A Review Paper on Analysis and Design of Pre Cast Box for RUB and Road

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Abstract: *In this study the T-beam Bridge is to be analysis on the STAAD pro software. A T-beam bridge is composite concrete structure which is composed of slab panel, longitudinal girder and cross girder. This project looks on the work of analysis and design of bridge deck and beam on software the specific bridge model is taken of a particular span and carriageway width the bridge is subjected to different IRC loadings like IRC Class AA, IRC Class 70R tracked loading etc. in order to obtain maximum bending moment and shear force. From the analysis it is observed and understands the behavior of bridge deck under different loading condition and comparing the result. The different codes of design will be use in this project are IRC 5-2015, IRC 6-2016, IRC 112-2011, IRC 21-2000.*

Keywords: *T-beam bridge, Staad pro software, IRC Codes, Loadings*

I. INTRODUCTION

A bridge is a structure having a total length of above 6m for carrying traffic or other moving loads across the obstacle, such as a Body of Water, valley, or Road, without closing the way underneath. The development of the country based on the infrastructure available in the country. Highway which allows the flow of human beings and vehicles is a major part of infrastructure. T-beam bridges forms the major proportion of bridges constructed on the highways. IRC codes are developed and used from time to time based on the research work carried out all over the world. It is constructed for the purpose of providing passage over the obstacle, usually something that can be across an object. There are many different types of designs that each serve a particular purpose and apply to different situations. Designs of bridges depending on the function of the bridge, the nature of the terrain where the bridge is constructed, and the material used to make it, and the funds available to build it. A bridge is a structure which is built over an obstacle and hence providing a passage without obstructing the object. The passage may be for a railway, a road, a pipeline, a valley, or a canal. The physical obstacle can be a road, railway, water bodies like river or a valley. The T-beam Bridge is best suited when the span ranged is between 10 to 25 m. T-beam are so called because the longitudinal girders and deck slabs are cast simultaneously to form a T shaped structure. The Superstructure consists of longitudinal girder, cross girder, deck slab, cantilever portion, footpath handrails and wearing coat. T-beam, used in construction, is a load- bearing structure of reinforced concrete with a T shaped in cross section. The top of the T-shaped cross section called as a flange or compression member for resisting compressive stresses. The bridge superstructure and other component of bridge, is subjected to a set of loadings condition which the component must with stand. The design of bridge is based on these loadings. These loads may vary depending on duration, direction of action, type of deformation and nature of structural action such as (shear, bending, torsion etc.). In order to form a consistent basis for design, the Indian road congress (IRC) has developed a set of standard loading condition, which are taken into account while designing a bridge. A T-beam or beam and slab is constructed when the span is between 10- 20 meter. The bridge deck essentially consists of a concrete slab monolithically cast over longitudinal girders so that T- beam prevails. The number of longitudinal girders depends on the width of road. Three girders are normally provided for two lane road bridges. IRC 21- 2000 code is used for designing RCC road bridges and for precast bridges IRC 112 are used. Indian Roads Congress introduces new code of practice i.e. IRC 21 for designing of road bridges in India it is based on the working stress method and IRC 112 is based on the limit state method. IRC 112 contains both the bridge design, pre stressed and Reinforced Concrete bridge design. They have mentioned in the annexure about working stress method. The main object of providing new code of practice for the concrete road bridge is to establish a common procedure for design and construction of road bridges in India which are based on the limit state method. In the present work the comparison between the „T-Beam Girder‟ and „Box Girder‟ is carried out. This is helpful when we have two kinds for girder which can be used for same span; in that case the most economical one is to be selected for construction. This comparison will give the clarity about selecting the type of deck based on the span keeping economy in consideration. Deck slab is that part of the flyover which bears the load passing over it and transmits the forces caused by the same to the substructure. It is important to select the suitable type deck slab for different spans keeping aesthetic appearance and economy in consideration. A flyover is a structure which allows the Road or Railway vehicles to pass over existing Road or Railway lines. The construction of Flyover is necessary where there is a heavy traffic congestion which results in delay for the passengers. Construction of Flyover will reduce the delay and allow the vehicles to travel without interruption. As per the Indian standards IRC 92-1985, the Flyover or bridge is preferred when the PCU [Passenger Car Unit] value at the intersection exceeds 10,000. The planning of these structures has two important parts first is Traffic Assessment and second is layout and Structural design.

II. LITERATURE REVIEW

Anushia K Ajay (2017) "Parametric Study On T-Beam Bridge" In this study the Single span two lane bridge is subjected to IRC class AA tracked loading by varying the span is analyzed using software. In this project parametric studies are conducted on various bridge super structural elements. The study is mainly focused on theeconomical depth of a longitudinal girder for different span of bridge. Graphs and diagrams are also developed which can be used as a handy tool in the design of T- Beam Bridge. The optimal of effective length to the effective depth (I/D) ratio for the economical design of longitudinal girder using LSM is obtained as 14. Cost of girder will be increases if there is increase in grade of concrete and decreases when it is increase in thickness of deck slab so It is preferable to keep the thickness in between 170 mm and 200 mm.

David A.M. Jawad (2010) Study On "Analysis of The Dynamic Behavior Of T-Beam Bridge Decks Due to Heavyweight Vehicles" The study concluded the dynamic behavior of bridges due to vehicle loading has been the subject of considerable experimental and analytical research. The first important report on the matter was published in 1931 by a special committee of the ASCE. The recommendations of this committee, which were based on data obtained from a series of field tests, constitute the basis of American design specifications. In particular, it was recommended that the live load due to vehicles should be increased by an Impact Fraction (I0/ given by in which L is the loaded length in feet, and the maximum value of I is 0.25). The American Association of State Highway Officials conceived and sponsored a major experimental investigation in 1962 to determine the dynamic effects of moving vehicles on short span highway bridges. The standard specifications for highway bridges of AASHO. cite a variation on the impact fraction given by equation, whereby the maximum value of I should not exceed 0.3. In 1981, the ASCE committee on loads and forces. Confirmed current AASHTO practice concerning live load impact, except that the term impact be replaced wherever appropriate in current design specifications by the more descriptive term dynamic allowance for traffic loading.

P.**Veerabhadra Rao (2017)** Study On "Analysis Of Girder Bridge With IRC And IRS Loadings - A Comparative Study"" The study conduct on simply supported RC T-beam Bridge by rational method and finite element method using staad Pro. This study concluded that when it is compared with the Guyon Masssonet method Courbon"s Method gives the average result with respect to Bending Moment values in the longitudinal girder. The study also concludes that the bridge deck is analysis by both method grillage analogy as well as by finite element method. This study concluded that grillage analysis is easy to use and comprehend but analysis by finite element method, it is found that as compared to IRC the load per meter run of IRS loadings was increased by 210%, The Bending Moment due to IRS 25t Loading-2008 load combinations increased on an average of 4.6 times to the Bending Moment due to the IRC loading and Shear force and due to the IRS 25t Loading-2008 load combinations increased on an average of 3.2 times to the Shear force due to IRC load.

Mahantesh. S. Kamatagi, (Sep 2015), Worked on "Comparative Study of design of longitudinal girder of T- Beam Bridge" A simple span of T-beam bridge was analyzed by using staad pro. The study show that maximum bending moment is obtain while apply for class 70R vehicles loading. After getting the result the T-beam bridge is design by both the method i.e. (IRC21 &IRC112). It is noted that results obtained from finite element method is less as compared to the result obtained by working stress method. It is also noted that the design of bridge with IRC 112- 2011 is economically compared to IRC 21. It is noted that area of steel required is less in IRC 112-2011 as compared with the IRC2000. The modeling and analysis of RC T-beam bridge superstructure can be efficiently performed using staad pro and results in time saving. In design of concrete bridges IRC:112-2011 gives an economical design with a reliable safety margin since the design is based on probabilistic method of design. As compared to IRC:21-2000, designing the girders with IRC:112-2011, results in saving of longitudinal.

Abrar Ahmed, (July 2017) "Comparative Analysis and Design of T- Beam and Box Girder" The analysis of T-beam girder by IRC specification showed that the results obtained by FEM method is economical than the one dimensions analysis. The comparative design of T- beam and Box Girder for span up to the 25m or below the result shows that the T-Beam Girder is more economical section but if span is greater than 25 m Box Girder is always suitable. By getting the result it is found that the torsional rigidity is higher in box girders as they have closed section. By the study it is also found that Comparative design of I- Section and Box Section concludes that the Box girder is found to be Costlier for 16.3 m Span whereas for span 31.4 m the box girder is economical. Comparative design of RCC and PSC sections concludes that the Shear force and bending moments for PSC T-beam girder are lesser than RCC T-beam Girder Bridge so it is always preferable to adopt PSC sections rather than RCC, which is economical and Suitable for spans 24m and above. Life span of pre stressed concrete structures is very more as compared to reinforced concrete structure sand Steel structures.

