this reason, the design of bridges has gained great importance. This document originally relates to the analysis and design of the Staad pro Deck Slab Bridge using IRC Loading. It consists of a section of 100 m X 16m and has a system of 4 beams. The objective is to verify the result for a particular input design, properties and parameters and the approach is derived from the AASHTO standard design. Nodal displacement, beam property, vehicle load details, concrete design can be easily found by performing analysis and design method. Staad pro can easily analyze and design deck slab bridges according to IRC code (load here IRC 70R).

In relationGhafur H. Ahmad and Omar Q. Aziz [9] In this paper study series of the series of specimens with epoxied joints, were tested to evaluate shear behaviour of box girder segmental bridges, under direct shear loading. To the study confining stress level, concrete compressive strength and prestressing eccentricity. As well as we investigated shear behaviour, crack pattern of joints and shear capacity. The AASHTO formula estimate that value shear capacity values for epoxied keyed joints 11.3% is the average value. The Inexperienced shear capacity is more compared to estimate shear capacity by 4.6%, 15.7% and 26.9% for confining stress levels of 1MPa, 3MPa and 5MP respectively. Underestimated by the ultimate shear strength of a joint is 14.4% and 0.1% respectively for a concrete with 40MPa, 80MPa and 120MPa of compression strength. Quang-Viet Vuet al [10] In this paper an investigation open steel box section into the toad carrying capacity of a steelconcrete composite box girder bridge. In the paper study analyzed threedimensional finite element model of steelconcrete composite box girder by using software ABAQUS. The intermediate diaphragms significantly affect the load carrying capacity of the girder under the strength load combination, but not the strength load combination 3. For steel concrete structure 30 to 60m in length for the box girder, it is advisable to place an intermediate membrane in the diddle of the crossbar to prevent loss of bearing capacity. N. Loaiza et al [11] In-steel bridge girders, longitudinal reinforcement is mainly used to increase flexural and shear strength. The purpose of this article is to investigate the behaviour of longitudinal steel beams with long reinforcement: one-fifth of the beam depth in the patch load. A nonlinear elemental analysis is performed. Examine the interactions between geometric parameters that affect the resistance of the load patch. Finally, design recommendations for strict longitudinal beams are presented. In practice, long-term reinforcement is mainly used at b1 = 0.2 h to increase resistance to bending and shear. Cameron D. Murraya and Mauricio Diaz Arancibiab [12] A limited amount of published information on previously stressed concrete bridge failures is collected by cutting and timing. A concrete bridge was built to investigate the behaviour of the final bridges with particular attention to the capacity of the structure after cracks and full depth. When the filled beam failed, the diaphragm beam connection broke. They were seen to cause cracks in the outer rays and were eroding the end diaphragm platforms that had turned off the bridge. In addition to the test bridge, 2D and 3D computer models were constructed to determine the elastic embroidery distribution (DF) factors and to compare them with the factors obtained during the bridge test. Some guidance is provided on developing a bridge model to find DF. The computer model presented here provided a better resolution than the other and compared the results of the test scale bridge.

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Kalpana Mohan and S. P. Vijay Kumar [14] In this paper, we present the analysis and results of steel and reinforced steel bridge girders based on Staid pro analysis and manual analysis. Dzolev et al. [15] This paper presents the analysis of reinforced concrete Girder Bridge designed according to EN 1998-2, with the determination of the achieved ductility in plastic hinges at the target displacement for the designed seismic action, for confined and unconfined concrete cross sections, with and without the effects of geometric nonlinearity. In this paper, analyses were conducted for RC Girder Bridge with confined and unconfined concrete cross sections with and without the effects of geometric nonlinearity. Based on the pushover curves, it can be concluded that, for the same level of horizontal displacement, lower values of base-shear are obtained if P-Δ effects are applied.

Obtained target displacement and achieved local ductility also differ whether concrete is modelled as confined or unconfined, giving higher values in favour of confined concrete. Results are presented only for the shorter column. The cross section and the reinforcement are the same for both columns, but the stiffness, however, is different, being about inversely proportional to the third power of the column height. The shorter column will, thus, undertake larger seismic shears and develop higher design seismic moments, which will result in earlier yield and larger ductility demand in the plastic hinge. Sachin Kulkarni [16] This paper carry out a seismic evaluation case study for an existing RC bridge using nonlinear static (pushover) analysis. In the present study a 4 Span RC Bridge existed in SH-12 in Karnataka, India, was selected and by defining FEMA 356 Auto hinges conducted Nonlinear Static (Pushover)Analysis using (ATC 40) Capacity Spectrum Method and software SAP2000 was used to analyze the Bridge.

The evaluation results presented here shows that the selected bridge does not have the capacity to meet the desired performance level and it requires retrofitting. From the Pushover Analysis the performance levels of bridge are studied. From the Analysis it is evident that Spectral Displacement Demand is more than the Spectral Displacement Capacity in the analysed Bridge. So the analysed bridge requires retrofitting. Rajeev Sharma [17] This paper deals with theevaluation studies for the existing, RC bridge using non-linear static analysis. For the seismic assessment of the bridge a 3 span bridge is selected which is located on the hindon river at Ghaziabad (Uttar Pradesh). This area is highly vulnerable to the seismic activity because it is lie in the Zone – 4 .so, the high magnitude earthquake may be occurs in this region(may be greater than 7 magnitude). . For doing the seismic evaluation of the bridge at the time of earthquake open sees software is used. The open sees model is used to describe the various performances of the bridge. By comparing the various results obtained through the non-linear analysis (static and dynamic). The concrete developed by Chang and Mander is used for assessment. This new material is used in assessment enhance the existing bridge capacity against the bridge element damage during the seismic activity. From the various evaluation results it is worked out that the bridge structure under the designed seismic vibrations is safe and the results obtained from this pushover analysis is verified through the results obtained from the dynamic analysis. The present work is basically based on the use of force based beam column elements and their formulation the models of concentrated plasticity element and distributed plasticity element. The open sees software is used in this thesis work for creating the finite element models when using this software. The main stretch is given on the input units because his software is designed according to the American Customary System which is different from the units used in India T. Pramod Kumar et al [18] This paper deals with the analysis and design of super structure of road cum railway bridge across Krishna river proposed on downstream side of existing bridge between Mahanadu road of Sithanagaram and P.N.Bus station, Vijayawada. The bridge is made of through type steel truss which carries two railway tracks at lower level and a roadway of three lane carriage way in the upper level.

The span length matches with that of existing nearby Railway Bridge. Analyses of topfloor members, truss members and bottom floor members are done using STAAD. Pro. The design of structural members of the truss, top floor and bottom floor members is done as per Indian railway standard code and Indian roads congress code. In which they concluded that Road cum railway bridge reduce the construction cost by providing single bridge for both railway traffic road traffic instead of providing two separate bridges. It meets the increased railway and road traffic needs across the river Krishna. It reduces the land acquisition problem by providing single bridge. S.N.KrishnaKanth et al, [19] This paper deals with a design minor Bridge. We plan on covering every aspect of the redesign.

This is going to include the design of the actual replacement bridge, the affect this bridge will have on the surrounding area through an environmental impact, and the logistics associated with the construction phase. In completing this project, we are going to have to use a number of tools. We will have to get bridge history reports in order to see the deficiencies of the current bridge, including height issues and pier quality. We are also going to have to determine what the ASHTO design standards are and apply them to this bridge. Through these events, along with others, we expect to get a good understanding of the construction phase and end up with a product similar to what was designed and approved by Mass Highway for this bridge. STAAD PRO has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters

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which are designed as per IS: 456(2000). Beams are designed for flexure, shear and torsion.

VI. CONCLUSION

The structural stability of bridge structure depends upon various factors which include loading conditions, environmental conditions, cable design and base structure design. The bridge structure analysis has been done by various researchers using Staad pro simulation package. The feasibility of this package in evaluating strength, deformation and structural stability of bridge structure is established. Various standards are prescribed for analysis of bridge structures i.e. IS:456 (2000), FEMA 356 and AASHTO.

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