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Detailed Analysis of Pre-Cast Box Segment and Thrust Bed and Thrust Wall Using Staad Pro

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Abstract: ***The analysis of Pre cast box is done by using STAAD Pro. And design of Thrust bed is done by Limit state method manually. Box pushing is pushing a large precast reinforced concrete box horizontally through the ground, usually beneath a road or railroad that must not be interrupted. The major advantage of the process is its essential simplicity. The structure is built away from the roadway, in the clear, without the constraints of shoring and traffic controls. When the structure is ready, a shield is fitted to the front, hydraulic jacks are installed behind, and the box is pushed into final position while simultaneously the earth is excavated from within. The pushing of box generally takes only a few days to a week. During that time, traffic is proceeding overhead normally, unaware of the construction below. The nondisruptive nature of the process together with its inherent safety, simplicity and economy make box pushing a useful tool for the practicing civil engineer. This paper intends to bring a greater familiarity with the box pushing process to the reader and then give some considerations and guidelines to assist engineers in designing a project that can be built using the box pushing method. Box pushing is a well- established means of engineering culverts or tunnels under rail embankments or waterways to accommodate road or rail traffic.***
Keywords: Road under bridge, Level crossing, Box pushing technique, RUB, Subway.

I. INTRODUCTION

As the cities are well established, the land acquirement for construction of ROB is difficult and sometimes not possible, so under such conditions engineers go for RUB's. There are three main methods for construction of road under bridge: Box pushing method, rolling technique using RH girder and cut & cover method.

Box pushing method - In Box pushing method pre cast Box segments are used and pushed through the heavy embankments of rail or road by Hydraulic Jacks and process is called Jacking. The required thrust is generated through thrust bed and the line & level of precast boxes are also controlled by thrust bed.

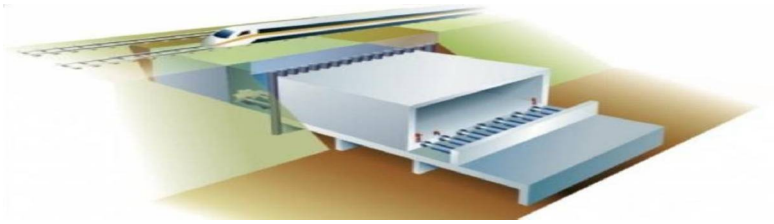

Figure 1 Box pushing technique

II. LITERATURE REVIEW

Chaithra U et al. (2021) Discussion on "Parametric Study on Single Cell Box Culvert Design Considerations" and the fact that box culverts are a cost-effective alternative to bridges and an important part of transportation networks. The stiffness matrix method is used in this paper to analyse box culverts. Assume discrete boundary conditions for box culverts. Specifically, we assume that the structure consists of a top slab, bottom slab, and two vertical side walls that form a closed rigid box frame. We also assume that the structure has an external design.

Khan and Mandloi (2020) The study focused on analysing and designing pre cast boxes for underbridge and bridge road applications. It was done using Staad Pro. The paper explains the Box Pushing Method of building a road under a bridge or a subway tunnel. It is normal for traffic to continue overhead during this time, oblivious to the construction beneath. A cycle's inherent ease, effortlessness and economy, as well as its inalienable wellbeing, make it a valuable tool for a practicing structural designer.

By means of this report, we intend to give a more in-depth understanding of the container pushing cycle to the perused, and then give a couple of considerations and rules for engineers to help plan an undertaking that can be made using the container pushing strategy. Pushing boxes under rails or streams is a familiar method for designing ducts or passageways to accommodate street or rail traffic under rail banks.

Bhujade and Gaikwad (2020) Researched the design of a RCC box culvert with and without a cushion. The purpose of this paper is to compare the performance of reinforced concrete box culverts without and with a cushion using the limit state method. In accordance with IRC, the culvert section is designed on the basis of vehicular loads. The thick culvert section and vehicular loads combined create a harmful effect for the structure. Using STAAD Pro, the engineering elements and requirements of steel are designed to withstand maximum bending moments and shear forces.

Patel and Jamle (2019) Researched the analysis and design of box culverts using the manual approach. In this study, the design parameters of box culverts are considered, including earth pressure effect, the depth of cushion at the top slab, braking force, impact load, live load, dispersion of loads through tracked or wheeled vehicles, effective width, and so on. The objective of this work is to analyse culverts with and without cushions to obtain bending moments and shear forces with and without culvert cushions under different types of IRC loading conditions. The paper provides a detailed discussion of the provisions and justifications provided by Indian Standards while considering their design implications.

Ranjeet et al. (2019) discuss the Procedure and Construction of Road under Bridge by Box Pushing Method. This paper describes various types of Road under Bridge construction. In this paper, the detailed about implementation of RUB soil friction, capacity of jacks and its uses and skew Angles.

