Analysis of a Deck Bridge Using Different Construction Materials

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Abstract
A Girder bridge is a bridge that utilizations braces as the methods for supporting the deck. A bridge comprises of three sections: The Foundation of projections and bearings and Substructure of projection and dock and The Superstructure (brace, bracket, or curve) and deck. A Girder bridge is likely the most usually fabricated and used bridge on the planet. Its fundamental plan, in the most improved frame, can be contrasted with a log extending from one side to alternate over a stream or river.The two sections must cooperate to make a solid, durable bridge. Prestressed Concrete is fundamentally concrete in which interior worry of reasonable extent and dispersion are presented pressure coming about because of outer load are concentrated to wanted degree. In this research work we are analyzing a girder bridge with the effect of prestressed concrete and compare it with general deck bridge. In terms of finite elemental analysis, forces and cost analysis. Here it is concluded that implementation of prestressed deck is resulting in economical, stable and load resisting member.

Keywords: Deck Bridge, Substructure, Structural Analysis, SAP2000, Prestressed Concrete, Vehicular load.

INTRODUCTION

The Superstructure is everything from the bearing cushions, up - it is the thing that backings the heaps and is the most unmistakable piece of the bridge. The Substructure is the establishment, what exchanges the heaps from the superstructure to the ground. The two sections must cooperate to make a solid, durable bridge. Pre-stressed Concrete is fundamentally concrete in which interior worry of reasonable extent and dispersion are presented pressure coming about because of outer load are concentrated to wanted degree. In this dissertation work we will analyze a girder bridge with the effect of Pre-stressed concrete and compare it with general deck bridge. In terms of finite elemental analysis, forces and cost analysis. In Bridge structures many sort of vehicles like little vehicles, light vehicles and substantial vehicles are streaming in inevitably, so primary idea of bridge is the manner by which to end up a safe under different kinds of stacking state of vehicles in a single bearing. By and large the vehicles are stream in structure, the heap of vehicles are Both side scatter in 45 degree from edge of feel burnt out on vehicle in both longitudinal and parallel bearings implies ranges heading and length of Structure headings. So this scattering of load is specifically influenced to best of bridge (Deck section) and after that longitudinal support and in addition cross brace. After that the long individual from bridge superstructure like brace is transported the heap towards the substructure of Bridge and afterward establishment to soil. The plan of superstructure is by and large utilized with RCC, however now a days in length range individual from Bridge utilizing with PSC, forget significantly more preferred standpoint and security of Structure.

Finite element analysis, using the finite element technique (FEM), is a result of the computerized age, going to the fore with the approach of advanced PCs in the 1950s. It takes after on from framework strategies and finite distinction techniques for analysis, which had been produced and utilized some time before this time. It is a PC based analysis device for reproducing and breaking down building items and frameworks. FEA is a to a great degree strong science outline utility, however one that ought to be utilized with awesome consideration. For instance, it is conceivable to coordinate a framework with PC helped plan programming, prompting a kind of ignorant push-catch analysis in the outline procedure. Lamentably, titanic mistakes can be made at the push of a catch, as this notice clarifies.

2. LITERATURE REVIEW

Neeladharan. C et al. (2017) (optimization and analysis of cable suspension bridges) In general, a suspension bridge, the pinnacle of bridge technology is highly capable of spanning up to 7000 feet managing such feat dealing with the two forces namely compression and tension. The authors report is based on a Suspension Cable Bridge of 1000m span with single lane road where the intensity of road was captured as 20 number of vehicles each loading with 350 KN using the application SAP1000. The maximum bending moment along with the values of shear force were analyzed on the application software SAP 1000 and a detailed comparison was done with the manual design of Suspension Cable Bridge.

Shrivastava et al. (2017) (**analysis of Box culvert minor bridge under the action of vehicular and seismic loads**) The author demonstrated the structure analysis and design of RCC box type minor bridge using MDR Method along with computational approach using IRS-CBC codes. The results generated from the author's analysis proved that the maximum design forces developed for the loading conditions when the top slab was subjected to the dead load and live load and sidewall was subjected to earth pressure and surcharges when the culvert was empty. While estimating the positives and negatives it was observed that Computational method (Stadd.pro) was comparatively more competent than Moment Distribution Method (MDM) in terms of time consumption along with efficiency of results.

