"ANALYSIS OF DIFFERENT SPAN CANTILEVER BRIDGE AS PER IRC LOADING USING STAAD BEAVA"

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Abstract— Long-range bridges are built by offset cantilever technique with segmental development. For cement and steel the time-subordinate factors, for example, creep, shrinkage and unwinding and so forth are the components which cause high variety in load for the duration of the life of long-length spans and such circumstance, seismic evaluation gets basic and goal. Prior exploration has underscored the significance of time-subordinate elements like downer, shrinkage and unwinding and so on in the investigation of an adjusted cantilever bridge, the current codes and experts in this field recommends the singular amount arrangements, prompting lacking assessment of remaining quality/administration stress which may prompt basic condition.

In the event that such extensions are exposed to seismic tremor forces/activities, the criticality could be higher and prompting an unsatisfactory condition. In this manner, the investigation ought to be refreshed/did considering the consolidated effect of time-subordinate properties and seismicity. Such investigations are insufficient or obscure and consequently an investigation of seismic conduct of offset cantilever bridge with the thought of time-subordinate elements is done.

The main aim of this investigation is to determine the stresses inducing in a cantilever bridge for three different span length. On the study the inference is that by comparing the output of STAAD.Pro (structural analysis and design) analysis results of different sections and results were computed on the parameters of base shear, bending moment, Axial force and Deflection.

Keywords: Cantilever Bridge, STAAD.Beava, Bending Moment, Deflection, Shear Force.

I. INTRODUCTION

From the most recent couple of decade's Bridge has been going about as an interface to associate different deterrents to fly street over streams or channel to stream the transportation organize. With the most recent developments and trend-setting innovations, there has been the substitution of conventional Bridges to a practical structure framework. The cutting edge period even built up the most proficient strategies for the examination and structure of the advanced periods. To be specific, the new strategy presented for such intention is the Finite component technique, AASHTO and Grillage, and Finite Strip Method. Vehicle load limit examination of an extension superstructure is required according to IRC determination arrangement and manuals for standard and particular for Indian street conditions. Its fundamental intention is to guarantee, that Bridge is ok for the client or open. By the load limit investigation, a Bridge may be discovered to be unequipped for safely passing on some lawful load. Besides when the loads are past the scope of grant loads should use a specific structure, load limit examination can offer a response about which loads are safely good. STAAD.Pro is proficient and exact programming utilized for cement and steel connect investigation and structure. The benefit of the product is that it fuses this arrangement of allocating pivotal load according to type for bridge plan details and IRC particulars. STAAD.Pro is a broadly useful basic investigation and configuration apparatus with applications mainly in the commercial structures, extensions and expressway developments, modern developments, substance plant structures, dams, holding dividers, establishments, ducts, and other installed structures, and so forth. STAAD. Professional depends on Finite Element Analysis for completing the calculations for Analysis and Design of a Structure. An extension is a structure, by which a street, railroad, or other help has persisted a hindrance, for example, a stream, valley, and other street or rail route line. The superstructure of an extension is the part legitimately liable for conveying the street or different administrations. Its design is resolved generally by the air of the administration to be conveyed. Supports in advantageous areas. An ordinary arrangement of a bracket connect is a 'through support's design. There is a couple of support braces associated at the base harmony level by a deck that additionally conveys the traffic, crossing between the two brackets.

In this proposed work, a cantilever bridge with various ranges is examined for the vehicular load according to IRC particulars including dynamic loading according to zone

dispersion, to decide the absolute best and an affordable area that can structure according to Indian norms. For this investigation, three different spans are considered and for modelling and analysis staad.pro software is considered.

II. CANTILEVER BRIDGE

A cantilever connect is an extension constructed utilizing cantilevers, structures that venture evenly into space, upheld on just one end. For little footbridges, the cantilevers might be basic pillars; nonetheless, huge cantilever spans intended to deal with street or rail traffic use brackets worked from auxiliary steel or box supports worked from prestressed concrete. The steel support cantilever connect was a significant building advancement when initially set up as a regular occurrence, as it can traverse separations of more than 1,500 feet (460 m), and can be all the more effectively developed at troublesome intersections by utilizing almost no false work.

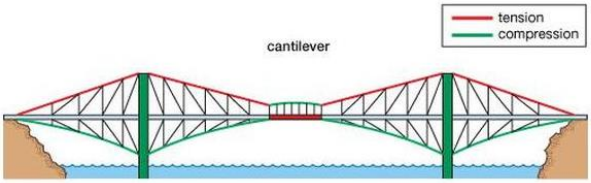


Figure 1: Cantilever Bridge

III. LITERATURE REVIEW

ARDRA M R et al (2019) the investigation paper presented an assessment of a bent adjusted cantilever connect an aspect of the Kochi Metro. The advancement begins from the enduring docks and proceeds reasonably to mid-extend. The examination of the extension model direct during advancement mastermind when presented to the dead load and working stage when presented to live load, specifically, the live burden was performed. From IS 456, compelling moment worth was resolved, and differentiated and second worth got from the STAAD assessment.

Results communicated that qualities acquired from the examination were inside this limit. For essentially maintained shaft limit state of functionality has given the limit for preoccupation as length/250. the qualities were found safe under the range.

Anjani Kumar Shukla and P R Maiti (2019) the investigation paper inspected the cantilever footbridge connect retrofitted by a steel coat to check the preoccupation and stress limit of the expansion and results communicated that the platform was secured. The exhibiting and assessment of the enlargement were done using Staad.Pro V8i.

Convincing information expressed that the most extreme resultant displacing was 9.526 mm, which was on the sliding side. The Maximum Horizontal Displacement in the X heading was 4.957 mm. The Maximum Axial Compressive Stress was - 9.227 N/mm2 in both steel shaft which was fix with the essential help of the extension and between center 22-26 and 3-10. The Maximum Axial Tensile Stress was 21.824 N/mm2 in Both steel bar which was fix with the guideline support of the Bridge and between Node 17-28 and 12-14.

Closure

Understandings from the above writing survey recommend the utilization of limited component displaying of superstructure utilizing STAAD.pro to examine the extension structure considering the different forces which follow up on the structure to get them down to earth results.

IV. OBJECTIVES

The primary goals of the current examination are as per the following:-

a) To investigate and plan of cantilever connect with three unique ranges.
b) To make a near investigation of these extensions.
c) To decide the cost investigation of various extension types.
d) To determine effect of vehicular loading and lateral forces over the structure.

V. METHODOLOGY

Here examination on a cantilever connects with three unique ranges is shown in the examination program STAAD.Pro in which joints interface is checked and improved, and IRC Class AA and seismic load are considered.

Three cases have been considered for near examination:

- Cantilever Bridge 200.00 m length.
- Cantilever Bridge of 300.00 m length.
- Cantilever Bridge of 400.00 m length.

The accompanying three cases must be examined and contrasted with set up a near report -

a. Planning of calculation and sectional properties in STAAD.pro.

b. Relegating sections according to Indian standard steel.

c. Allotting loads as IRC Class AA and seismic Provisions.

d. Arrangement of results and post-processing outputs.

Following steps are considered for completion of this project are as follows:

Step 1: Selection of the math of the superstructure by utilizing an organized framework in STAAD Pro or plot over the AUTO CAD, which can be imported in Staad-Pro according to the element of the support, c/c separation of joints, and no of interfacing individuals, and soon.



Figure 2: Modelling of the structure using staad.pro

Step 2: Extension models with three distinct ranges were set up of similar measurement and same loading Conditions according to Indian Road Congress Class AA and seismic. loading condition. The measurements with three diverse range and same width 12 meters wide, which incorporate check width material property of the structure according to Indian areas.

Step 3: Apply the area and material property to the models structured in the progression above, after that help condition has been considered at the bearing areas of the superstructure which is pinned/hinged

Step 4: Assigning support condition at the bottom of pier at the abutment.

Step 5: Seismic Load is applied to the structure considering zone IV according to IS 1893-2016 which even incorporates 1893 Part 4.

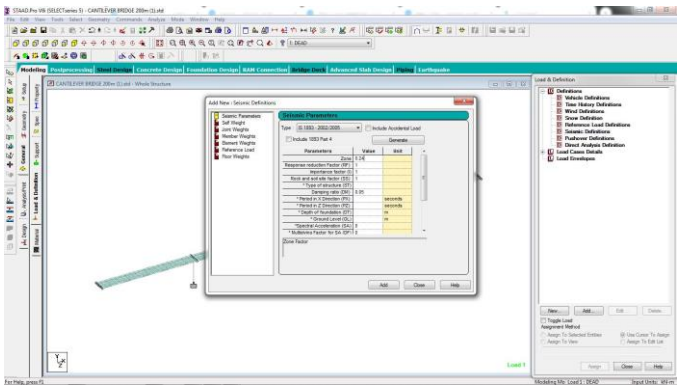


Figure 3: Seismic load as per I.S. 1893-I:2016

Step 6: Deck creation considering fixed depth for analysis of all the three cases.

Step 7: Assigning four lanes on custom (Define Roadways window). Here the dynamic path was characterized alongside the source purpose of the X and Z direction.

Step 8- Assigning Vehicular load as per IRC Class AA load. This was done using staad beava.

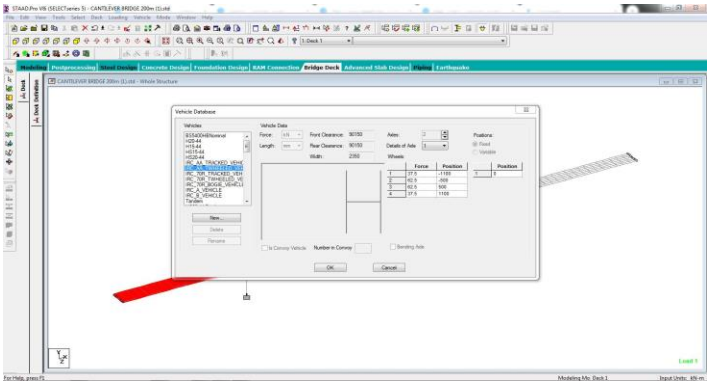


Figure 4: Assigning IRC loading

Step 9 This step fragmented the results based on deflection.

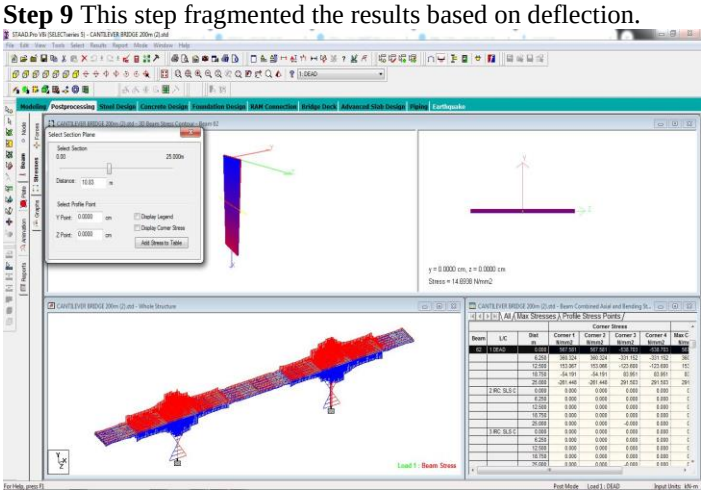


Figure 5: Analysis results

Table 1: Description of geometrical data

S.no	Description	Values
1	Span:	200, 300, 400 m
2	Width of deck	12 m
3	Width of carriage way:	2.6 m
4	No of lanes:	4
5	Type of super structure	Cantilever
6	Footpath details	1.75m wide on each side
7	Concrete Grade for Superstructure	M50
8	Steel Grade	Fe 500
9	Support type	Fixed support

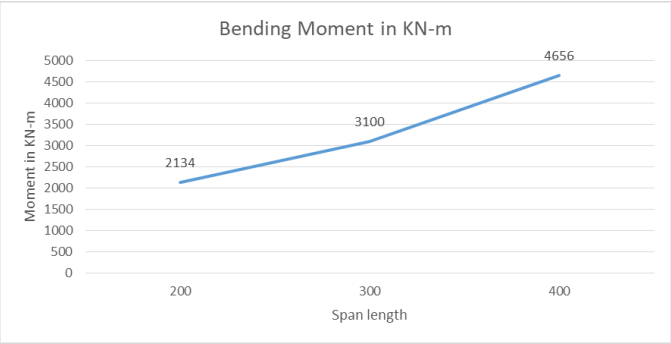
VI. ANALYSIS RESULTS

There are various loads that act up on the bridges and are considered for computing purpose. The information on loads discussed below is taken from IRC:6-2017.

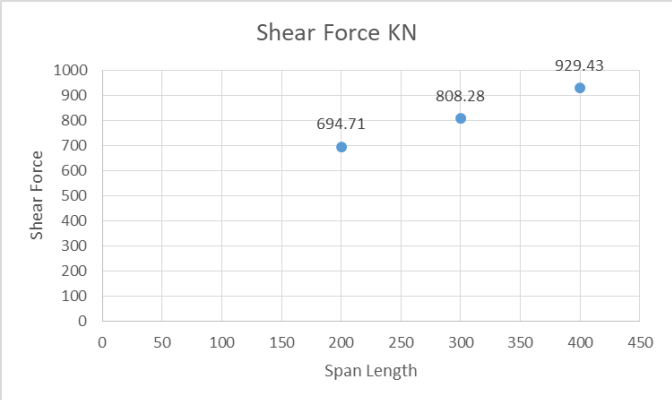
1. Dead Load

2. Live Load (Vehicular as per I.R.C class AA)

3. Seismic Load.



Graph 1: Bending Moment KN-m



Graph 2: Shear Force KN

Table 2: Deflection

Deflection of the Structure	
Span (m)	Deflection in mm
200	113.99
300	116.48
400	78.65

VII. CONCLUSION

Considered Class A+ 70R vehicle load cases along with seismic and dead load for the R.C.C. bridge for analysis by using Staad-Pro software.

Maximum bending moment

It is observed that maximum bending moment in seen with increase in the size of span of the bridge which was found increasingly linear.

Maximum shear force.

It is observed that maximum shear force in seen in seen with increase in the size of span of the bridge which was found increasingly linear.

Maximum axial force

An axial force is any force that specifically follows up on the middle pivot of a question. These forces are normally extending force or pressure force, contingent upon heading. Also, when the force stack is even over the frame's geometric focus, it is concentric, and when it is uneven, it is offbeat. It is observed that maximum axial force in seen a non-linear hike in 300m and low scale was seen in 400m span bridge.

Maximum Deflection.

The deflections was found linear in the valuation of loads as per IRC specifications. But due to seismic effect vibrations modes are generating which are observed low in long pan structure in comparison.

Summary:

Here in this study it can be concluded that in comparison to three different span structures, as we are increasing length forces are also increasing at a certain ration whereas seismic forces are distributing more linearly in long span structure upto study limitations.

REFERENCES

1. aldo giordano, giorgio pedrazzi and giovanni voiro, [balanced cantilever girder bridge over the danube-black sea channel], article no.4, romanian journal of transport infrastructure, vol.2, 2013, no.2.
2. boris azinović, david koren and vojko kilar, [seismic safety of the precast balcony cantilever elements for prevention of thermal bridges], ar 2014/2.
3. suhas s vokunnaya, ravindranatha and tanaji.thite, [construction stage analysis of segmental cantilever bridge], international journal of civil engineering and technology (ijciet), volume 8, issue 2, february 2017, pp. 373–382 article id: ijciet_08_02_040.
4. karthik .h. purohit and dr a.a bage, [construction stage analysis of cable stayed bridge by cantilever method of construction (nagpur cable stayed bridge)], international journal of innovative research in science, engineering and technology, vol. 6, issue 7, july 2017.
5. jn mahto and sc roy, [experimental analysis of propagation of crack in brass cantilever beam under forced vibration], international journal of mechanical engineering and technology (ijmet), volume 7, issue 5, september–october 2016, pp.316–320, article id: ijmet_07_05_030.
6. r.anbarasi, s.aruljothy, r.balamurugan and r.renganathan, [segmental analysis and design of superstructure for box girder balanced cantilever bridge by irc specification using midas civil], international journal of intellectual advancements and research in engineering computations, issn:2348-2079, volume 7 issue 2. vol.–07(02) 2019 [3159-3167]
7. hamid aadal, pejman ghasemipoor sabet, ali bagheri fard and kiyanoosh golchin rad, [cast in-situ balanced cantilever for building a bridge], journal of basic and applied scientific research, 3(9)311-317, 2013.
8. jn mahto, sc roy, j kushwaha and rs prasad, [displacement analysis of cantilever beam using fem package], international journal of mechanical engineering and technology (ijmet), volume 4, issue 3, may - june (2013).
9. ardra m r, arya k s, athira m s, sreelakshmi m s and kichu paul, [study and analysis of balanced cantilever bridge at kochi metro], international research journal of engineering and technology (irjet), volume: 06 issue: 4 | apr 2019.
10. rubina p. patil and r. s. talikoti, [seismic analysis of balanced cantilever bridge considering time dependent properties], international journal of engineering research & technology (ijert), issn: 2278-0181, vol. 3 issue 7, july – 2014.
11. n sobhana , a ramakrishnaiah and p somusekhar, [pushover analysis of balance cantilever bridge], international research journal of engineering and technology (irjet), volume: 04 issue: 11 | nov -2017.
12. abhilash pokkilan and ramayanapu rajesh kumars, [studies on large span cantilever structures by using staad pro. analysis], international journal of engineering sciences & research technology, issn: 2277-9655, impact factor: 2.114, october, 2014.
13. g.f. giaccu, d. solinas and g.p. gamberini, [time – dependent analysis of segmentally constructed cantilever bridge comparing two different creep model], ceb-fip model code, thomas telford services ltd., london, 2012.
14. lukáš krkoškaa, and martin moravčíka, [the analysis of thermal effect on concrete box girder bridge], xxiv r-s-p seminar, theoretical foundation of civil engineering (24rsp) (tfoce 2015).
15. asterios liolios, dimitrios konstantinidis, georgios konstantinidis and fani antoniou, [design of twin leaf balanced cantilever bridges in greece under seismic conditions], 2014.
16. pandule ashok, bangar datta, shubham kadam, banduke satish and n.a. maske, [analysis and design of pre-stressed concrete box girder deck slab bridge], international research journal of engineering and technology (irjet), volume: 06 issue: 05 | may 2019.\
17. anjani kumar shukla and p r maiti, [retrofitting and rehabilitation of damage footbridge over yamuna river], international journal of recent technology and engineering (ijrte), issn: 2277-3878, volume-8 issue-2, july 2019.