Mahto D et al. (2018) A Review on Bridge Construction Technology: This paper describes the details about the bridge construction technology. This paper also review the existing various types of bridges with the history of worldwide bridges and their classification based on materials used in the performance.

K. Asudullah Khan (2017) the study of problems involved during execution of Railway under bridge using box pushing technique and its remedies: This paper gives attention towards problems that arises during execution of RUB using box pushing technique and its remedies. It also explains about the methodology involving in application in subway construction.

Manisha D. Bhise et al. (2015) Analysis of push back Bridge: The design steps of RCC Box explained in this paper. Design has been examined by 2D frame with various load combinations and soil stiffness. Importance of RCC box type underpass also described.

Mohankar R. H. et al. (2015) Parametric Study of Underpass Bridge: 3D model of box bridge structure has been analyzed in this paper. The comparison of various conditions for the sheer force, bending moment, stiffness and other factors of design have been compared in this paper.

G.Sampath Kumar (2015) Box pushing technique on Railway under bridge for cross traffic works: This is a case study of Railway under bridge (RUB) construction by box pushing technology. The design of pre cast box prepared by using STAAD pro software.

Jha et al, (2015) had done Comparative Study of RCC Slab Bridge by Working Stress (IRC: 212000) and Limit State (IRC: 112-2011) and found that the thickness of slab was 500mm for WSM which was reduced to 400mm for both carriageways still there was about 20% saving in amount of concrete and 5-10% saving in amount of reinforcement for LSM i.e. LSM was considerably economical design compared to WSM.

Lingampally Maithri Varun et al. (2015) Analysis, design and technology that is pushing box (Bridge): The pushing of RCC Box methodology has been explained in detail. Tools and supporting instruments/structures required for box pushing technology, such as, thrust bed, front shield, rear shield, pin box, jacks, etc. are also described.

Shivanand and Shreedhar (2015) had done Comparative Study of Slab Culvert Design using IRC 112:2011 and IRC 21:2000 and found that in limit state method of design, the utilization capacity of limiting moment increased with increasing the span which was up to 65%.

A. Nagaraju and B.Vamsi Krishna (2015) Analysis, Design and Execution of Cross Traffic Works Using Box Pushing Technique for Railway under Bridge: This paper describes the case study of road widening while crossing through the Railway track. It explains about the methodology involve in execution of pushing technique and detailed arrangement of thrust bed is explained.

Mali et al., (2014) studied some of the design parameters of box culverts like angle of dispersion or effective width of Live load, effect of Earth pressure and depth of Cushion and without provided on top and bottom slab of box culverts . They concluded that box with zero Cushion have low design moments and shear stress as compared to the box having Cushion. So steel required was less in the box with no Cushion case as compared to box with Cushion.

Vinayak Demane et al. (2013) Soil Structure Interaction of Underpass RCC Bridge: This paper describes soil structure interaction of RCC box Underpass Bridge. The study conducted by comparing the structure in conditions of rigid support and soil structure interaction applied to base and side walls.

III. MODELING AND SOFTWARE

A. Analysis Software

STAAD stands for Structural analysis and design computer Program originally developed by Research Engineers International in Yorba Linda, CA. Research Engineer International was bought by Bentley Systems. The different versions of the software are used in present time. STAAD III is used by Iowa State University for educational purposes for civil and structural engineers. Now we are using STAAD pro v8i software for structural analysis and design. It can perform various form of analysis in 2-dimension and 3-dimension subjected to different load combinations, support condition etc. depending on engineer's requirement. The provisions for steel design, concrete design, foundation design etc. are also provided according to their relevant codes. The problems of 1st order static analysis, 2nd order p-delta analysis, geometric non-linear analysis, buckling analysis, dynamic analysis, response spectrum etc. can be performed easily. In present work box segment is analyzed by using STAAD.pro software.

B. Model Description

The box is modeled as per the parameters given in Table 1 and the element considered as beam element. Model is shown in fig. 1.

Table 1 Details of structure

S. No.	Particulars	Details
1	Size of the box	7.5 m × 5.15 m
2	Thickness of top slab	0.6 m
3	Thickness of bottom slab	0.6 m
4	Thickness of end vertical walls	0.75 m
5	Effective height	5.75 m
6	Effective span	8.25 m
7	Support condition	Simply Supported

