Base Isolation for Multistoried Buildings with Lead Rubber bearing

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Abstract- Seismic base isolation is a simple structural design approach to ease earthquake damage possible. The concept of seismic isolation has become a practical reality with the development of multilayer elastomeric bearings. These bearings are very stiff in the vertical direction and can carry the vertical load of the building but are very flexible in horizontally, thereby enabling the building move laterally like a rigid mass under strong ground motion. The main purpose of this study is to check the behavior of the buildings in seismic zone by using base isolation concept, and reduce the story acceleration, story drift and increase the period of oscillation due to earthquake ground excitation, applied to the superstructure of the G+8 building by installing base isolators like lead rubber bearing (LRB) at the foundation level then compare the performance between the fixed base condition and base isolated condition by using SAP software.

Keywords – Base isolation, Lead rubber bearing, Seismic isolation, Multistory Building

I. INTRODUCTION

The concept of base isolation is now broadly accepted in earthquake-prone region of the world for helpful important structures from strong ground motion. There are two basic different approaches to ensure the earthquake resistance design and construction of structures, i) Conventional earthquake resistant design approach. ii) Seismic isolation earthquake resistant design approach. Conventionally, seismic design of building structures is based on the concept of increasing the resistance capacity of the structures against earthquakes by employing, for example, the use of shear walls, braced frames, or moment-resistant frames. However, these traditional methods often result in high floor accelerations or large inter-story drifts for buildings. Because of this, the building contents and nonstructural components may suffer significant damage during a major earthquake. For buildings whose contents are more costly and valuable than the buildings themselves, such as hospitals, police and fire stations and telecommunication centers etc. Therefore, special technique to minimize inter-story drifts and floor accelerations, Seismic isolation earthquake resistant design is increasingly being adopted. Base isolation is to prevent the superstructure of the building from absorbing the earthquake energy. Therefore, the superstructure must be supported on base isolators to uncouple the ground motion

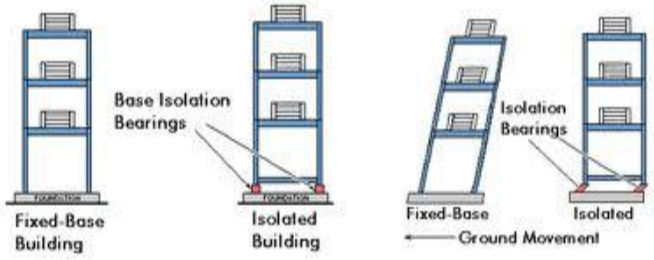


Figure 1. Behavoiur of fixed base and isolated building

II. PRINCIPLES OF BASE ISOLATIONS

1. The concept of base isolation is quite simple
2. The system decouples the structure from the horizontal components of the ground motion by interpose structural elements with low horizontal stiffness between the structure and the foundation.

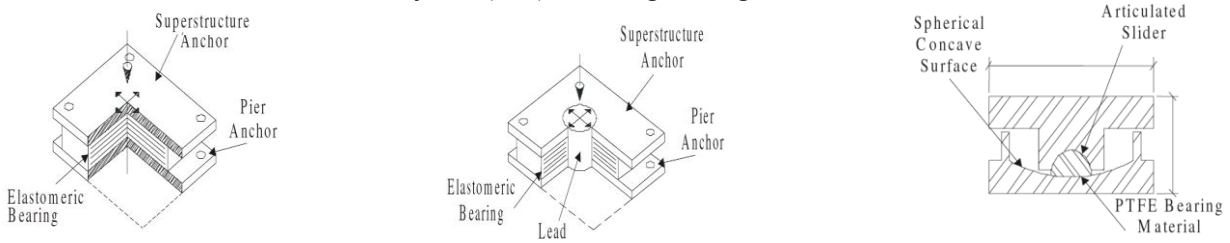
3. The fundamental principle of base isolation is to modify the response of the building so that the ground can move below the structure without transmit these motions into the building.
4. The structure and ground move the same amount
5. A building that is perfectly flexible will have an infinite period
6. A major benefit of using seismic isolation is that, by shifting the fundamental frequency of the structure away from the dangerous for resonance range, amplification of the ground acceleration is avoided.

III.BASE ISOLATION DEVICES

3.1 *Types of Base Isolators*

The most common use types of base isolators in buildings are,

1. Laminated Rubber (Elastomeric) Bearing.
2. High Damping Rubber (HDR) Bearing.
3. Lead Rubber Bearing (LRB).
4. Friction Pendulum System (FPS) or Sliding Bearing.



(a) (b) (c)

Figure 2. Various types of base isolator (a) Elastomeric/ HDR Bearing, (b) Lead Rubber Bearing, (c) Friction Pendulum Bearing

3.2 *Mechanical Propertise of Lead Rubber Bearing*

A lead rubber bearing is formed of a lead plug force fitted into a pre-formed hole in an elastomeric bearing.
Lead rubber bearing are always modeled as bilinear elements, with their characteristics based on three parameters: k_1, k_2 and Q . As shown in Figure 3.

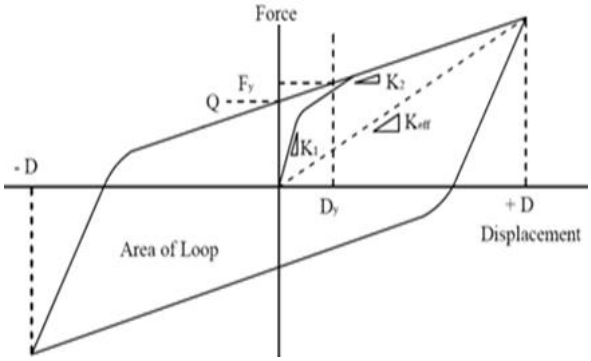


Figure 3. Parameters Basic Hysteresis Loop

IV. ANALYSIS OF G+8 BUILDING

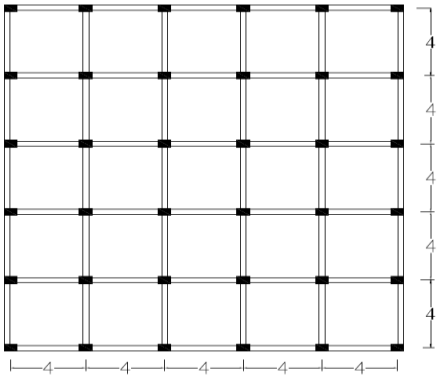


Figure 4. Location of isolators Analysis is done by Equivalent Lateral Force Procedure (at Design Period 2.5 sec)

4.1 Material Properties and Service Loads

Live load = 3.0KN/m^2 , Floor finish = 1.0KN/m^2
Water proofing = 2.0KN/m^2
Earthquake load as per IS-1893 (part I) – 2002, Type of soil = Type II, medium as per IS: 1893
Story height = 3m, Walls = 0.230 m thick brick masonry wall
Material Properties- Concrete- M30, E_C= 27386.12 N/mm^2

Table -1 Summary of equivalent lateral force procedure Uniform Building Code -1997 is used

Items	G+8
	BI-Bottom
Design Period	2.5
MCE Period	3.5
T_X (Sec)	0.9
$K_{D\ MIN}$	38194
$K_{M\ MIN}$	19487
$K_{D\ MAX}$	46682
$K_{M\ MAX}$	23817

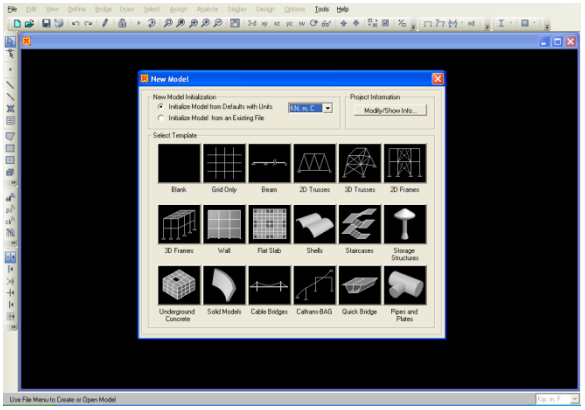
Table -2 Summary of design of base isolators

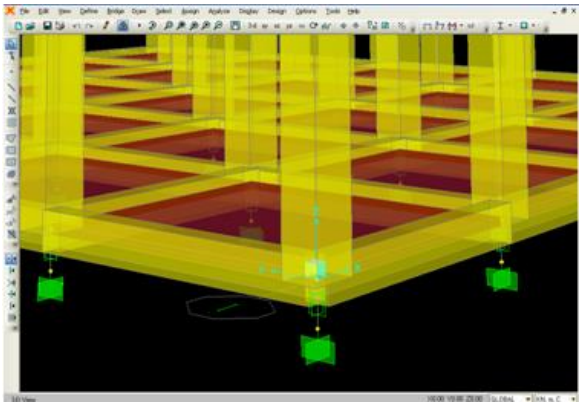
	G+8
Design period	2.5
No. of isolator	36
Load/isolatr	1648
K_{eff} / isolator	1061
K_1 / isolator	8110
K_2 / isolator	811
Q / isolator	131
Rotation of K_2 / K_1	0.1

4.2 Software for Present Study

In this present study SAP 2000 is used. SAP 2000 has capability to perform equivalent static analysis, response spectrum analysis, linear response history analysis, and non-linear response history analysis.

