International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 6, September-October 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Analysis and Design of Box Underpass Bridge Using Software

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ABSTRACT

In the last few decades, there has been an enormous increase in traffic volume on highways due to population growth and rapid urbanization. To maintain traffic flow, numerous new highways and flyovers have been built. As part of the modern world, bridge construction has come to be considered of international importance. It provides passage over obstructions without closing off the path below. Recent technological advancements have made conventional bridges obsolete. Innovative and cost-effective structural systems have replaced conventional bridges. These days, box type bridges are becoming more popular in modern highway systems, including urban interchanges, because of their efficient dispersal of congested traffic, their economic considerations, and their aesthetic appeal. The structures have many advantages that are useful in freeway and bridge construction, including structural efficiency, serviceability.

***KEYWORDS:** freeway, box type, aesthetic, Innovative, efficiency, serviceability, traffic*

How to cite this paper: Piyush Tiwari | Abhay Kumar Jha | Barun Kumar "Analysis and Design of Box Underpass Bridge Using Software" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-6, October 2021, pp.906-909, URL: www.ijtsrd.com/papers/ijtsrd47525.pdf

IJTSRD47525

INTRODUCTION:

The Underpass RCC Bridge has become popular for moving traffic after it had rarely been used in bridge construction. In some cases, they are built to allow animals to cross the road. It's India's first underpass designed specifically for wild animals, connecting two famous national parks - Kanha and Pench (NH44) - and contributing significantly to the long-term sustainability of tiger populations in the central Indian landscape. These days, box type bridges are becoming more popular in modern highway systems, including urban interchanges, because of their efficient dispersal of congested traffic, their economic considerations, and their aesthetic appeal. The structures have many advantages that are useful in freeway and bridge construction, including structural efficiency, serviceability, improved stability, aesthetics, and economics. At the intersection of the expressway, the Project, and all state highways and district roads, underpasses and overpasses shall be provided for vehicular traffic. In addition to the Project Expressway, under/over passes must also be provided across other roadway categories that cannot be terminated and must continue across the expressway.

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.

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.

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

OBJECTIVE OF THE PRESENT STUDY

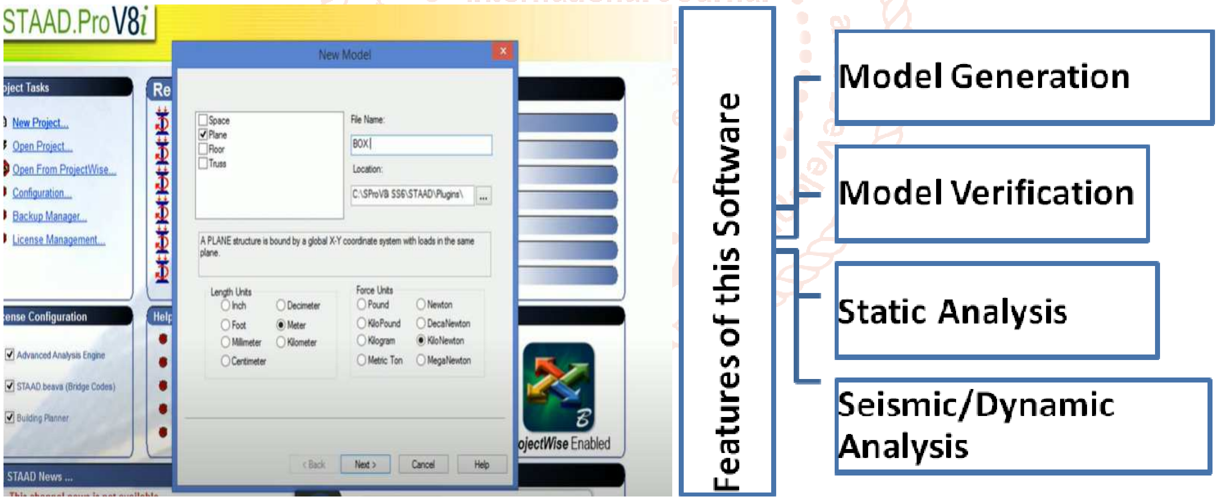
1. The goal of this study is to determine which load combinations produce the worst damage to a structure.
2. To examine the behaviour of box culverts without cushion loads.
3. The economic effect of thickness of haunches in box culverts.
4. Using STAAD pro, analyse RCC box bridges.
5. Designs all structural elements of the box bridge.
6. To check safety of bridge.

FORMULATION

Box structures typically have clear spans of 7m and slab thicknesses of 0.55m, and the slab is fixed supported. Various loads are simulated by STAAD-Pro. Furthermore, the results were analysed by STAAD-Pro which passes through different loads conditions in terms of shear, bending moments, axial forces, and deflection. This resulted in the maximum design moment.

