iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.56888

A Review on Different Types of Bridge Girders and Different Tendon Profiles

Arpit Shrivastava[1], Dr. Savita Maru[2]
[1]Mtech Student, Department of Civil Engineering, Ujjain Engineering College
[2]Professor, Department of Civil Engineering, Ujjain Engineering College

Abstract: A bridge is a structure that allows traffic to cross over an obstruction without blocking the path below.The necessary passage may be for a pipeline, a canal, a road, a railroad, or pedestrians.

The pre- stressed concrete bridges have excellent riding characteristics that reduce traffic vibrations, torsional rigidity, are less likely to crack early, have continuous spans, and are strong.

However, the most notable feature is that the natural frequency of vibration hardly matches with vehicle frequency, leading to wide acceptance in freeways, flyovers on highways and in contemporary metro train systems. In order to obtain a structure that behaves at the level of life safety under powerful earthquakes, bridges must be able to endure both static and dynamic stresses, particularly earthquake-induced loads.

The current study examines static and dynamic behavior while demonstrating the linear dynamics of T-beam girder, rectangular and trapezoidal box girder bridge.

Keywords: Prestressed, Box Girder, CSI Bridge (V-20), Pre-tensioned Bridge, Post-tensionedBridge, IRC-112(2011), IRC Class-A Loading.

I. INTRODUCTION

Bridge design is a purpose and, moreover, a mind-boggling strategy for a structural design. Span length and live loads are invariably crucial factors, just as they would be if a bridge design situation were to arise. These elements have an impact on how quickly a plan can be conceptualized.

For various extents, the effects of live load are shifting. A range in which investigation should be possible in the structural system for a cross bridge system has is fragments like economy and safety that are produced have an effect. Using code approach, we can choose a structural system. T-beam and box girders, for example. The choice of a frugal and constructible fundamental framework depends on theoutcome.

Dead load is a significant rising factor as Span rises. If the shear deformations can be ignored or not, this results in the shape of a box girder or cellular structure. Unnecessary material that is not fully employed is pulled out of section in order to reduce the dead load. A box girder bridge is the structure that results from connecting the tension flanges of longitudinal girders. Comparatively fewerpiers are required for a given valley width when using a box bridge girder than a T-beam girder bridge,which results in cost savings.

II. LITERATURE REVIEW

1) Ashish B Sarode and G R Vesmawala (2012) In this article, LUSAS FEA software is used to analyze the various models for curved box girders for various parameters,including span, radii, loadings, and lengths. Different curved box girder’s resulting bending moments, shear moments, and torsional moments are compared. Additionally, the viability and stability of curved box girders with different span lengths and radii are explored. The following are the study's primary conclusions:
   a) For the particular span length with varying radius, it is noted that there is no appreciable variance in the bending moments and shear forces for DL, SIDL, and LL.
   b) As the box girder's span radius is reduced, the torsional moments rise noticeably. Torsion varies more when the span radius is below 200 m and less when the span radius is above 400 m. It is clear from the responses that box girders with a safety factor against overturning of less than 1.5 are not practical. Avoid the sharp radius below 100 meters. If such severe curves are unavoidable, structural modifications to the cross-sectional dimensions may be necessary to stabilize them, or hold-downs or tension bearings may need to be added.

2) Amit Saxena, Dr. Savita Maru (2013) Comparative Analysis and Design of T-Beam and Box Girder Superstructures. In this study, a 25 m-long RCC T-beam and Box girder are taken into consideration. IRC class A loading is used in superstructure. STAAD Pro is used for analysis. Dead load calculations are performed by hand. Both cases involve cost analyses. Cost of concrete for T-Beam Girder is less than two cell Box Girder as quantity required by T-beam Girder. Because the quantity of steel for T-beam Girder is less, the cost of steel in T-Beam is less than that of two cells Box Girder Bridge. T-Beam Girder is more inexpensive for 25 m spans, however Box Girder is always appropriate for spans greater than 25 m. This type of Bridge lies in the high torsional rigidity available because of closed box section. It has been found that two cell box girder bridges have lower service dead load bending moments and shear forces than T-beam girders. After analyzing the steel's moment of resistance for each, it was determined that the T-Beam Girder had a greater capacity for a 25 m span. For a 25 m span, the shear force resistance of a T-Beam Girder is greater than a two-cell Box Girder.
3) Rajamoori Arun Kumar, B. Vamsi Krishna (2014) "Design of Pre-Stressed Concrete T-Beams" In this work, a significant bridge with a span of 299 meters, 36 PSC beams, and 8 RCC beams is taken into consideration. The PSC Beams, where the Beam post tensioning values, rate of elongation, and behavior may be defined after stressing, are the focus of the major attempt. IS: 1343 - 2012 is the primary code that is followed in this course. Code of Practice for Pre-stressed Concrete is the title. The outcome shows that PSC T-beam girders have lower bending moments and shear forces than RCC T-beam Girder Bridges. For a 24 m span, PSC T-Beam Girders are stronger shear force resistant than RCC T-Girders.
4) Wang Hui-li, Feng Guang-qi, and Qin Si-feng (2014) "Prestressed Concrete Bridge Pier with Fiber Model: Hysteretic Behavior." This article looked into the prestressed concrete bridge pier's hysteretic behavior and seismic properties. The fiber model analysis approach has been used to determine the impacts of the prestressed tendon ratio, the longitudinal reinforcement ratio, and the stirrup reinforcement ratio on the hysteretic behavior and seismic properties of the prestressed concrete bridge pier. The analysis's findings on the prestressed concrete bridge pier are presented. First off, a higher prestressed tendon ratio and more longitudinal reinforcement may result in a more pronounced "pinching effect" of the pier's hysteresis loop, a smaller residual displacement, and a reduced energy dissipation capacity. Secondly, the greater the stirrup reinforcement ratio is, the greater the hysteresis loop area is. This implies increased shear capacity and improved ductility for bridge piers. The study's findings will give the understanding of the prestressed concrete pier's hysteretic behavior a theoretical foundation.
5) Nila P Sasidharan, Basil Johny (2015) A study of box girder curved in plan with rectangular cross-section has been carried out in the present investigation. The finiteelement software ABAQUS is used to carryout analysis of these box girders. The analysis is carried out for the dead load, super imposed dead load and live load of IRC Class A loading. In this research, a parametric study of curved box girders with a constant span to depth ratio and changing span and radius of curvature is presented. The parametric studies carried out on curved box girders aid in assessing how various parameters affect the girder's behavior. Bridge engineers will be able to comprehend the behavior of curved concrete box girders better thanks to this study. The graph plotted between reaction and radius of curvature shows that reaction decreases with increase in radius of curvature and with decrease in span length. So the minimum reaction can be obtained by increasing the radius of curvature. If minimum deflection is the criteria for selecting a particular radius of curvature, it can be concluded that for 40m span the mid span deflection isminimum at radius of curvature equal to 200m. But for 30m span, the minimum is observed at 150m radius of curvature. In the case of 20m span, the mid span deflection is minimum at a radius of 100m. The bending stress and shear stress decreases with increase in radius of curvature.
6) G. C. Ezeokpube (2015) In this paper review analysis over the elastic analysis of the box girder bridges has been given through different methods. Numerous academics have worked on a variety of projects aimed at improving the effectiveness of box-girder bridge analysis and design. The proposed solutions have not led to a thorough and all-encompassing examination and design of these kinds of structures. However, much work need be done. These will include the application of a method that is stochastically oriented with less computation and ease of operation, whose results are simple and all-encompassing while defining and detailing the loads and corresponding resistances (for example, a combination of FEM and FSM in a probabilistic environment), safe, economical and reliable. The method to be employed should be varied and incorporating authentic computer simulation and results of experimental investigation in order to achieve sufficient level of design, predicting safety and economy for box-girder bridges.
7) Mayank Chourasia, Dr Saleem Akhtar (2015) This paper discusses the parametric study of two different cross-sections of box-girder for same loading conditions to find the most economical cross-section. The Box-girder superstructures subjected to IRC class AA loading were designed in accordance with the Indian IRC design standard. A comparison of the various design characteristics led to the discovery of optimized cross-sections. This exercise revealed that the stresses and bending moment for

the self-weight and superimposed dead load varied depending on the cross-section. Less steel is needed to counteract bending stresses in the cross section with the lowest value of bending moment. The most cost-effective box girder cross-section has less reinforcing. According to the results, multi-cell box girders are more expensive than single-cell box girders when the loading and support conditions for both cross-sections are maintained constant. The MIDAS Civil Software, which is used for analysis,In this research paper a comparative study between four cell and single cell pre-stressed concrete box girder Cross-sections has been done. This study demonstrates that the most practical and cost-effective cross-section for two-lane Indian national highway bridges is the single cell pre-stressed concrete box girder.

8) Nila P Sasidharan (2015) The analysis of various curved box girder models is carried out in ABAQUS software by varying span and radius of curvature. The span to depth ratio is kept constant. The models are created by varying the depth according to a span to depth ratio of 16. The variations in reactions, bending stress, shear stress and mid span deflections are observed by conducting the parametric study. From the results obtained after the analysis of curved single cell rectangular box girder, the following conclusions are made:

a) According to the graph that graphs the response against the radius of curvature, the reaction decreases as the radius of curvature grows and the span length decreases. As a result, increasing the radius of curvature produces the least response.
b) If the requirement for selecting a certain radius of curvature is minimal deflection, it may be deduced that for a 40m span, the mid span deflection is minimum at a radius of curvature of 200m. However, for a 30m span, the minimal radius of curvature is seen at 150m. The mid-span deflection of a 20-meter span is lowest at a radius of 100 metres.
c) As the radius of curvature increases, the bending stress reduces. Bending stress is independent of curvature radius for a 20-meter span. For maximum bending strength, it is preferable to choose a radius of curvature less than 200 meters as span grows.
d) The shear stress will rise as the radius of curvature decreases. Additionally, shear stress increases as span grows. Above a 150-meter radius of curvature, the shear stress distribution is homogeneous for every span under consideration.

