

Modelling and Analysis of a Flyover using CSi BRIDGE Software

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ABSTRACT: As the number of vehicles increases, at specific important junctions, there is need to build a flyover. Since the analysis of a heavy structure like flyover, manually is a tedious process, software can be a hand in this purpose. Such a software is CSi BRIDGE, which can be used to analyse the bridge or flyover exclusively. This software can be used for many purpose like modelling, analysis, designing of bridge etc. Here we are using the software for modelling and analysis of a flyover and the resulting values of bending moment, shear force, axial forces etc can be used for the design purpose which can be done either by the same software or manually.

KEYWORDS: CSi BRIDGE, Flyover analysis, Flyover modelling.

I. INTRODUCTION

Palarivattom flyover resided in Kochi city of Ernakulan district. The location is a pipeline junction and it intersects the NH 66. The flyover connects Palarivattom to Vytilla over a span of 631.87m. The flyover was in finished stage in 2015. There is also a pipeline road that runs under the flyover which connects Edappally to Kakkanad. The deck of flyover is firstly constructed using deck continuity system and later due to the formation of crack and failure of the bearing to take the load, they are transformed into simply supported condition. Cracks were visible in the girders, diaphragm, piers etc. and on the pavement. The flyover consist of 19 spans among which 2 are prestressed. Usually it take only 10 minutes to pass from Palarivattom to Vytilla, in the presence of flyover. But now, it takes almost half an hour to pass through due to the malfunctioning.

Modelling, analysis and design of bridge structures can be done effectively using CSi Bridge. It is used to create the bridge models, analysis of the bridge, design of bridge, and as others. Using CSi Bridge, engineers can easily draw the complex bridge geometries, boundary conditions and load cases. The bridge models are done using the terms that are used or familiar to the bridge engineers like spans, bearings, abutments, and post-tensioning.

In section II, we will be discussion about the assumptions used for analysis in brief, in section III, we will be discussing the procedure for analysis, in section IV, we will be discussing the results of analysis and in section V, about the conclusion.

II. ASSUMPTIONS FOR ANALYSIS

- i. According to NHAI (National Highway Authority of India), the criteria for future expansion is to be taken into account while bridges are designed, that's why a long span of 35m is considered.
- ii. Since size of the analysis file is too large, the analysis takes hours or even days to complete. So we have selected a short span where the bending moments are all are assumed to have greater values.
- iii. Since it is a bridge structure, the maximum bending moment will at the longer span.
- iv. As per NHAI, the speed limits should be provided at both ends. As the same class vehicles are moving, there is a possibility that they meet at the same point and it will be at the center. So maximum moment will take place at the centre.

III. PROCEDURE FOR MODELLING AND ANALYSIS

Click on the 'CSi Bridge20' icon to get new window. Now, a new template is created from the file menu in which some common types of bridge model that are used for modelling are displayed. By clicking on 'Blank' we can start designing a new model. And the units are set to KN, m, and C.

To start modelling, the first step is defining the layout lines i.e., line object and lanes and layout line is the orientation line which is used to set the horizontal alignment. We will select starting station as 0m and end station as 35m.

The bridge components are defined using 'Bridge wizard' option and the components consists of different material properties such as type of material used, width, lanes etc. and components such as diaphragm, abutments, bearings, foundation springs, bents, girders etc. We can select the components required in our design and complete the details step by step.

Different loads act on the bridge. Loads are defined using 'load' option. As per our requirements, first we have to import a vehicle class according to different IRC classes. In this tab, dead loads, moving loads or live loads, prestress loads are added uniquely and line loads such as kerbs, end blocks, etc. are to be added separately to each lane or each side of the deck. Different colours are also used to distinguish between lanes and their properties.

The final step towards completion of bridge model creation is defining bridge objects. In this, more specific details like number of spans required, number of longitudinal and cross girders required, prestress tendons and other details are specified. After completing all the icons step by step, using 'update' icon, in that 'update as area model' is used to update the model to assign the details specified. Area model will allow us to get solid models other than line models. This will incorporate all the data filled in the tabs and show it in the bridge model.

Next is analysing the model. The purpose of analysis is to determine the behavior of bridge under different loads. This behavior includes finding the bending moment and shear forces acting on the structure which will be the end results of analysis. Before carrying out analysis, depending on the requirements of the bridge we need to define the type of live load from different IRC classes. We are selecting IRC class AA tracked vehicle since this class is used for highways. After analysis is completed, a deformed model of the bridge is obtained.



