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Analysis and Design of Deck Slab Culvert for different Mix Design And Span

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Abstract— *Culverts are required to be provided under earth embankment for crossing of water course like streams, Nallas across the embankment as road embankment cannot be allowed to obstruct the natural water way. The culverts are also required to balance the flood water on both sides of earth embankment to reduce flood level on one side of road thereby decreasing the water head consequently reducing the flood menace. Culverts can be of different Shapes such as arch, slab and box. These can be constructed with different material such as masonry (brick, stone etc.) or reinforced cement concrete. In this project we design deck slab culvert and also compare them by using different mix design and span.*
Keywords*—Deck slab, culvert, Stream, Nallas, Water Head.*

I. Introduction

A culvert is a structure providing passage over an obstacle without closing the way beneath. It is well known that roads are generally constructed In embankment which come in the way of natural flow Of storm water (from existing drainage channels). As, Such flow cannot be obstructed and some kind of cross Drainage works are required to be provided to allow Water to pass across the embankment. The structures to accomplish such flow across the road are called culverts, small and major bridges depending on their span which in turn depends on the discharge. The culvert cover up to waterways of 6 m (IRC: 5-1998) and can mainly be of two types, namely, box or slab.[5] The box is one which has its top and bottom slabs monolithically connected to the vertical walls. In case of a slab culvert the twoslabs is supported over the vertical walls (abutments/ piers) but has no monolithic connection between them. A box culvert can have more than single cell and can be placed such that the top slab is almost at road level and there is no cushion. A box can also be placed within the embankment where top slab is few meters below the road surface and such boxes are termed with cushion.[1]

The size of box and the invert level depend on the Hydraulic requirements governed by hydraulic designs. The height of cushion is governed by the road profile at the location of the culvert. This Paper is devoted to box culverts constructed in reinforced concrete having one, two or three cells and varying cushion including no cushion. The main emphasis is on the methodology of design which naturally covers the type of loading as per relevant IRC Codes and their combination to produce the worst effect for a safe structure. The IS: 1893-1984(Clause 6.1.3) provide that box culverts need not be designed for earthquake forces, hence no earthquake forces are considered.[11] Although box of maximum three cells has been discussed but in practice a box culvert can have more cells depending on the requirements at site.

II. Difference between bridge and culvert

A very common confusion between two vital structures is present among students and engineers as well that is "What is the difference between culvert and a bridge". Culvert and a bridge both span a clear space and looks similar to each other, but there is a clear difference between their purpose as well as their design. In this post we will be trying to understand that difference and after reading this post you will be able to easily distinguish between them just by looking

2.1. BRIDGE IN BREIF

First of all don't confuse the word "Bridge" with that of the card game played mostly and is very popular among teens. "Bridge is a structure that spans a physical natural hurdle or obstruction like river or a valley. A bridge carries a passage that can be a roadway or railway across an obstruction that can be a river or a railroad or even another road as well"

2.2. CULVERT IN BRIEF

"Culvert is a structure that allows the easy passage of water through a physical obstruction that can be a hill or a roadway or a passage or a walkway".

III. Types Of Culvert

3.1. PIPE SINGLE AND MULTIPLE

Pipe culverts are made of smooth steel, corrugated metal, or concrete material. Their primary purpose is to convey water under roads, although a variety of wildlife uses them as passageways. Pipe culverts typically range from 1- 6 feet in diameter and are the least expensive type of culvert. Round culverts are best suited to medium and high stream banks.

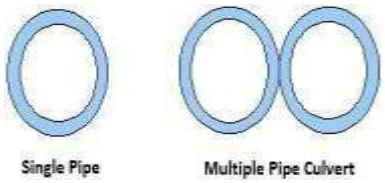

Fig 1: Pipe single or multiple

3.2. PIPE ARCH SINGLE AND MULTIPLE

Pipe-arch culverts provide low clearance, openings suitable for large waterways, and are more aesthetic. They may also provide a greater hydraulic advantage to fishes at low flows and require less road fill.

