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A REVIEW ON BOX PUSHING TECHNIQUES AND ITS ANALYSIS

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Abstract

Box culverts are used to drain water from roads, railway lines, overpasses, etc. These are structures used when rivers flow along the river. They are generally less expensive than bridges, making them ideal for crossing natural streams. This study includes the analysis and opinions of different authors regarding the design and analysis of box culverts using software methods and a comparison of the software and the manual. The design of concrete culvert adopts IS standard of Road and Bridge Design Guide (IRC-6-2000, IS 21-2000). This article investigates different IRC load groups and their effects on irregular and irregular shapes of box culverts. Then check the tank pressure for padded and unpadded cargo tanks. The design should take into account pressures (fixed, full, overloaded) and impact loads, braking forces, load distribution due to backfill, good width, soil pressure coefficients, live loads, etc. It includes taking into account factors such as: The structure is designed to withstand maximum bending moment and shear force respectively. In this study, the requirements, decisions and rationales in the specifications for all of the above designs are discussed in detail.

Keywords:
Box Culvert, Design Coefficients, Loadings Types, Moment, Shear, Pressure Cases.

Introduction

A culvert is a device that creates a barrier between a stream, river, or road, allowing it to pass without blocking the road below. The grille is defined as a standard specification with a clear distance of 6 m for each model, whether single or multi-cell. Box culverts are so named because of their shape and orientation, which resembles a hollow box in which two plates and two vertical walls are connected together as one piece. Box culverts are simple in design and economical in construction. It is designed to carry all the loads of the upper table and send them to the base plate with the help of vertical walls, which are generally located in places where soil capacity is low. Box culverts are very economical due to their rigidity and monolithic operation, there should be no separation when the base plate is placed on hard soil. The model was designed as a rigid frame and the time distribution method was used to obtain the final time distribution along the vertical wall. Box culverts generally occur in three places; the first is at the bottom of a depression where natural waterways do not exist, the second is where a natural stream intersects a road, and the third is where surface water must pass below into the channel. road and driveway. Locations of neighboring properties. Box culverts have problems such as performance, strength, rock wear and deterioration. The main reason for masonry culverts is mud and rock accumulation and clogging. There are two types of vents; rigid culverts (e.g. concrete) and flexible culverts (e.g. steel). Rigid culverts can withstand bending moments while flexible culverts cannot. The process and hydraulic design of box culverts is different from the construction, maintenance, replacement and repair processes of bridge construction. The main features of box culverts are, firstly, that they are hydraulic, the culvert is designed with maximum flood or peak, and the inlet is submerged in water to increase hydraulic efficiency. Secondly, the culvert system is designed to withstand all dead loads, live loads, high loads, impact loads and braking forces protected by the structure and soil. The third is maintenance, especially when the culvert will be seasonally flooded, where debris and rubble are a problem. The fourth is to use the strength of the container and the surrounding embankments to use the culverts to move the truck. Finally, the fifth point is that material quality is a big problem for water structures such as box culverts. Corrosion and wear of consumables can harm the environment.

Culverts are primarily divided into several groups according to the type of material, the first is

concrete material. Culverts can be prefabricated or cast-in-place. The choice depends on size, type, flexibility, etc. It depends. Precast concrete is easy to use and install. Cast-in-place culverts are constructed on site and take a long time to construct. The second is corrugated steel, which is produced in factories and called corrugated steel plate, this type of culvert pipes are made from steel pipe profiles. It is used in steel plate steel pipe grilles to obtain wide openings. Third, corrugated aluminum corrugated culverts are made using factory-made corrugated aluminum pipes and can be used as standard panels for box culverts and tall models. The fourth type is plastic pipes, which are made of various materials depending on the resin base made from the chemical formula, have good strength and good performance, and the final resin is used to form the pipes. According to the shape of the box, the first type is the round pipe, which is the best part of the culvert pipe. Small span pipes are often preferred because they are structurally and hydraulically efficient in many cases. The second is the arch tube or elliptical shape, usually used where the distance from the reverse duct to the road surface is limited, compared to the round shape used in areas where vertical clearance is less. Third, arch culverts cause less impact on waterways than pipe arches, and these structures also meet scour design standards. The fourth is the box-shaped section or square and rectangular section, which is currently frequently used, due to the corners of the structure is not good hydraulically and structurally, it is best to solve the light problem of angles. Fifth, where the channel is very wide, more units are used, and openings of the same length and height are used to provide the necessary channels for the flow of water to prevent clogging problems when the water volume is large.

