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Comparative Structural Analysis of Different Types of Box Culvert

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Abstract: *In box gutters, the four sides of the structure are built monolithic, and also provide angles to reduce the effect of water pressure. In this type of gutter there is no need for an additional basis, because the lower plate acts as a carpet foundation. When the discharge flood is small, we prefer unicellular blankets. In the case of passages, we provide only three sides, and they are built monolithic. When the flood discharge is high, we need to increase the size of the box, and this leads to an increase in the thickness of the walls. This can lead to a non-economic autopsy. The present work consists of the analysis of the box culvert for different loading cases as per standard code.*

Keywords: Box Culvert

I. INTRODUCTION

Culverts boxes are ideal monolithic structures across the highway or railway embankment to balance flood water on both sides. It consists of an upper plate, a lower plate and two vertical side walls. Consified concrete rigid frame boxes are used for square or rectangular holes with a span of up to 6 m. The upper part of the box section may be at road level or may be at a depth below the level of the road with filling depending on the conditions of the site.

- Type Culvert: The choice of shape and type of gutter depends on several factors
- Rigid: reinforced concrete pipe (RCP), horizontal elliptical reinforced concrete pipe (HERCP), reinforced concrete box (RCB), reinforced concrete pipe (RCP arch), structural plate (SPP), flexible: corrugated steel pipe (CSP), corrugated metal pipe. Box gutters are drainage structures that consist of two horizontal plates and two or more vertical walls.

Plates and walls are built monolithically. The use of a four-sided cap includes detention; tunnels (for transporters, utilities, access tunnels, escape tunnels); bridges with short spans (above highways, waterways, railways, golf courses); and stormwater for the transportation of stormwater, wastewater or industrial waste. In recent years, pendants with a front box have gained popularity for use as underground passages, tunnels, subways, bridges, gutters, material processing, storage, waterproof tanks and more.

Available in different standard sizes, as well as custom design, blanket boxes can be built with functions that meet the exact needs of any project: foot walls, hatch holes, hats, wing walls, pipe holes, forged ends, waterproof connections, etc. While prepaid fists promise a long service life. There are three types of four-sided box gutters 1. Monolithic poured 2. Two pieces of the middle seam 3. Crown and base. Four-sided monolithic poured caps are poured as one thing. The two-part cult box of the middle seam is a three-sided "U" and an inverted three-sided "U", attached for the manufacture of four-sided sliding. A crown and base box coupler is another way to make a four-sided cap. The crown and base cover is a prefabricated inverted "U" that connects to the concrete base

II. REVIEW OF LITERATURE

Mr. Mangesh S. Sulke et al. The finite element method made the most accurate and new SAP 2000 software. At FEM, we model the structure using a shell element. In this paper, we find out such voltages as the bending moment and the shear force of the structure under the railway load, and these voltages were calculated by computational methods, as well as compared to the usual method. Design parameters are also calculated on the basis of Indian railway standards. In this paper, we also study the design of the box for exposure and the comparative study of reinforcement details. The size of the drain fan is fixed on the basis of the flood discharge on the upper side. The clear dimensions of the box in the box are 3mX3m. Plate thickness 400 mm. Concrete variety - M30, steel class - Fe415, and rest angle - 30 TH.

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Ramamurtam et al. Cultures and bridges often serve one purpose; however, they differ in design size. Culver boxes are ideal for streams where the hydraulic head is limited. For the equivalent area of the waterway to round pipes, the boxes can be adjusted so that they have less effect on the water level upstream and the flow rate downstream than the equivalent pipe structures. This report devotes box gutters built of reinforced concrete that have different aspect ratios. Culver boxes are analyzed for different cushions and do not load the cushion. The main emphasis is on the behavior of the structure under the download types according to IRC codes, and their combinations at the top give the worst download effect for a secure structure. Comparisons and conclusions are made based on the maximum bending points shown for different download cases.

Richard M. Bennett et al. Calverts must be provided under the earth's embankment for crossing water, such as streams, Nallas, etc. through the waterfront, because the embankment of the road can not interfere with the natural waterway. Culvers are also required to balance flood water on both sides of the Earth's waterfront to reduce floods on one side of the road, thereby reducing the water head, reducing the threat of flooding. This paper discusses some of the design parameters of box gutters, such as the dispersion angle or the effective live load width, the impact of the pressure on the ground and the depth of the cushion provided on the top plate of the box gutters. The depth of the cushion, the ground pressure factor for the lateral pressure on the walls, the width or angle of the dispersion for live loads on the cushion-free box and with the cushion for structural deformations are important items.

Kiangsi Kim and Chaih.Yoo 2005 rated the design download on deep-buried Culverts boxes. Linear and nonlinear analysis of finite elements was used to study the effective density or coefficient of interaction of the soil structure for deeply buried boxes. ABAQUS (1998) and ISBILD were used mainly for analysis and CANDE -89 for verification and comparison.

Richard M. Bennett, Scott M. Wood, Eric Dramm and N. Randy Rainwater 2005 analyzed the vertical loads on concrete boxes under high embankments. Vibrating wires, deformation gases and pressure cells were used to determine internal forces and pressure on the drain through the backfill. A strong correlation was achieved between the height of the filling and the internal forces in the gutter, which suggests that the coefficient of interaction of the soil structure does not depend on the ratio of H / B.

III. METHODOLOGY

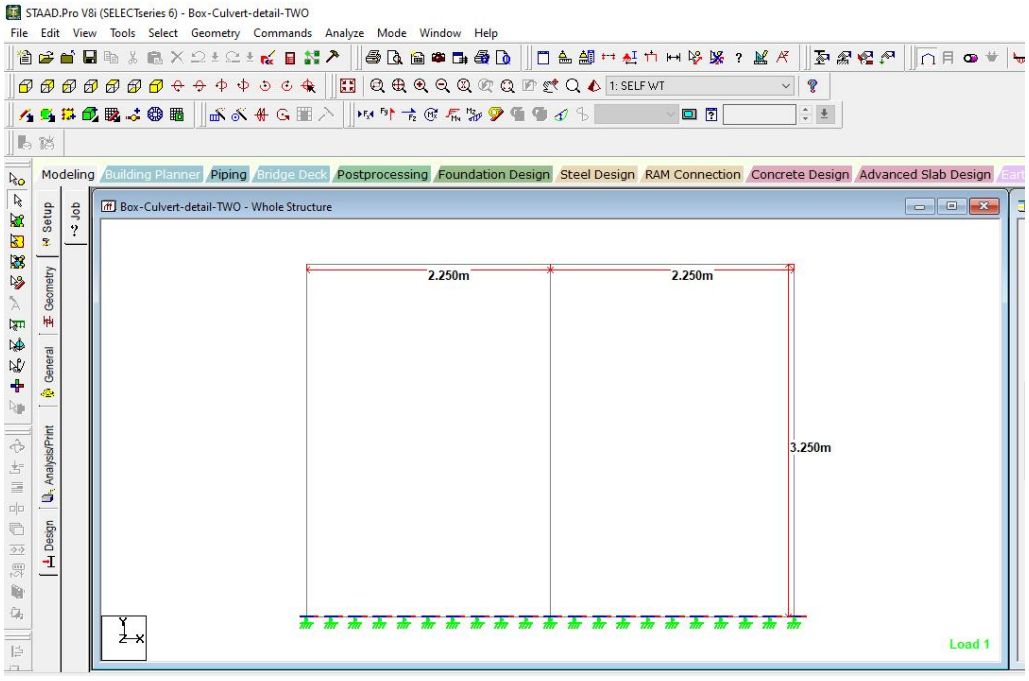

Fig.1: Dimensions of the Double box culvert

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The RCC Culvert is analyzed is for dead load, live load, earth pressure & water pressure using STAAD-Pro software. The following models are analyzed.

1. Model-I: Single Box Culvert with 40T loading
2. Model-II: Single Box Culvert with 70R loading
3. Model-III: Single Box Culvert with 70R loading with surcharge
4. Model-IV: Single Box Culvert with 40T loading with surcharge
5. Model-V: Double Box Culvert with 40T loading
6. Model-VI: Double Box Culvert with 70R loading
7. Model-VII: Double Box Culvert with 40T loading with surcharge

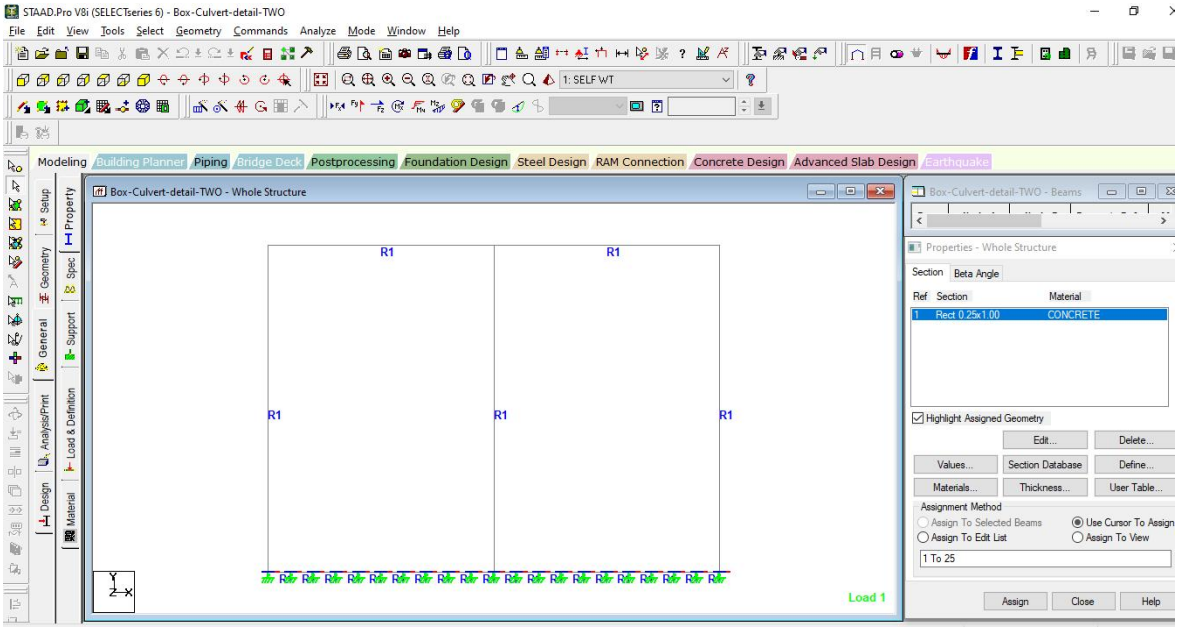

Fig.2: Properties of the Double box culvert

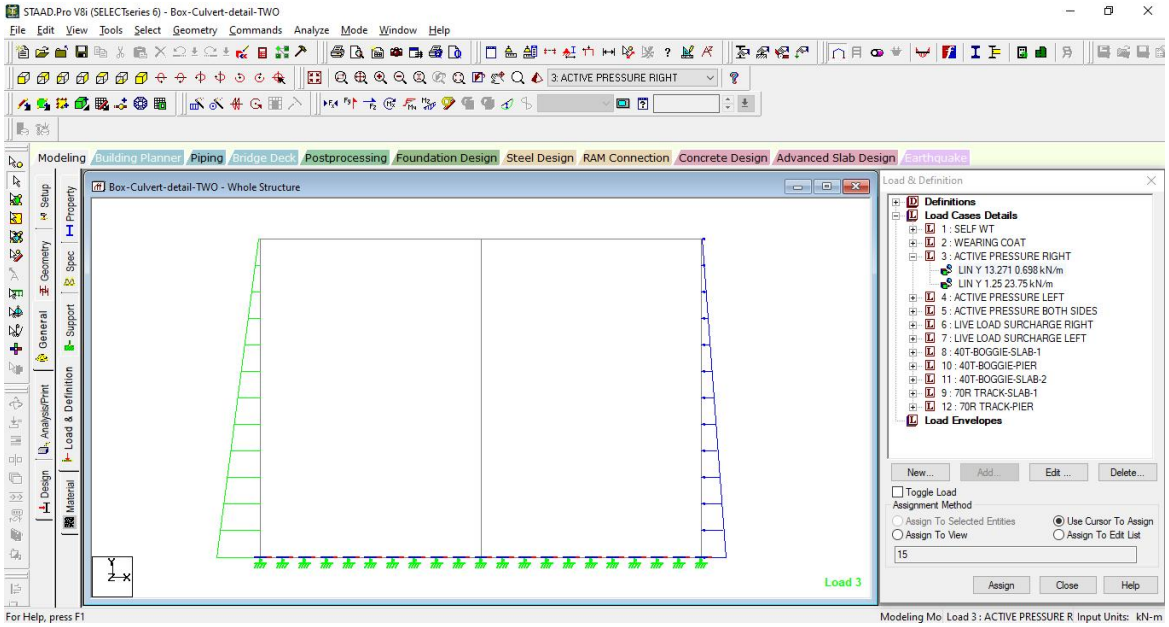

Fig.3: Load assignment of the Double box culvert

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IV. RESULTS

The results obtained in the STAD-PRO software and they are mentioned as follows.

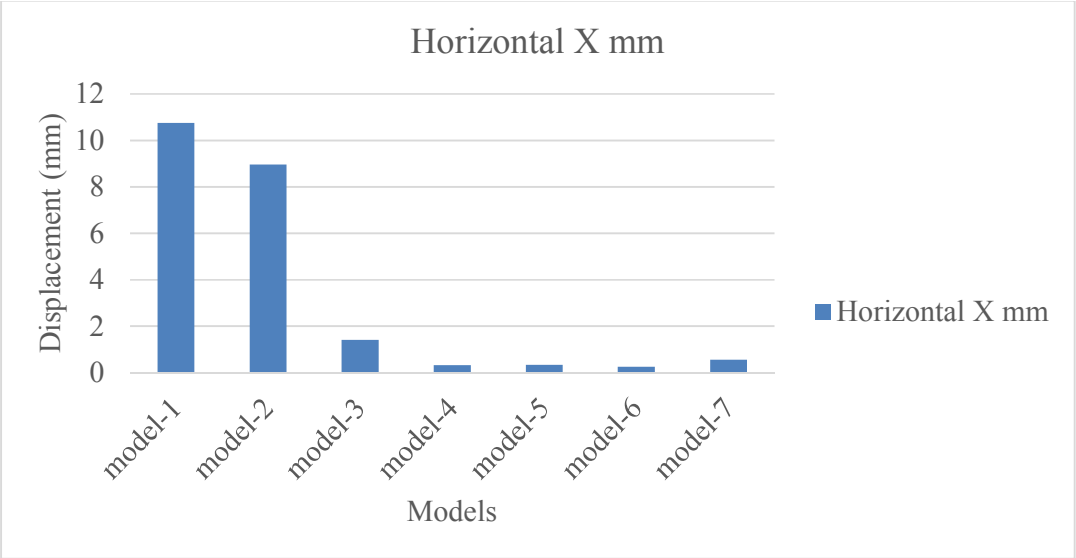

Figure 4: Horizontal Displacement for all the models

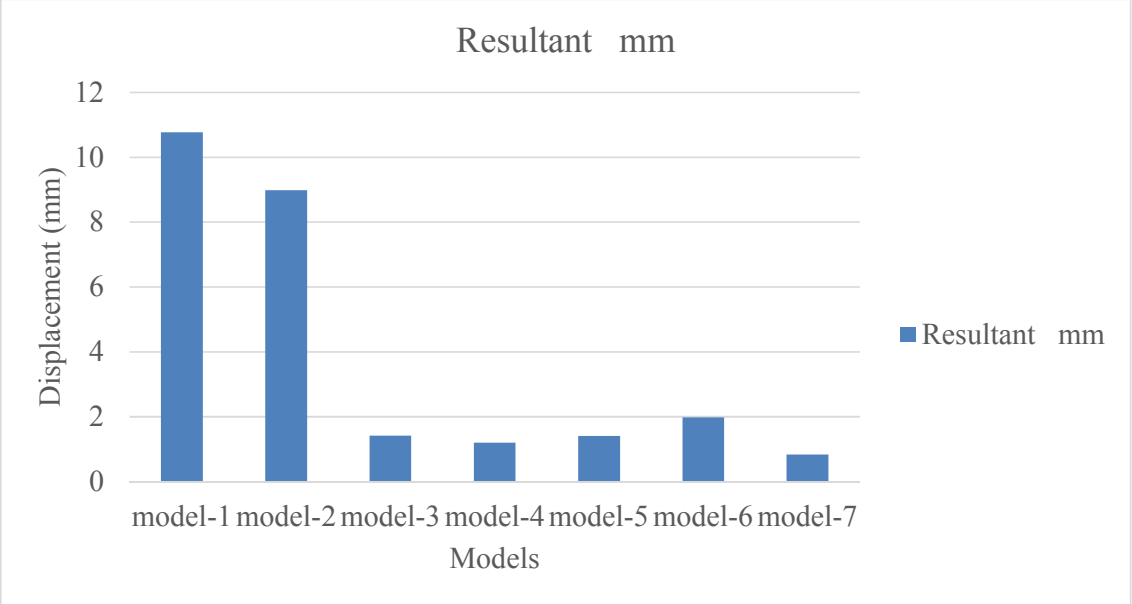

Figure 5: Resultant Displacement for all the models

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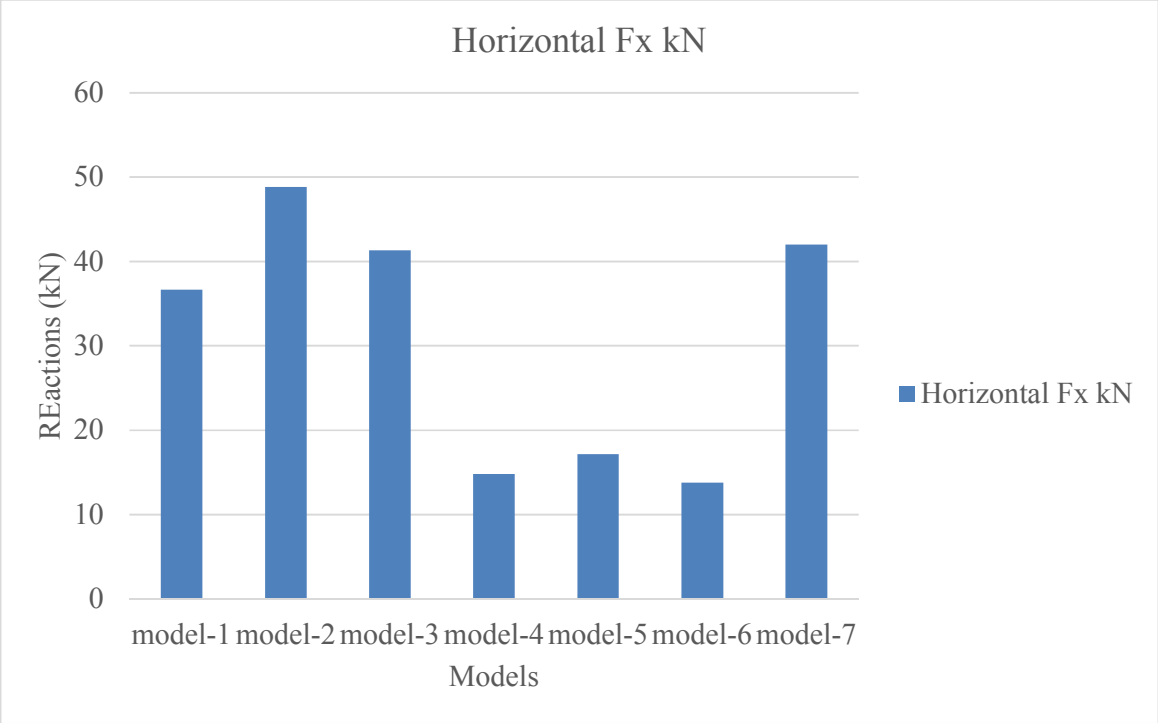

Figure 6: Horizontal Reactions (Fx) for all the models

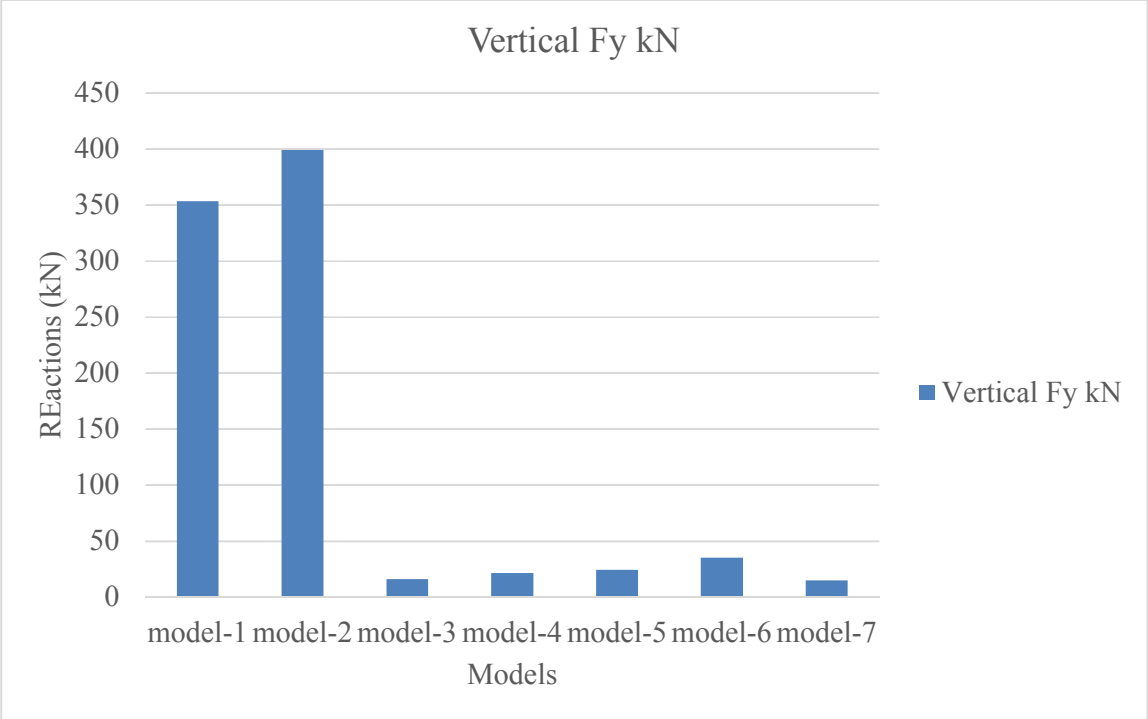

Figure 7: Vertical Reactions (Fy) for all the models

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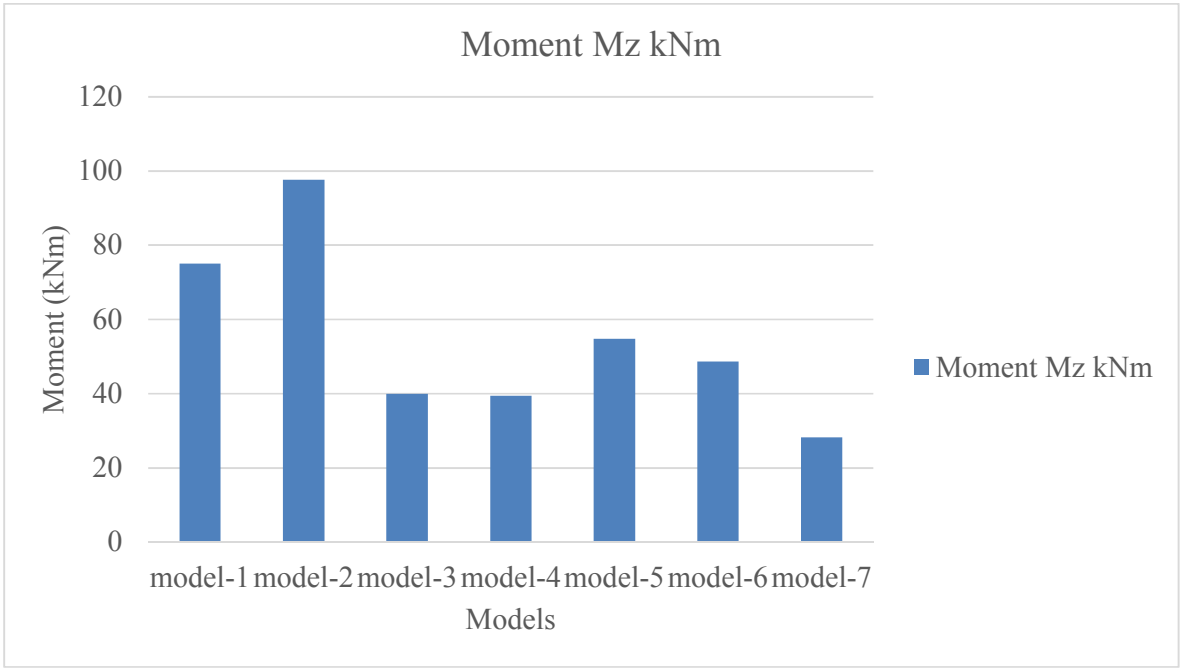

Figure 8: Reactions (Moment Mz) for all the models

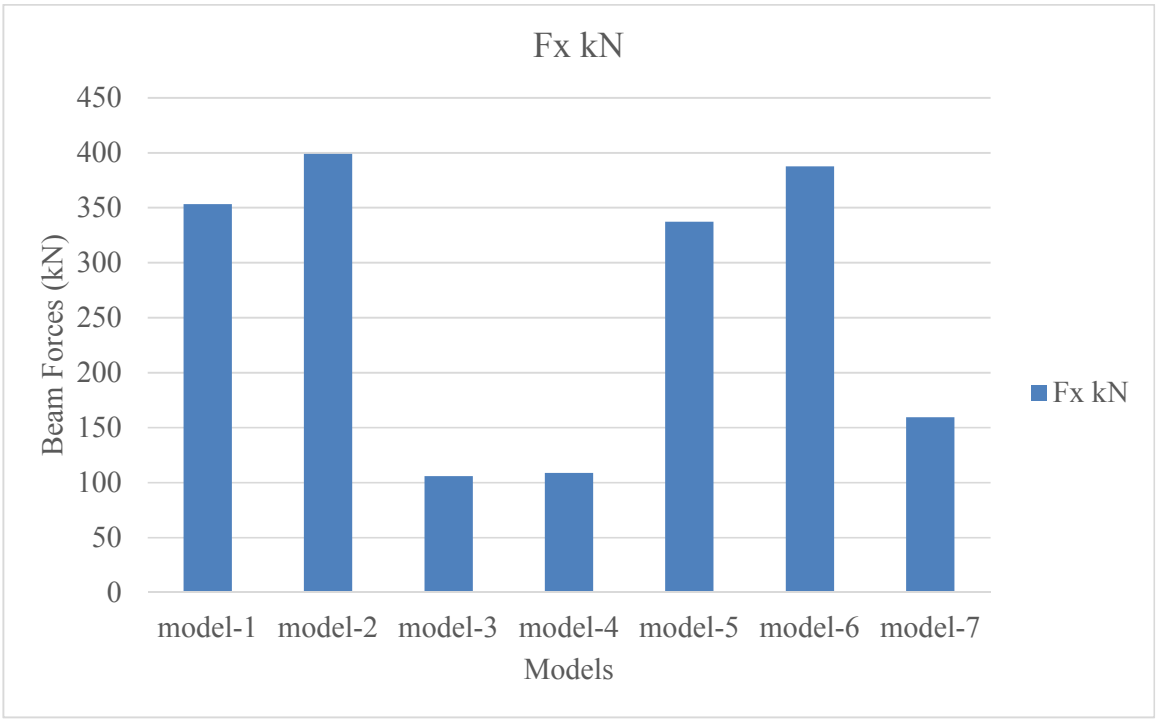

Figure 9: Beam Forces (Fx) for all the models

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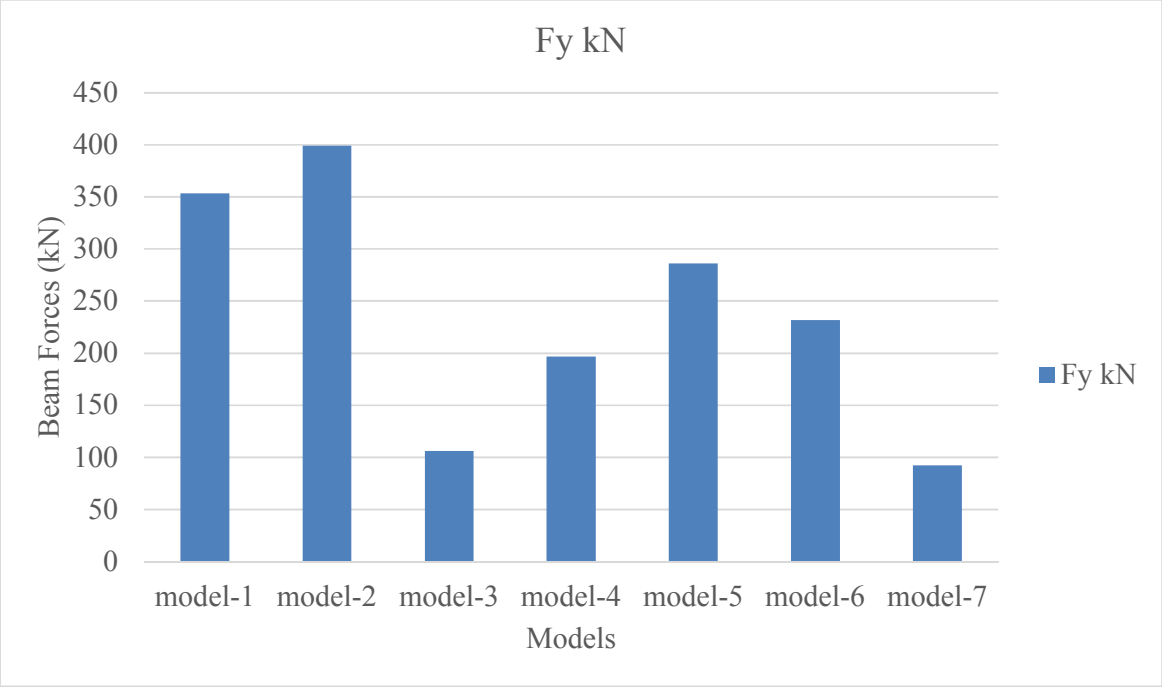

Figure 10: Beam Forces (Fy) for all the models

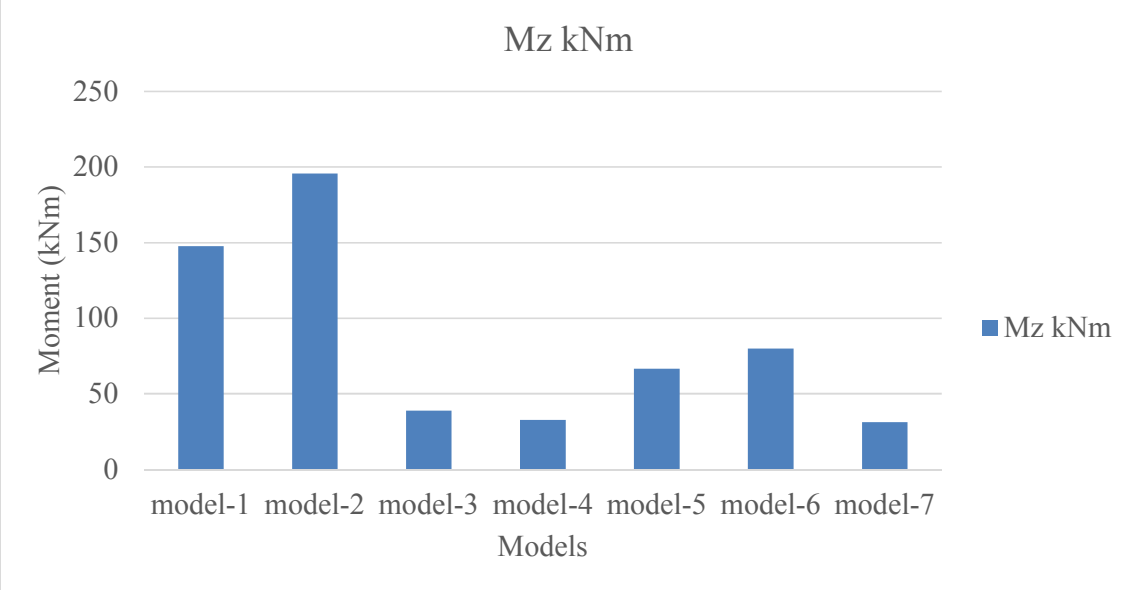

Figure 11: Beam moment (Mz) for all the models

V. CONCLUSION

The results obtained in the STAAD-PRO for the different types of the box culvert and the following conclusions are drawn.

1. The resultant displacement is maximum in the model-1 as compared to the other models.
2. The horizontal displacement is observed to be minimum in the case of model-6.
3. The reactions observed to be maximum in the model-2.
4. The beam moments are maximum in the model-2 and minimum in the model-4.

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REFERENCES

[1]. Kyungsik Kim & Chai H. Yoo., "Design Loading on Deeply Buried Box Culverts" Journal of Geotechnical and Geoenvironmental Engineering, Vol. 131, No.1, January 1, 2005, @ASCE, ISSN 1090-0241/2005/1-20-27.

[2]. L. M. Gil et al.,"Simplified method for the analysis of square cross section buried structures", Soil Dynamics And Earthquake Engineering, Vol 21, pp. 735-740, May 2001.

[3]. Lande Abhijeet Chandrakant, Patil Vidya Malgonda International Journal of Advanced Technology in Engineering and Science Volume No.02, Issue No. 06, June 2014 ISSN (online): 2348 – 7550

[4]. M.G. Kalyanshetti and S.A. Gosavi, "Analysis of box culvert - cost optimization for different aspect ratios of cell", International Journal of Research in Engineering and Technology, Vol. 03, Issue 04, pp. 508-514, April 2014.

[5]. M.G. Kalyanshetti, S.A. Gosavi IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308.

[6]. Mr. Mangesh S. Sulke, Mr. Ganesh P. Chaudhari, Mr. Vishal B. Waghchaure and Mr. Swapnil G. Rane International Journal on Recent and Innovation Trends in Computing and Communication IJRITCC | April 2016 Volume: 4 Issue: 4

[7]. Ramamurtham&R.P.Sharma., "RCC Box Culvert Methodology and Designs including Computer method" Journal of the Indian Roads Congress, October-December 2009, Paper 555.

[8]. Richard M. Bennett., M. ASCE, Scott M. Wood., Eric C. Drumm. and N. Randy Rainwater., " Vertical Loads on Concrete Box Culverts under High Embankments" Journal of Bridge Engineering, Vol. 10, No. 6, November 1,2005. @ ASCE, ISSN 1084-0702/2005/6-643-649.

[9]. S. Shreedhar and R. Shreedhar, "Design coefficients for single and two cell box culvert", International Journal Of Civil And Structural Engineering Volume 3 No. 3, pp. 475-494, March 2013.

[10]. Sujata Shreedhar and R.Shreedhar International Journal of Civil And Structural Engineering Volume 3, No 3, 2013 January 2013Published on March 2013.

[11]. T. R. Jagdeesh and M.A. Jayaram, "Design of bridge structures", PHI Delhi, second edition, pp. 134-149, 2014.

[12]. Tae-Hyung Lee, Duhee Park, Duy Duan Nguyen, Jeong-SeonPark, "Damage analysis of cut-and-cover tunnel structures Under seismic loading", Springer, Oct 2015.

[13]. Terzaghi and Karl, "Theoretical soil Mechanics" John Wiley and Sons, ING, 1962.

[14]. Y. Vinod Kumar, Dr. Chava Srinivas IJESR/ July 2015/ vol-5/ issue-7/850-861 international journal of engineering & science research.