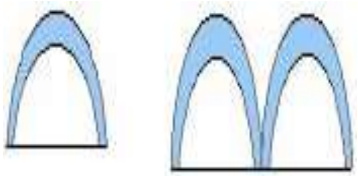

Fig 2: Pipe arch single or multiple

3.3. BOX CULVERT SINGLE OR MULTIPLE

Box culverts are used to transmit water during brief runoff periods. Theses are usually used by wildlife because they remain dry most of the year. They can have an artificial floor such as concrete. Box culverts generally provide more room for wildlife passage than large pipe culverts. Box culverts are usually made up of Reinforced Concrete (RCC)

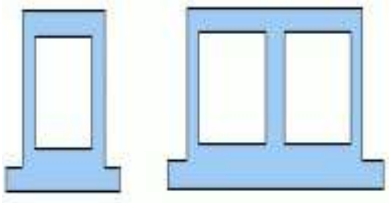

Fig 3: Box culvert single or multiple

3.4. BRIDGE CULVERT

Bridge culvert replace box culvert where the foundation is not erodible and the paved floor is not necessary.

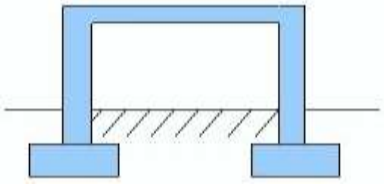

Fig 4: Bridge culvert

4. DESIGN PROBLEM

DESIGN OF DECK SLAB CULVERT FOR DIFFERENT SPAN
CASE 1-WATER PRESSURE

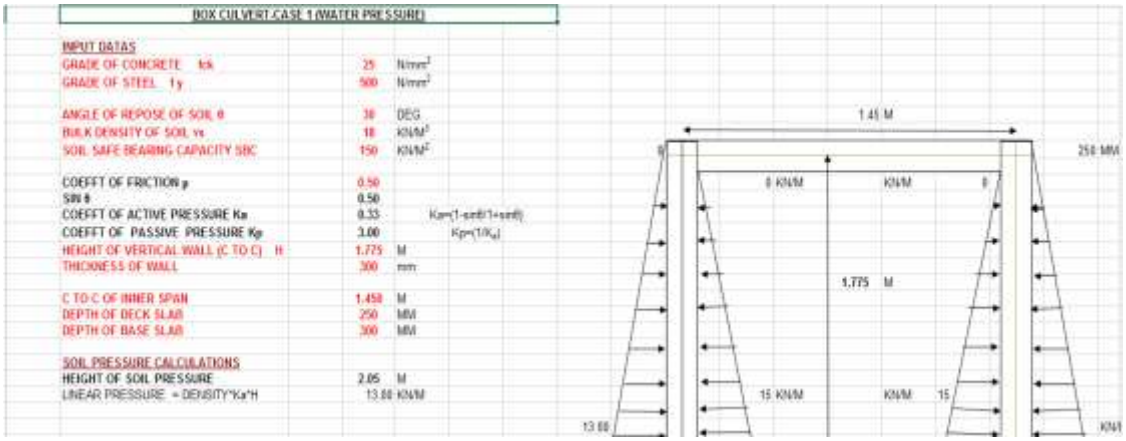

Fig 5: DESIGN PROBLEM FOR CULVERT FOR CASE 1

CASE 2-SURCHARGE PRESSURE

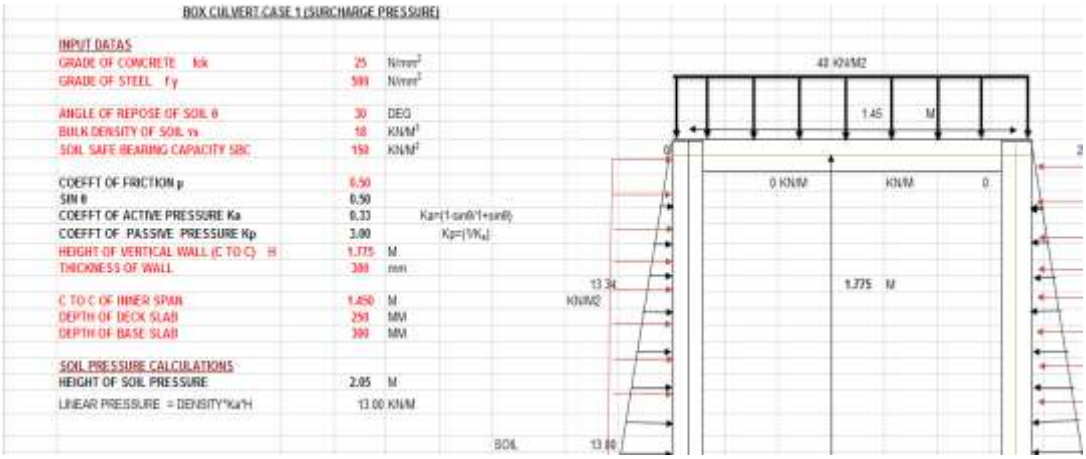

Fig 6: DESIGN PROBLEM FOR CULVERT FOR CASE 2

