ISSN : 2455-9679
Impact Factor : 4.256

ijrtsm

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"DESIGN AND ANALYSIS OF RCC T-BEAM FOR CIVIL STRUCTURE BY USING FEA"

Deo Prakash [1]***, Rachana Bajaj*** [2]

[1]*M. Tech Scholar, Department Of Civil Engineering, Rabindra Nath Tagore University, Raisen (M.P.)*

[2]*Assistant Professor, Department Of Civil Engineering, Rabindra Nath Tagore University, Raisen (M.P.)*

ABSTRACT

Recent trends of structural mechanics applications in finite element analysis demonstrate an increasing demand for efficient analysis tools. This paper presents finite element analysis for modeling T-beams structure used in building service system (mechanical, electrical, communications, and plumbing). The experimental program reported in this paper tested T-beams to failure effect on various beam behaviors. Using ANSYS, finite element models were developed to simulate beam deflection behavior. In reality, uncertainties exist in a system and environment that may make the application of deterministic design unreliable which causes the values of the variables that are acting on the system cannot be predicted with certainty. The 'ANSYS' model accounts for the nonlinearity, such as, bond-slip of longitudinal reinforcement, post-cracking tensile stiffness of the concrete, stress transfer across the cracked blocks of the concrete. Here T Beam –I and T beam – II used so by using FEA analysis here find out T Beam –II is best compare to exiting T beam –I. So this beam can be recommended for further research.

Keyword*: Analytical, Study, T-Beam, ANSYS.*

I. INTRODUCTION

Reinforced concrete structures are largely employed in engineering practice in a variety of situations and applications. In most cases these structures are designed following simplified procedures based on experimental data. Although traditional empirical methods remain adequate for ordinary design of reinforced concrete members, the wide dissemination of computers and the development of the finite element method have provided means for analysis of much more complex systems in a much more realistic way. The main obstacle to finite element analysis of reinforced concrete structures is the difficulty in characterizing the material properties. Much effort has been spent in search of a realistic model to predict the behaviour of reinforced concrete structures. Due mainly to the complexity of the composite nature of the material, proper modelling of such structures is a challenging task. Despite the great advances achieved in the fields of plasticity, damage theory and fracture mechanics, among others, an unique and complete constitutive model for reinforced concrete is still lacking. The shear failures in reinforced concrete (RC) structures are highly brittle when compared with the flexural failures. The addition of chopped steel fibers in the concrete matrix is effective in mitigating the brittle failures of RC structures. The addition of fibers in the matrix improves the strength and post cracking tensile stiffness of the concrete. The chopped fibers induce confinement effect in concrete matrix, which contributes to the increase in the strength characteristics of concrete. The toughening mechanisms, such as, fiber pullout, fiber bridging or fiber fracture at crack interface improves the post cracking tensile stiffness of the matrix. Thus, the presence of fibers increases the strength and results in a relatively ductile type of failure of RC beams. In the literature, the modeling of various effects due to the addition of fibers in RC structures has not been attempted extensively .The present study addresses this lacunae and reports the details of the finite element analysis of eleven shear critical partially prestressed concrete T-beams having steel fibers over partial or full depth. The finite element

ISSN : 2455-9679
Impact Factor : 4.256

(FE) analysis of the T-beams has been carried out in the 'ANSYS' program. The predicted results, namely, loads, deflections and cracking behavior using the 'ANSYS' model have been compared with the corresponding test data
T-beams are formed when reinforced concrete floor slabs, roofs, and decks are cast monolithically with their supporting beams. Generally, formworks are placed for the bottom and sides of the beams and soffit of slabs. Bent up bars and stirrups of the beam are extended up into the slab. After that, all the elements are cast at once, from the lowest point of the beam to the top of the slab.The part of the slab around the beam, called flange, would work with the beam and resist longitudinal compression force. Interior beams have flanges on both sides and are termed as T-beams, while edge beams have flanges on one side and are called L-beams. The part of the beam extending below the slab is called a stem or web. The design of the reinforced concrete T-beams is similar to that of a rectangular reinforced concrete beam except for flanges that need to be considered in the former type of beam.

