

Comparative Study on Bridge Pot bearing by using ANSYS and SAP2000 Software

R Arunkiliyal¹, S Abinaya², R.Divya³, K.Suganthi⁴, M Sridhar⁴

PG Student, Starlion College of Engineering and Technology, Thanjavur, Tamilnadu, India¹

Assistant Professor, Starlion College of Engineering and Technology, Thanjavur, Tamilnadu, India²

Assistant Professor, As-salam College of Engineering and Technology, Aduthurai, Tamilnadu, India^{3,4}

ABSTRACT: The present paper describes the comparative study on bridge pot bearing. In this case analysis is doing by using ANSYS and SAP 2000 software. After analysis design of the bridge pot bearing by using IRC: 83 code. A technical solution to the problem of unavoidable movements in bridge structures is the use of bridge bearings. Bridge bearings are small integral part of the entire bridge structure serving several purpose, such as connection, transfer of forces allowing movements force damping etc. Bridges bearings are important the components of modern bridge system and plays a key role to attenuate the vehicular traffic loads on piers. The design of elastomeric bearings for heavy load requires that the stability of the individual bearings be demonstrated at the maximum bearing displacement and loading condition. The elastomeric bearings are sensitive components and vulnerable to wear and tear and deterioration due to its function of movement. The present study verifies the finite element method for the suitability of POT PTFE (poly tetra fluoro ethylene) bearing as a bridge predicting critical loads in elastomeric bearings. The results of FEM (finite element method) are also validated through the literature available.

KEYWORDS: Bridges, pot bearings, Elastomeric bearings, Finite Element Method, POT PTFE bearing, SAP2000 software.

I.INTRODUCTION

In the early days of bridge construction, masonry was the prime construction materials and the arch was the predominant structural form. But the fact is that, no bridges will last forever and that proper managements contains design, material and construction, preventive and curative nature to ensure that, bridge will perform properly at least for the period of 100 to 120 years nominal life. In order to have better bridge for longer duration it is necessary to coordinate and implements the following task associated with the care of bridges. Bearings can termed as the mechanical part of a bridge structure. The earliest bridges were built of high mass of stones, bricks or timber material. A bearing which carries vertical load by compression on an elastomeric disc confined in a steel cylinder and which accommodates rotations by deformations of the disc. A bridge structure can be divided into two main bodies, the superstructures and the substructures; the superstructures bears its own weight and the traffic load, and the sub structures bears the load from the superstructures. Pot bearing was first used on Germany's bridge in 1958; after years of development, it has gradually become the most widely used metal bearing in the world's bridges. Pot bearings places an elastomer inside a steel pot and press the top of the elastomer by using a steel plate; the elastomer functions like a viscous fluid inside a hydraulic jack and the top steel plate behaves like the piston. Inside the pot of elastomer is to be laterally restricted, is not able to be compressed, and not able to horizontally lengthen. The bearing can hold substantially high pressure and enable slight rotations under homogeneous compression stress; these aforementioned items are the principle of a pot bearings. Layout of pot bearing is shown in figure 1