Figure 1: Isometric view of the model

IV. ANALYSIS RESULTS

i. Bending moment diagrams due to dead load and live load in the entire bridge section and in the girders.

Bending moment diagram for the entire bridge section due to dead load is shown in figure 2. Then the analysis is performed and a maximum value of 21549.86 kNm is obtained as the bending moment due to dead load. Since the support condition is simply supported, there will not be moments at the support.

Bending moment diagram for the girder due to live load is shown in figure 3. After the analysis with simply supported condition, a maximum value of 17961.623kNm is obtained.

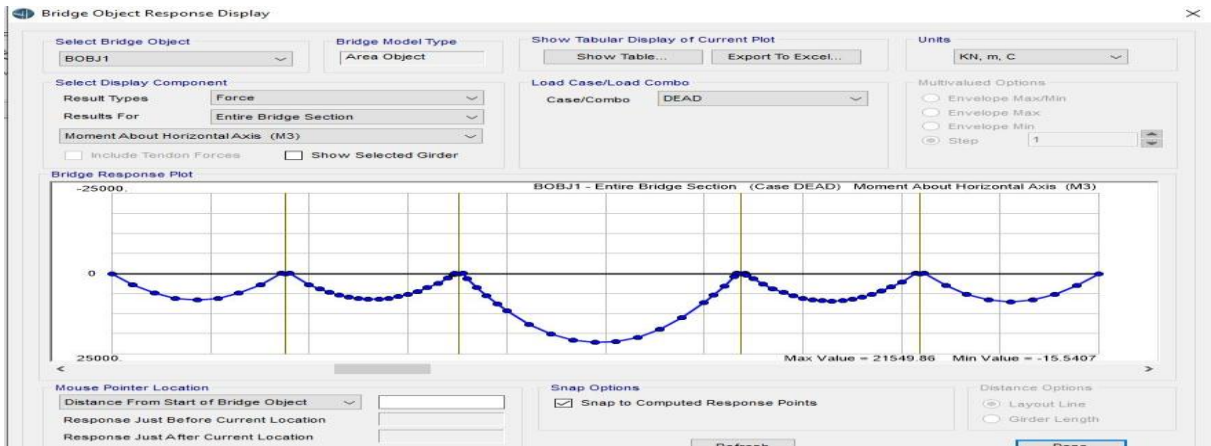


Figure 2: Bending moment due to dead load for the entire bridge section

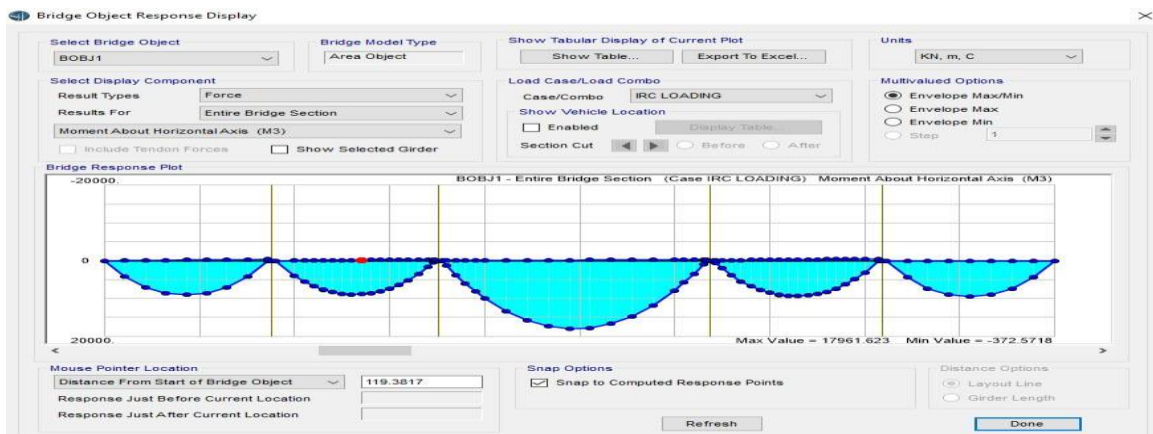


Figure 3: Bending moment due to live load for the entire bridge section

Bending moment diagram for girder due to dead load and live load is shown in figure 4 and 5.

