Design of Box Culvert for A Heavy Traffic Highway under the Presence of Moving Loads

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***Abstract*- Ducts are required to be given under earth bank to intersection of water course like streams, Nallas and so forth over the dike, as street dike can't be permitted to discourage the characteristic conduit. The courses are likewise required to adjust the flood water on the two sides of earth bank to lessen the flood level on one side of street accordingly diminishing the water head thusly decreasing the flood danger. This paper manages investigation of a portion of the plan parameters of box ducts like point of scattering or viable width of live burden, impact of earth weight and profundity of pad gave on top piece of box courses. Profundity of pad, coefficienve loads on box without pad and with pad for basic disfigurements under essential things**

Index terms- angle of dispersion, box culvert, coefficient of earth pressure, cushion, lateral earth pressure etc.

I. INTRODUCTION

Box Culverts comprises of two Horizontal and two vertical chunks assembled solidly are in a perfect world appropriate for a street or railroad connect crossing with high dikes crossing a stream with a constrained stream.

Box courses are practical because of their unbending nature and solid activity and separate establishment are not required since the base piece laying specifically on the dirt, fills in as pontoon section. For little releases, single celled box course is utilized and for extensive releases, multicelled box ducts can be utilized. The barrel of the container ducts ought to be adequate length to suit the carriageway and the kerb. These influence the plan altogether and in this manner, required to be surveyed accurately to structure a protected structure. Along these lines an endeavor is made to consider the impacts of pad, co-effective of earth weight and edge of scattering for live burden.

Fig.: Box Culvert

II LITERATURE REVIEW

Dr. Mohankar.R.H, Dr. Ronghe.G.N given an exchange on "Investigation and Design of underpass RCC connect" and said that the Underpass RCC Bridge is once in a while embraced in scaffold development however as of late the Underpass RCC Bridge is being utilized for traffic development. In this paper, the examination of the underpass RCC connect is done. The investigation of this underpass RCC connect is finished by considering fixed end condition. Limited Element Method (FEM) investigation is performed and results are exhibited. Examination of various powers somewhere in the range of 2D and 3D models for fixed end condition is given.

Mahesh Tandon (2005)has considered that with the event of each serious tremor, there has been before, just about an overall inclination to build the limit request of the structure to check such occasions. It is just in the most recent decade that new procedures

have been effectively created to deal with this issue financially. The present global practice has moved towards an exhibition based building plan, wherein the complement is on usefulness and wellbeing under various dimensions of size of seismic tremors. Also, he inferred that There is degree after both „passive" control by endorsed itemizing methods just as „active" control by explicit gadgets for tremor safe extensions. The sensible utilization of these thoughts can prompt practical and safe extension structures.

Y. Vinod Kumar and Dr. ChavaSrinivas (2015) have displayed a total investigation of box course by utilizing computational techniques, for example, Grillage examination and Finite component strategy. Grillage examination is flexible in nature and can be connected to verity of extension decks having both straightforward and complex arrangements effortlessly and certainty. Grillage investigation has done by most usually utilizing softwre STAAD Pro. Their primary goal was to know the conduct of box course and variety of worries regarding Shear power and twisting minute qualities.

LandeAbhijeetChandrakant, PatilVidyaMalgonda (2014)seen that auxiliary plan of box course includes thought of burden cases and factors like live burden, compelling width, dispersal of burden through fill, sway factor, co-proficient of earth weight and so forth. The basic components are required to be intended to withstand greatest twisting minute and shear drive. So exceed expectations program is created for examination and it is contrasted and programming results. So investigation of box course is done for it for different box conditions and auxiliary structure is proposed for basic cases.

III METHODOLOGY

CO-EFFICIENT OF EARTH PRESSURE

The earth can apply weight, least as dynamic and most extreme as inactive, or in the middle of called weight very still. It relies upon the condition acquired at site (Terzaghi4 and Gulati5). For instance if there should be an occurrence of a holding divider where the divider is allowed to yield and can move far from the earth fill the weight applied by the earth will in general achieve dynamic state and consequently be least. As to achieve dynamic state just a little development is required which can regularly be accomplished if there should be an occurrence of a holding divider, additionally before disappointment of the divider by tilting, the inlay will undoubtedly achieve dynamic state. The divider in this way can securely be intended for dynamic weight of earth, with co-proficient material for dynamic weight.