Fig.1 Bridge actual photograph

II. FINITE ELEMENT METHOD

The finite element method is a well known tool for the solution of complicated structural engineering problems, as it is capable of accommodating many complexities in the solution. In this method, the actual continuum is replaced by an equivalent idealized structure composed of discrete elements, referred to as finite elements, connected together at a number of nodes. Thus the finite element method may be seen to be very general in application and it is sometimes the only valid form of analysis for difficult deck problems. The finite element method is a numerical method with powerful technique for solution of complicated structural engineering problems. It is mostly accurately predicted the bridge ehavior under the truck axle loading. The finite element method involves subdividing the actual structure into a suitable number of sub-regions that are called finite elements. These elements can be in the form of line elements, two dimensional elements and threedimensional elements to represent the structure. The intersection between the elements is called nodal points in one dimensional problem where in two and three-dimensional problems are called nodal lines and nodal planes respectively. At the nodes, degrees of freedom (which are usually in the form of the nodal displacement and or their derivatives, stresses, or combinations of these) are assigned.

III. MODELING & SIMULATION

Boundary condition

Load = 900 KN

Fixed support

ISSN : 2455-9679
Impact Factor : 4.256

Modeling T beam exiting model

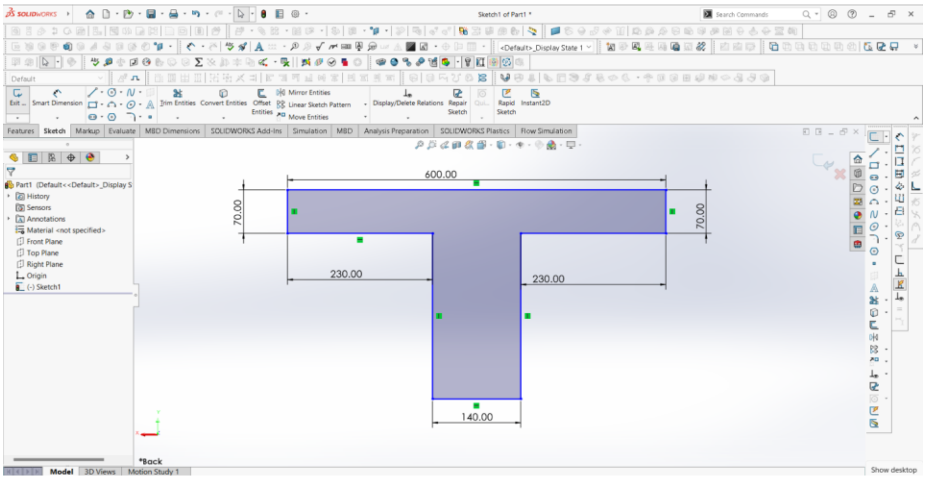

Fig.2 2D sketch exiting model of T beam with exiting model in solid work 2021

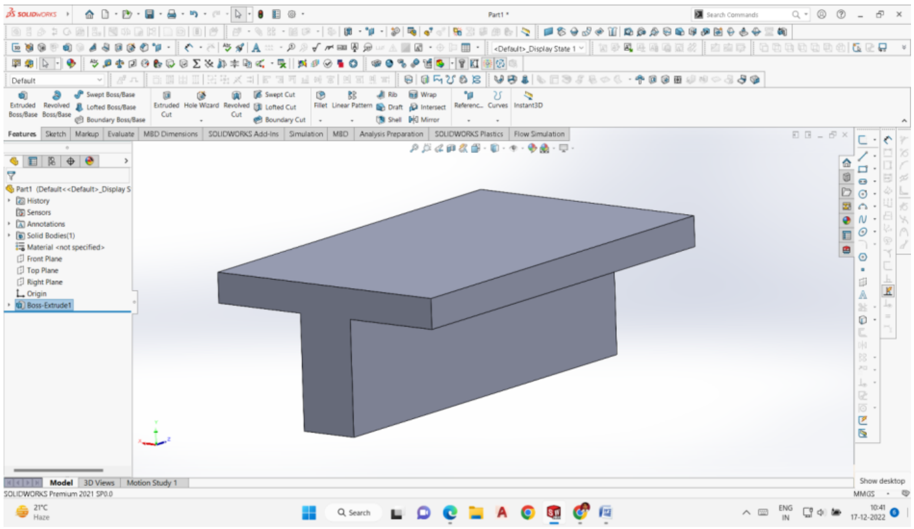

Fig. 3 3D sketch exiting model of T beam with exiting model in solid work 2021

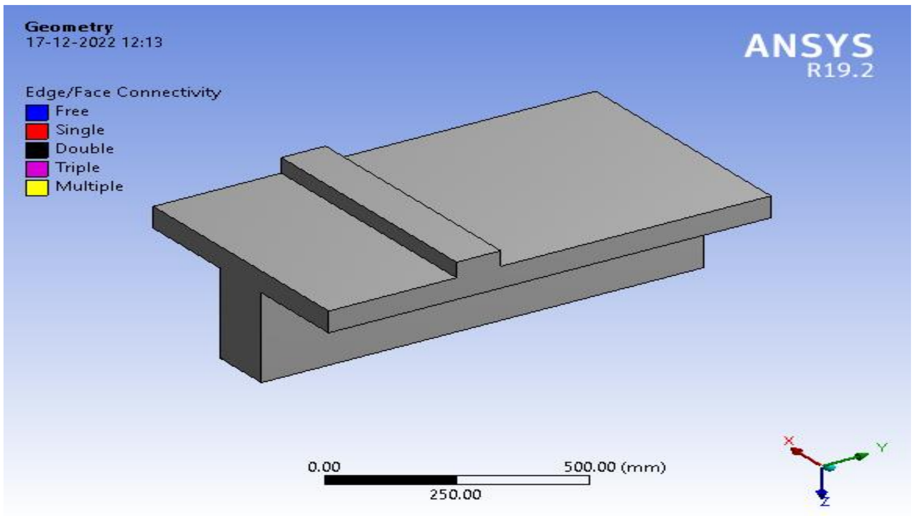

Fig.4 T beam exiting model import to ANSYS workbench

ISSN : 2455-9679
Impact Factor : 4.256

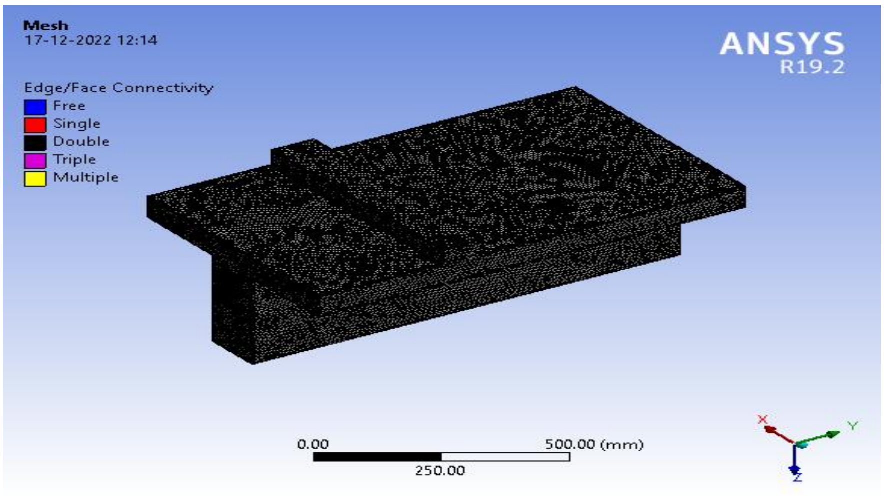

Fig.5 T beam exiting model meshing [nodes 296695 , elements 173761]

