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A Review Paper on Base Isolation Technique

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Abstract: ***Earthquake is one of the nature's greatest hazards, throughout historic time they have caused significant loss of life and severe damage to property, especially to Man-Made Structures. Base Isolation is an effective method for earthquake resistant design to reduce vibration transmitted from ground to the structure. Base isolation, is also known as seismic base isolation or base isolation system, is one of the most popular means protecting a structure against earthquake forces. In the present paper, different base isolation techniques are discussed.***
Keywords: ***Lead Rubber bearing Isolator (LRB), Analysis, Seismic, steel, Rubber.***

I. INTRODUCTION

A. General

An earthquake (also known as a quake, tremor or temblor) is the shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's lithosphere that creates seismic waves. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss people around and destroy whole cities.

At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground. When the epicentre of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides, and occasionally volcanic activity.

B. Causes of Earthquake

Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicentre is the point at ground level directly above the hypocenter.

Earthquakes are usually caused when rock underground suddenly breaks along a fault. This sudden release of energy causes the seismic waves that make the ground shake. When two blocks of rock or two plates are rubbing against each other, they stick a little. They don't just slide smoothly; the rocks catch on each other. The rocks are still pushing against each other, but not moving. After a while, the rocks break because of all the pressure that's built up. When the rocks break, the earthquake occurs. During the earthquake and afterward, the plates or blocks of rock start moving, and they continue to move until they get stuck again.

II. NEED OF PRESENT STUDY

The Possible risk of loss of life adds a very serious dimension to seismic design, putting a moral responsibility on the structural engineers. In recent times many new systems have been developed either to reduce the earthquake or to absorb a part of seismic energy. One of the mostly implemented and accepted seismic protection systems is base isolation.

Base isolation is one of the most widely accepted seismic protection system in earthquake prone areas. It mitigates the effect of an earthquake by essentially isolating the structure from potentially dangerous ground motions. The term isolation refers to reduced interaction between structure and ground. The other purpose of base isolation is to provide the additional means of energy dissipation, thereby reducing the transmitted acceleration into the structure. The decoupling allows the building to behave more flexible which improves its response to an earthquake.

The concept of the base isolation can be explained through an example building resting on the frictionless rollers. When the ground shakes the rollers freely roll. But the building above does not move. Thus no force is transferred to the building due to shaking of the ground. Simply the building does not experience the earthquake.

III. BASE ISOLATION

Base isolation is a relatively recent development in seismic design. The principal is to insert a discontinuity at the base of the structure that has relatively low resistance to shear. As earthquake motions are transmitted upward from the ground, the effect of the soft discontinuity will be to increase the natural period of the structure and to absorb energy by shear deformation. In general, this will reduce magnitude of the response of the structure to earthquake shaking, particularly if the structure is founded on

bedrock. Although base isolation may be effective in reducing response to horizontal shaking, the necessity for vertical stiffness in the structure to resist gravity loads makes isolation from vertical shaking impracticable.

A. Base isolation technique

The base isolation technique is a seismic design approach in which, due to the insertion of a flexible layer between the foundation and the superstructure, the fundamental frequency of the system decreases to a value lower than the predominant energy containing frequencies of earthquake ground motion. In addition, the damping capacities provided by the isolation systems help dissipate the energy imparted during seismic activities. Seismic base isolation, which is now recognized as a mature and efficient technology, can be adopted to improve the seismic performance of strategically important building such as schools, hospitals, industrial structures, multi-storey buildings etc. In order to minimize inter storey drifts, in addition to reducing floor accelerations; the concept of base isolation is increasingly being adopted. Base isolation has also been referred to as passive control.

The main principal of base isolation is to try and isolate the structure from the ground movement so you could just about put it on ball bearings if you like and the ground could move underneath it and the building stays still.

Seismic isolation is important for two reasons, one it protects the structure, now it is possible always to build a strong enough structure, however it may not be economic. One can reduce the forces being transmitted to the building, in an earthquake, by following a seismic isolation approach. Now the most important thing is that seismic isolation protects the contents.

B. Types of Base Isolators

1) *Lead Rubber Bearings:* Lead rubber bearing (LRB) are the laminated rubber bearing containing one or more lead plugs to deform in shear. The lead in the bearing deforms physically at a flow stress of 10 MPa, providing the bearing with bilinear response. For that reason the lead must fit tightly in the elastomeric bearing, and this is achieved by making the lead plug slightly larger than the hole and applying force at the time of inserting it in the hole.
2) *High Density Rubber Bearings:* High density rubber bearing (HDRB) is another type of elastomeric bearing which consist of thin layers of high damping rubber and steel plates in alternate layers. Like LRB this type of bearing does not contain lead at the center of bearing. The rubber used is either natural rubber or synthetic rubber which provide a sufficient amount of damping.
3) *Friction Pendulum System:* The friction pendulum system (FPS) is a sliding type isolation system and consists of a spherical stainless steel surface and an articulated slider, covered by Teflon based composite material. It works on the principal of simple pendulum. Friction Pendulum bearings are seismic isolators that are installed between a structure and its foundation to protect the supported structure from earthquake ground shaking.

IV. MATERIALS USED FOR BASE ISOLATORS

Lead rubber bearings were developed as base isolators in the 1970s. They consist of three basic components- a lead plug, rubber and steel, which are generally placed in layers.

A. Rubber

The rubber provides flexibility through its ability to move but return to its original position. At the end of an earthquake, if a building hasn't returned to its original position, the rubber bearings will slowly bring it back. This might take months, but it will return to its original position.

B .Lead

Lead was chosen because of its plastic property-while it may deform with the movement of the earthquake, it will revert to its original shape, and it is capable of deforming many times without losing strength. During an earthquake, the kinetic energy of the earthquake is absorbed into heat energy as the lead is deformed.

