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Comparative Analysis of Different types of Box Culvert using Staad-Pro & Manual Calculations

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Abstract: The windows of the Culvert are a monolithic structure to pass through the roadway, the railway lines, and the T. Culvert is used to balance the flood waters on both sides. The box takes different kinds of loads generated by water, movement, cushion, soil, etc. In this paper is studied culvert with and without pillows, analyzed for different classes of IRC loads and conclusions made on the basis of bending moments and shear forces with and without cushioning cases. The present work involves Indian Standards, their justifications and considerations are taken into the account for design purpose. In the present work five models are analyzed using STAAD-PRO and the results obtained in terms of the displacement, reactions, forces, moments and stresses on the box culvert.
Keywords: Box culvert, STAAD, RCC & IRC loading

I. INTRODUCTION

A box with a low rise in bridge or structure that is used for unloading water in the proper channel at the intersection of Rail, flyover, roads, etc. and is used where the bearing capacity of the soil is low. Culverts are always economical than the cities where the discharge in the opening is 18 m2, it depends on the number of cells that are commonly used, where the roadway crosses the high embankment. The window culverts are usually thrown in place in India, but in other countries the box is preferred in regard to low cost and economically with have fast quality. The box simply name given for its shape can be found in different types of shapes, and it can be acted as minor bridge when the number of cells increases and spans more than 6 m in length. Its height depends on the span. It can control all the water coming from irrigation, surface waters, rivers and canals, they control all the storm water and flood during the rainy season.

II. REVIEW OF LITERATURE

Earthlet is studied on the project coefficients for single and two cell boxes, that design coefficients designed to bend torque, shear and normal traction in critical sections for different loading cases allows the constructor to come on design forces in such a way, reducing the design time and effort.

The study found that the maximum positive point of developing in the center of the upper and lower slabs provided that the culvert side does not carry a live load and culvert runs full water and the maximum negative points are developing to support the sections of the lower slab provided that culvert is empty and the upper plate bears dead load and live load.

Navarro ET Al analyzed the large reinforced concrete structure of the box shape and completely embedded into the soil. The analysis examines dynamic pressure on walls, roof and floor, due to body and surface waves. He has made some recommendations on the choice of seismic forces to be considered to analyze the underground rectangular structure and more attention should be given when massive buildings are buried in the structure pending.

Kalyanshetti et al have done a study on the assay Box culvert and cost optimization for a variety of proportions. They concluded that for different cells and different heights optimized thickness of the box for Culverts should be obtained by different formulas that would cost effective box design.

Li and others performed an analysis of a rectangular single, double and triple box to determine the state of damages and the corresponding damage indices (DIs) in seismic load. The structure of the tunnel modeled on the nonlinear frame elements is attached to a number of normal and shear springs to simulate the interaction of the tunnel. The output was made, that the duct tunnels are not immediately destroyed even at plastic hinges form on all exterior corners of the structure, primarily due to the support from the surrounding soil. However, double and triple tunnels may fall because of the failure of bending when the internal column is destroyed.

III. METHODOLOGY

A. Model-I (3M X 3M)

This model is created in STAAD and the manual calculations are also carried out for this model.

