iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VIII **Month of publication:** August 2022

DOI: https://doi.org/10.22214/ijraset.2022.46403

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VIII Aug 2022- Available at www.ijraset.com

Seismic Performance of Multi Story Building with Different Base Isolators

Gautam Rajput[1], Vinayak Mishra[2]
[1]M. Tech, Structural Engineering, Institute of Engineering and Technology, Lucknow, Uttar Pradesh, India
[2]Assistant Professor, Civil Engineering Department, Institute of Engineering and Technology, Lucknow, Uttar Pradesh, India

Abstract: Earthquakes are one of nature's most dangerous hazards; throughout history, they have resulted in substantial loss of life and serious property damage, particularly to man-made structures. Seismic activity of large magnitude is a major source of risk for all types of constructions. We apply unique methodologies based on performance-based seismic design to protect structures from earthquakes. One way for reducing the influence of large-scale vibration created during an earthquake is the base isolation method. Seismic isolation can be used to give an efficient solution for a variety of seismic design difficulties according to well-established practices that have been examined by several researchers. It compares the performance of two types of isolators: Lead Rubber Bearing (LRB) and Friction Pendulum Bearing (FPB). G+12 R.C structure is taken in this study & Time History analysis is performed with ETABS software. Story drift and Story force are compared for the building with the base isolator against the building with the fixed base. In comparison with a fixed base building, parameters are changed in each direction due to the presence of an isolator. The analysis examines the characteristics and the effects of base isolation on structures with the Uttarkashi earthquake.
Keyword: Seismic analysis, Time history analysis, Lead rubber bearing, Friction pendulum bearing.

I. INTRODUCTION

The concept behind base isolation is that a structure can be significantly separated from the destructive horizontal components of earthquake strong ground motions. Diagonal bracing and shear wall are the main control measures used in rigid structures to reduce inter story displacement during an earthquake. In base-isolated buildings, the main control strategy is to use dampers and isolators to control the destruction. Nevertheless, risks of serious destruction of the building are increases by inter story drift & storey accelerations of highly stiffening components, notably under a significant earthquake. High-rise buildings with flexible structures can efficiently prevent resonance conditions decreasing structural response.

II. LITERATURE REVIEW

Considering the El Centro, Kobe, and Northridge earthquakes, researchers examined the impact of base isolation on a four-story reinforced concrete building. According to UBC-97, high damping rubber bearings are created for earthquakes close to fault lines. A bi-linear hysteretic type is used to model the isolator's force deformation behavior. It was discovered that the analytical results and the design calculation results were identical. When compared to fixed type buildings, base isolated structures have lower storey drifts.(1)

This paper conducted a comparison of the performance of a G+10 storey, irregular RC building utilizing friction pendulum base isolators and lead rubber bearings. The analysis was done using SAP 2000 software with and without base isolators. El Centro earthquake was used for Equivalent Static Analysis and Time History Analysis. Lead Rubber Bearings exhibit less displacement and variation than Friction Pendulum System when measured for storey displacements and drifts in Earthquake Zone V utilizing 15% damping in both isolators. The vertically uneven L-shaped building with both isolators was determined to have the same base shear.(2)

Examined the seismic performance of a G+14 conventional RCC building utilizing lead rubber bearings and time history analysis to determine reaction spectrum. Here, vertical geometric irregularity, stiffness irregularity, and mass irregularity were investigated. Excitation from the El Centro earthquake was used to analyze time history.

For base isolated buildings, the shear force, maximum bending moment, story acceleration, base shear and story drifts were minimized. As a result, base separation successfully lowers the seismic responses. As base isolation reduces the rigidity of the buildings, the fundamental time period for base isolation lengthens.(3)

Base isolation system is the major method utilized for seismic resistance. Three earthquakes have undergone time history analysis: Compared the results of isolated base condition with conventional building, El Centro, Loma, and Coyote, found that isolated base technique decreases base shear & story drifts. Time history analysis is carried out with base-isolated model with fixed-base model has shown that isolated base system lowers the base shear & story drifts. (4)

III. DETAIL OF MODELLING

In the first model we made fixed base building for G+12 story and in the second modeling we made the Lead rubber isolated building (LRB) for G+12 story and for the third one model we made the Friction pendulum bearing (FPB) of G+12 story.

