INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

www.ijprems.com
editor@ijprems.com

Vol. 02, Issue 08, August 2022, pp : 88-90

e-ISSN : 2583-1062

Impact Factor : 2.265

STUDY OF VIBRATION CONTROL ON LONG SPAN STEEL BRIDGE: A LITERATURE REVIEW

Juned khan[1], Dr. Raghvendra Singh[2]

[1]P G Student, Department of Civil Engineering, Ujjain Engineering college- Ujjain M.P., India.

[2]Professor Department of Civil Engineering, Ujjain Engineering college- Ujjain M.P., India.

ABSTRACT

Structural vibration control is an advanced technology in engineering consists of implementing energy dissipation devices or control systems into structures to reduce excessive structural vibration, enhance human comfort, and prevent catastrophic structural failure due to strong winds and earthquakes, among other inputs. When the bridge carries heavy traffic, vibrations in the bridge structural elements are subjected to high levels of stress. This tension bridge is subjected to fatigue. This work presents a review of work done by various authors on vibration analysis of steel truss bridges.

Construction of long span bridges has been very active in the world in the past few decades. Today, modern bridges tend to use high strength materials. Therefore, their structure is very slender. As a result, they are very sensitive to dynamic loadings such as wind, earthquake and vehicle movement. As bridge span gets longer, they become more flexible and prone to vibrate. Vibration can have several levels of consequences; from a potentially hazardous effect (causing immediate structural failure) to a more extended effect (structural fatigue). In addition, vibration can affect safety as well as comfort of users and limit serviceability of the bridge. Therefore, extensive studies have been carried out to understand mechanisms behind bridge vibration and to reduce this undesirable vibration effect. The main advantages of structural steel over other construction materials are its strength and ductility. It has a higher strength to cost ratio in tension and a slightly lower strength to cost ratio in compression when compared with concrete.

1. INTRODUCTION

The structural steel is an efficient and economic material in bridges. Structural steel has been the natural solution for long span bridges since 1890, when the Firth of Forth cantilever bridge, the world's major steel bridge at that time was completed. Steel is indeed suitable for most span ranges, but particularly for longer spans. Howrah Bridge, also known as Rabindra Setu, is to be looked at as an early classical steel bridge in India. This cantilever bridge was built in 1943. It is 97 m high and 705 m long. Steel trusses are commonly used to build railway bridges. Deck type bridges, through type bridges, and Semi-through type bridges are the three types of truss bridges classified by carriageway location. In India, the through type truss bridge is the most common of these three designs. Warren truss, Pratt truss, Howe truss, K-type truss, and other types of truss sections are utilized for bridges**.**

For the analysis of vibration of the bridge. There are a number of bridges that are situated in high vibration areas. Some are extremely important bridges, such as Assam's Bogibeel Bridge. It is located in seismic zone V and has a 128-meter greatest span length truss member, truss members only function in compression or tension, simplifying calculations. To reduce vibration Gusset plates are used to link contemporary truss bridges, and the bending moment and shear force of members are also taken into account while analyzing the performance of truss bridges using finite element software. Because axial forces determine member stress conditions but not bending moment or shear force, such assumptions are unlikely to generate significant differences between real bridges and design models. When responding to dynamic loads, the members of the truss are in tension, compression, or both, according to this assumption.

2. LITERATURE REVIEW

Seung, et al. (2001) done a seismic analysis of truss arch bridge crossing the Mississippi river. Different foundation models are used in time history analysis. The first model is the model in which the support conditions are assumed to be fixed for all degree of freedom. In the second model, the stiffness matrix of the pile foundation is obtained without consideration of the pile-soil-pile interaction (PSPI). In the third model, the PSPI effects are taken into account. PSPI factor is the ratio of displacement of unloaded pile due to loading of adjacent piles to displacement of loaded pile. These results suggested that the fixed base model cannot represent the dynamic characteristics of the overall bridge structure, thus indicating the need to include the modelling of foundation characteristics in seismic analysis of an entire bridge system. The result also indicates modest difference in dynamic characteristics and bridge responses between model 2 and model 3 implying that the PSPI effect could for all practical purposes be neglected.

Mehta, et al. (2003) studied seismic analysis options for steel truss bridges. The summary of the study is that the equivalent beam model, in conjunction with single mode response spectrum analysis, can be accurately used for short span truss bridges with constant cross section. However, this choice of options will not be suitable for a large truss bridge with suspended spans and varying cross section. Multi-mode spectral method in conjunction with the finite element model may be appropriate in region of low to moderate seismicity for such a bridge. Push-over analysis or nonlinear time history analysis should be performed when the bridge members are expected to be stressed well beyond the yield limit during an earthquake.

Pandey, et al. (2006) perform dynamic analysis of railway steel arch bridge with abutments at each end shaped as a curved arch. The mechanism of the bridge is by transferring the weight of the bridge and its load into a horizontal thrust against abutments at each side. Seismic zone V and modified broad gauge loading (as per Bridge Rule 1964) is considered while analysing on STAAD.Pro 2004. Damping ratio 2% for steel structure and response reduction factor 2.5 is used. The result has been interpreted by analysing time period, deflection and mode shapes. Arch bridge with two ribs shows more deflection in transverse direction, which is on higher side where as the arch bridge with three ribs is safer to lateral and vertical deflections.

Kumar, et al. (2009) perform analysis and design of super structure of road cum Railway Bridge with the help of STAAD.Pro software. The bridge is made of steel truss (through type) which carries three lane roadways in the upper level and two broad gauge railway tracks at bottom level. The span length matches with existing railway bridge i.e.

89.066 metre. The goal of research is to evaluate the financial significance of rail cum road bridge. The results indicate that it is beneficial to construct a single rail cum road Bridge instead of two separate bridges. There is decrease in expense of development by providing single scaffold to both street and railroads.

Ghogare, et al. (2013) performs comparative study of seismic forces for the industrial structure. Design is done for a Howe type roof truss with length of building 32 m, width is 15 m, spacing of trusses 8 m, both ends of truss is hinged and Fe 415 steel is used. When values of forces are compared with the effect of DL + LL & DL+ LL+WL, it is clear that the magnitude of forces decreases when wind is considered. However, natures of forces are not getting changed drastically. Same structure when subjected to seismic forces, it is marked that max beam end forces are developed for combination of DL+LL. On contrary, with introduction of seismic forces the magnitude of horizontal forces in X & Z direction decreases. With change in seismic zones the magnitude of beam end forces is increased.

Gupta, et al. (2015) presented the analysis and design of steel truss railway bridge of span 50 meters, the bridge with same railway loadings of 32.5t axle load has been assigned on different type of truss sections (Pratt truss, K- type truss, Howe truss, Warren truss) to determine the best stable and economical section. The result indicates that there is maximum deflection in Howe truss bridge whereas least in Warren type truss and maximum axial force in Pratt truss whereas least in the Howe truss and Howe truss bridge shows least steel structure weight.

Saluja. et al. (2016) performed seismic analysis of foot- over bridge for different soil conditions. This paper highlights the effect of different soil conditions in different earthquake zones with response spectrum analysis using STAAD.Pro software. They found that reactions and moments at nodes goes on increasing with earthquake zones and with change in soil conditions.

Rashid, et al. (2017) presented a comparative study on analysis of girder bridge with IRC and IRS loadings. The analysis has been performed using MIDAS Civil software and STAAD.Pro software. They use five loading combinations of 25t loading – 2008 as per IRS Bridge Rule It is found that fifth combination of locomotive loading as per IRS gives maximum bending moment and shear force in both MIDAS Civil software and STAAD.Prosoftware.

ZaedAmmar. et al. (2017) studies and focuses the effect of vibration of steel truss bridges under the moving load. In this, the impact of vehicle speed and damping ratio investigated along the bridge. They found that speed of vehicle is most important factor in bridge vibration. The second factor which is important is proper damping ratio.

RohitGakre, et al. (2018) presented the analysis of railway bridge steel sections with different types of trusses for 32.5t axle loading. For this study, four different steel truss sections are considered; they are Howe truss, Pratt truss, Warren and K- type truss with 50 meter span length simply supported at the ends. In this study it is concluded that Pratt truss bridge shows comparatively more stiffness and stability to resist load whereas in cost comparison, Howe type truss bridge is more economical.

3. CONCLUSION

The literature survey has proposed that Warren truss, Pratt truss and Howe truss are generally used as a superstructure for the railway truss bridge. The Warren truss and Pratt truss shows comparatively more stiffness and stability to resist the load for 50-meter span length of bridge. It is also cleared from the review that 25t axle loading- 2008 with double headed 22.5t loco gives maximum bending moment and shear force in the truss members. Using of proper seismic factors such as damping ratio, response reduction factor, importance factor, zone factor, etc are very important in analyzing the effect of earthquake forces on the structure. If only forces in superstructure has to be calculated then seismic mass of the superstructure components is taken into account and should not include any mass from substructure. For the seismic analysis of the truss bridge because it is based on the application of Finite Element Method and uses Seismic Coefficient Method (Single Mode Response Spectrum Method) for the analysis of the earthquake forces on the structure. Possible future scope is that we can compare the vibrational behavior of the different truss types along with different steel section, also changing support condition as well as using damper at supports can be explored further.

4. REFERENCE

[1] Wanchalearm, Seung et al (2001) "Vibration analysis & control of truss arch bridge crossing the Mississippi river" 12th World Conference on Earthquake Engineering.

[2] Sanjay Mehta a project engineer with New York city offic of Lichtenstein "Vibration analysis & control options for steel truss bridges" MSC, American Institute of Steel Construction. (2003)

[3] Sangeeta Pandey, "Vibration analysis & control of railway steel arch bridge" Department of Earthquake Engineering, IITRoorkee. (2006)

[4] T. Pramod Kumar et al "Vibration analysis & control and design of superstructure of road cum railway bridge across krishna river" International Journal of Engineering and Science Research. (2009)

[5] Kavita k. Ghogare "Comparative study of Vibration analysis, control of forces for the industrial structure" International Journal for Research in Applied Science & Engineering Technology. (2013)

[6] Shubhank Gupta et al "Comparative analysis of different truss type railway bridge considering railway loading for Vibration analysis & control" International Journal of Engineering Science and Research Technology. (2015)

[7] Vipin A. Saluja and S. R. Satone "Seismic analysis and vibration control of foot over bridge for different soil conditions" International Journal of Engineering Development and Research (2016)

[8] Abdul Rashid et al "Analysis of girder bridge with IRC and IRS loadings – A comparative study of vibration control and analysis" International Journal of Innovative Research in Science Engineering and Technology. (2017)

[9] Mohamad Ibrahim Zaed Ammar et al " Effect and control of vibration located on the steel truss bridges under moving load" The 2nd International Conference on Civil Engineering Research.(2017)

[10] Rohit Gakre et al "Vibration analysis & control of railway bridge steel sections with different types of trusses for 32.5t axle loading" International Journal for Research in Applied Science & Engineering Technology. (2018)