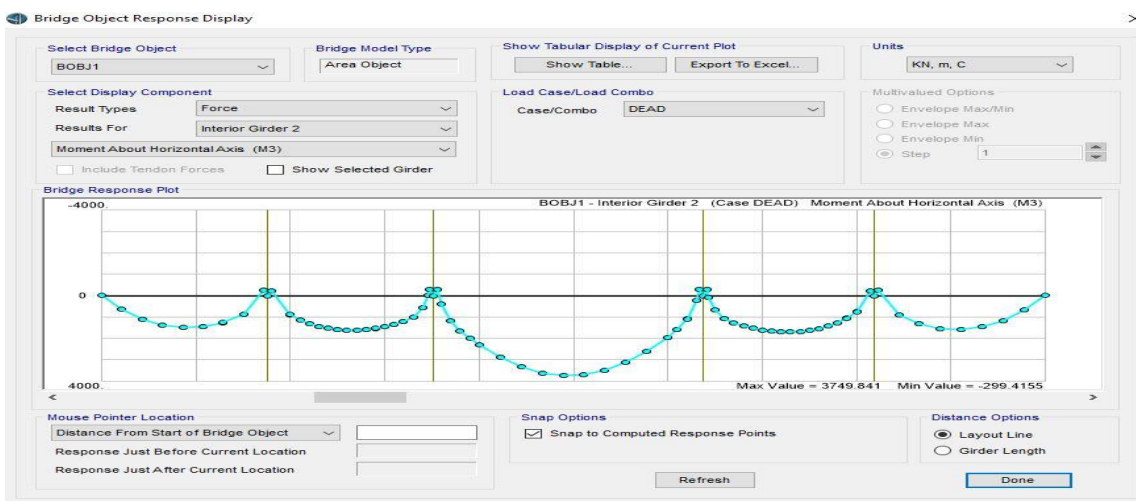


Figure 4: Bending moment diagram for girder due to dead load

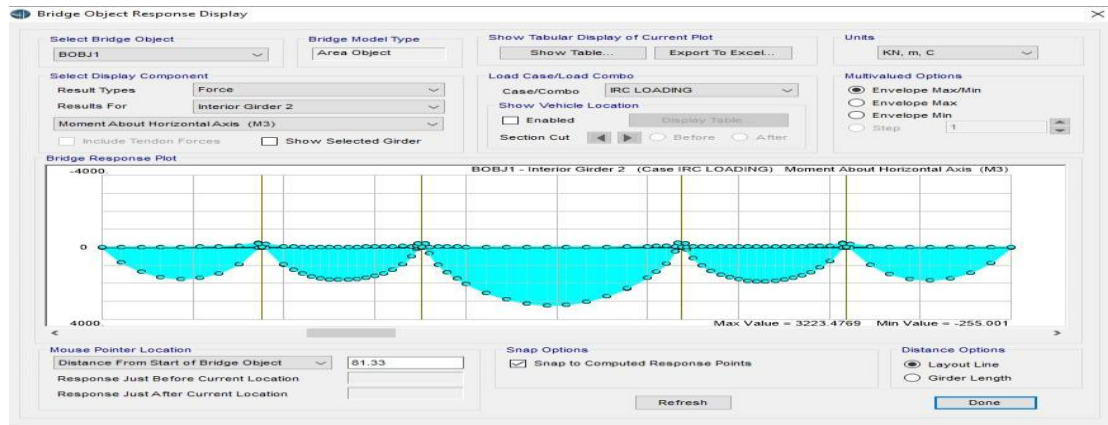


Figure 5: Bending moment diagram for girder due to live load

ii. Axial force diagrams due to dead load and live load for the entire bridge section.

Axial force diagrams due to dead load for the entire bridge section is shown in figure 6. The maximum value is obtained.

Axial force diagrams due to live load for the entire bridge section is shown in figure 7. The maximum value of is obtained.

