e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:03/Issue:05/May-2021 Impact Factor- 5.354
www.irjmets.com

MODELLING AND ANALYSIS OF SUSPENSION BRIDGE AS PER IRC IN MIDAS CIVIL

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ABSTRACT

The suspension bridge is type of the bridge in which the deck girder is below the suspension cables on vertical hanger. The elements of a suspension bridge consist girders, the main cables, pylon, and the anchorages for the cables. The main cables are hanging between pylons and connected to the anchorage or the bridge deck, and vertical hangers carry the load of the deck as well as traffic load on it. The main load carried by the main cables, which are tension element casted by using high-strength steel wire. The cable system is main element of the bridge. Bridges are normally designed for D.L, L.L and other Moving loads. All loading cases in the analysis and design are as per IRC 6-2017 code specifications. The total modelling of the suspension parts of the bridge was done per IRC 112-2020 by using MIDAS CIVIL.

Suspension cable bridge having 1000 m span with six lane road, the intensity of vehicle moving load as per IRC 6-2017 (heavy loading class 70R and class A wheel load) is analyze by MIDAS CIVIL . The result of analysis includes moments, axial loads, shear force and displacements. Moments and load at each point within the element can be easily observed from the software output results.

Keywords: Analysis, Force, Midas Civil, Moment, Modelling, IRC 112-2020, IRC 6-2017.

I. INTRODUCTION

The Bridges are those marvels in civil engineering tool kit which help in connecting the places located on other side of bank. Varieties of bridges have evolved from history. Of them one is suspension bridge. The suspension bridge allows for the longest span ranging from 2000 ft. to 7000 f t in length. Suspension bridges have attractive view. Suspension bridge is most commonly built to span across water body. It is constructed by suspending the deck from hanger attached to a main cable which passing above the longitudinal direction of the bridge. The strong and light in weight, suspension bridges are attractive.

The suspension bridge is a continuous deck suspended by hanger, which passing through the pylon with the supported by saddle, and end of the cable is anchored to the ground. The forces in a bridge are tension force in the cables and compression force in the pylon. The deck, which is usually a box girder, is attached to the main cables by hangers, which are in tension.

The weight is convey by the cables to the pylons, and transfer the weight to the anchorages on ends , then to the ground. The suspension cable can only carry the tensile stresses. Also because of this, the cable will never “buckles” and highly efficient use of high strength steel materials becomes possible. The use of suspension bridges makes longer main spans

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achievable than with any other types of bridges, and they are practical for spans up to around 2 kilometer or even larger.

A suspension bridge is a type of bridge which is built by suspending the roadway from cables attached to a master cable which runs above the length of the bridge.

II. METHODOLOGY

load considered for design as per IRC 6:2017

1. Self weight
2. Wearing Coarse
3. ACB (Anti Crash Barrier)
4. Footpath
5. Earth Pressure
6. Temperature Load
7. Water Pressure
8. Wind load In Transverse, Longitudinal & Upward Direction
9. Moving Load (Class A & Class 70R Vehicle).

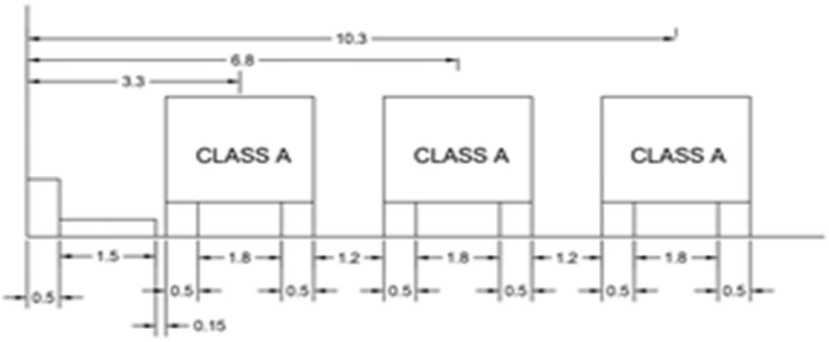

Figure 1: Case I – Class A Vehicle Load Offset

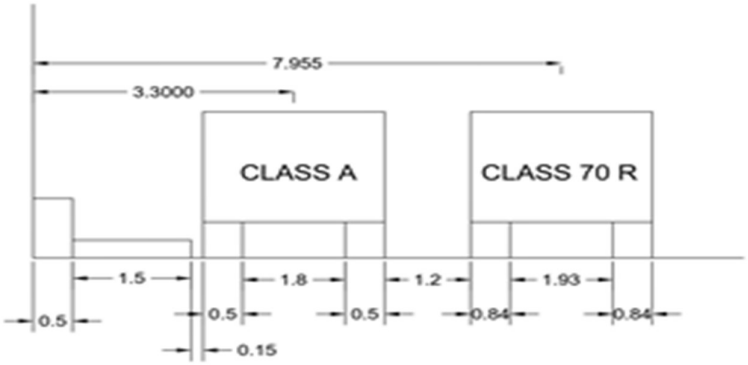

Figure 2: Case II – Class A & Class 70R Vehicle Load Offset

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Geometry of bridge modelling in Midas civil

