JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

SEISMIC BASE ISOLATION DEVICES FOR BUILDING

Kunal Shiklagar, Kshitij Rhatval, Sagar kamble, Kedar Kadam, Mr. Y. U. Kulkarni

5th Assistant Professor, Department of Civil Engineering, SITCOE, Yadrav, Kolhapur
1,2,3,4 Students, Department of Civil Engineering, SITCOE, Yadrav, Kolhapur.
[1] Department of Civil Engineering,
[1]Sharad Institute Of Technology College Of Engineering, Yadrav, Ichalkaranji, India.

Abstract : In an earthquake-prone area, many buildings collapse or suffer various types of damage due to earthquake waves. So for this we have studied every aspect of earthquakes in a new way, EPI centre of earthquakes, types of tectonic plates, types of faults and movements of earth's ground layers during earthquakes, magnitude and intensity of earthquakes etc. we have studied types seismic base isolation devices in an way to reduce the damage of buildings in earthquakes. We decided to use it ball and roller bearing. From the study of different types of seismic base isolation devices we select ball and Roller bearing Base Isolation Device and by designing and testing it we reached the result as per our objective and concluded our project. We conclude by showing graphical results how roller based solution technique is better and more useful than other seismic base isolation devices. In earthquakes how damage is reduced with use of that device we design with study of some review and research paper related to that subject. In earthquakes, ground motion caused by seismic waves, horizontal displacement of ground surface with some magnitude and the resulting dynamic changes in the building. We used our device to demonstrate how ball and roller seismic base isolation device can reduce the seismic vibrations caused by ground motion without reaching the building, and how damage to the building can be reduced. We have taken previous earthquake data and test that data on our device with the use of shaking table for damage reduction. we have got the successful damage reduction results in the form of graphical view.

I. INTRODUCTION

The sudden ground displacement changes caused by seismic waves in earthquake time that are divided into low and high seismicity patterns. This analysis is determined by the magnitude and intensity of the earthquakes. An earthquake, due to the movements in the ground caused by the seismic waves, sudden movement in the foundation of the building is caused by vibrations and that vibrations reach the building structure and there is a possibility of the building damage or collapsing. However, in order to reduce the damage to the building due to these causes of earthquakes, we studied several principles related to earthquakes and studied several types of seismic base isolation devices to reduce damage due to earthquake. After many considerations, ball and roller bearing was selected as the seismic base isolation device and proper study was started on it. After properly studying how roller bearings can be fitted to a building to reduce the amount of seismic waves on the building structure, the guide help to decide on a way to build a prototype model and conduct tests on it. For this we concluded by using a shaking table which is similar to the horizontal movement of the ground and by attaching the device we have made to it and attaching it to a temporary building for testing. Using a specific amount of data from previous earthquakes to reference that information, we graphically concluded how the damage reduces. using this device was reduced compared to the damage from previous earthquakes associated with our device.

II. MATERIAL AND METHODOLOGY:

In the way of our project objectives we have studied about various parameter related with the earthquake like types of earthquakes, types of earthquake zones, faults, tectonic plates, earthquake waves, intensity & magnitude of earthquake, epi centre & focus point of earthquakes, its effects, and recent earthquakes etc. after study of earthquake parameter we start to study purpose and importance of base isolation, Types of Shear Force Resisting Techniques, types and principle of seismic base isolation devices etc.

After perfect useful study of all this above data we decide which type of base isolation technique we select to reduce damage due to earthquake effects and we finally select ball & roller bearing as a seismic base isolation device. Collected all information we use we to design prototype model of making ball & roller bearing to take tests as well as results on it. We take MDF sheet for make two plates and six hollow spherical iron balls and make six brackets for six rollers to free movement while displacement due to horizontal shaking. Take four nut bolts of ten mm diameter to fix with shaking table machine as well as upper structure. We fit it that prototype device to servo shaking table machine and apply the three parameters of earthquake

(displacement, velocity, time) from servo shaker machine software to machine for results. When machine shake horizontally the structure can move shortly due vibrations and displacement. When device is applied in between structure and shaking table the shaking of structure reduces due to roller movement. Rollers cannot pass this waves into the structure they absorb it and they can move freely but structure was safely stabilized and balanced. that are results can take by one sensor is fixed with side part of the structure and that can collect the result in parameter difference in that we can see in software in form of graphical view.

- **Result and discussion**

A. Recent Earthquakes in India

Date (2023)	Magnitude	Epicenter
March 21	6.8	Afghanistan, jolted parts of India
March 12	4.8	76 km from Wangjing, Manipur, India
March 8	4.0	10 km depth in Gilgit-Baltistan, Pakistan
March 7	4.9	10 km depth in Andaman and Nicobar Islands, India
March 3	4.1	10 km depth along Arunachal Pradesh, India
March 2	4.0	10 km depth along Lobujya, Eastern region, Nepal
February 24	4.1	10 km depth in Islamabad, Pakistan
February 22	4.8	27 km depth in Jumla, Mid Western, Nepal
February 16	4.3	61 km depth along Chhatak, Sylhet, Bangladesh
February 12	4.0	65 km depth along Mangan, Sikkim, India

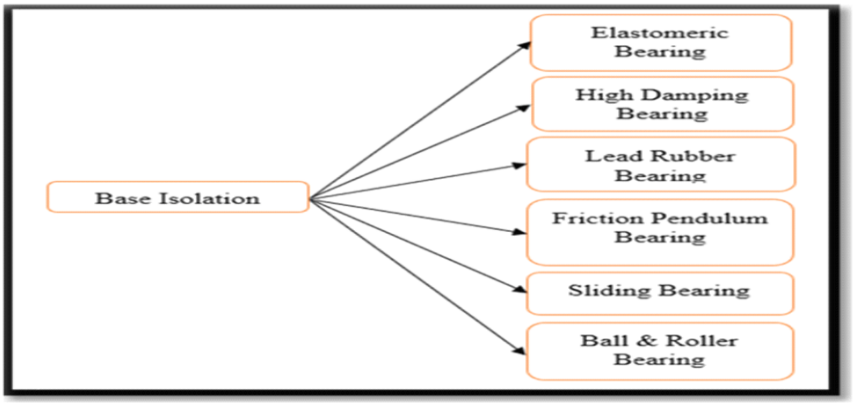


Fig. 1 Types of seismic Base Isolation devices

III. Prototype device model making -

Previous earthquake parameter (displacement, velocity, time) apply from the software through shaking table and we got two comparative type of result first without base isolation and with base isolation. we select five different past earthquakes for testing is given below. The comparative results of experimental testing result obtained from servo shaker machines software in graphical format.

Fig. 2. Roller bearing base isolation prototype device

Fig. 3 Servo shaking table machine with prototype structure setup

III. Graphical Representation of Results -

Result 1 –

The 1940 El Centro earthquake (or 1940 Imperial Valley earthquake)

Occurred at 21:35 Pacific Standard Time on May 18 in the Imperial Valley in southeastern Southern California near the international border of the United States and Mexico. It had a moment magnitude of 6.9 and a maximum perceived intensity on the Mercalli intensity scale.

- In this result the normal structure the maximum displacement is 16 mm & with fixed base isolation device the maximum 6 mm.
- With fixing the base isolation device the damage will reduce by 57%.