IV. Result

Table 1:- SF and BM values for Different span of Culvert

SPAN	CASES	BASE SLAB			DECK SLAB			VERTICLE WALL	
		BM(+ve)	BM(-ve)	SF Max	BM(+ve)	BM(-ve)	SF Max	BM Max	SF Max
2m	Case 1	**7.19**	**4.06**	**22.50**	**0.44**	**3.31**	**7.50**	**4.06**	**2.81**
	Case 2	25.20	21.70	93.80	15.90	19.70	17.30	21.70	36.70
2.5m	Case 1	**11.50**	**6.08**	**28.10**	**0.43**	**5.43**	**9.38**	**6.47**	**4.35**
	Case 2	**25.80**	**23.10**	**78.10**	**16.90**	**20.20**	**59.40**	**23.10**	**33.10**
3m	Case 1	**17.00**	**8.31**	**33.80**	**0.22**	**8.22**	**11.30**	**9.86**	**6.32**
	Case 2	**36.40**	**33.90**	**93.80**	**24.80**	**28.70**	**71.30**	**33.90**	**42.80**
3.5m	Case 1	**23.60**	**10.80**	**39.40**	**0.12**	**11.60**	**13.10**	**14.10**	**8.38**
	Case 2	**48.70**	**47.00**	**109.00**	**34.40**	**38.30**	**83.10**	**47.00**	**53.50**
4m	Case 1	**31.60**	**13.40**	**45.00**	**0.00**	**15.80**	**15.00**	**19.60**	**10.90**
	Case 2	**62.60**	**62.40**	**125.00**	**45.80**	**49.20**	**95.0**	**62.40**	**65.20**