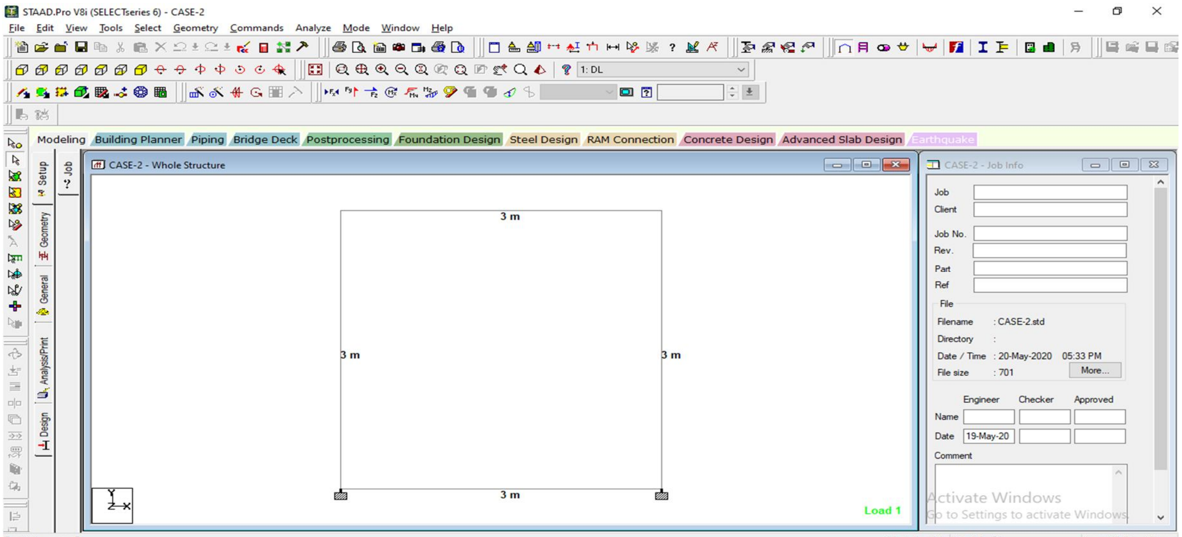

Figure 1: Model-I

B. Model-II (1.4M X 1.5M)

This type of model is analyzed in STAAD-PRO

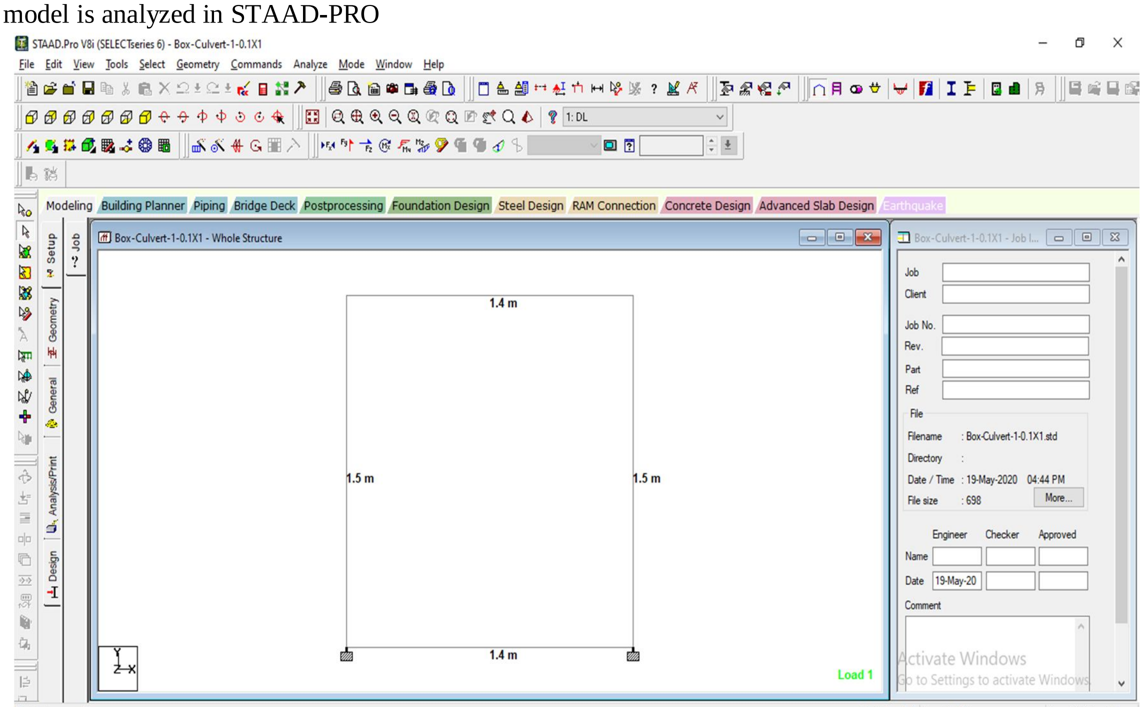

Figure 2: Model-II

MODEL-III (2.8M X 3.0M)

MODEL-IV (2.25M X 2.25M)

MODEL-V (2.25M X 2.25M –two culverts)

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IV. RESULTS

The following models are studied and analyzed using STAAD-PRO and the results are obtained.

