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Analysis of single and Multi-span Slab Bridges using CSi Bridge Software

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Abstract— ***Bridges are authoritative to one and all and which are the most prerequisites of the transportation system but they are likely to fail if its structural insufficiencies are not recognized. And also, Every structure can be analyzed with by static method as well as the dynamic method by Selecting a suitable analysis method whereas this is influenced by a various number of factors. Namely, the purpose of analysis, the importance of the structure, various methods obtainable for analysis, type of the bridge or type of structure and soil conditions as well as soil-structure interaction. To overcome this problem, the paper aims to carry out the analysis of single and multi-span RC Slab Bridge with static and dynamic analysis. CSI bridge software has been used to analyze the Reinforced concrete slab Bridge.***

Index Terms— ***slab bridges, static analysis, dynamic analysis***

I. INTRODUCTION

The ideal purpose of the study search out obtains an correct measure of supposed fundamental response for a likely type of shock. To answer this purpose, a method that is secondhand for study is also concerned significantly. Also, the significance of any form plays a meaningful duty. The static adaptable reasoning is ruined all types of structures. For common forms motionless analysis is acceptable, except for main structures specifically for bridges, the vital study must be carried out. Also, forms mainly have an uneven configuration in addition to a variable subsurface condition that can be resolved by utilizing vital analysis system. Static reasoning maybe carried out manually or through a calculating program. The forms and skills are usually applicable to the bridge design society. Inappropriately, static adaptable study is appropriate for only a limited class of bridges. Dynamic reasoning transfers an correct amount of anticipated fundamental answer for a likely type of earthquake occurrence or order of temblors. If a precise fundamental model maybe settled, the calculated all-encompassing displacements maybe secondhand directly to base seat widths and separations, and local deformations and flexibility necessities can be secondhand straightforwardly to decide the mandatory analyses These models must perform accompanying the appreciative that no level of complicatedness in fundamental displaying can overcome the basic danger in basaltic stowing. The dynamic reasoning maybe used to support an insignificant measure of certain answers, that will ensure the acceptable depiction of the building. It is a gravity loading due to the structure which is simply calculated as a product of volume and substantial density of the bridge whereas torsional stiffness of main structural elements was varied [1]-[6].

A. Live Load

Highway Road bridge decks should be created to bear the live loads particularized apiece Indian Road Congress (I.R.C: 6-2010 Section II). In India, artery bridges are created under IRC bridge rule IRC: 6 - 2010 Section II that gives the requirements for the miscellaneous loads and stresses expected deliberate in bridge plotting. There are three types of standard loadings for that the bridges are planned that is to say, IRC class AA stowing, IRC class A stowing and IRC class B stowing.

B. Seismic Load

If a bridge is situated in an shock-likely field, the upheaval or basaltic forces be entitled to deliberation in fundamental design. Earthquakes cause upright and level forces in the makeup that is to say equivalent to the pressure of the building. Both level and upright elements have to stop living into give reason for the design of bridge constructions. IS: 1893 –1984 concede possibility be refer to for the real design loads [7].

C. Impact Load

For I.R.C. class A loading chart, The impact allowance is Given as a fraction of the applied live load and is Calculated by the following equation,

$$I=4.5/(6+L)$$

Where, I=impact factor fraction, L= span in meters

II. STATIC AND DYNAMIC ANALYSIS

The structural analysis mainly emphases on the variations taking place in the performance of a physical structure under surveillance when provided with a force or in case of structures, load. Now if this load is virtual that is very slow, the inertia forces found from the basis of newton's first law of motion would be ignored and therefore the analysis turns out to be static. Whereas the static loads are very slow on the time rate graph after the observations made. Static structure analysis methods are as follows, non-linear static analysis and linear static analysis. Conflicting to this, if the force or load applied to have a high rate of change of velocity during the process then it gets converted into the dynamic analysis, the basis and consequenceportion comes in to play here. The system under contemplation is observed for the expansion going on during a sequence of time and then the cause of those changes has been analysed [8].

Dynamic loads are always applied as a function of time or as a function of frequency and the time or frequency-varying load application brings frequency-varying response that is displacements, velocities, accelerations, forces, and stresses. These time or frequency-varying physical characteristics make the dynamic analysis more difficult as well as more accurate than the static analysis. Dynamic structure analysis method is as follows, Non-linear time history analysis, " Non- linear" static analysis, Linear elastic time history analysis, Modal- superposition, linear static analysis. All the loads are considered here are dynamic by nature but at some point of time they were inattentive and which also comprises the self- weight of the structure [9].