C. Steel

Using layers of steel with the rubber means the bearing can move in a horizontal direction but is stiff in a vertical direction.

D. Advantages of Base Isolators

1) Structural Damage is restricted when the structure is built on a suitable seismic isolating system.

2) Damage to indoor services and facilities would be of little concern which would normally affect gas, water or sewage leakage for unfortified structures. The base isolation will protect the structure by preventing plastic deformation of structural elements, because the superstructure demonstrates elastic behavior during initial and following excitation of the base.
3) Secondary damage as a result of falling furniture would be restricted. In other words, the level of safety is increased significantly when using base isolation system rather than conventional systems.
4) The function of buildings can be ensured during an excitation or even after a major earthquake as super structure is designed to remain elastic. Therefore, plastic deformation of structural elements can be prevented and the building is still a safe place to remain and life can continue as normal.
5) Base Isolation can be retrofitted to suitable existing structures but too many variables to give meaningful indication of cost
6) Base isolation allows for a reduction in structural elements of the building with less ductile detailing needed.
7) Crawl spaces or basements can have multiple benefits e.g. in siting services, additional income from a car park, flexibility for future development.
8) Building is safer for occupants and contents are protected.
9) When viewed against the savings it can in some cases result in a slightly lower construction cost overall
10) Isolates Building from ground motion
11) Lesser seismic loads, hence lesser damage to the structure.
12) Minimal repair of superstructure.

E. disadvantages of Base Isolators

1) Cannot be applied partially to structures unlike other retrofitting
2) Challenging to implement in an efficient manner
3) Inefficient for high rise buildings
4) Not suitable for buildings rested on soft soil.

V. SUMMARY

Study of lead rubber bearing is the most important method in base isolation as compared to other two methods.
It is applicable to low to medium of building and also protect the building from earthquake forces.
It gives needed flexibility to the structure and by using this bearings it stands against ground motion with high frequencies.

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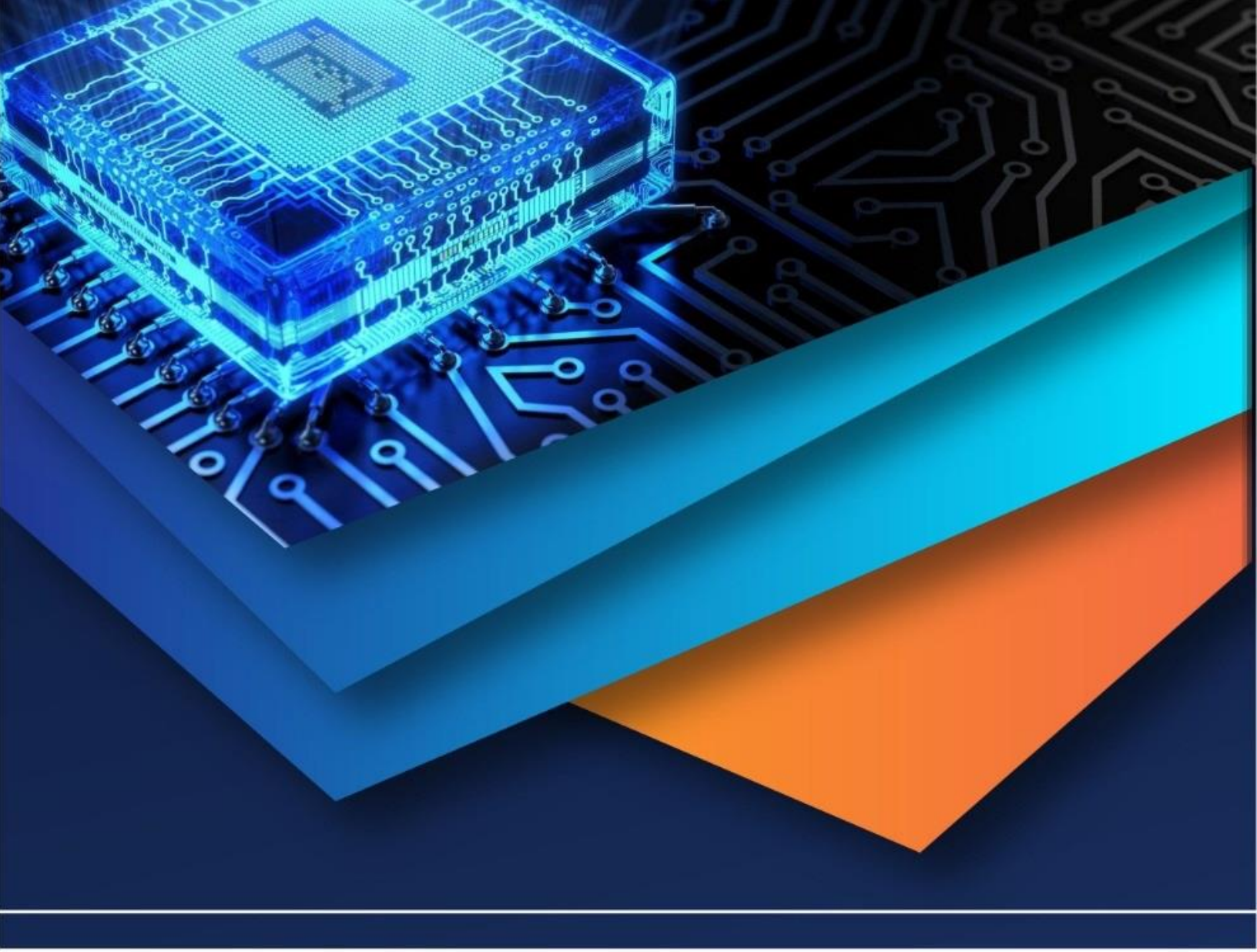

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