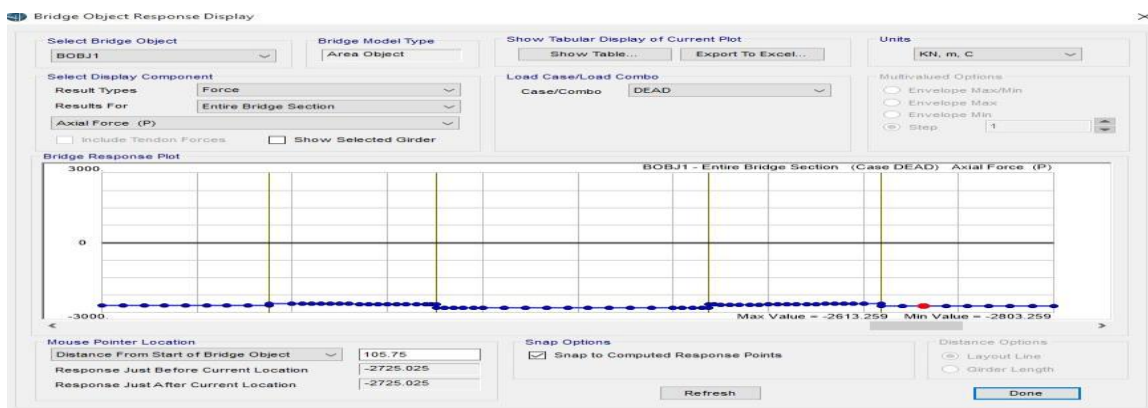


Figure 6: Axial forces due to dead load for the entire bridge section

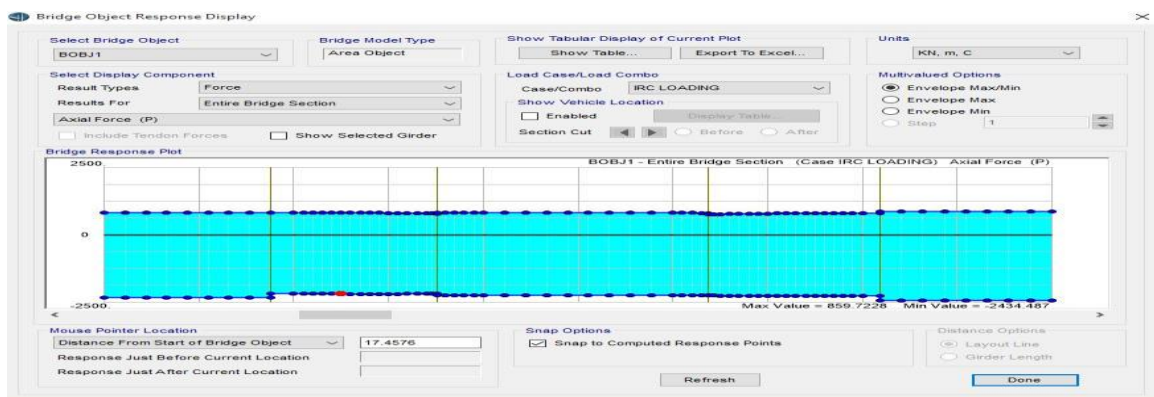


Figure 7: Axial forces due to live load for the entire bridge section

iii. Shear force diagrams due to dead load and live load in the girder.

Shear force diagram for the girder due to dead load is shown in fig.4.9. Here the maximum value will be 1211.1361kN. These values are used for the design of prestressed longitudinal girder.

Shear force diagram for the girder due to live load is shown in figure 8. Here the maximum value will be 849.4679kN. These values are used for the design of prestressed longitudinal girder.

