

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Analysis and Design of Suspension Cable Bridge

C. Neeladharan¹, G. Gayathri², J. Rasigha³, V. Thulasi priya⁴

Assistant Professor, Department of Civil Engineering, C. Abdul Hakeem College of Engineering and Technology,
Vellore, Tamil Nadu, India¹

U.G Student, Department of Civil Engineering, C. Abdul Hakeem College of Engineering and Technology, Vellore,
Tamil Nadu, India^{2,3,4}

ABSTRACT: Structural design requires a full understanding and knowledge of all the components comprising the structure. A suspension bridge is a type of bridge in which the deck (the load-bearing portion) is hung below suspension cables on vertical suspenders. The design of modern suspension bridges allows them to cover longer distances than other types of bridges. The main element of a cable suspended bridge is the cable system. Bridges are normally designed for dead load, live load and other occasional loads. All loading and unloading conditions in analysis and design are provided as per IRC codal specifications. The whole modeling of the suspension parts of the bridge was done by using SAP2000. Suspension cable bridge having 1km span with single lane road, the intensity of road is given has 20 numbers of vehicles each loaded with 350KN (heavy loading class A-A track load) is analysed by SAP2000. The output of the software presents results including moments, axial loads, shear force and displacements. Moreover, moments and axial load at each node and at any point within the element can be easily obtained from the software output. This thesis examines issues analysis and design calculation in over a structure will safe under all conditions.

KEYWORDS: Suspension Cable, SAP2000, Software Output, Design Calculations.

I. INTRODUCTION

Nowadays, in our technical age with a well-developed infrastructure, computer Communication, heavy equipment readily available and a better understanding of the behavior of such structures, cable supported bridges are becoming much more common. A suspension bridge, the pinnacle of bridge technology, is capable of spanning up to 7,000 feet. It manages this feat by successfully dealing with two important forces called compression and tension. Compression is a force that acts to compress or shorten the thing it is acting on. Tension is a force that acts to expand or lengthen the thing it is acting on. Compression and tension are present in all bridges, and it's the job of the bridge design to handle these forces without buckling or snapping. Buckling is what happens when the force of compression overcomes an object's ability to handle. Compression and snapping is what happens when the force of tension overcomes an object's ability to handle tension. The best way to deal with these forces is to either dissipate them or transfer them. To dissipate force is to spread it out over a greater area, so that no one spot has to bear the brunt of the concentrated force. To transfer force is to move it from an area of weakness to an area of strength, an area designed to handle the force. The force of compression pushes down on the suspension bridge's deck, but because it is a suspended roadway, the cables transfer the compression to the towers, which dissipate the compression directly into the earth where they are firmly entrenched. The supporting cables, running between the two anchorages, are the lucky recipients of the tension forces. The cables are literally stretched from the weight of the bridge and its traffic as they run from anchorage to anchorage. The anchorages are also under tension, but since they, like the towers, are held firmly to the earth, the tension they experience is dissipated. Almost all suspension bridges have, in addition to the cables, a supporting truss

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

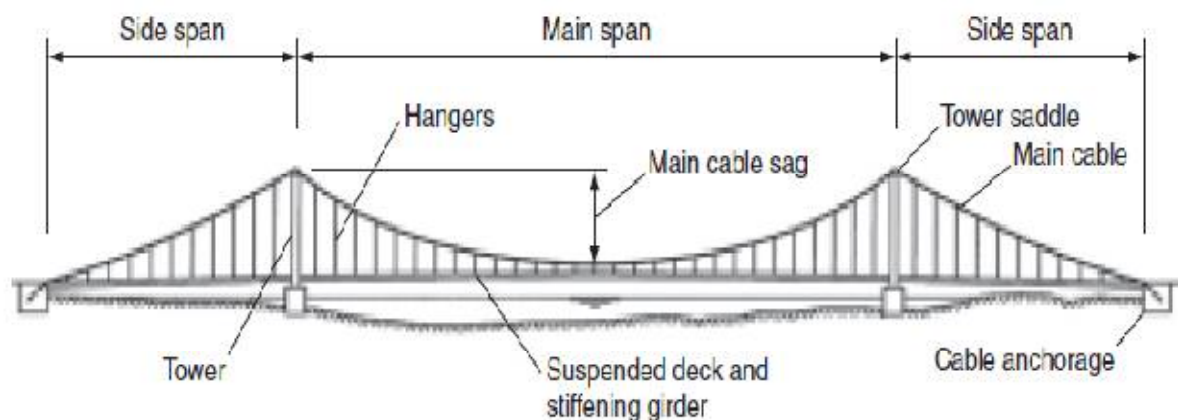
Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

system beneath the bridge deck. This helps to stiffen the deck and reduce the tendency of the roadway to sway and ripple.

