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Review on Design and Analysis in Ultimate State of Bridge for Class 70R IRC Loading

Mr. Himanshu K. Dhawale[1], Prof. Girish Sawai[2]
[1]*Students, M-Tech Structural Engineering, Department of Civil Engineering, V.M. Institute Of Engineering And Technology, Nagpur, Maharashtra*
[2]*Project Guide, M-Tech Structural Engineering, Department of Civil Engineering, V.M. Institute Of Engineering And Technology, Nagpur, Maharashtra*

Abstract: ***Due to its increased carrying capacity, pre-pressurized concrete bridge flooring have recently seen growth in the field of bridge engineering. IRC codal keywords were used for the analysis. One of the largest varieties of cast in situ concrete decks with a concrete slab attached to belts are T-beam bridge decks. The standard structural analysis method FEM (standard feature approach) in STAAD Pro rates the continuum mechanics problem. This study analyses a single-span t-beam bridge by varying the lengths by 25, 30, 35, and 40 metres while keeping the width constant. To ascertain the curve time and shear strength, models of bridges of the IRC AA category and the IRC loading system of section 70Rtracked were used. According to the investigation, there are no discernible differences between the Courbon method and the limited feature method as the span increases.***
Keywords: 70R IR Code, Finite element method, Bridge **etc**

I. INTRODUCTION

A bridge, a structure of public engineering, a structure that has been utilised to traverse any disturbance beneath it from ancient times. Who would have imagined that a straightforward method of overcoming difficulties would be applied in so many various contexts and with so many variables that it would now become a sizable body of knowledge? The bridge is currently one of the best examples of a public engineering structure. Modern technology and material science have made it possible to construct a variety of bridge types.

In order to sustain the bridge and transfer weights from the superstructure to the base, the bridge substructure, which consists of the pier and abutments, must be able to withstand both a direct load and a horizontal force. The steel is typically the compressive part of the bridge, subject to substantial biaxial moments and shear forces in both transverse and longitudinal directions.

Today, the bridge's construction has grown to a point where it is significant on a global scale. Any road network must have bridges, and prestress girder bridges have a strong reputation in the engineering community because to their exceptional stability, usefulness, economy, aesthetic appeal, and structural efficiency. IRC: 70 R was utilised in this analysis to support the thesis and to build compressed concrete bridges (Deck Slab, T-Girder, and Box Girder).

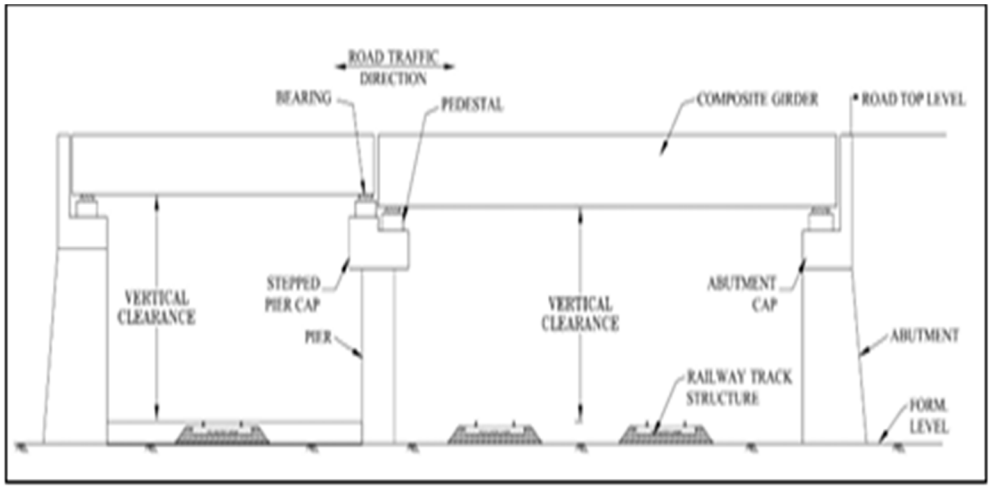


Fig.1. Schematic Diagram of Road over bridge

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II. PROBLEM STATEMENTS

A bridge is a building that offers a route to cross a gap without obstructing the way down. A road, railway line, pedestrian path, ditch, or pipeline may be necessary for passage. It may be necessary to cross a river, road, railway, or valley. An obstruction such as a station, road, or rail that is under stress or interruption can be carried by a bridge.

Nowadays, a wide variety of bridges are being constructed.

1) An easily supported bridge is our main focus in this work.
2) A constant bridge.

A. Simply Supported Bridge

The number of individual spots is typically split by the length of the bridge.The carrying member is simply based on both ends in each scenario. Where the next width inherently varies in length and depth, or where the adjacent width has highly varied geometries with no-frame constructions that don't lend themselves to continuity, like variety of timber spaces or framing frames, easy-to-support bridges should be provided. Ideally, when the stage will necessitate the removal or addition of one or more places because the bridge is a part of a building, such an exchange.

B. Continuous Bridge

The breadth of continuous bridges spans two or more foundations. They are unstable mathematical constructs. If there is no uneven resolution of the foundations, they are helpful. Continuous bridges require far less time to bend and remove from any location within the pen than Easy support does. Such a decrease in bending time and deviation eventually ushers in the bridge's profitable period. The term "substructure" often refers to the part of the bridge structure that is above the founding level and below the bearing level. A bridge's overall design includes the design of the substructure, which has a significant impact on the aesthetics, safety, and economics of the bridge. A bridge's substructure is a crucial component because it safely distributes loads from the superstructure to the earth while ensuring that the soil is not overstressed and that any subsequent deformations are within acceptable bounds. The kind of subsoil, the proposed location of the bridge, and other factors all play a role in choosing the foundation system for a specific site be constructed i.e. over a river, road, or a valley, etc. & the scour depth.

III. OBJECTIVES

The following is a summary of the project's main goals:

1) To determine the Class A and Class 70R Vehicle IRC Loading based on road width.
2) Modelling the slab and girder of the superstructure in STAAD Pro, analysing the impacts of moving the live load, one's own weight, and the SIDL of one's clothing, and achieving reactions at the bearing site.
3) To simulate and evaluate the pier under various load scenarios in accordance with IRC Codes.
4) To confirm that the pier is stable in accordance with the codes' requirements.
5) To first provide reinforcement for calculating stresses, fracture width, and moments in biaxial bending according to IS and IRC codes.
6) If the reinforcement doesn't meet the aforementioned standards, it should be revised.

IV. LITERATURE REVIEW

R. W .LI et.al (2021): "Collapse Analysis and Damage Evaluation of Typical Simply Supported Double Pier RC Bridge Under Truck Collision" is the title of this research study. The extent of damage sustained by the bridge during its collapse. By computationally simulating the actual heavy truck bridge collision, the revised FE model of the typical simply supported two spans double pier RC bridges is built and confirmed based on the prototype truck pier collision tested on full scale drop weight test on RCC beam.

Akram Zaky et.al (2020): "Seismic failure analysis of concrete bridges exposed to scour" is the topic of this research. In this study, the influence of scour depths on the seismic performance of the bridge should be assessed in relation to the soil layer surrounding the bridge pile groups by Rcc pier columns and PSC girders.The bridge was simulated in 3D FEM for scour depth scenarios at pier thirteen.

Parisa Hosseini et.al (2019): "Performance based Reliability analysis of bridge piers subjected to vehicular collisions; extremity and failure" was carried out in this work. Accidental collisions between heavily loaded vehicles and bridge piers are regarded as excessive loading events that could have negative repercussions.

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Steven Auyeung et.al (2019): "Performance based design of bridge piers under the vehicle collision" was used in this work. The response of the bridge piers to collision was taken into account while determining the impact of the various design factors, including the pier diameter and the transverse reinforcement ratio. Shear force, bending moment, and displacement. A continuous surface cap model (SCM) is used to simulate the behaviour of concrete when subjected to dynamic loads.

Amit katkar et.al (2018): "Parametric study of bridge piers" is the title of this research. adjusting the parameters of an analysis of integral bridge piers to provide useful findings. That will assist the designer in deciding on the size or shape of the pier. Using Midas Civil software, several characteristics, such as displacement stress of the RCC concrete pier, are studied. After the entire analysis, it is also determined which portion size is cost-effective.

Singh Shailendra et.al (2017): In order to compare the behaviour of continuous bridges with that of simply supported bridges, this paper will first transform the simply supported bridges into Continuous bridges. Six simply supported scenarios are taken into consideration for this purpose. The bending moments created in continuous bridges are significantly less as compared to simply supported bridges, allowing for the adoption of smaller sections and a reduction in the use of steel and concrete.

Rashmi R.Vanahallil et.al (2017): In this essay, the superstructure's intermediate supports are bridge piers. Piers are subject to a variety of forces both vertically and laterally, including wind, earthquake, and water current forces. The type, size, and proportions of the superstructure affect the pier's shape. Pier types include hammerhead, solid, round, trestle, and solid.

R. Shreedhar et.al (2016): T-beam bridge decks are one of the main forms of cast-in-place concrete decks in this essay. The decks of T-beam bridges are made of a concrete slab joined to girders. The finite element method is a general method of structural analysis in which the analysis of a collection of finite elements, connected at a finite number of nodal points and representing the solution domain of the problem, approximates the solution of a continuum mechanics problem.

Anilkumar H. et.al (2015): In this study, Tee beam deck slab bridges are the most common type of cast-in-situ concrete bridge. They are made up of main girders, cross girders that give the deck slab lateral strength, and a deck slab that constantly spans across T beams. Numerous techniques, including the Courbon's method, the Guyon-Massonet method, and the Hendry-Jaegar method, are used to analyse Tee beam bridges. Mand A set of suitable finite elements that are interconnected at points known as nodes represent structures using the finite element method, a potent tool for structural analysis that provides numerical solutions to complicated problems.

Balamurugan M. et.al (2014): In this essay, a bridge is a building that allows traffic to pass across an obstruction, such as a railway track or a pipeline. One of the most common types of cast-in-place concrete decks are T beam bridges. It is made up of a concrete deck slab that was formed in one piece over the longitudinal girders. Static and dynamic loads are the two main types of loads that affect bridge structures. But when designing structures, only static loads are taken into consideration.

J.B. Mander et.al (1998): "Capacity design of the piers and analysis of the over strength" is the title of this essay. For the design of bridges, the capacity design technique is used. Before moving on to the design of the foundation and substructure, consider the columns. The purpose of the project is to provide a standardised method for determining the strength factor for column elements.The study is being done to investigate the variables that affect strength.

V. RESEARCH METHODOLOGY

The proposed work is planned to be carried out in the following manner ,

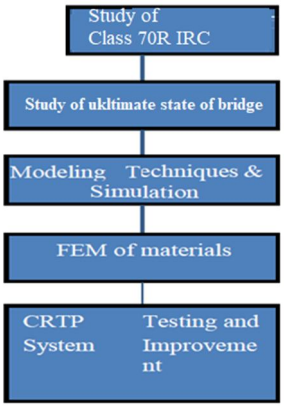


Figure 1. Planning of work

The STAAD 3-Dimensional model will be used for the study with various span parameters. Bridge The Spaniard's length ranges from 30 to 36 metres with a 6.525-meter minimum standing limit. The width of the trailer is estimated to be 10.5m (i.e. two rows) with the exception of the Crash-Barrier which is 0.5m wide on both sides. To the STAAD model at the proper location, such as IRC: 6-2017, various loads including Dead Load, Live Load (i.e., Class A Vehicle, 70R Wheelbarrow, Special Vehicle), Braking Force, Earth Pressure, and Live Load Payment will be appliedLive animated uploads will be distributed on the top slab in accordance with IRC: 112-2011's (Appendix B-3) working width approach. Microsoft Excel will be used to modify the design. Analysis and the goal of the design will be taken into consideration. When combining the reinforcement requirement, the outcomes of the two sessions will be compared.