Manoharet al. (2018) (Finite Element Analysis of slabs, cross girders and main girders in RC T-Beam Deck Slab Bridge) Studied that the analysis of a single span two lane T-beam bridge is carried out by varying the span of 8m, 28m for analysis of girders and size of slab 3x2, 3.5x2.5, 4x3, 4.5x3.5, 5x4m by varying the spans of the bridges, deck slab depth as 200,225,250,275,300mm using software SAP 2000. In order to obtain maximum bending moment shear force and deflection, the bridge models are subjected to the IRC class AA Tracked, IRC class 70R and IRC class A loading system. The cross girders and deck slab of varying depth for different live loadings also presented in the study. It can be observed that with the increase in the span shear force, bending moment and deflection in the girder increases and also the models subjected to the IRC Class AA Tracked vehicle gives higher values of shear force, bending moment and deflection in comparison to those subjected to the IRC Class 70 R and IRC class A loadings.

3. METHODOLOGY

Following steps are required in a sequence for proper completion:

Step-1 Determine the site condition and position for casting bridge.

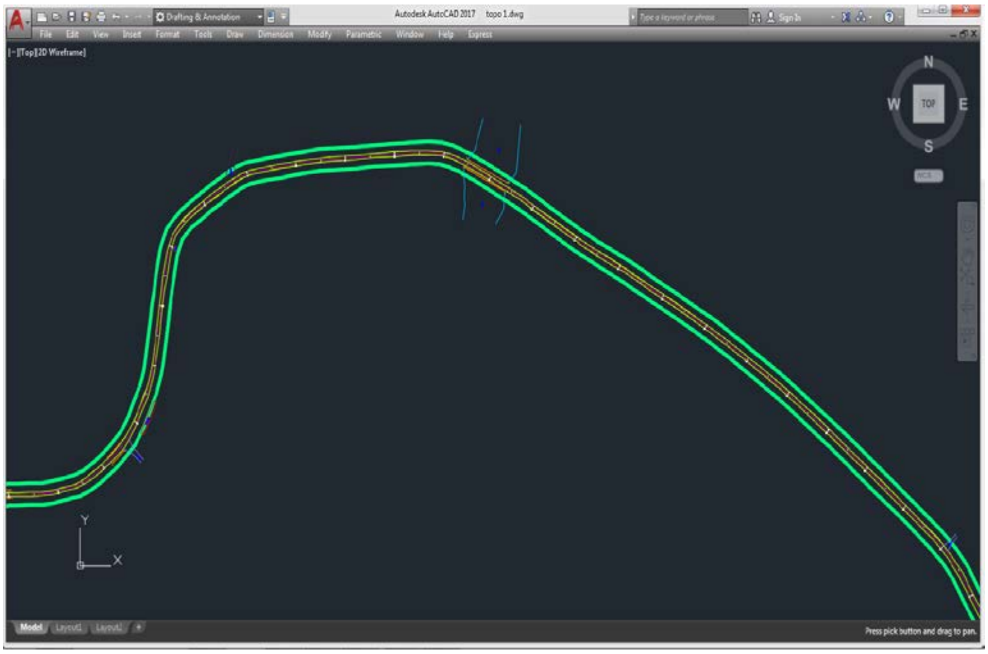

Fig 1: Road Plan.

Step-2 Hydraulic design to determine required Bridge length and profile grade.
Step-3 Preparation of geometry of Bridge in SAP 2000

