Literature Review on Parameters Identification of Pre-Stressed Continuous Rigid Frame Bridge

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Abstract— The dynamic response of a pre-stressed bowstring composite concrete type arch bridge under seismic loading is investigated by using finite element model in ANSYS software. The bridge taken as New Kozhencherry Bridge in Kerala, India was selected for the study. The bridge is a proposed work of the Public Works Department, Kerala. This paper mainly deals with static analysis and seismic analysis and also fatigue analysis of the bridge and comparison of the results with reinforced concrete and composite added concrete. The study presented in this paper is a possible suggestion for design improvements to the structure, under consideration of fatigue life of the bride due to vehicle load.

Key words: Tied Arch Bridge, Continuous Rigid Frame Bridge

I. Introduction

The Tied Arch Bridge is the type of arch bridge in which the outward horizontal forces of the top chord are carried as tension by the bottom chord of the bridge. This elimination of horizontal forces from the abutments allows tied-arch bridges to be constructed with less powerful foundations. Therefore, tied arch bridges can be situated at top elevated piers of bridge or constructed in areas having unstable soil conditions. So the structure does not depend on horizontal compressive forces for its integrity in arch bridge. The tied-arch bridges can be prefabricated in offsite, and can subsequently assemble at site.

Of the many methods employed for the determination of optimum performance of structures during seismic occasion, at the time of vehicle load acting on the deck of the bridge continuously. Therefore, to estimate the fatigue damage or fatigue life of the bridge components by a simulation of bridge-vehicle interaction dynamics due to the action of the actual traffic on the deck. Although the effect of seismic events and bridge vehicle interaction are well studied and the studies in the field of bridges are quite rare. Buildings and bridges excite very differently in seismic events. Studies exist on static analysis, seismic analysis. But this study focuses on a fatigue analysis of the proposed bridge.

II. Literature Survey

A. *V.G. Rao and S. Talukdar"Prediction of fatigue life of a continuous bridge girder based on vehicle induced stress history" (2003)*

.The fatigue damage assessment of bridge components by conducting a fatigue testing. A thing, therefore, exists to estimate the fatigue damage of bridge components by a progressive simulation of bridge-vehicle interaction dynamics due to the action of the actual traffic on the bridge. In the present paper, a systematic method is used to find the fatigue damage in the continuous rigid frame bridge girder from stress range frequency histogram and fatigue strength parameters of the bridge materials used. Vehicle induced time history of maximum flexural stresses has been obtained from Monte Carlo simulation process and Used to develop the stress range frequency histogram taking into consideration of the traffic volume in annual. The linear damage Accumulation theory is used to calculate cumulative damage index and fatigue life of the bridge deck. Effect of the bridge span, pavement condition, and increase of vehicle operating speed, weight and suspension characteristics on fatigue life of the bridge has been examined.

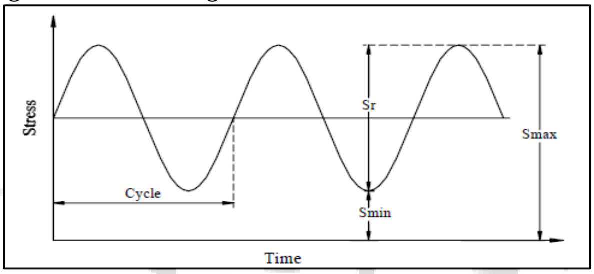

Fig. 1: A typical stress history for the constant amplitude loading.

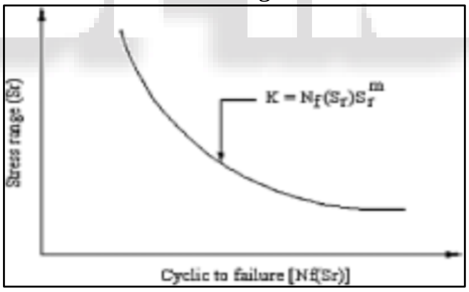

Fig. 2: A typical S-N Curve for constant amplitude test results.

