

Planning and Design of 2 Lane T-Beam Bridge At Attumanpuram

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ABSTRACT: A bridge is a structure providing passage over an obstacle without closing the way beneath. The required passage may be road, a railway, pedestrians, a canal, a pipeline. T -beam bridge decks are one of the principal types of cast in place concrete decks. T beam decks consist of a concrete slab integral with girders. The finite element method is a general method of structural analysis in which the solution of a problem in continuum mechanics is approximated by the analysis of assemblage of finite elements which are interconnected at a finite number of nodal points and represent the solution domain of the problem. The T beam bridge is analyzed as a three dimensional structure using finite element plate for the deck slab and beam elements for the main beam using software STAAD Pro. The T beam bridge is by far the most commonly adopted type in the span range of 10 to 25 m. This project is based on the planning and design of a T beam bridge. This is a proposed project at Attumanpuram at Vithura by PWD, Trivandrum constructed across the river Kallar at a span of 15m.

KEYWORDS: T-beam, I. R.C Loading, FEM, STAAD Pro V8i.

I. INTRODUCTION

This project is based on the planning and design of a Bridge at Attumanpuram at Vithura by Kerala PWD, Trivandrum constructed across the river Kallar at a span of 15m. A bridge is a structure providing passage over an obstacle without closing the way beneath. The required passage may be road, a railway, pedestrians, a canal, a pipeline. T -beam bridge decks are one of the principal types of cast in place concrete decks. T beam decks consist of a concrete slab integral with girders. There are many different designs that each serve a particular purpose and apply to different situations. Designs of bridges vary depending on the function of the bridge, the nature of the terrain where the bridge is constructed and anchored the material used to make it, and the funds available to build it. A bridge is a structure providing passage over an obstacle without closing the way beneath. The finite element method is a general method of structural analysis in which the solution of a problem in continuum mechanics is approximated by the analysis of assemblage of finite elements which are interconnected at a finite number of nodal points and represent the solution domain of the problem. The T beam bridge is analyzed as a three dimensional structure using finite element plate for the deck slab and beam elements for the main beam using software STAAD Pro. The T beam bridge is by far the most commonly adopted type in the span range of 10 to 25 m.

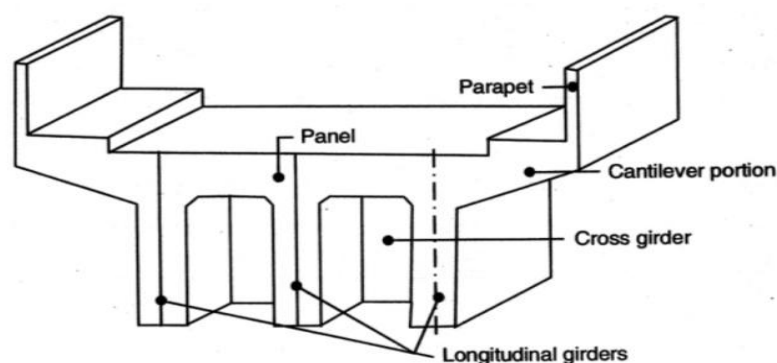


Figure 1: Components of T Beam



II. RELATED WORK

Prof. M.G Kalayanshetti (2015) has made a study “Alternative forms of 2 lane T beam bridge superstructure”, concerned with effectiveness of cross beams on T beam bridge. Cross beams are provided mainly to stiffen the girders and to reduce torsion in the exterior girders.

Sandesh Upadhyaya.K (2016) made a study on the paper “A comparative study of T beam bridges for varying span lengths”. He takes into account of all components of a T beam bridge such as cantilever slab, girders and cross beams. A complete FEM analysis of T Beam Bridge with ordinary deck slab supported on girders was performed. FEM analysis was validated conventionally using Courbon’s Method, FEM analysis for both the configurations of T beam bridges were extensively studied based on result of maximum shear force, maximum bending moments and maximum deflection values.

III. METHODOLOGY

The project gives an idea about the analysis and design of Deck Slab Bridge using IRC Loading 70R by STAAD.Pro V8i. Here the model is being designed as per IRC 70R loading which is applicable on all roads on which the permanent bridges and culverts can be constructed. Analysis and Design process by STAAD Pro determines the performance of Structures. The designing by the software saves the design time and by this way we can check the safety of the structure very easily. The sections are also designed for shear and torsion by providing the appropriate reinforcement as per the design procedure in IRC 21:2000.