1	Main Span	600 M
2	Side Span	200 M
3	Total Span	1000 M
4	Width of deck	26 M
5	Height of Pylon	80 M
6	Deck	Box Girder
7	Number of lane	6-Lane

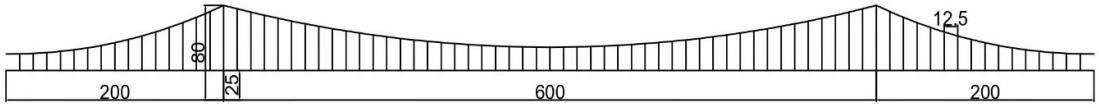

Figure 3: Dimensions of Suspension Bridge.

III. MODELING AND ANALYSIS

There are three stages in operating program, which consist input, process & output. In the input stage, the user have to assign the bridge loading cases, material properties, and section properties of bridge elements. On sectional property, the user have to assume what cross-sectional dimension have to be used. Next, the program will process the input data parameters that have been assigned. On the last stage, the program will show the output data parameter that will be used for the analysis. The output are deflection, moment and force.

IV. RESULTS AND DISCUSSION

The deflection criteria is satisfied for the suspension bridge in all loading conditions of heavy loaded vehicles (Class A and Class 70R) as per the IRC 112: 2020 (Cl. 12.4.1). The appropriate limiting values of deflection taking into account the nature of the structure, bridge deck furniture and functional needs of the bridge should be established. Our deflection results are under the deflection criteria that is less than the (1/1000) as per the IRC 112:2020.

The Model is safe under all forces due to the static and dynamic loading on the bridge. All the Geometry size of the suspension bridge components is satisfied under all loading cases as per IRC 6:2017. Also satisfied the compressive stress in the concrete limit as per the IRC 112: 2020 (Cl. 12.2.1). Maximum compressive stress in concrete under rare combinations of loads shall be limited to 0.48 fc k, in order to keep the longitudinal cracks, micro cracks or creep within acceptable limits is satisfied.

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Deformation (Max)	0.241 M
Force (Max)	3393.58 KN
Bending Moment (Max) Due to Moving Load	18721.63 KN-M
Cable Force (Max)	116.18 KN
Reaction of Pylon	44277.6 KN
Stress in Suspender (Max)	2665.98 KN/Sq. M < 6474.66 KN/Sq. M

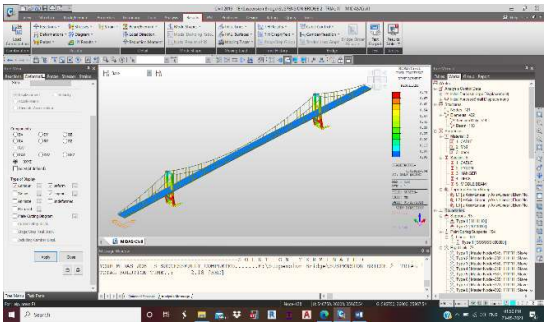

Figure 4: Deformation Result.

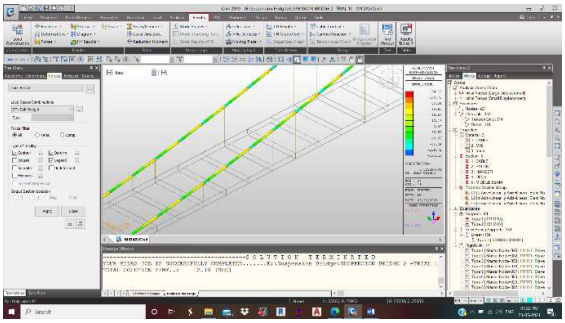

Fig: Cable Forces.

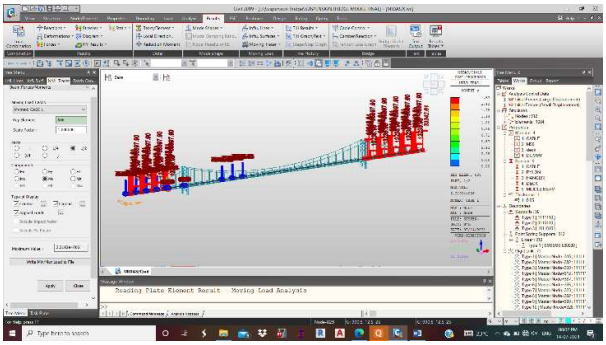

Figure: Moving Load Forces / Moment.

V. CONCLUSION

The analysis for Suspension Bridge having span 1 Km of 6-lane, the Road intensity is given as number of heavy loaded vehicle (Class A And Class 70R) as per IRC 6-2017 is carried out by using Midas Civil. The Results of

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Analysis involved the deformation, bending moment, forces of each node at every point within the element can be easily obtained from the Midas Civil software output.

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