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Relative Study of Analysis of PSC Girder and Steel Girderbridge Superstructure Using MIDAS-CIVIL

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***Abstract:*— Composite Bridge is a type of bridges that are being used now-a-days on a large scale for the construction of various kinds of flyovers to ease the traffic flow. This paper deals with the Comparative study between PSC girder composite bridge and steel composite superstructure to come to an optimum section for given span of 22.8m with application of Indian standard loading as per IRC. It was done with the help of a finite element bridge software MIDAS-CIVIL. The superstructure is applied with all the required loadings and after-loading effects such as Bending -moment, Deformation etc. have been analyzed and the best suitable choice of section is being concluded also considering the prevailing rates of construction cost to be adopted.**

***Index Terms* - Composite Bridge, PSC girder, Steel girder, MIDAS-CIVIL, Comparison of superstructure**

I. INTRODUCTION

Bridge is life line of street system, both in urban and provincial zones. Composite bridge is named because of the way of construction being done. Composite material offers unique properties that may justify their gradual introduction into bridge repair and construction. The bridge deck appears to be one of the most suitable bridge components for use of structural composites in Highway applications. The main advantages of composite bridge construction are their relative lighter weight, corrosion resistance and fabrication in modular units which may be rapidly installed without the need for shoring and formwork. The present paper analysis will give the response of a structure over time during and after the application of a load. It will help in understanding the overall behavior of structure over a period of time with applied load on it. The purpose of this study is to understand the behavior of composite PSC-Girder bridge and Steel girder bridge under standard loading and to come out at an optimum section for superstructure for a particular length of span using a finite element analysis software MIDAS-CIVIL. The effect of LL fir different length od span are varied. In short spans track load governs whereas in long spans wheel load governs. Selection of structural system for a particular span is every time an iterative process & also a scope of research. Structural system finalized are the effect of factors like safety, economy & complexity in construction. The detail design has been completed with IRC loadings. The decision of sparing and constructible auxiliary system is relying upon the outcome.

Fig.1 Composite Bridge Structure

II. OBJECTIVE OF THE STUDY:

a. To study the Behavior of PSC composite superstructure and steel composite under standard IRC loadings.
b. To Know the Optimum solution for superstructure under given set of conditions.

III. METHODOLOGY

The steps mentioned below were been used in the study behavioral study of composite bridge structure under after applying Time-History Analysis.

i. Materials

The Finite element analysis software used for the analysis of both kind of composite bridge superstructures is MIDAS-CIVIL-2016(v2.2). It has a very distinctive user friendly interface and optimal design solution functions that can be accounted for construction stages and various time dependent

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properties such as creep, shrinkage etc. The advancely developed modeling and analysis software, It enable the engineers to overcome common drawbacks of Finite element analysis. Midas-Civil is basically a bridge analysis and design software made to design and analyze Curved, Composite, segmental, post-tensioned, suspension, cable-stayed, skewed, frame and culvert bridges. The analysis is being carried out with various analysis methods and design is done as per IRC112:2011. It provides optimal solution for the bridges.

ii. STRUCTURAL DATA :

Span of bridge : 22.8m
Deck Width : 9m
Width of Carriageway : 10m
No. of Lanes : 2
Type of Superstructure : PSC I-girders/steel girder& Cast-in-situ Deck slabComposite bridge
Grade of concrete for Slab : M40

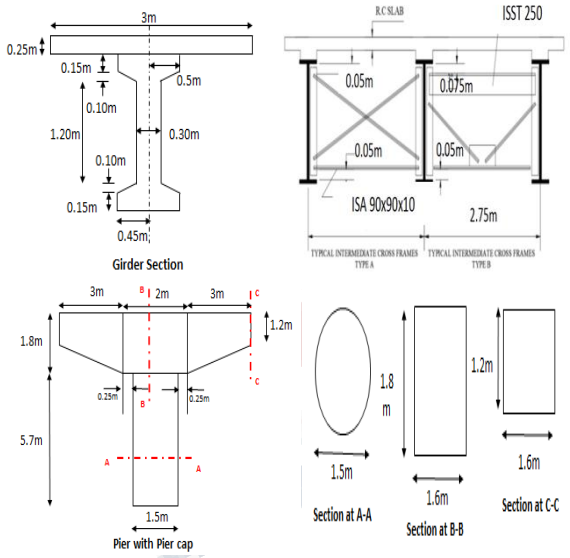

Fig.2 Sectional Properties of Various Elements

iii. LOADING CONSIDERATION AS PER IRC SPECIFICATIONS

1. DEAD LOAD for various structural elements such as deck slab, I Girder, Diaphragms, Pier, Pier-Cap as per IRC6:2014
2. Super imposed dead load due to Footpath, wearing coat, crash barrier etc. as per IRC6:2014
3. Moving loads due to standard IRC vehicle i.e. Class A and 70R and their combination as per IRC6:2014.
4. Forces due to shrinkage and creep of concrete.

iv. FINITE ELEMENT MODELLING USING MIDAS-CIVIL.

The workbench used for the modelling and analysis of composite bridge was MIDAS-CIVIL due to its advanced feature of finite element analysis and construction stage analysis also due to efficiency of analyzing composite sections. The modelling of the structure is done with the help of tutorials available for the modelling of composite structure in which the modelling is done by the method of node-line element for all the parts such as pier, pier-cap, girders, deck slab etc. after completion of modeling and assignment of suitable sections & boundary conditions the loading is applied as per IRC6:2014 for DL & SIDL, Live load is applied considering the width of the structure and no. of lanes accordingly. After application of loading appropriate load combinations were applied and construction-stage sequence is taken into consideration by the in-built feature of MIDAS-CIVIL. The Pre-stress load is applied for PSC girder with proper consideration of no cables and their parabolic profile with suitable coordinated& erection sequence is considered for the steel girder. The analysis is carried out for the bridge and the results were obtained for normal condition and under ULS & SLS conditions then performing the analysis the various parameters of the structure are being assessed.

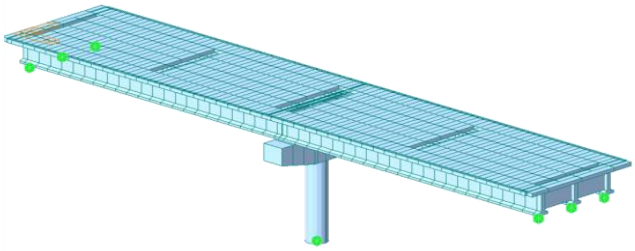

Fig.3 Three Dimensional View of the Model generated in MIDAS Civil

IV. RESULTS AND DISCUSSION

After application of proper loading conditions as per IRC standards the results have been tabulated

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graphically as follows:

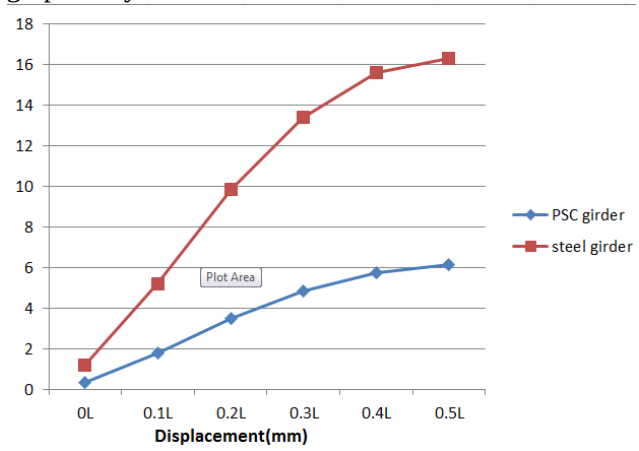

Fig4: Displacement comparison

From fig.4 it can be seen that the deflections produced bt PSC girder is less as compared to steel girder bridge which states that steel girder is advantageous in terms of ductile failure whereas service life behaviour is better in case of PSC girder bridge.

