Finite Element Analysis of Slab & Box Culvert under Heavy Traffic Loading using SAP-2000

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Abstract— Ducts are required to be given under earth dike to intersection of water course like streams, Nallas and so forth over the bank, as street dike can't be permitted to block the normal conduit. The courses are likewise required to adjust the surge water on the two sides of earth bank to diminish the surge level on one side of street along these lines diminishing the water head therefore lessening the surge threat. This Study manages consider the correlation of two distinctive kind of courses under substantial activity stream and water powered stream according to site. This examination work will help in future working conditions where we can execute the one which will be steadier similarly and practical in correlation.

Key words: SAP2000, F.E.M., Structural Analysis, Hydraulic Pressure, I.R.C Loading, Cost Analysis

I. INTRODUCTION

A scaffold is a structure worked to traverse physical impediments without shutting the route underneath, for example, a waterway, valley, or street, to provide entry over the snag. There are various outlines that each fill a specific need and apply to various circumstances. Plans of scaffolds change contingent upon the capacity of the extension, the nature of the territory where the scaffold is built and tied down, the material used to make it, and the assets accessible to construct it.

A. Preliminary Design Process

- Bridge Survey
- Geotechnical Report

1) Determine the most economical type structure and span arrangement
2) Hydraulic Analysis
3) Preliminary Cost Estimate
4) Foundation Borings
5) Determine Foundation Type

B. Final Design Process

- Top to Bottom Design (twice)
- Design methods per I.R.C. CHAPTER 6 Bridge Manual
- Analysis via
- Computations using software's
- spreadsheets
- Detail plans are produced by technicians (Analysis results)
- Plans are checked
- Quantities computed
- Special Provisions written
- Plans are advertised for bidding
- Low Bid Contractor builds the bridge

Kalyanshetti [2017] had done on the study of analysis of box culvert and cost optimization for different aspect ratios. They concluded that for different cells and different heights the optimized thickness of box culverts is to be obtained by the different formulas which will a cost effective design of the box.

Kattimani [2017] has analyzed the box culvert by considering different Parameters. The study deals with the design parameters of box culverts like angle of dispersion of live load, effect of co-efficient of earth pressure and depth of cushion provided on top slab of box culverts.

M.G. Kalyanshetti et. al. [2015] Considered Reinforced solid box culvert comprises of best section, base chunk and two vertical side dividers assembled solidly which frame a shut rectangular or square single cell. In the present work 12 m channel length is consider for examination with 2m to 6m stature variety which is again separated into single cell, twofold cell and triple cell. IRC class AA followed live load is considered.

Lee [2015] performed analysis of rectangular single, double and triple box structures to define damage states and corresponding damage indices (DIs) under seismic loading. The tunnel structure modeled by nonlinear frame

Do dai thang et. al. [2014] exhibited a paper in which, ideal cost plan of steel box support connect is done by fluctuating of shut rectangular and open trapezoidal areas.

II. AIM & OBJECTIVES

The main motive of this study is to determine the most stable and resistible structure in resisting same vehicle loading condition and hydraulic pressure. This study is performing a comparative analysis using F.E.M analysis tool SAP 2000, In this study we are also discussing the cost analysis of both the cases considering S.o.R 2014.

III. METHODOLOGY

Following steps are required in a sequence for proper completion:

1) Measuring Culvert location and condition nearby at site.
2) Hydraulic design to determine required culvert length and profile grade.
3) Modelling and Analysis in SAP-2000
4) Comparative results are prepared in Excel
5) Outcome Results & Conclusion.

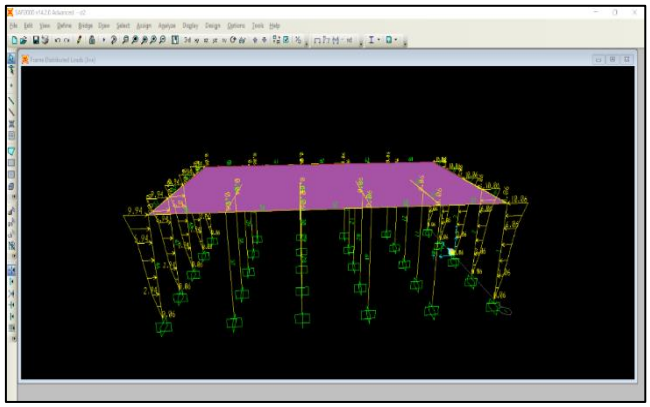

Fig. 1: Analysis of Slab Culvert

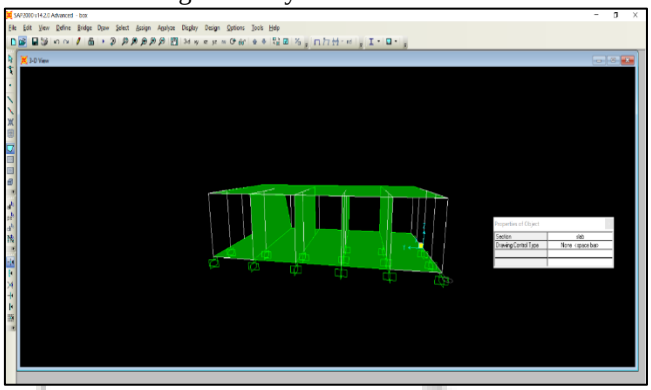

Fig. 2: Analysis of Box Culvert

IV. RESULT & DISCUSSION

A. *Side Wall*

1) Bending Moment kN-m

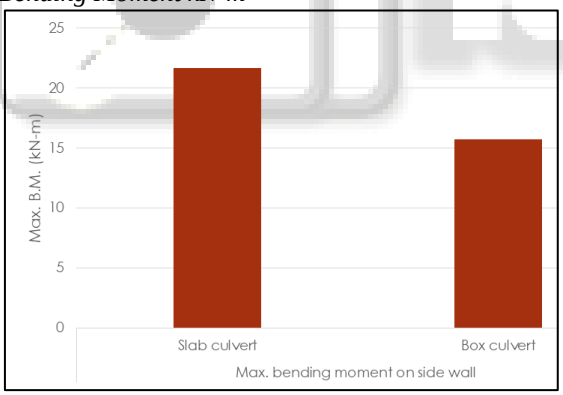

Figure 3: Bending Moment at Side Wall

2) Shear wall kN

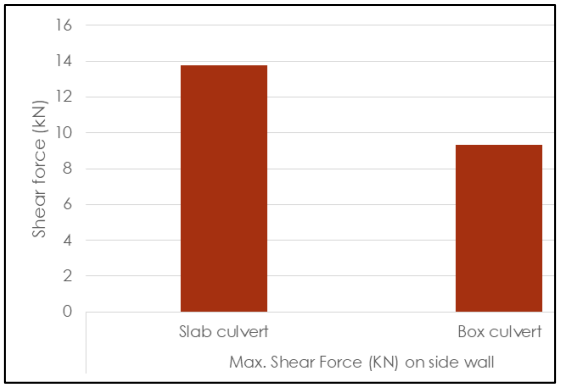

Figure 4: Shear Force at Side Wall

3) Top Deck Analysis Result

S.no	Top Deck Slab	
	Slab Culvert	Box culvert
B.M. (KN-m)	38.34	26.87
S.F. (KN)	29.04	18.45
A.F. (KN)	28.95	20.12

Table 1: Result Analysis

4) Analysis

Cost estimation of Box culvert					
concrete (cu.m)	Rebar (kg)	S.O.R. rate concrete	S.O.R. rate rebar	total concrete	total rebar
201	22140	4500	24	9,04,500	531360

Table 2: Box Culvert

Cost estimation of Slab culvert					
concrete (cu.m)	Rebar (kg)	S.O.R. rate concrete	S.O.R. rate rebar	total concrete	total rebar
236	27860	4500	24	10,62,000	6,68,640

Table 3: Slab Culvert

V. CONCLUSION

- In this comparative analysis it is clearly stated that box culvert is more stable in resisting load.
- In this study Hydraulic calculation is determined using topography sheet available as per Indian standard using dickens formulae.
- In this study we manually calculate the total discharge and assigned it in software.
- It is concluded that in terms of cost slab culvert is comparatively more costly than Box culvert.
- Here vehicle load using I.R.C. loading is applied to justify its implementation using SAP-2000

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