



---

## **Study of Box Culvert Bridge: A Review**

***Kamal Sahu<sup>1</sup>, Prof. Gaurav Shrivastava<sup>2</sup>***

<sup>1</sup>*M. Tech. Student- Department of Civil Engineering, VITM College, Gwalior (M.P.), India*

<sup>2</sup>*Professor- Department of Civil Engineering, VITM College, Gwalior (M.P.), India*

---

### **ABSTRACT:**

Today's box culverts are helpful for giving nearby pedestrians with access and natural drainage. These culverts are crucial to the transit system because they offer a much more cost-effective alternative to large bridges.

Culverts are almost identical to the bridges that provide access to the waterway for cars and pedestrians. When there is a limited hydraulic head available, these are typically chosen. Culverts come in three different shapes: block, arch, and box. These are constructed of a variety of materials, including RCC, stone, and bricks. This article reviews the work of several authors, displays their ideas in the design, and then analyses a box culvert made of RCC while taking various aspect ratios into account.

**Keyword:** *Box culvert, aspect ratio, Staad pro, IRC codes.*

---

### **I. INTRODUCTION**

Culverts are frequently used at natural drainage and stream crossings to pass water under a road as well as cross-drains to alleviate drainage of ditches at the roadside. They are frequently empty when discovered beneath roadways. A culvert can also resemble a bridge and be built to let vehicles or pedestrians travel over a waterway while still allowing enough room for the water to flow through. Culverts can be found in a variety of sizes and forms, including elliptical, round, pear-shaped, flat-bottomed, open-bottomed, and box-like designs. The hydraulic performance requirements, restrictions on upstream water surface elevation, and roadway embankment height are used to determine the style and shape of the culvert.

---

### **II. BOX CULVERT**

Similar to pipelines, but much larger, are culverts. They are constructed of a variety of materials, including high density polyethylene, concrete, steel, and plastic.

Concrete culverts are typically chosen. Culverts made of concrete can be strengthened or unreinforced. Cast in situ culverts are culverts that are built on the spot in some circumstances. There are also precast culverts available. The aforementioned materials can be combined to create composite culvert varieties.



Figure 1 Box Culvert Bridge

### III. LITERATURE REVIEW

Various works are given on the box culvert bridge which summarized are as follows-

Kenneth W. (1986) Straightforward strength of material connections are utilized to decide the layer powers following up on an evenly stacked cement or steel box culvert bridge. The longitudinal film power  $N_n$  is found by treating the box culvert as a bar. The layer shear power  $N^{\wedge}$  is found by separating  $N_{xs}$  with regard to  $x$  (longitudinal bearing) and incorporating concerning  $y$  (cross over bearing). The cross over layer power  $N_{,}$  is found by further separating  $N_{xx}$  as for  $x$  and incorporating concerning  $y$ . A mathematical model shows how the conditions determined can be applied to a viable model.

Bruno Massicotte (1994) The experience acquired in field checking can be applied to a substantial design - bridges, structures or on the other hand dams. The logical investigations 12'15"16'17 that followed the trial program worked on the information of the conduct of this segmental bridge. The significant discoveries, relevant to both post-tensioned and precast, pre stressed substantial bridges, are summed up here: Quick restoring glue for electrical strain measures is suggested in any field testing program. Surface vibrating wire measures are solid and precise strain-estimating gadgets. Their utilization is suggested for both short-and long haul checking programs for a long time: their precision, the chance of remote programmed information procurement without wire length issues, a measure length all around adjusted to estimation on concrete, and their solidness over extremely significant stretches.

Khaled M. Sennah (2002) The curvilinear idea of box culvert bridges alongside their mind boggling avoid examples and stress fields have driven fashioners to embrace inexact and moderate techniques for their investigations and plan. Ongoing writing on straight and bended box culvert bridges has managed insightful definitions to more readily comprehend the conduct of these complex primary frameworks. Hardly any creators have attempted exploratory examinations to research the precision of existing techniques. This paper presents features of references relating to straight and bended box culvert bridges as single-cell, different spine, and multicell cross segments. The writing study introduced in this manages: flexible investigation, and test review on the flexible reaction of box culvert bridges. Diagrid primary framework gives greater adaptability in arranging inside space and exterior.