Advantages of Box Pushing techniques

Box pushing techniques, despite their drawbacks, also offer several advantages:

- **Cost-Effective:** In terms of initial investment, pushing boxes requires minimal equipment, making it a cost-effective method for moving goods within a warehouse or logistics environment.
- **Simplicity:** The technique is straightforward and easy to implement, requiring minimal training for workers to execute effectively.
- **Versatility:** Box pushing can be used in various settings, including warehouses, retail spaces, and even small-scale operations, making it a versatile method for handling goods.
- **Accessibility:** Unlike more sophisticated methods that require specialized equipment, box pushing can be employed without reliance on expensive machinery or technology.
- **Adaptability:** It can accommodate different types of boxes and packaging, allowing flexibility in handling various sizes and shapes of items.
- **Quick Setup:** There's no extensive setup required, allowing for immediate use in situations where rapid movement of items is necessary.
- **Space Utilization:** While it has drawbacks in space efficiency, in some cases, box pushing can be advantageous for moving boxes in open spaces or when there's ample room for maneuverability.
- **Supplement to Automation:** In conjunction with automated systems or machinery, box pushing can complement operations, especially when moving items within a facility to and from automated zones.
- **Reduction of Forklift Traffic:** In environments where forklifts or other heavy machinery might not be ideal or feasible, box pushing can reduce traffic and potential hazards associated with larger equipment.
- **Temporary Solution:** In situations where other means of transportation are temporarily unavailable or unsuitable, box pushing can serve as a temporary solution for moving goods.

While box pushing has limitations, its simplicity, cost-effectiveness, and adaptability make it a viable option in certain scenarios, especially in smaller-scale operations or when used as part of a broader logistics strategy.

Drawbacks of Box Pushing techniques

Box pushing techniques, often employed in logistics and warehouse management, have several

drawbacks:

- **Labor Intensive:** Physically moving boxes can be labor-intensive, leading to fatigue, potential injuries, and increased labor costs.
- **Space Inefficiency:** Pushing boxes can take up more space than necessary, especially if they are not stacked optimally, leading to inefficient use of storage space.
- **Limited Weight Handling:** There's a limit to the weight that can be pushed, which might restrict the handling of heavier items.
- **Risk of Damage:** Pushing boxes, especially if done hastily or without care, can lead to damage to the boxes or the items inside, affecting inventory quality.
- **Uneven Surfaces:** Pushing boxes on uneven surfaces or rough terrains can be challenging and might cause difficulties in maneuvering.
- **Limited Maneuverability:** In crowded or narrow spaces, pushing boxes might not be feasible due to limited maneuverability, potentially leading to delays or accidents.
- **Health and Safety Concerns:** Continuous box pushing can result in repetitive strain injuries or musculoskeletal issues for workers.
- **Lack of Precision:** Pushing techniques might lack precision, making it difficult to accurately position or organize boxes, especially in intricate storage systems.
- **Environmental Impact:** Constant movement of boxes via pushing might contribute to wear and tear on packaging materials, leading to increased waste generation.
- **Speed and Efficiency:** While pushing can move items, it might not be the fastest or most efficient method, particularly in high-volume operations.

Optimizing handling methods by combining pushing with other techniques or implementing automated systems can help mitigate some of these drawbacks.

Literature

1. D Patil, A. A Galatage (2016), The maximum bending moment of each load may be calculated without buffering, the analysis is done manually, and the box's design and analysis can be completed with buffering. The combination is critical for all rates, whether the frequency is variable or fixed (with or without buffering) and bending time. The water ratio of 1:1.5 has very little effect, but the ratio of 2:3 has no effect at all.

2. Ajay R. Polra, Pro. P. Chandresha, Dr. K.B Parikh (2017), Analysis and comparison are done on design factors such as load cases, widths or distribution angles, cushions, and global pressure box coefficients. Consequently, there will be more stress produced in the absence of the pad and a maximum live load generated either with the pad and zero distribution angle or without the pad.

3. Ayush Tiwari, Dr. Sudhir S. Bhadouria (2017), Every project has its slab and RCC box inspections, measured with quantity estimates, specs, and SOR details finished. Consequently, solid slabs are recommended for RCC box bridges up to a span of 9 meters, and for spans up to 15 meters, solid slabs should be utilized.

4. B. Sravanthi, G. Ramakrishna Rao, Dr. M. Kameshwara Rao (2015), Using Staad pro software and IRC and IS codes, all design elements and coefficients were manually designed and analyzed. Therefore, depending on the length and a few other parameters, the quality of the culvert box is either one or two culvert boxes.