In the event of a tied down mass head, the earth weight on the grapple plate will in general accomplish latent state in light of the fact that the stay plate is hauled against earth and extensive relocation can be permitted, one can consider inactive co-proficient for the plan of grapple, obviously, some factor of security need be taken as expected removal to accomplish aloof state before the mass head gives way may not be handy. In situations where the structure is developed before refill earth is set in position and the circumstance is to such an extent that structure isn't in a situation to yield on either side, the earth weight will achieve a state very still.

LATERAL EARTH PRESSURE FOR AT REST CONDITION

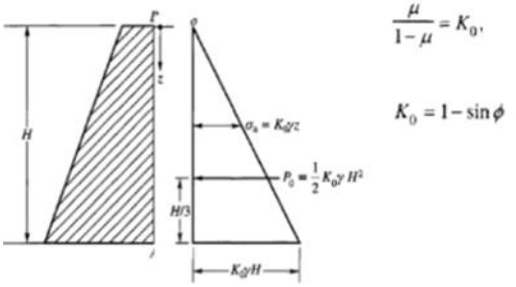

Fig.: EARTH PRESSURE

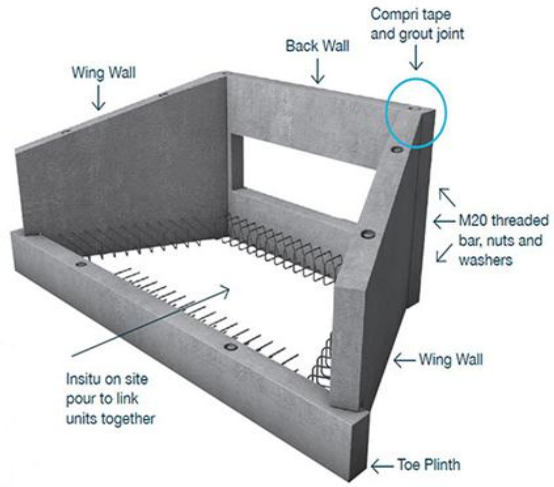

Fig.: Cross-section of Box Culvert

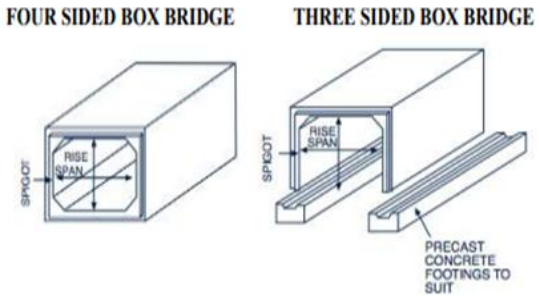

Fig.: Box Culvert

EFFECTIVE WIDTH

Compelling width in the keep running of course (length crosswise over range) is required to be influenced by a moving live burden. This width assumes a huge job similar to thought of live burden in the plan of course. Where be that as it may, there is vast pad the live burden gets scattered on an extensive region through the fill and the heap per unit zone turns out to be less and does not stay noteworthy for the plan of box, especially in contrast with the dead burden because of such huge pad. If there should be an occurrence of dead burden or uniform extra charge load the compelling width has no task to carry out and such loads are to be assumed control over the whole region for the structure. Powerful width assumes an imperative job for box without pad as the live burden turns into the fundamental burden on the best section and to assess its belongings per unit keep running for plan as an inflexible edge, this heap is required to be separated by the viable width. In that capacity assessing compelling width accurately is of significance. The applicable IRC Codes, different Codes, books, hypothesis/ideas are at change the extent that powerful width is concerned and requires discourses at some length.