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

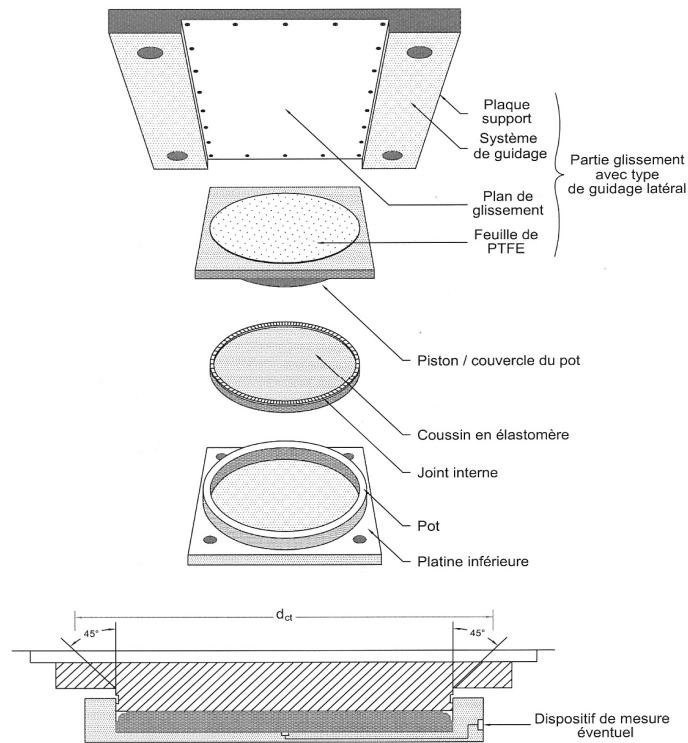


Figure: 1 Layout of pot bearings

II. DESIGN OF POT PTFE BEARING

Pot bearing is consisting of metal piston supported by a disc of unreinforced elastomeric pressure pad, confined within a metal cylinder for allowing rotational movement about any axis in horizontal plane and to bear and transmit the vertical load. Pot bearing is to be designed, duly considering the effect on load, force and movements of the structure. While designing the bearing resistance due to friction at the sliding interface of the bearing if any may be ignored. Pot bearings will not permit translation. When subjected to high compressive forces, the unreinforced elastomeric disc behaves similarly to a liquid. Rotations can occur due to a constant volume of the elastomer. This type of bearing combines two desirable properties, rotation capacity with a very small resistance and transmission of the bearings reaction over a defined area. Pot bearings are used for vertical forces from 1000 kN up to 100000 kN. These bearings have the advantage of very high vertical stiffness. The standard type of pot bearing allows only rotation. Vertical forces are transmitted to the pad, horizontal forces from the lid to the pot.

III. MATERIAL SPECIFICATIONS

- i) Mild Steel : IS: 2062 Grade-B
- ii) Stainless Steel : IS: 6911
- iii) Cast Steel : IS: 1030 grade 280-520W
- iv) Elastomer Pad :
 - a) IRC: 83(Part-II) Standard Specifications and code of practice for Road Bridges
 - b) IRC: 83 (Part-III) Properties of confined elastomer.
- v) PTFE :
 - a) BS: 3784 grade 'A' Specification for poly tetrafluoroethylene (PTFE) sheet.
 - b) IRC: 83 (Part-III) for permissible pressure on confines PTFE.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

c)BS: 5350 Standard method of test for adhesives,

IV. BEARING REACTIONS

- i) Maximum vertical force and minimum horizontal force.
- ii) Minimum vertical force and maximum horizontal force.
- iii) Maximum horizontal force and maximum vertical force.
- iv) Minimum horizontal force and minimum vertical force.

V. RESULT AND DISCUSSIONS

The design of Pot-PTFE bearings has been done for large railway bridges based on above codal provisional and provisional drawings have been issued. The bearings should normally be designed to serve for the full lifetime of the bridge. The materials used in their manufacture and the method adopted for protection against corrosion should be such as to ensure that the bearings function properly throughout their life.