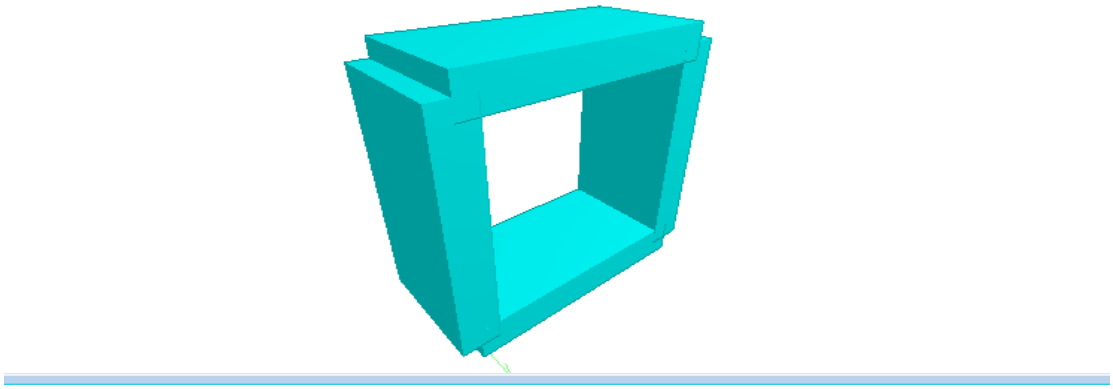

Fig 6: STAAD PRO 3D DAIGRAM OF CULVERT

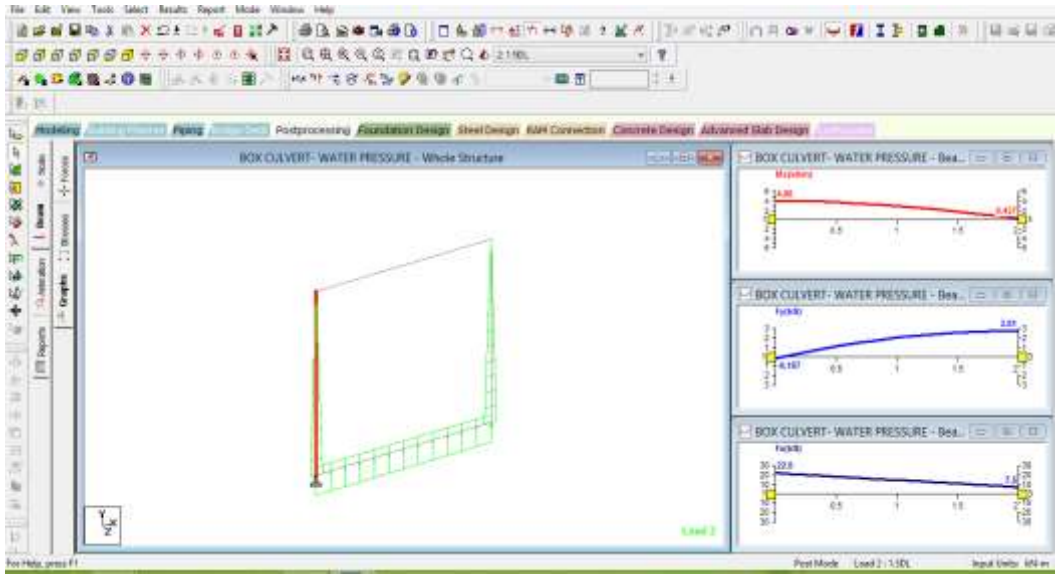

Fig 6: DAIGRAM SHOWING THE BENDING MOMENT AND SHEAR FORCE GRAPH

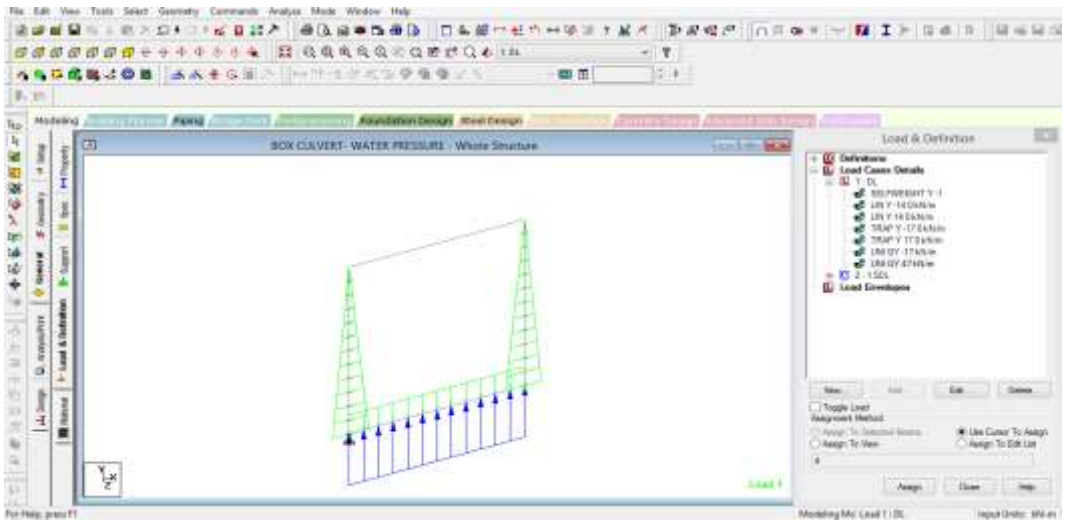

Fig 6: DAIGRAM SHOWING THE DIFFERENT LOADING ON CULVERT

V. Conclusion

1. As compare to the small bridge, Culvert are many advanteges
2. For short span bridges section of bridge is not economical
3. For short span bridges section culvert is most economical
4. For short span, culvert have more strength as compare to bridges

5. Widening of carriage way in culvert is easy as compare to bridges
6. As you can see in the result there is no effect of grades of concrete on moment
7. As you can see in table there is no effect of mix design on shear
8. Table shows that as we increase the span there is increase of moment
9. Table shows that as we increase the span shear will increase

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