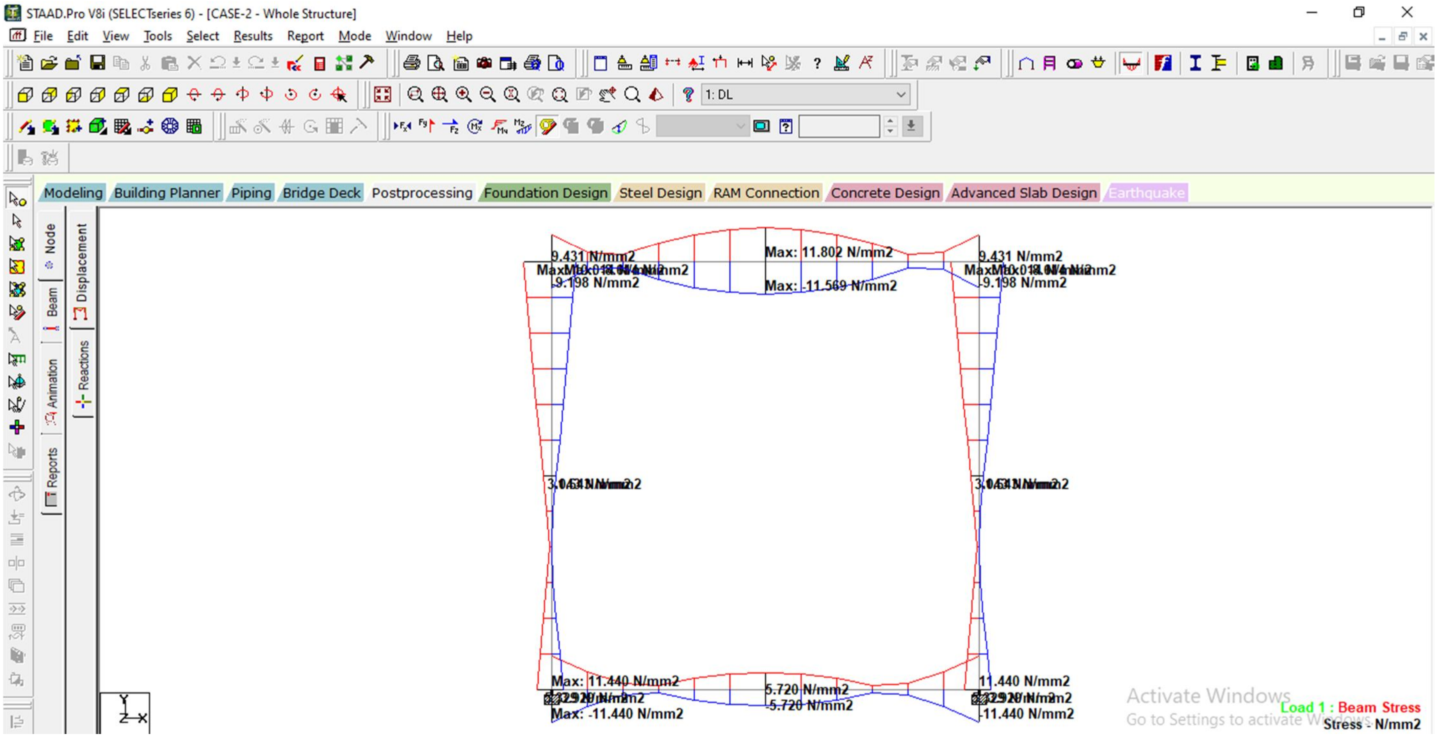

Figure 3: Stresses on case-II for model-I

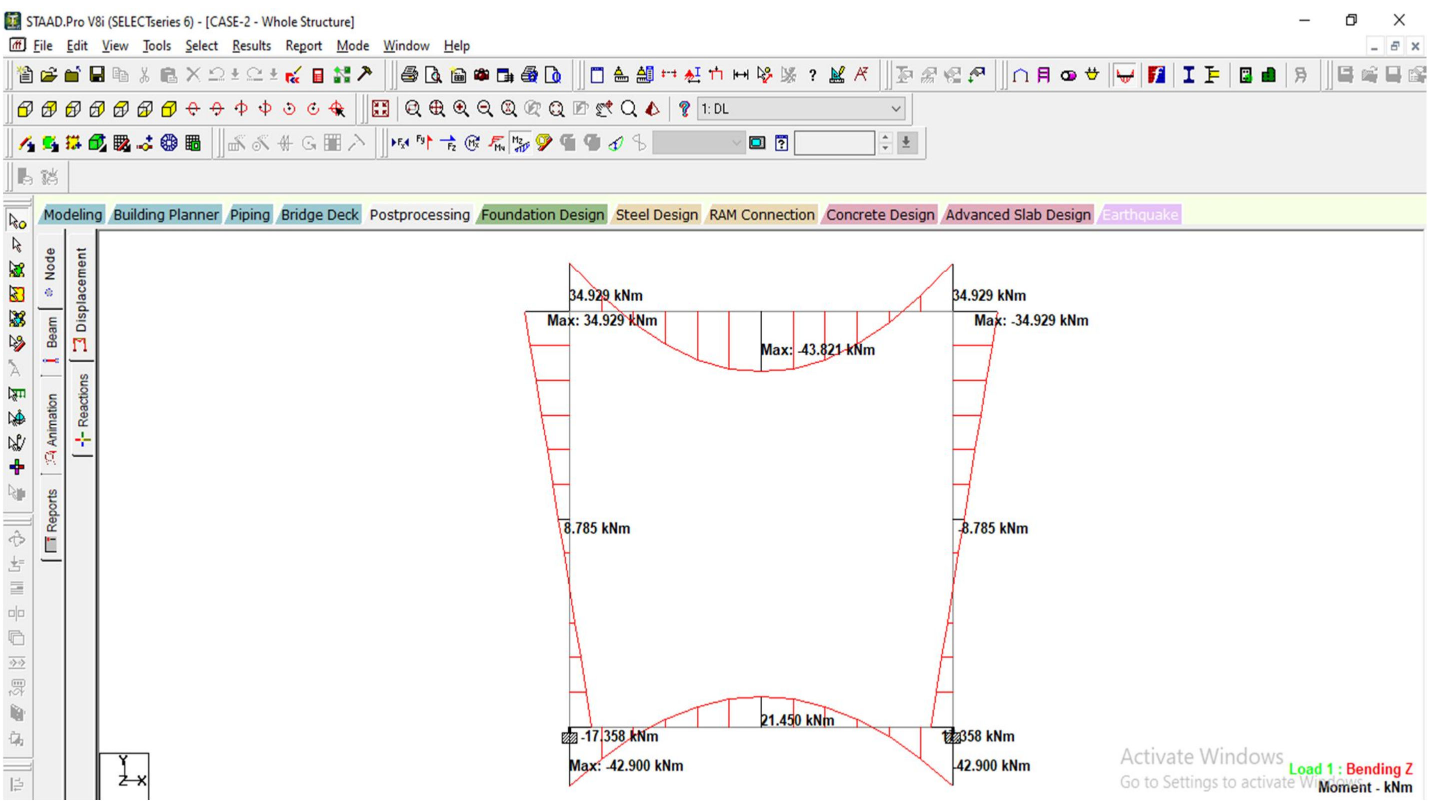

