Dynamic Analysis of PSC T-Beam & Box Girder Bridge

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Abstract— The pre-stressed concrete bridges have excellent riding characteristics that minimize traffic vibrations, torsional rigidity, less likely to crack prematurely continuous span, strength and the most noteworthy characteristic is natural frequency of vibration hardly matches with vehicle frequency therefore attained spacious acceptance in freeway, highway flyovers, and in modern metro rail systems. As bridges are the important structures should be capable to withstand static as well as dynamic loads specially, earthquake-induced load to achieve a structure that behave at the level of life safety under enormous earthquakes. The present article shows the linear dynamic behavior of T-beam girder and box girder bridge deck and compares static as well as dynamic behavior. Response spectrum analysis has been performed by using FEM based software in order to check the resonance criteria of bridge and to determine most favorable option from above two. The results show that response parameters for box girder such as bending moment, shear forces, deflection, time period, base reaction, longitudinal stresses and shear stresses are increases as the span length increases while fundamental frequency decreases. From the study it is finalized that box girder is the conservative solution as compared to T-beam girder bridge superstructure.

Keywords: T-beam girder, Box girder, Dynamic analysis, ANSYS

I. INTRODUCTION

Bridges are the life line of road network, both in urban and country zones. With fast innovation development, the commonplace bridge has been supplanted by creative practical structural system. One of these courses of action presents basic RCC framework that is T-Beam and Box Girder.

Bridge design is a goal and what's more personalities boggling approach for an structural design. Just as there should rise an occasion of Bridge design, span length and live loads are consistently fundamental variables. These parts affect the conceptualization time of plan. The impacts of live load for different extents are moving. Choice of structural system for a cross is continually a range in which investigate should be possible. Structural system got is influenced by fragments like economy and fancy being created. Code strategy engages us to pick structural system i.e. T- Beam Girder and Box Girder. The decision of sparing and constructible basic framework relies on upon the outcome.

A. *Advantages of T-Beam*

- T- Beam bridges are helpful for short spans.
- Long distances are normally covered by placing the beams on piers.
- It has simply geometry.
- Easy to cast in construction.
- It mostly adopted Bridge.
- Slab act as monolithically with beam.

B. *Advantages of Box-Girder*

- Reduces the slab thickness and self-weight of bridge
- Cost-effective
- Greater strength per unit area of concrete
- Quality assurance, as precast girders are made off-site

II. OBJECTIVES

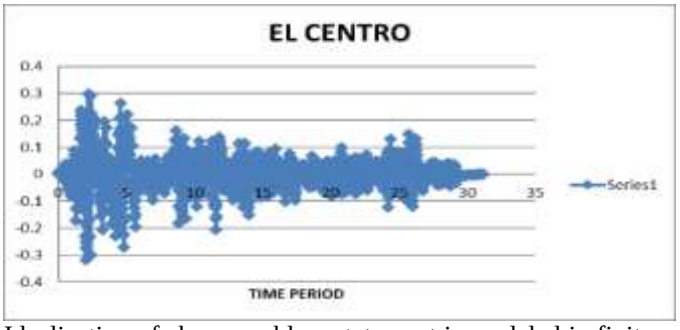
- To concentrate the conduct of basic simple RCC T-beam beam and Box Girder bridge under standard IRC loading, and the comparing analysis depends on the analytical modeling by FEM for various spans in ANSYS software for various spans of bridge
- To study the deck slab interaction with the loading considered 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 for concrete girder bridges.

III. METHODOLOGY

The design parameters are check and verify by the structural analysis program (ANSYS). The structural design is a very important part of the bridge which defines safety in overall context and the major cost of the project. Therefore, the choice of the correct and appropriate code will save a high value of the cost of construction, in addition to the safe and successful design. To decide the size (dimension) of the member and the amount of reinforcement required. To check the weather adopted section will perform safely and satisfactorily during the life time of the structure. Design Philosophy, Loading and pattern of loading, Safety factors. Shear force and Bending Moment induced in the components, Reinforcement required for each design, from these comparative studies, we can have idea about the best design standards.