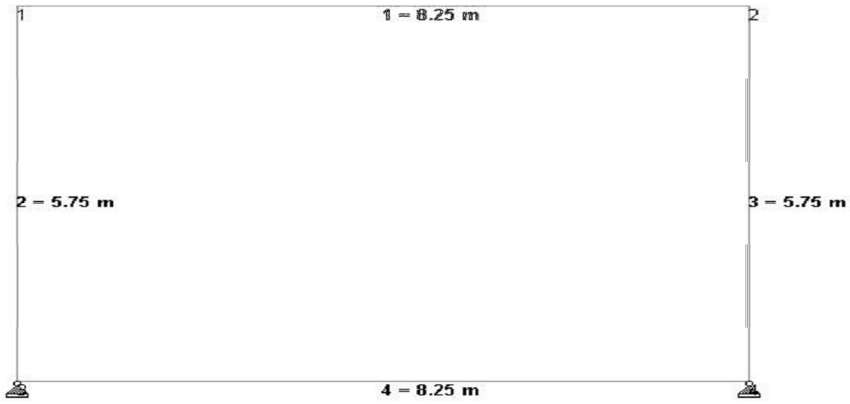

Figure 1 STAAD model of Box segment

IV. CONCLUSION

Based on the above study following conclusions can be made

1) With the box pushing technique, there is no interruption to the traffic moving around.
2) Better quality control due to the provision of precast boxes.
3) Quantities will be less as compared to the conventional method of construction.
4) The cost of construction is less as compared with the conventional method.

V. ACKNOWLEDGMENT

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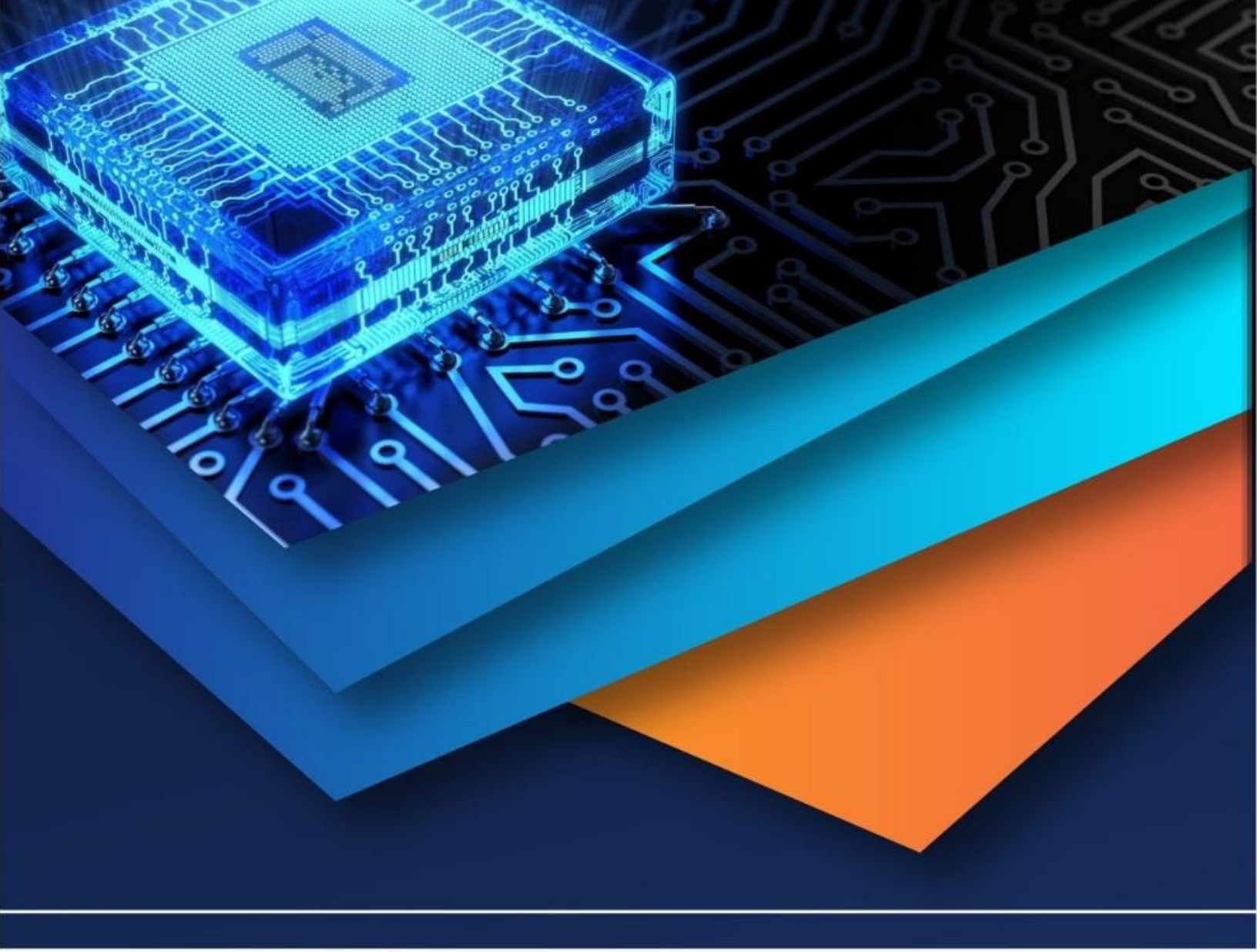

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