Figure 4: Bending moment for Case-II on model-I

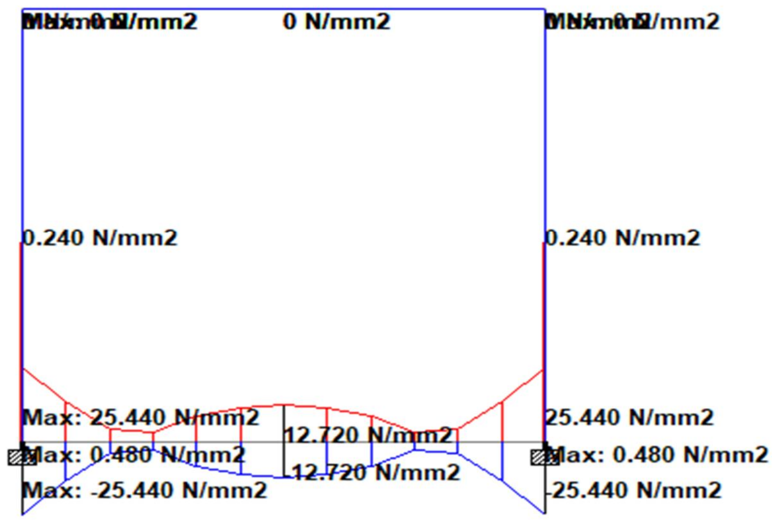

Figure 5: Bending stresses for case-III (Model-I)

