iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** V **Month of publication:** May 2023

DOI: https://doi.org/10.22214/ijraset.2023.51369

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

A Research Paper on Manual Design and Modelling of Box Culvert

Shaista Choudhary[1], Akshay Singh[2], Umakant Sharma[3]
[1, 2, 3]*Student at Dronacharya Groups of Institutions*

Abstract: ***Box culverts are the structures which are used when the path of water in the natural stream crosses roads, railway lines, flyovers etc. They are normally cheaper than bridges, which make them the natural stream passes through channels. In this work, the review of various authors and their views in the design and analysis of box culvert with software approach and comparison between software and manual approach has shown. The IS standard requirements in the design manual for roads and bridges (IRC-6-2000, IS 21-2000) is used in the structural designing of concrete box culverts. In this paper study about the different classes of IRC loadings and their effect on without and with cushioning conditions imposed on box culvert. The pressure cases are then checked for both with cushioning and without cushioning loading cases. The structure designing includes the considerations of pressure cases (Box empty, Full, surcharge load) and factors such as Impact load, Braking force, Dispersal of load through fill, Effective width, Coefficients of earth pressure, Live load etc. The structural elements are designed to withstand the maximum bending moments and shear forces respectively. In the present study, this paper provides full discussion on the provisions in the codes, considerations and justifications of all the above aspects of design.***
Keywords: Box Culvert, Design Coefficients, Loading Types, Moment, Shear, Pressure Cases*.*

I. INTRODUCTION

Box Culvert is the arrangement made to cross an obstacle in the form of a stream, a river or a road to pass without closing the way beneath. A Culvert is defined as standard specifications as any structure whether made up of single and multiple cell construction with a clear span of 6m. Box Culvert which has got its name due to its shape & orientation and looks like a hollow rectangular box with two slab & two vertical walls which connects monolithically. Box culverts are easy to design and easy to construct economically. It is designed to carry all the loads comes from top slab and transferred with help of vertical walls to bottom slab which rest generally where the bearing capacity of soil is low. Box Culverts are economical due to their rigidity and monolithic action no separate foundation is required when bottom slab is rest on hard soil. The structure is designed such as rigid frame adopting moment distribution method for obtaining final distributed moments based on the vertical walls and slabs. Box Culverts are generally found in three locations, the first is at the bottom of depressions where no natural water course exist, second is where natural stream intersect the roadway and third is at locations required for passing surface water carried in the ditches beneath roadways and driveways to adjacent property. There are many general problems occur with box culvert such as serviceability and strength, abrasion and deterioration of concrete. For masonry culverts there will be major cause due to sedimentation and blockage by debris.

There are two types of culverts which are rigid culvert for example concrete and flexible culvert for example steel. Rigid culverts are made to bear the bending moments where the flexible culverts are not.

The structural and hydraulic design of box culvert is different from the bridge design for construction, maintenance, replacement and repair procedure. The basic characteristic of box culverts the first on is hydraulic in which the culvert is design for highest flood level or peak value with a submerged inlet to improve hydraulic efficiency. Second is structural culverts are used take all the Dead load, live load, load due to pressure, Impact load and braking forces that are safely to be resist by structure and soil. The third one is maintenance there is a problem with the blockage by debris and sediment, especially when the culvert are subjected to seasonal flow. The fourth one is the construction in which culvert are made to take the vehicle load by combined strength of box and surrounding embankment. The last fifth one is Durability of materials are major problem in box culverts and other drainage structure. In counteractive environment can cause corrosion and abrasion of the available materials.

