iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** III **Month of publication:** March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3621

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Study Between Laminated Rubber Bearings and Friction Pendulum Bearing of Base Isolation System: A Review

Yogesh N. Sonawane[1], Chetan J. Chitte[2]
[1, 2]Department of Civil Engineering RCPIT Shirpur

Abstract: For every civil engineering structures safety is measure concerned in seismically proven zone. So our threat is to protect existing structures from effect of earthquake. To overcome that threat base isolation systems have become a significant element to improve reliability during earthquake. During last past decades base isolation technique has become more and more popular in the field of seismic protection which can be adopted for new as well as existing structures. The basic aim of this paper is to study of different types of base isolators like laminated rubber bearing, lead rubber bearing and friction pendulum bearing from reviews of various research papers
Keywords: Base isolation systems, Isolators, Lead rubber bearing, Laminated bearing, Friction pendulum bearing.

I. INTRODUCTION

Earthquakes are one of the most destructive of natural hazards which are unavoidable and unmanageable. Earthquakes are responsible for significant loss of life, damage to property and disrupt essential services such as water supply, sewerage systems, communication and power, transport etc. They not only destroy villages, towns and cities but the aftermath leads to destabilize the economic and social structure of the nation. . Therefore earthquake resistance design has always been a high priority for the seismic protection of the structure in order to assume safety of people and its contents. Earthquake occurs due to sudden transient motion of the ground as a result of release of elastic energy in a matter of few seconds. The impact of the event is most disturbing because it affects large area, occurs all on a sudden and unpredictable.

II. EARTHQUAKE HAZARDS

The primary hazards associated with earthquakes are fault displacement and ground shaking. Secondary hazards include ground failure, liquefaction, landslides and avalanches, and tsunamis and seiches.

A. Fault Displacement and ground shaking

Fault displacement, either rapid or gradual, may damage foundations of buildings on or near the fault area, or may displace the land, creating troughs and ridges. Ground shaking causes more widespread damage, particularly to the built environment. The extent of the damage is related to the size of the earthquake, the closeness of the focus to the surface, the buffering power of the location's rocks and soils, and the type of buildings being shaken. Secondary tremors that follow the main shock of an earthquake, called aftershocks, may cause further damage. Such tremors may recur for weeks or even years after the initial event.

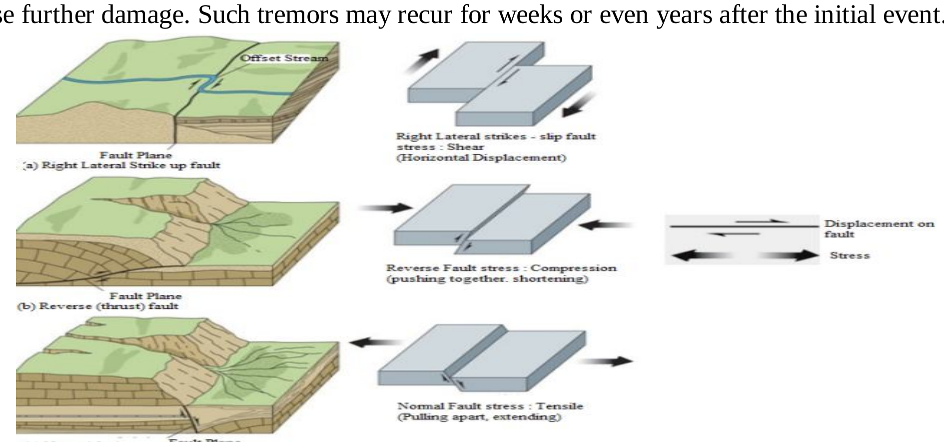


Fig. 1 Fault Displacement and ground shaking

B. Landslides and avalanches

Slope instability may cause landslides and snow avalanches during an earthquake. Steepness, weak soils and presence of water may contribute to vulnerability from landslides. Liquefaction of soils on slopes may lead to disastrous slides. The most abundant types of earthquake-induced landslides are rock falls and rock slides usually originating on steep slopes.

C. Ground failure

Seismic vibrations may cause settlement beneath buildings when soils consolidate or compact. Certain types of soils, such as alluvial or sandy silts are more likely to fail during an earthquake.