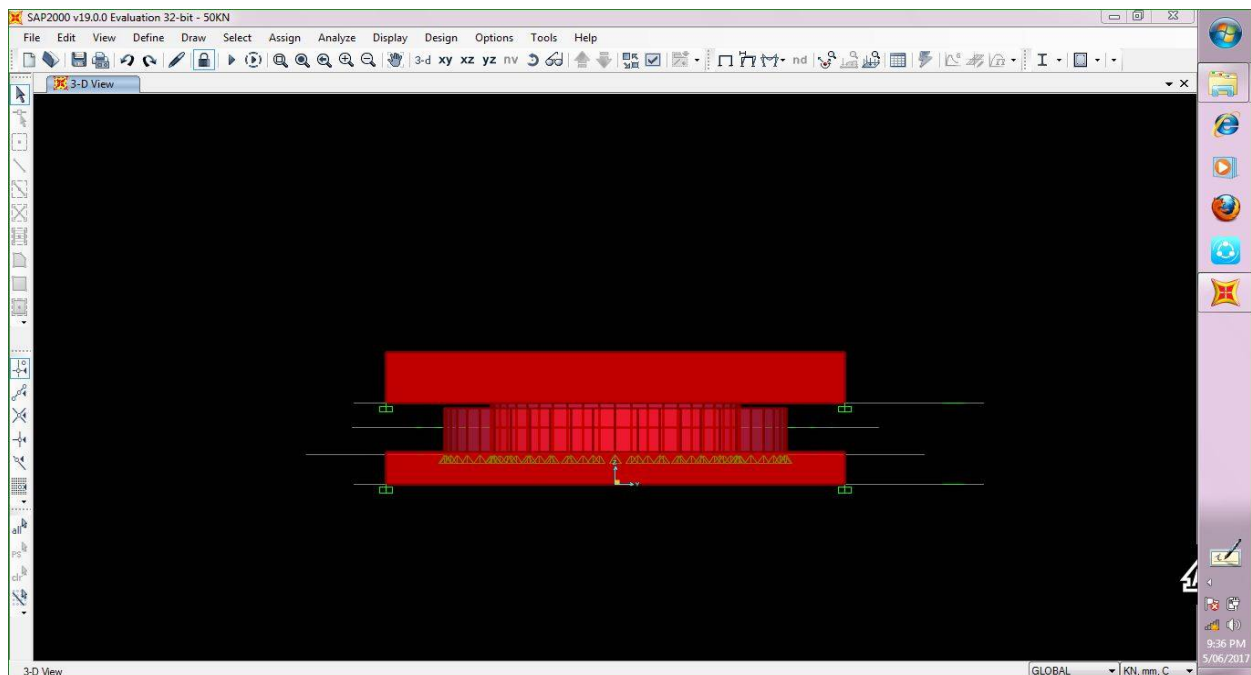


Figure: 2 Modeling of the pot bearing

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

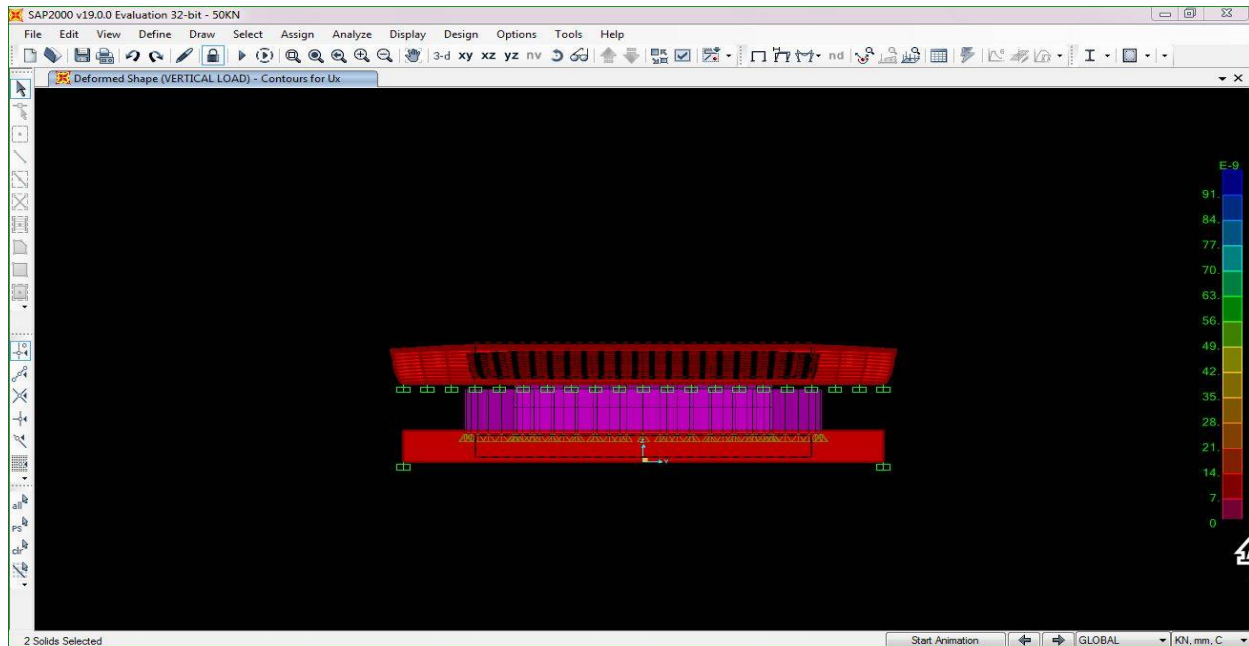


Figure:3 Vertical displacement of the pot bearing

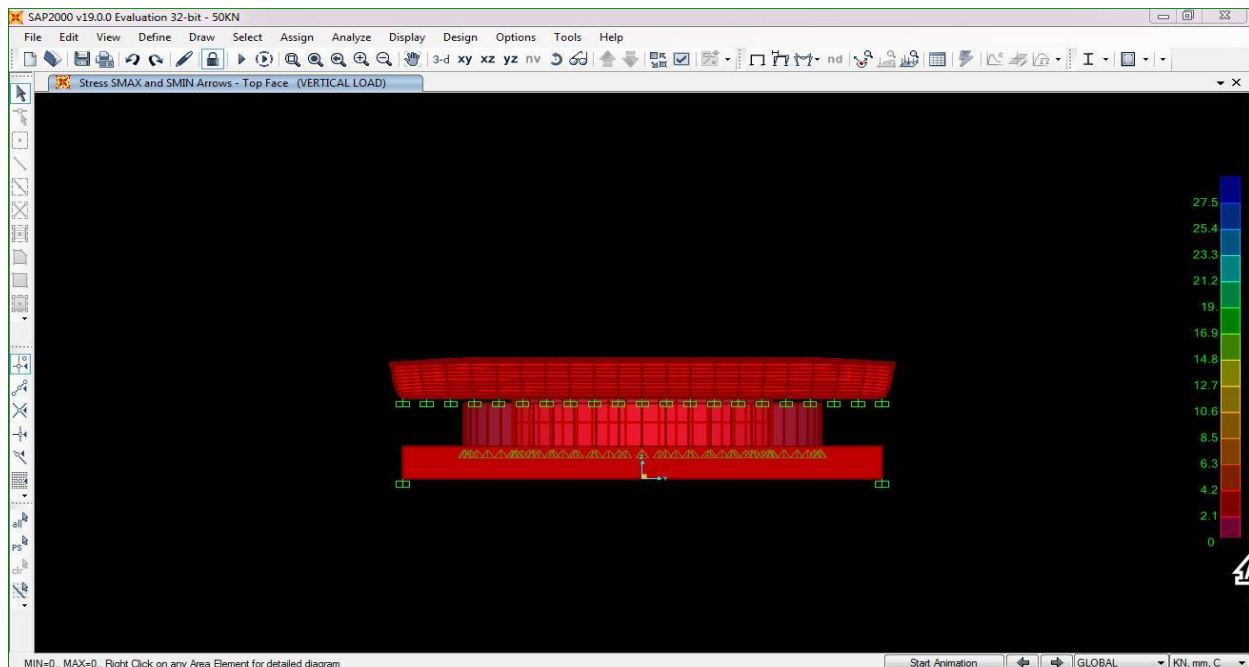


Figure:3 Vertical stress on the pot bearing

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

Table 1 **LOAD VERSUS DEFLECTION (ANSYS)**

SL. No.	Load (KN)	Deflection (mm)
1	50	0.146E-11
2	100	0.291E-11
3	200	0.583E-11
4	300	0.874E-11
5	400	0.117E-10
6	500	0.146E-10
7	600	0.175E-10
8	700	0.204E-10
9	765	0.223E-10
10	880	0.256E-10
11	1000	0.291E-10
12	1500	0.437E-10
13	2000	0.583E-10
14	2500	0.728E-10
15	3000	0.874E-10
16	3500	0.102E-09
17	4000	0.117E-09
18	4500	0.131E-09
19	5000	0.146E-09
20	5500	0.160E-09
21	6000	0.175E-09

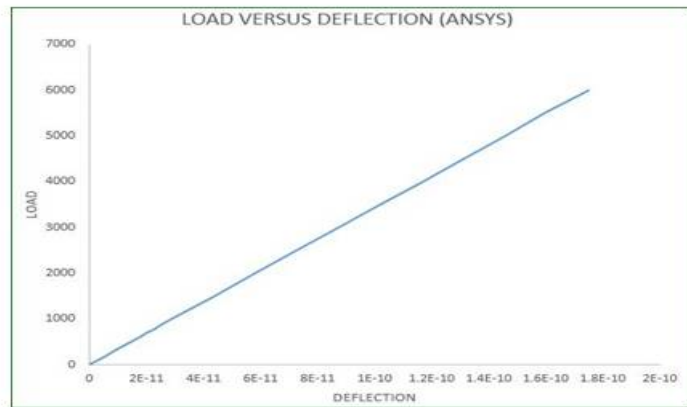


Figure:4 **LOAD VERSUS DEFLECTION (ANSYS) GRAPH**

Table 2 **LOAD VERSUS DEFLECTION (SAP2000)**

SL. No.	Load (KN)	Deflection (mm)
1	50	9.10E-08
2	100	1.29E-07
3	200	3.62E-07
4	300	5.63E-07
5	400	9.14E-07
6	500	1.74E-06
7	600	3.17E-06
8	700	4.15E-06
9	765	5.21E-06
10	880	6.12E-06
11	1000	7.21E-06
12	1500	1.10E-05
13	2000	1.80E-05
14	2500	2.60E-05
15	3000	3.30E-05
16	3500	4.00E-05
17	4000	4.60E-05
18	4500	5.30E-05
19	5000	6.21E-05
20	5500	7.50E-05
21	6000	9.10E-05