III. MODELING AND SOFTWAREVALIDATION

A. Analysis Software

STAAD speaks to Structural examination and plan PC Program at first made by Research Engineers International in Yorba Linda, CA. Investigation Engineer International was bought by Bentley Systems. The different variations of the item are used in present time. STAAD III is used by Iowa State University for informational purposes for normal and fundamental authorities. As of now we are using STAAD master v8i programming for fundamental examination and plan. It can perform diverse kind of assessment in 2-estimation and 3-estimationpresentedtodifferent weightmixes, maintain condition, etc. depending upon expert's need. The courses of action for steel setup, strong arrangement, foundation plan, etc. are in like manner given by their significant codes. The issues of first solicitation static examination, second solicitation p- delta assessment, numerical non-straight examination, fastening assessment, dynamic examination, response range, etc can be performed with no issue. In present work box segment is dismembered by using STAAD.pro programming.

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 infigure.1.

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

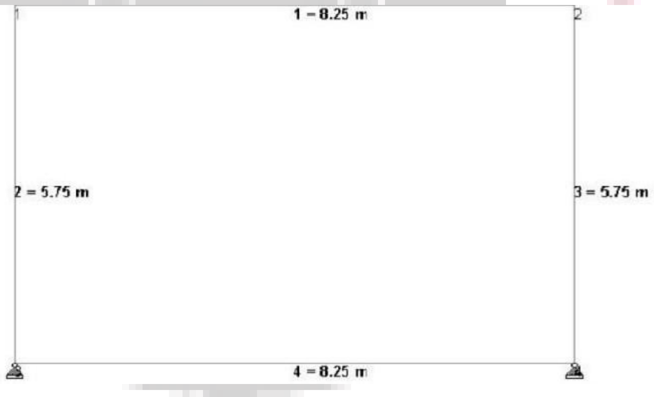

Figure 1 STAAD model of Box segment

C. Software Validation

Above model for dead load is taken to validate the STAAD results. Problem is solved by manually, STAAD. Pro software and results are compared.

AboxhavingDeadloadontopslab=7.755t/m²=7.755×9.81=76.051kN/m²andDeadloadon bottom slab = 11.0625 t/m² = 11.0625

× 9.81 = 108.486kN/m².

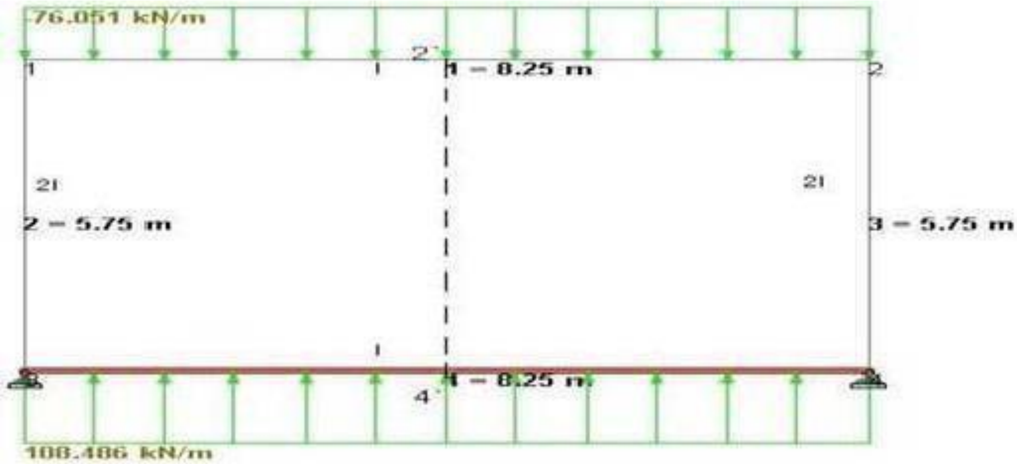

Figure 2 Loading Diagram

D. Manual Analysis

Problem Statement: Analyze the plane box frame shown in figure 2 using the moment distribution method and making use ofsymmetry.