There are two types of link elements that are built into SAP2000: ISOLATOR1 is usually used to model elastomeric-type bearings and ISOLATOR2 is considered for friction pendulum bearings





V. RESULTS

5.1 Model Period

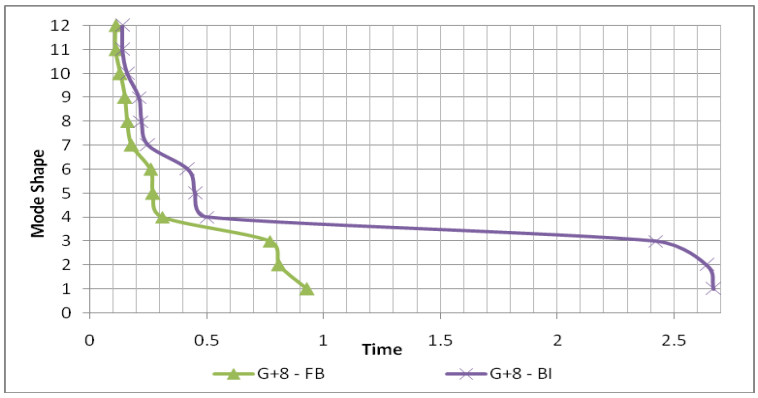


Figure 5. Model period for G+8 Building

5.2 Displacement

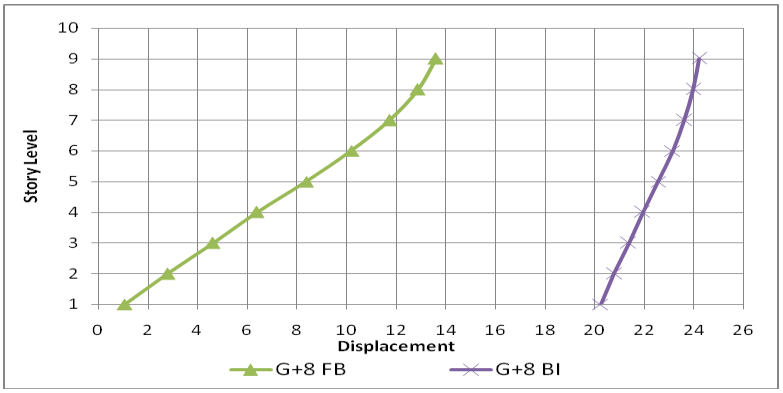


Figure 6. Displacement

5.3 Story Drift in X and Y direction

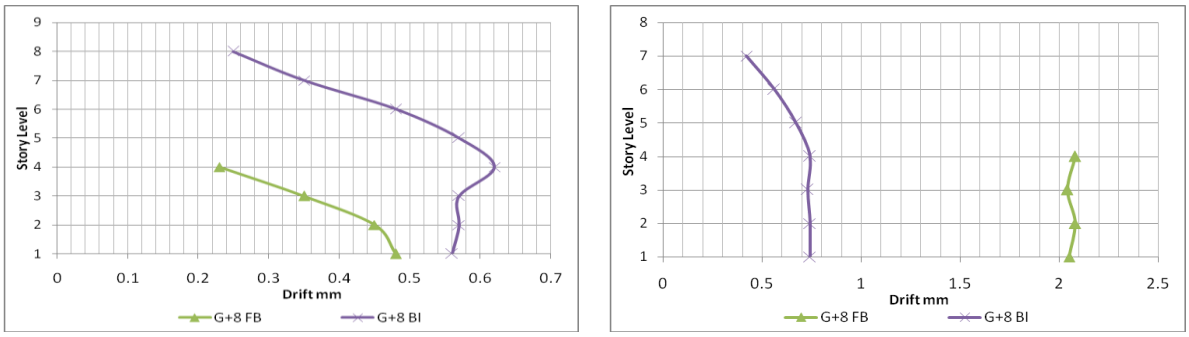


Figure 7. Strory drift in X direction and in Y Direction

Nomenclatures
FB- Fixed Base Structure
BI - Base Isolator

VI.CONCLUSION

In this period of technology revolution the world of seismic engineering is in require of inspired thinking and advanced technology beyond conventional solutions. Seismic solution is a suitable technology for protection of a selection of buildings that have the necessary dynamic characteristics. The theory of seismic isolation permit considerable cost saving for isolated buildings compared to conventional construction methods.
From the present study, a comparison is made between base isolated and fixed supported building models. From this study it is found that, by using seismic base isolation technology to building models, the story accelerations are reduced significantly. Story drift can be reduced in base isolated buildings.

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