Table 1. Dimensions of structure

S. no	Type of Member	Dimensions or nos.
1.	Top Slab	8000 mm x 21250 mm x 500 mm
2.	Bottom Slab	8000 mm x 21250 mm x 550 mm
3.	Outer Wall	500 mm x 21250 mm x 5000 mm



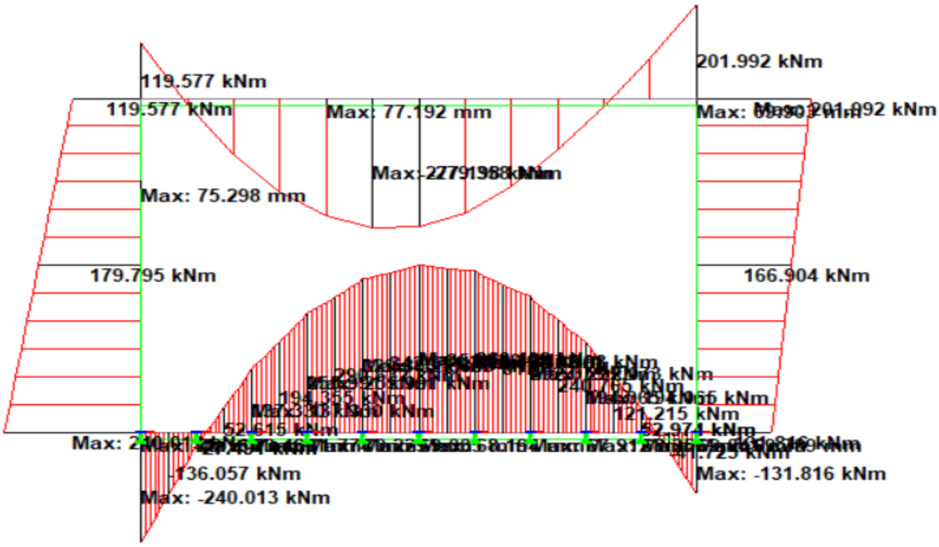
Model generation and analysis Features of this Software

Methodology

We have adopted the following methodology to achieve the objectives mentioned above:

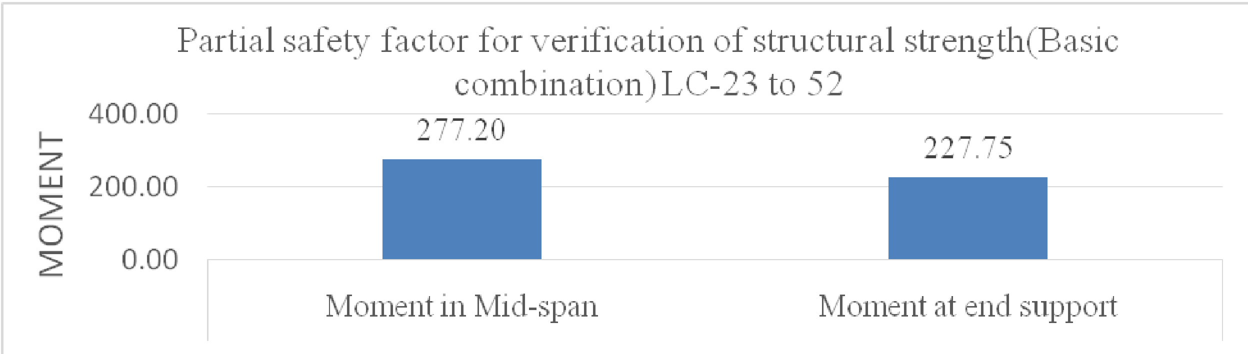
1. Review historical and contemporary literature pertaining to bridge structures of the box type (Underpass Bridge).
2. Materials are evaluated according to engineering properties (such as modulus of elasticity, poisons ratio, tensile strength etc.).
3. Structure modeling and Analysis are completed using the STAAD-Pro V8i software.
4. The geometrical box and the size of the elements are chosen in such a way as to ensure optimal accuracy in the analysis.
5. Specifying the thickness (top slab, side walls, bottom slab) and material properties.
6. The bottom slab has now been provided with spring support.

Maximum Bending Moment



Maximum Bending Moment

RESULTS AND DISCUSSION



Partial safety factor for verification of structural strength (Basic combination) LC-23 to 52 Moment for Top Slab

CONCLUSIONS

From the results obtained and graphs drawn for various loading variations it can be concluded that:

- shear stress at a reference point vary with the variation in position of loads along the longitudinal edge.
- Absolute maximum total deformation (moment) first increases with variation in position of from edge to 3.75 m from RHS and then decreases from 4.5 m to edge from RHS.
- Total deformation, shear stress at a reference point decreases with the reduction in size of box structure.
- Absolute maximum values of Bending Moment occur at center and Maximum Shear force occur at the support of the beam.

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