$$I_1 = \frac{1\times(.5)^3}{12} = I$$

$$I_2 = \frac{1\times(.75)^3}{12} = 1.95I \cong 2I$$

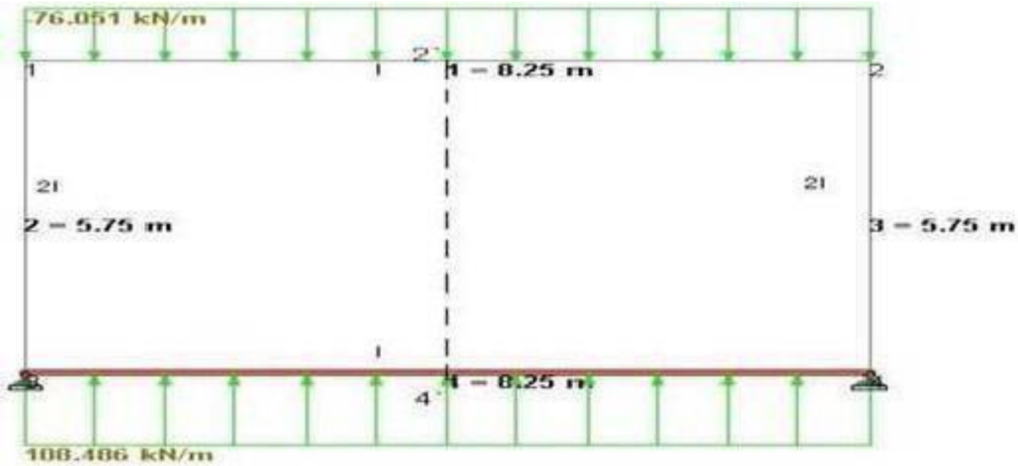

Figure 3 Loading diagram for MDM

The box frame is symmetrical and the centerline is passing through the mid span and then takes the stiffness of beam1and beam 4 as half of its original value and carryout the end moment distribution for half of the box only.

1. Fixed end moment

$$Mf'_{12} = \frac{wS^2}{12} = \frac{7.775\times8.25^2}{12} = 43.98tm$$

$$Mf'_{21} = \frac{wS^2}{12} = \frac{7.775\times8.25^2}{12} = 43.98tm$$

$Mf_{1\ 3} = 0$

$Mf_{3\ 1} = 0$

$Mf_{3\ 4}' = \frac{wS^2}{12} = \frac{11.0625 \times 8.25^2}{12} = 62.74 tm$

$Mf_{4\ 3} = -\frac{wS^2}{12} = -\frac{11.0625 \times 8.25^2}{12} = -62.74\ tm$

Joint	Member	Relative Stiffness	Total R S	DF
	12'			0.148
1	13		$\frac{38.75I}{94.875}$	0.852

International Journal of Trend in Scientific Research and Development (IJTSRD) @ www.ijtsrd.com eISSN: 2456-6470

3	31	$\frac{I}{5.75}$	$\frac{3875I}{94.875}$	0.852
	34'	$\frac{1}{2}\left(\frac{I}{8.25}\right)$		0.148

3. Moment Distribution

Table 3 Moment distribution method

Joint	2'	1		3		4'
DF	1	0.148	0.852	0.852	0.148	1
FEM	43.98	- 43.98	0	0	62.74	- 62.74
Balanced		6.51	37.47	- 53.45	- 9.29	
COM	3.255		-26.725	18.735		- 4.645
Balanced		3.955	22.77	- 15.96	- 2.775	
COM	1.9775		- 7.98	11.385		- 1.3875
Balanced		1.18	6.8	- 9.7	- 1.685	
COM	0.59		- 4.85	3.4		- 0.8425
Balanced		0.72	4.13	-2.9	- 0.5	
COM	0.36		-1.45	2.065		- 0.25
Balanced		0.2146	1.2354	-1.76	- 0.305	
COM	0.11		-0.88	0.6177		- 0.1525
Final End Moments	50.27	-31.4	30.52	-47.56	48.185	-70.02

E. STAAD Analysis

Problem Statement: Analyze the plane box frame shown in figure 4 using STAAD Pro software.