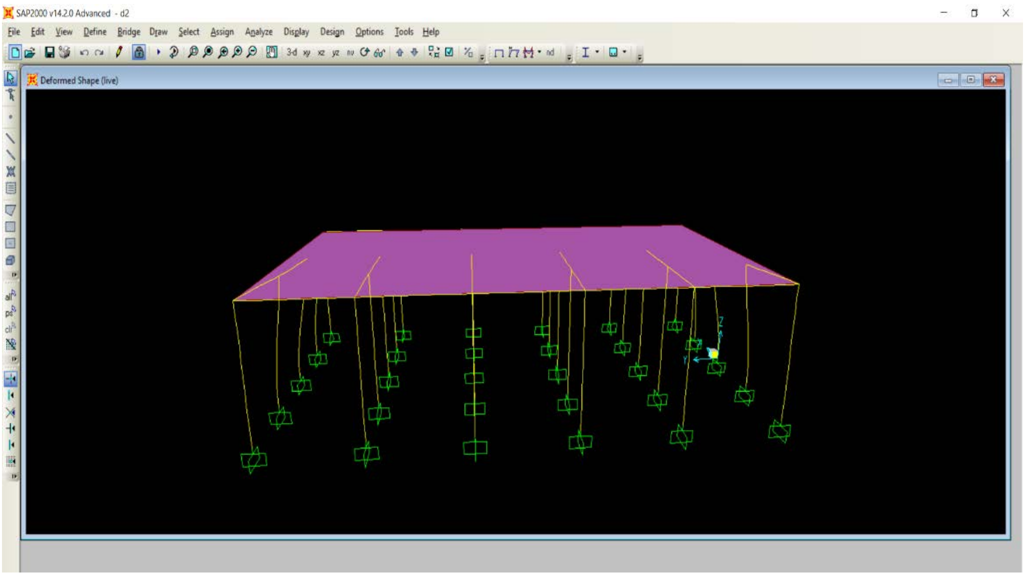

Fig 2: Pre-stressed Deck Modelling.

Step-4 Assigning of Loads and section properties with support conditions.
Step-5 Assigning hydraulic load and vehicle load as per I.R.C.
Step-6 Analysis (finite element)
Step-7 assigning Pre-stressed deck

ISSN: 2581-3404 (Online)
International Journal of Innovative Research in Technology and Management, Vol-4, Issue-6, 2020.

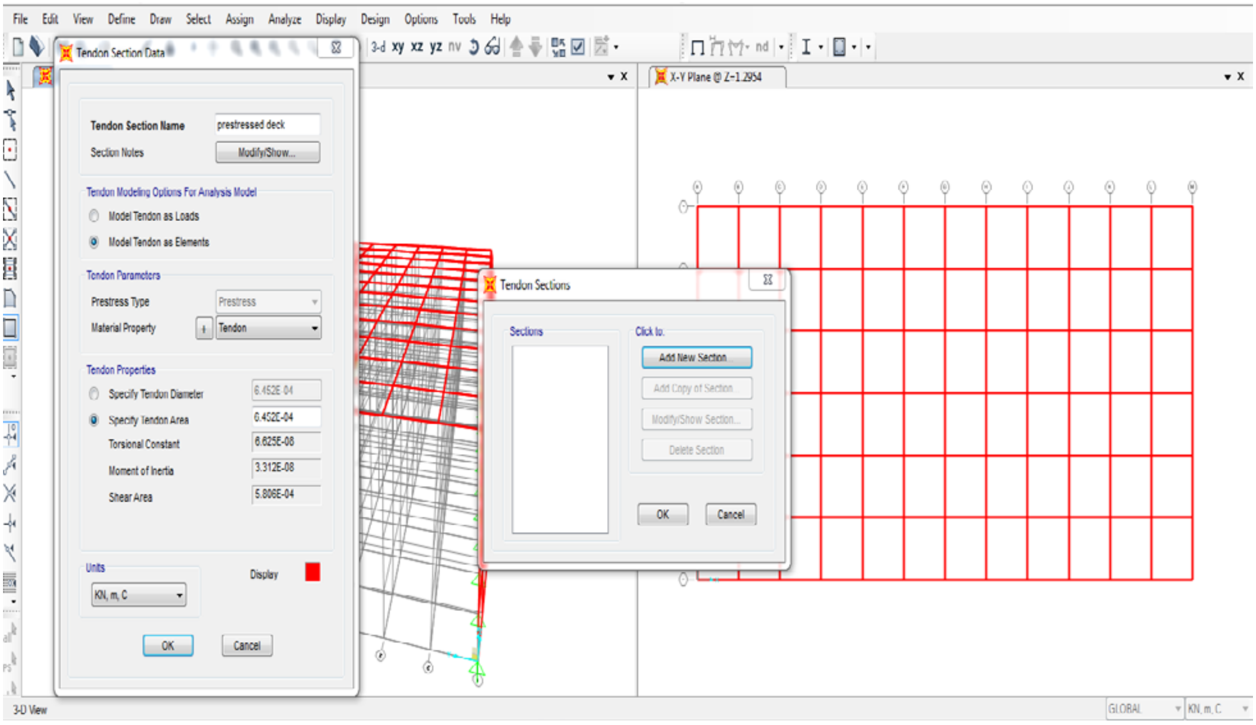

Fig 3: Assigning Pre-stressed deck.