TABLE I.
STRUCTURAL CONFIGURATION (IS 456:2000)

S No.	Parameters	Dimension
1.	Grade of steel	Fe 415
2.	Grade of concrete	M25
3.	Storey height	3.2 m
4.	Beam dimension	300×600mm
5.	Column dimension	450×450mm
6.	Wall thickness	230mm
7.	Slab thickness	150mm
8.	Live load on floor	3KN/mm^2

TABLE II.
SEISMIC PROPERTIES (IS 1893:2016)

1.	Zone	V
2.	Importance factor	1
3.	Damping ratio	5%
4.	Soil profile	Medium soil-II
5.	Response Reduction Factor	5

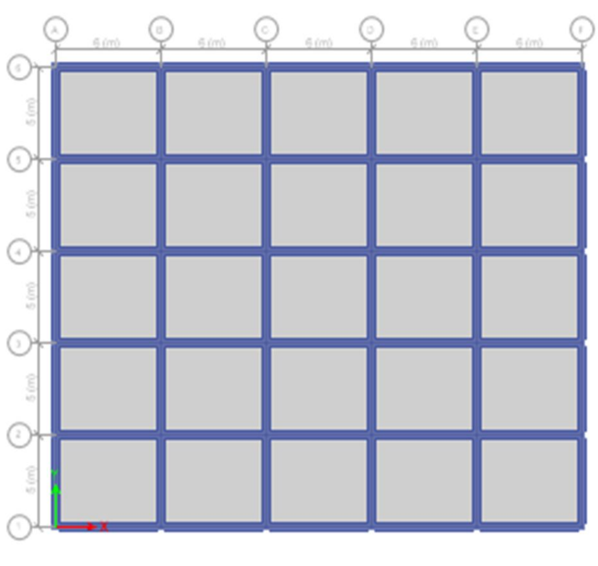


Fig.1- Plan view for (G+12) Building

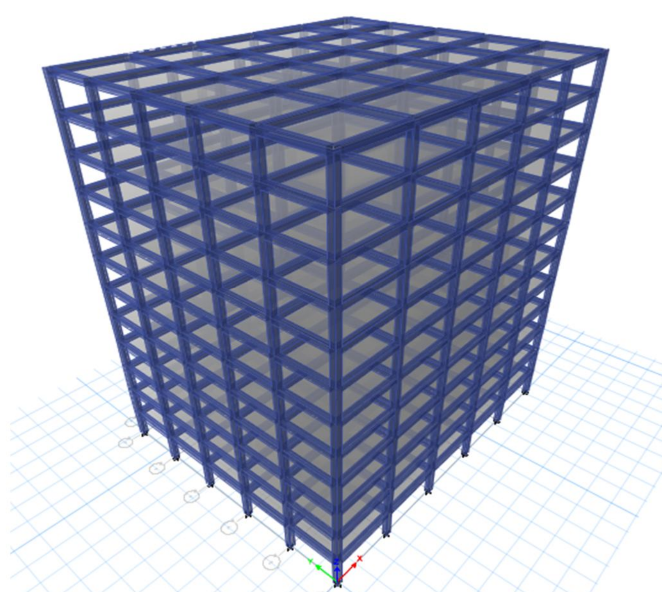


Fig.2 -Elevation view for FB (G+12) Building

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VIII Aug 2022- Available at www.ijraset.com

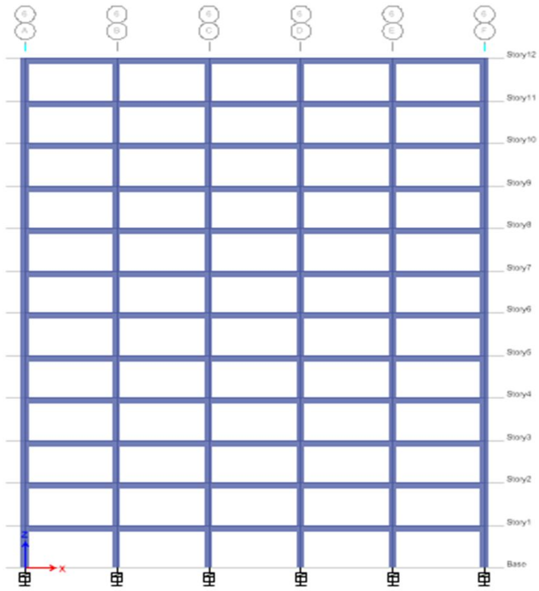


Fig.3- Model for LRB (G+12) Building

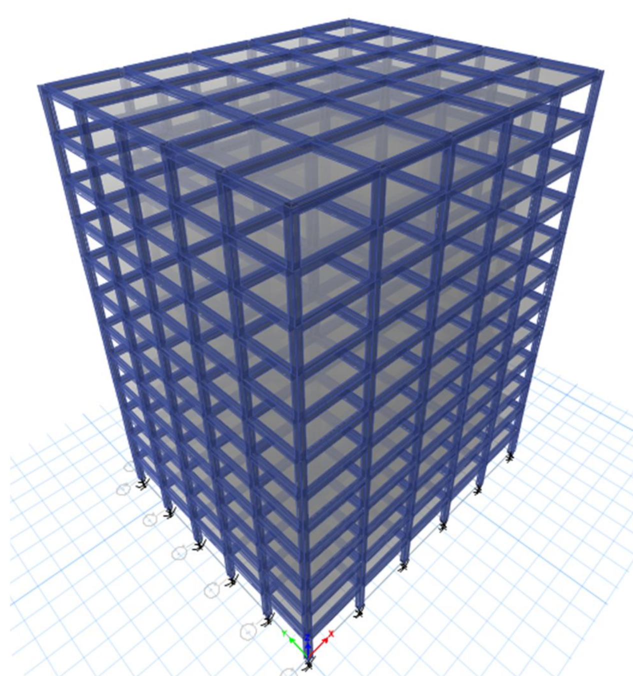


Fig.4-Model for FPS (G+12) Building

IV. METHODOLOGY

PREPARING BASE ISOLATED LRB, FPB AND SIMPLE G+12 BUILDING USING ETABS SOFTWARE

CHOOSE APPROPRIATE METHOD FOR ANALYSIS TO GET PRECISE RESPONSE FOR MEDIUM SOIL CONDITION

ANALYSIS FOR PREPARED MODELS EQUIPPED WITH SEISMIC ABSORBERS TO DETERMINE SUITABLE STRENGTH ON MEDIUM SOIL

SEISMIC PARAMETERS SUCH AS STORY DRIFT, DISPLACEMENT & STORY FORCE ARE REQUIRED TO BE EXTRACTED FROM MODEL RESULT

CONCLUSIONS

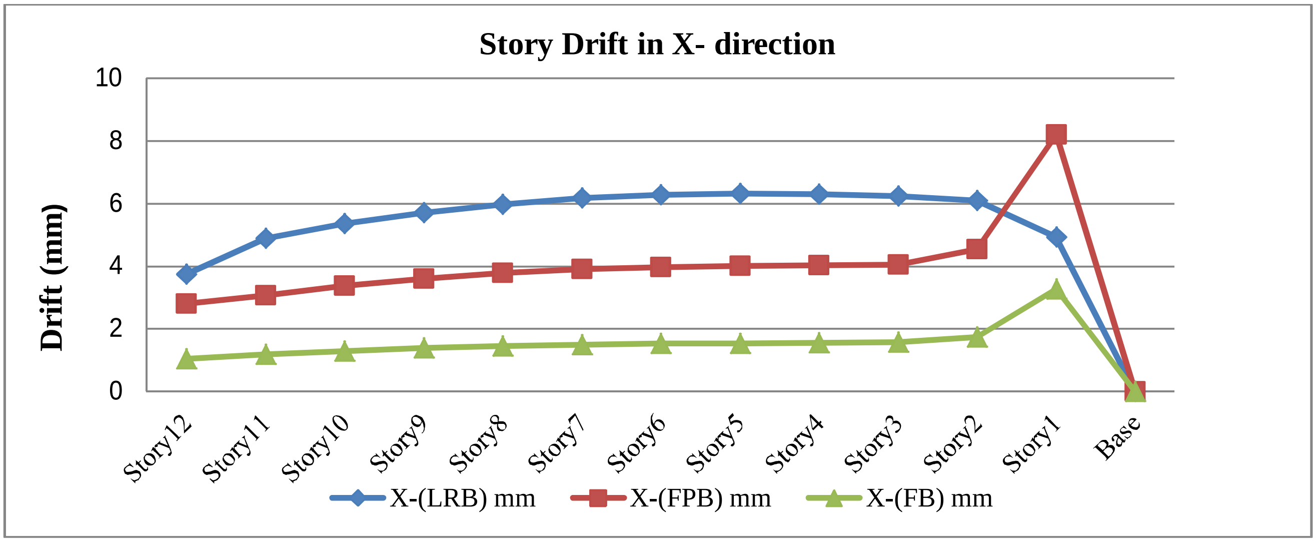
V. RESULTS AND DISCUSSION

A. Story Drift

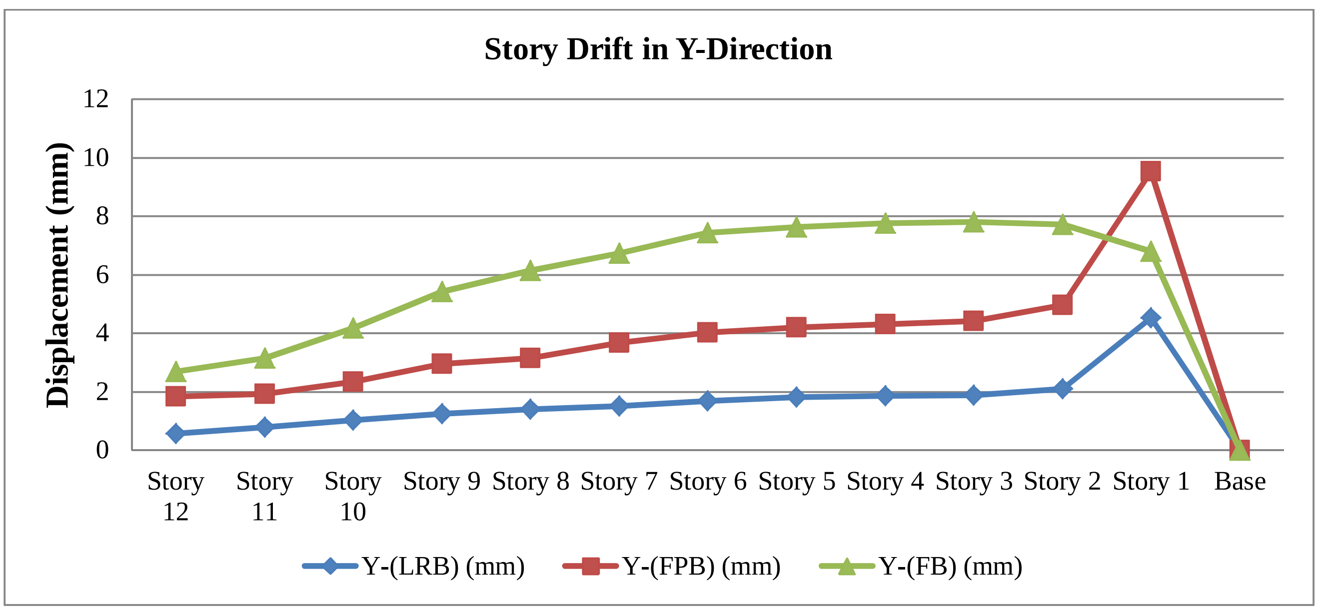
The difference in story displacement among two adjoining stories is defined as story drift. Drift ratio is defined as the ratio for storey drift to total height of the structure. The graphs give the storey drift values in millimeters for fixed base, friction pendulum and lead rubber bearing isolated models.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VIII Aug 2022- Available at www.ijraset.com

The story drifts was analyzed using time history analysis. The story drift was more at lower floor in case for fixed base model which is 3.28 mm and decreases as we move to top floors which is 1.042 mm. Story drift for lead rubber bearing & friction pendulum bearing model is 4.93 mm and 8.2 mm respectively at bottom and decreases as we move towards top floors which is 3.75 mm in LRB and 2.8 mm in FPB. As per the IS Code 1893:2016 the permissible value for story drift is 0.004× (Story Height). In our study this value is equal to 156 mm; and hence we can say that our results are much below the permissible limit.