G. C. Ezeokpube (2006) Different works have been done by numerous specialists towards the effective examination and plan of box-culvert bridges. The arrangements proposed have not came about into an all encompassing and far reaching investigation and plan of these sorts of structures. Notwithstanding, much work need be finished. These will incorporate the utilization of a strategy that is stochastically situated without breaking a sweat of activity, whose outcomes are basic and sweeping while at the same time characterizing and itemizing the relating protections (for instance, a blend of FEM and FSM in a probabilistic climate), protected, practical and solid. The technique to be utilized ought to be differed and joining real programmatic experience and consequences of exploratory examination to accomplish adequate degree of configuration, foreseeing wellbeing and economy for box-culvert bridges.

He Jun (2008) he ends show that the ordinary burdens of the areas between two redirection focuses in the mid-range just rely upon the tractable power, while those between the harbor point and the redirection point change with the parameters. It is proposed the sensible proportion of the outer ligament to be 30% ~ 40% for this bridge, and the prestressing power ought to be no under 60% of trademark worth of tractable strength. The decisions give a reference to the plan of inside and outer ligaments of composite box culvert bridge with layered steel networks.

Dongzhou Huang (2008) The current version of the determinations contains arrangements that might bring about irrationally moderate burden limit appraisals. In this paper, the consequences of field tests and examinations led on the Veterans' Memorial bended steel-box culvert bridge are talked about. Test and insightful outcomes show: current AASHTO guide particulars with respect to the main cross over stiffener separating at the basic end backing of a bended culvert might be excessively moderate for bridge load limit evaluations; current AASHTO guide details may significantly misjudge the

powerful loadings of bended box culvert bridges with long range lengths; and a plane network limited component model of around 20 components for every range the longitudinal way can be utilized to examine bended multiculvert bridges with outer bracings found uniquely over upholds. The examination results are enlightening what's more material to bridge plan and bridge load-rating exercises.

Zakia Begum (2010) In this paper Because of effective dispersal of blocked traffic, monetary contemplations, and tasteful allure evenly bended steel box culvert bridges have become progressively well known these days in current expressway frameworks, including metropolitan trades. Albeit huge exploration has been in progress on cutting edge investigation for a long time to all the more likely comprehend the conduct of a wide range of box-culvert bridges, in any case, the consequences of these different exploration works are dissipated and unevaluated. Henceforth, a reasonable comprehension of later work on straight and bended box-culvert bridges is profoundly wanted. The non-composite steel area should uphold both the new concrete and the whole development stacks thus steel box culverts are at their basic stage during development. In the current review, non composite straight and bended steel boxes are broke down with shaft and shell components utilizing the three dimensional limited component examination and their conduct is explored.

J.S. Kalyana Rama (2010) Box culverts can be all around applied according to the perspective of load conveying, to their lack of interest concerning whether the twisting minutes are positive or negative and to their torsional solidness; according to the perspective of economy. A continuous work has been taken as a contextual investigation for the present work. Investigation standards for twist and contortion impacts are applied to the part chose, and saw as acceptable. Correspondingly, the issue has been examined and intended for flexure and shear by giving due contemplations for torsional and distortional impacts as a preparatory measure.

Peter Feenstra (2012) The current paper portrays an itemized, dynamic three-dimensional limited component examination consolidating models of the bridge, including shape, and of a moving vehicle including multi level of-opportunity suspension framework. A primary advance of the examination is the technique by which we move the model vehicle over the model bridge utilizing the contact element of ANSYS. The design is a thin, prestressed built up substantial box culvert bridge that is essential for a metropolitan light-rail framework. The bridge is a double track light rail bridge with three traverses that will traverse an aggregate of 584 feet.

Laxmi Priya Gouda (2013) With the end goal of the parametric review, five box culvert bridge models with steady range length and shifting arch. To approve the limited component displaying technique, an illustration of box culvert bridge is chosen from writing to direct a approval study. The model box culvert is displayed and examined in SAP 2000 and the reactions are viewed as genuinely coordinating with the outcomes revealed in writing. With the end goal of the parametric review, the five box culvert bridges are displayed in SAP2000. The range length, cross-segment and material property stays unaltered. The main boundary that changes is the span of curve. The cross segment of the superstructure of the box culvert bridge comprises of single cell box. The ebb and flow of the bridges shifts just even way. Every one of the models are exposed to self weight furthermore moving heap of IRC class A followed vehicle. A static investigation for dead burden and moving burden, and a modular examination are performed. The longitudinal pressure at top and lower part of cross areas, twisting second, twist, redirection and central recurrence are recorded. The reactions of a box culvert bridge bended in arrangement are contrasted and that of a straight bridge. The proportion of reactions is communicated as far as a boundary. From the reactions it is tracked down that; the boundaries like twist, bowing second, and diversion is expanding as curve of the bridges increment.