4. GEOMETRIC PROPERTIES

Table no 1: Geometric Properties of Structure.

Sr. no.	**Description**	**Values**
1	Bridge length	30 meter
2	Bridge width	12.50 meter
3	No. of lanes	Two
4	Carriageway length	6.25 meter
5	Slab thickness	2.5 meter
6	Pier height	6.5 m
7	Size of Girder	650 x 800 mm
8	Size of Pier	1.0 x 1.2 m
9	Support section	Fixed

5. Material properties

In the table 2.Below, description of material and their specifications are mentioned.

Table 2: Description of material.

s. no	**Description**	**Values**
1	Material property	Values
2	Grade of concrete	M-40
3	Young’s modulus of concrete, E_c	$2.17x10^4$ N/mm^2
4	Poisson ratio	0.17
5	Tensile Strength, Ultimate steel	500 MPa
6	Tensile Strength, Yield steel	250 MPa
7	Elongation at Break steel	70 %
8	Foam concrete	24.5 MPa
9	Hinges (tendons)	Fe 500
10	Jacketing tension strength	10 kN

6. SELECTION OF THE LOAD CONDITION

In the table 3 below, load combinations as per I.S 875-I for bridge is provided.

Table 3: Loadings and Combinations.

S. No.	**Loading Type**	**Standard**
1	Dead Load	I.S. 875-I
2	Live Load	I.S. 875-II
3	Vehicle Load	I.R.C. 70R Class Loading
4	Combination 1	1.5 DL + LL
5	Combination 2	1.2 DL + LL + Vehicular load
6	Combination 3	0.9 DL+1.2 LL+1.2 Vehicular load

ISSN: 2581-3404 (Online)
International Journal of Innovative Research in Technology and Management, Vol-4, Issue-6, 2020.