A. Loads acting on Bridge

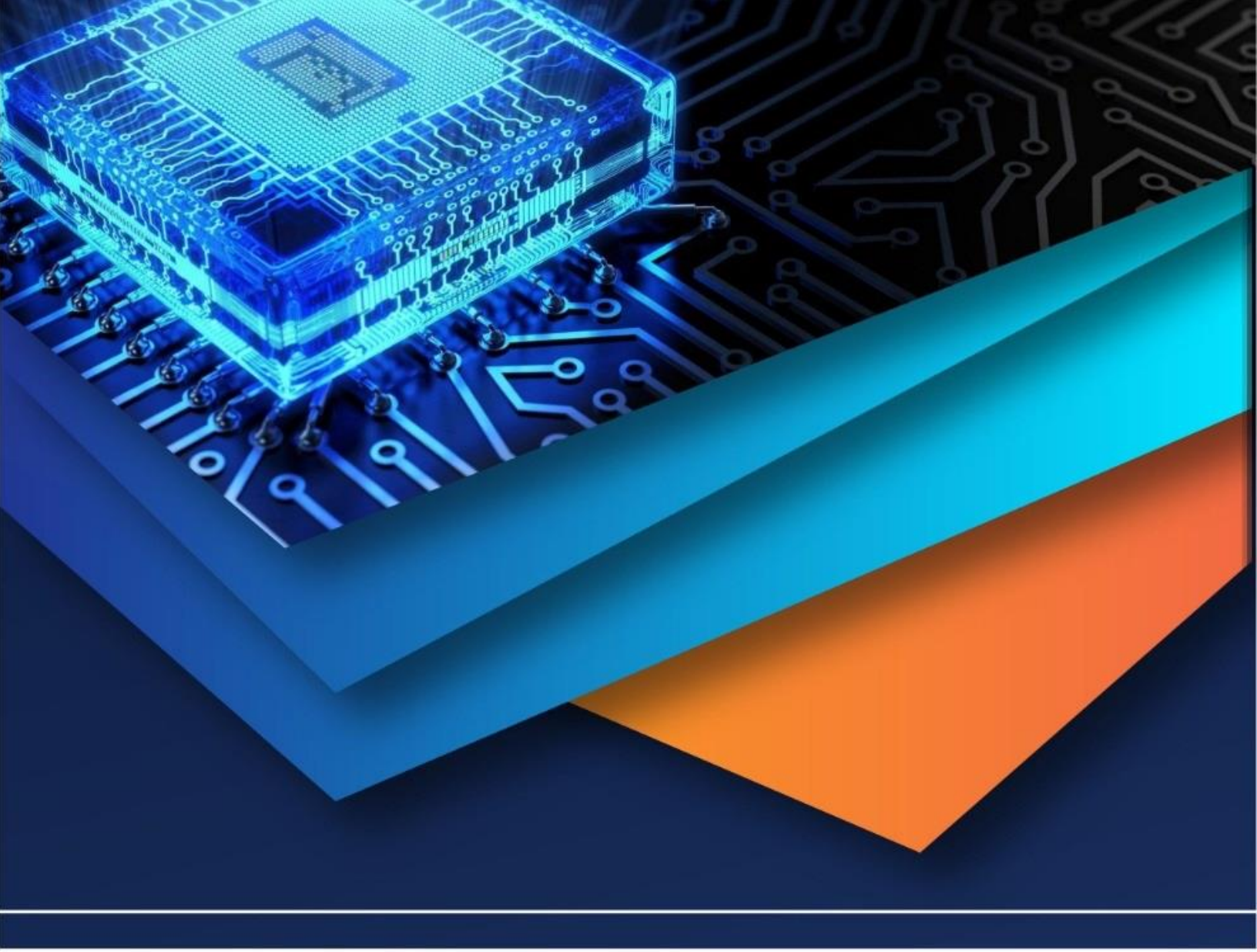
1) *Dead Load:* Gravity's loading caused by the building and other objects that are permanently affixed to it is known as dead or permanent loading. It only counts as a volume by material density product.
2) *Live Loads:* Live upload refers to a load that moves slowly over time. These loads are categorised according to how they are configured and how long they last. Multiple IRC class uploads, including IRC class70R loading, IRC class A loading, and IRC class B loading.
3) *IRC Class AA loading:* There are two distinct types of tracked vehicles with wheels that are listed under this category. A vehicle was followed by an IRC Class AA (imitating a military tank) with a 700 KN and a large military truck with a 400 KN rating.
4) *IRC Class 70 R Loading:* These three different vehicle types are included in the IRC 70 R loading. a) A truck car with two tracks that each weigh 350 kN and a total load of 700 KN. b) A vehicle with four wheels and a load capacity of 100 KN to 400 KN. c) A vehicle with seven axles and four wheels that can carry 1,000 kN of weight.

VI. CONCLUSION

Analytical assessments of the readily compressed bridge deck employing Staad Pro's logical and finite element methods have been used in comparative research. In this study, the bridge area is examined using the Courbon and Staad Pro method by altering the length of the bridge deck; the spaces employed are 25 m, 30 m, 35 m, and 40 m. Based on this research, the Courbon approach performs about as well as the Guyon Massonet method in terms of BM BM longitudinal band values. When the findings were analysed, it was discovered that the results from the conventional feature model were less significant than the results from the one-sided analysis, i.e., the results from the I.R.C. uploads, and FEM provides a design that is affordable.

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