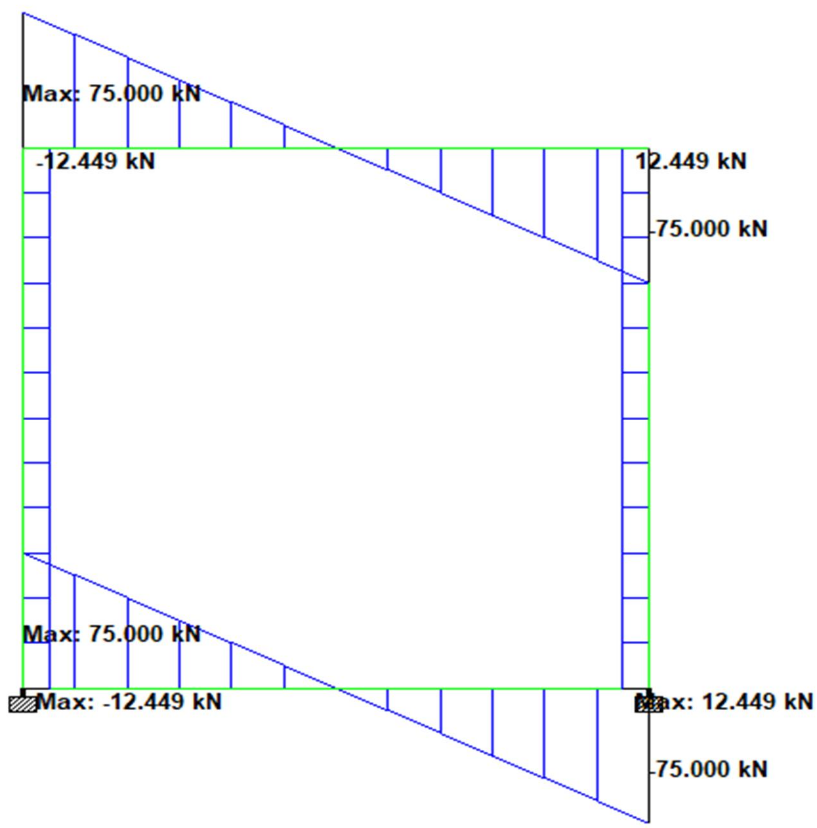

Figure 6: Shear Force in Case-IV (Model-I)

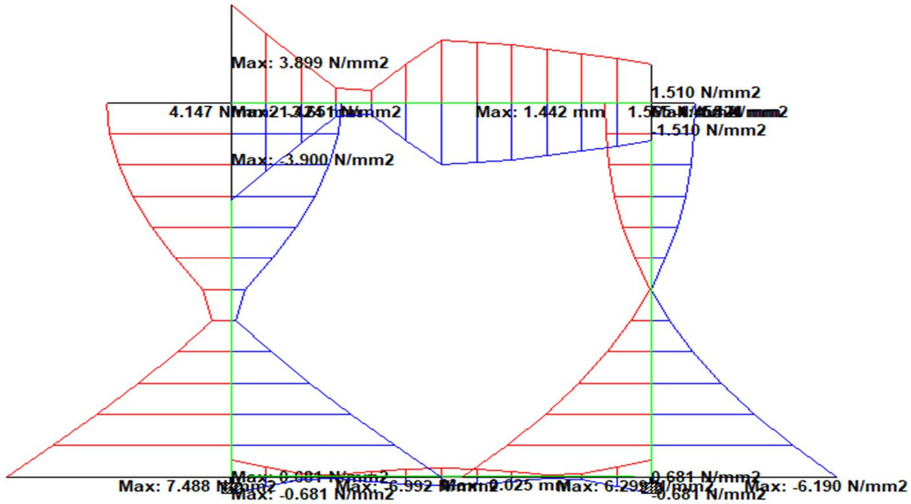

Figure 7: Beam Stresses on model-II

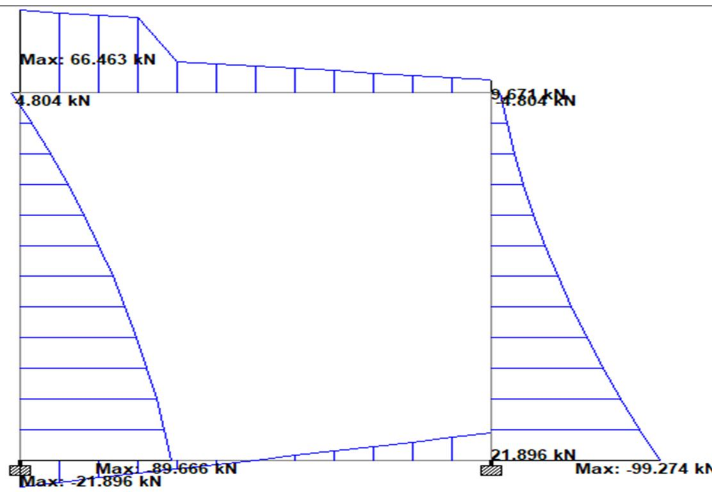

Figure 8: Shear force on Model-III

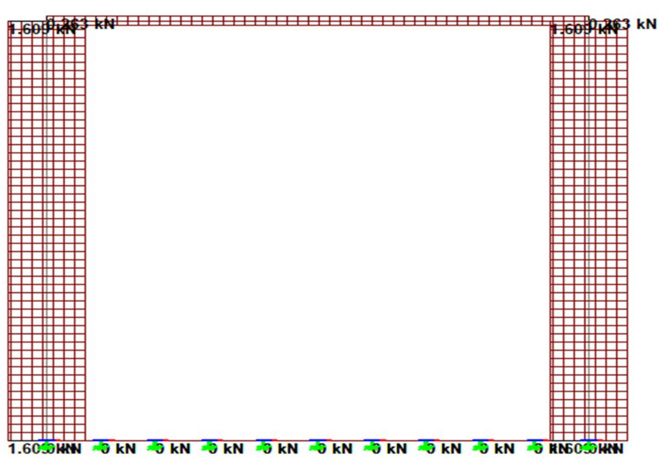

Figure 9: Axial force (wearing coat condition) on model-IV

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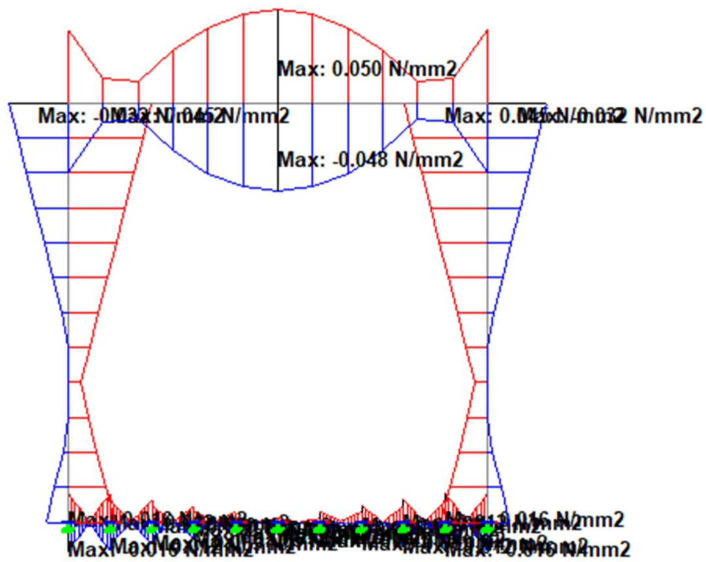


Figure 10: Beam stresses for wearing coat condition of model-IV

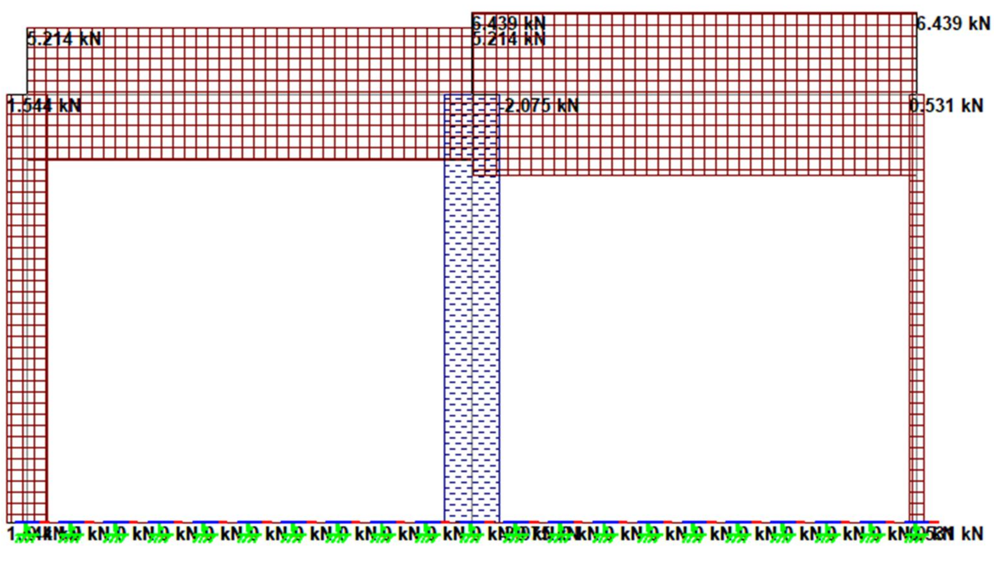


Figure 11: Axial force on Active pressure-left condition for model-V

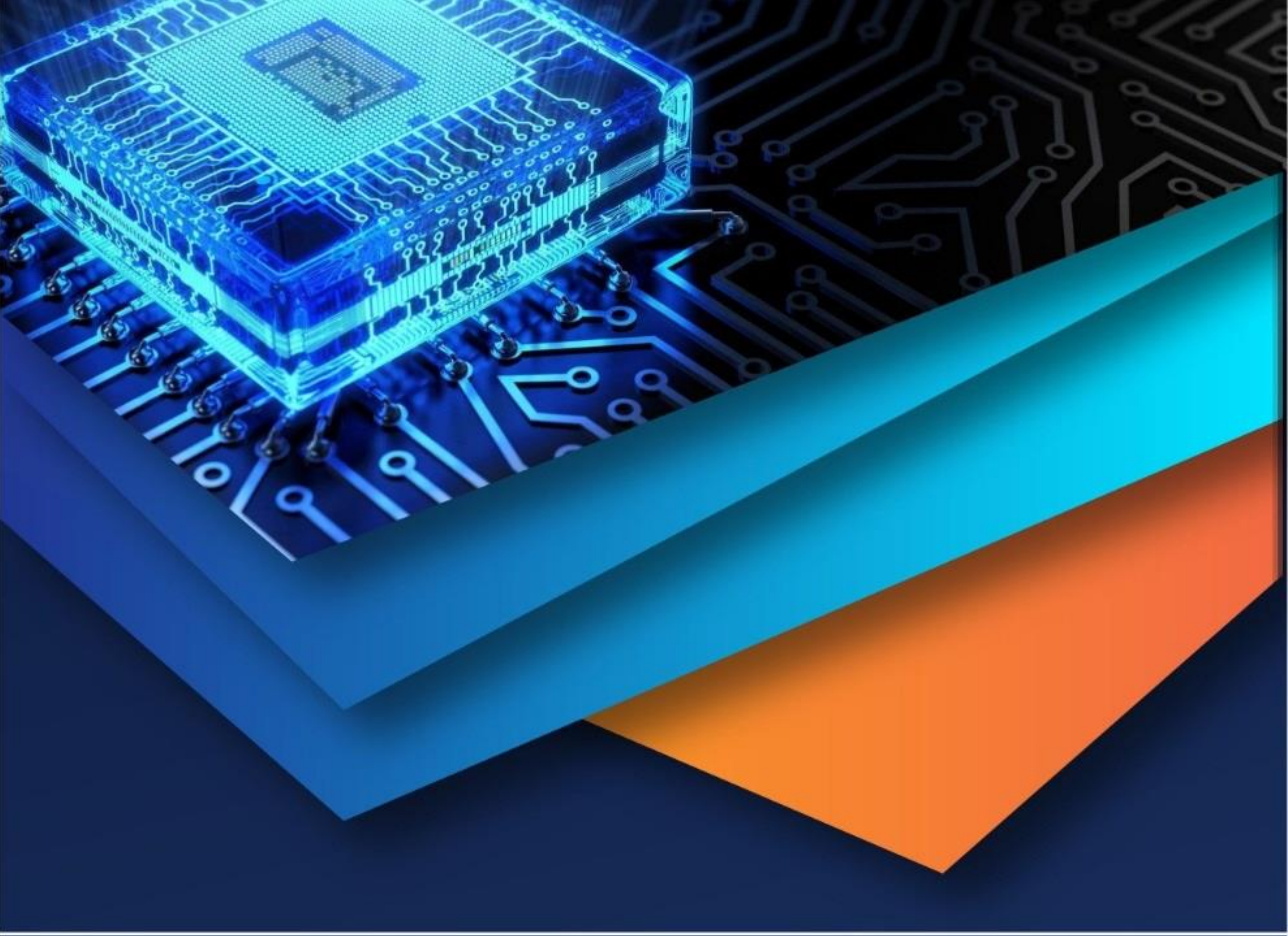
V. CONCLUSIONS

From the above study of five models consisting of MODEL-I (3M X 3M), MODEL-II (1.4M X 1.5M), MODEL-III (2.8M X 3.0M), MODEL-IV (2.25M X 2.25M), MODEL-V (2.25M X 2.25M –two culverts) following conclusions can be obtained:

A. Axial forces are maximum on model-V (2.25M X 2.25M –two culverts) when compared with other models.
B. Shear forces are found to be minimum in model-I (3M X 3M- single culvert)
C. The different five cases are considered for model-I (3M X 3M- single culvert)
D. The displacement is found to be maximum in the model-II
E. The stresses are minimum in the model-V.

REFERENCES

[1] Abdel-Karim A.M., Tadros M.K., and Benak A.J. (1993). "Structural response of full-scale concrete box culvert." Journal of Structural Engineering, 119(11), 3238-3254.ASCE.
[2] Abolmaali A., and Garg A. K. (2008). "Effect of wheel live load on shear behavior of precast reinforced concrete box culverts." Journal of Bridge Engineering, Vol. 13, No. 1, January 1, 2008, 93-99, ASCE.
[3] Ali Abolmaali. And Anil K. Garg., "Effect of Wheel live load on Shear Behaviour of Precast Reinforced Cocrete Box Culverts." Journal of Bridge Egineering, Vol. 13, No.1, January 1, 2008, @ ASCE, ISSN 1084-0702/200/1-93-99.
[4] B.N.Sinha and R. P.sharma, Analysis of Box culvert by Stiffness Method, journal of Indian Road Congress, Paper No. 555, PP. 189-219, 2009.
[5] C. Navarro, "Seismic analysis of underground structures",Earthquake Engineering, Tenth World Conference, pp. 1939-1944, 1192.
[6] David Z. Yankelevsky., "Loads on Rigid Box Buried In Nonllinear Mdium", Journal of Transportation Engineering, Vol. 115, No. 5, September, 1989. @asce, ISSN 0733-947X/89/0005-0461. Paper No. 23870.
[7] IRC : 21-2000, "Standard Specification and code of practice for road Bridges" , Section III
[8] IRC 6, Standard specification and code of practice for road bridges section II Loads and stresses, The Indian Road Congress, 2014.
[9] IRC: 6-2000, "Standard Specification and code practice for road Bridges", Section II.
[10] IRC:21, "Standard Specifications and Code ofPractice for Road Bridges", Section III,2000.



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