7. RESULTS

Finite element results

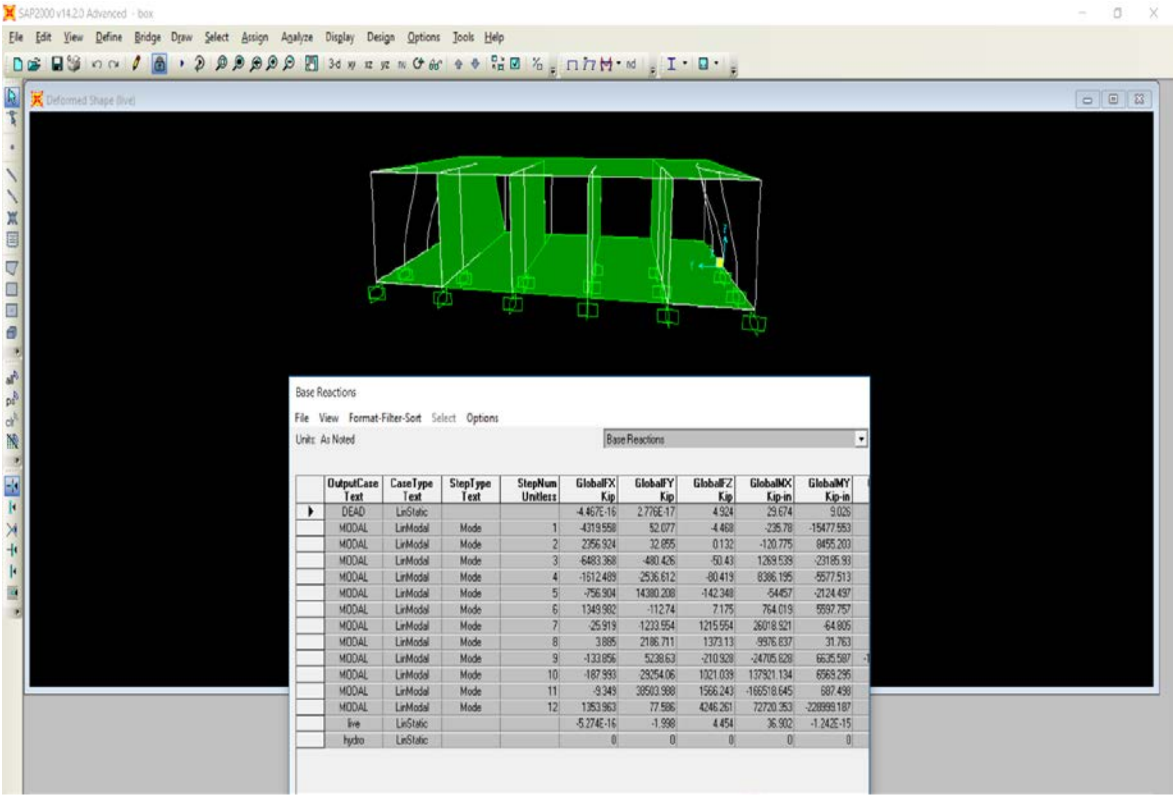

Fig 4: FEM.

A. Maximum Bending Moment

Table 4: Maximum Bending Moment.

Max. bending moment in Pier			
Deck Bridge (RCC)	**Deck Bridge (Foam Concrete)**	**Pre-stressed deck bridge**	**Pre-stressed deck bridge (Foam Concrete)**
387.98	**382.54**	**367.09**	**359.09**

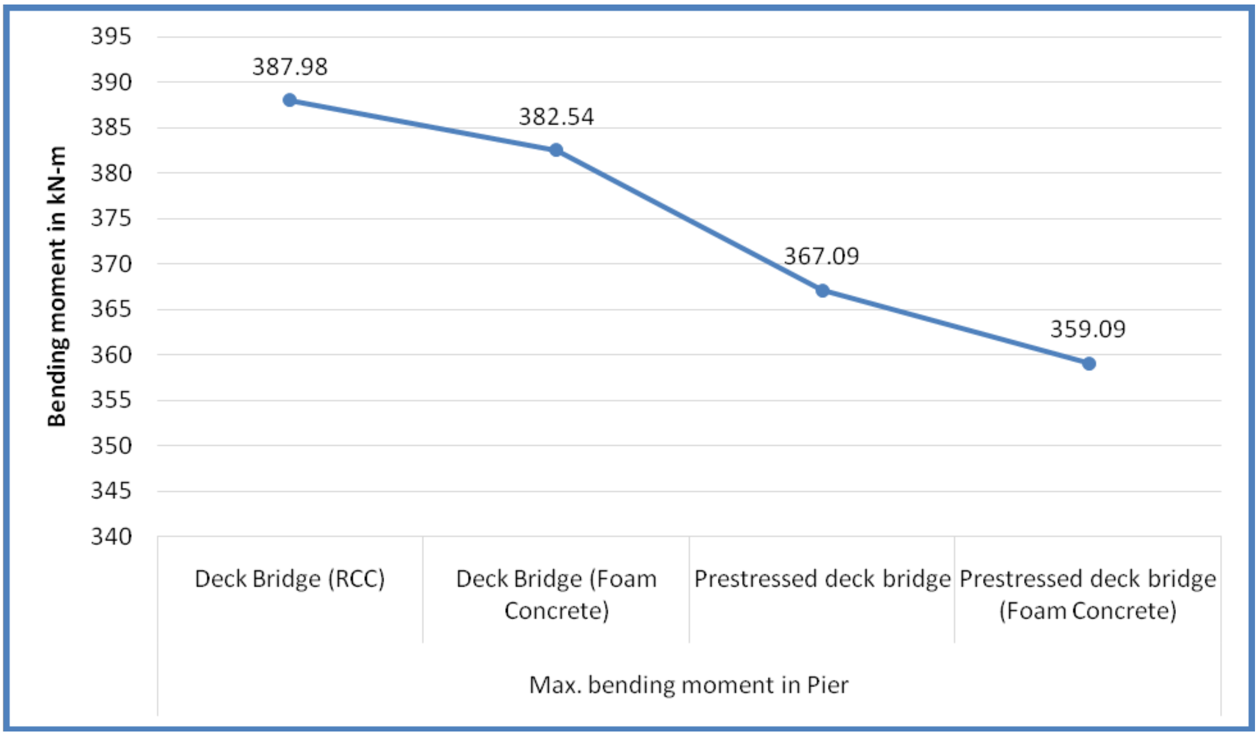

Fig 5: Maximum Bending Moment.

