International Journal for Modern Trends in Science and Technology, 9(05): 602-607, 2023

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0905103
Available online at: http://www.ijmtst.com/vol9issue05.html

Comparative Analysis of RCC Girder and Prestressed Girder fr Bridges by using STAAD.Pro

Syed Sofiya[1] | Porumatti Santhi[1]| Mathangi Varshitha[1]| S Padmaja[2]

[1]Department of Civil Engineering, Narayana Engineering College, Nellore, Andhra Pradesh, India
[2]Assistant Professor, Department of Civil Engineering, Narayana Engineering College, Nellore, Andhra Pradesh, India

To Cite this Article
Syed Sofiya, Porumatti Santhi, Mathangi Varshitha and S Padmaja. Comparative Analysis of RCC Girder and Prestressed Girder fr Bridges by using STAAD.Pro. International Journal for Modern Trends in Science and Technology 2023, 9(05), pp. 602-607. https://doi.org/10.46501/IJMTST0905103

Article Info
Received: 21 April 2023; Accepted: 18 May 2023; Published: 22 May 2023.

ABSTRACT

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 pedestrains, a canal or a pipeline. In India R.C.C structures are commonly used for residential as well as commercial buildings, it has high compressive strength compared to other building materials. Prestressed concrete consists high strength concrete and high tensile steel which has greater advantages in bridge construction. This study presents the Comparative analysis of R.C.C girder and Prestressed girder of roadway bridge for the span of 50m. It determines the distribution of live load and dead load among the longitudinal T-beam girders by using STAAD. Pro software (V8i version). From the analysis it observed that the results of Bending moment, Shear force, Deflectionetc., by comparing the T-beam girders of R.C.C and Prestressed bridge. This project determines the durability, economical sections with increased aesthetic appearance and time for construction of bridges by using STAAD. Pro software (V8i version).

KEYWORDS: Prestressed concrete (PSC), Reinforced cement concrete (RCC), STAAD. Pro software (V8i version).

1. INTRODUCTION

A bridge is a structure built to span a physical obstacle (such as a body of water, valley, road, or rail) without blocking the way underneath. It is constructed for the purpose of providing passage over the obstacle, which is usually something that is otherwise difficult or impossible to cross. There are many different designs of bridges, each serving a particular purpose and applicable to different situations. Designs of bridges vary depending on factors such as the function of the bridge, the nature of the terrain where the bridge is constructed and anchored, and the material used to make it, and the funds available to build it. The earliest bridges were likely made with fallen trees and stepping stones. Modern designers have written about elegance or aesthetics since the early 19th century, beginning with the Scottish engineer Thomas Telford. Bridges ultimately belong to the general public, which is the final arbiter of this issue, but in general there are three positions taken by professionals.

- The first principle holds that the structure of a bridge is the province of the engineer and that beauty is fully achieved only by the addition

of architecture.

- The second idea, arguing from the standpoint of pure engineering, insists that bridges making the most efficient possible use of materials are by definition beautiful.
- The third case holds that architecture is not needed but that engineers must think about how to make the structure beautiful.

Prestressed bridges

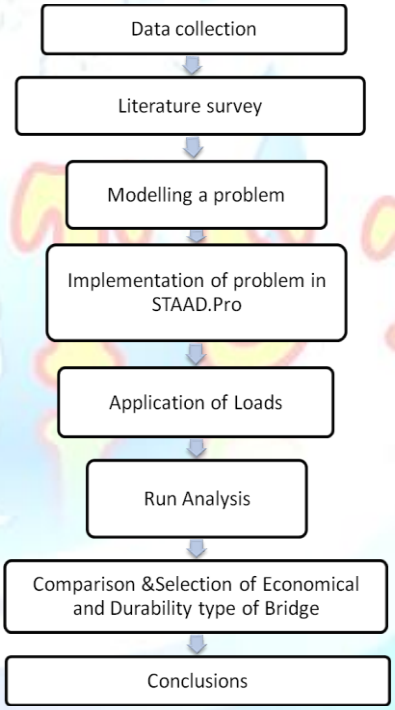
Prestressed concrete bridges are the bridges in which concrete is poured around the already-tensioned cables and allowed to harden and hold the cables in place. When the concrete is solid and cured, the ends of the tensioned cables are cut and the tension is released into the beam orslab.