Graph 1. Story drift graph in X-direction



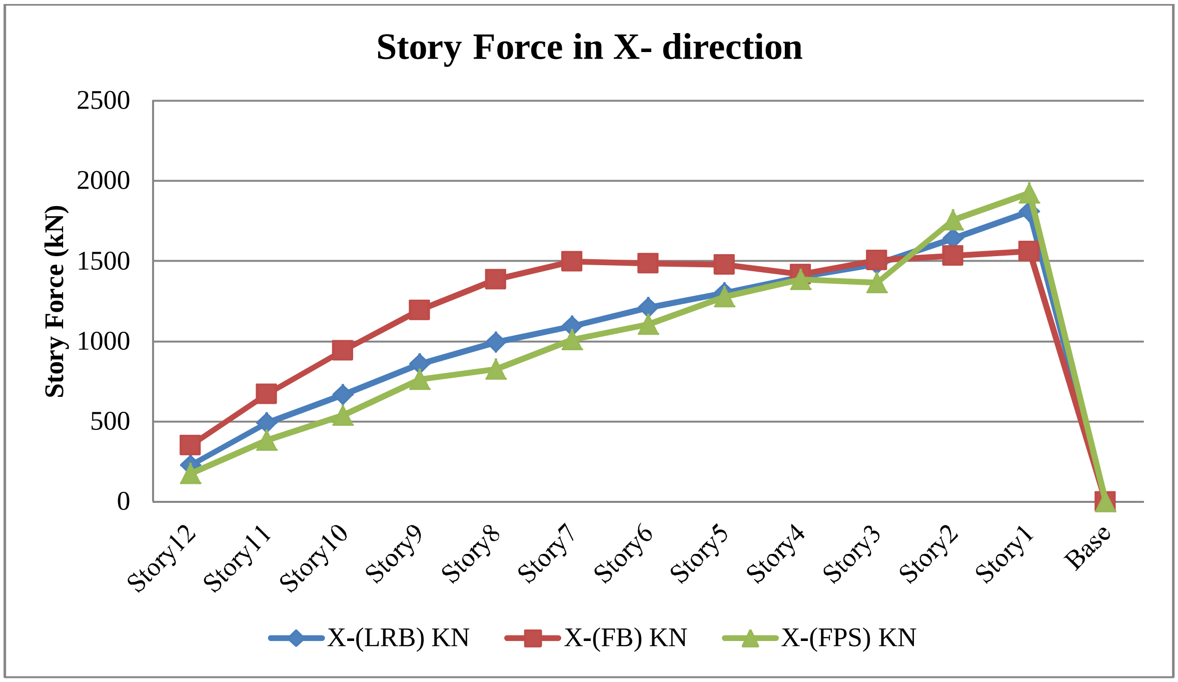
Graph 2. Story drift graph in Y-direction

The story drifts was analyzed using time history analysis. The story drift was more at lower floor in case for fixed base model which is 6.798 mm and decreases as we move to top floors which is 2.70 mm. Story drift for lead rubber bearing & friction pendulum bearing model is 4.530 mm and 9.547 mm respectively at bottom and decreases as we move towards top floors which is 0.576 mm in LRB and 1.85 mm in FPB. As per the IS Code 1893:2016 the permissible value for story drift is 0.004× (Story Height). In our study this value is equal to 156 mm; and hence we can say that our results are much below the permissible limit

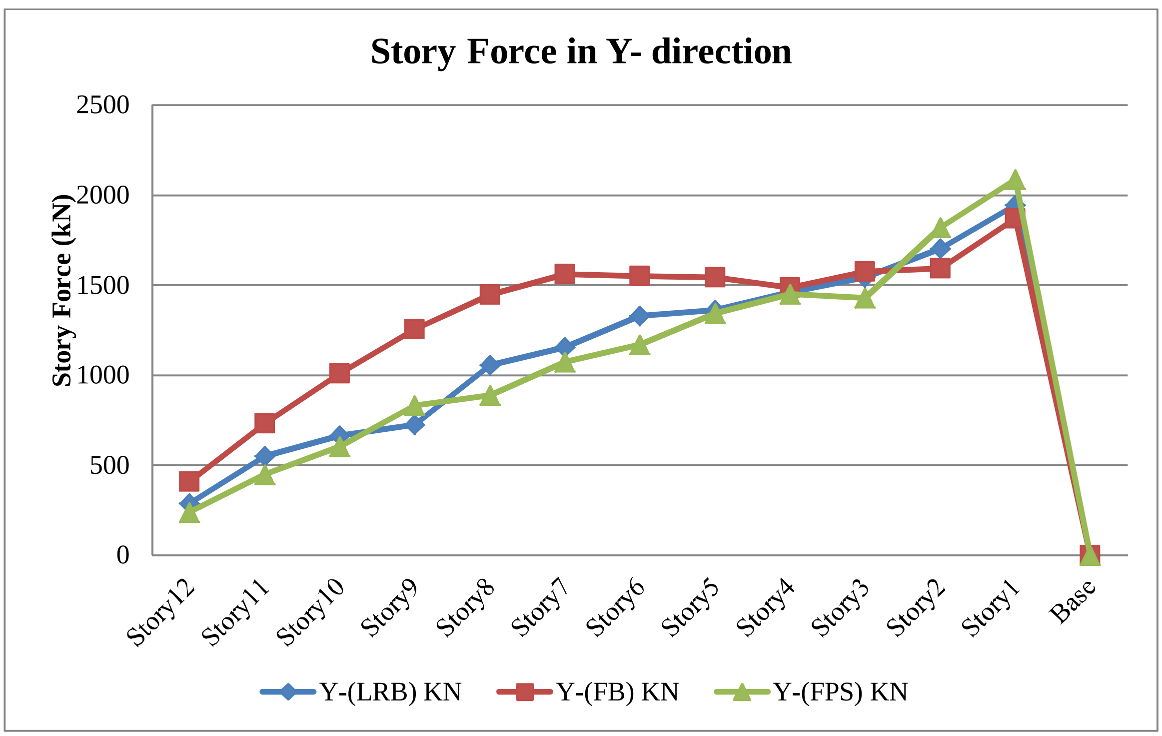
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VIII Aug 2022- Available at www.ijraset.com

B. Story Force

Story shear is the total for all calculated lateral forces at all floors above the considered story. Here we tabulate story force of G+12 building. The first floor's story force is 1561.9 kN for fixed base and 1809.89 kN and 1923.1 kN for isolated base with Lead rubber bearing & Friction pendulum bearing model respectively.



Graph 3. Story force graph in X-direction



Graph 4. Story force graph in Y-direction

In the Y- direction, we tabulate story force of G+12 building. The first floor's story force is 1869.39 kN for fixed base and 1945.94 kN and 2086.54 kN for isolated base with Lead rubber bearing & Friction pendulum bearing model respectively.

VI. CONCLUSIONS

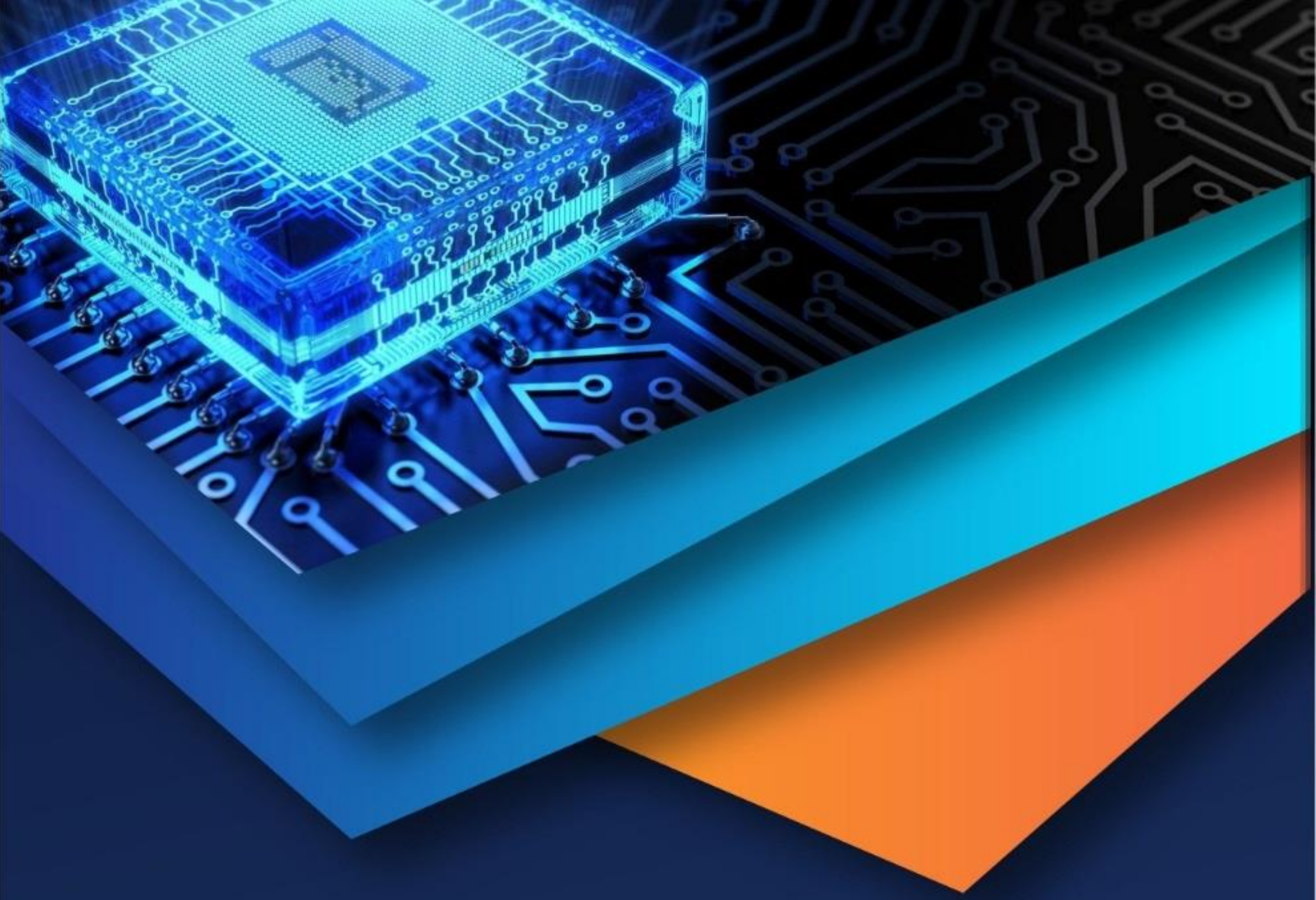
1) A tall building with 12 stories with isolated base (FPB & LRB) and fixed base have been analyzed for medium soil conditions. The purpose of the study was to investigate the seismic performance of an isolated base building, according to IS code; the responses of the building, such as story drifts, story forces, time period have been studied. Time history analysis carried out by Etabs software with Uttarkashi earthquake was done for fixed and isolated base models. After the analysis of the models it can be concluded that;
2) According to the study mentioned above, the first floor gives maximum story drift, which is the result of the flexibility introduced by isolators. The story drift limit gets compensated by providing base isolators; this is the main advantage of providing base isolators.
3) The story force is more in friction pendulum bearing as compared to lead rubber bearing and fixed base model. The story force is more in friction pendulum bearing as compared to lead rubber bearing and fixed base model.
4) As per our values and results outcomes we can conclude that the Friction pendulum bearing has better performance than the other Lead rubber bearing and Fixed base method.

VII.FUTURE SCOPEOF STUDY