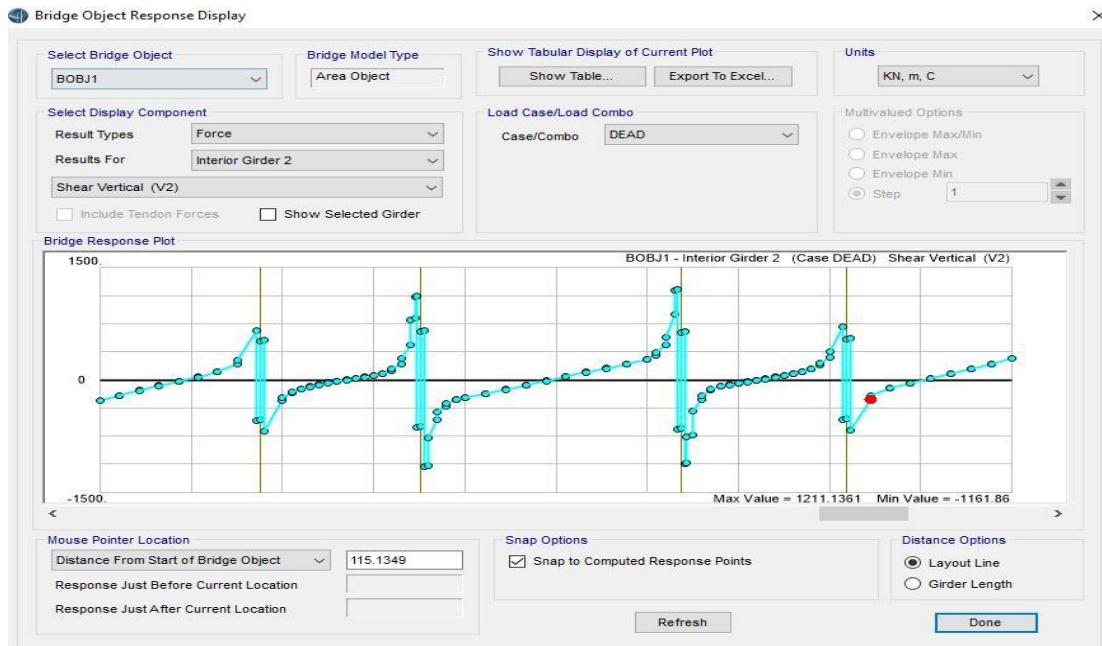


Figure 8: Shear force diagram for girder due to dead load

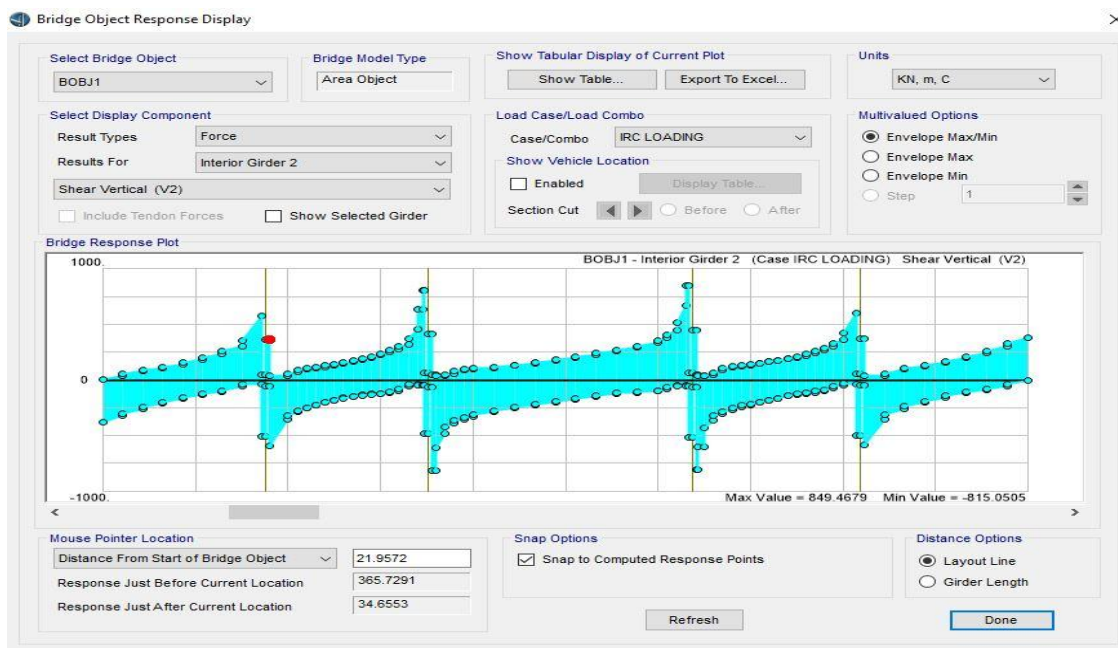


Figure 9: Shear force diagram for girder due to live load

V. CONCLUSION

We have conducted the modelling and the analysis of a flyover using CSI BRIDGE software and the bending moment diagrams, shear force diagrams and axial force diagrams are obtained as shown above. The value from these diagrams can be now used to do the design part either manually or by the software itself.

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