STAAD.PRO Software

STAAD is the abbreviation for Structural Analysis and Design. STAAD.Pro is one of the popular software that is used for analyzing & designing structures like–buildings,towers, bridges, industrial, transportation and utility structures. Gives accurate results for the Number of reinforcements used longitudinally, Shear Reinforcement. Civil engineers can design structures for any type of loads such as Dead or Live loads, wind loads, snow loads, area loads, floorloads, and more.

LITERATURE REVIEW

Dynamic Analysis & Optimization of Prestressed Concrete T-Beam & Box Girder Bridge Superstructure. With the increase in span, time period goes on increasing and T-beam girder has less time period of vibration than Trapezoidal box Girder Bridge. [6] Design of Pre-Stressed Concrete T-Beams had concluded that Bending moments and Shear force for PSC T-beam girder are lesser than RCC T-beam Girder Bridge. As we go Total Super structure of a Bridge Project the Quantity of steel and the Cost of concrete for PSC T-Beam Girder is less than RCC T-Beam Girder.Durability for PSC T-beam Girder is more than RCC T-Beam Girder Bridge.[8] Reinforced concrete beams are generally heavy. They always need shear reinforcements besides the longitudinal reinforcement for flexure. Prestressed concrete beams are lighter. By providing the curved tendons and the pre-compression, a considerable part of the shear is resisted.[13] design of prestress and RCC bridges using limit state method. In regards to this, present study has been performed to know how design of IRC-112 differs from IRC-21 and an attempt is made to study undefined parameters ofIRC: 112-2011 such as span to depth (L/d) ratio. It is observed that L/d ratio of 10 in working stress method and L/d ratio of 14 in limit state method ismost preferable.



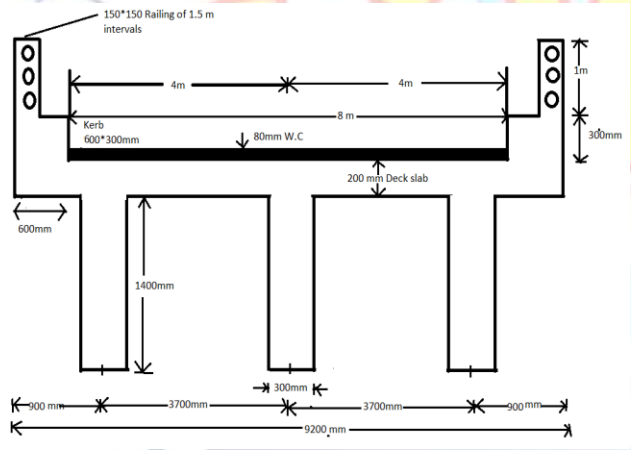
I. BRIDGE DESCRIPTION

A. *Span parameters*

Type of bridge structure	**RCC Bridge**	**PrestressedBridge**
Cross section	T – Beam girder bridge	
Span Length	50 m	
Carriage way width	8 m	

Lane of bridge	Two lane	
Height of bridge	14 m	
Cross Girders size	300mm * 600mm	
Thickness of slab	200mm	
Supports	Fixed	
Loads	1.Dead load 2.Live load-IRCclass -AAloading 3.Wind load	1.Dead load 2.Live load-IRCclass-AA loading 3.Wind load 4.Post tension load

B. Grider Cross Section



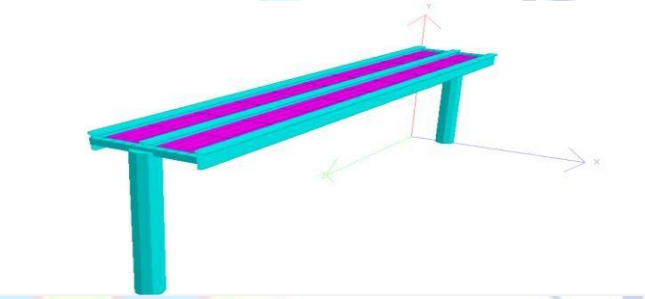
C. Loads on bridges

Dead loads are the most basic of all the loads any structure would have to resist. These include the self-weight of the structure and the superimposed dead loads, which are loads applied by railings such as crash barriers, medians, and wearing courses. Traffic loads, or moving loads, are not stationary & they become important to obtain the critical vehicle position, which may cause the worst loading effect or, in other terms, may govern the design. So, IRC recommended some imaginary vehicles as live loads which will give safe results against the any type of vehicle moving on the bridge. The vehicle loadings are categorized in to three types and they are:

- IRC class AA loading
- IRC class A loading
- IRC class B loading

Wind loads are lateral loads that are critical in transverse direction since bridges have less resistance in the transverse direction. One should note that wind forces defined as per code are for bridge spans of up to 150m and pier heights of up to100m. Wind pressure applicable at any location is dependent on its geographical location, terrain of the surrounding area, fetch of terrain upwind of bridge location, local topography, height of the bridge above ground, cross-section of bridge elements, and horizontal dimensions.

