

Analysis of Long Span Bridges With Different End Conditions: A Review

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Abstract- Cable-stayed bridges have good stability, as they make the best use of structural materials, as they are aesthetic and tremendously low designed. They require very less protection costs and are efficient structural traits. The cable-stayed therefore, are kind of bridges which are becoming more and more famous and are generally preferred for lengthy span crossings as compared to the suspension bridges. A cable-stayed bridge includes more than one tower with cables helping the bridge deck. The best examples of cable stayed bridges are fan, harp, and semi fan bridges. Because of their big length and nonlinear structural behaviour, the analysis of these kinds of bridges is more complex than conventional bridges. However in these bridges, the cables are the principle supply of nonlinearity. An optimal design of a cable-stayed bridge with minimum cost with accurate strength and serviceability necessities is a challenging project.

In this paper we are reviewing the researches done in past related to long span bridges with tendons and tensioning members.

Keywords- structure analysis, software utilization, cable stayed, tendons, review, span, pylon, arrangement of cables.

I. INTRODUCTION

Cable stayed bridge works on the concept: that deck of the bridge can be supported by way of the inclined chambers which might be stretched from the tower and acts as the tension members to carry the load coming over the bridge and transfer the load into the sub structure through the towers. The concept of cable stayed bridge was first posted by the French engineer Navier in 1823. He has done lots of investigation regarding bridge deck supported by the wrought iron chains.

In this review paper we are presenting researches done in past related to long span bridges as follows:

MycherlaChaitanya (2018) modelled Girder Bridge and Cable stayed bridge and investigate its performance under dynamic loading conditions. They consider dead load, live

load and combined load for analysis purposes. At last author made comparative analysis with reference to internal forces, stresses and deformation of structure under various load effects.

KrunaliMavani (2017) performed the modelling of Cable Stayed Bridges with different pylon arrangements. Author realised that there is a need of examination of dynamic response on the effect of shape of pylon. Also in their research work the bridge specifications and other performance parameters were kept constant and the only variation is made in pylon shape with variation in height of the pylon for assessment purpose.

PravinMalwiya (2017) did linear static and nonlinear static analysis using this software SAP2000. He also investigated the cable tension, deck deflection, and base shear and made comparison for the study of behaviour of cable-stayed bridge.

PawanPatidar and Sunil Harne (2017) checked the economic status of Plate Girder Bridge (Railway) on various spans keeping one parameter constant and other parameters varying.

Praveen kumar M et al (2017) here the author gave a proficient, incorporated system for seismic examinations of long-length link stayed spans. The productivity originates from the emotional decrease in planning time and the degrees of freedom (DOF) related with the structure, utilizing the incorporated finite strip method (IFSM) alongside the utilization of a powerful and effective time history technique (THM) utilizing the Newmark conspire for the dynamic examination of the scaffold structure. The past variants of the limited strip technique are restricted to displaying the scaffold deck just, though other auxiliary segments are supplanted by accepted limit conditions. Utilizing the IFSM, all parts of the long-range link stayed scaffold can be demonstrated in a bound together framework, and thus, the genuine unique conduct including the associations between deck, wharves, and links can be splendidly considered.

To confirm the arrangement, the geometric and dynamic properties of the KapShuiMun (KSM) Bridge, as a genuine case of a long-range link stayed connect, are determined by the proposed limited strip technique. At that point, the seismic reaction of KSM Bridge under uniform and non-uniform quake loadings is researched by utilizing the THM. The outcomes demonstrate that the IFSM can be connected effectively for the seismic examination of long-range link stayed spans, and the investigation was performed in a negligible measure of time.

The authors exploration was performed in nature of the IFSM for seismic investigation of long-range link stayed spans. Utilizing the coordinated framework, the dynamic properties of the entire extension can be inferred by utilizing the limited strip technique. The present routine with regards to utilizing the limited strip techniques for playing out the dynamic examination is restricted to the examination of the scaffold superstructure, exposed to mimicked limit conditions over the wharf supports and links.

Hence, the cooperations between the scaffold deck (superstructure) and different segments couldn't be viewed as when utilizing the regular limited strip techniques. By utilizing the limited strip arrangement proposed in the ebb and flow inquire about, the whole scaffold can be demonstrated as an incorporated framework, in which the basic collaborations between the basic components can be considered moreover.