II. LITERATURE STUDY

Iraja.C.Cecy et.al. [1] A suspension bridge project was performed on the preliminary design of the main structural members as per standards. The original purpose of the thesis was to analyze a new concept in suspension bridges, which employs several main cables, interconnected through lateral ties which were supposed to significantly increase the later stability on suspension bridges. Based method proposed by **Jaco Reusink.et.al.**, [2] The deck and the cables fulfil their functions and the stresses are lower than for steel structures, which is positive for the fatigue and allows further optimization. A structure using Fibre Reinforced Polymer both in the cables and the deck structure. **Jean-Pierre Michel Chacar.et.al.**, [3] This report is based on Design of Cable Systems for Cable Suspended Bridges; Structural design requires a full understanding and knowledge of all the components comprising the structure. The main element of a cable suspended bridge is the cable system. This thesis provided properties and design of suspended cables. **Kunal N. Suthar et.al.**, [4] This thesis is intended to provide a basic guideline for using the blast load analysis on the suspension bridge. The results obtained from live loading on the same suspension bridge were implemented to allocate costs depending upon the effect of particular vehicle on the bridge deck.



III. ANALYTICAL STUDIES

A Suspension Cable bridge is to be analysed. The bridge plan consists of span 1000m along X direction. Placing tower at 100m from each end with height of tower 20m in Z direction. A main girder of ISMB 600 is placed at centre of tower. Such that, it coincide with centre of tower. Over main girder, cross girder of ISMB 500 is placed at spacing 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 3m. 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 0.2m. The suspension cable bridge is designed and various results are compiled and analysed.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

