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ANALYSIS OF A RCC UNDERPASS BOX-BRIDGE

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ABSTRACT

The RCC Underpass Bridge structure is constructed mainly to allow various parameters to travel safely from one location to another. In the present study, one such RCC Underpass railway bridge consisting of piping system, carrying fly ash flow was considered. Two models consist of box-bridge hinged at base; subjected to static live load and soil pressure and same box-bridge surrounded by soil springs on two vertical faces and one bottom face of it and live load on the top facewere analyzed and compared by using commercial finite element analysis software package ANSYS 12. Through parametric study has been carried out to study the effect of soil-structure interaction on RCC Underpass box-bridge. From this study it was observed that the shear force values of the later model varied to a great extent compared to the first one. Also, the accuracy of the results were observed to be increasing with the increase in the number of soil springs.

Keywords: RCC Underpass Bridge, ANSYS, Soil Structure Interaction.

I. INTRODUCTION

A bridge is a structure built to span physical obstacles such as body of water, valley or road for the purpose of providing passage over the obstacle. Design of bridges varies depending on the function of the bridge, nature of the terrain where the bridge is constructed, the material used to make it and the funds available to build it.

Aim of the present research work is to study the performance of R.C.C Underpass Bridge by applying various analytical techniques. Two dimensional finite element model of R.C.C Bridge is established and analysis is performed for static loading. The outcomes of static loads actually arriving on R.C.C Bridge are studied. Also, as the box structure directly rests on soil and also soil pressure acts at the sidewalls, it is essential to examine the Soil Structure Interaction of structure. To study the response of such structure, the underground bridge structure is modeled with rigid supports and with soil structure interaction applied to base and side walls of the structure and correlating the results with the STAAD report. Analysis is performed by using FE analysis software ANSYS 12.

II. PARAMETRIC STUDY

To understand the methodology, accuracy of results and to study the static behavior of RCC Bridge, a case study was carried out and results were compared. The case study considered was similar to the original RCC Bridge in terms of loading conditions.

An underpass box culvert example was considered to study its response. RCC box dimensions were 3.8 m x 3.8 m. The thickness of the vertical and horizontal slabs was 300 mm throughout. Unit length of the box was considered. Keeping all the parameters same, the analysis is carried out using two methods i.e. conventional moment distribution method (manual results) as shown in Table1 and other by using ANSYS 12.

For the analysis followingconditions foundation is taken for the study:

Live load, Dead load and Earth pressure acting, with no water pressure from inside. Figure 1 shows the dimensions of RCC Underpass Box centre to centre dimensions of RCC Underpass Box. For this case, the structure is idealized as shown in the Figure 2. In this case the boundary condition is hinged.Figure 3-6 shows shear force and bending moment results.