In this examination, the improvement of the IFSM was quickly introduced. Utilizing the solidness and mass networks got from IFSM, the time history investigation of link stayed spans was performed by the Newmark strategy. The proposed dynamic limited strip examination was planned and modified by complete scripts and projects, including C++ and MATLAB. The precision of the proposed strategy was assessed by contrasting the normal frequencies of the KSM Bridge gotten by the limited strip technique with those acquired by FEM, and those revealed from the field-test estimations and were observed to be in generally amazing understanding. The distinction in qualities was lower than 4.8 and 10%, individually. The seismic examination of the KSM Bridge, under uniform and non-uniform excitations, utilized inside the IFSM, demonstrated that the relocation and speeding up reactions at various areas along the scaffold were higher for uniform tremor excitations, which is likewise reliable with the outcomes acquired from the FEM investigation of a similar extension.

The computational time is a significant factor in the seismic examination of long-length spans. As a result of the extensive decrease in the DOF, the created code for the IFSM

is sufficiently effective in convoluted investigations of monstrous structures, for example, dynamic examination of the KSM Bridge. Complete displaying of a long-length link stayed connect utilizing IFSM and use of the time-space strategy recommended that the seismic investigation of a disfigured structure can be performed in an insignificant measure of time. The numerical outcomes demonstrate that the union and productivity of the IFSM was high in correlation with those of other numerical techniques.

G. Lakshmi Poornima and R. Bharath (2017) here the author made some examination on the structure plan of Cable-Stayed Bridge, static investigation, dynamic investigation and Construction of the structure was proposed. Link stayed Bridge is a sort of scaffold, for which the brace was dismantled up by range link to connect towers. Link stayed Bridge with its extraordinary focal points of vast range and fewer docks have been assuming an undeniably significant job in human life. The scaffold comprised of the extension tower, link, support (essentially exposed to bowing minutes). The support was pulled up by links, which were associated with the scaffold tower. In this paper, the creator made some examination on the structure of Cable-stayed Bridge. The discussions were made on the static investigation, dynamic examination and development of Cable-stayed Bridge. There were a few calculations to ascertain the link compel, each had their very own benefits. There were three principle wellsprings of geometrically nonlinear conduct: droop impact, extensive uprooting and pillar section impacts. There were 5 sorts of frameworks: Floating System, Consolidated System, Elastic Restraint System, asymmetry limitation framework and goeey damper framework. Recreation examination of link stayed connect development control strategies was summed up in three primary ways: Formal figuring, Inversion computation, Non-stress state strategy. BP neural system was the most generally utilized. BP neural system was perfect for development control and displaying of a perplexing framework.

Guru prasad D (2016) here the author exhibited the explanatory investigations of the dynamic reaction of the Indiano Cable-Stayed Bridge in Florence, Italy. The observed part depended on encompassing and traffic-initiated vibration tests, which permitted separating the dynamic qualities of the structure as far as reverberation frequencies, modular shapes and damping. These were contrasted and those got from a limited component model for which the geometrical qualities and the mechanical properties of the materials utilized in the auxiliary plan of the extension have been received. To enhance these examinations, identical static investigations were performed to yield amplitudes of reaction and worries in auxiliary components. This form of the examination was

performed by reaction range procedure utilizing uniform reaction spectra communicated as far as pseudo-speeds as information. The reaction spectra were acquired from contemporary, seismic peril ponders performed in Florence site.

The dynamic reaction appraisal and considerable seismic investigation of the Indiano Cable-Stayed Bridge were performed by methods for (a) watched test information and resulting in ghastry examinations and (b) systematic models utilizing structure geometric parameters. Contemporarily, the investigation of the seismic danger in Florence site delivered the uniform reaction spectra regarding pseudo-speeds. These were utilized as a contribution to the dynamic examination of the scaffold, completed as far as reaction range investigation.

The author recognized several reverberation frequencies from the observed dynamic reaction information and furthermore from modular examinations utilizing a scientific model. The modular shapes deduced from watched information were fundamentally the same as those acquired from modular investigations utilizing the numerical model. The structure demonstrates a modular shape whose common relocations are the longitudinal way because of the movement of the towers. Traffic-incited vibration amplitudes, both in vertical and in longitudinal headings, was high so that to decide visit needs of support works. Estimations of evaluated auxiliary damping are extremely high contrasted and those decided for link spans. This event was identified with the nearness of a few wellsprings of damping (rubbing) in joints and in the heading. Despite the fact that Florence was not a high-power seismic site, the normal tremor dependent on MCS force VIII would cause a noteworthy increment of worries in the extension.

The nonattendance of longitudinal limitations was normal in link stayed spans, however for this situation, the above event was enhanced due to the nonappearance of side link stayed ranges and on the grounds that the framework isn't self-tied down. From the dynamic perspective, one of the end orientation could be a fixed pivot, however the static outcomes of such a sort of progress ought to be dissected in detail (changes in the link worries under non-symmetrical burdens, worries in the wharfs because of flat powers).