Steps to model the bridge:

1. Establish layout of the bridge.
2. Define deck section and diaphragm properties.
3. Define lane properties.
4. Define bearing properties.
5. Define foundation and abutment properties.
6. Assigning values for bridge object.
7. Define load and vehicle classes.
8. Define load pattern and load cases.
9. Run analysis and obtain results.

IV. SPECIFICATIONS

| Specifications | T Beam |
|----------------------------|--|
| Span of the bridge | 15m |
| Number of lane | 2 |
| Lane width | 3.6m |
| Centreline offset | 1.8m |
| Number of interior girders | 4 |
| Slab thickness | 0.2m |
| Size of T beam | 1.4m x 0.3m |
| Size of abutment | 1.2m x 3.6m |
| Vehicle IRC | Class AA, Class 70R (Tracked vehicle) |

Table 1: Specification of T Beam



V. EXPERIMENTAL RESULTS

Table 2: Reinforcement details of Long girder (15m)

| Section (Hogging) | Tension bar provided | Depth of section (mm) | Moment capacity of section (kNm) |
|--------------------|----------------------|-----------------------|----------------------------------|
| Section at 0.000 m | 4T20 | 140.03 | 589.39 |
| | 8T20 | 280.07 | 1126.20 |
| Section at 7.50m | 3T20 | 105.03 | 446.97 |
| Section at 15m | 4T20 | 140.03 | 589.39 |
| | 8T20 | 280.07 | 1126.20 |

Table 3: Reinforcement details of Short girder (3.6m)

| Section (Sagging) | Tension bar provided | Depth of section (mm) | Moment capacity of section (kNm) |
|-------------------|----------------------|-----------------------|----------------------------------|
| Section at 0.720m | 3T20 | 105.03 | 446.97 |
| Section at 1.800m | 3T20 | 105.03 | 446.97 |
| | 6T20 | 210.05 | 864.37 |
| Section at 2.880m | 3T20 | 105.03 | 446.97 |
| Section at 3.600m | 3T20 | 105.03 | 446.97 |

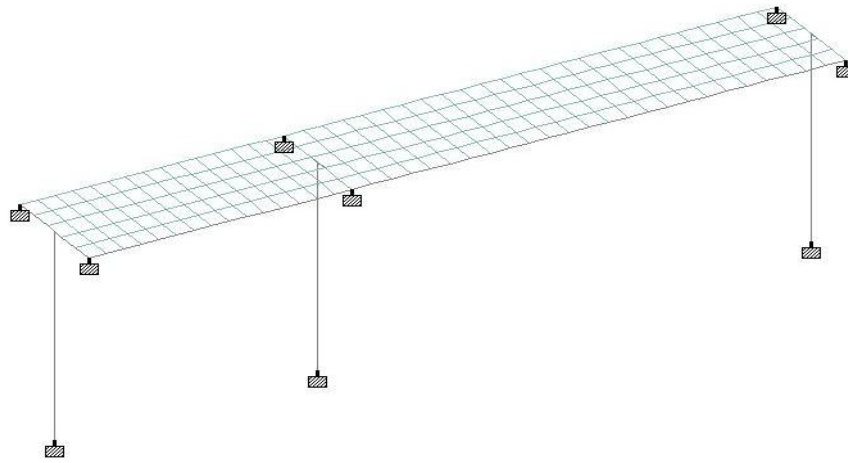


Figure 2: Bridge Deck Model

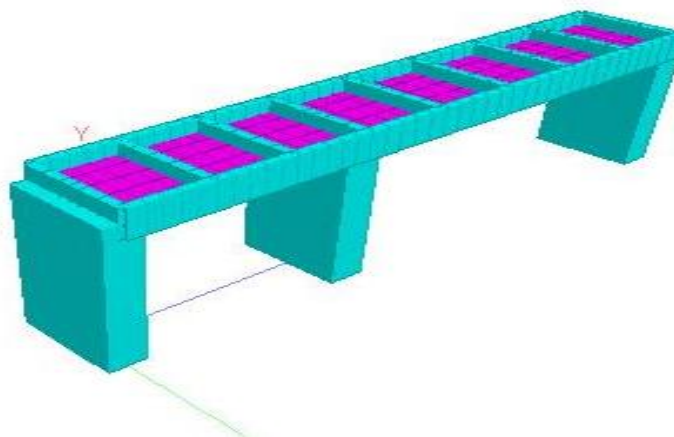


Figure 3: 3D View

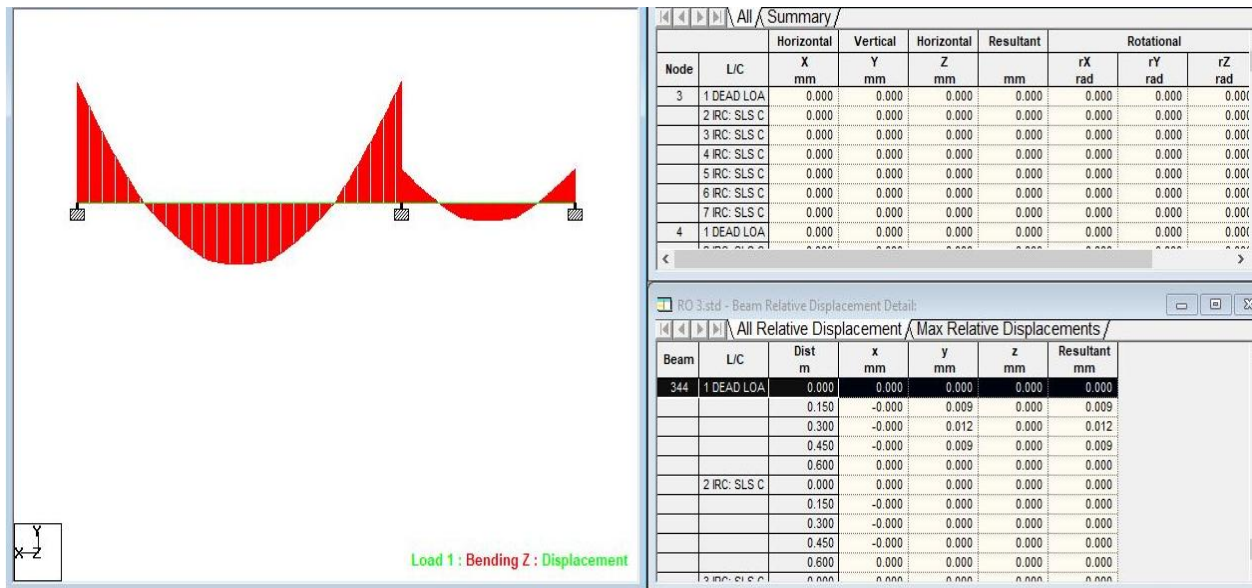


Figure 4: Front View of Bending Moment Diagram

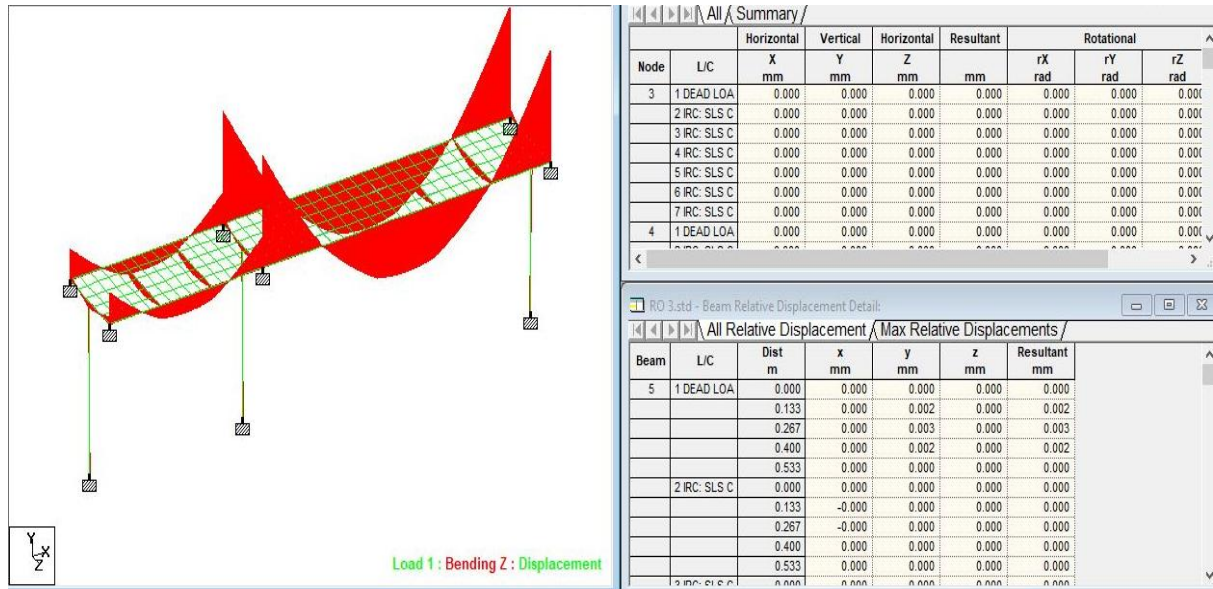


Figure 5: Side View of Bending Moment Diagram

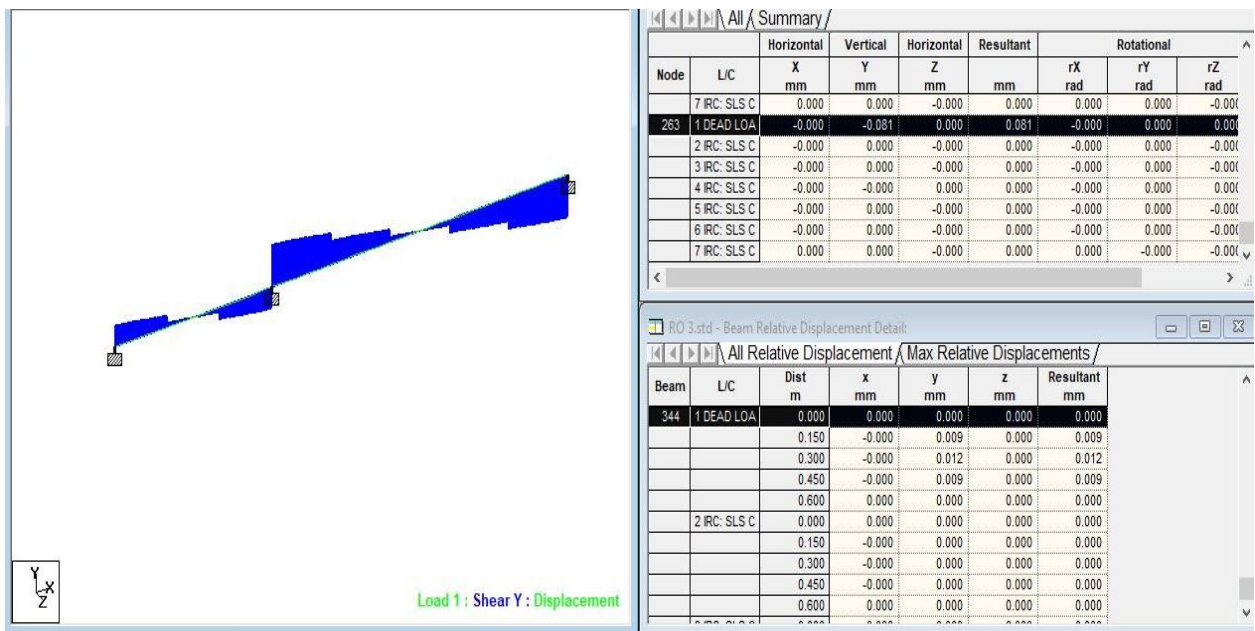


Figure 6: Shear Force Diagram

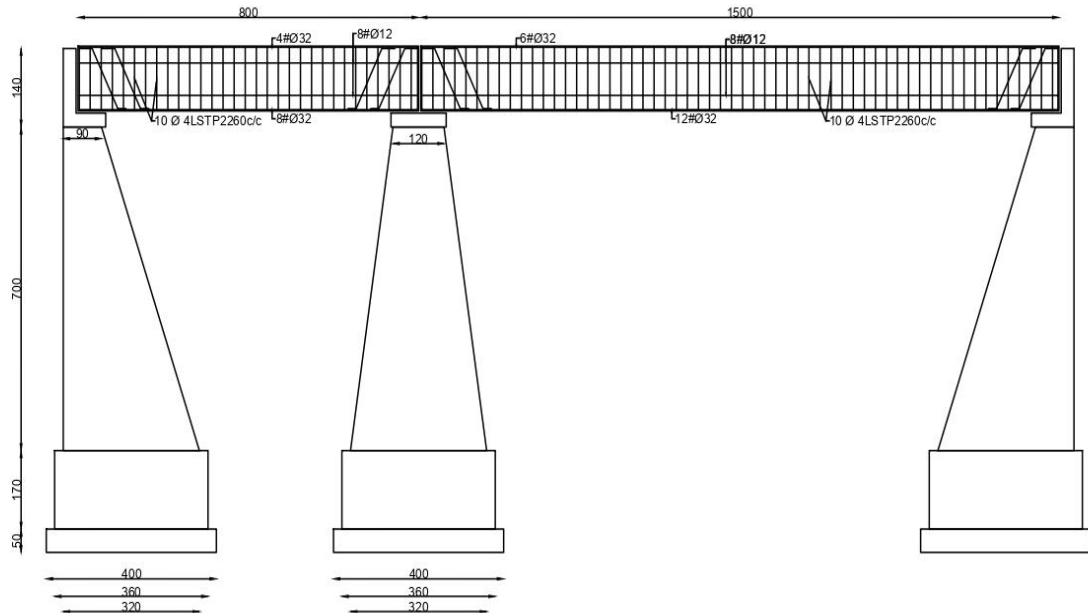


Figure 7: Cross Section of the Bridge

VI. CONCLUSION

This project is based on the planning and design of a Bridge. This is a proposed project at Attumanpuram at Vithura by Kerala PWD, Trivandrum constructed across the river Kallar at a span of 15m. A bridge is a structure providing passage over an obstacle without closing the way beneath. T-beam bridge decks are one of the principal types of cast in place concrete decks. T beam decks consist of a concrete slab integral with girders. There are many different designs that each serve a particular purpose and apply to different situations. Designs of bridges vary depending on the function of the bridge, the nature of the terrain where the bridge is constructed and anchored the material used to make it, and the funds available to build it. Bridges connect destinations. So proper planning to adapt the bridge into the natural ecosystem has to be done. A bridge is a structure providing passage over an obstacle without closing the way beneath. The finite element method is a general method of structural analysis in which the solution of a problem in continuum mechanics is approximated by the analysis of assemblage of finite elements which are interconnected at a finite number of nodal points and represent the solution domain of the problem. The T beam bridge is by far the most commonly adopted type in the span range of 10 to 25m. Bridge should design by considering traffic condition & water logging problem. Computation of bending moment, shear force and tensile force are done. Abutment laterally supports the embankment which serves as an approach to the bridge. Check for stability and check for overturning are satisfied. Therefore given section of abutment is adequate. The decking is considered as the road or the rail surface of the bridge. The decks are supported by the girders or huge beams. Design of deck slab and kerb are done. Design of Bridge at Attumanpuram is done and is satisfied.

REFERENCES

1. Chapman and Balakrishnan, "Behaviour of seventeen simply supported composite T beams", www.istructe.org, issue-11(1964).
2. R Al-Mahaidi, C.Giaccio, "Strength and Load Distribution Analysis of a T Beam Bridge Deck" (1997).
3. R.Shreedhar Spurti Mamadapur, "Analysis of T beam bridge using Finite Element Method", Volume 2, Issue 3, (2012).
4. Prof. M.G Kalayanshetti, "Alternative forms of 2 lane T beam bridge superstructure", Volume 5, Issue 3, (2015).



5. Y. Yadu Priya and T Sujatha, “Comparative Analysis of Post Tensioned T beam bridge deck by Rational method and FEM”, Volume 6, Issue 9, (2016).
6. Sandesh Upadhyaya.K, “A comparative study of T beam bridges for varying span lengths”, Volume 5, Issue 6, (2016).
7. IRC 112 2011, IRC 6 2010, IRC 8 1987, IRC 21 2000.
8. IRC 2911 2010, IRC 78 2014.
9. IS 456: 2000.
10. Anushia K Ajay, Asha U Rao, N.A Premanand Shenoy, “Parametric study on T beam Bridge”, Volume 8, Issue 6, (2017).
11. Manohar.R, B.S Suresh Chandra, “Finite Element Analysis of slabs, cross girders and main girders in RC T Beam Deck Slab Bridge”, Volume 5, Issue 8, (2018).