B. *Kanemaru and mitsuo tokunaga "earthquake-resistance of four-span continuous pc rigid-frame box Girder Bridge" (2000)*

The bridge was examined in this analysis, is a four-span continuous prestressed concrete, a frame-type box girder bridge with the length of 410 meters; span proportion is of 61+135+135+77 (m). It has piers of different height; 33, 104 and 33metres. In Japan, one of the countries frequently attacked by strong earthquakes, the earthquake-resistance of structures is required during and after construction against earthquake. For continuous bridges with piers of different height, seismic forces act on each pier differently due to the difference in stiffness in bridge. The stiffness of a shorter pier is increased, sectional forces tend to accumulate on it, thus, requiring a larger section. For the effective section of bridge pier, the high strength reinforcement concrete bridge pier is the most appropriate selection for the selected bridge model type. The Nonlinear dynamic analysis is conducted for the examining earthquake resistance of bridge with high strength reinforced concrete piers of the existing bridge.

C. Xing-shun Liu, a Jian-tao Peng, Xiao-jun Ning "Great span continuous rigid frame bridge piers earthquake response analysis"(2015)

According to analyze the form of piers span continuous rigid frame bridge seismic impact on the order of a continuous rigid frame bridge, the use of large-scale professional FEM analysis software (MIDAS CIVIL) build dynamic analysis models their different cross-sectional forms modal pier analysis is used, by using dynamic response spectrum analysis method for calculating the dynamic response of the structure, and comparative analysis of different results of the bridge structure. The conclusions of large span continuous rigid frame bridge seismic analysis and design of the bridge just enough to provide appropriate basis.

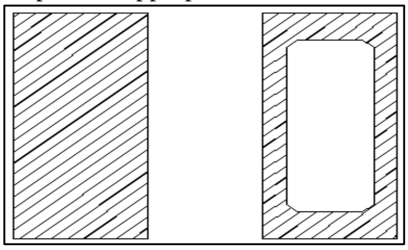

Fig. 3: Pier-section

D. Shengnan Huang, Lieping Ye and Xinzheng Lu "Damage Identification of Continuous Rigid Frame Concrete Bridge" (2014)

During a bridge construction life, many factors can cause damage such as overloaded traffic, fatigue effect, and so on. Hence, the identification of damages have been received wide attention to prevent sudden fatal accident. An experiment of a continuous rigid frame concrete bridge, which has 3 spans and total length 18 meters, was presented in this paper. Two load stages and ten different load steps were taken to test various parameters of long-term loading and different levels of overload. Curvature mode method was used to detect the damage during the exercises. The difference in curvature modes were used to detect damage after the ten load steps. This is the excellent method to identify the damage position of bridge. So, it is concluded that the curvature modes can be used to detect damage in actual bridge structures. Moreover, the Finite-Element Analysis (FEA) was utilized, and the experimental work was verified positively through Finite Element Analysis model.

E. Kaizhong Xie,and Limin Sun "Study on Collapse-mechanism of Long Span and High-pier Continuous Rigid Frame Bridges during Strong Earthquake"(2008)

In this study, dynamic response of long span and high-pier continuous rigid frame bridges (70m+127m+70m) during strong earthquake is studied with the use of damage model of reinforced concrete by explicit dynamic analysis code. The development of the concrete elements from cracking to failure of the deck and the bridge from part collapse to the whole collapse of the bridge are studied in this. The damage and collapse mechanisms during strong earthquake are given by Long Span and High-pier Continuous Rigid Frame Bridges. References are provided for the seismic analysis of these kind of bridges.

F. Gheorghe Asachi"comparison of the experimentally obtained dynamic characteristics of a bridge with ambiental and forced vibrations (2015)

This paper presents a study case performed on a bridge over the Danube channel, located in Cernavoda, Romania. The tested structure was subjected to several vibrations, resulted from the natural movement of the bridge and from the movement of a truck that is traffic load, a train and an excavator. The monitoring system used to record the in situ data was composed of using four seismic transducers positioned in the first span of the bridge. The speed integration and modes of vibration identification was performed using artemis Extractor. That is placed on analyzing the mode shapes and observing the relation between frequency and modal coordinates from the specimen.

G. Yunnan Jiaotong College, Kunming"Continuous rigid frame bridge side span and mid-span ratio of optimization and analysis"(2015)

The bridge pre-stressed concrete continuous rigid frame bridge is a best kind of good integrity, reasonable force, construction technology is mature, less cost, spanning ability and driving comfort ability, etc.And in the actual project got a lot of applications while further development events are very bright. After a long design practice, continuous rigid frame bridge design parameters have been done gradual development and optimization. With MIDAS CIVIL modeling and analysis approach to each side span and mid-span ratio taken as an indicator, through the analysis of these results obtained will help improve the performance of the main beam span parameter combinations of the specimen.

H. Jitao Li and Qingshan Yang"Seismic responses analysis of long continuous rigid-framed bridge subjected to multi-support excitations(2008)

In this study, effects of multi-support excitations on seismic responses of an existing long span pre-stressed concrete continuous rigid-framed bridge was investigated by using time-history method. This bridge is named Houzhu Bridge, in Quanzhou. There is no material difference between the result of the 3D finite element model modal analysis and modal test that confirms the 3D finite element model reasonable. This ground motions come from relatively non-stationary earthquake accelerograms simulation with EI-Centro wave. Wave passage effect, incoherence effect and local effect is considered in the numerical simulation of the model. The contrast of results multi-support excitations and uniform excitation is that the wave passage effect is very important for this type of continuous rigid frame bridges, the other effect is not very important in this. A conclusion is given that the uniform seismic excitation is not able to control the seismic design for long span pre-stressed concrete continuous rigid-framed bridge in the specimen, and the influence of the multi-support excitations on the seismic responses of the long span pre-stressed concrete continuous rigid-framed bridge must be considered in this.

I. Fernando N,Leitao,Jose Guilherme S"Fatigue analysis and life prediction of composite highway bridge decks under traffic loading"(2013)

Steel and composite concrete highway bridges are currently Subjected to dynamic actions of variable magnitude due to convoy of vehicles crossing on the deck pavement of the bridge. These dynamic actions can generate the nucleation of fractures in deck or even their propagation on the bridge deck structure. Proper consideration of all of the aspects mentioned pointed in our team to develop an analysis methodology with emphasis to evaluate the stresses through a dynamic analysis of highway bridge decks including the action of vehicle load. The design codes recommend in the application of the curves S-N associated to the Miner's damage rule to evaluate the fatigue and service life of steel and composite concrete bridges. In this work, the developed computational model adopted the usual mesh refinement techniques present in the finite element method simulations implemented in the ANSYS program. In The investigated highway bridge is constituted by four longitudinal composite girders and a concrete deck pavement, spanning 40.0m by 13.5m. The analysis methodology and procedures presented in the design codes were applied to evaluate the fatigue life of the bridge determining the service life of the structure. The main conclusions of this investigation focused on structural engineers to the possible distortions of the bridge, associated to the steel and composite bridge's service life of bridge when subjected to vehicle's dynamic actions in this specimen.

J. Aicheng "Analytical Research on Deformation Monitoring of Large Span Continuous Rigid Frame Bridge during Operation" (2015)

This study about Pushover analysis and time history analysis are conducted to explore the bi-directional seismic behavior of composite (steel-concrete) rigid frame bridge, which is composed of RC piers at bridge and steel-concrete composite girders. Both longitudinal and transverse directions excitations are investigated by using Open Sees. Firstly, the applicability of pushover analysis based on the fundamental modes of vibrations is discussed. Secondly, an improved pushover analysis method considering the contribution of higher modes of vibration is proposed, and this applicability on composite rigid frame bridges under bi-directional earthquake is verified in this. Based on this method, an approach to predict the displacement responses of composite rigid frame bridge under the random bi-directional seismic excitations by revising th elasto-plastic demand curve is proposed. It is observed that the developed Method is yield a good estimate on the responses of the composite rigid frame bridges under bi-directional seismic excitations.

III. Findings

The fatigue problem is certainly much more complicated and is influenced by several highway bridge types, further research in this area is required and Adopt some modern sensor technology, to investigate the structural responses like fatigue problem, dynamic problem etc. Then the Damage identification effect decreased when the damage was serious. Then Disease of continuous rigid frame bridge deck pavement is not only determined by pavement material strength. But also related to design, construction technology and quality, Traffic volume and environment

IV. Conclusion

The results and discussions show that displacement, and Acceleration of the continues rigid frame bridge. The fatigue life of the bridge considering its dynamic interaction with the vehicle. The method requires the stress time history of the fatigue critical detail and fatigue strength parameters of the bridge.

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