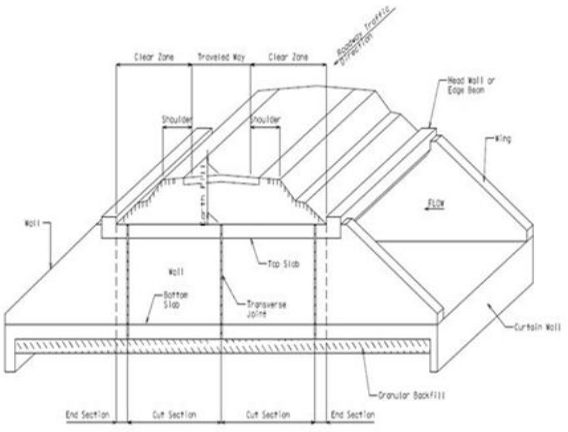

Fig.: Box culvert

It is required to comprehend the idea driving compelling width. Fundamentally, it is the width of section opposite to the range which is influenced by the heap put on the highest point of piece. It will be identified with the region of piece expected to distort under burden. It tends to be all around envisioned that this territory of section which may get influenced will rely upon how the piece is bolstered whether one way or the two headings and also on the state of help that is without whether or constant or halfway or completely fixed. It can likewise be envisioned that the width will be bigger ifslab is permitted to slide over help under the heap as if there should arise an occurrence of uninhibitedly bolstered, and a similar will decrease if the section is controlled from sliding and more the limitation the less will be the width. In this view the successful width will be least for completely fixed and step by step increment for mostly fixed, increment further for constant piece and will achieve greatest for chunks openly bolstered at closures. Where support on one side is unique in relation to on the opposite side the compelling width ought to be acquired taking this reality in thought. The separation of the heap from the close help influences viable width, more the separation bigger will be the successful width and will achieve most noteworthy when the heap is at focus. The proportion of broadness (unsupported edges) and the range likewise influences viable width. All components referenced above should be considered while getting the viable width

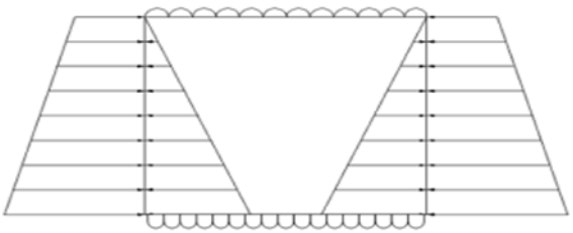

Fig.: Cushion Consideration

BRAKING FORCE

This is another zone where feeling of the fashioners change in two different ways initially, in the case of braking power brought about by moving burdens will disfigure the crate structure and ought to along these lines be considered in the plan of box. Furthermore, on the off chance that it is to be viewed as what viable width ought to be taken to acquire power and

minute per unit keep running of box. Obviously the braking power will influence the worldwide dependability and change the base weight to some degree. The IRC Code is quiet the extent that container is concerned. It will be so as to disregard impact of braking power on box having substantial pad. In such circumstance the braking impact will be consumed by the pad itself and no power will be transmitted to the container underneath. Question will, in any case, emerge up to what pad stature no braking power need be taken. This tallness by and large is taken to be 3 m. Therefore no braking power for pad stature of 3 m and more and full braking power for no pad

Table 1 Comparison of Moment in kN.m for different Earth Pressure Co-efficient keeping all other parameters same

Box Designation	[1/3 x 3/ 5]		[1/3 x 3/ 0]	
Member	Ka = 0.333	Ka = 0.5	Ka = 0.333	Ka = 0.5
Support A&B	71.3	82.5	115.8	119.9
Support C&D	83.8	95.5	79.1	83.6
Mid-span AB	80.5	69.3	90.9	86.9
Mid-span DC	85.5	79.3	52.2	47.7

Table 2 Shows Moment and Reinforcement for Different Values of α Keeping other Parameters

Design	α values	Moment in kN.m.				Area of reinforcement in mm²			
		M_{AB} (Support)	M_{DC} (Support)	M_{AB} (Mid-span)	M_{DC} (Mid-span)	Support A & B	Support D & C	M_{AB} (Mid-span)	M_{DC} (Mid-span)
As per design carried out	0	119.8	83.6	87.0	47.7	1834.8	1375.3	1331.4	1422.8
	0.8	86.4	72.3	61.3	54	1322.6	1189.1	938.1	887.6
	0.9	83.1	70.9	58.9	43.6	1272.0	1166.4	901.8	717.8
	1.0	80.4	67.0	56.8	46.4	1231.3	1102.1	870.7	726.4
	2.0	65.0	64.5	45.2	41.69	995.2	1051.4	692.8	685.8
	2.6	59.8	62.8	41.2	41.1	916.0	1033.6	630.4	676.2
As per Standard design of MORTHS	Standard design compares with values between α = 0 to 1	Standard design provide only reinforce-ment as shown	–	–	–	1398	1398	1005.3	1570.8

IMPACT OF LIVE LOAD

Moving burdens make sway when these move over the deck section (top chunk). The effect relies upon the class and kind of burden. The IRC:6-2000 Code offers equation to acquire sway factor for various sort of burdens by which the live burden is to be expanded to represent sway. The container without pad where the best section will be exposed to affect is required to be intended for live loads including such effect loads. Any such effect should follow up on box with pad. Consequently no such effect factor will be considered for box with pad. The effect by its very nature should act at lower profundity and no effect is considered for the base piece of the container. It doesn't influence the vertical dividers of the crate and not considered in the structure.

SHEAR STRESS

The container is intended for greatest minute for its solid segment and fortifications. It is checked forshear at the basic area and on the off chance that it surpasses passable shear worry for the extent of segment; blend of cement and level of fortifications, the segment must be expanded to bring shear worry inside as far as possible. Then again, the fortification can be expanded to increment permissible shear quality. The third choice is to give stirrups to counter abundance shear pressure. This may must be embraced in circumstance where thickness of section can't be expanded because of specific limitations.

Table 3 Comparison of Designs without Braking Force with the Design when Braking Force is Considered

Culvert Designation	[1/6 x 6/ 0]				[1/2 x 2/ 0]			
Location	Support A	Support D	Mid AB	Mid CD	Support A	Support D	Mid AB	Mid CD
Moment with braking force, in kN.m.	390	286	244.5	165.2	44	27	42.8	19
Moment without braking force, in kN.m.	301	184	244.5	165.2	27.5	8	42.8	19
Reinforcement with braking force in mm²	3378	2187	2118	1263	835	504	813	355
Reinforcement without braking force in mm²	2607	1407	2118	1263	522	149	813	355
Standard Design Reinforcement in mm²	2576	3142	3020	2576	1118	1118	804	804

LOAD CASES FOR DESIGN

Primarily three burden cases administer the structure. These are given underneath (Ramamurtham11)

a) Box vacant, live burden extra charge on top section of box and superimposed additional charge load on earth fill.
b) Box inside full with water, live burden extra charge on top piece and superimposed additional charge load on earth fill.
c) Box inside full with water, live burden additional charge on top section and no superimposed extra charge on earth fill.

Moment and Shear values by Manual Calculation

Item	Location	Members	By Manual Calculation
Bending Moment (kNm)	Support	M_{AB}, M_{BA}, M_{AD}, M_{BC}	82.50
		M_{DC}, M_{CD}, M_{DA}, M_{CB}	95.52
	Mid span	M_{AB}, M_{BA}	69.32
		M_{DC}, M_{CD}	79.34
		M_{AD}, M_{BC}	15.06
Shear Force (kN)	At d_{eff} from support for slabs	A & B	112.93
		D & C	133.06
	At d_{eff} from top slab for wall	A & B	76.51
	At d_{eff} from bottom slab for wall	D & C	78.40

VI. CONCLUSION

1. Box for cross waste works crosswise over high banks has numerous points of interest contrasted with a chunk duct.
2. It is anything but difficult to include length in case of broadening of the street.
3. Box is fundamentally exceptionally solid, inflexible and safe.
4. Box does not require any intricate establishment and can without much of a stretch be set over delicate establishment by expanding base chunk projection to hold base weight inside safe bearing limit of ground soil.
5. Box of required size can be put inside the dike at any rise by differing pad. This is preposterous if there should arise an occurrence of chunk course.
6. Right box can be utilized for stream of water skew way by expanding length or giving edge bar around the container and it isn't important to configuration skew box.
7. Easy to build, for all intents and purposes no upkeep, can have multi-cell to coordinate release inside littler stature of bank.

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