5. Ketan Kishor Sahu, Shraddha Sharma (2015), We appreciate the efforts made with the aid of software, which included hydraulic parameters, yield capacity, load, bending moment, shear force, charts, graphs, and directions. variations in the outcomes of several parameters, such as. Software that focuses on the bending moment of the floor, side walls, and ceiling is not used in the findings obtained in accordance with the hydraulic instructions; please refer to the table for various products.

6. Mahesh D. Kakade, Rajkumar A. Dubai (2017), IRC guidelines and FEM (ANSYS) software were used in the study's execution. As an example, consider a 3 x 3 m box culvert. The design period, total load, and braking force are determined, and the deformation is evaluated under unbuffered and

buffered situations as well as under normal stress, main stress, and Von no stress. This means that in the absence of the pad, there will be greater deformation, a higher maximum central stress, and greater normal stress, shear stress, and tensile balance..

7. M. Bilal Khan, M. Parvez Alam (2015), This page discusses the flow field's hydraulic design, the maximum HFL, the field's length, cross-section, velocity analysis, and the empirical Dickens formula for calculating flow, depth, and leap height. the apron's length and area. The 2 m x 2 m box culvert is required. The culvert is designed manually. The box size and shape are defined by the flow rate and scour depth. The jumping platform is identified as the wave jumping platform.

8. Neha Kolate, Molly Mathew, Snehal Mali (2014), All design choices for roads and bridges were made through research utilizing manual computations and IRC codes, and the appropriate boxes were created by hand as well. The outcome is a box culvert, which has several benefits and is more cost-effective than pipe. If it is implemented, it will affect the design.

9. Saurav, Ishaan Pandey (2017), Using ANSYS software, a comparison was done between the models that were utilized in the final system and Staad pro software. Outcomes They discovered that a decent FEM of 16.8% with ANSYS software might result in significant cost savings and more inexpensive design using two analytical techniques.

10. Sujata Shreedhar, R. Shreedhar (2013), The thrust coefficients, shear force, and bending moment of single- and double-chamber culverts were computed using Staad Pro software. Consequently, the culvert box's design is L/H = 1.0, L/H = 1.25, etc. includes details on the effects of the variations. Also displayed are loads and moments.

11. Vaishali Turai, Ashish Waghmare (2016), Through the use of cost, time, performance, and data analysis, the Berackeven technique and payback duration were investigated. They therefore determined, by use of two approaches, that the prefabricated construction's cost and duration were less than the on-site structure's.

12. Vasu Shekhar Tanwar, M. P Verma, Sagar Jamle (2018), Using Staad Pro software, a particular analysis of the culvert was conducted. The results are shown in the figure along with guidelines for reducing bending moment and displacement. Consequently, software is used to minimize bending and changing time, which is then reported as a percentage of the outcomes. Responses to the enlarged section's model modifications were positive.

13. Vasu Shekhar Tanwar, Dr. M. P Verma, Sagar Jamle (2018), This article examines how the tension of expansion rises and the shear rate falls as expansion increases. The leader is less stressed and adapts to changes well. Therefore, employing extended sections in various scenarios, the study provides drawings and their modifications with the stress value lowered.

14. Virendra Singh D. Chauhan, Gunvant Solanki, Minu Tressa (2017), The diagonal model, seismic response, dynamic response, etc. are covered in this article. He carries out investigation, analysis, and several tests to reinforce the diagonal box's displacement at all angles, including Consequently, as comparison to a straight road, the inclined road's length drops before it does, the bridge deck's deflection lowers as the angle increases, and the pier's stiffness increases as the angle grows. impact on the bridge's rigidity.

15. Zengabriel Gebremedhn, Guofu Qiao, Jilong Li (2018), This article models and analyzes the prefabricated steel box culvert using the finite element technique and ABAQUS. It also tests the box's stress and deflection and verifies its performance by creating load-deflection and load-stress graphs. The findings demonstrate that process warnings may be sent prior to the sample failing by modeling and analysis of the prefabricated box utilizing finite element analysis and an understanding of the steel requirements (primarily load, deflection curves, and load-stress curves).

Conclusion

Accessible in a variety of sizes, shapes, and materials. The most affordable and long-lasting hollow box culverts are made of concrete. When making situational decisions, creating and evaluating boxes can help you save time and money, enhance planning and management, and lower risk. Making the

box is simple, quick, and achievable in terms of cost. Using the time distribution approach, it is possible to analyze the results of the specified parameters. Compared to boxed items, unboxed products cause higher stress. Three high tanks are intended to be housed within the culvert box. Class A loads are also computed using Class-70(R) loads.

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