Shivanshi and Pinaki (2016) here the author attempted a parametric report to research the impact of shoot loadings with various material properties, segment properties and diverse measure of dangerous materials, to decide harmed zone, number of loss of shell components just as link components because of the blast. With respect to the aftereffects of FE investigation, it is inferred that the greatest 3 links would be lost by a lot of TNT identical material because of harm of the safe haven zone.

Here the author completed A numerical investigation of the romanticized link stayed connect deck model exposed to impact loadings A far-reaching parametric examination was attempted and the significance of utilizing a specific model (which had with exact material properties and vital details) under a few shoot loadings just as abrupt loss of cable(s) with non-direct impacts was explored.

The author reasoned that By 1 ton of TNT, the harmed zone is about $4\text{m} \times 3.6\text{m}$, while the harmed zone is made by 27tonne is bigger than $10\text{m} \times 10\text{m}$. A belytschkotsay component without considering Cowper-Symonds demonstrated the biggest shell component misfortune in both 1tonne and 27 tons of TNT. For the extension under thought, 1 ton of TNT proportional dangerous did not prompt any loss of links, while the explosion of 27 tons of TNT identical touchy close to the endpin bolster prompted the loss of three links. To get precise outcomes, material properties and mix equation ought to be picked legitimately.

Additionally, the confirmation examination, (for example, contrasted and the test results) ought to be completed.

G. M. Savaliya (2015) here the author gave an assortment of perspectives to delineate the component of the deck-stay cooperation with the suitable starting states of link stayed spans. In view of the smooth and united scaffold shapes received by the underlying shape investigation, the OECS and MECS models of the Kao Ping Hsi Bridge are created to confirm the appropriateness of the explanatory model and numerical plan from the field perceptions in the creators' past work. For this reason, the modular examinations of the two limited component models are directed to figure the characteristic recurrence and standardized mode state of the individual methods of the scaffold. The modular coupling evaluation is additionally performed to acquire the summed up mass proportions among the auxiliary segments for every method of the scaffold. To additionally research the deck-stay association qualities of link stayed connects under tremor excitations, the dynamic removals and interior powers of the two limited component models are determined dependent on the seismic examinations.

The numerous inventions proved that the coupled modes are credited to the recurrence loci veering and mode confinement when the "unadulterated" deck-tower recurrence and the "unadulterated" remain link recurrence approach each other, inferring that the mode states of such coupled modes are basically unique in relation to those of the deck-tower framework or stay links alone. The dissemination of the summed up mass proportions between the deck-tower framework and remain links are helpful lists for quantitatively

surveying the level of coupling for every mode. To broaden the two limited component models to be under the seismic excitation, it is apparent that the dynamic removals of the stay links are effectively caught by the MECS model, yet not by the OECS model. What's more, the dynamic relocations of the deck-tower framework, just as the dynamic inside powers of the stay links and those of the deck-tower framework, are sensibly recreated by both the OECS and MECS models. These outcomes are exhibited to completely comprehend the instrument of the deck-stay connection with the proper beginning states of link stayed spans.

Deep Gupta et al (2016) here the author dissected the cable-stayed bridges for accomplishing the link powers, brace minutes and sheer powers of the support and the arches. The techniques received for achieving the link powers is the strain vitality rule. This strain vitality standard was embraced from a diary of ASCE and a similar technique is pursued from that diary. This diary was fused with certain suspicions. Similar suspicions were considered for making this report. The got link powers which are finished by the strain vitality standard are cross-checked with the STAAD results. As the strain vitality guideline is a technique which includes an arduous iterative procedure, a "C" writing computer programs is made for this strategy, which plays out the investigation as indicated by our prerequisite of the no. of links, support range, dock parcel, stacking conditions, tower measurements, firmness everything being equal, position of links. Consequently, the contrast between these estimations of the link powers got from the strain vitality technique and that acquired from the STAAD gave very little distinction, the STAAD Pro examination is performed for the model picked for structuring. The model picked for planning is performed for examination and later on, completed with the structuring of the arch measurements, steel support and the deck section alongside the solid arch.

In this task with the assistance of diaries dependent on Strain Energy, "C" programming, STAAD investigation and from this the aftereffects of the examination were contrasted and the manual estimations and STAAD investigation on the grounds that the acquired link powers were more than the outcomes gotten from the strain vitality investigation for planning on a more secure side. Utilizing STAAD Pro. programming results the structure is done physically. For the future extent of the undertaking, the author finished with solid arches and for expansion of the task, everyone can proceed with the postulation with steel arches and consider the outcomes and economy of the venture. Brace which is structured utilizing steel could likewise be supplanted by solid support and analyze the outcomes and economy of the venture.

Mohammed Yakub Ali & Gugulothu Swarna (2016) here the author's examination primarily centred around the impact of temperature on the dynamic attributes of structures, for example, vibration mode and recurrence. This paper examines the impacts of uniform temperature changes on the seismic reactions of a link stayed connect. A three-dimensional limited component model of a link stayed connect utilizing OpenSees is built up for nonlinear time history examination, and uniform temperature load is connected to the model scaffold before the leading of seismic excitation. Three ground movement records were considered from the PEER solid movement database dependent on the structure range. Contextual investigations were then performed thinking about the fluctuating temperature and the associations between the deck and arches of the extension. The outcome demonstrates that the seismic reactions of the scaffold are altogether expanded with the thought of temperature load. In the mean time, the sorts between the deck and arch additionally impactfully affect the seismic reactions of the extension with and without temperature changes.

The fundamental motivation behind the research paper was to investigate the impacts of uniform temperature on the seismic reactions of a link stayed connect. A three-dimensional limited component model was developed for nonlinear powerful time history investigation of the link stayed connect. The nonlinear practices, for example, geometry nonlinear, material nonlinear, and $p \square D$ impact were considered in the limited component model. A contextual analysis was performed to explore the impacts of the temperature changes on the seismic reactions of the scaffold. The principle results obtained from the numerical investigation were that the seismic reactions of the extension are essentially expanded with the thought of temperature load. They directly increment with the temperature changes of $_{20_C}$ and $_{35_C}$. The outcome demonstrates that the impacts of temperature load on the seismic reactions of the extension ought to be considered amid the plan period of link stayed spans. The associations between the deck and the arches affect the seismic reactions of the extension with and without temperature load. It was additionally discovered that the reactions of the basic parts in Connection 3 (deck to the arch was limited the longitudinal way) was a lot bigger than those in different associations. Consequently, Connection 1 (deck to arch is associated by bearing) or Connection 2 (deck to arch isn't associated) can be chosen by and by with the thought of both seismic tremor and temperature loads.

Nikhil R (2017) here the author planned and analyzed an extension model for these links course of action by STAAD Pro programming. The most proficient course of action is proposed after examination among the three. The examination

is made for Shear constrain, bowing minute, removals for the cases. The outcomes are abridged and talked about. At that point, correlations were made for the three cases. The end was made concerning the productivity of one of the courses of action. This could be helpful in adjusting the downsides of others. This work would offer bearings to make different courses of action increasingly proficient.

Here in the authors venture execution of three sorts of links game plan for the structure of the link stayed spans have been presented considering fan, semi-fan and harp courses of action. The shear constrains, bending minute, the avoidance for three sorts of link stayed spans were contrasted and one another and the aftereffect of examinations are accounted for. In the first place, the extension was produced for the fan, semi-fan and harp game plans of link stayed spans. At that point the impact of these game plans on the solidness and productivity of scaffold segments are researched for the fan, semi-fan and harp game plans are thought about. At last, the most productive out of all these three courses of action were proposed. The outcomes demonstrated that the fan game plan is more effective than two other courses of action.

HussainHararwala (2016) here the author dissected one link stay connect utilizing STadd.pro. the goals behind the author's investigation were to analyses & configuration link stayed connect fan and harp type including span wharf. To decide the characteristic recurrence, the timeframe of a characteristic link stayed connect utilizing the application Stadd genius. To play out a non-straight powerful examination of fan and harp type link stayed connect exposed to different ground movement. To play out a similar investigation of fan and harp type Cable Bridge for avoidance, important pressure, twisting pressure, shear pressure.

Here in the author ponder direct investigation of link stayed connect was finished utilizing FEA instrument Stadd-Pro. Writing audit different ground movement information gathered Sanfrancisco, IS1893.1979 royal valley 1940 supreme esteem and so forth to perform tie history investigation of the link stayed connect. Harp type link stayed connect was demonstrated containing 40 links 541.8m range, tallness 87m.

II. CONCLUSION

Because of their large size and nonlinear structural behaviour, the analysis of these types of bridges is more complicated than conventional bridges. In these bridges, the cables are the main source of nonlinearity. Also for structural engineer it is a challenging task for obtaining optimal design of a cable-stayed bridge with minimum construction cost and

simultaneously achieving good strength and serviceability requirements.

In our work, cable stayed bridge is analysed by changing the cables arrangement each time, to obtain the results for bending moment, forces, deflection.

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