

A review on box Girder Bridge, Cable-Stayed Bridge and Extra-dosed Bridge

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ABSTRACT: Bridges were constructed to cross the obstacles and transport access, which can either be water, infrastructure or the elevation difference. For this purpose bridges are very important element in the transportation system as its capacity governs the system. Its failure or defective performance will result in serious disturbance of the traffic flow and also the cost per kilometer of the bridge structure is many times that for the road or rail track on either side of bridge. It is prudent therefore to devote special attention in design to ensure adequate strength and serviceability consistent with safety and cost. This review is mainly focused on extra-dosed bridge cause its new type of bridge concept.

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

INTRODUCTION:

Building a functional transportation infrastructure is a high priority for our country. Equally important is maintaining and upgrading its integrity to keep pace with increasing usage, higher traffic loads and new technologies. Bridges occupy an inherent part of this infrastructure with the use of modern structural analysis computer programs, the most reliable design alternative, providing the most probable response of a bridge structure due to a range of designed loads can be identified. In some countries the used of bridges are girder bridge and cable-stayed bridges but nowadays every country adopted new types i.e. extra-dosed bridge for construction. There are only three extra dosed bridges in every country. The aim of the paper is to summarize review from recent research done on these three bridges.

LITERATURE REVIEW:

Literature is focused on pre-stressed concrete bridges. Usually the designer suggest to use girder bridge for minor bridges and cable-stayed and extra-dosed bridge for major bridges. A significant amount of research work was done on these three bridges which were discussed by different authors.

1.jan Bujnaket.Al: He conducted the verification of extra-dosed bridge both theoretically and experimentally, which were carry out on transformation model on which he used 3D FEM modeling along with static and dynamic behavior as assessed. The experimental data and numerical models were helpful which present powerful tools for their identification of real spatial bridge construction behavior.

2.Hiroshi Mutsuyoshi & Nguyen Duc Hai. They both have published paper on recent technology of pre-stressed concrete bridge in Japan. The recent techniques in design and construction of PC bridges in Japan were used in this paper with emphasis on their background and development as well as their applications in actual structures. The paper also examines that it is not only to improve the structural properties in terms of safety, aesthetic and economical aspects, such innovated technologies were developed to enhance the long term durability, which is becoming one of the serious problems in concrete structures nowadays.

3.Veners staupe and ainars paeglitis: They published a 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. They want to improve the fatigue condition of the cable-stayed bridge by installing active device. They have analyzed behavior of a cable system under uniformly distributed load as well as under variable loads and studying deformation of their components.

4.Xiangbo Meng and Chonghou zhang: They have published paper on extra-dosed and intra-dosed cable stayed bridges with continuous cable. They have focused on the conceptual aspect in this paper and also presented to improve the mechanical behavior of the traditional extra-dosed bridge.

5.C.X.Liet.al. He also published on this 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 macro/micro dual scale strain energy density factor is obtained which serves as governing quantity for the fatigue crack growth is studied in this paper.

6.M.H.El Ouni et.al. His paper on numerical and experimental dynamic analysis on bridge. In this paper author has made mathematical model for bridge cable. And made experiments on cable via computer software's.

7.S.Yamaguchi & K.Fujit.al: He published on " Mechanical Behavior of a composite Box bridge used for 40 years". In this paper authors has analyzed mechanical behavior of kandobashi bridge located in Japan which is using from last 40 years. Thickness of web reduced to 40% due to corrosion. The collected some pieces of bridge and tested in lab for different loading for shear behavior and deformation. They came on conclusion that 40% corrosion wastage had very small effect on the ultimate load carrying capacity of bridge. The safety ratio was 1/7 on design member.

8.K.K.Mermigeas: H had done thesis on behavior and design of extra-dosed bridge(University of Toronto-canada). In this thesis Mermigas studied history of bridge and behavior of bridge and design extra-dosed bridge as per Canadian standards.

