Review on most efficient innovations in the field of bridge engineering technologies

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***Abstract* - Bridges are constructed to provide a pathway helping upon avoiding obstacles in the form of water, infrastructure etc. Bridges have been one of the most important source of transportation in the recent few years of which is very obvious from the amount of bridges which have got constructed in the past few decades. Therefore, it becomes compulsory for designers and those related to this field to take special concern in regards to designing and maintenance of such heavy structures. This review is mainly focused on Extra dosed Bridge; as it is a new type of bridge engineering design concepts**

Keywords - Bridges, Box Girder Bridge, Cable-stayed Bridge, Extra dosed Bridge, Stay cable behavior, Pre stressed Bridge Deck, recent research of bridges.

I.INTRODUCTION

Bridge engineering has become one of the most important needs for today therefore getting it updated with technological trends is of utmost importance in order to provide with proper sustenance against future threats. For bringing the term technology into picture it has become very important to use newer tools which have more organized computing functionalities as in to get accurate results when comes to heavy load transfer and building a safe design. In India mostly used bridges are Girder Bridge and Cable-stayed bridges although adding to the advancements they have started adopting new bridge type i.e. extradosed bridge for construction. There are only four extra dosed bridge in India. The aim of the paper is to summarize review from recent research done on the bridges.

II.LITERATURE REVIEW

Literature is focused on analysis carried out on different bridges. Designer suggest to use Girder Bridge for minor bridges and cable-stayed and extradosed bridge for major bridges. A significant amount of research work was being done on these three bridges such as:

Static Analysis

Hiroshi Mutsuyoshi& Nguyen DucHai [1] Published paper on Recent technology of prestressed concrete bridge in japan. The authors focused upon presenting the background as well as development models for prestressed bridge construction in japan. Herein, they mainly focused upon long term durability coupled with aesthetics and overall wellbeing; durability as it has become a real concern with reinforced concrete structures.

VernersStraupe and AinarsPaeglitis [2] published paper on Analysis of Geometrical and Mechanical Properties of Cable-Stayed Bridge. They have prepared mathematical model for analyzing the interaction between elements of cable-stayed bridge. Based upon universally distributed loads and varying loads with major focus upon fatigue conditions improvement in cable stayed bridges.

XiangboMeng and Chonghou Zhang [3] published paper on 'extradosed and intradoses cable stayed bridges with continuous cable'. In this paper, they take conceptual consideration upon improving the mechanical behavior of the traditional extradosed bridge.

S. Yamaguchi & K. Fujiiet.al[4] published paper on 'Mechanical Behavior of a Composite Box Bridge Used for 40 Years'. In this paper authors has analyzed mechanical behavior of Kando-bashi bridge located in japan, which is using from last 40 years. Thickness of the web had reduced by 40% due to corrosion which when taken on sample basis and tested in laboratory for shear and deformation concerns was found that corrosive activities have little or no effect on the bridge cable. The safety ratio was 1.7 on design member.

Jose Antonioet.Al[5] published paper on 'direct simulation of the tensioning process of cable stayed bridges'. Here the authors introduced a new type of algorithm know as direct algorithm which has proven to be quite efficient with newer bridge construction technologies.

Dynamic Analysis

M.H. El Ouni et.al published [6] paper on numerical and experimental dynamic analysis on bridge. In this paper author has made mathematical model for bridge cable therefore conducting experiments on bridge cable via using different computer software.

Kwang Sup Chung et.al [7] published paper on 3D catenary cable. They took in parametric studies upon mid span of cable-stayed bridge is under extreme forces during earthquake and typhoon. They have carried out calculation using 3D cable sliding model. The finite element presented out of which provides a useful tool for the nonlinear analysis and geometry control of cable-supported structures subjected to extreme loads such as earthquakes and strong winds.

J.H.Bia et.al [8] published paper on 2D numerical analysis for water film on cable. In order to reveal the mechanism of RWIV, 2D coupled equations of water film evolution and cable vibration are derived based on the combination of lubrication theory and

vibration theory of the single-mode system, and the relationships between rivulets, aerodynamic lift and vibration of cable at different wind speeds are investigated by numerical solution of the coupled equations.

K.Kleisslet.Al [9] published paper to Comparison of aerodynamics of bridge with helical fillets. In this paper, the aerodynamics of bridge cables with helical fillets and a pattern-indented surface are examined. An extensive wind-tunnel test campaign was undertaken to measure the static force coefficients about the critical Reynolds number region, with varying relative cable-wind angles.

Teng Wu et. Al [10] published a paper on On the excitation mechanisms of rain–wind induced vibration of cables: Unsteady and hysteretic nonlinear features. In this paper Models for simulating rain–wind induced vibrations (RWIVs) are proposed that capture often ignored basic excitation mechanisms involving unsteady aerodynamics and hysteretic nonlinearity. The need for these features becomes important since the conventional quasi-steady (QS) theory based model cannot account for these aerodynamic features adequately due to the absence of any consideration of the fluid memory effects.

C.M. Mozos , A.C. Aparicio [11] published a paper on Parametric study on the dynamic response of cable stayed bridges to the sudden failure of a stay, Part I: Bending moment acting on the deck. A parametric study on the response of cable stayed bridges to the sudden rupture of one stay has been developed in this paper. The bridges studied were defined by combining characteristics such as the layout of the stays, fan or harp pattern, the stiffness of the deck and the arrangement of the stays in one or two planes.

Combined Static and Dynamic Analysis

Jan Bujnaket. Al [12] conducted a verification analysis on theoretical and experimental work on extradosed bridge. The load test was verified using transformation model, while static and dynamic behavior was assessed using 3D finite element modelling. Experimental data and numerical models present powerful tools for identification of real spatial bridge construction behavior.

K.K.Mermigas [13] has done thesis on Behavior and design of Extradosed Bridge [university of Toronto-Canada.]. In this thesis Mermigas studied history of bridge and behavior of bridge and design extradosed bridge as per Canadian Standards.

Sami Laatikainen [14] presented his thesis on Introduction to Extradosed Bridge (Finnish language). [University of OULU]. In this thesis author has studied history of this bridge and primary design step of extradosed bridge.

M. Ebrahim Fazly [15] has done thesis on Extradosed-Brücke [Technical University of Hamburg] (French language). In this thesis fazly has done analysis and design of Extradosed Bridge.

J.D. YauamdY.B. Yang [16] has published paper on Vibration reduction for CSB traveled by highspeed trains. In this study, a hybrid TMD system that is composed of several subsystems, each tuned for one resonant frequency, is proposed for mitigating the multiple resonant peaks encountered in the train-induced vibration of cable-stayed bridges. The train is modelled as a series of sprung masses.

T. Kitada et.al [17] published paper on New technologies of steel bridges in Japan. The author has studied static and dynamic behavior of steel bridges using computer program. It includes ultimate strength of steel plates, seismic design, joints and bolts.

Dabo Xin et.al [18] published paper on Experimental study on static characteristics of the bridge deck section under simultaneous actions of wind and rain. This paper analyzes the rain-induced effect on the static force on a bridge deck, which includes three influencing factors. Accordingly, the experimental method for measuring the three factors was brought out. With the experiment of the twin-box bridge deck model performed in the joint wind–rain environment, the theory about the three factors was further explored.

Failure Analysis

C.X. Li et.al have published [19] paper on Fatigue crack in Cable of steel. On the physical background of the problem, a restraining stress zone that can describe the material damaging process from micro to macro is then introduced and a macro/micro dual scale edge crack model is thus established. The expression of the macro/micro dual scale strain energy density factor is obtained which serves as a governing quantity for the fatigue crack growth is studied in this paper.

L.dunai and B.kocesdi [20] published paper on fatigue life of girder. It was an experimental study on trapezoidal corrugated webs. The tests were completed to study the effect of the corrugation profile, the normal stress ratio, the effect of the combined normal and shear stresses and the weld size on the fatigue life. The test program was conducted to support the design of the new moraferenc bridge at the M43 highway over the tisza river in hungry.

C.M. mozos et.al [21] published paper Numerical and experimental study on the interaction cable structure during the failure of a stay in a cable stayed bridge. On Corrosion, abrasion and fretting fatigue may cause deterioration and, eventually, the failure of a posttensioning tendon or a stay cable on a cable supported structure. Therefore the stress acting due to such actions on the remaining portion was then analyzed based upon theoretical and numerical analysis.

Johan Maljaars [22] published a paper Fatigue failure analysis of stay cables with initial defects: Ewijk bridge case study. A failure assessment method of stay cables containing fractured wires is presented through an example of an existing bridge. A probabilistic model is put forward for assessing the resistance of the stay cable based on a fracture mechanics model of the individual wires.

V. Périer et.al [23] published a paper Fretting-fatigue behaviour of bridge engineering cables in a solution of sodium chloride. This paper deals with the study of drawn steel wires submitted to fretting-fatigue in a solution of sodium chloride. Experimental tests were conducted to reproduce the contact conditions in spiral strands undergoing free bending deformations and submitted to corrosion.. The recorded tangential force shows stabilized partial slip regime after about 10,000 cycles.

III.CONCLUSION

From the whole survey done above it could be seen that a lot of work was done using computerized tools and putting in cyclic loading into play upon cables of the different bridges talked about. The observations tell that it's preferable to use high-strength steel cable to avoid fatigue failure of cable and to provide aerodynamic spiral, micro dent in cable outer portion or provide a grip on cable to reduce wind, rain and ice loading occurring on cable. For Box Girder Bridge suggested Safety factor is 1.7. Extradosed bridge has shorter tower than cable stayed and shallower girder than a girder bridge, but deeper than a cable stayed bridge; In Extra

dosed bridge Cables are designed in a way so as to pre-stress the deck, fatigue resulted is correspondingly low and an uniform size of cables is ensured; Extradosed bridge is experimentally and theoretical proved that it is effective for practical implementation.

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