IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

A Comparative Study Of T-Beam Bridge & Slab Bridge For Varying Span Length

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Abstract: T-beam bridge are one of the most commonly used type of bridge and hence it is necessary to constantly study, update analysis techniques and design methodology. Structurally they are simple to construct and maintain. Hence they are preferred over other type of bridge when it comes to providing connectivity within short distances. The aim of our study was to determine the variation and suitability of two different configuration of these bridges, namely ordinary deck slab supported on girder and T-beam configuration of deck slab. In this study we have considered span length of 10m, 15m & 20m. The deck slab has been conventionally analysed for IRC class AA Loading. Seismic load of zone III is applied on structure. The process was to made faster by analysing the structure on STAAD Pro. and the results of maximum bending moment, shear force & deflection values arising from the dead load, live load, vehicle load & seismic load. The conclusive results provide us with the best option, out of the two configuration for the varying span considered in the study. From this study, T-beam configuration of deck slab proves to be effective than ordinary deck slab supported on girder.

***Index Terms* - T-beam Bridge, Slab Bridge, Class AA Loading, Staad pro, Seismic Analysis.**

I. Introduction

A bridge is a structure built to span a physical obstacle (such as a body of water, valley, road, or rail) without blocking the way underneath. It is constructed for the purpose of providing passage over the obstacle, which is usually something that is otherwise difficult or impossible to cross. There are many different designs of bridges, each serving a particular purpose and applicable to different situations.

Designs of bridges vary depending on factors such as the function of the bridge, the nature of the terrain where the bridge is constructed and anchored, and the material used to make it, and the funds available to build it.

Highway bridges have been designed and built since the advent of the wagon, and the general structure types used and described in this chapter are not likely to change. There are many areas where these structure types can be improved—hence the need for future research. The research needs for highway bridges (and for that matter, bridges of all uses) fall into five general areas:

- Optimize structural systems
- Develop ways to extend service life
- Develop systems to monitor bridge conditions
- Develop details and methods to accelerate bridge construction
- Develop a full life cycle approach to bridge data management

II. Slab Bridge

Slab bridges are generally the simplest bridge cross section. It can be used for single span and multi-span bridges with span length up to 12m. For short spans, one solid reinforced concrete slab spans between two abutments with no intermediate supports. Simple reinforcement design is enough to carry the load. For longer spans, care needs to be taken to mitigate the extra self-weight introduced by the thicker slab. This can be achieved by adding pre-stressing bars to control the crack and deflection, and/or introducing "voids" into the slab to reduce its deadweight.

Figure 1:- Showing Slab bridges

III. T- BEAM BRIDGES

T- beam bridges have cast-in-place, reinforced concrete beams with integral deck sections to either side of the tops of the beams. In cross section the beams are deeper than their deck sections, which produces the T-shape that gives them their names. The primary reinforcing steel is placed longitudinally in the bottom of the beam to resist the tension (the forces that would pull apart) on the beam. The deck that forms the top part of the T-shape is subject to compression (forces that squeeze or push it together). As concrete resists compression, it is concentrated in the deck along with less substantial reinforcing steel laid across the width of the bridge.