9) Sanket Patel, Umang Parekh (2016) PSC. Box Girder and PSC. Tee Girder Comparative Study. The current study covers a parametric analysis of the superstructure of a prestressed concrete girder bridge. The length to span ratios forthree distinct spans of 30 m, 35 m, and 40 m are 14, 15, and 16 correspondingly. With CSI Bridge 2014, the box girder and tee girder were compared, and the resultssuggest that the box girder performs better as the span grows. Box girder requires fewer prestressing cables to resist the load as measured by the number of cables. The loads are practically same between the two girders, but for a 40-meter span, a box girder is the ruling section; nonetheless, it has drawbacks of its own. Its shuttering is intricate, necessitating the use of more qualified personnel.

10) Bhagyashree C jagtap, Prof. Mohd. Shahezad (2016) This project presents the comparative study of prestressed concrete girder and steel plate girder for roadway over bridge. The design and cost analysis of steel and prestressed concrete girders are included in this paper. In the good old days, steel girders, either plate girders or triangulated girders, were mostly employed for higher spans. Pre-stressed concrete was greatly used in larger span bridges after its introduction. PSC girders are mostly used because of their low starting cost. PSC girders are undoubtedly cost-effective during the first phases of construction, however this may not be the case when taking other aspects into account and the life cycle cost. This effort aims to design steel girders and prestressed concrete for different spans, and then compare the outcome. An MS Excel computer software was created to design prestressed concrete and steel plate girders based on the comprehension of the manual design process. Finding the more advantageous choice between the first two is the aim of the study. Prestressed concrete girders are more cost-effective than plate girders, according to the study that was done. The cost keeps rising as the span length does. Steel plate girders are less durable than prestressed concrete girders. In summary, for spans up to 15 metres, steel plate girders are the preferable alternative. Other factors, such as the size and location of the project, should be considered when selecting spans between 15 and 36 metres. For spans more than 24 metres, prestressed concrete girders are obviously superior to alternative solutions. In fact, for spans more than 25m, ordinary steel plate girders become more than 37% more expensive and cease to be an alternative.

11) Phani kumar, S.V.V.K.Babu, M.Tech (2016) :- In this thesis, IRC:112-2011 is used to analyse and design prestressed concrete bridges (Deck Slab, T-Girder, and Box Girder). The Indian Road Congress released the unified concrete code (IRC:112) in November 2011, which combines the codes for prestressed concrete and reinforced concrete structures. This code is a new generation code that differs greatly from the earlier codes (IRC:21 for RCC structures and IRC:18 for PSC structures). The withdrawal of IRC:21 and IRC:18 coincides with the release of IRC:112. The primary distinction between the prior codes and IRC: 112 is that the latter is based on working stress design philosophy, whilst the former is based on limit state theory.

Following observation was made from the analysis and design of post tensioned box girder bridge for various span to depth ratios. The various span to depth ratio is taken for the analysis of box girder bridges, and for all the cases, deflection and stresses are within the permissible limits. Prestressing force and cable count both decrease with decreasing box girder depth. Prestressing allows concrete to be used to its full strength and effectively regulates serviceability. The new code (IRC:112) calls for more cover for posttensioned ducts and pretensioned strands, which will result in thicker deck slabs and soffit slabs for PSC box girder bridges and PSC girders. LSM uses less steel than WSM for the same cross section and applied moment, hence for a greater percentage of steel difference, it is preferable to alter the steel grade rather than raise the concrete grade.

12) Punil Kumar M P, Shilpa B S (2016) “Dynamic analysis of box girder bridges” Now days the dynamic performance of structure is very much essential while designing any structure. This research aims to analyze the PSC Box girder bridge both statically and dynamically. Here, the performance of the bridge is examined both with and without the introduction of dynamic loads. The bridge study includes the bearing between the top of the pier and the girder. The impacts of the bridge model are thoroughly examined by adding pre-stress, axial forces, moving loads, vehicle (or) truck loads, and moving loads.

13) Karthika Santhosh, Prof. P Asha Varma (2016) "Parametric Study on Behavior of DifferentShaped Box Girder Bridges Based on Torsion." In this study, SAP2000 V14 is used to examine a box Girder Bridge with a single cell type. Triangle, trapezoid, and rectangle considered, and the bridges' curvature only vary in the horizontal direction. A tracked vehicle is used to carry a moving load of the IRC class, and static studies are carried out under various loading scenarios. This study compares the various PSC Box Girder Multi Cell (3 Cell) Bridge forms, including the following: (1) Vertical side; (2) Slopped side; (3) Clipped side; (4) External Girder with Radius; and (5) Maximum Slopped. IRC-112 (2011) is utilized for analysis, and IRC Class-A loading is employed. The CSI Bridge (V - 2017) is utilized for modeling and analysis purposes.

14) Amit Upadhyay, Dr Savita Maru (2017) This work attempted to compare the various shapes of PSC Box Girder Multi Cell Bridge using CSI Bridge (V-2017). This study compares various shapes of PSC Box Girder Multi Cell (3 Cell) Bridges such as (1) Vertical side, (2) Slopped side, (3) Clipped side, (4) External Girder with Radius, and (5) Max. Slopped. The IRC Class - A loading is used, and the analysis is performed using IRC - 112 (2011). CSI Bridge (V - 2017) is used for modelling and analysis.

15) Savio John, Reshma Prasad (2017) Although extensive advanced analysis study has been conducted over a long period of time to better understand the behavior of all sorts of box girder bridges, the outcomes of these numerous research activities are Unorganized and unassesed. Therefore, it is imperative to have a clear understanding of more current research on both straight and curved box-girder bridges. The major goal is to provide a comprehensive understanding of straight and curved non-composite box girder bridges. Through this study, bridge engineerswill be better able to comprehend how box girders behave under numerous variations in characteristics like curvature and shape. There are several published works on the study of box girder bridges with distinct variations in factors such as shape, span, depth, material utilized, technique of construction, cell configuration, curvature, and so on, according to a succinct review of the various literatures offered. Engineers have begun to employ curved beams because of the ease with which complex models of curved beams can now be analyzed, thanks to the quick development of computers and a variety of analytical techniques. Curvature-based results are inconsistent and unreliable, therefore more research in this field is possible in the future. In further research, seismic and dynamic analysis may be taken into account.

16) Harish M K, Chethan V R, Ashwini B T (2017) Single and Multi-cell box girder bridges are considered for the analysis. IRC class AA loading conditions were applied to the models, and the resulting bending moments and object reaction stress levels were compared. Results can be summarized as follows:

a) According to the results, the bending moment was determined to be the greatest for the Single cell box girder when compared to the Four cell girder.

b) For the analysis of beam bridges, the varying span to depth quantitative relationship is used, and deflection and stresses are at intervals within the acceptable limits in all circumstances.

c) It is discovered that the deflection obtained as a result of different loading circumstances and in service is well within the IRC permitted limits. The greatest vertical deflection is discovered to occur near the beam's mid-span point.

d) The bending moment and stress results for self-weight and superimposed weight are the same, but they are completely different for the moving load concept, since IRC codes provide style for considerable loading.

e) Finally, this comparison research shows that a single cell girder bridge is more cost effective than a four cell girder bridge.

17) Pragya Soni, Dr. P.S. Bokare (2017) The goal of this study is to determine the box girder bridge's effective cross-section. IRC 21: 2000, IS 456: 2000, IRC 6: 2014, and the analysis makes use of the public works department's (Chhattisgarh) rate schedule. The MIDAS civil 2016 Software package is used to do finite element analysis. The analysis shows that trapezoidal cross sections are more economical than rectangular sections. of comparison to rectangular sections, the central deflection of trapezoidal sections is 7.6% greater. In a trapezoidal section, there is less shear force from the results obtained from the design and analysis following conclusions are drawn

a) Concrete and steel are used more frequently in rectangular sections than in trapezoidal sections. Therefore, when comparing the trapezoidal section to the rectangular section, the cost of steel is 25% cheaper and the cost of concrete is 7% less..
b) Because there are fewer pedestals needed in a trapezoidal portion, there will be fewer pedestals overall, which will lower maintenance costs going forward.
c) Central deflection in trapezoidal section is 7.06% higher than that of rectangular section. (Satwik Mohan Bhat, 2016) also observed that for the same section properties deflection ismore in trapezoidal section.
d) Shear force is more in rectangular section. (Satwik Mohan Bhat, 2016) made a similar observation, noting that shear force will be larger for the rectangular cross section in a box girder with two distinct cross sections but the same width and span.
e) Use of trapezoidal section will increase aesthetic appearance of the bridge.

18) Prof. Dr. Srikrishna Dhale, Prof. Kirti Thakare (2018) In present study the main concern of this thesis is with T-Beam Girder Bridge and Box Girder Bridge. The work's goal is to evaluate and create the sections for the various Indian Road Congress Codes, or IRC 6 and IRC 21. This was accomplished by using tools, such as STADD PRO, to analyze the structure and manually verify the results by creating Microsoft Excel sheets. For the computation of the bending moment in four distinct scenarios, they employed Piegurd's curve. For a vehicle load, we measure the bending moment and shear force. We measure the depth, design the bridge in STAAD-pro, and then evaluate the bridge to get the desired outcome. The IRC 70R vehicle is shown to have the greatest impact on the sections. The current study compares "T Beam Girder" with "Box Girder" construction methods.. This is helpful when we have two kinds of girder which can be used for same span; in that case the most economical one is to be selected. The detailed design of two types of deck is carried out and comparative conclusion is given as per the results obtained.

a) Box girder bridges have been determined to be superior to T-beam bridges over long spans.
b) T-beam girder bridges have higher principle stresses than box girder bridges.
c) The plain stresses of a box girder bridge grow as the span decreases.
d) The maximum displacement of a T-beam bridge girder is greater for longer spans.
e) T-beam girders have larger bending moments than box girders.
f) Shear force is greater in T-beam girders than in box girders.

19) Jayasri, V. Senthil kumar (2018) “A Study on Behavior of Girder Bridge Under Class AA Loading and Class 70R Loading "Bridges are the most frequently encountered large structure in highway engineering, as well as the most diverse in terms of design. Bridges can be as simple as a timber deck on stringers with support at each end can have extremely intricate designs. From 6 meters (20 feet) to hundreds of meters (foot), span lengths might vary. It may be necessary to cross a river, road, railway, or valley. Designing new structures and maintaining or restoring old ones are both parts of structural engineering practice. A bridge is a building that allows a road, train, or pipeline to travel over an obstruction. This study aims to comprehend how the Girder Bridge behaves whenit has two lanes with differing spans. Performance analysis is done using the ANSYS program.

20) D.V.S. KChaitanya (2019) Four unique scaffold supports are considered for this inquiry, notably Rectangular Single and Double Cell Box Girder (RSBG and RDBG), Trapezoidal Single and Double Cell Box Girder (TSBG and TDBG) in the 20-, 30-, 40-, and50-meter ranges. Using the SAP2000 Connect wizard, Direct Static and Modal Analysis are conducted on all the extension supports that are taken into consideration. The IRC Class AA Tracked Loading framework is taken into consideration for the test. A close description of the dynamic properties of all the considered extension braces using SAP2000. When compared to all other girders under consideration, the Rectangular Double Cell Box Girder (RDBG) has the highest stiffness for all spans under consideration. Rectangular Double Cell Box Girder (RDBG) has the least amount of deflection among all the examined girders for all spans with dead and moving loads.

21) Gokul Mohandas, Dr. P. Eswaramoorthi (2020) The superstructure is analysed in this thesis for un-factored gravity loads and moving vehicle loads according to IRC: 6-2014 and IRC: 18-2000. This study discusses the modelling and analysis pattern of prestressed concrete bridges for various tendon profiles using the MIDAS CIVIL programme. The curved tendon design lowers stress and deflection when compared to a straight tendon profile. A straight and parabolic tendon profile was created for the four-cell prestressed girder, and the effects of eccentricity, prestressing force, and cable profile were explored. The static structural features of the girder stated above, such as deflections and stress distribution, were investigated. For straight tendon profiles, the deflection resulting from the application of a live load at the critical section is 7.5 mm, but for parabolic tendon profiles, it is 7.06 mm.For a parabolic shape, the stress due to loads at the critical section is 1.745 N/mm2, but for a straight cable profile, it is 9.217 N/mm2.
22) H.R.Nikhade A.R.Nikhade, M.R.Wagh, S.G.Hirekhan , A.R.Gajbhiye ,A.G.Hirekhan (2020) :- In this project around eighteen papers were reviewed & from literatureit was realize that Box Girder Configuration is the best one for long span RCC Bridge. For the design of long span RCC Bridges IRC specification were carefully studied, (IRC:6-2000, IRC:21-2000, IRC:78-2000, IRC:18- 2000). The Indian Road Congress has drafted the specifications resulting in simplified approach of design of box girder bridges. To begin with, a 50m span box girder bridge was designed according to specifications, and it was discovered that the following parameters are significant in the analysis and design of box girder bridges (Depth of Web, DLBM & LLBM at mid span section, DLBM & LLBM at mid support section, Prestressing Force, Eccentricity, Quantity of Steel & Concrete).Bridges with 60m and 70m spans were developed as a result. In this research article, a mathematical model for analysing different spans of a box girder bridge is created using pertinent IS codes.

a) The IRC6-2000, IRC21-2000, and IRC78-2000 provide extensive provisions for RCC Bridge design.
b) Developed Excel sheets can provide design output for any long Span Box Girder Bridge.
c) Box Girder Bridge analysis and design for any span may be achieved using mathematical models without the need for extensive computations.
d) By simply entering span values into mathematical models, we may receive analysis and design parameters for any lengthy span. RCC bridge with box girders.

23) Avinash Kumar Vidyarthi, Dr. P. K. Singhai, Rohit Sahu (2021) The straight and parabolic tendon profiles were designed for the four-cell prestressed girder, and the effects of eccentricity, prestressing force, and cable profile were investigated. The above-mentioned girder's structural static characteristics, such as deflections and stress distributions, were investigated. The deflection caused by the application of a live load at the critical section is 7.5 mm for the straight tendon profile and 7.06 mm for the parabolic tendon profile. Stress due to loads at critical section is 1.745 N/mm2 for parabolic profile and 9.217 N/mm2 for straight cable profile.
24) Wasim Sheikh, Mayur Singhi, Nikita Thora (2021) In this project a comparative study is performed on concrete 2 cell and 3 cell rectangular and trapezoidal box girders using SAP2000 software. The various reactions including shear force, deflection, torsion, and bending moment around horizontal and vertical axes at the entire girder are explored in this for different cells and varied forms. In this project, different models of cell girders with different cells and shapes were analysed for a specific span, and the results for static and dynamic analysis of the girder were compared on the basis of stresses, displacements, and modal frequencies obtained for different models. So, when we compare the horizontal acceleration of two cell rectangular and trapezoidal girders to three cell rectangular and trapezoidal girders, we see that three cell rectangular and trapezoidal girders have more acceleration than two cell rectangular and trapezoidal girders, and trapezoidal girders have more acceleration than rectangular girders, and we see that as the cell size increases, the frequencies and eigen values decrease, so two cell girders are more effective. The shear force and moment of 3 cell rectangular and trapezoidal girders are greater than those of 2 cell rectangular trapezoidal and rectangular girders. We can conclude that because the moment is greater in 3 cell girders, the reinforcement provided should be greater, making it ineffective to construct a 3-cell girder.
25) Gambhire, Vikas Arunrao, Prof. Hamane (2022) The current study examines static anddynamic behavior while demonstrating the linear dynamics of T-beam girder and trapezoidal box girder bridge decks. The 35, 40, 45, and 50-meter bridge superstructure's planned T-beam and box girder behavior is investigated. By comparingstatic and dynamic reactions, it became evident through dynamic analysis that the box girder is a more effective and cost-effective girder system than the T-beam girder. The study includes a bridge with bearings between the girder and the pier's top. The bridge model's effects are thoroughly investigated by adding moving load, vehicle (or) truck load, pre-stress, and axial forces.

a) It is observed that there is no significant variation in the bending moments and the shear forces for DL, SIDL and LL for the specific span length with different radius.
b) Torsional moments grow dramatically as the span radius of the box girder decreases. Torsion varies more when the span radius is less than 200m, and less when the span radius is more than 400m.
c) Based on the responses, box girders with a factor of safety against overturning less than 1.5 are not practical. Sharp radiuses less than 100m must be avoided.

III. CONCLUSION

This study compares several forms of PSC Box Girder Multi Cells Bridges such as rectangular and trapezoidal, straight and curved sides, and varied degrees of inclination. It also compares different number of cells or interior girders provided in the different shapes of the box girders. It also allows us to investigate different tendons profiles, such as straight, parabolic, and circular which are employed for pre-stressing. The IRC Class - A loading is used, and the analysis is performed using IRC - 112 (2011). CSI Bridge (V - 20) is used for modelling and analysis. Because this is a review paper, the final results and comprehensive work, graphs, diagrams, and so on will be described.

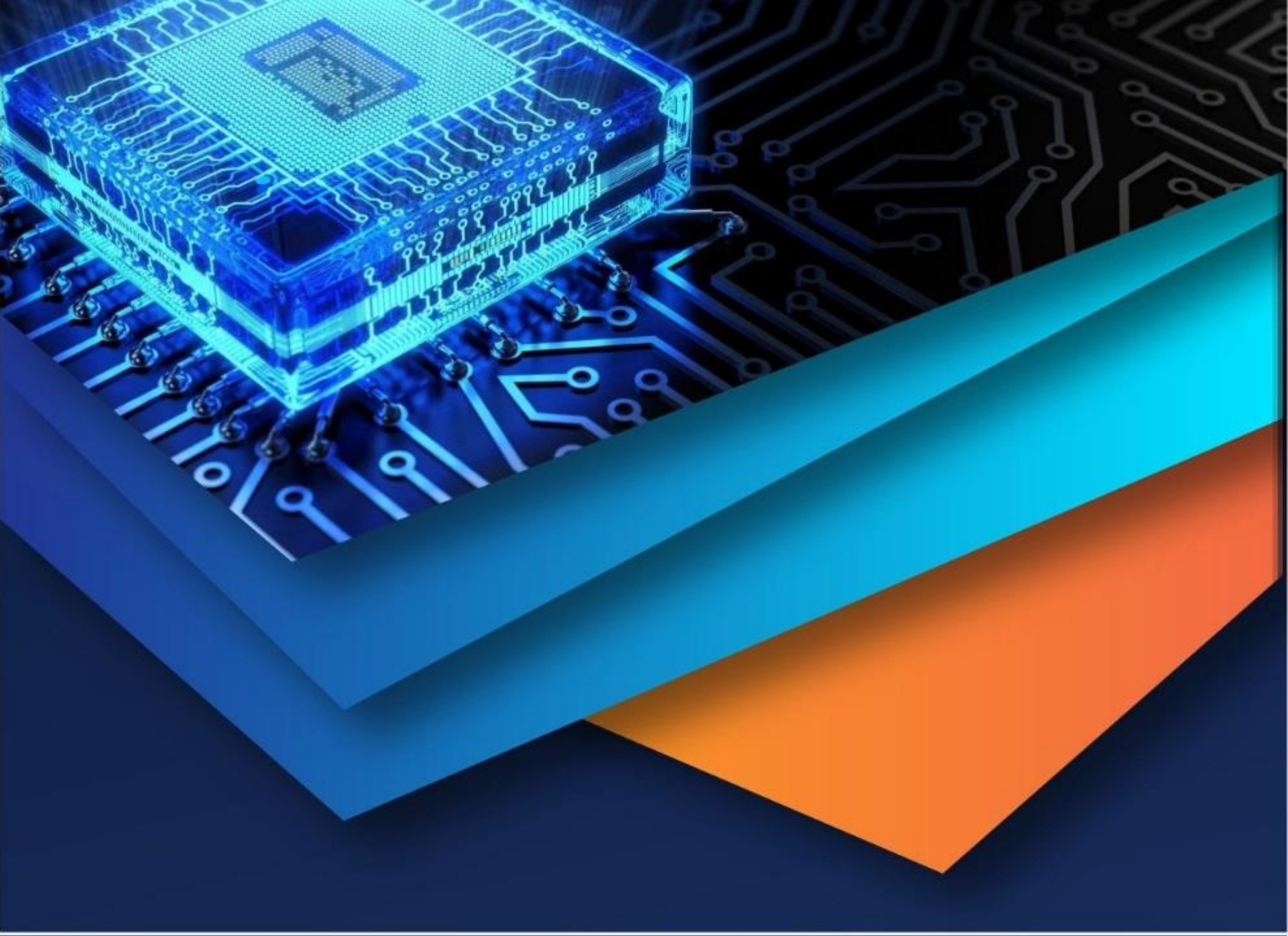
IV. ACKNOWLEDGMENT

I am thankful to my guide, Dr. Savita Maru in Civil Engineering Department for her constant encouragement and able guidance. Also, I thank my parents, friends etc. for their continuous support in making this work complete.

REFERENCES

[1] Analysis and Design of Prestressed Box Girder Bridge by IRC: 112-2011 Phani Kumar.Ch Student of final year M.Tech Structural Engineering, Volume 2, Issue 2, 2016, PP 1-10 ISSN2454-8693 www.arcjournals.org
[2] Comparison of T-Beam Girder Bridge with Box Girder Bridge for Different Span Conditions.Prof. Dr. Srikrishna Dhale, Prof. Kirti Thakare ISSN (e): 2319 – 1813 ISSN (p): 23-19 – 1805
[3] Review of elastic analysis of box girder bridges G. C. Ezeokpube (2015) NIJOTECH vol – 34
[4] COMPARATIVE ANALYSIS USING SAP SOFTWARE OF 2,3 CELL RECTANGULAR BOX GIRDER AND2,3 CELL TRAPEZOIDAL BOX GIRDER Wasim Sheikh, Mayur Singi , Nikita Thora Volume:03/Issue:01/January-2021 Impact Factor- 5.354 www.irjmets.com
[5] ANALYSIS OF PRESTRESSED CONCRETE GIRDER FOR BRIDGES Gokul Mohandas V, Dr. P.Eswaramoorthi, e-ISSN: 2395-0056 Volume: 07 Issue: 02 | Feb 2020
[6] Comparative Study of Prestressed Concrete Girder and Steel Plate Girder for Roadway OverBridge Bhagyashree C Jagtap, Prof. Mohd. Shahezad, © 2016 IJSRSET | Volume 2 | Issue 1 |Print ISSN: 2395-1990 | Online ISSN: 2394-4099
[7] Comparative Study of PSC Box Girder Multi Cell (3-Cell) Bridge of Different Shapes: A ReviewPaper, Amit Upadhyay, Dr. Savita Maru Volume 2 | Issue 6 | May 2017 ISSN: 2455-5703
[8] Design and Analysis of Prestressed Concrete Box Girder by Finite Element Method (4 Cells & 1 Cell) 1Mayank Chourasia, 2Dr. Saleem Akhtar, Vol. 3, Issue 1, pp: (413-421), Month: April 2015
[9] Study of Box Girder Bridge and Relevant IS Code, H.R.Nikhade , A.R.Nikhade , M.R.Wagh , S.G.Hirekhan , A.R.Gajbhiye ,A.G.Hirekhan, ISSN: 2248-9622, Vol. 10, Issue 5, (Series-II) May2020, pp. 21-24
[10] Research on Concrete Box Girder (Single & Double Cells) Bridges using Finite Element Method D.V.S. KChaitanya, ISSN: 2278-3075, Volume-8, Issue- 6S4, April 2019
[11] FINITE ELEMENT ANALYSIS AND PARAMETRIC STUDY OF CURVED CONCRETE BOX GIRDER USING ABAQUS SOFTWARE, eISSN: 2319-1163 | pISSN: 2321-7308
[12] Analysis of Prestressed Concrete Girder for Bridges, Avinash Kumar Vidyarthi, Dr. P. K. Singhai , Rohit Sahu, (IJTSRD) Volume 5 Issue 6, September-October 2021
[13] AN OVERVIEW ON BOX GIRDER BRIDGES Savio John, Reshma Prasad, e-ISSN: 2395 -0056Volume: 04 Issue: 01 | Jan-2017 p-ISSN: 2395-0072
[14] Parametric Comparison of Rectangular and Trapezoidal Box Girder Bridge Deck SystemPragya Soni, Dr. P.S. Bokare, e-ISSN: 2395-0056 Volume: 04 Issue: 09 | Sep -2017 www.irjet.net p-ISSN: 2395-0072
[15] REVIEW ON DYNAMIC ANALYSIS OF PSC T BEAM & BOX GIRDER BRIDGESUPERSTRUCTURE FOR DIFFERENT SPAN LENGTHS Gambhire Vikas Arunrao,Prof. Hamane A. A. IJARIIE-ISSN(O)-2395-4396
[16] Torsional Behavior and Constancy of Curved Box Girder Superstructures Ashish B Sarode andG R Vesmawala, 15 October 2012
[17] B.Paval "Analysis of Multi-Cell Pre-stressed Concrete Box-Girder Bridge" International Journalof Engineering Technology ISSN 2394 – 3386 Volume 3, Issue 4
[18] Selvan V* and Gobinath RS "Pre-Stressed Concrete Box Girder Multi Cell (3-Cell) Bridge of Different Shapes a Comparative Study: A Review Paper" ISSN: 2574-187X December 03, 2019
[19] Punil Kumar M P, Shilpa B S "Dynamic analysis of box girder bridges" International ResearchJournal of Engineering and Technology, Volume: 03 Issue: 07 | July-2016
[20] Jayasri, V. Senthil kumar "A Study on Behavior of Girder Bridge Under Class AA Loading andClass 70R Loading" (IRJET) Volume: 05 Issue: 04 | Apr-2018

[21] Wang Hui-li, Feng Guang-qi, and Qin Si-feng (2014) "Hysteretic Behavior of Prestressed Concrete Bridge Pier with Fiber Model". Hindawi Publishing Corporation, Scientific WorldJournal, Volume 2014.
[22] Sanket Patel, Umang Parekh (2016) "Comparative Study of PSC. Tee Girder and PSC. Box Girder". IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue11 | May 2016
[23] Amit Saxena, Dr. Savita Maru (2013) "Comparative Study of the Analysis and Design of T-Beam Girder and Box Girder Superstructure". IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, and Issue 2, April-May, 2013.
[24] Chen Cheng, Kaiyin Zhang "Research on temperature field and temperature stress of prestressed concrete girders". I.J. Intelligent Systems and Applications, 2011, 1, 25-32,Published Online in MECS on February 2011.
[25] Byungik Chang, Kamal Mirtalaei, Seungyeol Lee, and Kenneth Leitch (2012) "Optimization ofPost-Tensioned Box Girder Bridges with Special Reference to Use of High-Strength Concrete Using AASHTO LRFD Method". Advances in Civil Engineering, Volume 2012 (2012), Article ID 673821, Received 9 January 2012; Revised 17 May 2012; Accepted 24 May 2012
[26] M K Maroliya (2012) "Comparative Study of Flexural Behavior of Reinforced Concrete Beam and Prestressed Concrete Beam". International Journal of Engineering Research and Applications (IJERA), Volume 2, Issue 6, November- December 2012, pp.230-233.
[27] Natraj Singh, N.P. Devgan, A.M. Kalra, Surinder Pal (2016) "Effect on Economy on Successive Increase in the Span of Bridges". Proceedings of the 2nd International Conference on Civil, Structural and Transportation Engineering (ICCSTE'16) Ottawa, Canada – May 5 – 6, 2016.
[28] Paul J. Barr, Marc O. Eberhard, and John F. Stanton (2001) "Live load distribution factors inprestressed concrete girder bridges". JOURNAL OF BRIDGE ENGINEERING / SEPTEMBER/OCTOBER 2001.
[29] B. Paval (2015) "Analysis of Multi-Cell Prestressed Concrete Box-Girder Bridge". International Journal of Engineering Technology Science and Research IJETSR, ISSN 2394 –3386 Volume 3
[30] Chetan T Naik, Dr.M M Achar, K Lakshmi (2015) "Analysis and Design of Multi Cell Post- Tensioned PSC Box Girder". IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE),Volume 12, Issue 4 Ver. VII (Jul. - Aug. 2015), PP 56-64



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY