A Review Article on Study of Effectiveness of Hendry Jaeger Method in Analysis of T-Beam Bridges

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Abstract— The development of the nation is mainly from Agricultural and industrial activities, so, it is required to facilitate the proper transportation by providing the Flyovers and Bridges. For constructing the flyovers or the bridges we find many types of section among which T-beam and box type are very popular. In order to find out the most suitable section, this project looks on the work of analysis, design and cost comparison of T-Beam and Box girders for different spans. The purpose of this study is to identify the suitable section for bridges of different spans and also identifying the suitable method of analysis.

Key words: T-Beam, Compressive Membrane Action, Punching Shear, Transverse- Reinforcement, Bridge Deck Slab

I. INTRODUCTION

Bridges may be of Reinforced concrete or steel construction. Reinforced concrete is well suited for the construction of highway bridges in the small and medium span range. Their durability, rigidity, economy and ease with which pleasing appearance can be obtained make them suitable for this purpose. The usual types of reinforced concrete bridges are slab bridges, Girder and slab(T-beam) bridges, Hollow girder bridges, Balanced cantilever bridges, Rigid frame bridges, Arch bridges, Bow string girder bridges. As bridge cost is by far higher than that of roads, it become necessary to have a proper planning for the best utilization of funds for transportation network. This planning can be achieved by the use of best design method. Though good planning and design of bridges shows the innovation, imagination and exploration of designers but it is only possible when the design method itself is sound.

II. LITERATURE REVIEW

Arnold W. Hendry (2018) The object of this paper is to give a brief resume of the method as applied to simply supported spans and to discuss its application to the analysis of interconnected continuous beams. The analytical procedure depends on whether or not the longitudinal possess torsional stiffness and will be illustrated by considering the Solution for a three girder bridge.

Kapil Kushwah (2018) The Bridge is a structure imparting passage over an impediment without remaining the way under. The desired passage may be for a road, a railway, pedestrians, a canal or a pipeline. T-beam bridge decks are one of the predominant sorts of forged-in vicinity concrete decks and consist of main girders, cross girders which imparts lateral tension to the deck slab and deck slab which runs among T-beams constantly. Bridges are exceedingly investment systems and vital landmarks in any country. Besides being crucial links in transportation device. Strength, protection and economy are the three key capabilities that cannot be left out before the finalization of kinds of bridges. While deciding the forms of bridge, spans and other parameters are to be studied cautiously to fulfil out the need of suitability to site situations. The analysis of a three span two lane T-beam bridge is carried out by varying the span of 10m, 15m, 18m, and number of longitudinal & cross girders using software Staad Pro v8i. In order to obtain maximum bending moment and shear force in girder, maximum Stresses in slab and maximum reaction and moment at the support, the bridge models are subjected to the IRC class AA Tracked loading system and concluded that with the increase in shear force, bending moment and deflection in the girder and variation of stresses in slab.

Anushia K Ajay (2017) the infrastructure available in a country judges the development of that country. Highway which allows the flow of human beings and material is a major part of infrastructure. Tee-beam bridges forms the major proportion of bridges constructed on the highways. IRC codes are developed and reused from time to time based on the research work carried out all over the world. IRC 112-2011 replaces two codes of practice IRC 21-2000 and IRC 18-2000. Also IRC 112-2011 introduces limit state method of design of RCC bridges. Single span two lane bridge is subjected to IRC class AA tracked loading by varying the span is analyzed using software VB6.0. In this study 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. Nomograms are also developed which can be used as a handy tool in the design of T- Beam Bridge

Abubakar (2017) this paper reviews the current design practices of transverse slab reinforcement design in concrete bridge deck, which consist of concrete deck slab on wide concrete T-beams. The conventional bridge design method results in the provision of excessive transverse steel reinforcement in the concrete bridge deck slab due to the fact that, the slab is assumed to bear the applied vehicular loadings alone without considering the contribution of the wide T-beam flanges. Thus, the design which is based on bending and failure proved to be too conservative. Through critical review, issues regarding some design approaches were discussed. It has been found that, designing the deck slab in transverse direction would enable the vehicle wheel loads to be supported by the wide T- beam flanges and performance enhancement can be achieved by compressive membrane action resulted from the natural stiffness of the wide girder flanges. The presence of this membrane forces provides a punching shear capacity, which is far beyond the flexural design capacity for the new bridge deck system. This capacity would result in substantial reduction of the transverse reinforcement within the slab.

L.P.Huang (2017) Load distribution factor (LDF) is an important index for evaluating the performance of existing

bridges. However, few researchers have studied the change of transverse load distribution coefficients of beams before and after the widening and reinforcement of existing bridges. To work out such problem, a reinforcement method for widening longitudinal and cross beam was proposed. A Finite element (FE) model was built to simulate the widening reinforcement of existing bridge, Load distribution factor for all girders were analyzed in the cases of different position, quantity and stiffness of cross beam, different added width of girder, different existing bridge stiffness and different connection system. Results show that the LDF of side beams decreases by 63.92% to the highest extent after bridge reinforcement, which significantly improves load-carrying condition of girder. However, the LDF at fulcrum increases by 30% after reinforcement. Therefore, some strengthening measures are necessary in these positions. The quantity, position and dimension of cross beam have not much influence on the LDF of each girder. The LDF of beams are smaller when the widened girders are connected rigidly to the old girders than that hinge connected to. The LDF of each girder shows not much difference when the main beams are connected to widened girders with rigid or hinged connection, respectively. This study is meaningful for the development of widening and reinforcement design of existing bridges.

Abrar Ahmed (2017) the development of the nation is mainly from agricultural and industrial activities, so, it is required to facilitate the proper transportation by providing the Flyovers and Bridges. For constructing the flyovers or the bridges we find many types of section among which T-beam and box type are very popular. In order to find out the most suitable section, this project looks on the work of analysis, design and cost comparison of T-Beam and Box girders for different spans. The purpose of this study is to identify the suitable section for bridges of different spans. The Prestressed concrete sections have been considered in this case as the spans designed are more than 25 meters for which the Reinforced concrete sections are uneconomical. The aim and objective of the work is to analyse and design the sections for different Indian Road Congress, IRC vehicles. This has been done by analysing the structure by CSI bridge software and validating with manual results by developing the Microsoft Excel Sheets using Working Stress Method and by adopting Courbon's theory. It is found that the IRC 70R vehicle producing maximum effect on the sections. Cost comparison has shown that the T-beam girder is suitable for spans up to 30metre, as we go for higher spans the depth of T-beam girder increases drastically which makes it uneconomical. Therefore for higher spans the box girder is suitable. The result of this analysis can be used to find the suitable section for respective spans. From the obtained results we can conclude that the software results are acceptable and can be adopted for the design of substructures also.

R. Shreedhar (2016) a bridge is a structure built to span of a physical obstacles such as a water body, valley or road to have accessibility for people and vehicle. The design and construction of road bridges require an extensive and thorough knowledge of the science and technology involved with adequate experience of bridge engineering. In India, till now Pre-stressed concrete road bridges are designed and constructed according to Indian road congress guidelines as per IRC: 18-2000 code in which working stress method is adopted. Recently Indian road congress has introduced another code IRC- 112: 2011 for design of pre-stress bridges using limit state method. The study of bridge design using the limit state method is discussed to enlighten the recently introduced IRC-112: 2011. The present study has been performed to know the difference in design using IRC-112:2011 and IRC-18:2000 and attempt is made to study undefined parameters of IRC: 112-2011 such as span to depth (L/D) ratio. The present study is based on the design of PSC Box girder by working stress method using IRC- 18-2000 and limit state method using IRC- 112: 2011 code specifications. It is observed that for Box girder, L/D ratios are 33 and 26 respectively for limit state method and working stress method. In Box girder bridge quantity of concrete can be saved in limit state method. The present study may help in limit state method of Box Girder Bride design for defining L/D ratio