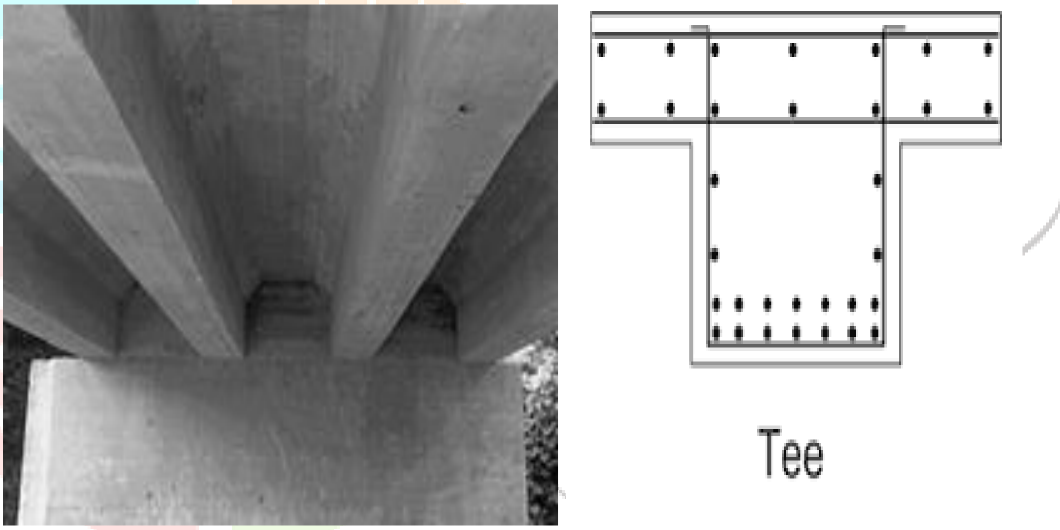

Figure 2:- Showing T-Beam Bridge

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IV. OBJECTIVES

The objectives of the present study are-

- To understand the concepts of Slab bridge and T-Beam bridge.
- To prepare Slab Bridge and T-Beam Bridge Model using Staad Pro V8i
- To analyse Slab bridge and T-Beam Bridge using the standard codes, principles and Staad Pro V8i.
- To carry out study by comparing the results of the Slab bridge and T-Beam Bridge.

V. METHODOLOGY

Below is the following methodology used.

- Study of IRC Codes and IS codes for design & analysis of Bridge
- Modelling of Slab Bridge & T-beam bridge on STAAD Pro Software.
- Analysing the Structure for moving Load & Seismic Load
- Computing the result & comparing
- Concluding the best type of bridge.

VI. DETAILS OF THE STRUCTURE

This includes all the details required by the designer for carrying out analysis

- Grade of concrete (Superstructure)-M30
- Grade of steel-HYSD Bar as per IS 1786 Fy=500MPa
- Length of Bridge- 30m
- Span – 10m
- Overall Width – 12 m
- Percentage of camber- 2.5%
- Cover-75 mm for foundation and 40mm elsewhere
- Nature of traffic (live load)