IV. RESULTS AND DISCUSSION

A. *Data Collected*



Idealization of above problem statement is modeled in finite element analysis tool ANSYS .Following models are prepared for comparative analysis of bridge structure

	BOX GIRDER	PSC T- BEAM
MODEL NO.1	35m span	35m span
MODEL NO.2	40m span	40m span
MODEL NO.3	45m span	45m span
MODEL NO.4	50m span	50m span

B. Box Girder Models and Results in ANSYS

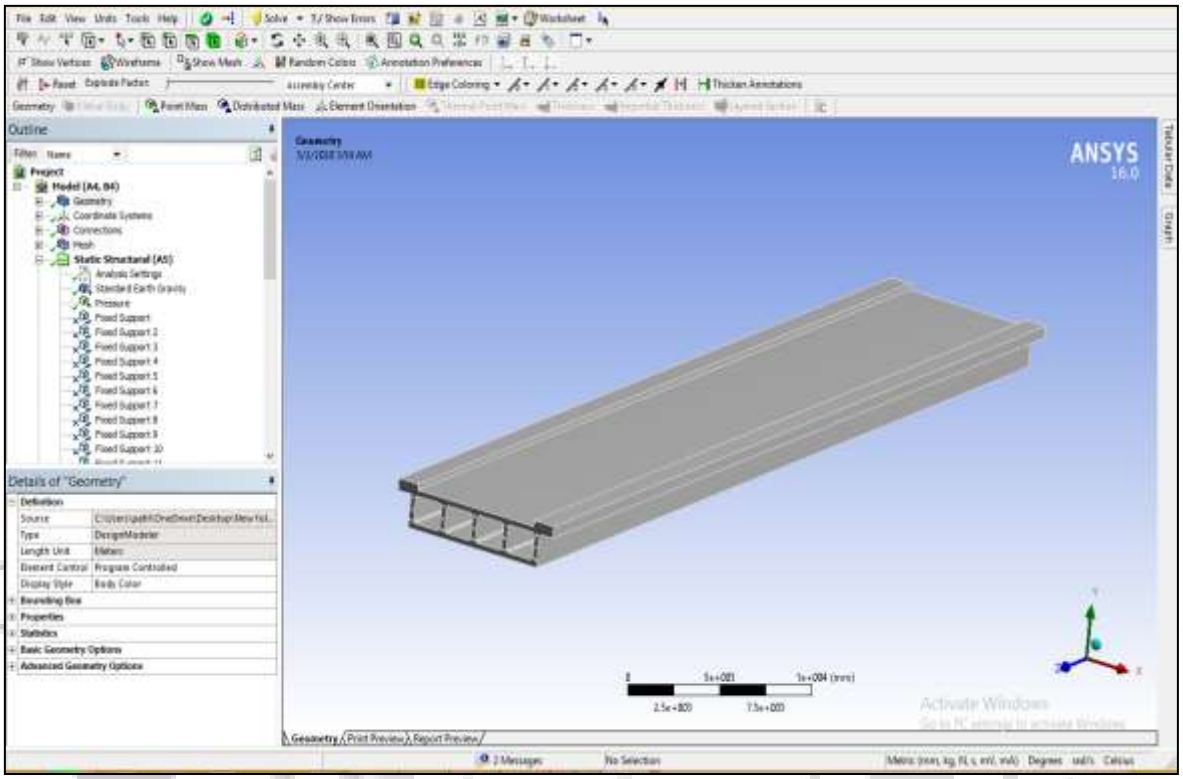
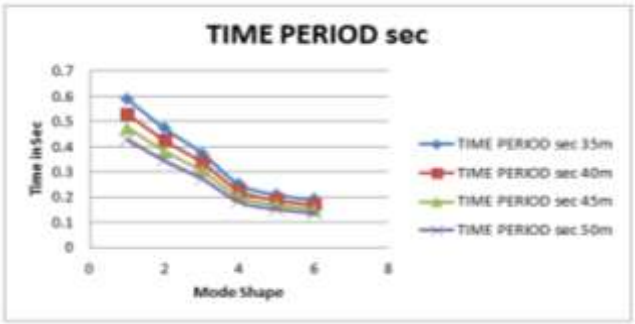


Fig. 1: Modeling of box Girder in ANSYS

TIME PERIOD BOX GIRDER sec				
Mode Shape No.	35m	40m	45m	50m
1	0.590318772	0.531286895	0.478158	0.430342
2	0.473484848	0.426136363	0.383523	0.34517
3	0.376335993	0.338702394	0.304832	0.274349
4	0.250978817	0.225880935	0.203293	0.182964
5	0.210344755	0.18931028	0.170379	0.153341
6	0.189103837	0.170193453	0.153174	0.137857

Table 1: Time Period



Graph 1: Time Period Box Girder

As the Above results shows that Time Period of Box Girder for span 35m, 40m 45m, 50m will be subject mode shapes 1 to 6. Whereas Time Period of 35m span is more than other spans by 10-12%.

C. PSC T- Beam Models and Results in ANSYS

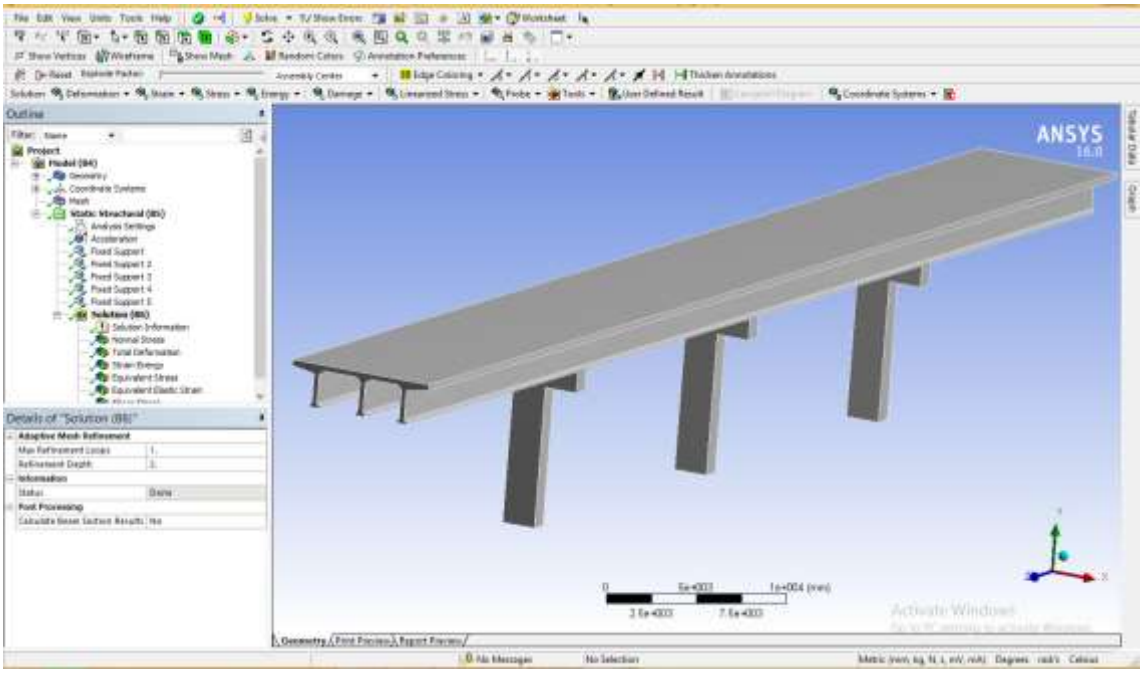
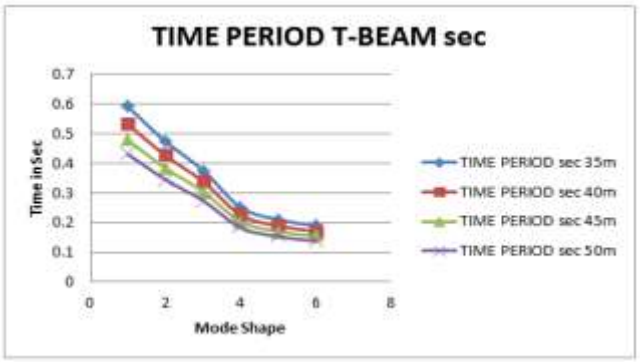


Fig 2: PSC T- Beam Bridge Structure

TIME PERIOD T-BEAM sec				
Mode Shape No.	35m	40m	45m	50m
1	0.65318772	0.587868948	0.529082	0.476174
2	0.573484848	0.516136363	0.464523	0.41807
3	0.493781976	0.444403778	0.399963	0.359967
4	0.414079104	0.372671194	0.335404	0.301864
5	0.334376232	0.300938609	0.270845	0.24376
6	0.25467336	0.229206024	0.206285	0.185657

Table 2: Time Period



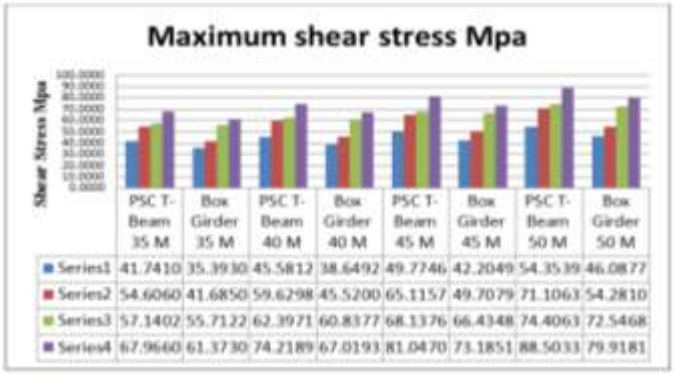
Graph 2: Time Period T-Beam

As the Above results shows that Time Period of T-Beam for span 35m, 40m 45m, 50m will be subject mode shapes 1 to 6. Whereas Time Period of 35m span is more than other spans by 10%.

D. Comparative Analysis of Bridge PSC T-Beam & Box Girder

MAXIMUM SHEAR STRESS Mpa								
Load Step	PSC T-Beam 35 M	Box Girder 35 M	PSC T-Beam 40 M	Box Girder 40 M	PSC T-Beam 45 M	Box Girder 45 M	PSC T-Beam 50 M	Box Girder 50 M
0.2000	41.7410	35.3930	45.5812	38.6492	49.7746	42.2049	54.3539	46.0877
0.4000	54.6060	41.6850	59.6298	45.5200	65.1157	49.7079	71.1063	54.2810
0.6000	57.1402	55.7122	62.3971	60.8377	68.1376	66.4348	74.4063	72.5468
0.8000	67.9660	61.3730	74.2189	67.0193	81.0470	73.1851	88.5033	79.9181

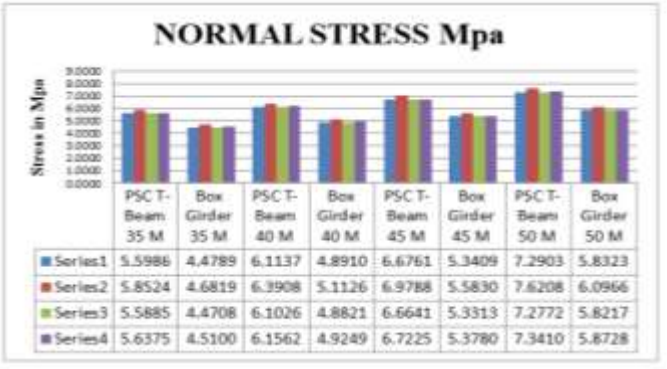
Table 5: Maximum Shear Stress



As the Above results shows that Maximum Shear Stress of PSC T-Beam & Box Girder for span 35m, 40m, 45m, 50m will be subject load steps 0.2 to 0.8. Whereas Maximum Shear Stress of PSC T beam is more than box girder in all spans by 5-10% for every load step.

NORMAL STRESS Mpa								
Load Step	PSC T-Beam 35 M	Box Girder 35 M	PSC T-Beam 40 M	Box Girder 40 M	PSC T-Beam 45 M	Box Girder 45 M	PSC T-Beam 50 M	Box Girder 50 M
0.2000	5.5986	4.4789	6.1137	4.8910	6.6761	5.3409	7.2903	5.8323
0.4000	5.8524	4.6819	6.3908	5.1126	6.9788	5.5830	7.6208	6.0966
0.6000	5.5885	4.4708	6.1026	4.8821	6.6641	5.3313	7.2772	5.8217
0.8000	5.6375	4.5100	6.1562	4.9249	6.7225	5.3780	7.3410	5.8728

Table 5.8: Normal Stress



As the Above results shows that Normal Stress of PSC T-Beam & Box Girder for span 35m, 40m 45m, 50m will be subject load steps 0.2 to 0.8. Whereas Normal Stress of PSC T beam is more than box girder in all spans by 10-15% for every load step

V. CONCLUSION

The behavior of T-beam girder and box girder proposed for bridge Superstructure of spans span 35m, 40m, 45m, 50m is studied. By conducting Dynamic analysis, it was clear that box girder is an efficient and economical girder system by optimization of cross-section as compared to T-beam girder section by comparing following static and dynamic responses

As the Above results shows that Maximum Shear Stress of PSC T-Beam & Box Girder for span 35m, 40m, 45m, 50m will be subject load steps 0.2 to 0.8. Whereas Maximum Shear Stress of PSC T beam is more than box girder in all spans by 5-10% for every load step.

As the Above results shows that Normal Stress of PSC T-Beam & Box Girder for span 35m, 40m, 45m, 50m will be subject load steps 0.2 to 0.8. Whereas Normal Stress of PSC T beam Is more than box girder in all spans by 10-15% for every load step

As the Above results shows that Time Period of Box Girder Box Girder is less than PSC T-Beam subject mode shapes 1 to 6 by 10-12%.

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