D. Liquefaction

Liquefaction is a type of ground failure which occurs when saturated soil loses its strength and collapses or becomes liquefied. During the 1964 earthquake in Niigata, Japan, ground beneath buildings that were earthquake resistant became liquefied, causing the buildings to lean or topple down sideways. Another type of ground failure that may result from earthquakes is subsidence or vertically downward earth movement caused by reduction in soil water pressure.

E. Tsunami

Tsunami is a Japanese word meaning “harbor wave”. Tsunamis are popularly called tidal waves but they actually have nothing to do with the tides. These waves, which often affect distant shores, originate from undersea or coastal seismic activity, landslides, and volcanic eruptions. Whatever the cause, sea water is displaced with a violent motion and swells up, ultimately surging over land with great destructive power

III.HOW TO DECREASE EARTHQUAKE EFFECTS ON BUILDINGS?

Conventional seismic design attempts to construct buildings that do not collapse under strong earthquake shaking, but may continue damage to non-structural elements like glass facades and to some structural members in the building. This may cause to be the building non-functional after the earthquake, which may be difficult in some structures, like hospitals, which need to remain functional in the outcome of the earthquake. Special techniques are required to design buildings such that they remain practically undamaged even in a severe earthquake. Two basic technologies are used to protect buildings from damaging earthquake effects.

A. Base Isolation Devices

The idea behind base isolation is to detach or isolate the building from the ground in such a way that earthquake motions are not transmitted up through the building, or at least greatly reduced.

B. Seismic Dampers

Seismic dampers are special devices introduced in the building to absorb the energy provided by the ground motion to the building (much like the way shock absorbers in motor vehicles absorb the impacts due to undulations of the road).

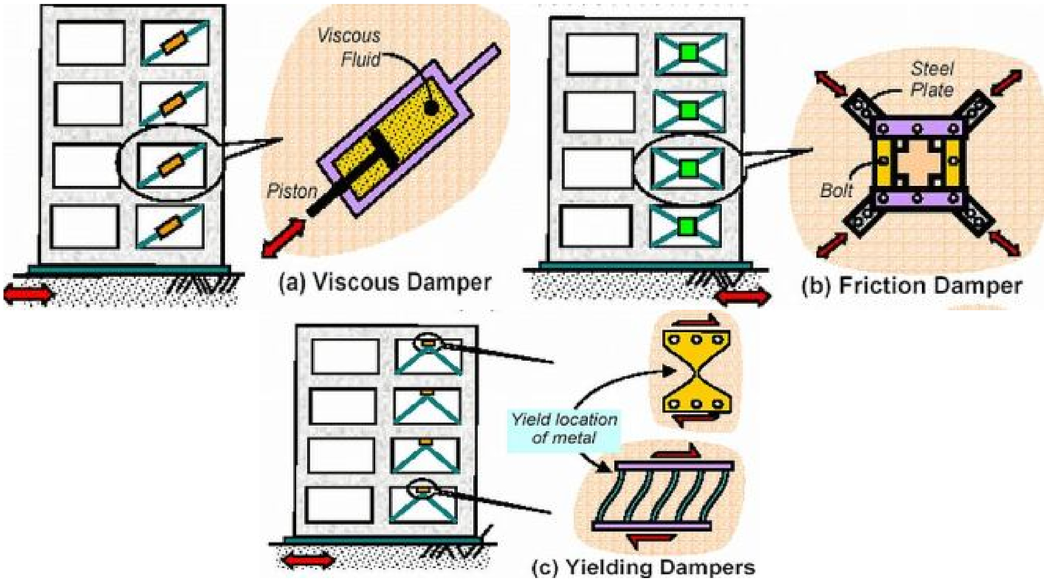


Fig. 2 Seismic Energy Dissipation Devices

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

C. Response control concept

Structural response control for seismic loads is a rapidly expanding field of control system; also know as earthquake protective system. The aim of this system is the modification of the dynamic interaction between structure and earthquake ground motion, in order to minimize the structure damage and to control the structural response. The family of earthquake protective system has grown to include passive, active and hybrid (semi-active) system as shown fig1. The control is based on two different approaches, either the modification of the dynamic characteristics or the modification of the energy absorption capacity of the structure.

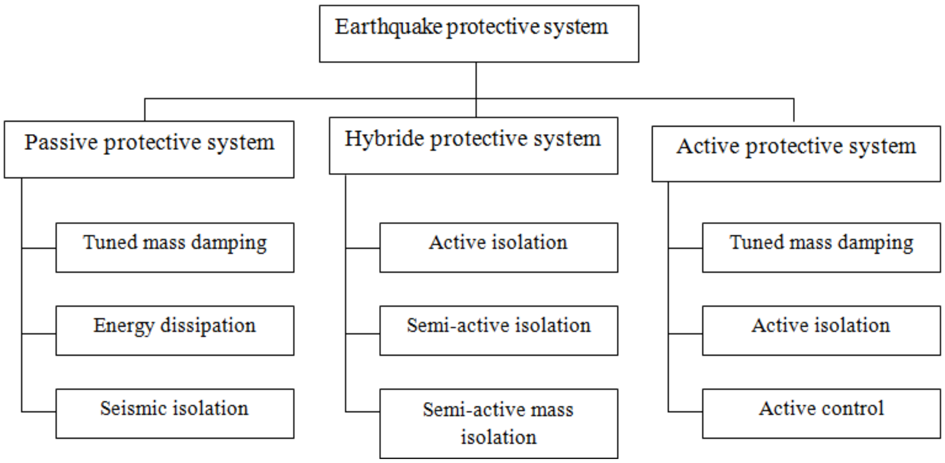


Fig. 3 Family of Earthquake protective system

In the first case, the structural period is shifted away from the predominant period of the seismic input, thus avoiding the risk of the resonance occurrence. It is clear here that the isolation is effective is only for a limited range of frequencies of structure (fig 2.). The acceleration responses in the structure for some earthquake can be reduced at the same time; for other type of the earthquake the responses have to be much worse.

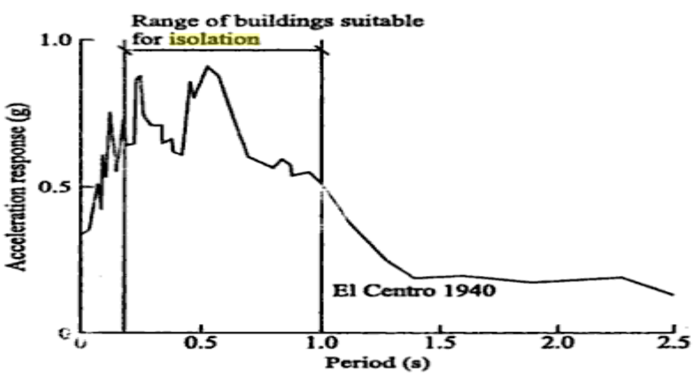


Fig. 4 Earthquake response spectra and isolation

D. Earthquake Protective Systems

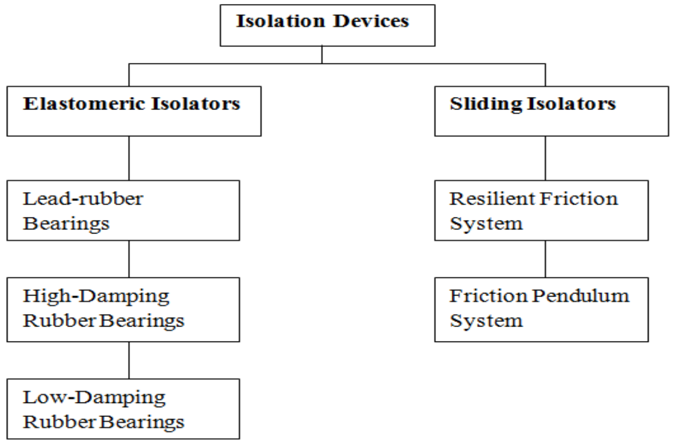
1) *Passive control systems*: A Passive control system includes the tuned mass dampers, seismic (base) isolation systems, mechanical dissipaters, and the like. These systems have significant application to buildings, bridges and industrial plants. Seismic base isolation is the most developed system at the present time. The basic concept of seismic isolation is to reduce the response to earthquake motion by (i) reducing the stiffness, (ii) increasing the natural period of system, and (iii) provision of increased damping to increase the energy dissipation in the systems.
2) *Active protective systems:* In these systems mechanical devices are incorporated in buildings, which actively participate in the dynamic behavior of the building in to the measurements of its behavior during the earthquake ground motion. The goals of active systems are to keep forces, displacement and acceleration of structure below specific bounds, in order to reduce the damage in case of a strong earthquake.
3) *Hybrid (semi-active) protective systems:* A Hybrid systems are system implying the combined use of passive active control systems.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

E. Base Isolation for Earthquake Resistance

A base isolated structure is supported by a series of bearing pads, which are placed between the buildings and building foundation. The main feature of the base isolation technology is that it introduces flexibility in the structure. Due to the flexibility in the structure, a robust medium-rise masonry or reinforced concrete building becomes extremely flexible. The isolators are often designed, to absorb energy and thus add damping to the system. This helps in further reducing the seismic response of the building.

Most Common Types of Isolation Components (Isolators)



(a) (b) (c)

Fig. 5 (a) Lead Rubber bearing (b) High damping rubber bearing (c) Friction Pendulum bearing

Fig. 6 High damping rubber bearing used in bridge

F. Advantages of Rubber bearing

1) Safe in strong earthquake.
2) Response of the isolated structures can be reduced by 1/8 ~ 1/2 of those of the traditional structures, according to testing result and the records in real earthquakes.
3) It is very effective to reduce response of structure in earthquake
4) Save the structure cost.
5) Comparing the seismic isolation structures with traditional anti-seismic structures, the building cost of isolation structures can be saved
6) Free architectural design.
7) The seismic isolation rubber bearing system can be used in the following aspects.

New design structures and existed structures.
Important buildings and civil buildings especially for house building
Both for protecting the building structures and for protecting the facilities inside the buildings

G. Lead Rubber bearing

Laminated Elastomeric Bearings with one or more lead cylinder / plug in the center are named as lead core rubber bearings where these lead plugs facilitates very effective damping during extreme movements of these bearings. Main body of the bearing, rubber being highly elastic, does not suffer any damages, where as lead plug in middle of bearing will experience the same deformation as rubber but generate heat and reduces in size, or dissipates, energy of motion--i.e., kinetic energy--by converting that energy into heat, also thus by reducing the energy entering building. This helps to slow and eventually stop the building's vibrations sooner than would otherwise be the case: helping to dampen building's vibrations. Thus, lead inserted as center core of bearing dissipates the energy of earthquake while the rubber, reinforced with steel plates, provides stability, supports structure and isolates vibrations. LRB bearings also provide excellent base isolation provided there is enough space for bearing and thermal movements are not too extreme. Lead rubber bearings can, not only be used with new building but also can be incorporated into foundations of existing buildings.

H. Friction Pendulum bearing

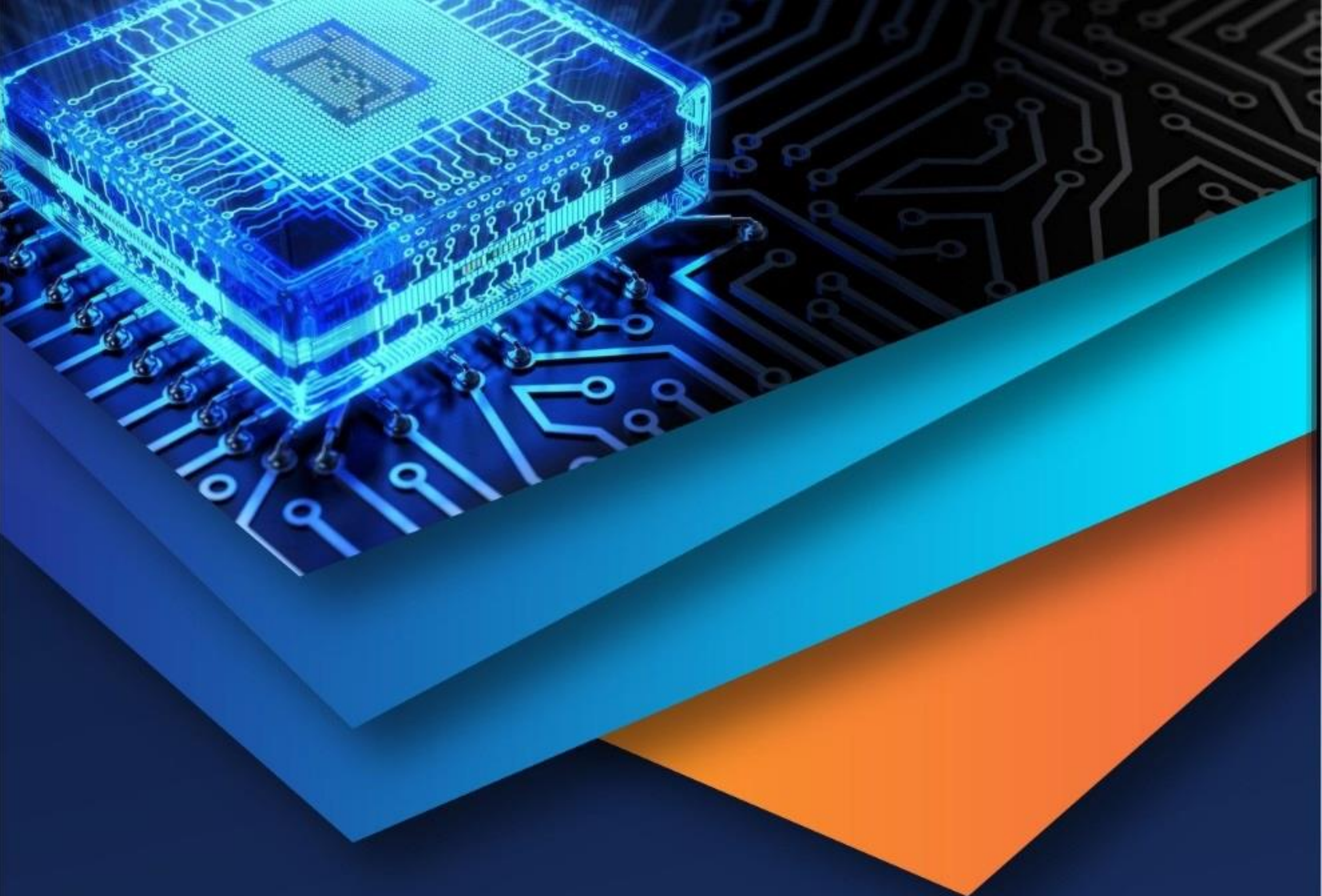
Friction Pendulum Seismic Isolation Bearings protect buildings, bridges, and industrial facilities from earthquake damage. They are structural supports that use an innovative way to achieve a pendulum motion of the supported structure. By placing these concave spherical bearings at each support point, the structure sways with a gentle pendulum motion during earthquake ground shaking. This allows the ground to shake without damaging the structure.
Principle of Friction Pendulum Isolation System **-** The period of the Friction Pendulum bearing is selected simply by choosing the radius of curvature of the concave surface. It is independent of the mass of the supported structure. The damping is selected by choosing the friction coefficient.

IV. CONCLUSIONS

From reviews of some research papers we conclude that performance of base isolated building in earthquake is better than conventional earthquake resistance design structures. We can reduced story acceleration, elastic base shear as well as inter story drift effectively by using lead rubber and friction pendulum bearings. These also reduce structural damages. Also from review we confirm that base isolation work as flexible elements as well as sliding elements that increases fundamental period of the structures and prevent transmission of earthquake force.

REFERENCES

[1] Arati Pokhrel, Jianchun Li, Yancheng Li, Nicos Maksis and Yang Yu, “Comparative Studies of Base Isolation Systems featured with lead Rubber Bearings and Friction Pendulum Bearings”, Applied Mechanics and Materials, ISSN: 1662-7482, Vol. 846, pp 114-119
[2] Parth Shah, Yash Rane, Jemini Patel and Nauka Patel, “Comparison Between Friction Pendulum System And Laminated Rubber Bearing Isolation System”, International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 02 | Feb -2017, pp 81-85
[3] K S Sable, J S Khose, V P Kulkarni, “Comparison of Different Bearing Types Performance in Multistoried Building”, International Journal of Engineering and Innovative, Volume 1, Issue 4, April 2012, pp 336-341
[4] Zaheer Ul Hassan Samdani, Ravichandra.R, Banulatha.G.N, Manu.J, “Comparative Study on Performance of Multi-Storey Structure Rubber Bearing and Friction Pendulum Base Isolation Systems”, International Journal of Advanced in Eduation Technology (IJARET), Vol. 2, Issue 2 (Apr. - June 2015), pp 150-154.
[5] Pankaj Agarwal, and Manish Shrikhande, “ Earthquake Resistance Design of Structures”, PHI Learning pvt. Ltd. New Delhi-110001-2008
[6] IITK-BMTPC Earthquake Tips:: Learning Seismic Design and Construction, National Information Centre of Earthquake Engineering at IIT Kanpur, INDIA



10.22214/IJRASET

INDEX COPERNICUS 45.98

ISRA JIF IMPACT FACTOR: 7.129

SJIFactor TOGETHER WE REACH THE GOAL IMPACT FACTOR: 7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY