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Review On Parametric Study Of Performance Of Different Types Of Trusses For Pune Railway Bridge Across Bhima River

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Abstract— A bridge must be constructed to resist all reasonable loads and forces that may occur over its lifespan. In India, a general form of steel bridge is now being developed, albeit the mild steel bridge pattern will need to be elevated over time owing to increased train traffic and short distance routes. A bridge is a structure that carries a road, railway, or other service across a barrier such as a river, valley, or other road or railway line, either without intermediate support or with a limited number of supports at appropriate locations. Steel is frequently employed in the building of bridges of different sizes all around the globe. It is a flexible and efficient substance that offers efficient and long-term solutions. It is suggested in this dissertation to conduct analysis and design of several kinds of trusses for a steel bridge in Pune. The present research entails analysing and designing the truss using STAAD PRO software. A length of 366 m and a width of 7.6 m are taken into account. The number of bays is 30 by 12.2 m, the number of tracks is two, the track gauge is broad gauge, and the track width is 1.676 m. For seismic analysis, seismic zone III is used, and IS 1893 (Part III) 2016 is used. Wind analysis is performed using IS 875 (Part III). For static and dynamic analysis, Warren trusses, Pratt trusses, and Howe trusses are compared. And create the most cost-effective structure for the Bhima River.

Keyword: Steel bridge, STAAD PRO, IS 875, IS 1893, static and dynamic analysis

1. INTRODUCTION

A bridge is an essential structure that is required for a transportation network. Traditional bridges have been replaced with a cost-effective structural system as a result of fast technological advancement. In India, a general form of steel bridge is now being developed, while the mild steel bridge pattern is expected to grow over time owing to increased train traffic and short distance routes. A bridge is a structure that carries a road, railway, or other service across a barrier such as a river, valley, or other road or railway line, either without intermediate support or with a limited number of supports at appropriate locations. The primary benefit of structural steel over other structural materials is its strength and ductility. When compared to concrete, it has a greater strength-to-cost ratio in tension and a slightly lower strength-to-cost ratio in compression. Steel has a substantially greater stiffness-to-weight ratio than concrete.

1.1. Advantages of Steel Bridge

Steel bridges are quite common in India and other modern nations for several good reasons..

1. They could support more weight over greater distances with less material loss, allowing for shallower footings.
2. If time is of the essence during the building process, steel is a good choice since it may be partially constructed off-site before being assembled in its final location.
3. Constructing steel bridges in congested metropolitan areas with little room to manoeuvre causes little interruption to local residents and businesses.
4. Steel bridges last longer in operation than their concrete counterparts.
5. Steel bridges, because to their shallow profile, are visually pleasing.
6. When compared to other types of bridges, steel truss spans may save you money.
7. Steel truss bridges are quick to assemble and save building times.
8. The architecture of this bridge exemplifies adaptability.
9. Dynamic loads are no match for the steel bridge's strength.

10. A steel truss bridge has Reduced effort required for upkeep

2. STATE OF DEVELOPMENT

Shubhank Gupta (2017) The study and design of a 50-meter long steel truss railroad bridge is shown here. Different truss sections were tested with the identical 32.5-ton rail load to find the most stable and cost-effective one. Optimizing the section and identifying the most stable portions for comparison are analysed and designed using STAAD PRO. The truss's structural members are designed in compliance with the requirements of the Indian Railway Standard Code and the Indian Road Congress Code. This form of truss bridge was determined to have the lowest values among the four examples studied, which suggests that for the same load, it would need less weight of building material, making it more cost-effective. [1]

T.Pramod Kumar (2015) The article analyses and designs the road and rail bridge that crosses the Krishna river. The programme STAAD PRO is used for the analysis of the upper story, truss, and lower story components. Indian Railway Standard and Indian Road Congress Code are taken into account throughout the design process of the truss structural parts. Their research indicated that by combining a road and rail bridge into a single structure, construction costs could be reduced. The issue of land acquisition is also addressed by this plan. [2]

Sumit V. Bajare (2016) The loads outlined in IRC Appendix: 6-2014 are taken into account as the author designs a steel beam with a span of 24 metres. A total of 385 tonnes can be carried in the 30 metre long vehicle. For the purposes of analysis and design only, the IRC live load for a given vehicle type will be taken into account. R.D.S.O.'s standard design will be compared to the special vehicle's load, and the feasibility of the section will be evaluated for a new IRC load, in this case the special vehicle. For this project, we will be comparing the R.D.S.O. design span of 36.0 m to other available span lengths (ie 36.0 m). Wind, earthquake, braking force, and the dynamic influence on live load will be taken into account in addition to the RDSO-required characteristics, since they were largely ignored by IRC 6 -2014. While the cross-section is secure under shear and deflection control, it was determined that it would fail under the unique vehicle load and that its characteristics would need to be modified to accommodate the bending moment of the design. [3]

V. R. Shinde (2021) A steel truss bridge, measuring 70 metres in length, 7.5 metres in width, and 6 metres in height, is the subject of this article's analysis and design. STAAD PRO is used to conduct the analysis. Maximum axial forces, shear forces, torsional values, and moments are taken into account as comparison criteria. Howe, Pratt, and Warren trusses are all taken into account for this analysis. The conclusion is that a truss bridge can withstand up to 690.141 mm of displacement. When compared to the Pratt truss bridge and the Howe truss bridge, this is an increase of 15% and 5%, respectively. [4]

Ghassan Shaker Abd (2019) With the help of (ANSYS Workbench) and boundary conditions, a 3D bridge truss made entirely of steel is designed and analysed in this paper. Analyses of static factors like axial force, stress, shear stress, and deformation are performed. To see which material combination would be most effective, the bridge floor was switched from steel to concrete. As a result, the axial force and stress values in a concrete floor are much lower than those in a steel floor. [5]

Anjali Verma (2019) In this study, we use the STAAD PRO software to perform a parametric analysis of the critical vehicle load position on a 200.00 m span railway steel bridge, taking into account railway criteria and load norm. The Howe truss, the Pratt truss, the rectangular truss, and the X truss are the four trusses examined. They found that this truss bridge type had the lowest values of deflection and displacement out of the four cases studied, meaning that it could support the same load with a smaller amount of structural material. [6]

Gopal Dayaram Pal (2021) There was an attempt to create a steel truss bridge design in this paper. Optimal cross-sections and material qualities were prioritised in order to reduce the total deformation of the structural element. Since truss trusses are the most commonly used in steel bridges for railways and pedestrian crossings, analysis of the truss bridge structure under IZS loading is given primary attention. Different truss sections were tested on a bridge carrying the same rail load. [7]

Santosh Kumar Suman (2018) The focus of this study is on the planning and evaluation of interchangeable bridge constructions for rail networks. Steel is used to construct many truss designs, and each one is analysed in order to draw comparisons with the others. The research takes into account four different forms of truss architecture: the rectangular truss, the X-type truss, the V-type truss, and the K-type truss. STAAD PRO is used for the calculations to provide the findings. Both the software and the ideals are held in high regard. The results are compared in terms of the responsiveness of the supports, the amount of movement, the shear force, and the amount of twisting. After looking at the amount of possible critical values in a maximum displacement analysis, they found that the X-Type bridge consistently produced the lowest estimates across all four scenarios studied. For the four scenarios considered here, the K-type truss bridge has the lightest values, indicating that it can support the same load with a less quantity of structural material. [8]

3. CONCLUSION

This research is solely discussed in terms of a literature review. The study's findings suggest that several scholars have looked at various truss types in their pursuit of knowledge about steel railway bridge design and analysis. Software like STAAD Pro, ETABS, and ANSYS are used for analysis. In a small scale analysis, we accounted for wind and seismic impacts of a bridge with a greater span. Although the articles only evaluate one lane of traffic on the bridge, two lanes may be taken into account in the future.

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IS CODES:

i. IS: 875-2015 Wind Loads on Buildings and Structures

ii. IS 1893 – 2002 Earthquake Resistant Design of Structures

iii. IS 800 (2007) Code for general construction in steel structures.

iv. IRC-24-2001 for the design of steel or wrought iron bridges carrying rail

v. IRC Class A- Loads Considered for Design of Bridge Structures