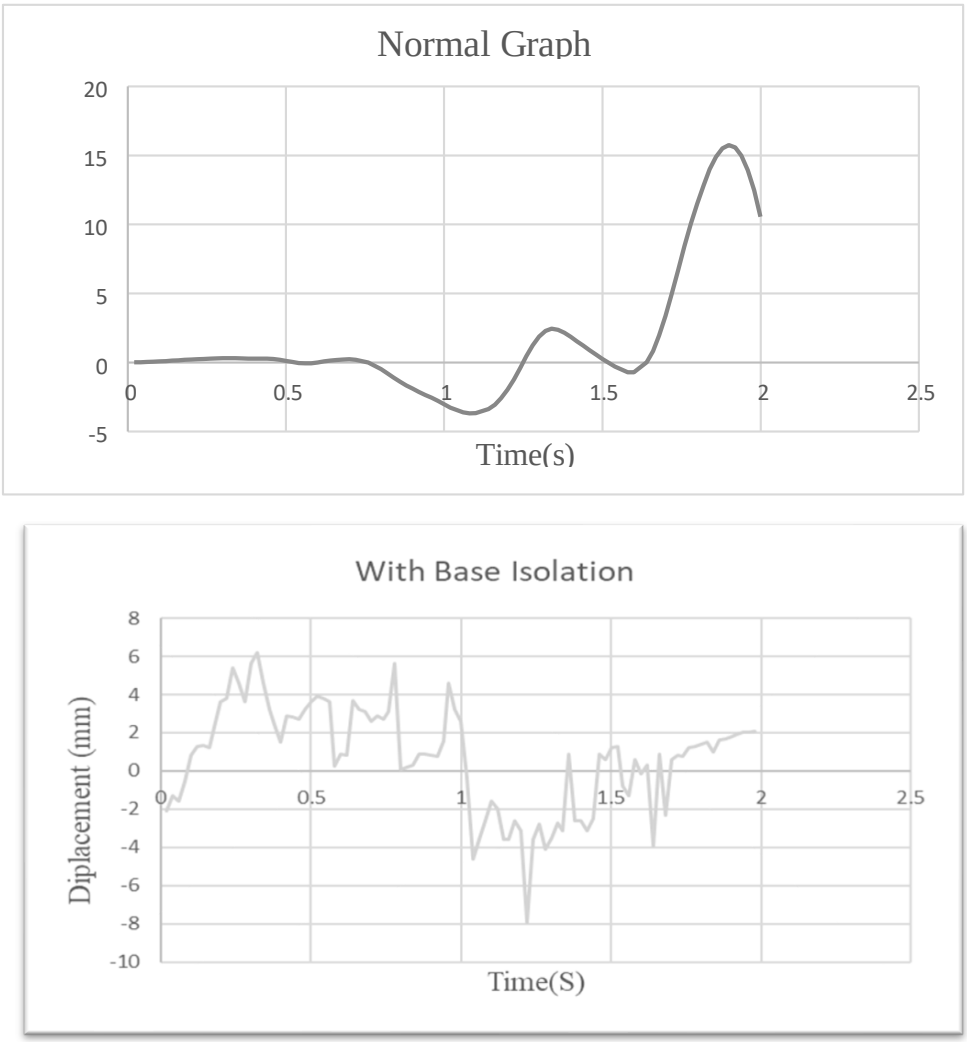
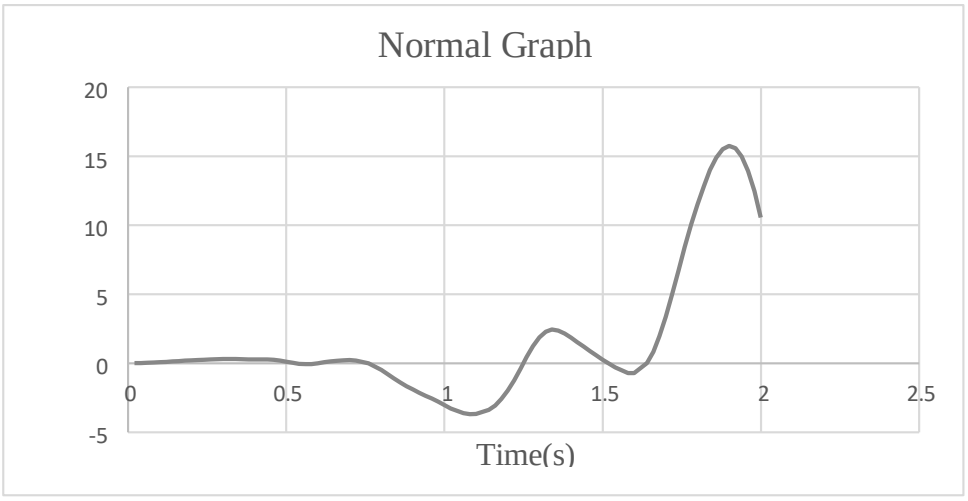


