International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072

TIME HISTORY ANALYSIS OF MULTI STORY BUILDING WITH AND WITHOUT BASE ISOLATION

TANVEER M[1], C S VIJAYA KUMAR[2], Dr M N SHIVAKUMAR[3]

[1]*Post Graduate in Structural Engineering, BIET College, Davanagere-577004, India*
[2]*Assistant Professor, M. Tech Structural Engineering, BIET College, Davanagere*
[3]*Associate Professor, M. Tech Structural Engineering, BIET College, Davanagere*

Abstract - *Base isolation (BI) is a technique that has been used around the world to protect the building structures from the damaging effects of earthquake. The installation of isolator in building at base level considerably increases the time period of the structure, which means it reduces the possibility of resonance of the structure giving rise to better seismic performance of the building. The analysis is performed to compare the effectiveness of base the multi-storied RC frame building. For this study, multi storied R.C frame building has been considered and Time History analysis is carried out using ETABS software version 2016. The results obtained from the analysis are compared in terms of story displacement, story drift, story stiffness and story acceleration. Story stiffness for base isolated structure decrees and it increases flexibility in structure. Due to the presence of isolator, story stiffness and story acceleration are significantly reduced in each direction (X and Y direction) as compared to fixed base building.*

Key Words: **Time history, lead rubber bearing, Fixed base, Isolate base, Multi story.**

1. INTRODUCTION

In the current world the growth of population and population density is very rapid that leads the area available for the people is goes on reducing day by day. The necessity of the more comfort and less available area leads to the innovation of multi story buildings. The basic necessity of any structure is to resist all types of loads acting on it and to provide comfort for living. For the design of these multi story building we need to consider lateral loads along with the gravitational loads. As the height of the building increases the effect of wind force and the earth quake effect increases and may cause higher damage. Among all the lateral forces seismic force is considered as the Predominate force because it acts in a shorter period of time and levees higher damage to the structure. The sudden abrupt shaking of the earth crust causes the earth quake this is due to collision between the plates of the earth. It causes release of tremendous amount of energy in the form of waves that leads to induction of seismic force in the structure.

Naturally occurring earth quake doesn't affects human beings but the structure made by the humans will affect due to the improper resistance to the seismic loads, depending on the previous experience we are able to predict the possible damage that can occur on the structure and we have developed suitable analysis method and software that helps in structure response of structure for the better design.

2. SEISMIC CONTROL

In the building there is always some vibration due to earthquake and wind pressure and many other lateral loads and these can be minimize by several essential kind of means. These intangible methods may include some parameters like rigidity, damping, and some forces like active and passive forces. Up to date there are several methods were used to control the structure and new invention methods were also taking place and they are showing success when they are used and approaches helps in extension of their application and performance improvement. Presently research is reaching its peak level to control or minimize the building by using some control device and hock to hock efforts are been taking place from last 20 years to make control devices into a better workable technology. It also noted that these are part of some hospitals and some other retrofitting structures. Presently isolation methods or tuned mass are quite offenly seen and buildings were remain to stay in elastic perfectly.

2.1 Lead rubber bearing

These are mainly built up for dampers of low elastomers and cores of lead of around 15%-33% of bearing bonded diameters. The bearing affords the anticipated displacements for earthquake isolation. Use of combination of lead-plug and laminated-rubber bearings which affords enormous dissipation energy (hysteretic energy) which leads to a merging of single component and for the successful system or isolation system the dampers are essential. Lead-plug bearings shear strain range between the 12.5% and 20% and it varies as a purpose or function as producer or manufacturer. Usually these LRB isolators are of cylindrical in nature of bearings along with steel shims reinforcement. There will be alternate placement of rubber and shims and at isolators both ends steel plates are provided a typical LRB is shown in fig 1 Load carrying capacity is enhanced by the steel shims which in turn stiffened under the vertical loading and which in turn flexible under the horizontal loading. The rectification of the response of the building is the main essential (fundamental)

principle of base isolation system without any conveying these motions into the frame. In an ideal system to achieve this flexibility in structure this separation would be required. But In the existing world there is a need to have some contact between the superstructure and sub structure we provide some device that can help to reduce the transfer of load through these isolators.

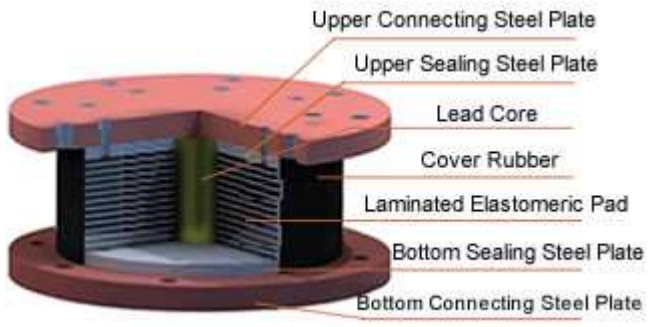

Fig-1: Typical Lead rubber bearing

3. TIME HISTORY ANALYSIS

For performing seismic analysis we are considering nonlinear dynamic analysis or time history analysis. It is considered as one of the most effective analysis in this we are considering a real time earth quake data and subjected the structure to that earth quake and observing its response. In this project we considered an earth quake held on the 26th January 2001 in Gujarat at 8:46 AMIST and lasted for 120 seconds. It is famously called as Bhuj earth quake. The intensity of earth quake reached 7.7 on the moment magnitude scale and had maximum select intensity of X (Extreme) on the mercalli intensity scale. The earth cause a death of around 33828 peoples and injured 167000 and nearly 400000 houses were destroyed in the fig 2 shows the time history graph of Bhuj earth quake.

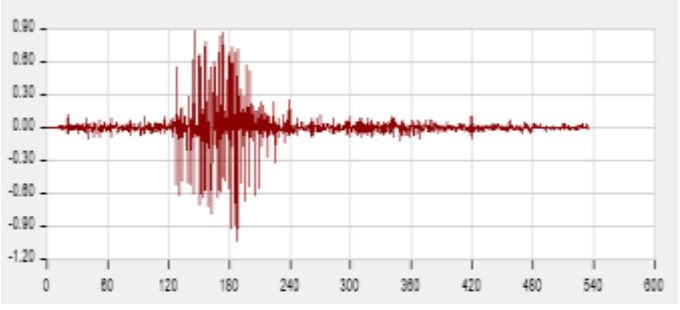

Fig-2: Time history data of Bhuj earth quake

4. OBJECTIVE OF THE STUDY

1. To carry out modelling of base isolated and fixed base building using ETAB-2016 software and study the effect of earthquake ground motion on the model.
2. To know the behaviour of multi story building with and without base isolation
3. To find the response of RC building subjected to a selected earth quake ground motion by time history analysis.

5. METHODOLOGY

1. A multi-story building of G+23 story having a story height of 3m and total height of 72 m is modelled
2. The conventional building is modelled with the fixed base
3. The isolated building is modelled by providing LRB isolators.
4. The LRB were designed manually by using maximum vertical reaction of structure.
5. This model includes structural components such as beam, column and slab. The joints were assumed to be rigid.
6. For performing time history analysis Bhuj earth quake of 2001 is considered.

6. MODELING AND ANALYSIS

6.1. Gravitational loading on structure.

- Live load on floors = 3 kN/m^2
- Dead load on roof = 1.5 kN/m^2

6.2. Geometric Properties

- Column size = 300mm x 300mm
- Beam size = 300mm x 450 mm
- Slab thickness = 125mm

6.3. Material properties

- Grade of concrete=M30
- Grade of steel=Fe500

6.4. Seismic parameters

- Seismic zone= zone V
- Response reduction factor, R=3
- Importance factor, I=1
- Type of building = Commercial