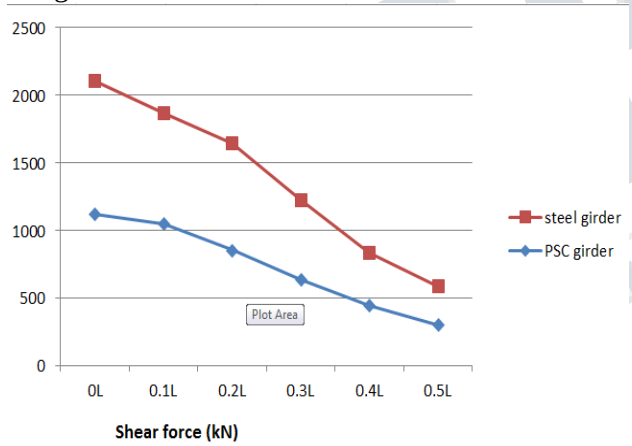

Fig5: Shear forcecomparison

From the fig.5 it is evident that the shear force developed is more in case of PSC girder bridge as compared to steel girder bridge which is due to the fact that steel has less weight density in turn self weight as compared to PSC girdergiving less reaction and load on sub-structure.

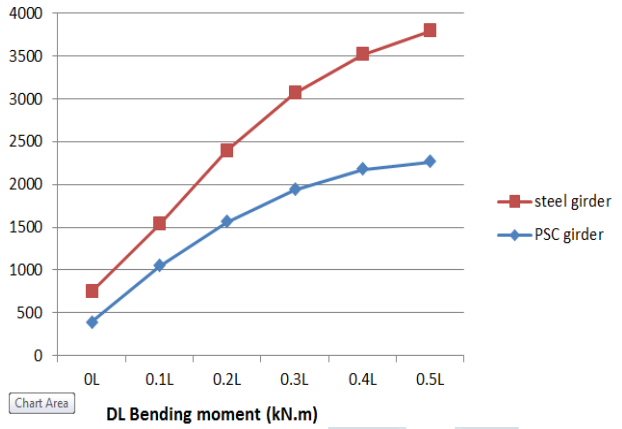

Fig6: DL BM comparison

From the fig.6 it can be seen that due to less weight density the moment developed due to steel girder bridge is less as compared to PSC girder bridge.

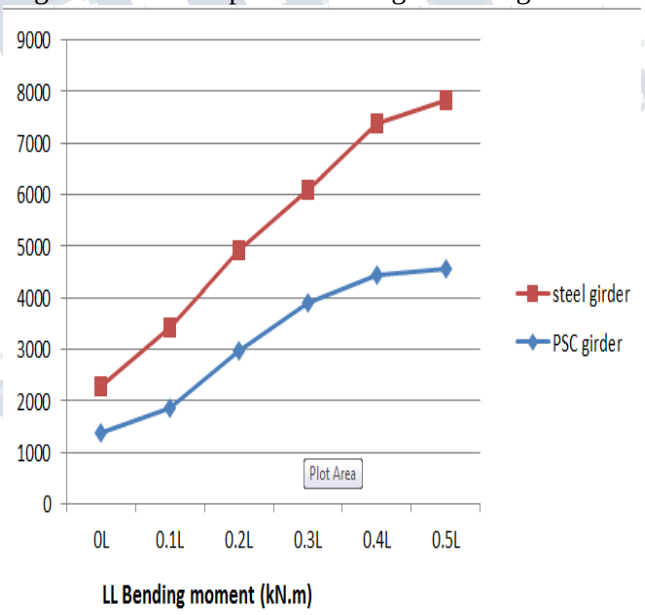

Fig7: LL BM comparison

From the fig.7 it can be seen that the live load moments arosed in cae of steel girder are less as comparede to PSC girder bridge that is only due to the less weight density of steel.

V. CONCLUSION

i. The displacement of steel girder bridge is more than PSC girder bridge.
ii. The shear force is less in case of steel girder

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than PSC girder due to less weight

iii. The DL moment of steel girder bridge is less than PSC bridge due to less weight .

VI. RECOMMENDATIONS

From the study carried out in above paper it is recommended that instead of PSC I-girder of small spans steel I-girder will be more economical and feasible by considering various criteria such as ease of construction, speed of construction, weight density and service life of bridge.

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