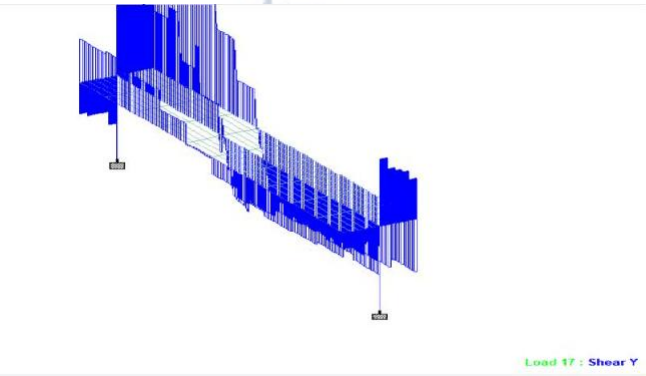
D. Performance of Griders



3D Render view of Prestress bridge

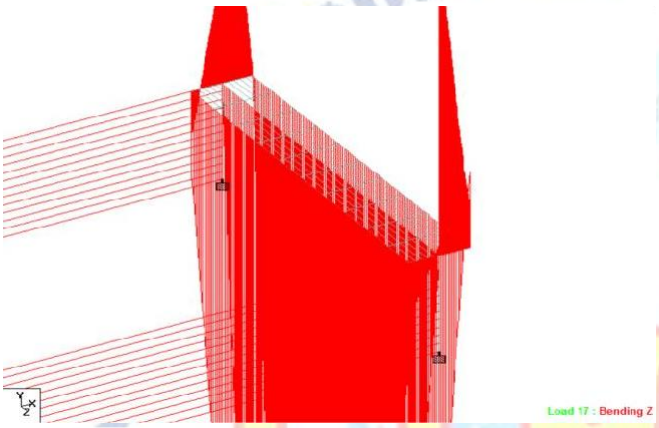
A.Shear Force

Shear stress occurs when two fastened structures (or two parts of a single structure) are forced in opposite directions. If left unchecked, the shear force can literally rip bridge materials in half. Shear force is a force acting in a direction that's parallel to (over the top of) a surface or cross section of a body, like the pressure of air flow over an airplanewing.



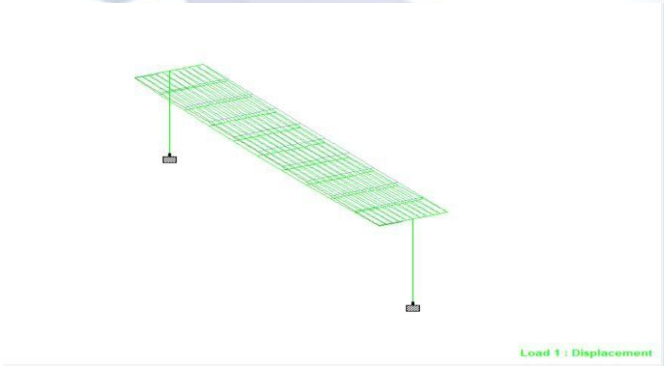
B. Bending Moment

In solid mechanics, a bending moment is the reaction induced in a structural element when an external force or moment is applied to the element, causing the element to bend. The most common or simplest structural element subjected to bending moments is the beam. The maximum bending moment occurs in a beam, when the shear force at that section is zero or changes the sign because at point of contra flexure the bending moment is zero.

