International Journal of Scientific Research in Civil Engineering
© 2023 | IJSRCE | Volume 7 | Issue 2 | ISSN : 2456-6667

Analysis of a Cable Stayed Suspension Hybrid Bridge Considering Vehicular Loading A Review

Vivek Soni[1], Rahul Satbhaiya[2]
P.G. Scholar[1], Assistant Professor[2]
Department of Civil Engineering, Infinity Management & Engineering College, Madhya Pradesh, India

ARTICLEINFO

Article History:

Accepted: 05 April 2023
Published: 12 April 2023

Publication Issue
Volume 7, Issue 2
March-April-2023

Page Number
97-101

ABSTRACT

Cable-stayed bridges are built for providing connectivity over obstacles such as rivers, mountains, flyovers over rotary squares and valleys for a long span. Cable stayed bridge provides ample stability and utilises structure material and further its advantages goes in for cheap maintenance and design. Design of the bridge is highly dependent on its function and purpose and the nature of terrain of the site.

A bridge type known as a suspension bridge has its deck suspended by vertical suspenders and suspension cables. The main structural elements of a suspension bridge system are stiffening girders/trusses, main suspension cables, main towers, and cable anchorages at each end of the bridge. Vertical suspenders sustain the weight of the deck and the traffic load, while the main cables are stretched between towers and eventually connect to the anchorage or the bridge itself. The superstructures of suspension bridges are constructed utilising the cable erection technique similarly to other cable-supported bridges.

In This paper presenting review of bridges related to advance hybrid technology.

Keywords : Cable Stayed Bridge (CSB); Suspension Bridge (SB); Cable Stayed Suspension Hybrid Bridge (CSSHB),Pylon, Seismic Analysis ,CSi Bridge.

I. INTRODUCTION

Long span bridge are increasing day by day to facilitate the need of construction projects. Cable stayed bridges and suspension bridges are the systems used to achieve long span bridges. The spans of cable-supported bridges range from 200 to 2000 metres. The greatest span of a cable-supported bridge system is determined by the density, stiffness, and strength of the materials utilised. In the design and analysis of cable-stayed bridges and suspension bridges, high strength steel cables are a key component, which is superior for effective tension resistance. The advantages of a cable-supported bridge are in the way that the system uses the materials.

A suspension bridge is a form of bridge in which the deck is suspended on vertical suspenders from below suspension cables. In the early 1800s, the first examples of this kind of bridge were constructed in the modern era. In many hilly areas of the world, simple suspension bridges with no vertical suspenders have a long history.

Thousand years ago, people cross water bodies with the help of cable attached with wooden block. It was born of cable stayed and suspension bridge but mainly cable stayed bridge developed in 1595 and commonly used in 19th century. In early days, Cable Bridge was constructed with combination of suspension bridge and cable stayed bridge. In 1808 an American inventor named James give the born of modern cable bridge. Two cables are used over the top of many towers and anchoring this chain on the either side of bridge structure. Although suspension bridges and cable stayed bridges are quite similar, the main distinction between the two is how the deck force is transferred to the cable in a suspension bridge. In a cable stayed bridge, the cable is connected directly to the deck. Because of its low weight, improved aesthetics, and long span designs, cable stayed bridges have gained popularity. The primary purpose of a cable-stayed bridge is to handle its own weight and impending traffic loads safely while also being aesthetically beautiful and demonstrating excellent serviceability under any conceivable load scenario. Steel wire cable is used to suspend a cable stayed bridge deck. The top vertical towers are fixed with these cables, which transmit shear force to the vertical members, which then transform it into compression force.

In this study, three distinct cases—a suspension bridge, a cable-stayed bridge, and a hybrid cable-stayed suspension bridge—are largely examined. CSI Bridge's analytical application was used to model the data and conduct the analysis while accounting for seismic and vehicle loading.

II. Review of Literature Summary

Rajni Verma and Rashmi Sakalle (2022) in the research paper, girder Bridge and cable stayed bridge was modelled and comparative analysis was carried out for dynamically loading conditions. A comparison was made between bridges for dead load,live load and combined load. Structural analysis was done to determine internal forces, stresses and deformation of structure under various load effects. the modelling and analysis of both the cases was performed using analytical application SAP 2000.

The support response in the Cable stayed bridge is 1091.65 K.N., whereas the Girder bridge is 1427.87 K.N., indicating that stresses are properly distributed in the Cable stayed bridge scenario. As a result, in the case of a cable-stayed bridge, the support reaction is 21.11 percent lower. Based on the results of the moment, forces, and deflection given in the preceding chapter, it can be concluded that a Cable Stayed bridge is more stable in resisting load. When comparing the cost of a cable-stayed bridge to the cost of a girder bridge, the cable-stayed bridge is 18% more expensive. The results showed that the cable-stayed bridge was more stable and adequate for big loads, while the girder bridge was more cost effective.

Chao Zhang et.al (2021) The cable-stayed bridge with diamond concrete pylons' lateral seismic fragility assessment was provided in a research study. The prototype bridge is a standard cable-stayed bridge with a diamond-shaped pylon. The SAP2000N platform has a three-dimensional FE model of the prototype CSB. The weak points of pylons and piers are identified using capacity demand ratios. According to the bending moment-curvatures, the plastic hinge in the FEM simulates all weak points. Four alternative limit states (LSs) and damage indices for each component of the CSB are defined.

The fragility curves of the bridge system on the lower and upper bounds exhibit little variation in SD states and MD states, according to the seismic fragility study of the bridge system. These are seen in the ED and CD states, though, where each component's failure probability is different. The entirety of a cable-stayed bridge is vulnerable to minor and moderate damage. Additionally, the fragility of the entire bridge as a whole is greater than the fragility of any one system component.

Farhan Farid Reshi et al (2021) Parts of the suspension bridge and cable-stayed bridge were the subject of research paper analysis and design. STAAD.pro, an analytical tool, was used to design and analyse the model. To examine the dynamic behaviour of suspension and cable-stayed bridges, the wind load analysis is offered. Zones 4 and 5 of the wind zones were taken into consideration, with wind speeds of 47 and 50 m/s, respectively.

Conclusion stated that cable-stayed bridge is an innovative structure and is preferred to conventional steel suspension bridges for long spans mainly due to the reduction in moments in the stiffening girders resulting in smaller sections of the girders leading to economy in overall costs. This bridge type is useful for numerous traffic options, including automobiles, trucks, bicycles, and pedestrians. A cable-stayed bridge can be used for light rail in particular circumstances. When a span needs to be greater than a cantilever bridge can maintain because to weight, but it also needs to be short enough that suspension Cable-stayed bridges can be built more quickly than other alternatives.

Neel Shah et al (2021) In a study report, the dynamic impact of various pylon configurations for a cable-stayed bridge was examined. To analyse the dynamic response of the bridge, pylons are inclined at 5o, 10o, 15o, 20o, 25o, and 30o with both vertical and horizontal axes, and they are compared to vertical pylons. The 3D bridge models were created using the CSI BRIDGE software, and the Imperial Valley 1947 earthquake was used to analyse the bridge's seismic performance. The axial force, moment, and torsion of the bridge reaction were measured for the pylon, girder, and cable.

Results stated that minimum axial force was obtained at 10o in Cable at main span near pylon in X - Direction and Y - Direction both. Minimum axial force was obtained in girder at 10o at main span and side span both in X –Direction. Minimum axial force was obtained in pylon at 10o in X – Direction and at 15o for Y –Direction. Minimum moment in pylon was obtained at 10o and minimum torsion in pylon at 5o. Hence, it was stated that the different angle of the pylon has great influence in the seismic response of the cable-stayed bridge.

Priyanka Singh et.al (2021) The bridge design, model, and analysis for various types of pylons were reported in this research study utilizing STAAD Pro. H-type, A-type, and inverted Y-type pylons are the different types of pylons that are considered. The most efficient sort of pylon design was determined by comparing shear force and bending moment in terms of self weight for three scenarios. The results gained can be used to mitigate the disadvantages of other types of pylons.

The highest deflection was found to be 172.5mm in pylon type H, followed by 149.8mm in inverted Y-type pylon design, and 76.9mm in A-type pylon design, indicating that A-type pylon is the most suitable and stable section in comparison.

III. Conclusion

IN this review paper following observations has been made:

- In this review studied researched of various authors applying different loading condition on deck and other structural members of bridge.
- In this paper authors illustrated the different method of analysis.
- In this paper authors utilized various tools to analysis the bridge .

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Cite this article as :

Vivek Soni, Rahul Satbhaiya, "Analysis of a Cable Stayed Suspension Hybrid Bridge Considering Vehicular Loading A Review", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 7, Issue 2, pp.97-101, March-April.2023
URL : https://ijsrce.com/IJSRCE237211