6.5. Response spectrum

- Seismic zone factor, Z=0.36
- Soil type= II
- Damping ratio=0.05

6.6. Wind load parameters

- Wind speed=50 m/s

- Terrain category=3
- Importance factor=1
- Risk coefficient=1
- Topography=1

TABLE-1: SPECIFICATION OF LEAD RUBBER BEARING

SI NO	Parameters	Remark
1	Required stiffness	9965.08 kN/m
2	Bearing horizontal stiffness	2661.72 kN/m
3	Vertical stiffness	3463673.142 kN/m
4	Yield strength	57.911 kN
5	Stiffness ratio	0.1
6	Damping ratio	0.05

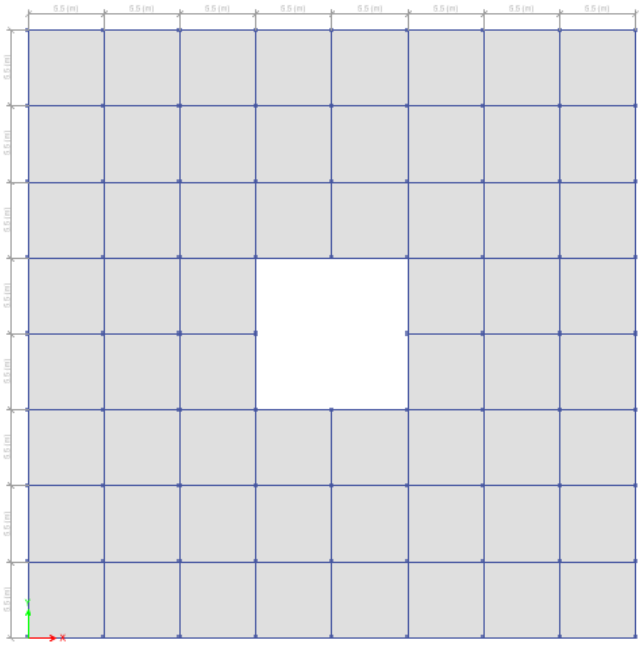

Fig-3: Plan of building in E-TABS

7. RESULTS AND DISCUSSION

7.1. Story displacement

Story displacement are extracted from the results. We can observe that base isolation has more displacement then fixed base for both X and Y direction.

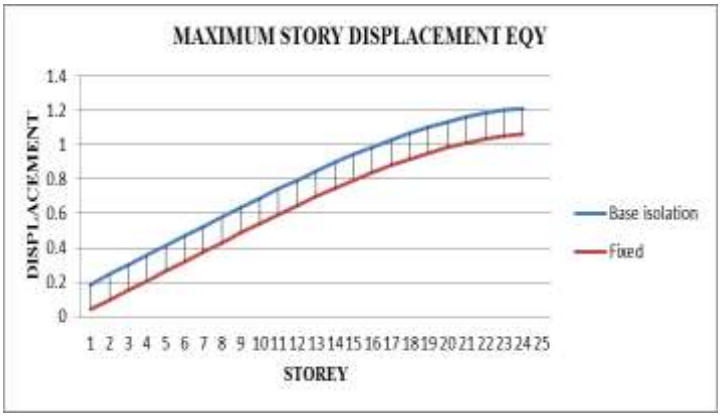

Fig-4: Comparison of story displacement in fixed base and base isolated structure for load case EQX

Fig-5: Comparison of story displacement in fixed base and base isolated structure for load case EQY

7.2. Story drift

Story drifts are extracted from the results. We can observe that the isolated base is having higher drift than fixed base in both the direction.