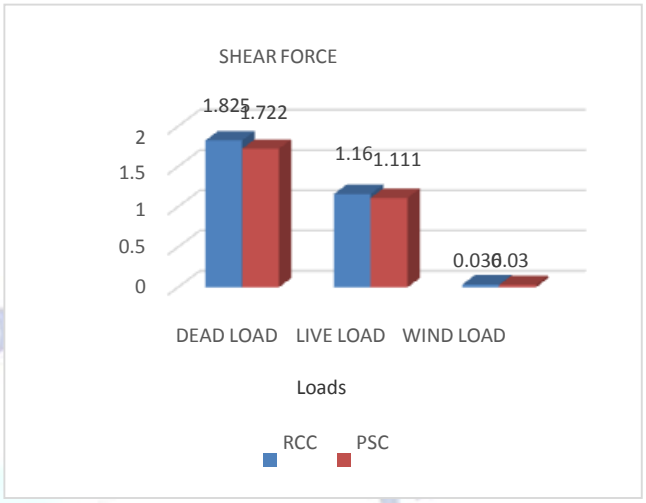


C. Deflection

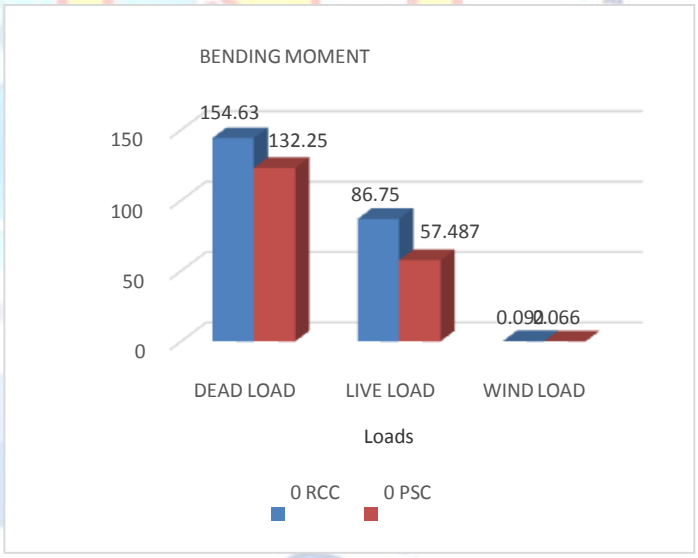
Bridge deflection is an important parameter in safety examination of bridge structures, which reflects the overall stiffness of the bridge structure and is thus closely related to its bearing capacity and the ability to resist dynamic loadings such as traffic, gusts and earthquake.



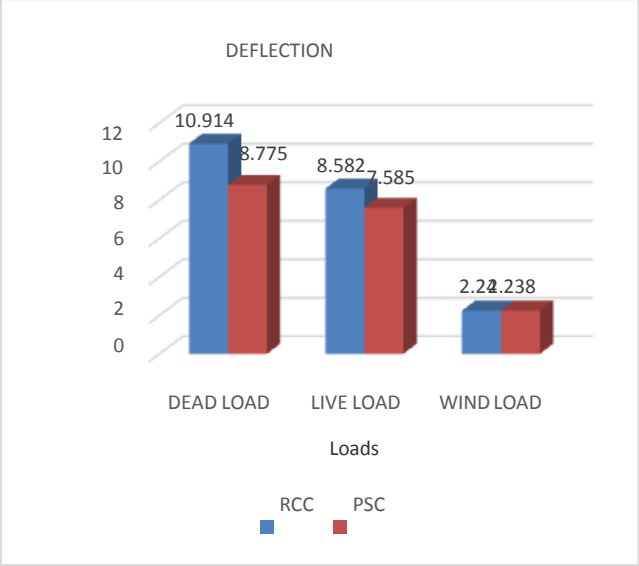
ANALYSIS OF BRIDGES



Dead load has 5.8% , Live load has 4.4% and wind load 18.18% difference of shear force occurred in prestress bridge. From the graph, it resulted as less shear force was formed when loads was applied to the prestressed girder.When loads applied to structure it tends to slide in one or more direction, as it is obtained that shear force is less in prestressed concrete bridge when compared to RCC.



Generally, bending moment occurs at the end of the members whereas, dead load has more value of15.83% , live load of 40.57% and wind load 32.91% occurred in RCC girder, this results RCC structure is heavy as compared to prestress. From this graph it concluded that Reinforced concrete bridge has more bending moment compared to prestressed bridge. Higher the bending moment then it has high probability to bend at that location.



When dead load was applied it has 7.8% ,live load has 12.33% and wind load has 13.22% of deflection difference decreases in prestressed bridge as compared to RCC bridge and live load is equal to both bridges.By comparing the deflection of both RCC and Prestressed concrete bridges it is obtained that prestressed T beam bridge has lesser deflection compared to RCC. Then it will lead to more serviceability.

CONCLUSIONS

- While comparing shear force of both the bridges it hasabout 5.8% dead load, 4.4% live load and 18.18% wind load was lesser in prestressed girder.
- For 50m span, it has dead load of 15.83% , live load of 40.57% and wind load 32.91% more bending moment in RCC Bridge of T- beam girder. It concluded that the nature of bending is more in RCC as compared to PSC.
- When dead load was applied on both bridges then it varies about 7.8% , live load has 12.33% and wind load has 13.22% of deflection decreased in Prestressed bridge.
- It concluded that the Serviceability is more in Prestressed bridge comparing to RCC. Thus the change in position of the member in bridge was less in prestress.
- By analysing this phenomenon, the durability of prestressed bridge is more when compared to RCCbridge.
- By comparing deflection, bending moment and shear force for 50m span of T-beam girder we concluded that the Prestressed bridge is more durable, reliable, and less time for constructionthan Reinforced concrete bridge.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] Ayush Tiwari, Dr. Sudhir S Bhadouria, "Cost Comparison of RCC Girder and PSC Girder" journal of International scientific Research & Development Volume(5) 2020.

[2] Dr. S. H. Mahure, Mr. Vishal, D. Dhore, "Comparative Study of RCC And Prestressed Concrete Beams For Various Spans" Journal of IJSART-Volume 3-September 2017.

[3] Nidhi P. Tiwari, Dr. P.Y.Pawade, K.R.Dabhekar, "Dynamic Analysis & Optimization of Prestressed Concrete T-Beam & Box Girder Bridge Superstructure" by International Journal of science Technology & Engineering vol(3) 2017.

[4] N. Krishna Raju, Design of Bridges, Oxford & IBH Publications, New Delhi, fifth edition-2018.

[5] Prashansha Sanjay Jaiswal, "Comparative Study of RCC Girder and Prestressed Girder for Roadway Bridge" by International Research Journal of Engineering and Technology, vol(9).

[6] Rajamoori Arun Kumar, B. Vamsi Krishna, "Design of Pre-Stressed Concrete T-Beams" International Journal of Scientific Engineering and Research vol(2).

[7] Shubham Landge, Umesh Bhagat, Shubham Bhaisare, Ved Prakash, Dr. I. P. Khedikar, "Analysis and Design of Pre-stressed Concrete I-Girder Bridge" by International Journal of science Technology & Engineering vol(5).

[8] Suchitra De & Shraddha Sharma "Economics of Continuous RCC and Prestressed Concrete beam and design in MS-Excel", International Journal of Innovations in Engineering and Technology, vol.7, Issue 2 August 2016.

[9] Shreedhar R., Shivanand Tenagi, (2015). "Comparative study of T-beam bridge longitudinal girder design using IRC 112:2011 and IRC 21:2000". International Journal for Scientific and Engineering Research (IJSER), ISSN 2229-5518, Vol. 6, No. 8, pp 1807-1815.

[10] A.R.Mundhada, Mohammad Shahezad "Economics of Continuous R.C.C. Beams Vis-à-vis Continuous Pre-stressed Concrete Beams" International Journal of Scientific & Engineering Research, Volume 3, Issue 7, July-2012 1 ISSN 2229-5518 IJSER.

[11] Andre Picard and Bruno Massicotte, "Serviceability design of Prestressed Concrete Bridges", Journal of Bridge Engineering, Vol.4, No.1, Pp. 48-55, 1999.

[12] S. Mourad and S.W. Tabsh, "Deck Slab stresses in Integral Abutment Bridges", Journal of Bridge Engineering, Vol. 4, No. 2, Pp. 125-130, 1999.

[13] C. Broquet, S. Bailey. M. Fafard and E. Brühwiler, "Dynamic Behavior of Deck Slabs of Concrete Road

[14] Bridges", Journal of Bridge Engineering, Vol. 9, No. 10, Pp. 137-146, 2004.

[15] A. Saxena and D.S. Maru, "Comparative study of the analysis and design of T-beam girder and box girder superstructure," International Journal of Research in Engineering & Advanced Technology (IJREAT), Vol. 1, No. 2, Pp. 2320-8791, 2013.
[16] IS 456-2000 Plain and Reinforced Concrete - Code of Practice.
[17] IS: 800:2007 – Code of Practice for general construction in Steel.
[18] IS 1343-1980 Code of Practice for Prestressed Concrete (First Revision)
[19] IRC 24-2010 Standard Specifications for Road Bridges.
[20] IRC: 22-2015 Composite construction of bridges.
[21] IRC: 6-2014 Loads and Stresses.
[22] IRC: 112-2011 Design of bridges.
[23] IS 875 Part (3) Wind load