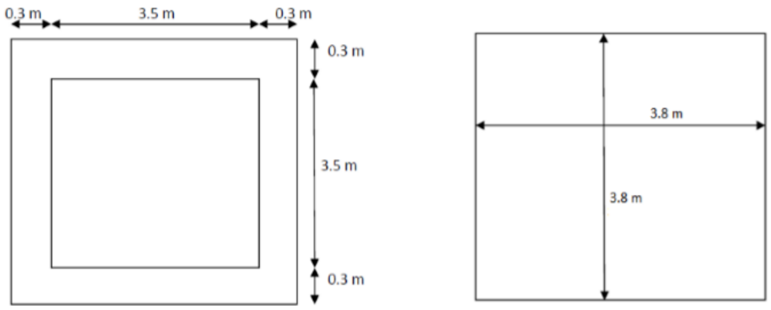

Fig. 1: Dimensions of RCC Underpass Box

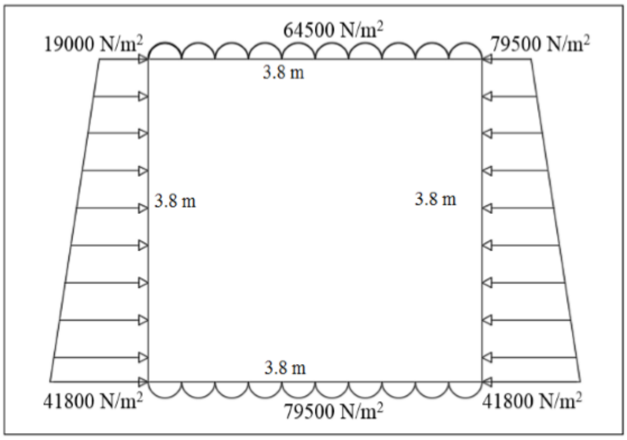

Fig. 2: loadings on RCC Underpass Box

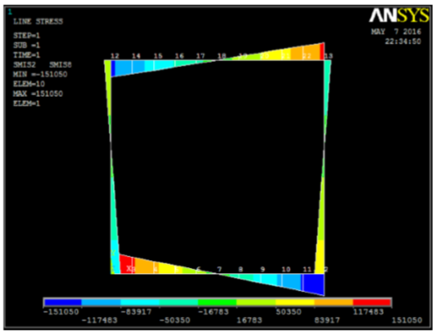

Fig. 3: Shear force results

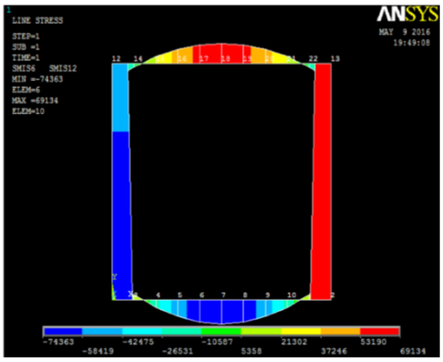

Fig. 4: Bending moment results

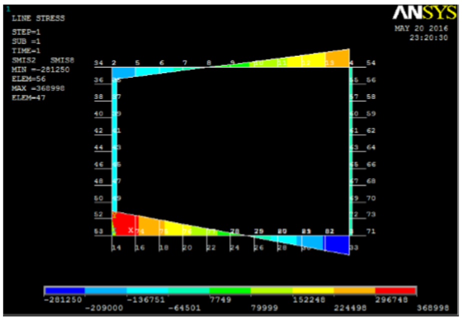

Fig.5: Shear Force Results for Loose Sand (5000 kN/m3)

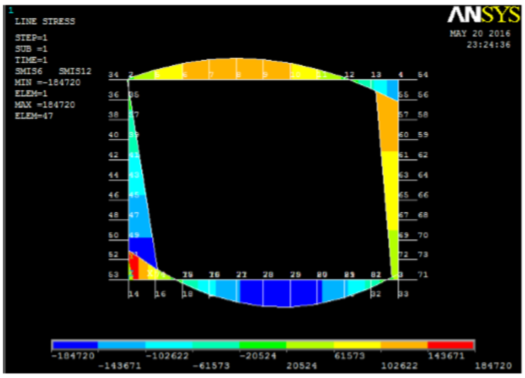

Fig.6: Bending Moment Results for Loose Sand (5000 kN/m3)

III. CONCLUSIONS

From the present research work the following conclusions are made;

- The interpretation for Shear force and Bending Moment for these cases was done with respect to the available analytical values. No abrupt variation in both comparisons was observed except for 0.12% and 0.14% in Bending Moment at mid span and edge respectively. Nevertheless, this change can be assumed to be within considerable limits.

- The shear force and bending moment values were found to be increasing with respect to the stiffness of the adjoining soil, whereas, for the other two faces of the box culvert the bending moment and shear force values were in fair agreement. The lowest range of the soil stiffness yielded close results with respect to the analytical values.
- From this parametric study, it was observed that for 80 nodes dicretization, the bending moment values for upper and lower faces have fair accordance with those of the analytical values except for the shear force values of side faces. Also, the percentage variation of all the results for 70 and 80 nodes is around 1%. Hence, 80 nodes dicretization is considered for the analysis.
- In the end, it can be stated that for accurate results, two dimensional analysis of Underpass box bridge subjected to different loads coming from the adjoining soil, bottom strata and various live loads (from vehicular movement above the box and impact loading due to pipes running within the box culvert), soil-structure interaction analysis is essential.

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