B. Maximum Shear Force

Table 5: Maximum Shear Force.

Max. Shear Force in Pier			
Deck Bridge (RCC)	**Deck Bridge (Foam Concrete)**	**Pre-stressed deck bridge**	**Pre-stressed deck bridge (Foam Concrete)**
543.23	**501.34**	**520.34**	**500.21**

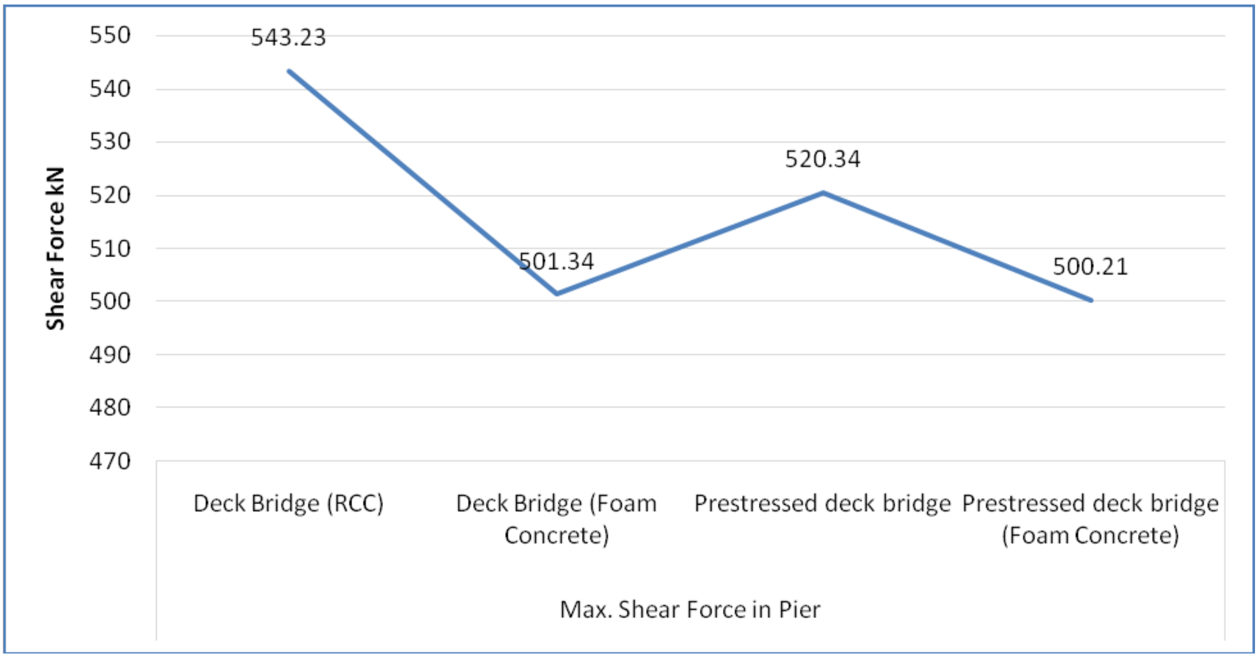

Fig 6: Shear force.

8. CONCLUSIONS

Findings of the project can be concluded as below:

1. In this comparative analysis it is clearly stated that Pre-stressed Bridge (Foam concrete) is more stable in resisting load.
2. In this study Hydraulic calculation is determined using topography sheet available as per Indian standard using dickens formulae.
3. In this study we manually calculate the total discharge and assigned it in software.
4. It is concluded that in terms of cost Deck type bridge R.C.C. is comparatively more costly than Pre-stressed Bridge.
5. I.R.C. loading is applied for justification of vehicular load analysis.

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