Seismic Design And Analysis of Balanced Cantilever Bridge Using Staad Pro

Miss Vanita Parasur[1], Prof. S.A. Karale sir[2]
[1] Dept of Civil Engineering
[2]Asst. Professor, Dept of Civil Engineering
[1, 2] S.N.D. College of Engineering & Research Centre, Yeola, India

Abstract- *Balanced cantilever construction is suited to precast segmental and cast-in-place bridges. The deck is erected segmentally on each side of the pier in a balanced sequence to minimize load unbalance and longitudinal bending in piers and foundations. The deck is self-supporting during construction, and it also supports erection equipment and construction materials stored on the cantilever. This construction method is particularly advantageous on long spans, in marine operations, and where access beneath the deck is difficult.in this paper balanced cantilever bridge are analysis for different spans under seismic loading by using STAAD PRO*

Keywords- Balanced cantilever, STAAD PRO, Time History

I. INTRODUCTION

Balanced Cantilever Bridge is so named due to its method of construction. It is one of the most efficient methods of building bridges without the need of false work. This method has great advantages over other forms of construction in urban areas where temporary shoring would disrupt traffic and services below, in deep gorges, and over waterways where false-work would not only be expensive but also a hazard. Construction commences from the permanent piers and proceeds in a “balanced” manner to mid span as shown below.

Fig -1: Balanced Cantilever Bridge

1.1 Objectives:

- To concentrate the conduct balanced cantilever bridge under standard IRC loading, and the comparing analysis depends on the analytical modeling by FEM for various spans in STAAD PRO software for various spans of bridge.
- To study the deck slab interaction with the loading considered as IRC Codes.
- To evaluate the suitability of the bridges for short as well as long spans
- To evaluate code expressions for live-load distribution factors.

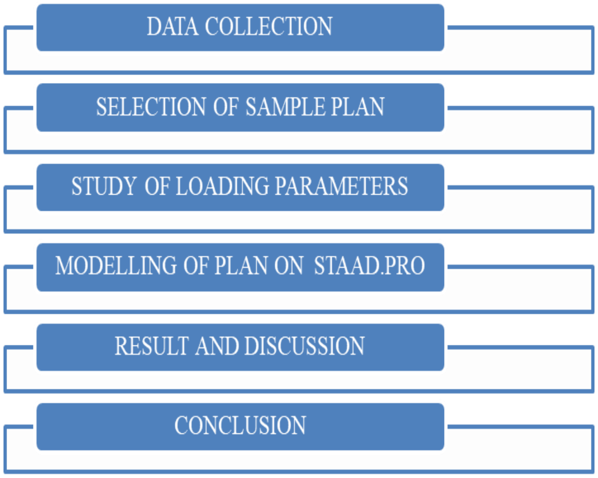
II. LITERATURE REVIEW

Jitha G et. al. The bridge structure has been modelled by Finite element Technique using MIDAS Civil and analysis has been performed to get various output such as primary and secondary bending moment, shear forces and torsion quantities at various locations of the bridge. The design of super structure is performed as per IRC standards.

Baofeng Pan et. al. To know about the structure behavior, geometric and internal force, it needs to simulate the entire construction process according to each construction stage, and to determine the ideal state of the stress and distortion of each stage of the construction process.

Alemdar Bayraktar et. al. experimental and analytical dynamic characteristics are compared. Good agreement is found between dynamic characteristics in the all measurement test setups performed on the box girder and bridge deck and analytical modal analyses.

Prof. Dr. Amorn Pimanmas The deflection due to creep is not negligible and must be accurately predicted for preparing the camber of the bridge. In this report, the authors are mainly concerned with the structural analysis and design of balanced cantilever bridge considering construction stages and effect of creep redistribution.



III. METHODOLOGY

3.1COMPUTERS AND STRUCTURES

STAAD PRO is general-purpose civil-engineering software ideal for the analysis and design of any type of structural system. Basic and advanced systems, ranging from 2D to 3D, of simple geometry to complex, may be modeled, analyzed, designed, and optimized using a practical and intuitive object-based modeling environment that simplifies and streamlines the engineering process.

IV. PROBLEM STATEMENT

Table -1: Balanced Cantilever bridge

Type of Bridge Superstructure	Balanced Cantilever bridge	
Cross section	Multi celled box girder	
Carriageway width	7.5 m	
Kerbs	600 mm on each side	
Foot Paths	1.25 m wide on each side	
Thickness of wearing coat	80 mm	
Lane of bridge	Two lane	
Longitudinal girders	4 main girders at 2.5 m interval	
Spacing of cross girders	5 m	
Cell dimensions		2 m wide by 1.8 m deep
TH. of Top &Bottom Slab	250 mm & 300mm	300 mm
Overhang Th.	180 mm	180 mm
Thickness of web	200 mm	300 mm
Span	35, 40 , 45, 50m	
Grade of concrete	M60	
Material	Pre-stressed Concrete	
Loss Ratio	0.8	
Type of Supplementary r/f	Fe-550 HYSD bars	
Loading Considered	Dead load, wind &Pre-stress, Class 70R-Wheeled vehicle, and Seismic forces	
	Class-1 type of structure confirming to the codes IRC:6-2014,IRC:21-2000,	
Design of bridge deck	IS:1893-1987,IS: 875 (Part-III) - 1987	

Table -1: BALANCED CANTILEVER BRIDGE

BALANCED CANTILEVER BRIDGE	
MODEL NO.1	35m span
MODEL NO.2	40m span
MODEL NO.3	45m span
MODEL NO.4	50m span

V. RESULT AND DISCUSSION

5.1 BALANCED CANTILEVER BRIDGE MODELS AND RESULTS IN STAAD PRO

The analysis is carried out using finite element method tool STAAD-Pro. The concrete slabs are modelled using shell elements. Simple support condition is provided

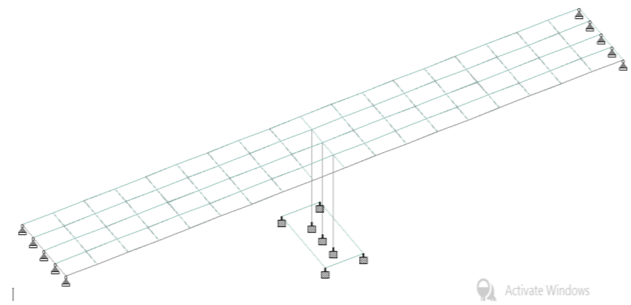
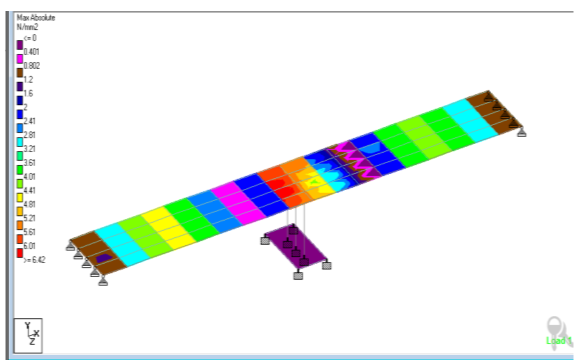


Fig -2: Balanced Bridge model for span 25 m



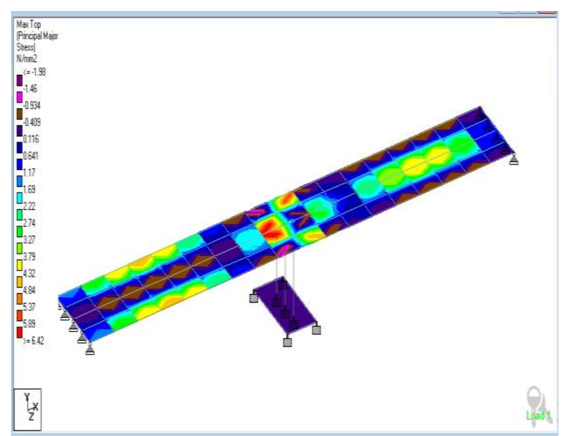


Fig -3: Balanced Bridge model for span 25 m

5.2 COMPARATIVE ANALYSIS BALANCED CANTILEVER BRIDGE

Table -1: Natural Frequency

NATURAL FREQUENCY Hz				
Mode Shape No.	25m	30m	35m	40m
1	1.694	1.6093	1.528835	1.452393
2	2.112	2.0064	1.90608	1.810776
3	2.6572	2.52434	2.398123	2.278217
4	3.9844	3.78518	3.595921	3.416125
5	4.7541	4.516395	4.290575	4.076046
6	5.2881	5.023695	4.77251	4.533885

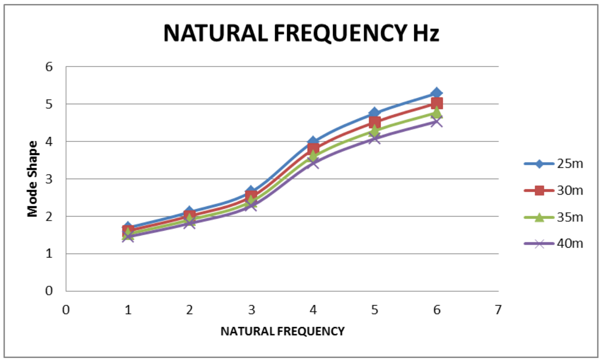


Fig -4: Natural Frequency

As the Above results shows that Natural Frequency of Balanced Cantilever Bridge for span 25m, 30m 35m, 40m will be subject mode shapes 1 to 6. Whereas Natural Frequency of 25m span Is more than other spans by 10-15%.

Table -1: Time Period

TIME PERIOD BOX GIRDER sec				
Mode Shape No.	25m	30m	35m	40m
1	0.5903187	0.53128689	0.47815	0.43034
2	0.47348484	0.42613636	0.38352	0.34517
3	0.37633599	0.33870239	0.30483	0.27434
4	0.25097881	0.22588093	0.20329	0.18296
5	0.21034475	0.18931028	0.17037	0.15334
6	0.18910383	0.17019345	0.153174	0.137857

Fig 5 Time Period

As the Above results shows that Time Period of Balanced Cantilever Bridge for span 25m, 30m 35m, 40m will be subject mode shapes 1 to 6. Whereas Time Period of 25m span Is more than other spans by 10-12%.

VI. CONCLUSIONS

The behavior of Balanced Cantilever Bridge proposed for bridge Superstructure of spans span 25m, 30m 35m, 40m is studied. By conducting Dynamic analysis, it was clear that 30m 35m is an efficient and economical Span by optimization of cross-section as compared to 25m & 40m span section by comparing following static and dynamic responses

- As the Above results shows that Natural Frequency of Balanced Cantilever Bridge for span 25m, 30m 35m, 40m will be subject mode shapes 1 to 6. Whereas Natural Frequency of 25m span Is more than other spans by 10-15%.
- As the Above results shows that Time Period of Balanced Cantilever Bridge for span 25m, 30m 35m, 40m will be subject mode shapes 1 to 6. Whereas Time Period of 25m span Is more than other spans by 10-12%.

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