IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

"ANALYSIS AND DESIGN OF SINGLE CELL RCC BOX TYPE VUP BY USING STAAD-PRO"

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Abstract: The Structure design and analysis is a systematic process in order to predict the responses of real structure under the action of load combination. The design criteria for Single cell RCC Box Vehicular under pass currently used are primarily empirical in nature. In order to have a better understanding of the field behavior of RCC box type vehicular under pass (VUP).Reinforced concrete box VUP consists of top slab, bottom slab and two vertical side walls built monolithically which form a closed hollow rectangular or square single cell or multiple cells. Culverts are required to be used under earth embankment to construct and pass roads. In this study, RCC Box type structure represents in the analyses by a series of beam elements connected at common nodes. The present work reflects on the analysis and design of bridges which are the main source of human life which helps to travel from place to place. The modeling and analysis of single cell VUP is carried out by using the software Staad-pro software. The Single cell VUP we designed is box Culvert Bridge. The design loads are considered as per IRC 6. Box structure VUP is designed by using Staad-pro and results are compared manually with excel calculation and staad.pro design report.

Keywords – **Structure, design, nature, analysis, beam, elements.**

I. INTRODUCTION

Bridge construction nowadays has achieved a worldwide level of importance. With rapid technology growth the conventional bridge has been replaced by innovative cost effective structural system. The efficient dispersal of congested traffic, economic considerations, and aesthetic desirability has increased the popularity of RCC Box type bridges these days in modern highway systems, including urban interchanges. They are prominently used in freeway and bridge systems due to its structural efficiency, serviceability, better stability, pleasing aesthetics and economy of construction. They are efficient form of construction for bridges because it minimizes weight, while maximizing flexural stiffness and capacity. It has high tensional stiffness and strength, compared with an equivalent member of open cross section. Although significant research has been underway on advanced analysis for many years to better understand the behavior of all types of RCC Box bridges, the results of these various research works are scattered and unevaluated. Hence, a transparent understanding of more recent work on straight and curved RCC Box bridges is highly desired which divulged the attention towards aiming a present study. The main objective is to provide a clear vision about the analysis and design of RCC Box type minor. This study would enable bridge engineers to better understand the behavior of RCC Box Bridge outlining a different approach towards analysis and design.

II .OBJECTIVES OF THE PRESENT STUDY

- Prepare model and analyze RCC Box using STAAD PRO software.
- To assess the results of STAAD PRO and manual calculations.
- To design elements of the RCC Box as per IS codal provisions with specifications.
- The main objective of this present study is to study the behavior of box type minor bridge or vehicular under pass when subjected to different combination of loads in terms of bending moment and Shear force variations.
- To show that the maximum design moments and forces developed for the loading condition when the top slab is subjected to the dead load and live load and sidewall is subjected to earth pressure.
- TO analyze Computational method (Staad Pro) is much more competent than Moment Distribution Method (MDM) in term of efficiency of result and time consumption.

III. LITERATURE SURVEY

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.

Rao and Rao (2015) The study was also represented on the topic of designing a structure manually using transactions with linking work using the STAAD PRO program, where the study showed that the possibility of using box culverts with one or more openings depends on the length of the facility, the quantity and strength of water flow, in addition to other factors.

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 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.

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.

IV.DESIGN METHODOLOGY

VUP Box structure can be of different shapes such as arch, slab and box. These can be constructed with different material such as masonry (brick, stone etc.) or reinforced cement concrete. Since Box structure pass through the earthen embankment, these are subjected to same traffic loads as the road carries and therefore, required to be designed for such loads. This Project deals with box structure made of RCC, without cushion. The size, invert level, layout etc. are decided by hydraulic considerations and site conditions. The cushion depends on road profile at the culvert location. The scope of this Paper has been further restricted to the structural design of box. The structural design involves consideration of load cases and factors like live load, effective width, braking force, impact factor, co-efficient of earth pressure etc. Relevant IRC Codes are required to be referred. The structural elements are required to be designed to withstand maximum bending moment and shear force. The Paper provides full discussions on the provisions in the Codes, considerations and justification of all the above aspects on design.

STRUCTURAL MODELING

DESIGN FOR VUP 1 X 15.0 X 7.0 M

This Report is prepared for Design of VUP at the project Stretch, The summery of the Structure is given in the table below.

Table 1: Proposed Span of VUP

S. No.	Proposed Span	Minimum Height (m)	Maximum Height (m)	Camber (%)
1.	1 x 15 m	6.650 ~ 7	6.922	-2.5 %

These Heights were taken after observing the Topographical Data, Geotechnical Report and proposed FRL's.
The Design is done considering the Height 7.0 m.

Table 2: Dimension of structure

S.No	Type of Member	Dimensions or Nos.
1	Top Slab	7000mm x 15000mm x 700mm
2	Bottom Slab	7000mm x 15000mm x 750mm
3	Outer wall	750mm x 15000mm x 7000mm

VANALYSIS IN STAAD PRO

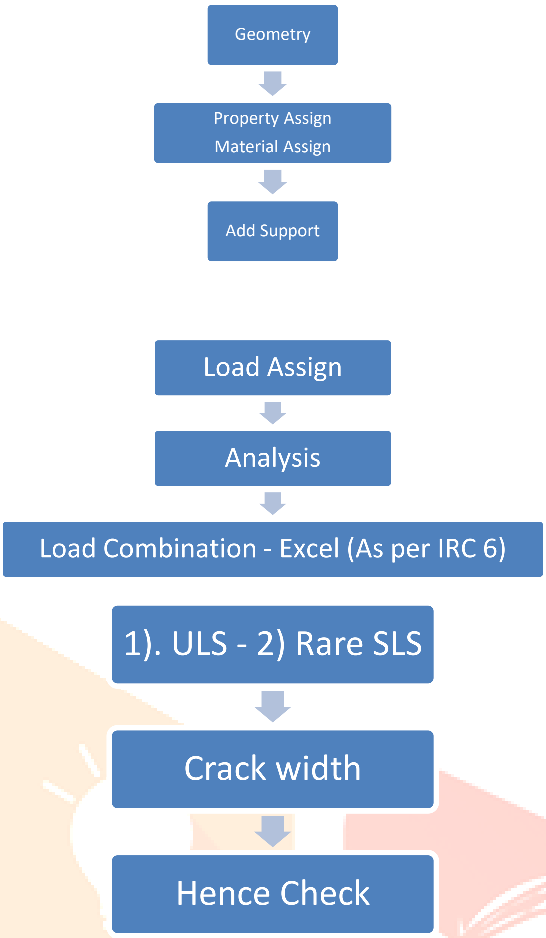

Figure 1 : Flow Chart of Analysis in Staad pro

Assigning Load

Step 1: Having applied the support conditions, we must now determine the Dead Load, SIDL, or structure dead load.