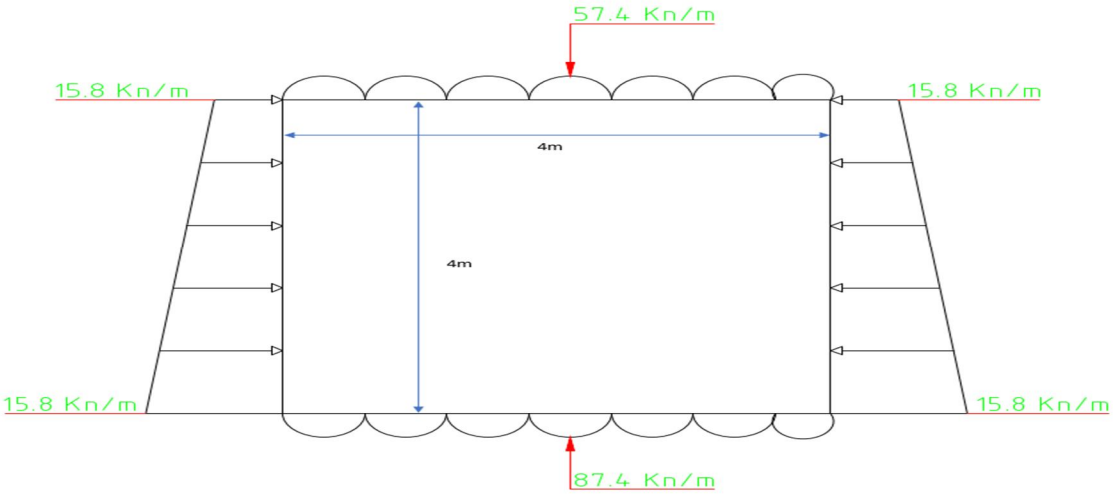
The culvert is divided into categories first is according to type of materials used in which first is concrete materials which the culvert is made either precast or cast in situ. The selection is depending on the size, type, flexibility etc. Precast concretes are easy to handle and installed. Cast in situ culverts are made on site requires more days for construction. Second is corrugated steel in which made by factory named as corrugated steel sheet this pipe culverts are made by steel pipe sections.

©IJRASET: All Rights are Reserved

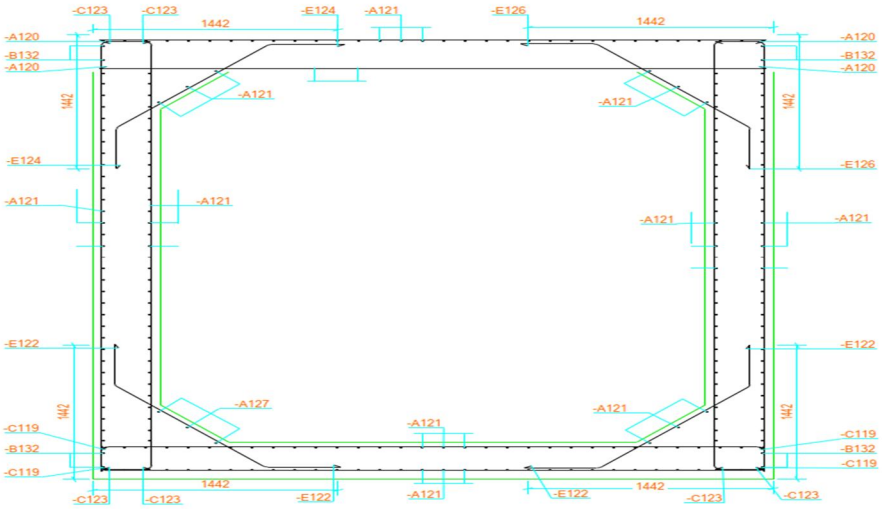
This is used in steel pipe culverts with steel sheet for greater span. Third is corrugated aluminium corrugated aluminium culverts are constructed by factory made corrugated aluminium pipe this are available as the conventional structure plate for box culvert and long span structure. Fourth one is plastic pipe are made from various materials and have a good strength and properties which depend on the base resin made by formulation of chemicals and final resin is used to produce the pipe. According to the shapes of box the first one is circular pipes is the most common shape for pipe culverts. It is structurally and hydraulically efficient under many conditions for smaller opening the pipe is generally preferred. Second one is pipe arch or elliptical shape is generally used when distance from channel invert to pavement surface is limited pipe arch and elliptical shape are not structurally efficient as compared to as a circular shape it is used in the areas with the limited vertical clearance. Third one is arch culvert offer less obstruction to the waterway than pipe arches the structure is also safe for scour design requirements. Fourth one is box section, or the square and rectangular section used generally nowadays due angular corner of the structure it is not hydraulically and structurally are not safe to solve this haunch is prefer at the corners. Fifth one is the multiple cells is used where channel is too wide and uses where span having more length by height used to give proper channel to waterways there is no problem of clogging when the discharge is more.