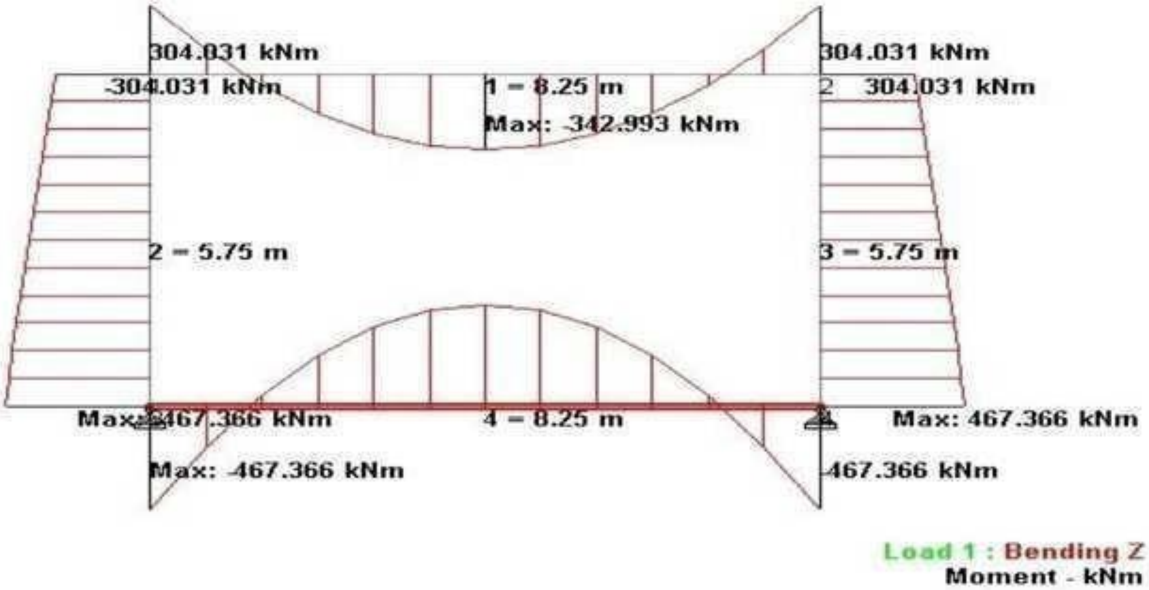

Figure 4 BMD for Dead load

Table 4 Comparison of BM between STAAD Pro and Moment Distribution Method

Joint	Manual	STAAD Pro	% Error
1	(31.4 + 30.52)/2 = 30.96 tm	304.031/9.81 = 30.99 tm	- 0.096
3	(47.56+48.185)/2=47.87tm	467.366/9.81 = 47.64 tm	0.048

The Bending moment calculated by STAAD Pro is found to be approximately similar as calculated by Moment Distribution Method.

IV. CONCLUSION

From the writing survey, it is reasoned that the correlation with the years prior innovation in development world was very evolved. So we develop the passages and over-spans utilizing the case courses fast and the expense of development is less and there is less danger and pushing innovation is broadly utilized these days and gives awesome after effect so work.

A. The essential regions considered are the point of convergence of scope of top and base lump sand the rump and at the center and back end of the vertical dividers since the most extraordinary arrangement powers make at these fragments due to various blends of stacking plans.

B. The examination shows that the most extraordinary arrangement powers delivered for the stacking condition when the top area is presented to the dead weight and live weight and sidewall is presented to earth weight and cheats, and when the course is unfilled.

C. The most prominent negative second make at the midriff of the top piece for the condition that the compartment is unfilled and the top lump passes on the dead weight and live weight.

D. The most extraordinary positive second make at the rear end portion of the top piece for the condition that the box is unfilled and the top area passes on the dead weight and live weight.

E. The most extraordinary positive second make at the midsection of the base piece for the condition that the hold arisen filled and the top lump passes on the dead weight and live weight.

F. The most outrageous negative second make at the posterior piece of the base segment for the condition that the box is empty and the top piece passes on the dead weight and live weight.

G. The most prominent positive second make at the rump of vertical divider when the compartment is empty and when sidelong weight (Earth pressure, Live Load Surcharge and Dead Load Surcharge) acts.

H. It was seen that Computational technique (Staad Pro) was essentially more capable than Moment Distribution Method (MDM) in term of profitability of result and time usage.

I. Quantities will be less when contrasted with the regular strategy for development.

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