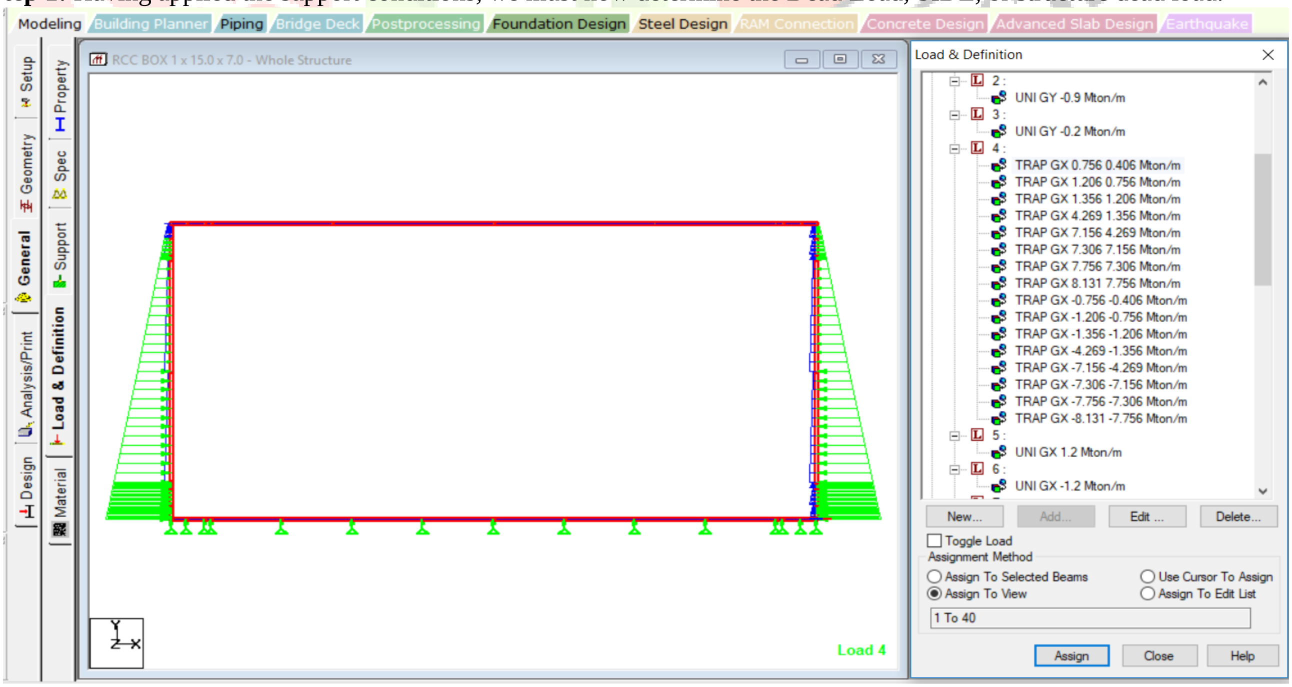

Figure 2. : Assign Support Conditions in STAAD Pro

After the analysis is completed, the design of the bridge is made in accordance with IRC 112-2011 for the optimal section of the bridge for each case considering the same loading and geometry.

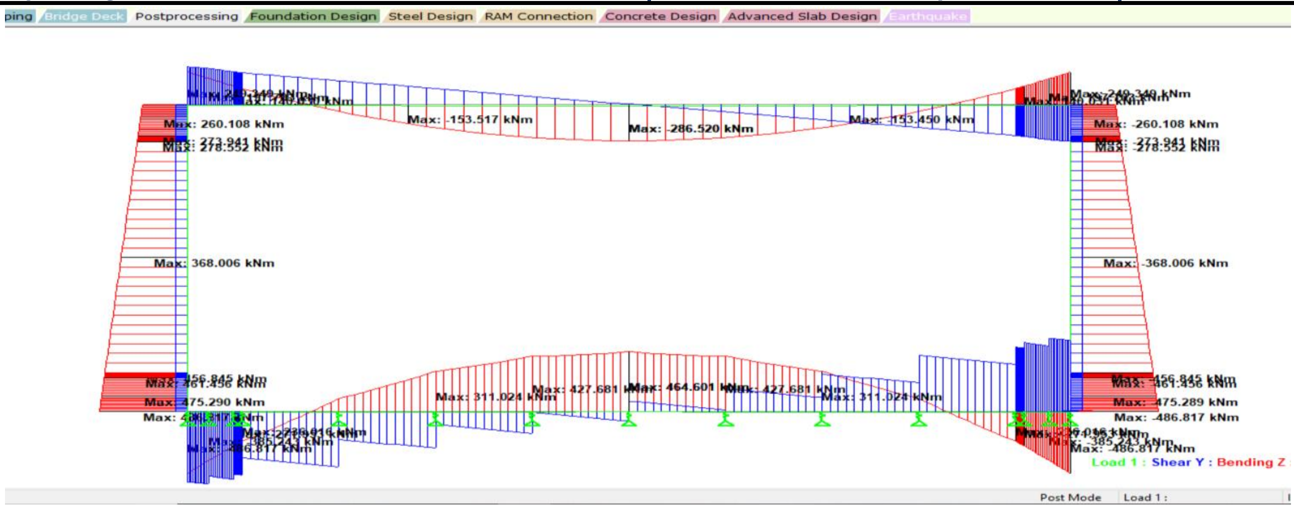

Figure 0. : Max Bending moment and shear force in STAAD Pro

VI.CONCLUSIONS

- It is easy to add length in the event of widening of the road using STAAD PRO.
- The design of RCC Box is covered by using three load cases. The values of design moments etc are marginally more than (close to) the values given by manual calculations for the three load cases.
- The study shows that the maximum positive moment develop at the centre of top and bottom slab for the condition that the sides of the RCC Box not carrying the live load.
- The maximum negative moments develop at the support sections of the bottom slab for the condition that the RCC Box is empty and the top slab carries the dead load and live load.
- The maximum negative moment develop at the centre of vertical wall when the RCC Box is running full and when uniform lateral pressure due to superimposed dead load acts only.
- The maximum shear forces develop at the corners of top and bottom slab when the RCC Box is running full and the top slab carries the dead and live load.

VII.ACKNOWLEDGMENT

This work was completed with the grants and facilities of Lakshmi Narain College Of Technology, Bhopal (M.P.). Authors are thankful to this institute and faculties for extending this cooperation.

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