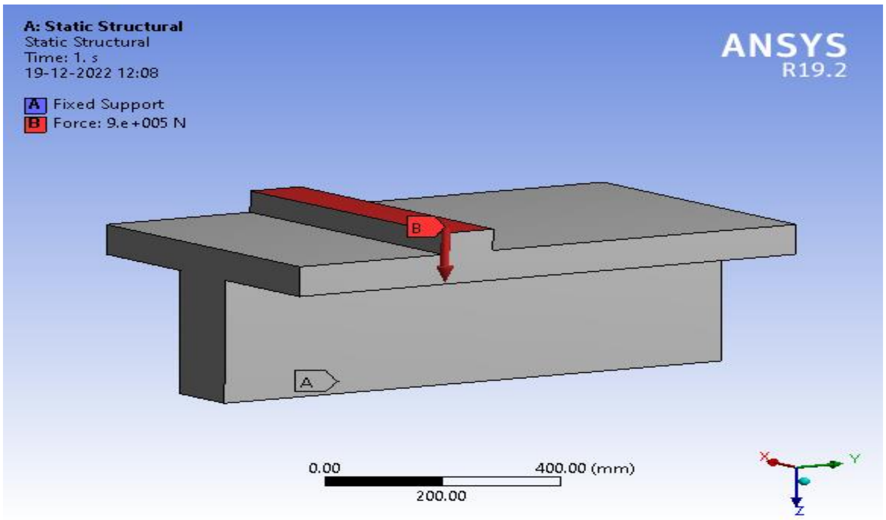

Fig.6 T beam exiting model meshing overall boundary condition applied

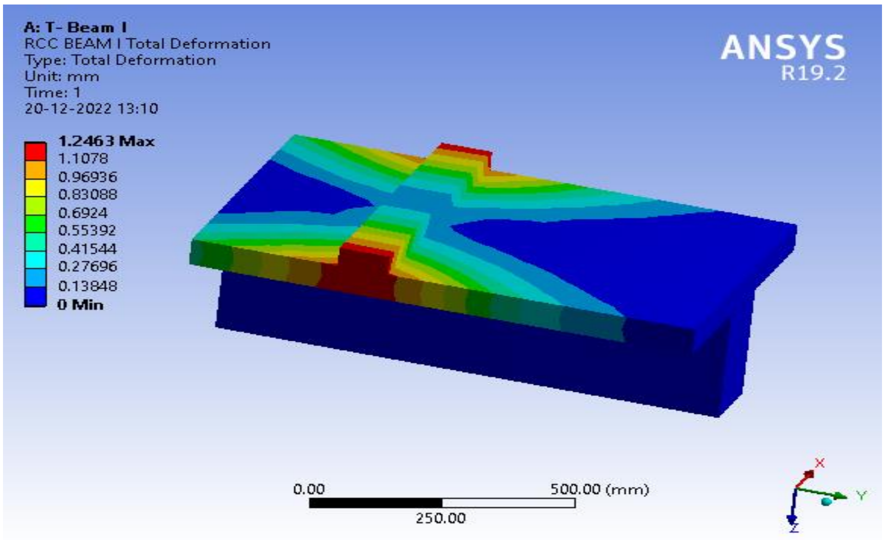

Fig.7 T beam exiting model total deformation results

ISSN : 2455-9679
Impact Factor : 4.256

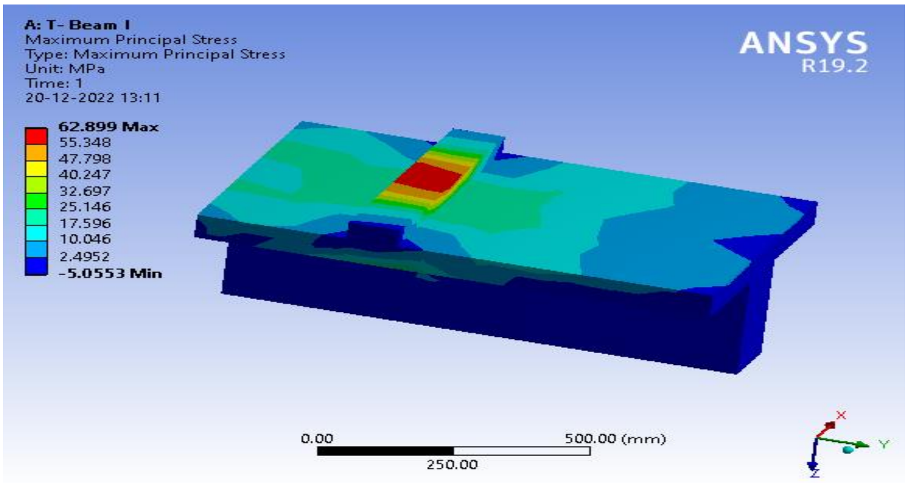

Fig.8 T beam exiting model stresses results

II MODEL T Section Beam

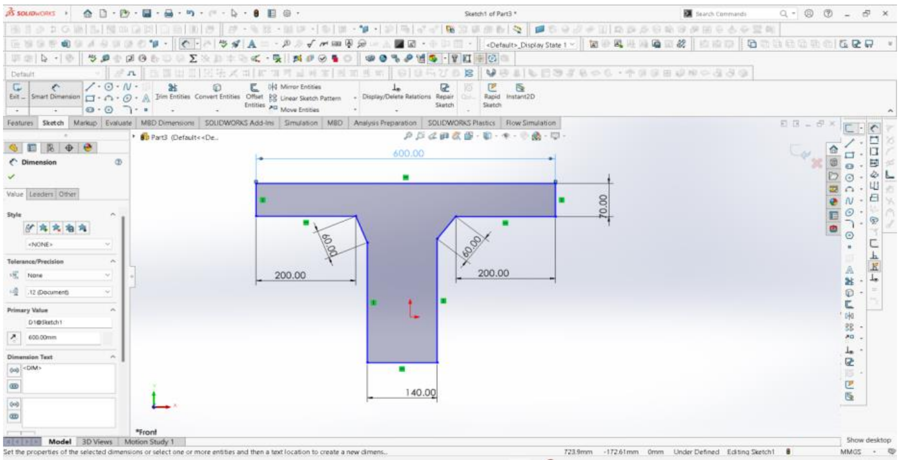

Fig.9 2D sketch new model of T beam with exiting model in solid work 2021

Modeling T beam new model with curvature effect

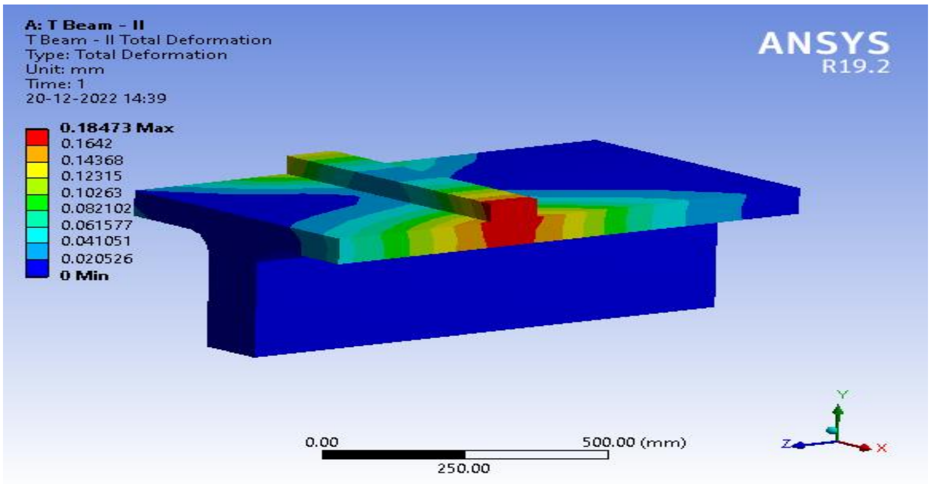

Fig.10 T-beam exiting model total deformation results

ISSN : 2455-9679
Impact Factor : 4.256

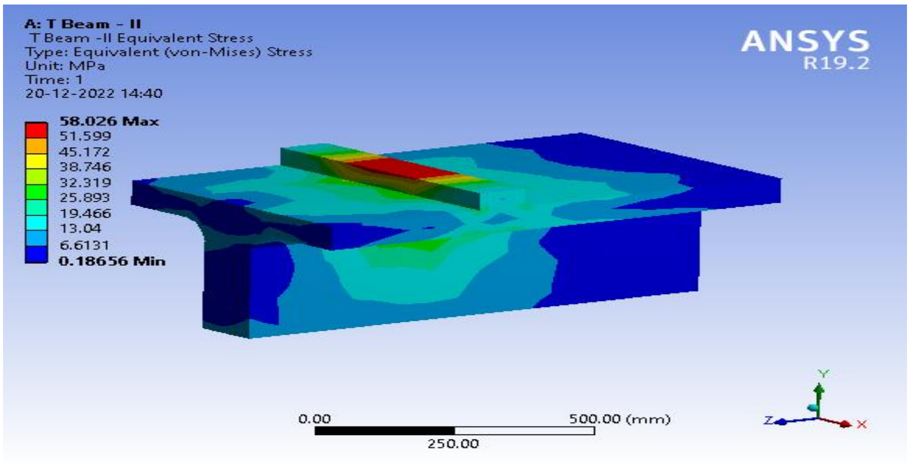

Fig11T beam exiting model stresses results

IV. RESULT

FE Analysis of the T-beams using the 'ANSYS' The partially prestressed concrete T-beams have been analyzed using the ANSYS. The 'ANSYS' model accounts for the nonlinearity, such as, bond-slip of longitudinal reinforcement, post-cracking tensile stiffness of the concrete, stress transfer across the cracked blocks of the concrete. Here T Beam –I and T beam – II used so by using FEA analysis here find out T Beam –II is best compare to exiting T beam –I. So this beam can be recommended for further research.

Table.1 T beams Comparison

Properties	T Beam- I	T Beam- II
Stresses (MPa)	62.8	58.06
Deformation (mm)	1.2	0.18

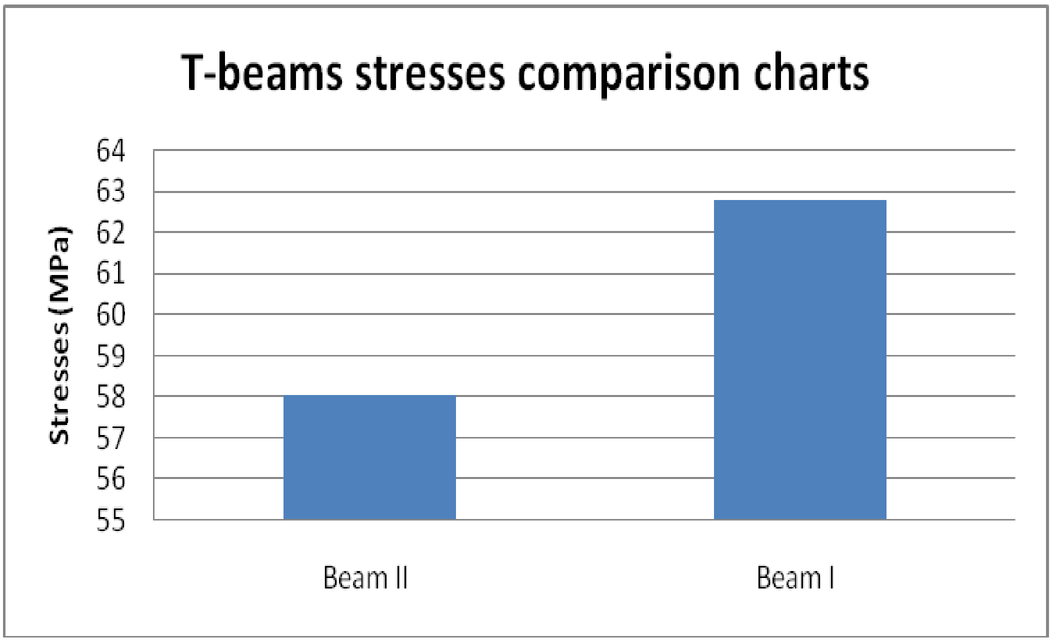

Fig12 T beams stresses comparison charts

ISSN : 2455-9679
Impact Factor : 4.256

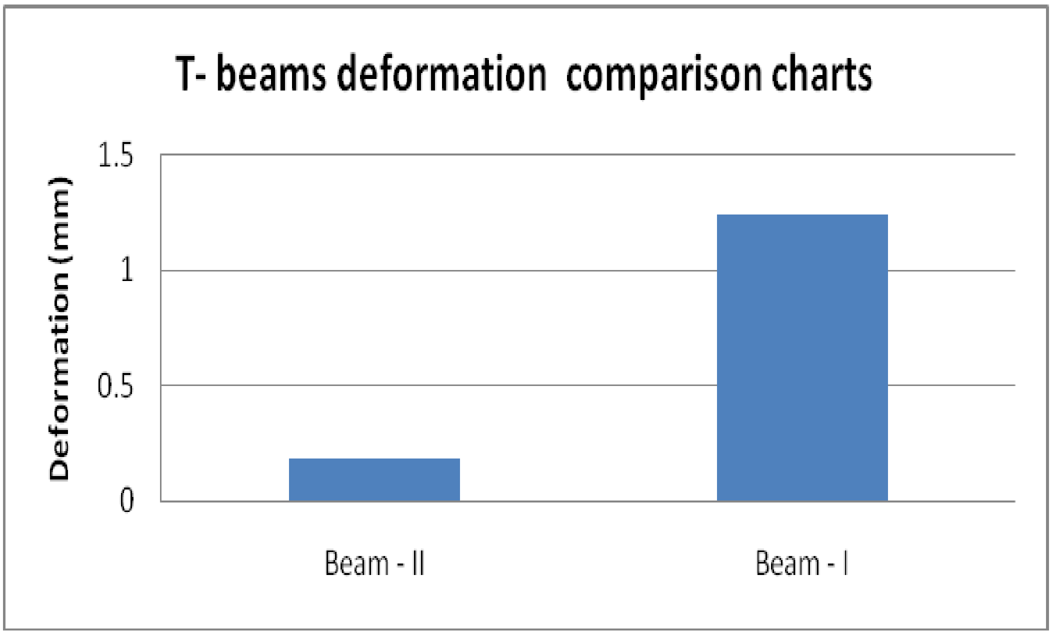

Fig.13 T beams stress comparison charts

V. Conclusion

Points of Conclusion are as follows:

- The predicted load in of T-beams at various stages was found to be in good agreement with the test data.
- The proposed model predicted slightly softer results in post-cracking regime of the load deflection response of T-beams. This variation is due to the difference in the 3D model of reinforcement used in the analysis when compared with that present in the test.
- The 'ANSYS' model correctly predicted the diagonal tension failure and shear compression failure of prestressed concrete beams observed in the experiment.
- It is expected that the modeling strategy for the finite element analysis proposed in this study will be used for designing/ analyzing beam members.

REFERENCES

[1] Manohar R, B Suresh Chandra Finite Element Analysis of slabs, cross girders and main girders in RC T-Beam Deck Slab Bridge, International Research Journal of Engineering and Technology (IRJET), Vol 5, Issue 08, 2018.
[2] Abrar Ahmed, Prof. R.B. Lokhande Comparative Analysis and Design of T-beam and box girders, International Research Journal of Engineering and Technology (IRJET),Vol 4, July 2017
[3] Sandesh Upadhyaya K and F Sahaya Sachin, A Comparative Study of T- Beam Bridges for varying span lenths, International Journal of Research in Engineering Technology, Vol 5, Jun 2016.
[4] Tangupalli Mahesh Kumar and J Sudhamani, Analysis of T-Beam Deck Slab Bridge in Different Methods,International Journal for Technological Research in Engineering, (IJTRE), Vol 4, Issue 12,Aug 2017.
[5] M. G. Kalyanshetti and R. P. Shriam, Study of Effectiveness of Courbons Theory in the Analysis of T Beam Bridges, International Journal of Science and Engineering Research, (IJSER), Vol.4, Issue 3, 2013.
[6] Amit Saxena and Dr. Savita Maru, Comparative Study of the Analysis and Design of T-beam and box girder Superstructure, International Journal of Research in Engineering and Advanced Technology (IJREAT), Vol 1, Issue 2, April-May, 2013.

ISSN : 2455-9679
Impact Factor : 4.256

[7] Soumya S and Umadevi R, Comparative Study of Courbons Method and Finite Element Method of RC T-Beam and Deck Slab Bridge, International Journal of Engineering and Management Research, (IJEMR) Vol 5 Issue 6, Dec 2015.

[8] .Praful N K and Balaso Hanumat, Comparative Analysis of T Beam Bridge by Rational Methodland STAAD Pro, International Journal of Engineering Science & Research Technology (IJESRT), June 2015

[9] Y Yadu Priya and T Sujatha , Comparative Analysis of Post Tensioned T-Beam Bridge Deck by Rational Method and Finite Element Method, International Journal of Research in IT, Management and Engineering, Vol 6, Issuue 7, Sept 2016.

[10] Pavan D.Tikate and S.N. Tande , Design Based Parametric Study of Box Culvert using Finite Element Method, Journal of Basic and Applied Engineering Research, Vol 2, Sept 2015.

[11] Fahad P. P. , Priyanka Dilip P, " Analysis and Design of Post Tensioned Box Girder Bridge Using SAP 2000," IJSRSET , Volume 3 , Issue 2 , Print ISSN: 2395-1990, Online ISSN : 2394-4099,2017.

[12] Phani Kumar, S.V.V.K.Babu, D.Aditya Sai Ram, "Analysis and Design of Prestressed Box Girder Bridge by IRC: 112-2011," International Journal of Constructive Research in Civil Engineering (IJCRCE) Volume 2, Issue 2, PP 1-10 ISSN 2454-8693, 2016.

[13] Sanket Patel, Umang Parekh, "Comparative Study of PSC. Tee Girder and PSC.Box Girder," IJSTE - International Journal of Science Technology & Engineering , Volume 2 , Issue 11 , May 2016.

[14] Pragya Soni, Dr. P.S. Bokare, "Review of Design Procedure for Box Girder Bridges," International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; Volume 5 Issue IX, September 2017.

[15] Jagdish Chand, Ravikant, "Design and Analysis of Bridge Girders using Different Codes", International Journal of Engineering and Innovative Technology (IJEIT), ISSN: 2278-0181, Vol 8 Issue 07, July-2019.