II. METHODOLOGY

The complete work will be done manually without any use of software, then the cases taken with respect to different loading types are then solved and the result will guide the whole work to the result and conclusion section. Following is the methodology approach are considered with cushion and for loading Class 70 (R), Class A.



Load Distribution



Reinforcement details

DECK SLAB	MAIN BARS DISRITUBTION BAR	Dia= 20mm Dia= 8mm	@ 250mm c/c @125mm c/c
SIDE WALLS	MAIN BARS DISRITUBTION BAR	Dia= 20mm Dia= 8mm	@ 250mm c/c @125mm c/c
BOTTOM SLAB	MAIN BARS DISRITUBTION BAR	Dia= 20mm Dia= 8mm	@ 250mm c/c @125mm c/c

Steps to solve With Cushion Cases: -

First to have silent features of data then the next is calculation of loadings on top slab, bottom slab, side walls and base pressure then the moment is calculated. Then distribution factors are carried out then by moment distribution method finding the fixed end moment due to dead, live and total load. In last design for top slab, bottom slab, side wall is done.

III. RESULTS AND DISCUSSION

The above literature analysis and design of box culvert is under the influence of different kinds of loading conditions. It can be noted that effect of depth of cushion, impact load, braking forces, coefficient of earth pressure and the angle of load dispersion due live load are important factors. Box culverts are analysed for different cases of pressure and their variations. It is seen that maximum bending moment occur for dynamic load case. The analysis and design of box can be done by using the Indian Standard Codes IS456-2000, Indian Road Congress, IRC 6-2000 & IRC 21-2000. The result will be analysed by variations in shear force, bending moment, impact load, braking force etc.

IV. CONCLUSIONS

There are many varieties of materials, Size and Shapes Concrete hollow box culverts are the best for the durability and economical satisfaction. To design and analysis of box saves time and money improving planning of road and management also reduces the risks when selection is based on whether condition. It is easy to construct the box with fast workmanship and cost effectiveness can be achieved. The result of analysis for given parameters can be solved by using moment distribution method. There are more stresses produces in without case with compared to cushion case.

The box culvert includes three pressure cases for designing. The Class-70(R) Loading has also been used as calculation of Class A Loading.