Cheng Kang (2015) The paper presented the development strategy for enormous portion facilitating and its trouble, and drawing up the relating plan of liner and stress checking. The paper gives the estimation technique for shear region for such a major cantilever slender walled steel box culvert segment, specifically the shear coefficient calculation hypothesis of Professor Hu Haichang, and the utilization of this shear region wonderful shaft component model, structure model and the trial demonstrate that the shell model is more reliable, given a specific reference for comparable area project.

Phani Kumar (2016) Bridge development today has accomplished an overall degree of significance. Bridges are the vital components in any street organization and utilization of prestress culvert type bridges acquiring notoriety in bridge designing clique in light of its better strength, functionality, economy, tasteful appearance and underlying productivity. In this postulation examination and plan of prestressed substantial bridges (Deck Slab, T-Culvert and Box Culvert) are done utilizing IRC:112-2011. The brought together substantial code (IRC:112) distributed by the Indian Road Congress in November 2011 consolidating the code for built up concrete and prestressed substantial designs addresses another age code, which is fundamentally unique when contrasted with past codes (for example IRC:21 for RCC constructions and IRC:18 for PSC structures). IRC:21 and IRC:18 stands removed, with the distribution of IRC:112. The major distinction among IRC:112 and old codes is that IRC:112 dependent on limit state hypothesis while the past codes depended on working pressure plan reasoning.

Harish M K (2017) Bridges square measure illustrated as constructions that square measure gave a section over a spot while not shutting way beneath. they'll be needed for a section of railroad, street, pathway and in any event, for carriage of liquid. The plan of a Highway bridge is fundamentally dependant on principles and measures for the security, quality and generally speaking expense of the project. Box culvert bridges are frightfully unexceptionally utilized. It's a bridge that has its principle radiates including culverts inside the type of empty boxes. The box shaft conventionally incorporates of pre-focused on cement, steel or steel concrete. Different programming's can be utilized for the Analysis and plan of bridges which will be vastly improved and less tedious contrasted with manual estimations. This venture examines the Analysis of Box culvert bridges under IRC stacking of two various sorts Single cell and Multi cell with IRC standard codes kept superstructures exposed to heap of weighty vehicles utilizing CSI Bridge programming 2015 rendition to know its primary conduct and to conclude which standard code is better when looking at the outcomes in deciding the prudent segment in all perspectives for the expected issue explanation. Likewise to be familiar with the demonstrating design utilizing CSI bridge and to know the primary behaviour considering the bridge object reactions and flat snapshots of both single cell and multi cell box culverts under IRC stacking conditions.

Sujith Mangalathu (2017) In this paper, To have a precise evaluation of provincial harm, it is basic to give delicacy bends that best address the bridge stock. Be that as it may, it is unfeasible to foster exceptional delicacy bends for each design across a territorial portfolio. One methodology that has been taken on to address this test is to bunch bridges into classes with comparative plan or primary execution. Generally, this gathering has been performed dependent on a somewhat emotional ID of sub-classes. Nonetheless, such a recognizable proof prompts various bridge classes and unjustifiable gathering. This work proposes an exhibition based gathering strategy to bunch the box-culvert bridges in California, and is the primary precise methodology in sub-binning bridge classes for the provincial danger evaluation. The proposed gathering and scientific delicacy system is utilized to infer delicacy connections for single edge box culvert bridges in California. This work finishes up with the use of AI methods for the age of bridge-explicit delicacy bends.

Xudong Shao (2017) The attainability of the proposed RPC box-culvert bridge structure was approved through the preliminary plan and the trial concentrates in this paper, further exploratory and mathematical investigations before the use of the new design are as yet required, including

enhancement of the prestressing and anchor subtleties for the prestressing ligaments, flexural limit of the box culvert, shear steadiness furthermore limit of the ribbed section structure, torsional impacts of the flimsy walled box culvert, temperature impacts of the box culvert, weakness conduct of the deck sections, dynamic conduct under wind loads, and seismic conduct of the entire bridge structure.