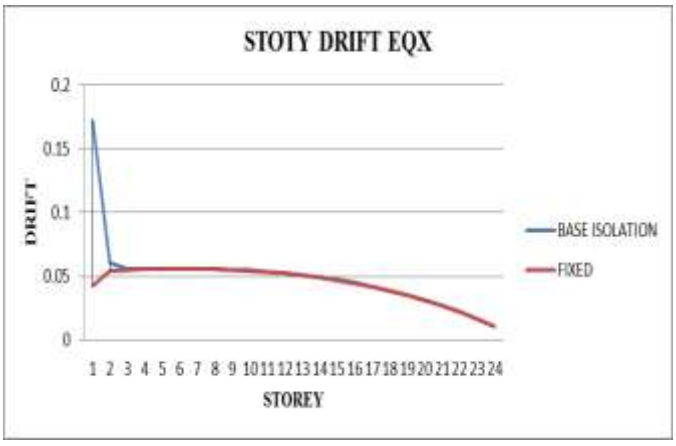

Fig-6: Comparison of story drift in fixed base and base isolated structure for load case EQX

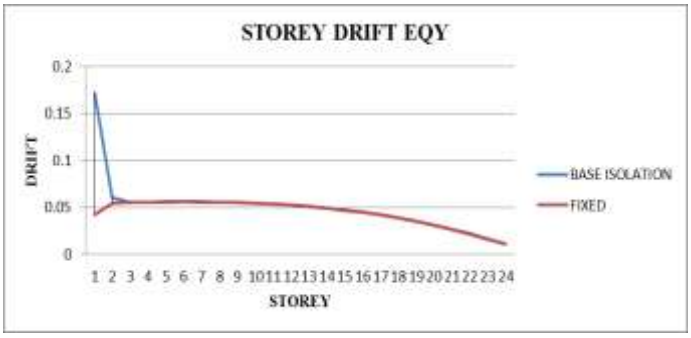

Fig-7: Comparison of story drift in fixed base and base isolated structure for load case EQY

7.3. Story stiffness

Story stiffness are extracted from the results.it is observed that stiffness of fixed base is more than isolated structure.

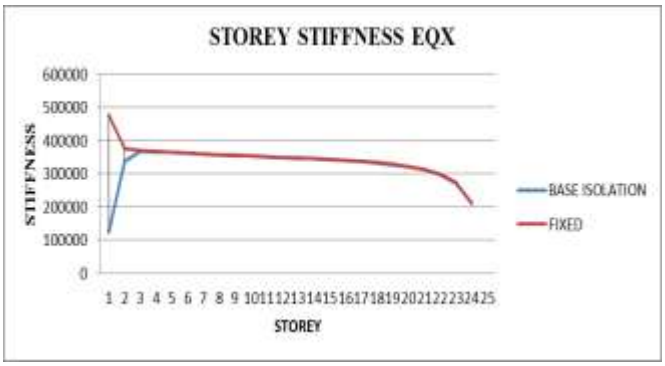

Fig-8: Comparison of story stiffness in fixed base and base isolated structure for load case EQX

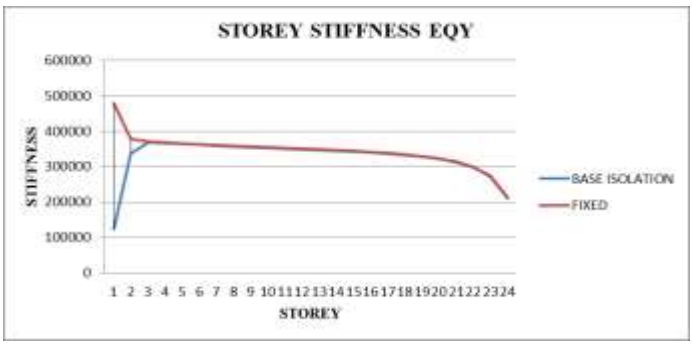

Fig-9: Comparison of story stiffness in fixed base and base isolated structure for load case EQY

7.4. Story Acceleration

Story acceleration are extracted from the results. We observe that story acceleration is less for isolated base than fixed base up to 6th story. From 7th story to 13th story the acceleration for isolated structure is more than fixed and then the acceleration for base isolation decreases than the fixed base.

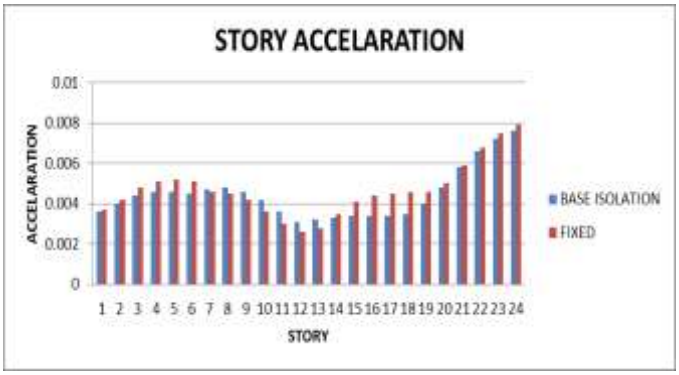

Fig-10: Comparison of story Acceleration in fixed base and base isolated

8. CONCLUSIONS

1. We can observe that base isolation has more displacement then fixed base for both X and Y direction.
2. we can observe that the isolated base is having higher drift than fixed base in both the direction
3. It is observed that stiffness of the isolated building is reduced, that imparts the flexibility in structure that helps to reduce the effect of seismic load on the structure.
4. We observe that story acceleration is less for isolated base than fixed base up to 6th story. From 7th story to 13th story the acceleration for isolated structure is more than fixed and then the acceleration for base isolation decreases than the fixed base.
5. From the above discussion we can conclude that the structure with isolated base have more resistance to the seismic loading than the fixe base.

9. SCOE FOR FUTURE WORK

1. This study can be further extended to the comparison with different type of base isolators for different seismic zones
2. We can add the shear wall in the structure with the base isolators to study its response for the seismic forces
3. We can further conduct the study on the comparison of design and percentage of reinforcement required in the structure having fixed base and isolated base.

10. REFERENCES

[1] Abrishambaf and G. Ozay (2010), "*Effects of isolation damping and stiffness on the seismic behaviour of structures*", ISBN: 978-960-474-251-6We can add the shear wall in the structure with the base isolators to study its response for the seismic forces.

[2] Athamnia Brahim and Ounis Abdelhafid (2011), "*Effects of seismic isolation in the reduction of the*

seismic response of the structure", International Journal of Applied Engineering Research, Dindigul, Volume 2, No 2, 2011, ISSN 09764259.

[3] Farzad Naeim and James M. Kelly (1999), "*Design of seismic isolated structure*", John Wiley and Sons, inc.Newyork.

[4] Farzad Naeim and James M. Kelly (1999), "*Design of seismic isolated structure*", John Wiley and Sons, inc.Newyork.

[5] IS 875-Part 1 (1987), "*Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures. Part 1 Dead load-Unit Weights of Building Material and Stored Structures*", Bureau of Indian Standards, New Delhi, India.

[6] IS 875-Part 2 (1987), "*Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures. Part 2 Imposed Loads*", Bureau of Indian Standards, New Delhi, India.

[7] "*Design Loads (Other than Earthquake) for Buildings and Structures. Part 3 Wind Loads*",Bureau of Indian Standards, New Delhi, India.

[8] Mehmet Komur, Turan Karabork and Ibrahim Deneme(2011), "*Nonlinear Dynamic Analysis of Isolated and Fixed-Base Reinforced Concrete Structures*" Gazi University Journal of Science GU J Sci 24(3):463-475.

[9] S.K. Sabu, H.S.Chore, S.B.Patil (2014), "*Effectiveness of Lead Rubber BaseIsolators, for seismic resistance of Buildings, supported on different soil stratas*," ISSN (Online): 2347-2820, Volume -2.

[10] T.K. Datta (2010), "*Seismic Analysis of Structures*", Indian Institute of Technology Delhi, India.

BIOGRAPHIES

TANVEER M
Post Graduate Student
Dept. of Civil Engineering
BIET College, Davangere

C S VIJAYA KUMAR
Assistant professor
Dept. of Civil Engineering
BIET College, Davangere

Dr M N SHIVAKUMAR
Associate professor
Dept. of Civil Engineering
BIET College, Davangere