REFERENCES

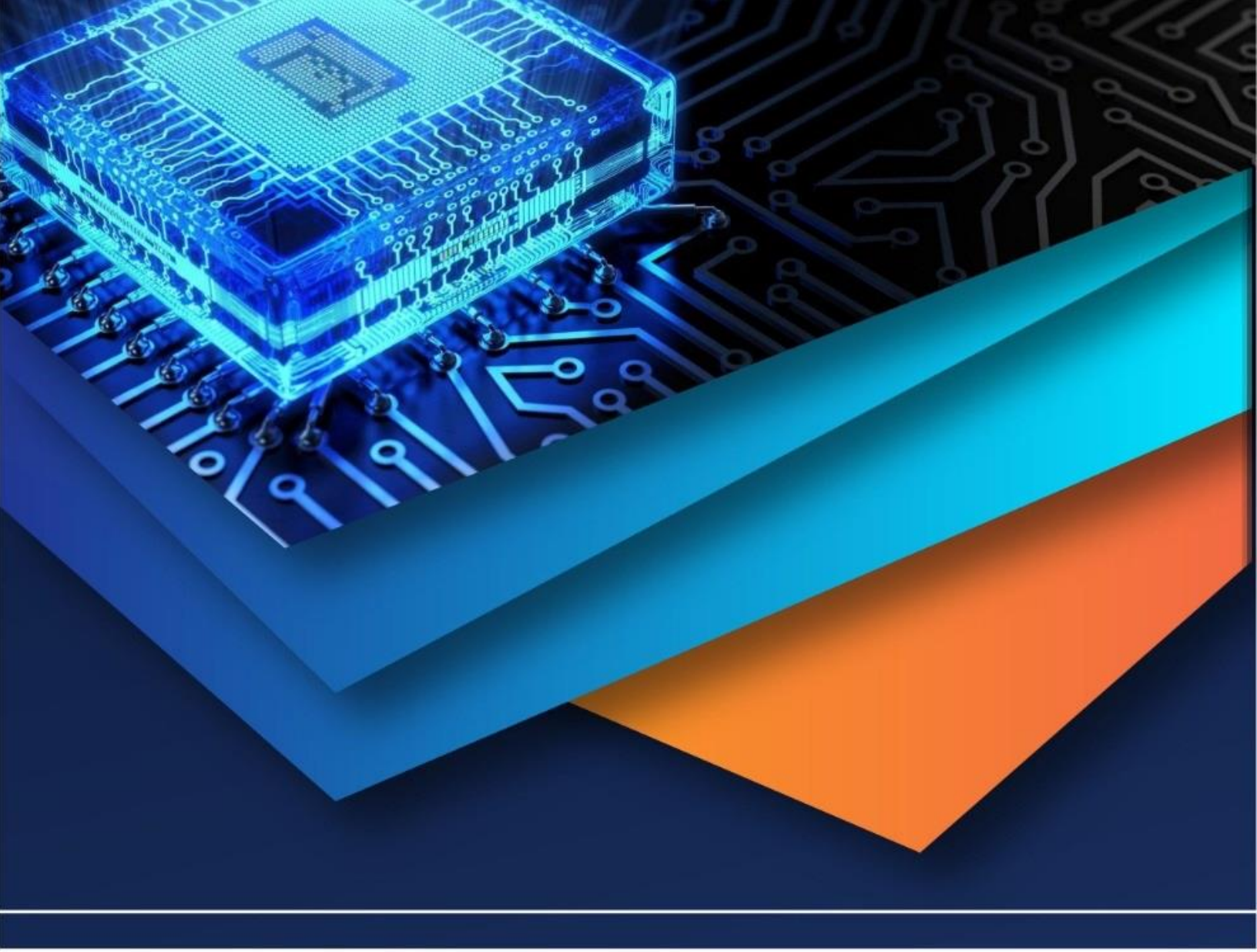
[1] D. Patil, A.A. Galatage (2016), " Analysis of box culvert under cushion loading ", International advanced research journal in science, engineering &technology, ISSN no.(o)2393-8021, ISSN no.(p) 2394-1588, Vol.03, Issue-03, p.p. 163-166.

[2] Afzal Hamif Sharif (2016), "Review paper on analysis and design of railway box bridge" International journal of scientific development & research, ISSN no.2455-2631, Vol.01, Issue-07, p.p. 204-207.

[3] Ajay R. Polra, Pro. J.P Chandresha, Dr. K.B Parikh (2017), " A review paper on analysis and cost comparison of box culvert for different aspect of cell " International journal of engineering trends & technology, ISSN no.2231-5381, Vol.44, Issue-03, p. p 112-115.

[4] Ayush Tiwari, Dr. Sudhir S. Bhadouria (2017)," Comparative cost evaluation of R.C.C box and solid slab " International journal for scientific research& development, ISSN no. 2321-0613, Vol.05, Issue-08, p.p. 365-367.

[5] B. Sravanthi, G. Ramakrishnadr, M. kameshwara Rao (2015), "A comparative design of one cell and twin cell R.C.C. box type minor bridge " International journal for scientific research & development, ISSN no.2321-0613, vol.03, Issue-06, p.p. 504-506.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)