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Numerical Investigation on Composite Cable Bridge

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Abstract: A bridge is a structure built to span physical obstacles without closing the way. A composite cable bridge is a type of bridge in which the deck is hung below using suspension cables on vertical suspenders at main span and stayed cables at both the side span. This type of bridge is usually allows engineers to cover long distance than any other type of bridges. Bridges are normally designed for dead load, live load and other occasional loads. All loading and unloading conditions in analysis are provided as per IRC codal provisions. The entire modeling of composite cable bridge is done by using SAP2000. Composite cable bridge having 1 km span with double lane road, the intensity of road is given has 20 numbers of vehicles each loaded with 350KN (class A-A track load) is analyzed by SAP2000. The output of the software provides results including moments, axial loads, shear force and displacements.

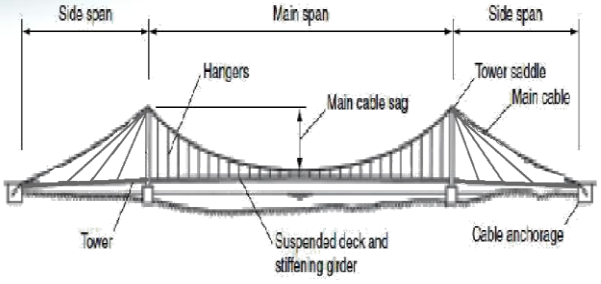
Keywords: Cables, SAP2000, Software Output, Design Calculations.

I. INTRODUCTION

Modern composite cable bridges taking advantage of the latest advances in automated fabrication and construction techniques are able to provide economic solutions to the demands of safety, rapid construction, aesthetics, shallow construction depth, minimal maintenance and flexibility in future use. The high strength-to-weight ratio of cable minimizes the structural weight of superstructures and thus minimizes the substructure costs, which is particularly beneficial in poor ground conditions. Minimum self-weight is also an important factor in the cost of transporting and handling components. Use of cable facilitates shallow construction depths, which overcomes problems with headroom and flood clearances, and minimizes the length and cost of approach embankments. Composite cable bridges are Innovative structures that combine both the ideas of suspension and cable stayed bridges. When engineers started experimenting with the use of cables in bridges, they met little success due to the fact that the statics were not fully understood and that unsuitable materials were used. Designing started on a trial and error basis and evolved slowly. The principle of carrying a load by suspending it to a rope or cable has been utilized since ancient times. But it was not until 1823 that the first permanent cable supported bridge was built in Geneva. Even though the span of the structures erected at the time was of modest dimensions, it was the start of a big impressive leap in bridge design.

II. LITERATURE REVIEW

MASANOBU SHINOZUKA (The University of California)[2] The Author Shows on Verification of computer analysis models for suspension bridges. The element or member based detailed three dimensional finite element simplified models of the bridges are developed. **ROBERT JAMES WESTGATE (The University of Sheffield) [3]** this report is based on the damages of suspension cables due to environmental effects. **MAN CHUNG TANG, T.Y. LIN INTERNATIONAL [4]** Configuration and general layout and loading conditions were obtained from "Cable-Stayed bridges". **M. WOLF & U. STARROSEK [5]** the different types of failures of cable stayed bridges were studied from "Cable loss analysis and collapse behavior of cable-stayed bridges".



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III. ANALYTICAL STUDIES

A Composite Cable bridge is to be analyzed. The bridge plan consists of span 1000m along X direction. Placing tower at 200m from each end with height of tower 20m in Z direction. A main girder of ISMB 600 is placed at centre of 4m C/C distance. Hence, total number of cross girder is 250 along X direction. Placing deck over cross girder, width and depth of deck is 5m and 0.5m respectively along Y direction. The diameter of main cable is 0.5m and the dip of cable at mid span is 10m. Under reamed pile is placed at both ends of the bridge in order to anchor the main cable. From the main cable, the suspenders are connected to the deck having diameter 0.3m. The Composite Cable Bridge is designed and various results are compiled and analyzed.

IV. SPECIMEN MODELLING

Analysis was carried out on Composite Cable Bridge Fig. 1 and Fig. 2 shows 3D modeling of Composite Cable Bridge. The applied lateral loads were based on load combination using AASTHO.

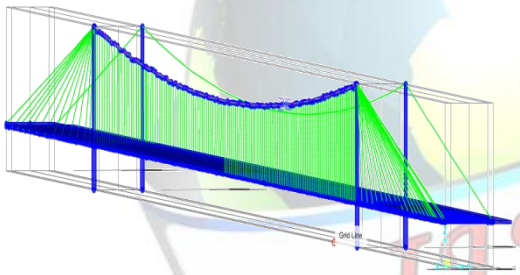

Fig. 1 3D Modelling of Composite Cable Bridge

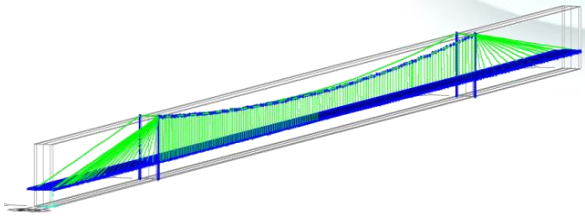

Fig. 2 3D modeling of Composite Cable Bridge

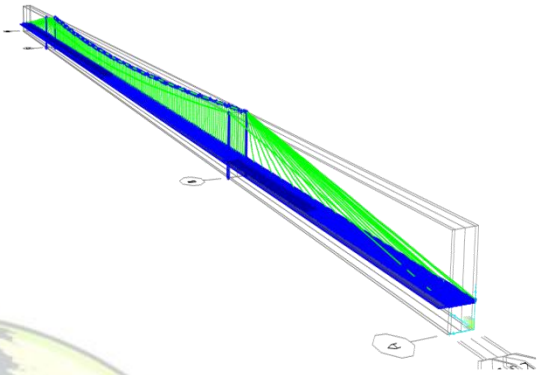

Fig. 3 Overall view of Composite Cable Bridge in SAP200

V. RESULTS

The Fig. 4 and Fig. 5 are the bending moment and shear force diagram for dead load and the load combinations applied in SAP2000 software.

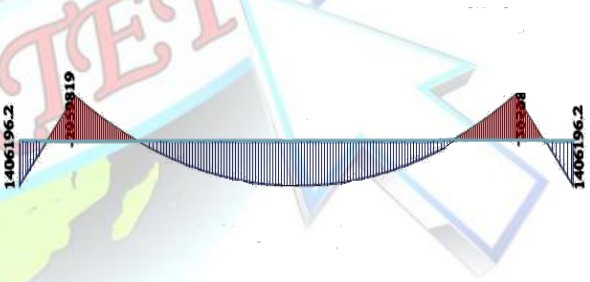

Fig. 4 Bending moment diagram for load combinations.

Fig. 5 Shear force diagram for load combinations

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VI. CONCLUSION

The analysis of the Composite cable bridge of 1000m span with double lane road, the intensity of road is given as 20 numbers of vehicle each loaded with 350 KN (Class A-A tack load) is carried out by using SAP2000. These results including Bending moments, shear force values at each node at every point within the element can be easily obtained from the software output. The maximum bending moment and shear force values are analyzed by software and compared with manual design of Composite Cable Bridge.

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