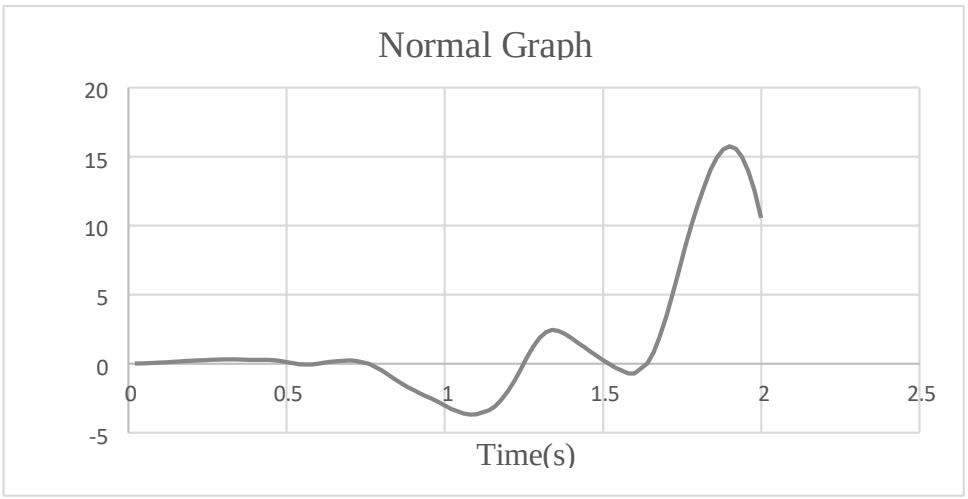
Fig.4 Test 1. **El Centro** Result in displacement vs. time graph

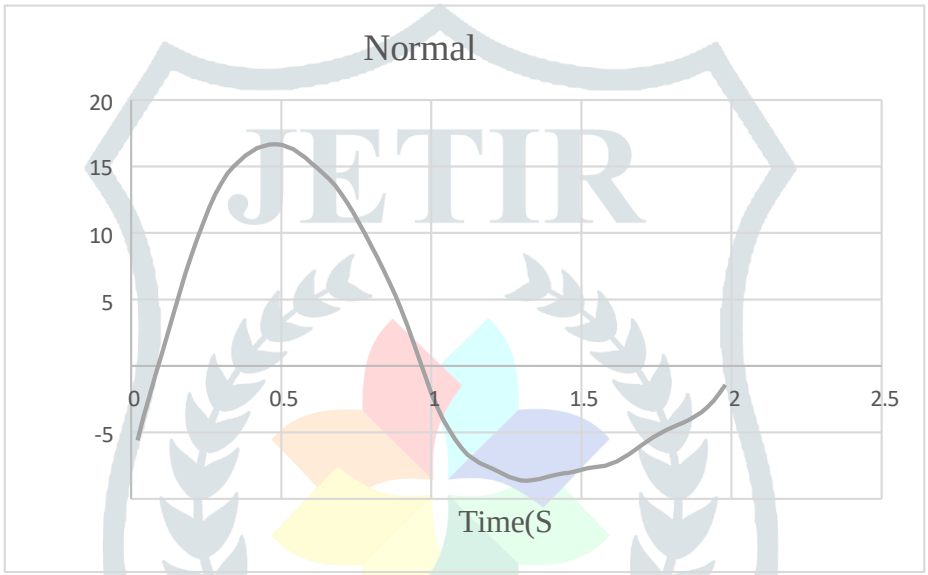
Result 2. Angola Earthquake –

The strongest recent earthquake of the past 10 years near Angola occurred on Feb 25, 2015 00:43 local time (Africa/Luanda time zone). It had a magnitude of 5.1 and struck 142 kilometers (88 mi) east-northeast of Luau, at a depth of 10 km. Discover more strong earthquakes near Angola in the list below

- In this result the normal structure the maximum displacement is 17 mm & with fixed base isolation device the maximum 10 mm .
- With fixing the base isolation device the damage will reduce by 48%.







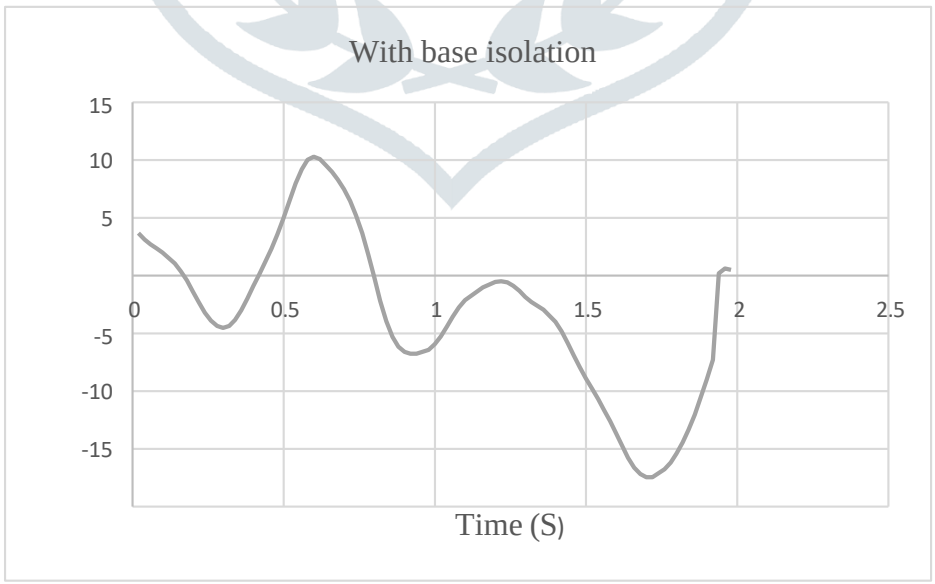


Fig. 5 Test 2 **Angola** Result in displacement vs. time graph

Result 3. Hawaii Earthquake

- In this result the normal Structure The maximum displacement is 16 mm & with fixed base isolation device the maximum 2.3 mm.
- With fixing the base isolation device the damage will reduce by 78 %.

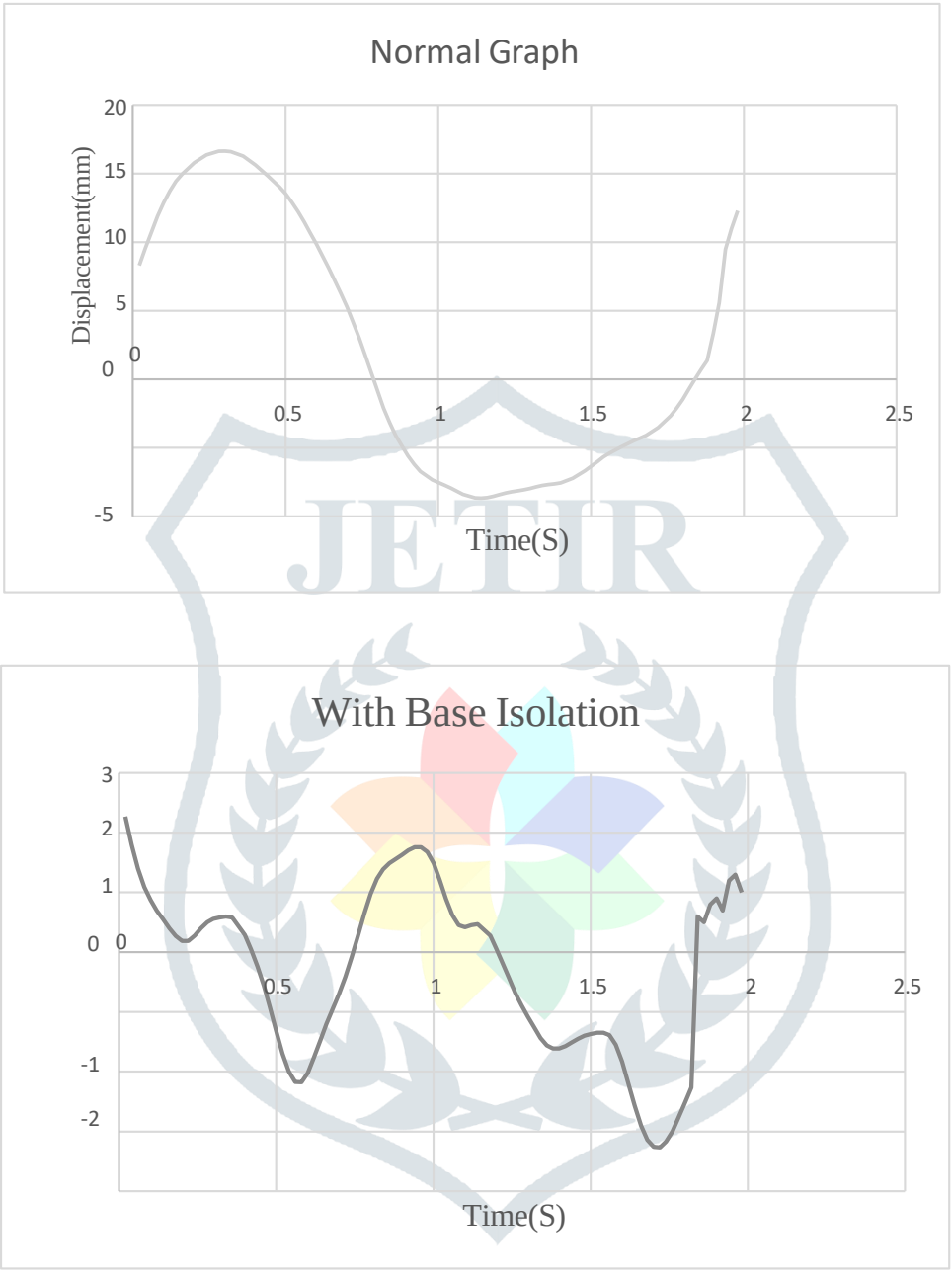


Fig. 6 test 3. **Hawaii** Result in displacement vs. time graph

Test Result -4 Trinidad Earthquake

- In this result the normal Structure The maximum displacement is 10 mm & with fixed base isolation device the maximum 6.5 mm.
- With fixing the base isolation device the damage will reduce by 65 %.

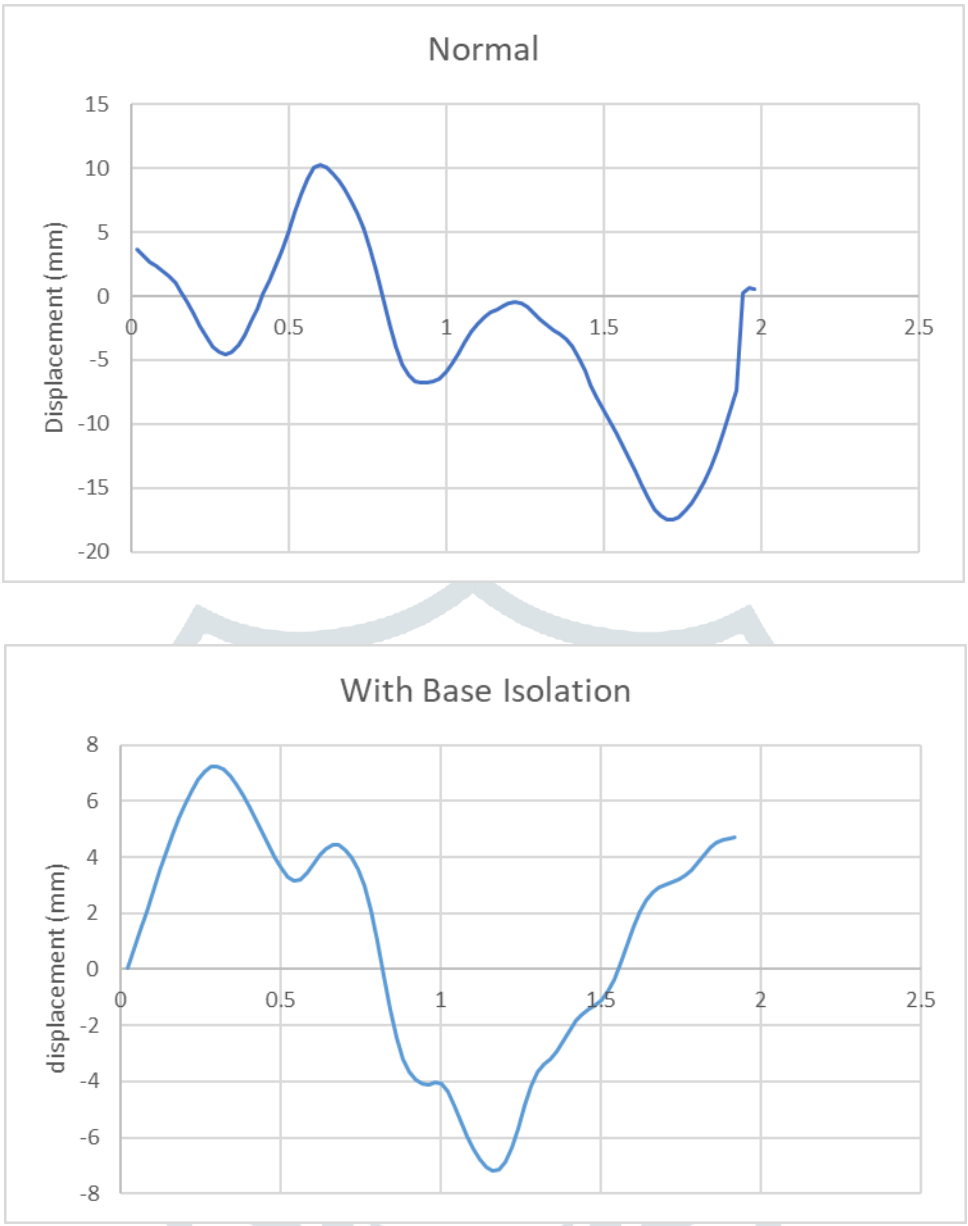


Fig. 7 test 4. **Trinidad** Result in displacement vs. time graph

Test Result – 5 Turkey Earthquake

- In this result the normal Structure The maximum displacement is 14.5 mm & with fixed base isolation device the maximum 3.5 mm .

➢ With fixing the base isolation device the damage will reduce by 65 %.

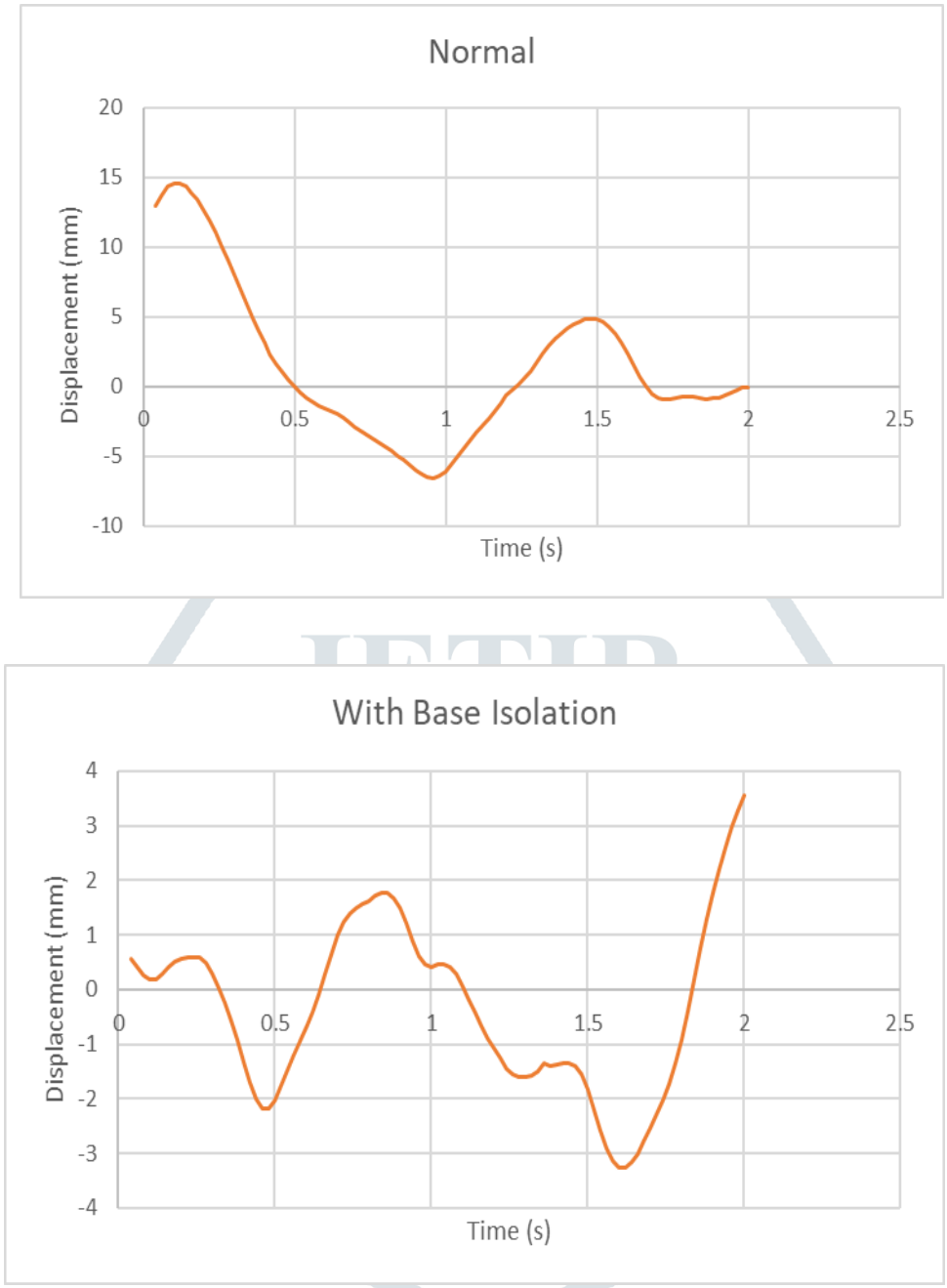


Fig. 8 test 5. Turkey Result in displacement vs. time graph

IV. CONCLUSION

- From the above study and results the ball and roller type base solation device can reduces the 55% displacement of structure causes due to earthquake ground shaking.
- The overall results indicate that the seismic base isolation devices is useful for reduce the damage causes due to earthquake in useful manner.
- Horizontal shaking as well as vertical loading of structure can take by this roller bearing with free displacement sockets to reduce a horizontal displacement vibration which is harmful for structure.
- When the total load of the building is more than the structure can automatically stabilized with its own weight on the use of gravity and its having less displacement with comparison of light weight structure.
- When building shakes the joints of building having most tension in that part. Shear force in that columns and slab can play important role in time of earthquakes shaking.
-

V. REFERENCES

[1] By Lin Su, Goodarz Ahmadi, and Iradj G. Tadjbakhsh "Performance of sliding resilient friction base-Isolation system", ASCE, Journal of Structural Engineering, vol 117'No 1(1991)

[2] Todd W. Erickson1 and Arash Altoontash2," Base Isolation for Industrial Structures; Design and Construction Essentials", ASCE, Structures Congress, (2010)

[3] J. Enrique Luco," Effects of soil–structure interaction on seismic base isolation "ELSEVIER, Soil Dynamics and Earthquake Engineering, pp166-167, (2014)

[4] A Review Paper on Base Isolation Technique by Miss.Sushma.G.Sawadatkar and Mr.Mandar.M.Joshi (IJRASET) Study of Base Isolated Building by Tejas Jitendra Chordiya, Vaishnavi Yogesh Totla (IRJET)

[5] A Critical Review On Base Isolation Techniques For Its Application As Earth Quake Resistant Buildings With Particular Need/Adherence In Eastern Uttar Pradesh by

Ajai Kumar Rai , Brajesh Mishra (IJESRT)

[6] Book – design of earthquake resistant structure (Pankaj Agarwal & Manish Shrikhande) it will give the knowledgeable information of base isolation &base shear calculations for selection of seismic base isolation devices.

[7] Indian Standard IS1893-1: 2002.It is an analysis of the dynamic response of the structure at each increment of time, when its base is subjected to a specific ground motion time history. on the perceived maximum seismic risk characterized by Maximum Considered Earthquake (MCE) in the zone in which the structure is located.