9.Sami Laatikainen. He presented thesis on "introduction to Extra-dosed bridge(finish language, university of OULU) . he has also studied the history of this kind bridge and primary design step of extra-dosed bridge.

10. M.Ebrahim Fazly: He also done his thesis on Extra-dosed BRUCKE (Technical university of Hamburg, French language) on which he has carry out the analysis of Extra-dosed bridge.

11.Jose Antonioet.Al: He also published paper on direct simulation of the tensioning process of cable-stayed bridges, in this paper they proposed a new and innovative algorithm, the direct algorithm DA which introduces for the very first time, the unstressed length of the stays concept into modeling of the construction process of cable-stayed bridges.

12.L.dunai and B.kocesdi: He also published paper on fatigue life of girder. It was experimental study on trapezoidal corrugated webs. The tests were completed to study the effect of corrugation profile. The normal stress ratio. The effect of combined normal and shear stresses and the weld size on the fatigue life. Their paper presented fatigue behavior of trapezoid ally corrugated web girders, the test program was conducted to support the design of new Moraferenec bridge at the M43 highway over the Tisza river in hungry.

13.Kwang Sup Chung et.al: He has published on 3D catenary cable. They noted that 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 here provides useful tool for the nonlinear analysis and geometry control of cable-supported structures subjected to extreme loads such as earthquakes and strong winds.

14. B.Faggianoet.A: He published paper on cable supported immersed inversed bridge. In this paper author have noted that effectiveness of cable-stayed bridge cable system freely reduces and ist cost enormously raised as the crossing length

increase. They have inversed cable in bridge and notes its main advantage. This design is good fore under water surface when bridge is floating.

15.J.H.Bia et al: He 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 of 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.

16. Feng-Chen Li et al: He published paper on ultrasonic thickness measurement system for study of water rivulets. In this paper author has developed and successfully used to measure the time dependent geometric and oscillation information of rivulets on a cable model surface when RWIV occurs, providing and effective approach for the investigation of RWIV phenomenon and ist mechanism.

17.Dong Hun Yeo et.Al: He published paper on computational study on aerodynamics mitigation of wind induce on CSB. Three dimensional DES flow around 401 yawed cylinders with various strake patterns was studied with a view to investigating their effectiveness in reducing large amplitude, low frequency vibrations of stay cables induced by oblique wind. Effects of the strake patterns on flow around, and the associated forces on, the cylinder were analyzed and compared to the aerodynamic characteristics of yawed bare cylinder. Frequency distributions of the process were examined to determine how the strake patterns effectively disturb or suppress the inherent mechanism of force generation along cylinder oblique to flow.

18.K.Kleisslet.Al: He published paper to comparison of aerodynamics of bridge with helical fillets. According to his paper the aerodynamics of bridge cables with helical fillets and pattern induced surface are examined. To this 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.

19.CM.mozoset.al: He has published a paper on numerical and experimental study on the interaction cable structure during the failure of stay in cable stayed-bridge. On corrosion, abrasion and fretting, fatigue may cause deterioration and eventually the failure of post tensioning tendon or as stay cable in cable supported structure. In the present study, the stress acting during the rupture on the remaining portion of the stay which fails is derived, and the role of rupture time on the response of the structure is discussed from a theoretical and numerical point of view.

20. J.D.Yauamd.Y.B.yang: They published the paper on vibration reduction for CSB traveled by high speed trains. In this study a hybrid TMD system that is composed of several subsystems, each tuned for one resonant frequency which is proposed for mitigating the multiple resonant peaks encountered in the train-induced vibration of cable-stayed bridges. The train is modeled as a series of sprung masses.

CONCLUSION:

It is clear from the above literature that every research was mainly carry out on various computer aided computer software through the aspect of cyclic loading. Different authors experimented their work on cable exterior design and find out the conclusion 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 and for cable supported bridges fatigue cycle of cable should be 2 million cycle.

Extra-dosed bridge has shorter tower than cable stayed and shallower girder than girder bridge, but deeper than a cable-stayed bridge. The cables sized in cable-stayed bridges is to pre-stress the deck. Low fatigue ranges for cables and uniform size range for cables. Extra-dosed bridge is experimentally and theoretical proved that it is effective for practical implementation. different authors have provided design for Extra-dosed bridge in their thesis.

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REFERENCES:

- [1] Jan Bujnak et. al, "Extra-dosed Bridge –Theoretical and Experimental verification" Concrete and concrete structures 2013, conference, 2013.
- [2] Hiroshi Mutsuyoshiet. Al. "Recent technology of pre-stressed concrete bridges in Japan" IABSEJSCE Joint Conference on Advances in Bridge Engineering-II, A, 2010.
- [3] Verners Straupe et.al. "Analysis of Geometrical and Mechanical Properties of Cable-Stayed Bridge" 11th International conference on structures and techniques, 2013.
- [4] Xiangbo Meng and Chonghou Zhang , "Extra-dosed and Intra-dosed Cable-Stayed Bridges with Continuous Cables: Conceptual Consideration " Journal of bridge engineering, 2013.
- [5] C.X. Li et.al, "Fatigue crack growth of cable steel wires in a suspension bridge: Multi-scaling and mesoscopic fracture mechanics" Theoretical and Applied Fracture Mechanics, 2010.
- [6] M.H. El Ouni et.al, "Numerical and experimental dynamic analysis and control of a cable stayed bridge under parametric excitation" Engineering Structures, 2010.
- [7] S.Uamaguchet. Al. "Mechanical Behavior of a Composite Box Bridge Used for 40 Years" Procedia engineering, 2011
- [8] Mermigas Konstantinos M.E. Thesis, "Behaviour and Design of EXTRA-DOSED BRIDGES" University of Toronto.
- [9] Sami Laatikainen PhD. Thesis, "Extra-dosed bridge" University of OULU (Finnish language)
- [10] M. Ebrahim Fazly M.E. Thesis, "Extra-dosed-brücke" Technical University of Hamburg (French language)
- [11] Jose Antonio Lozano-Galant et.al, "Direct simulation of the tensioning process of cable stayed bridges" 11th International conference on structures and techniques, 2012.
- [12] B. Kövesdi, L. Dunai, "Fatigue life of girders with trapezoidally corrugated webs: An experimental study" International journal of fatigue, 2013.
- [13] Kwang Sup Chung and et.al, "Three-Dimensional Elastic Catenary Cable Element Considering Sliding Effect" Journal of engineering mechanics- ASCE, 2013.
- [14] B. Faggiano et. al, "Cable Supported Immersed Inverted Bridge: A challenging proposal" Procardia engineering, 2010.
- [15] J.H. Bia, J. Wang et. Al, "2D numerical analysis on evolution of water film and cable vibration response subject to wind and rain" J. Wind Eng. Ind. Aerodyn, 2012.
- [16] Feng-Chen Li et.al, "An ultrasonic transmission thickness measurement system for study of water rivulets characteristics of stay cables suffering from wind-rain-induced vibration" Sensors and Actuators, 2009.
- [17] Dong Hun Yeo , Nicholas P. Jones, "Computational study on aerodynamic mitigation of wind-induced, large-amplitude vibrations of stay cables with strakes" J. Wind Eng. Ind. Aerodyn, 2011.
- [18] K. Kleissl , C.T. Georgakis, "Comparison of the aerodynamics of bridge cables with helical fillets and a pattern-indented surface" Wind Eng. Ind. Aerodyn, 2012.
- [19] C.M. Mozos et.al, "Numerical and experimental study on the interaction cable structure during the failure of a stay in a cable stayed bridge" Engineering Structures, 2010.
- [20] J.D. Yau , Y.B. Yang, "Vibration reduction for cable-stayed bridges traveled by high-speed trains" Finite Elements in Analysis and Design, 2004.