II. PROBLEM DEFINITION

The bridge analyses are in Table 1 and Cross-section of Bridge proved in Fig 1. The loads and load alliances on the bridge are intentional and the unchanging bridge is posed in CSi Bridge spreadsheet (Fig 2), bridge analyses

BRIDGE DETAILS				
SL NO	DESCRIPTION			
1.	Span of the bridge	4m	4m x 2	4m x 3
2.	Width of the bridge	7m	7m	9m
3.	Number of lanes	2	2	2
4.	Slab thickness	400mm	700mm	1000mm
5.	Type of loading	IRC class AA loading	IRC class AA loading	IRC class AA loading
6.	Compressive strength of concrete	30000kN/m^2	30000kN/m^2	30000kN/m^2
7.	Modulus of elasticity	27386128kN/m^2	27386128kN/m^2	27386128kN/m^2
8.	Poisson's ratio of concrete	0.18	0.18	0.18
9.	Type of analysis	Static and dynamic analysis	Static and dynamic analysis	Static and dynamic analysis

are proved in table 1 and dossier in addition to determinants secondhand for reasoning are proved in Table 2 and subsequently changeless and vital reasoning has existed completed activity to catch the maximum turning importance and active characteristics of the bridge.

TABLE 1: BRIDGE DETAILS

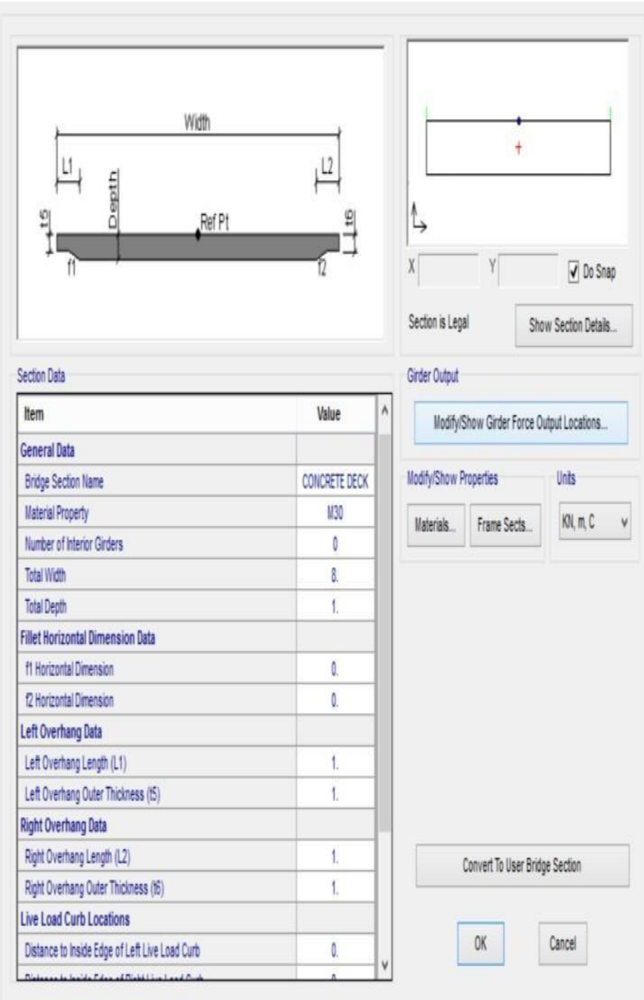


Fig 1 Cross-section details of Bridge

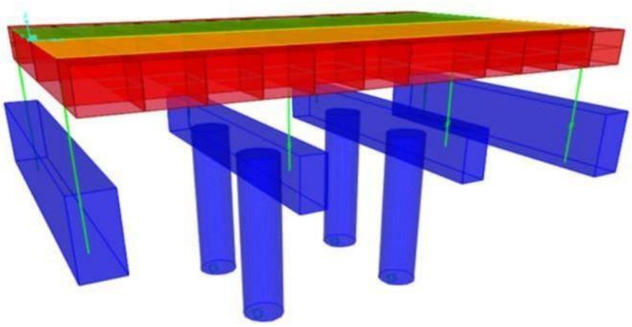


Fig 2 Bridge model in CSi Bridge

Table 2 Input data for analysis

Input data for analysis		
Sl no	Particulars	
1.	Density of reinforced concrete	25kN/m3
2.	Grade of concrete	M-30
3.	Type of live load	IRC class AA wheeled
4.	Impact factor	0.173
5.	Importance factor	1.2
6.	Response reduction factor	3.0
7.	Poisson's ratio of concrete	0.18
8.	Seismic zone	Zone 2
9.	Seismic zone factor	0.16

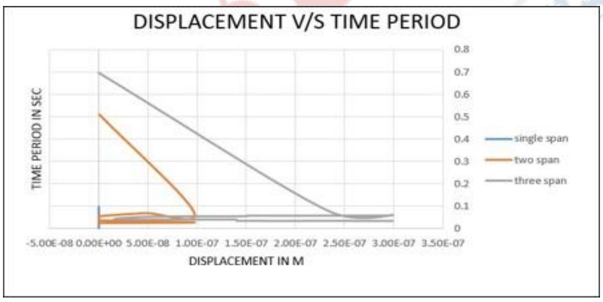
III. RESULTS AND DISCUSSIONS

A. Displacement and time period for dead load case

GRAPH 1. DISPLACEMENT VS. TIME PERIOD FOR DEAD LOAD CASE

Graph.1 shows a conspiracy of displacement v/s time period for dead load case. Where displacement values are plotted along x-axis and time period values are plotted along the y-axis. From the curves, it is observed that displacement for a single-span bridge is higher when compared to the two- span bridge. In the case of dead load, for a lower time period, the single-span bridge shows comparatively higher displacement when compared to higher span bridges. Which shows that singe span bridges are susceptible to earlier failure than two and three-span bridges. Whereas two and three span ridges are more flexible comparatively [11].

B. Displacement and time period for moving load case.



GRAPH 2. DISPLACEMENT VS. TIME PERIOD FOR MOVING LOAD CASE

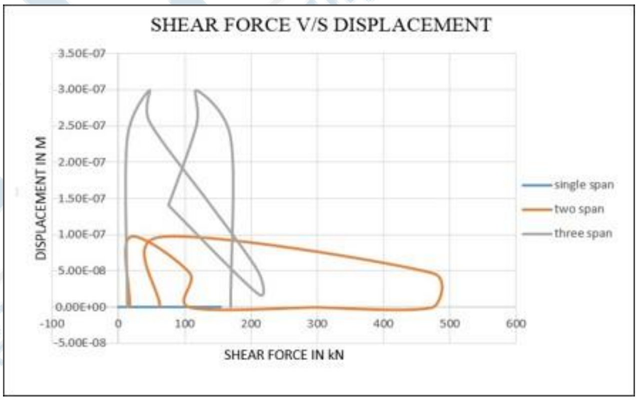
Graph.2 shows a plot of displacement v/s time period for moving load case. Where displacement values are plotted in abscissa and time period inordinate. For the moving load case also, we are obtaining the same results as that of dead load. From the obtained results we can observe that more the number of spans higher will be the displacement and higher time period shows more flexibility [10].

C. Shear force and displacement for dead load case

GRAPH 3. SHEAR FORCE VS. DISPLACEMENT FOR DEAD LOAD CASE

Graph.3 shows a plot of shear force v/s displacement for dead load case. Where shear force values are plotted in abscissa and displacement values are plotted inordinate. The above curve shows that single-span bridge displaces more for lower shear force values whereas two and three-span bridge displace comparatively more but carries higher shear force. From sheer force carrying capacity point of view short span bridges perform poorly compared to two and three-span bridges. Similarly, two-span will perform better than single span but inferior to the three-span bridge.

D. Shear force and displacement for moving load case.



GRAPH 4. SHEAR FORCE VS. DISPLACEMENT FOR MOVING LOAD CASE

Graph.4 shows a plot of shear force v/s displacement for moving load case. Where shear force values are plotted in abscissa and displacement values are plotted inordinate [13],[14]. From the above curve that is for moving load case, we can observe that two and three-span bridges show elastic behaviour. Although they show initial displacement and for the same displacement it takes more load and finally leads to failure. Whereas single-span bridge shows negligible elasticity from the observations made. Thereby two-span bridges show higher shear force carrying capacity for lower displacement [12].

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IV. CONCLUSION

1. From graph 1 we can conclude that in the case of dead load, single-span bridges are susceptible to earlier failure than two and three-span bridge.
2. From graph 2 we can conclude that more the number of spans higher will be the displacement and higher time period shows more flexibility.
3. From graph 3 we can conclude that from shear force carrying capacity point of view short span bridges perform poorly compared to two and three-span bridges.

From graph 4 we can conclude that from shear force carrying capacity point of view short span bridges perform poorly compared to two and three-span bridges

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