Hamad El Hamad (2018) The necessary measure of post-tensioning ligaments (PT) demonstrated to increment as the thinness expanded for both development techniques. The PT and the slimness of the bridge in this way clearly corresponded. This peculiarities is clarified by the differentness of each examined cross area. As the cross segment stature builds, the slimness diminishes. Unintentionally the cross segment region is additionally expanded which in its go gathers to a higher modulus of flexibility. With a high modulus of versatility a higher stiness, EI, is procured since the modulus of flexibility is reliant upon the mathematical properties, like tallness. Anyway the cross areas with higher stiness creates more modest interior bowing minutes and therefore less anxieties contrasted with the cross segments with lower statures (higher thinness proportions).

Anizahyati Alisibramulisi (2018) In this paper, a box culvert bridge, comprised of prestressed concrete and built by utilizing cast in situ factor profundity Balance Cantilever Method was utilized as a contextual investigation. The goals were to investigate dynamically and plan the box culvert bridge by utilizing both Ultimate Limit State (ULS) and Serviceability Limit State (SLS). This review was simply restricted to one part of the box culvert. STAAD.Pro programming was utilized to examine and plan for both cutoff states. The consequences of the two investigations were utilized for acquiring the measure of fortifications required furthermore for checking the break width limit. Ideally, this paper can be utilized as a rule for engineers in planning box culvert bridge dynamically. In this way, it tends to be presumed that, the cross over investigation (STAAD.Pro) and plan of the primary component in the box culvert examined, were viewed as agreeable under both extreme cutoff state (bowing and shear check) and workableness limit state (break limit check) conditions determined by BS5400.

Abdou Khalaf Mohamed (2018) Post-tensioned, pre-focused on bridges are portrayed by better dependability and execution. The pressure dispersion in the two ways, longitudinal "X" and cross over "Y", of Box-Culvert bridges is non-uniform, so it has complex conduct. As of late there are a lot of programming for the plan and examination of bridges. Utilizing programming for bridges' plan is obviously superior to the manual strategy. This paper includes displaying and examination of a Box-Culvert with three distinctive molded, post-tensioned cells. Three variable states of multi-cell Box-Culverts "Vertical-outside culvert, slopped-outside culvert and outside culvert with greatest slant" with similar region and various profundities (2, 2.3 and 2.6m) were displayed and investigated utilizing CSI-Bridge program, 2017-form. The examination is conveyed under dead burden, moving live burden (as indicated by the code of stacking in Egypt), and pre-focused on load. A few outcomes, for example, avoidance and longitudinal pressure were examined and dissected.

Md tauheed reyaz (2018) In this article, A bridge might be an implies that by that a street, rail line or elective assistance is extended partner degree deterrent like a stream, sorrow and elective street or rail line, either with no transitional help or with exclusively a confined scope of supports at advantageous areas. Strength, security and economy region unit the 3 key choices that can't be disregarded before the perfection of kinds of bridges. While choosing the sorts of bridge, ranges and elective boundaries region unit to be concentrated meticulously to satisfy the positive conditions.

Shubham Sirse (2020) Bridge is the construction which is utilized for conveying the traffic over the valley or stream by associating thruways or railroads. There are sorts of bridges which are T-shaft bridges and box culvert bridges where the T-radiates are compelling in opposing bowing giving pliability to the bridges. While box culverts gives high torsional solidness giving pliability, steadiness and furthermore style. Various codes with differing plan theory are utilized for planning these bridges, for example, IRC:21-2000 and IRC:112-2011. Consequently the motivation behind

this paper is to look at the consequences of investigation and plan of various papers performed utilizing these codes for both the sorts of bridges for example T-bar and box culvert bridge. Different scientists studies are accessible on the plan and examination of T-bar bridge and box culvert bridge utilizing IRC:112-2011 and IRC:21-2000. The motivation behind this review is to decide the most efficient and best plan code for both T-shaft bridges and box culvert bridges.

---

#### IV. CONCLUSION

Box culverts are incredibly solid, strong, and simple to build. These buildings can be used on soft soil because they don't need a distinct foundation. The stability and rigidity of the structure, as well as the almost complete lack of maintenance, are discussed in these evaluations. It can also be a box construction with two or three spans, and it can be examined under various loading conditions with various aspect ratios.

It can also be examined for variations in cushion depth on the culvert's upper slab. In order to easily implement the aspect ratio at the site, calculate the forces and stresses in the structure for various aspect ratios.