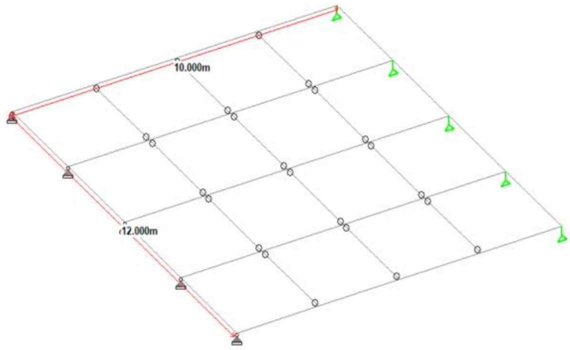

Figure 3:- Plan of T-beam bridge

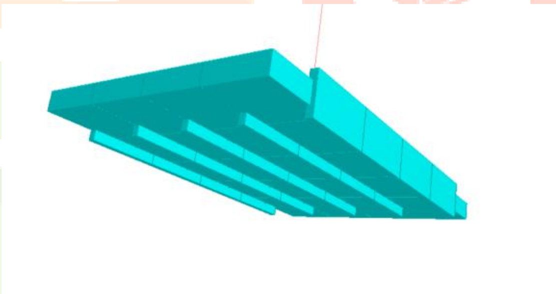

Figure 4:- 3D Model of T-Beam Bridge

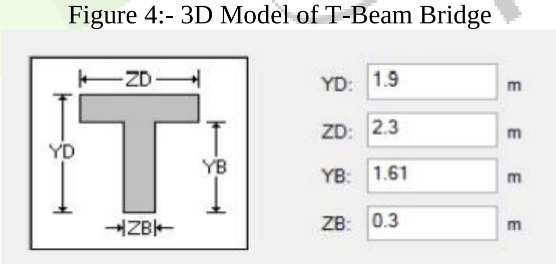

Figure 5:- Cross-section of T-beam bridge

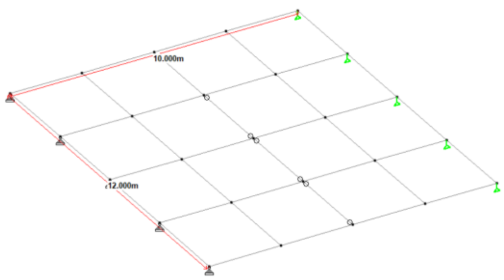

Figure 6:- Plan of Slab bridge

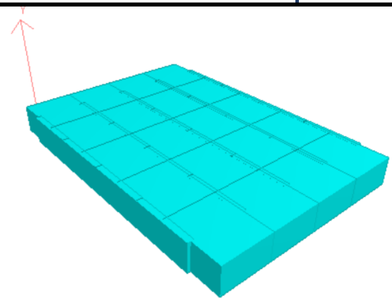

Figure 7:- 3D Model of Slab Bridge

VII. LOAD APPLIED

The Loads applied on the structure is

- Dead Load:-

1. Selfweight

2. Crash Barrier Load:- 15.636 kN/m

- Moving Load:- As per IRC Class AA Loading

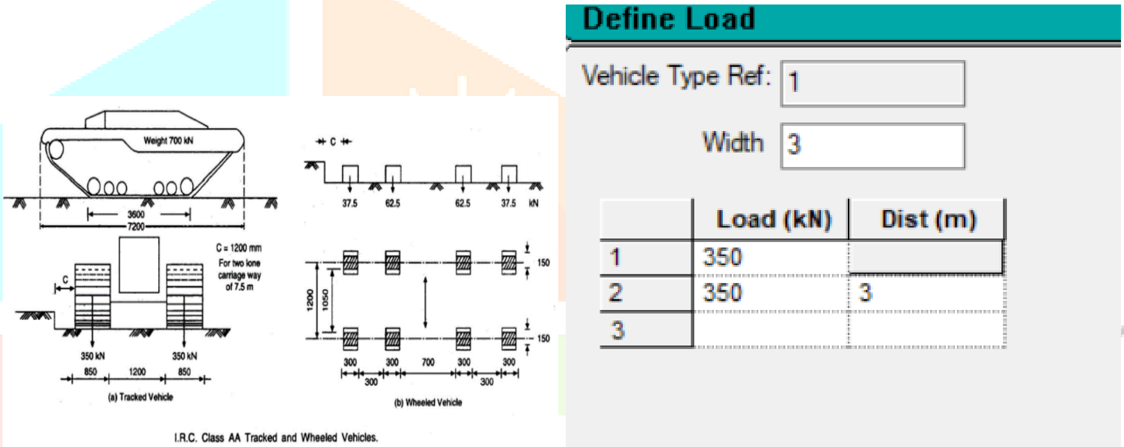

Figure 8:- Moving Load Applied on Staad Pro.

VIII. SEISMIC LOAD PARAMETERS

The seismic parameters are applied as per IS 1893:2016

- Zone:- Zone III (Factor : 0.16)
- Response Reduction Factor:- 5
- Importance factor:- 1.5
- Type of soil :- Hard Soil
- Type of Structure :- RCC structure.

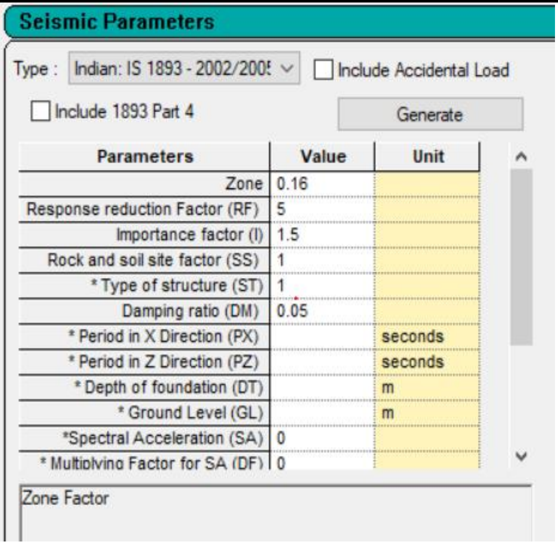

Figure 9:- Seismic Parameters applied in STAAD pro.

IX. RESULTS

The following are the results obtained from the analysis of T-beam bride & Slab bridge.

1. Comparison of Maximum bending Moment

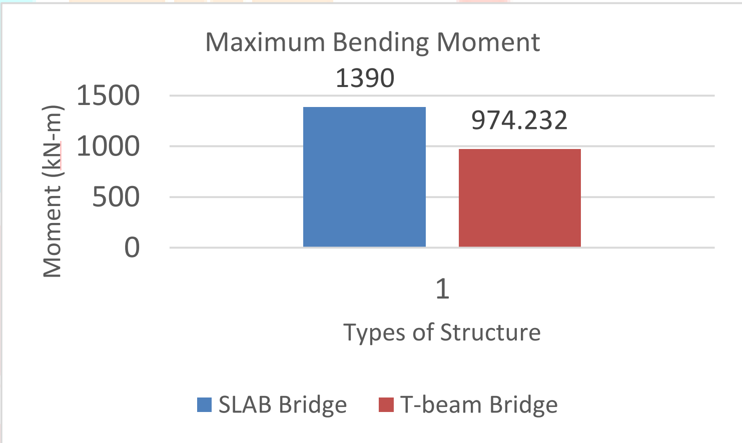

Figure 10:- Graph of Bending Moment

2. Comparison of Maximum Shear force.

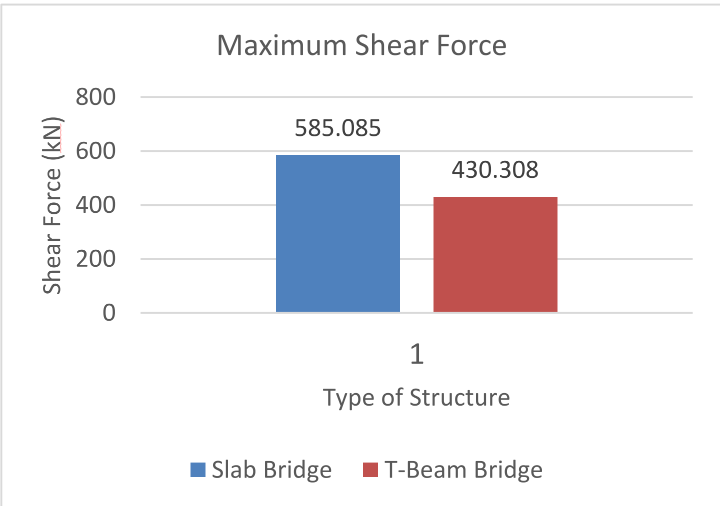

Figure 11:- Graph of Shear Force

3. Comparison of Deflection

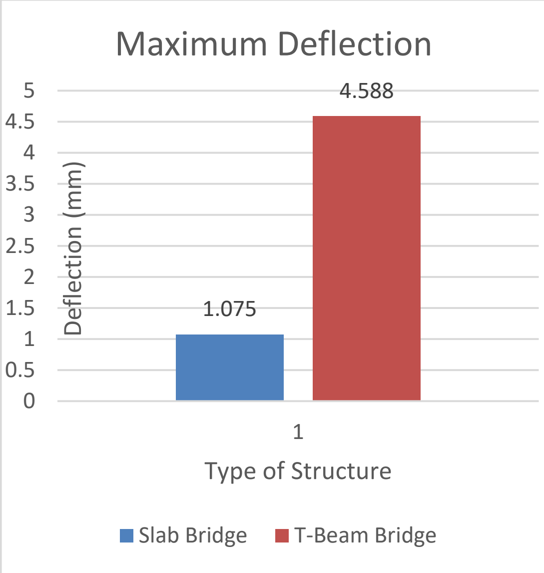

Figure 12:- Graph of Deflection

4. Comparison of Maximum Reaction

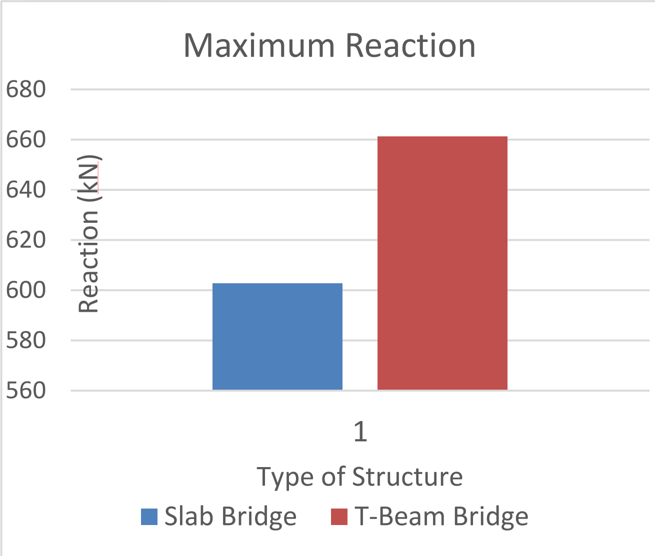

Figure 13:- Graph of Reaction

X. CONCLUSION

From the analysis of the bridges on STAAD Pro & results carried out

It was found that

1. The result for Bending Moment & Shear Force shows the T-beam bridge has effective results as compared to Slab Bridge

2. The result of Maximum Deflection shows a slight change in the behaviour as the slab bridge has les deflection than T-beam bridge

3. The maximum reaction at the support of the bridge have difference of more than 26 %

4. Overall the results shows the T-Beam bridge is 25-30% less values as compared to Slab Bridge.

5. Hence the T-beam bridge which is widely used for construction purpose shows better results than the Slab bridge.

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