

# International Journal of Innovative Research in Science, Engineering and Technology

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## Combined Base Isolations for Seismic Protection of Buildings

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**ABSTRACT:** Hospital buildings are of great importance after any natural calamity such as earthquake. The structural and non-structural components should remain operational and safe after earthquake. So to mitigate the effect of earthquake on the structure the base isolation technique is the best alternative as a seismic protective system. The basic idea of base isolation system is to reduce the earthquake induced inertia forces by increasing the fundamental period of the structure. The aim of this study is the use of High Damping Rubber Bearing (HDRB), Lead Rubber Bearing (LRB) and Friction Pendulum System (FPS) as an isolation device and then to compare various parameters between fixed base condition and base isolated condition by using ETAB software. In this study the (G+5) storey hospital building is used as a test model. Analytical result obtained natural period, horizontal by acceleration and total lateral forces or seismic base shear for fixed base building using IS 1893:2002 (Part-I).

**KEYWORDS:** Base Isolation, Nonlinear time history analysis, HDRB, LRB, FPS, Regular Building.

### I. INTRODUCTION

Base isolation is one of the most important concepts for earthquake engineering which can be defined as separating or decoupling the structure from its foundation. In other words, base isolation is a technique developed to prevent or minimize damage to buildings during an earthquake and protected from the destructive forces of earthquakes by increasing the strength of the structures so that they do not collapse during such events. In other words, more rigid attachment of a building to its foundation will result in less damage in an earthquake (the principle of strengthen to resist damage). However, if the foundation is rigidly attached to the building or any other structure, all of the earthquake forces will be transferred directly and without a change in frequency to the rest of the building.

Earthquake by itself, is not a disaster, it is natural phenomenon result from ground movement, sometimes violent. These produce surface waves, which cause vibration of the ground and structures standing on top. Depending on the characteristics of these vibrations, the ground may develop cracks, fissures and settlements. The possible risk of loss of life adds a very serious dimension to seismic design, putting a moral responsibility on structural engineers. In recent times, many new systems have been developed, either to reduce the earthquake forces acting on the structure or to absorb a part of seismic energy. One of the most widely implemented and accepted seismic protection systems is base isolation. Seismic isolation is a technique to shift the fundamental natural period of a structure to the long period range, e.g., two to four seconds, by placing horizontally flexible isolation devices at the base of the structure to physically decouple it from the ground. Base isolation, also known as seismic base isolation, is a seismic mitigation approach in which the building is protected from the horizontal components of earthquake forces. To protect a building from the damaging effects of earthquake, specially designed isolators with low horizontal stiffness are introduced above foundation.

One of the main advantages of seismic isolation includes the ability to eliminate or significantly reduce structural and non-structural damage in a building, and also to enhance the safety of the building contents and

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architectural facades, and to reduce seismic design forces. These potential benefits are greatest for stiff structures fixed rigidly to the ground, such as low- and medium-rise buildings, nuclear power plants, bridges, and many types of equipment. Some tectonic and soil-foundation conditions may, however, preclude the use of seismic isolation. Generally, two categories of isolation system exist and widely used. The first category includes the family of elastomeric bearings, in which we find the high damping rubber bearing system (HDRB), the lead rubber bearing system (LRBs) and other systems. The second category includes the family of sliding bearings, in which we found the friction pendulum system (FPS).

## II. RELATED WORK

Base Isolation:

Base isolation is one of the most widely accepted seismic protection systems in earthquake prone areas.

In seismic isolation, the fundamental purpose is to reduce substantially the ground motion forces and energy transmission. The cross-Section of effect of base isolation is shown in fig.1

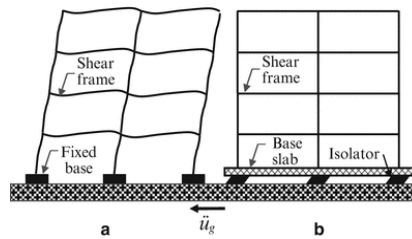


Fig.1 Effect of Base Isolation

The Concept of Base Isolation:

Significantly Increase the Period of the Structure and the Damping so that the Response is Significantly Reduced. The concept of base isolation is shown in fig.2

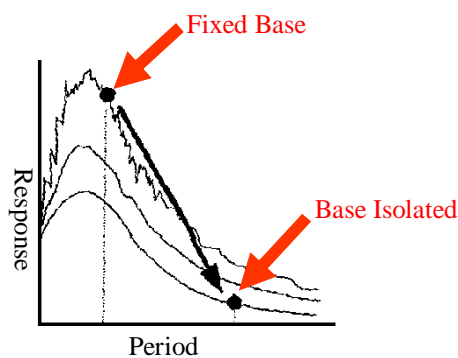


Fig.2 Concept of Base Isolation

## I. TYPES OF BEARING

1. LEAD RUBBER BEARING (LRB)
2. HIGH DAMPING RUBBER BEARING (HDRB)
3. FRICTION PENDULUM SYSTEM (FPS)

### 1. Lead Rubber Bearing:

A lead-rubber bearing is formed of a lead plug force-fitted into a pre-formed hole in an elastomeric bearing. The lead core provides rigidity under service loads and energy dissipation under high lateral loads. Top and bottom steel plates, thicker than the internal shims, are used to accommodate mounting hardware. The entire bearing is encased

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in cover rubber to provide environmental protection. When subjected to low lateral loads (such as minor earthquake, wind or traffic loads) the lead rubber bearing is stiff both laterally and vertically is shown in fig.3

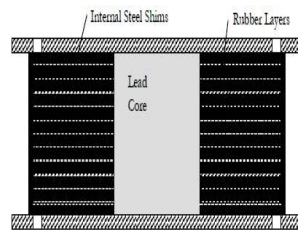


Fig.3 Lead Rubber Bearing

## 2. High Damping Rubber Bearing:

This type of bearing consist of thin layer of high damping rubber. High damping rubber is actually filled rubber compound with high damping properties due to the addition of special fillers such as carbon and resins is shown in fig.4

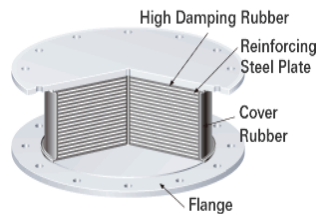


Fig.4 High Damping Rubber

## 3. Friction Pendulum System:

The Friction pendulum system (FPS) is a sliding isolation system wherein the weight of the structure is supported on spherical sliding surfaces that slide relative to each other when the ground motion exceeds a threshold level is shown in fig.5

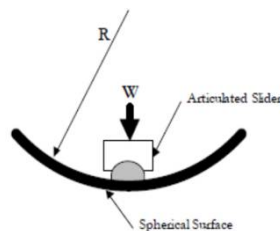


Fig.5 Friction Pendulum System

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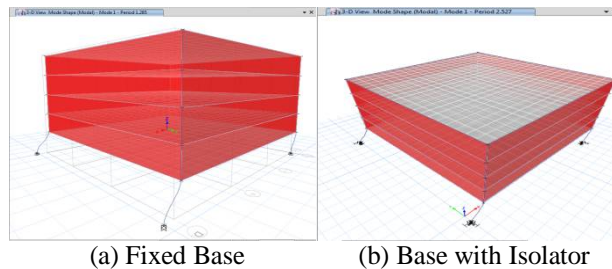
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## III. ANALYTICAL RESULTS

### Time Period Calculation:

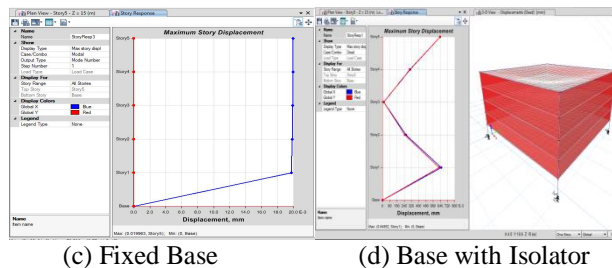


(a) Fixed Base

(b) Base with Isolator

**Result:** a) Time period of fixed base is 1.285 Sec.  
b) Time Period of Base with isolator is 2.527 Sec.

### Displacement Calculation:



(c) Fixed Base

(d) Base with Isolator

**Result:** c) Displacement of fixed base is X- Direction 20mm  
d) Displacement of base with isolator is X- Direction

- 1) I Storey 640mm
- 2) II Storey 240mm
- 3) III Storey 0mm
- 4) IV Storey 310mm
- 5) V Storey 640mm

## IV. CONCLUSION

Seismic base isolation method proved that to get better result as compare to fixed base method for earthquake design. Adoptable isolation system are requires to be effective during a wide range of seismic events. The success of this method is largely attributed to the development of isolation devices.

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