1) There is a very wide scope for the technique of base isolation. In the near future, there will be a wide possibility of earthquakes because of the undesirable changes in the surroundings. Base Isolation technique of earthquake resistance will prove immensely fruitful in such conditions.
2) The biggest advantage is that there will be no need of reconstruction of a structure to install the base isolation devices as it can be done through the technique of retrofitting.
3) A huge loss of life and property can be avoided by the use of base isolation devices.
4) Use of Base Isolation in high rise buildings, statues and bridges will almost nullify the tremors of earthquake, protecting it from considerable damage to life and property.
5) We believe that it is vital that important buildings like hospitals, rescue centers, government buildings, nuclear power plants etc. are seismically isolated so they remain fully functional during and immediately following earthquakes.

REFERENCES

[1] Gomase O.P. Performance of NonLinear Elastomeric BaseIsolated building structure. 2010.
[2] Zaheer Ul Hassan Samdani I, RavichandraR I, BanulathaGN I, ManuJ I, Professor A. Comparative Study on Performance of Multi-Storey Structure Rubber Bearing and Friction Pendulum Base Isolation Systems. International Journal of Advanced Research in Eduation Technology (IJARET) [Internet]. 150(2). Available from: www.ijaret.com
[3] Darshale SD, Shelke NL. A Review on Seismic Response of RC Building on Sloping Ground Innovative Research Publicat ions Seismic Performance of Multi-St orey RCC Building with Float ing Columns Seismic Response Control of Vertically Irregular R.C.C. Structure using Base Isolation. Issue: Special. 2016;2(5):683–9.
[4] Hassan A, Pal S. Effect of soil condition on seismic response of isolated base buildings. International Journal of Advanced Structural Engineering. 2018 Sep 1; 10(3):249–61.
[5] IS 1893(Part-1) :2016 Criteria of Earthquake resistant design of structure.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY