# Effect Of Base-Isolation For Building Structures

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***Abstract*— Base-isolation is best technique to prevent or minimize damage to buildings during an earthquake disaster. In the present study of base isolation in structural analysis for five storied moment resisting frame with lead rubber seismic isolation has been studied using SAP2000 software. In previous study various parameters were consider related with different base isolation technique for base shear, acceleration, torsion, storey drift etc. So in this research paper the performance of moment resisting frame in dynamic analysis studied with base isolation and the results are compared with the results obtained for moment resisting frame without base isolation. The symmetrical frame is used as test model. The analysis of using non linear seismic time history data for with and without base isolation condition. The analysis of results obtained is related for variation in displacement.**

***Index Terms*— SAP2000 software, Seismic Analysis, Seismic Base-isolation, Symmetrical**

## I. INTRODUCTION

### *A. GENERAL*

The low stiffness bearings and damper between foundation and superstructure is introducing by base isolation. This in the reduction of inertial forces and accelerations several times. Again and again Base isolation has been proposed for at least a century. Kawai in 1891, proposed a base isolated structure with timber logs placed in several layers in the longitudinal and transverse direction (Jurkovski, 1995). Variety of dampers but due to one reason or other none could be used as frequent as the isolation system comprising of elastomeric laminated rubber bearings. Earlier the elastomeric bearings were made up of natural rubber, which possess very low energy dissipating capacity resulting in unacceptably high displacements at isolation level.

The structural properties of the rubber better control in rubber technology have enabled the manufacturers of these bearings .This is achieved by mixing suitable amount of certain chemicals in the natural rubber. These filled rubbers can be used efficiently in the manufacture of isolation bearings. The laminated rubber bearings made by these filled rubbers have high initial stiffness, which reduces, at high level of shear strains. The purpose of this paper is to investigate the effectiveness of base isolation by filled rubber bearing and influence of bearing parameters viz. post-to-pre yield stiffness ratio and yield displacement on the isolation damping of reinforced concrete building excited unidirectionally with ground motions having different characteristics. The bearing is very stiff and strong in the vertical direction, but flexible in the horizontal direction. This is generally accomplished through the selection of an appropriate structural configuration and the careful detailing of structural members, such as beams and columns, and the connections between them.

### *B. How do base isolators work?*

It is a technique to prevent building during an earthquake. A fixed-base building (built directly on the ground) will move with an earthquake's motion and can sustain extensive damage as a result. Base isolators work in a similar way like car suspension. It is not suitable for all types of structures and is designed for hard soil, not soft.

### *C.Types of Isolator*

- *Lead-Rubber Bearin*
- *Laminated steel-rubber isolators*
- *Multi layer stones*
- *Filled rubber bearings*
- *Active base isolation*

### *D. Other Types*

Apart from bearing and sliding type, there are some other types of isolators, which are also used in building but rarely. Springs, rollers, sleeved piles are some examples of such isolators.

### *E. Installation of Isolator*

Base isolation system, that is, isolator is that the building be able to move horizontally relative to the ground, usually at least 100 mm and in some instance up to 1 m. A plane of separation must be selected to permit this movement. Final selection of the location of this plane depends on the structure.

### *F. Effects*

1. Horizontal components of earthquake motion mainly damage a structure rather than vertical component.
2. Damage to nonstructural systems resulted in loss of functionality of buildings, including critical facilities, and contributed to major economic losses

### *G. Response of Base Isolated Building*

The base–isolated building retains its original, rectangular shape while contrast, even though it too is displacing. It is the lead–rubber bearings supporting the building that are deformed. The deformation of base–isolated building itself escapes damage—which implies that the forces of inertial acting on the base–isolated building have been reduced. The analysis and observations of base–isolated buildings in earthquakes have been shown to reduce fixed–base buildings displacement of comparable, which



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each building undergoes as a percentage of gravity. As we noted above, increase inertial forces, and decrease, proportionally as acceleration increases or decreases.
The lead plug isolators reduces, the energy of motion, or dissipates —i.e., kinetic energy—by converting that energy into heat. And the energy entering the building by reducing, it helps to slow and eventually stop the building's vibrates sooner than would otherwise be the case —in other words, the building's vibrations due to it damps.

*H. Need for study*

Base isolation, as a strategy to protect structure from earthquake. It is a technique where in the structure is separated from the foundation by inserting base isolators under the building. These isolators allow the structure to move independently of the shifting ground below, thereby effectively isolating it from the ground motion. Base isolators can be of the following type's i.e. high-damping rubber, lead-core rubber .Base isolators made of rubber stretch with the building as the building is pushed to one side by the earthquake, then as the rubber seeks its natural form it pulls the building back into place.

## II. LITERATURE REVIEW

A. B. M. Saiful Islam*, Mohammed Jameel and Mohd Zamin Jumaat a great deal of research has been carried out regarding seismic isolation, there is a lack of proper research on its behavior and implementing technique in low to medium seismic region. The basic intention of seismic protection systems is to decouple the building[1]
Evany Nithya S., Dr. Rajesh Prasanna P. studied that using rubber elastomer for base isolation, it is possible to avoid large plastic deformation of moment resisting frame and reduce shear resulting from large scale earthquake. [3] this study shows that their may be significant application potential for non-linear semi-active devices in structural isolation.[7]

## III. FORMULATION OF PROBLEM

Modeling of the structure is done by analytically and these are used to create a 3-D structure in SAP2000 software. For analysis of the building structure with base isolation and fixed base.

*A. Earthquake Motions Considered*

In order to study effect of earthquake characteristics, earthquake motions recorded at different sites in India are considered in this study . Fourier spectra for these ground motions reveal that dominating frequencies covered by these ground motions ranges from 0.5 to 8.5 Hz.

## IV. AIM AND OBJECTIVE OF STUDY

The aim of work First includes working on the analysis of base isolation for structure. Second includes working on the correct modeling of structures with and without base-isolation.

Objectives of the work to the earthquake resistance of buildings and avoid the possible damage of building by using base-isolation technique.

*B. Scope of Problem*

To fulfill the aim following scope of work was outlined. As we see what is the effects of earthquake for structure, so analyzing structure design we provide the base –isolation. The various researches gives stability for structures with different Base –isolator characteristics is which types is suitable or efficient for isolation.

Analysis of the building with fixed base and building with base isolation is give the comparative result to resist seismic attack for structures.

**Future scope**:- Here soil-interaction and also unsymmetrical structure is not considered. Also height is not considered.

*B. Methodology*

**1.** Validation of the formulation

In the present research work three benchmark problems, available in the literature, will be solved to establish the validity of the formulation. The details of the benchmark problems are as follows:

**Benchmark problem 1**: Effect of displacement on isolation damping for building

**Benchmark problem 2**: The isolation system considered in this study is Rubber bearing.

**Benchmark problem 3**: Method Of Analysis Of Base Isolated Building by using software SAP2000

**2.** Comparison of results of problems with analysis using SAP 2000software.

## V.DESCRIPTION OF BUILDING

In the present work, a five storied reinforced concrete frame building situated in Zone IV, is taken for the purpose of study. The plan area of building is 12 x 10 m with 3.0m as height of each typical storey. It consists of 2 bays of 6m each in X-direction and 2 bays of 5m each in Y-direction. Hence, the building is symmetrical about both the axis. The total height of the building is 15m. The building is considered as a Special Moment resisting frame. The plan of building is shown in fig. and the front elevation is shown in fig.A

A.The sectional properties of elements in case of the Basic structure are taken as follows:

Size of Column = 400 x 400mm

Size of Beam = 345 x 500 mm

Thickness of Slab = 125mm thick

Soil interaction has not been considered and columns are restrained at the base.slabs defined area shell element.



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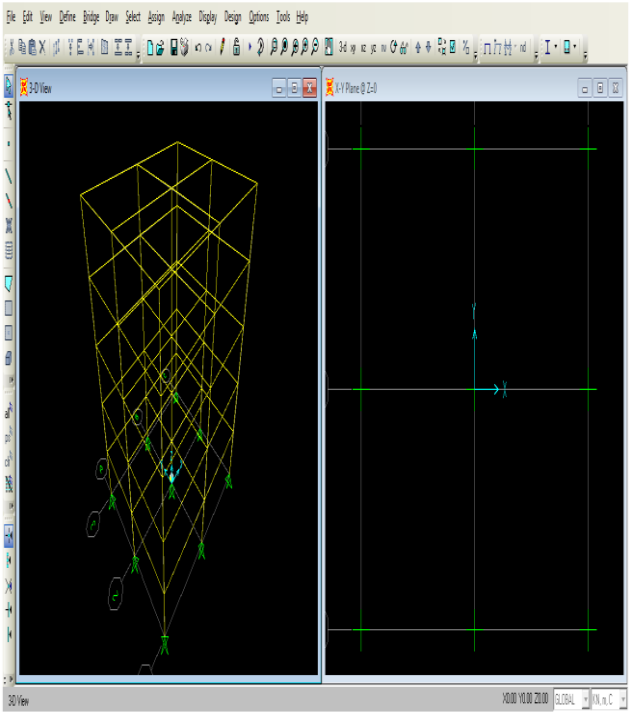


B. MATERIAL PROPERTIES :

*For concrete* **:**

Mass per unit volume= 2.5KN

Weight per volume = 25 KN/$M^3$

Modulus of elasticity,

Ec=2.5*10^7 KN/$M^2$

Damping Ratio=0.05

Poisson's ratio=0.20

Shear modulus=1500

Coefficient of thermal expansion=5.5*10^6

*C.. LOADS*

Live loads have been assigned as uniform area loads on slab elements as per

IS 1893(PART 1)2002 .Live load on all other floors=3.0 KN/$M^2$

*D.Seismic Loads*

The design lateral force at different floor levels have been calculated corresponding to fundamental time period and applied to model. In our case slab have been modeled as rigid diaphragms and in this connections the centre of rigidity (mass) and centre of gravity of building is considered same in order to neglect the effect of torsion.

EL In Y (Ux) direction=8.331*10^4 kN/$M^2$

EL In Y (Ux) direction(30%)=2.5*10^4 kN/$M^2$

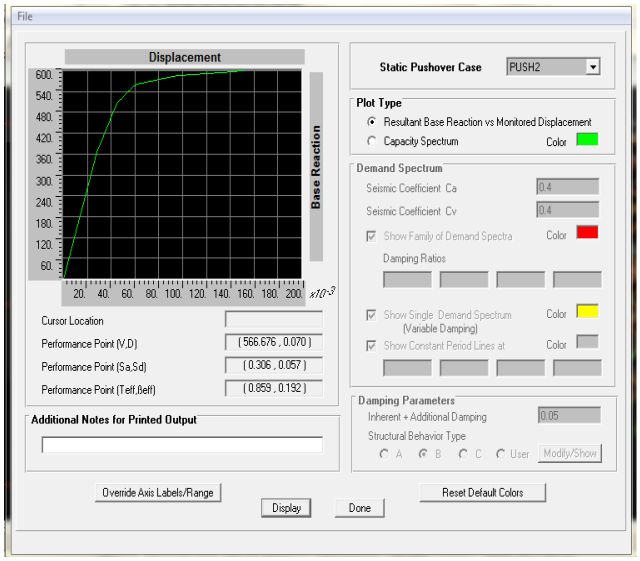
*E. Design of Rubber Bearing:-*

1. Thickness of Rubber bearing=19mm

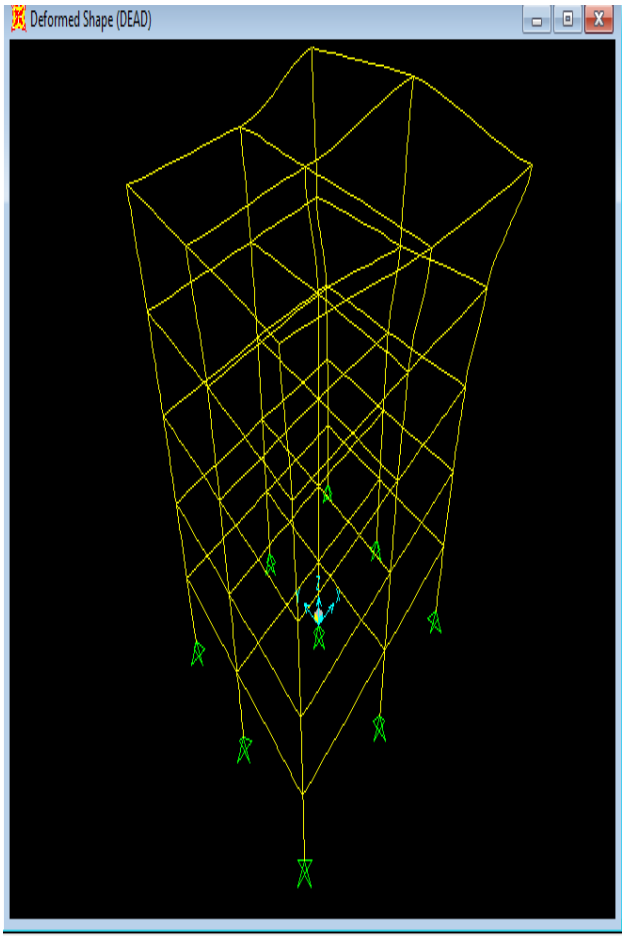
2. Height of Bearing=0.163m

3. No.of steel layers= 6

4.Steel =3mm




Displacement curve




**Deformed shape of building**



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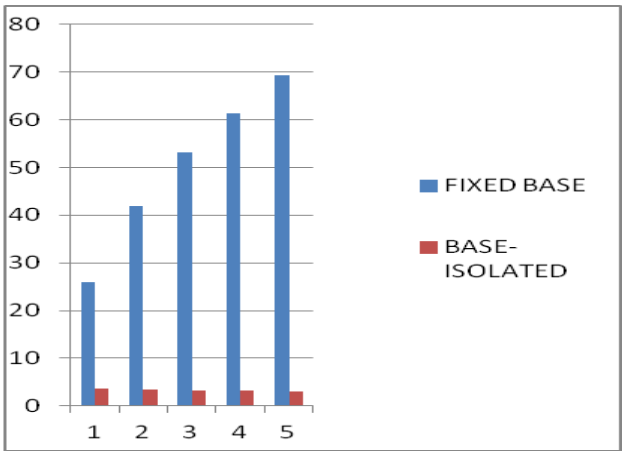
## VI.RESULTS

Comparing the Displacement:

| Displacement | Fixed Base (mm) | Rubber Isolation(mm) |
|---|---|---|
| 1st floor | 25.9 | 3.6 |
| 2nd floor | 41.9 | 3.4 |
| 3rd floor | 53.2 | 3.3 |
| 4st floor | 61.3 | 3.2 |
| 5st floor | 69.3 | 3.1 |




Comparison Of Displacement With And Without Base Isolation

## CONCLUSION

1.The present study the importance of keeping the superstructure stable while the foundation is being shaken by an earthquake. So important is that to design a system that puts this concepts into practice.

2. It is concluded that increases with height of building displacement is decreases for base-isolated building.

3. It is concluded that increases with height of building displacement is also increases for fixed base building.

4. By result obtained for displacement is less with base -isolation as compared to fixed base.

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