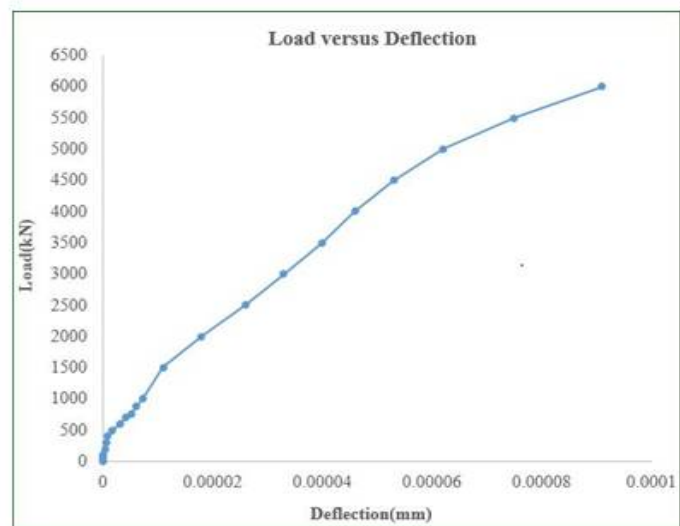


Figure: 5 **LOAD VERSUS DEFLECTION (SAP2000) GRAPH**

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

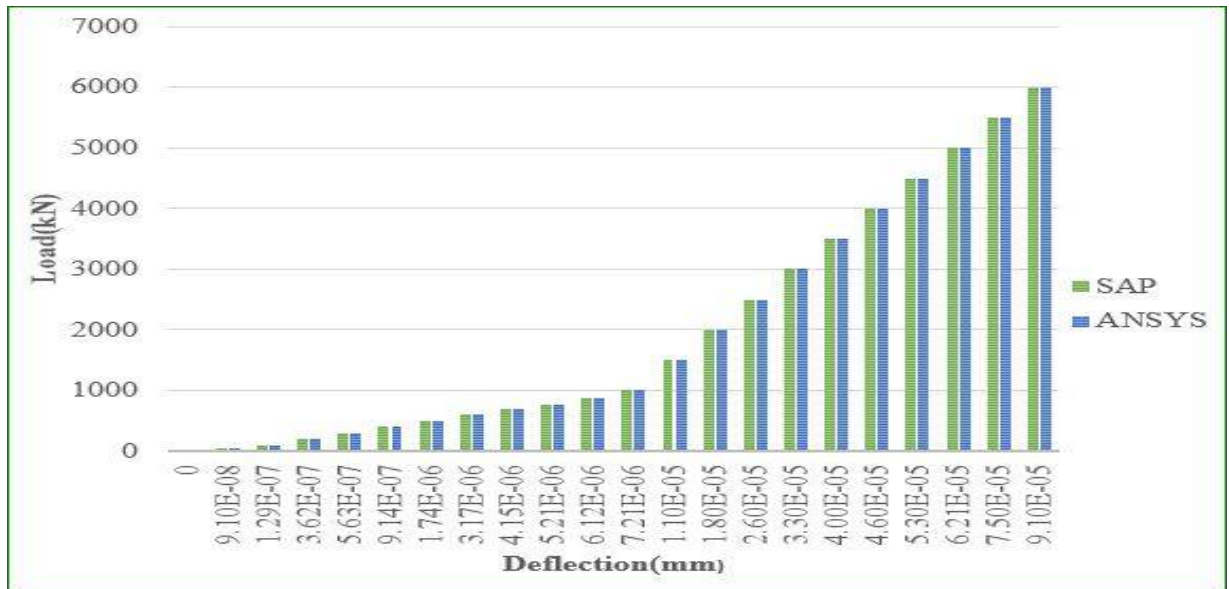


Figure:6 COMPARISION DEFLECTION RESULT BETWEEN SAP AND ANSYS

Sl. No	Vertical Load (KN)	Analytical Pressure Result By ANSYS	Analytical Pressure Result By SAP2000	% Of Error
1	50	24.01	27.51	14.57
2	100	48.24	51.35	6.44
3	200	98.23	105.41	7.30
4	300	145.42	162.53	11.76
5	400	198.93	212.84	6.99
6	500	249.93	262.32	4.95
7	600	296.13	317.02	7.05
8	700	342.25	365.77	6.87
9	765	369.07	409.46	10.94
10	880	494.18	542.06	9.68

Table:3 COMPARISION OF ANALYTICAL PRESSURE BY ANSYS AND SAP2000

VI. CONCLUSION

In practical where the bearing is supposed to take heavy loads, there would be a lot of vibration which have to be taken into consideration .In the design of PTFE bearing the analysis has been done considering the above condition.

Design of Pot-PTFE bearing is governed by the minimum average stress on the PTFE disc, elastomer Pad and the top plate at which all the system is fixed .It is evident from the figure and mathematical model that maximum stresses developed in the PTFE disc elastomer Pad and the top plate are considered for safe design. It is also evident from the figure the stress developed in the POT PTFE bearing is also under the critical stress as per the design consideration. It can be concluded that the POT PTFE bearing is very useful when it is subjected to the heavy load.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

It is observed that the minimum percentage of error between the analytical applied pressure by using ANSYS and the analytical applied pressure by using SAP2000 is 4.95 and maximum percentage of error is 14.57. It is observed that there is a tolerable difference between the analytical applied pressure by using ANSYS and SAP2000 on the pot bearing. It is also observed from the literature that the design of Pot-PTFE bearing is restricted due to the stimulated minimum average stress and can be feasible for railway bridge girders of spans 61.0 m and above.

REFERENCES

1. Ankit Gupta, Diwakar Prakash Verma, Girija Shanker (2014) Suitability of POT PTFE bearing in bridges, International Journal, 2, 47-53.
2. Cem Topkaya (2004) Analysis of specimen size effects in inclined compression test on laminated elastomeric bearings, Journal of Engineering structures, 26, 1071-1080.
3. European Committee for Standardization Structural Bearings- Part 5 Pot bearings, 2005
4. IRC 83 (Part-II) -1987 Standard Specifications and code of Practice for Road Bridges – Section IX Bearings – Part II Elastomeric Bearings.
5. Pugazhenti and Kumaran, G. Experimental study on pot bearing used for railway metro project, Master of Engineering, Department of Civil and Structural Engineering, Annamalai university, Annamalai Nagar, 2014.
6. Vinod Kumar Ishwaral Jangid (2014) Design development and Analysis of Structural Bearings for Torsional Forces, International Journal on recent and Innovation Trends in Computing and Communication, Vol.3(7), pp 4926-4928.
7. R. Divya, Dr. R. Sivagamasundari, Dr. G. Kumaran (2016) A Study On Bridge Pot Bearing By Using ANSYS, Journal of IJIRD, ISSN 2278-0211.
8. Mahantesh. S. Kamatagi, Prof. M. Manjunath (2015) Comparative Study of design of longitudinal girder of T- Beam Bridge, Journal of IRJET