R.Shreedhar (2015) T-beam Bridge is composite concrete structure which is composed of slab panel, longitudinal girder and cross girder. Present study is mainly focusses on design of longitudinal girder by IRC: 112-2011 and IRC: 21-2000. In India, till now girders are designed and constructed according to Indian road congress guidelines as per IRC: 21-2000 code in which working stress method is used. Recently Indian road congress has introduced another code IRC: 112-2011 for design of prestress and RCC bridges using limit state method. In regards to this, present study has been performed to know how design of IRC-112 differs from IRC-21 and an attempt is made to study undefined parameters of IRC: 112-2011 such as span to depth (L/d) ratio. Present study is performed on design of longitudinal girder using "working stress method" using IRC: 21-2000 and limit state method using IRC: 112-2011 code specifications. It is observed that L/d ratio of 10 in working stress method and L/d ratio of 14 in limit state method is most preferable. Quantity of materials required in limit state method is compared with quantity of material required in working stress method and it is found that concrete can be saved up to 25 to 30% using limit state method.

M.G. Kalyanshetti (2013) -In order to compute the bending moment due to live load in a girder and slab bridge, the distribution of the live loads among the longitudinal girders has to be determined. There are many methods to estimate load distribution. In this project Courbon's method is used to estimate the load distribution as it very popular and widely used because of its simplicity. But the Load factor obtained by Courbon's method is constant for all spans and this indicates the effect of variation of span is not at all considered. Therefore it is proposed to study "effectiveness of Courbon's theory" for various spans of bridge by varying number of longitudinal girders. In this project STAAD software is used in which bridge models are analyzed using grillage method. Finally load factor obtained from grillage analogy are compared with the Courbon's load factors to find out the difference and to obtain a new equation which considers the effect of span. The detailed study is carried out for four lane and six Lane bridges of spans 15m, 20m, 35m, 30m, 35m using IRC class A loading by varing a number of longitudinal girders. Also the study reveals that Courbon's theory gives higher values of bending moments for exterior girder. Therefore the problem of over estimation of load on

exterior girder is solved by using Modified Courbon's equation.

David A.M. Jawad (2010) this study investigates the dynamic behaviour of concrete T-beam bridge decks due to heavyweight vehicles. The three-dimensional model of an actual T-beam bridge deck design is implemented within the context of the finite element method, through use of the ANSYS 5.4 computer code. The deck is modeled with 20-node brick elements. Axle loads and configurations which correspond to the "permit vehicle" loading model are adopted for the vehicle model. The case study is considered for static, free vibration, and forced vibration analysis. The dynamic loading for forced vibration analysis is a harmonically (sinusoidal) varying load with magnitude equal to 10% of the axle load and a forcing frequency equal to the first(fundamental) frequency of the bridge deck, thus simulating a case of resonance. Dynamic amplification factors are evaluated at certain locations on the bridge deck for vertical displacement, normal stress in the longitudinal direction, and shear stress. Numerical results show a general trend for higher values than those specified by the AASHTO design code. It is also concluded that the values of dynamic amplification factors are response dependent, which suggests the use of three different types of dynamic amplification factors for the analysis of bridge decks.

III. Conclusion

After the review of previous researches, it becomes clear that more economical design method for transverse reinforcement in concrete bridge deck slab is needed. Summary of various design methods is presented. It can be seen that, the conventional design method is very conservative as it assumed flexural deck slab behavior without considering any other factor that might enhanced its ultimate strength capacity. Subsequent methods incorporate arching action behavior that enhanced the slab deck strength capacity and results in the use of reduced amount of reinforcement. Among all methods, Hendry Jaeger Method is the simplest and is applicable when the conditions are satisfied.

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