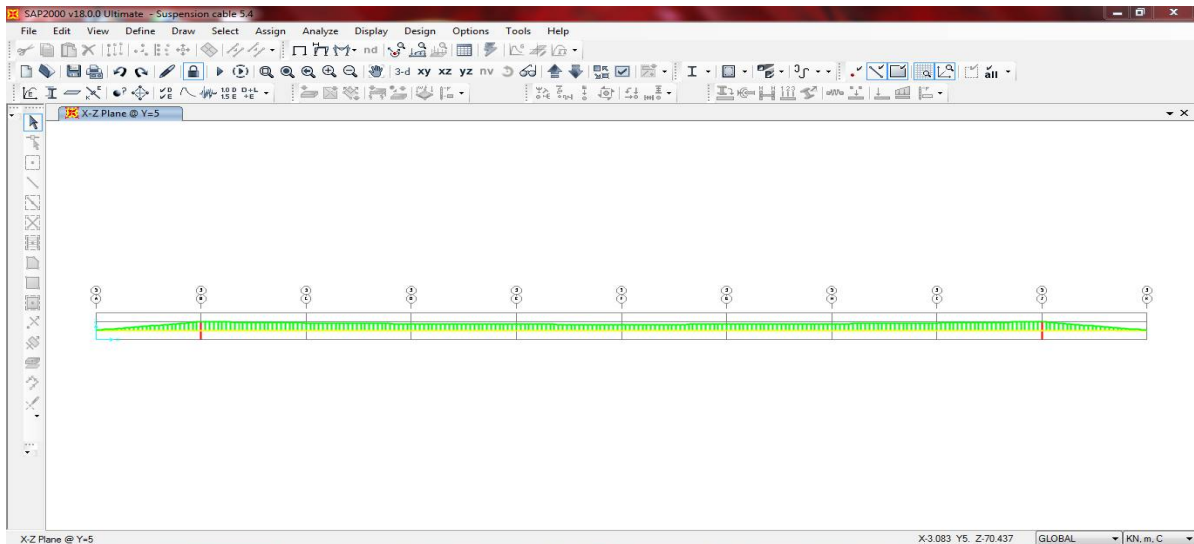


Fig.1 Element creation of Suspension Cable Bridge

SPECIMEN MODELING

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

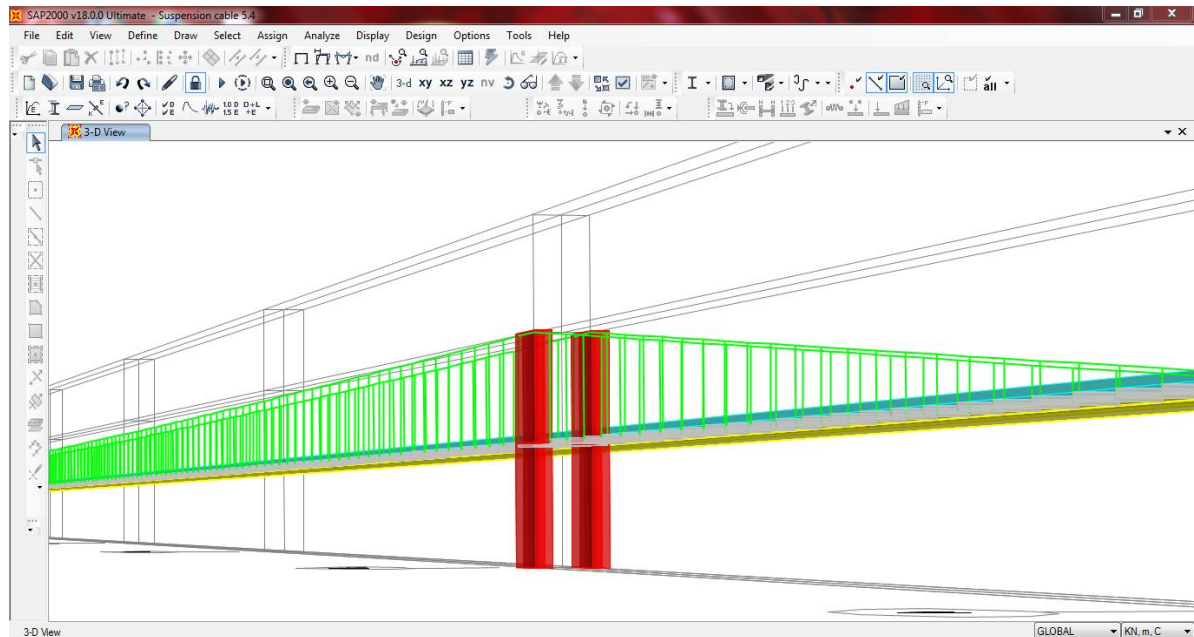


Fig 2. 3D modelling of Suspension Cable Bridge.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

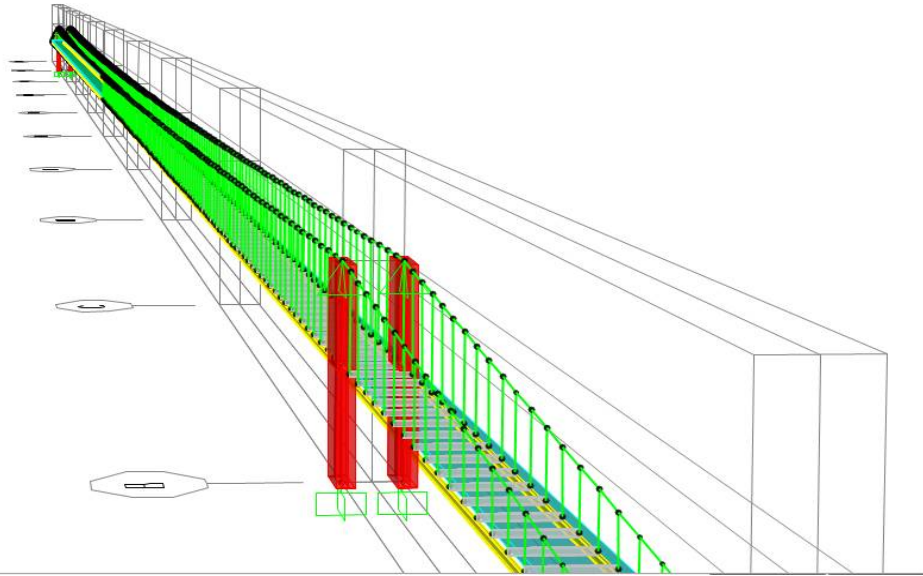


Fig 3. Overall view of Suspension Cable Bridge in SAP 2000

IV. RESULTS

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

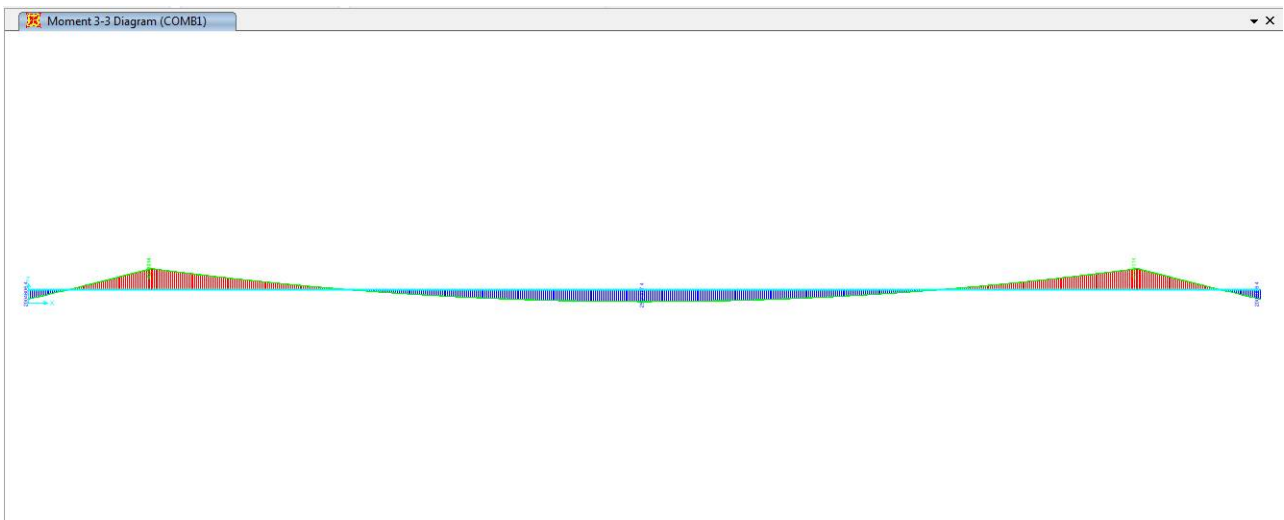


Fig 4. Bending Moment for load combination

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

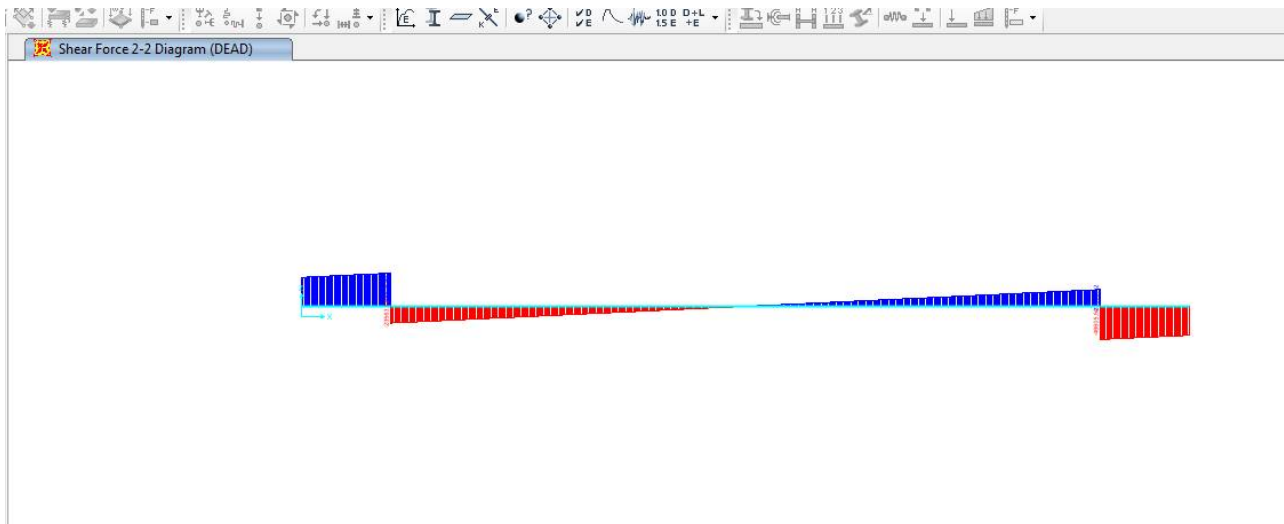


Fig 5. Shear force for dead load

V. CONCLUSION

The analysis of the Suspension cable bridge of 1000m span with single lane road, the intensity of road is given as 20 numbers of vehicle each loaded with 350KN (class AA-track load) is carried out by using SAP2000.

These results including Bending moments, shear force 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 analysed by software and compared with manual design of suspension Cable Bridge.

REFERENCES

- [1] Manabu Ito, "Cable Supported steel bridges: Design problems and solutions", Journal of Constructional Steel Research, Volume 39, Issue 1, pp 69 - 84, August 1996.
- [2] Chatterjee, P. K; Datta T.K; Surana C. S" vibration of suspension bridges under vehicular movement", Journal of Structural Engineering, Volume 120, Issue 3, pp 681 - 703, March 1994.
- [3] Moisseiff, L. S and Lienhard, F., " Suspension bridge under action of lateral forces", American Society of Civil Engineers, Volume 98, Issue 2, pp 1080 - 1095, 1934.
- [4] Saafan, A. S, "Theoretical analysis of suspension bridges", American Society of Civil Engineers, Volume 94, NO ST4, PROC PAPER 4885, PP 1 - 11, 1930.
- [5] IRC 21 - 2000 Standards specification and code for bridges (Section 2-cement concrete).
- [6] IRC 6 - 2014 Standards specification and code for bridges 9 section 3-load and stresses).
- [7] IS 9282 - 2002 wire rope and strands for suspension bridges.
- [8] AASTHO LFRD 2012 Bridge Design Specifications.