Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 05, May-2023

Comparative Study of Longitudinal Girders in RCC T-Beam Bridges

Ms. Mayuree Anil Kambale
Assistant Professor, Civil Engineering, Bharat Ratna Indira Gandhi College Of Engineering,
DBatu University Lonere, Solapur, India.

Abstract- *T-Beam structure is so named because the main longitudinal girders are designed as T-beams integral with part of the deck slab, which is cast monolithically with the girders.The present study is aimed to understand the different structural aspects related to this system the analysis of a single span RCC T -Beam Bridge girders was performed to know the live load distribution along the longitudinal girder. The analysis of T-Beam Longitudinal girder with variable length has been studied.*

Keywords- Longitudinal girder, Courbon's theory, T-beam bridge, Staad-pro, Indian Road Congress, IRC Live Loads.

I. INTRODUCTION

A Bridge is a structure providing passage over an obstacle without closing the way beneath. The required passage may be for a road, a railway, pedestrians, a canal or a pipeline. The demands on design and on materials are very high. A bridge must be strong enough to support its own weight as well as the weight of the people and vehicles that use it. The structure also must resist various natural occurrences, including earthquakes, strong winds, and changes in temperature.

The T-beam Bridge is by far the Most commonly adopted type in the span range of 10 to 25 M.Simply supported T-beam span of over 30 m are rare as the dead load then becomes too heavy. In T-Beam Bridge, the main longitudinal girders are designed as T-beams integral with part of the deck slab, which is cast monolithically with the girders.

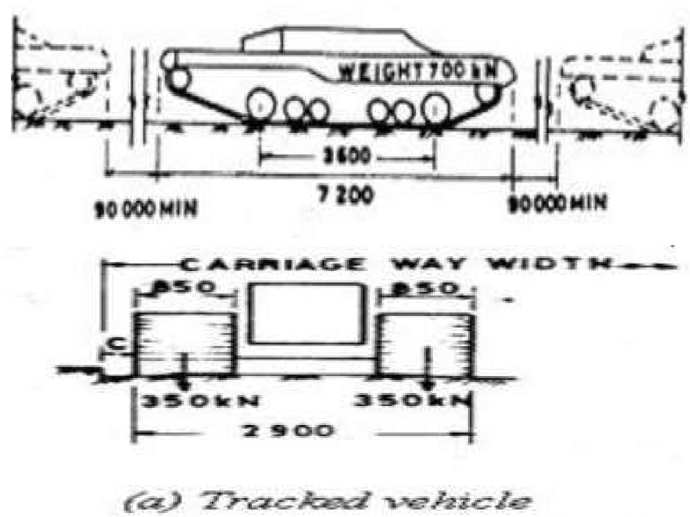
LOADS ACTING ON BRIDGE

Dead and Superimposed Dead Load

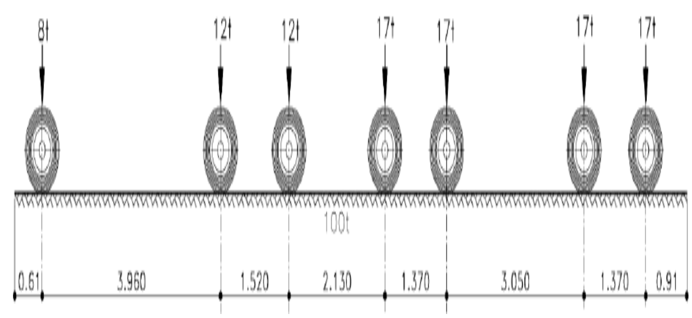
For general building structures, dead or permanent loading is the gravity loading due to the structure and other items permanently attached to it.

Live Loads

Road bridge decks have to be designed to withstand the live loads specified by Indian Roads Congress (I.R.C: 6-2000 sec2).There are three types of standard loadings for which the bridges are designed namely, IRC class AA loading, IRC class a loading and IRC class B loading.



IRC Class AA Wheeled Live loading



IRC Class 70R Wheeled Live loading

Normally, bridges on national highways and state highways are designed for these loadings. Bridges designed for class AA should be checked for IRC class A loading also, since under certain conditions, larger stresses may be obtained under class A loading. Sometimes class 70 R loading given in the Appendix - I of IRC: 6 - 1966 - Section II can be used for IRC class AA loading.

II. OBJECTIVES OF PRESENT STUDY

1. Analysis of 15-24m span T-BEAM Bridge for IRC

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 05, May-2023

class AA loading and 70R loading by Rational Method.

2. Analysis of 15-24m span T-BEAM Bridge will be performed by using Professional Software.

3. Parametric investigation will be performed by changing span and length of longitudinal girder.

III. METHODOLOGY

1. Study of previous work related to T- Beam RCC Bridge.

2. FEM Analysis of T-BEAM RCC Bridge is carried out by using STAADPro Software for different spans.

3. Analysis is done for IRC class 70R loading.

4. Study of analysis results in terms of maximum shear force, maximum bending moment, maximum deflection to understand the response of T-Beam RCC Bridge.

5. Comparison of rational method and FEM results from STAADPro software will be done.

IV. THEORETICALFORMULATION

A. METHODS OF ANALYSIS

The distribution of live load among the longitudinal girders can be estimated by any of the following rational methods.

1. Courbon's method
2. GuyonMassonet method
3. Hendry Jaegar method

.

A.1 Courbon's Method

Among the above mentioned methods, Courbon's method is the simplest and is applicable when the following conditions are satisfied:

- The ratio of span to width of the deck is greater than 2 but less than 4.
- The longitudinal girders are interconnected by at least five symmetrically spaced cross girders.
- The cross girder extends to a depth of at least 0.75times the depth of the longitudinal girders.

The center of gravity of live load acts eccentrically with the center of gravity of the girder system. Due to this eccentricity, the loads shared by each girder are increased or decreased depending upon the position of the girders.

This is calculated by Courbon's theory by a reaction factor given by

$Rx= (\Sigma W/n)\ [\Sigma I/\Sigma dx2.I)\ dx.e]$

Where,

Rx=Reaction factor for the girder under consideration,

I = Moment of inertia of each longitudinal girder,

dx= Distance of the girder under consideration from the central axis of the bridge,

W = Total concentrated live load,

n = Number of longitudinal girders,

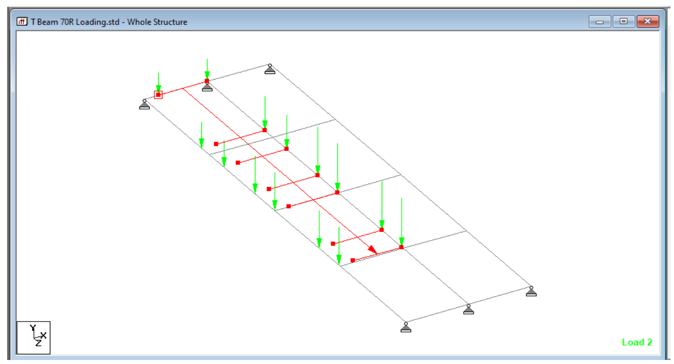
e = Eccentricity of live load with respect to the axis of the bridge.

B. SOFTWARE VALIDATION

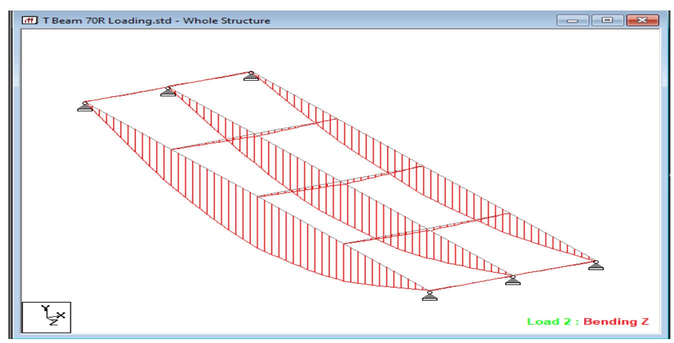
B.1IRC Class 70RWheeled Loading

For the purpose of software validation the theoretical problem was taken as below A R.C.C. T-Beam bridge having a deck slab 200 mm thick, wearing coat 100 mm thick, 3 longitudinal girder and 5 cross girders provided. Design long girder for the using following data

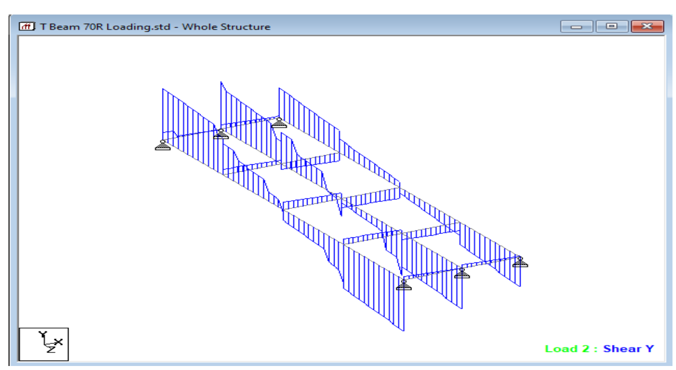
1. Carriage way width = 7.5 m
2. Span of bridge = 18 m
3. Live load IRC class 70R wheeled
4. Kerb 600 mm wide and 400 mm deep.
5. Web thickness for long girder and cross girder 300 mm
6. Spacing of long girder = 2.5 m
7. Use M30 grade of concrete and Fe500 steel



70R Load on T-Beam Bridge

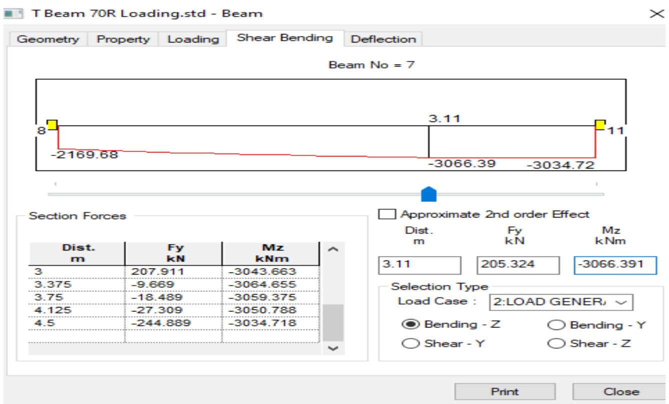


70R Load BMD

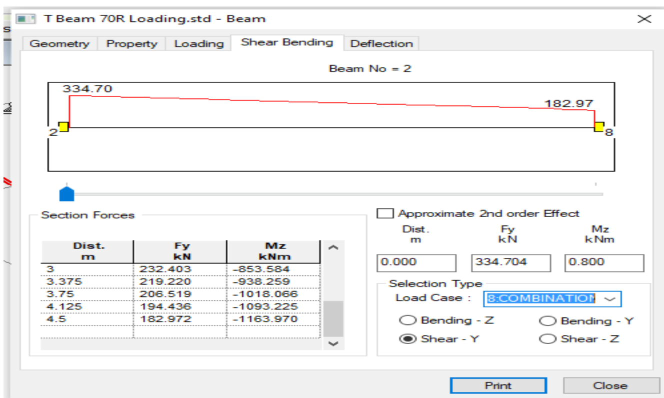


70R Load SFD

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 05, May-2023



70R Load BMD result



Dead Load SFD result

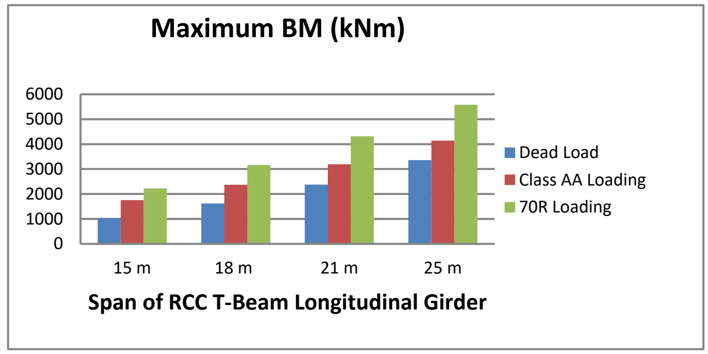
Sr. No.	Result	Load	Manual Calculation Results	STAADPro Results	Difference	% Difference
1	BM	DL	1592.982 kNm	1545.993 kNm	46.989 kNm	2.94 %
2	BM	70R	3179.04 kNm	3066.39 kNm	112.65 kNm	3.40 %
3	SF	DL	342.618 kN	334.70 kN	7.918 kN	2.30 %
4	SF	70R	662.97 kN	634.63 kN	28.34 kN	4.27 %

Middle girder Results for IRC Class 70R Loading

At the end, the result of the validation study is fairly matched with the bending moment and shear force results of the present study.

V. PARAMETRIC INVESTIGATION

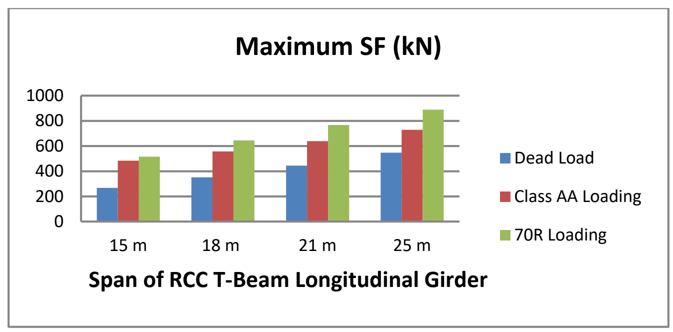
V.1 Comparative Analysis of T-Beam Longitudinal



Girder with Variable Length.

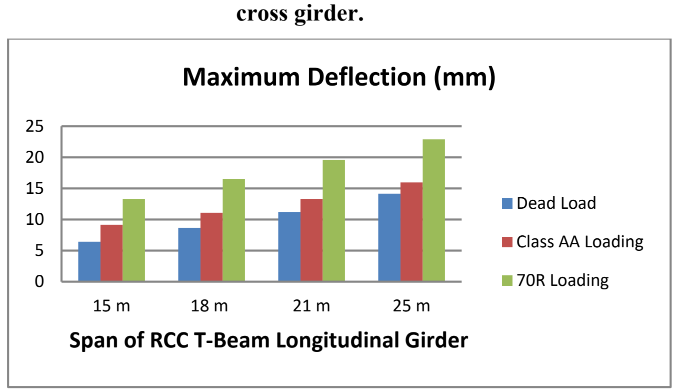
Span,m	Dead Load (kN-m)	Class AA Loading(kN-m)	70R Loading(kN-m)
15	1029.28	1752.68	2222.69
18	1621.56	2368.15	3158.17
21	2380.24	3191.24	4312.24
24	3357.44	4141.98	5581.51

Maximum Bending Moment for span 15m, 18m, 21m and 24m with cross girder



Span, m	Dead Load (kN)	Class AA Loading (kN)	70R Loading (kN)
15	268.47	484.18	515.63
18	351.75	557.14	645.49
21	444.92	638.70	767.75
24	547.97	729.38	889.03

Maximum Shear Force for span15m, 18m, 21m and 24m with cross girder.



Span, m	Dead Load (mm)	Class AA Loading (mm)	70R Loading (mm)
15	6.430	9.168	13.274
18	8.693	11.101	16.481
21	11.204	13.307	19.588
24	14.170	15.976	22.897

Maximum Deflection for span15m, 18m, 21m and 24m with cross girder.

VI. CONCLUSION

From the analysis of various types RCC T-Beam bridge following prominent conclusions are drawn.

- With increase in the span of RCC T-Beam Bridge the analysis results i.e. Maximum bending moment, Maximum shear force results are also increases for all type of loading i.e. dead load case, IRC class AA load case and IRC 70R loading.
- From Figure it shows that the IRC Class 70R loading gives more results compare to the IRC Class AA loading in Maximum bending moment as well as maximum shear force case and all other parameters.
- It is observed that IRC Class 70R loading gives nearly 25 % more Bending Moment compared to the IRC Class AA loading in maximum bending moment case.
- It could be seen that the IRC Class 70R loading gives nearly 16.80 % more results Shear Force compared to the IRC Class AA loading in maximum shear force case.
- It observed that with increase in the span of RCC T-Beam Bridge the deflection of the longitudinal girder also increases for all type of loading i.e. dead load case, IRC class AA load case and IRC 70R loading

REFERENCES

1. "Comparative study for shear design using IRC 112:2011 & IRC 21:2000",B.H.Solanki and Prof.M.D.Vakil. International Journal of Scientific & Engineering Research, Volume: 4, Issue: 6, June 2013
2. IRC 6 - 1966, "Standard Specifications and Code of Practice for Road Bridges", Section II Loads and Stresses, The Indian Road Congress, New Delhi.
3. IRC 6 - 2000, "Standard Specifications and Code of Practice for Road Bridges". The Indian Road Congress, New Delhi.
4. IRC 21 - 1966, "Standard Specifications and Code of Practice for Road Bridges", Section III Cement Concrete (Plain and Reinforced), The Indian Road Congress, New Delhi.
5. IRC 21-2000, "Standard Specification and Code of Practice for Road Bridges", Section III "Cement Concrete (plain & reinforced)", Indian Road Congress, New Delhi.
6. IRC: 112 –2011"Code of practice for Concrete Road Bridges", Indian road congress, New Delhi, India, 2011.
7. IS 456 – 2000, "Indian Standard Plain and Reinforced Concrete- Code of Practice". Bureau of Indian Standards, New Delhi.
8. Krishnaraju "Design of Bridges", Third Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
9. M. G. Aswani, V. N. Vazirani, M. M. Ratwani, "Design of Concrete Bridges", Khana Publishers, second edition.