## REFERENCES

- [1]. Kenneth W. and Shushkewich M. (1986) " Membrane Forces Acting On A Box Culvert Bridge" J. Struct. Eng. 1986.112:1900-1907 ASCE.
- [2]. Bruno Massicotte (1994) " Monitoring of a Prestressed Segmental Box Culvert Bridge During Strengthening" PCI JOURNAL.
- [3]. Khaled M., Sennah, M. and John B. Kennedy F.(2002) " Literature Review in Analysis of Box-Culvert Bridges". JOURNAL OF BRIDGE ENGINEERING ASCE.
- [4]. G. C. Ezeokpube (2006) " REVIEW OF ELASTIC ANALYSIS OF BOX CULVERT BRIDGES" Nigerian Journal of Technology (NIJOTECH) Vol. 34 ISSN: 1115-8443.
- [5]. HE Jun, LIU Yuqing and CHEN Airong (2008) " A review of the diagrid structural system for tall buildings" Journal of Highway and Transportation Research and Development Vol. 3.
- [6]. Dongzhou Huang (2008) " Full-Scale Test and Analysis of a Curved Steel-Box Culvert Bridge " Journal Of Bridge Engineering © Asce DOI: 10.1061/ASCE1084-0702200813:5492.
- [7]. Zakia Begum (2010) " Analysis And Behavior Investigations Of Box Culvert Bridges" University of Maryland, College Park.
- [8]. J.S.Kalyana Rama , V.R.Raghava Sudhir And V.Sampath Kumar (2010) " Study And Behaviour Of Box Culvert Bridge" V.R.Siddhartha Engineering College Kanuru, Vijayawada-520007 Nagarjuna University.
- [9]. Peter Feenstra and Jeremy Isenberg (2012) " Dynamic Amplification Factor for Light Rail Vehicle Transiting Box-Culvert Bridge" Structures Congress 2012 © ASCE.
- [10]. Laxmi Priya Gouda (2013) " Study On Parametric Behaviour Of Single Cell Box Culvert Under Different Radius Of Curvature" National Institute of Technology Rourkela Odisha.
- [11]. Cheng Kang (2015) " Research on Construction Process of Steel Box Culvert Bridge and Its Stress Analysis" AASRI International Conference on Industrial Electronics and Applications.
- [12]. Phani kumar, S.V.V.K. babu and Aditya Sai Ram (2016) " Analysis and Design of Prestressed Box Culvert Bridge by IRC: 112-2011" International Journal of Constructive Research in Civil Engineering (IJCRCE) Volume 2, Issue 2, ISSN 2454-8693
- [13]. Harish M K, Chethan V R and Ashwini B T (2017) " Analysis Of Box Culvert Bridges Under Irc Loading" International Journal of Scientific Development and Research (IJS DR) Volume 2, Issue 9 ISSN: 2455-2631
- [14]. Sujith Manglathu (2017) "Performance Based Grouping And Fragility Analysis Of Box-Culvert Bridges In California" Georgia Institute of Technology.
- [15]. Xudong Shao, Rensheng Pan, Hao Zhan, Wei Fan, Zhijie Yang and Wei Lei (2017) " Experimental Verification of the Feasibility of a Novel Prestressed Reactive Powder Concrete Box-Culvert Bridge Structure" DOI: 10.1061/(ASCE)BE.1943-5592.0001033. © 2017 American Society of Civil Engineers.
- [16]. Hamad El Hamad and Furkan Tanhan (2018) " Analysis of post-tensioned concrete box-culvert bridges " TRITA-ABE-MBT-18243 ISBN 978-91-7729-896-0.
- [17]. Anizahyati Alisibramulisi, Mohammad Noor Abu Hassan, Ahmad Ramlan Abu Talib, Hamidah Ramaley, Aqilah Ahmad Zaini and Renga Rao Krishnamoorthy (2018) " Transverse Analysis and Design of Box Culvert Bridge by using STAAD.Pro " International Conference on Concrete Engineering and Technology doi:10.1088/1757-899X/431/11/112005.
- [18]. Abdou Khalaf Mohamed, Abdel kader A. Haridy and Zakaria H. Awadallah (2018) "Behavioural Investigation Of Prestressed Concrete Bridges Having Box Culvert With Three Cells" Journal of Engineering Sciences Assiut University Vol. 6
- [19]. Md Tauheed Reyaz, and Syeda Nikhat Fathima (2018) " Analysis and Design of Segmental Box Culvert Bridge" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 03
- [20]. Shubham Sirse, Kuldeep R. Dabhekar, Isha P. Khedekar and M. B. Saiwala (2020) " Review of Design and Analysis of Box Culvert Bridges And T-Beam Bridges Using IRC Codes" International Journal of Scientific Research in Science and Technology IJSRST Volume 7 Issue 3 ISSN: 2395-6011.