International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 03 | Mar 2022 www.irjet.net p-ISSN: 2395-0072

Analysis Of Earthquake Resistant Structure By Base Isolation Method

Prof. Anjali Palheriya[1], Mr. Gaurav D. Dhumane [2], Mr. Shreyas Kotangale [3], Mr. Ratndip More [4], Mr. Vikki Singh Rawate [5], Mr. Suprit Badwaik[6]

[1]Assistant Professor, Department of Civil Engineering, Guru Nanak Institute of Technology, Nagpur, Maharashtra, India.

[23456]UG Students, Department of Civil Engineering, Guru Nanak Institute of Technology, Nagpur, Maharashtra, India.

---***---

Abstract: *Researchers have conducted various important studies on the base isolation system, which has been fully accepted in the engineering community as an earthquake-resistant design tool. Today, a full-scale shake table test is being conducted to test the different features of different isolators. The present review outlines the literature and theoretical aspects of this system. Additionally, the research papers examine the effectiveness of various isolators and their applicability. The review paper's main objective is to focus on different types of isolators and provide useful guidelines to make appropriate choices from a large number of available isolators.*

Key Words: base isolation, seismic analysis, Lead rubber isolator, E-TABS, story shear.

INTRODUCTION

Several preventive measures can be taken as per standard scientific guidelines to prevent the effects of earthquakes and minimize their effects. In earthquake-prone areas, these measures may prevent deaths and property damage. There is a need to educate the masses about standard construction measures in earthquake-prone areas to keep them from getting injured by disasters. In some papers, the authors also discuss the effectiveness of different isolation methods and the applicability of each. Its main purpose is to describe an overview of the history of isolators and provide useful guidelines to assist in making appropriate choices among the wide variety of isolators available

The concept of decoupling a building by using base isolation has been around for more than a century. It is one of the most popular tools for designing structures that will withstand earthquakes.

Hundreds of years of research have led to the development of base isolation systems in engineering fields. Even though so many typesof isolation systems are being developed, only ahandful have taken hold.

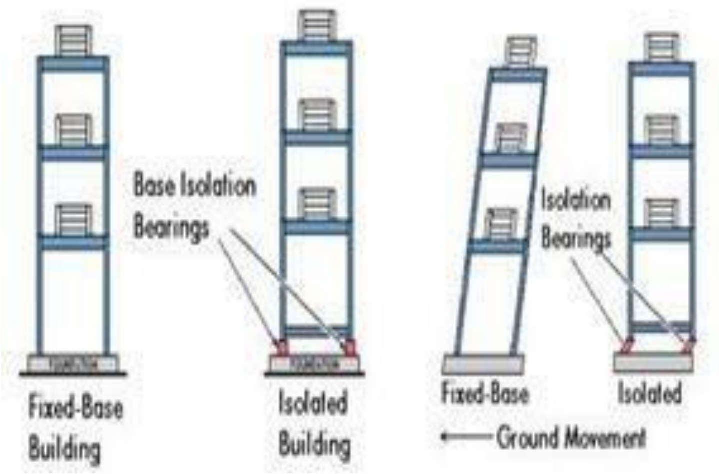
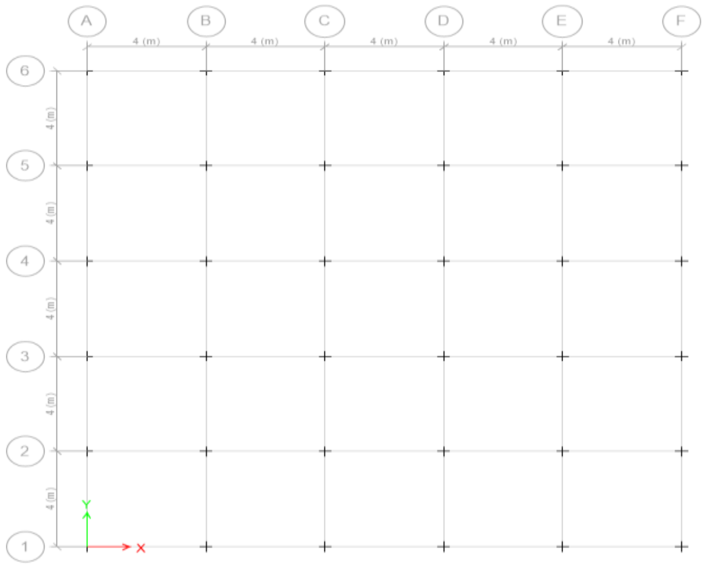


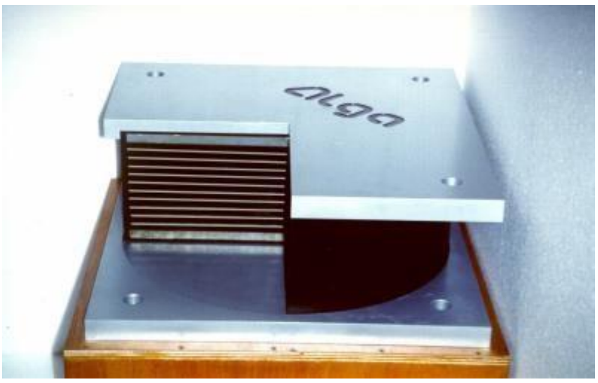
Fig a: Base Isolation Systems

METHODOLOGY:

In this project, we have used a G+10 story building with the same floor plan with 6 bays having the same lengths of 4 m along the longitudinal and the transverse direction as shown in the figure. This building is designed as per the IS Code1893(Part-1):2002 for Practice for Seismic Resistant. Design of buildings story heights of buildings is assumed to be constant including the ground story.

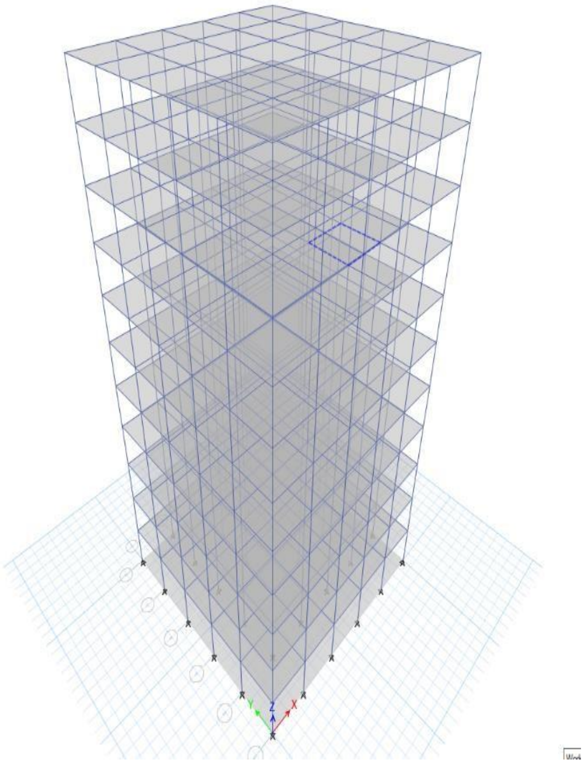
The buildings are modeled using software"E TABS".





Base Isolator

A lead plug is forced into a preformed hole in an elastomeric bearing to produce lead-rubber bearings. In the event of high lateral loads, the lead core provides rigidity under service loads and energy dissipation. A lead-rubber bearing is stiff both laterally and vertically when subjected to low lateral loads, such as those produced by a minor earthquake. The lateral stiffness of the lead plug is caused by its high elastic stiffness and its vertical rigidity. In addition to combining



rigidity and high service loads, lead-rubber bearings have other important benefits.

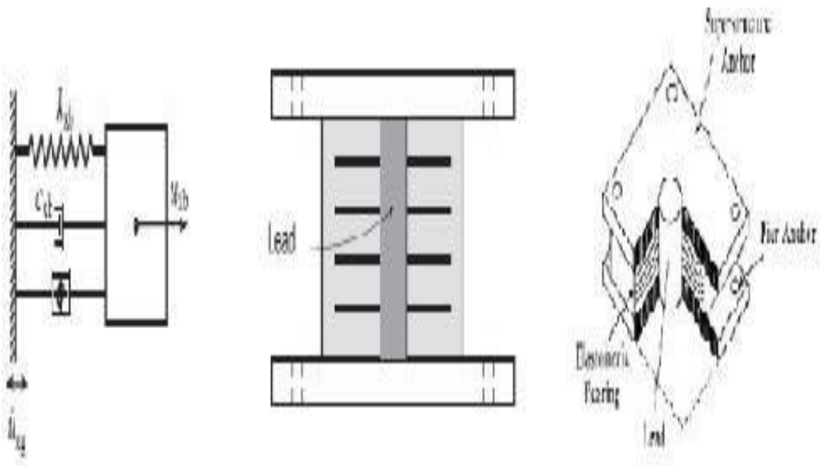


Fig. c: Typical Lead Rubber Bearing

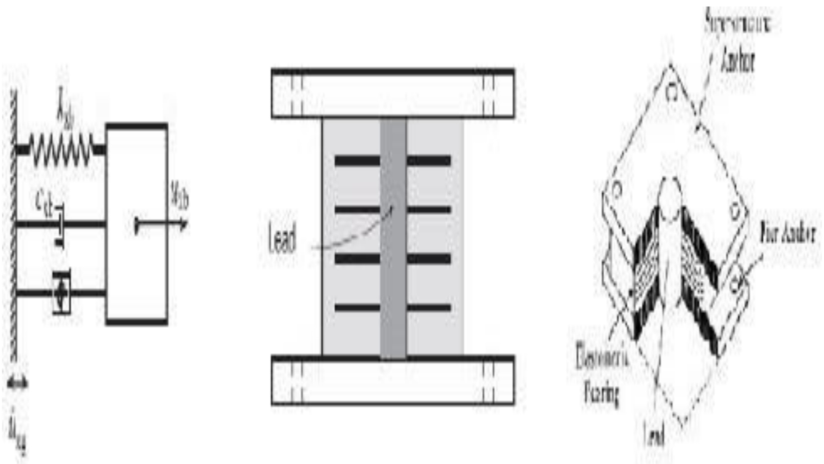


Fig. b: Center-Line Plan

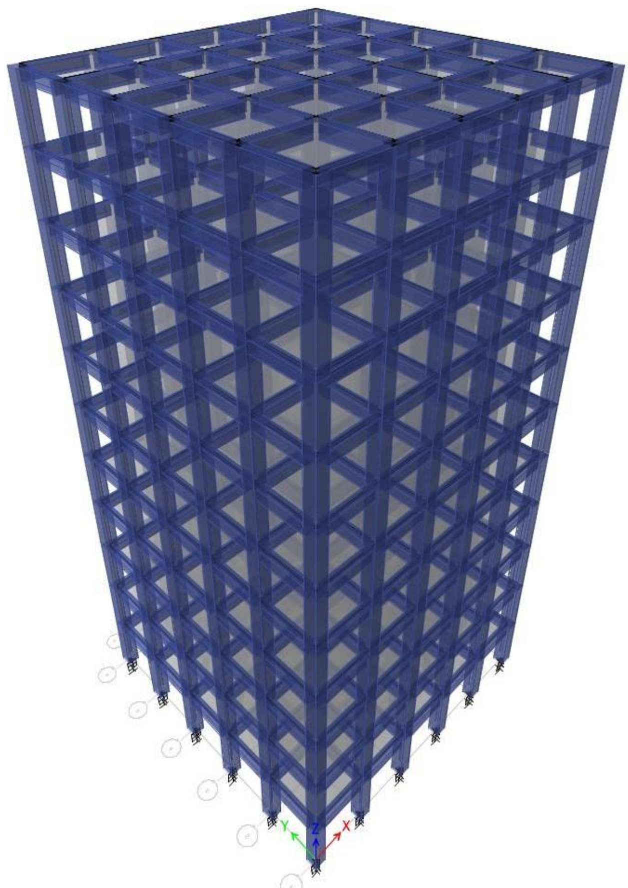


Fig. d: Structure With Isolated Base

Description of Building:

- Type of structure: multi-story residential building.
- Number of stories: 11(G+10).
- Floor height:3.5m.
- Seismic zone III (IS 1893 (part 1):2002).
- Materials Concrete: (M30) and Reinforcement(HYSD500).
- Bay sizes in the X-direction: 4m, 4m, 4m,4m, 4m&4m - 6 bays.
- Bay sizes in the Z-direction: 4m, 4m, 4m ,4m, 4m &4m -6 bays.
- Column 800 x 800 mm (for all columns).
- Beam 600 x 500 mm (for all beams).

- Type of soil: medium soil.
- Response spectrum as per IS 1893:2002

Loading Details

- Dead Load:

  Self-weight of structure = 1kn/m External thickness of wall= 230mm Internal thickness of wall =115mm Parapet wall=125mm

- Live Load:

1. All Floor = 2.5KN/m.
2. Earthquake Zone = Zone III.
3. Zone Factor = 0.16.
4. Earthquake Resistance Design of Structure = IS 1893(Part 1) 2002.
5. Safe Bearing Capacity of Soil = 250KN/ m^3.
6. Floors = G.F. + 10 Upper Floors.
7. Ground Floor Height = 3.5 m.
8. Assumed Thickness of Wall External wall = 230mmInternal wall = 115m.
9. Grade of Concrete for column and other = M30.10.Grade of Steel = HYSD Fe500.

For designing the base isolator following data should beinput into ETABS

Rotational Inertia1	0.2180	KN/m
For U1 Effective Stiffness	1316191.49	KN/m
For U2 & U3 Effective Stiffness	4013.432	KN-m
For U2 & U3 Efficient Damping	0.05	Percent
For U2 and U3 distancefrom end-J	0.0032	M
For U2 & U3 Stiffness	36981.77	KN/m
For U2 & U3 Yield Strength	145.203	KN

METHODOLOGY OF WORK:

1. The first step of this procedure is to initialize the Standard Codes and Country Codes.
2. Creation of Grid points & Generation of structure. As soon as ETABS opens, we select a new model, and a window appears where we can enter the grid dimensions and story dimensions of our building.
3. Defining the property - In this case, the material property had been defined first by selecting define menu material properties.
4. In this case, the material property had been definedfirst by selecting define menu material properties.
5. For structural components (beams, columns, slabs) we add new materials and give specific details in the definition. Then we define section size by selecting frame sections and adding the necessary sections for beams, columns, etc.
6. Assigning the Property Now that we have defined the property, we draw the structural components using the command menu. We draw a line for beams and create columns in regions for columns to assign the properties to the beams and columns. Assigning Supports Keeping the selection at the base of the structure and selecting all the columns, we assigned supports by selecting the joint/frame Restraints (supports) option in the assign menu.
7. Defining loads in ETABS All load considerations are first defined and then assigned. In ETABS, the loads are defined using the static load cases command from the define menu. The software assigns dead loads based on all the loads for external walls, while internal walls are handled automatically by the system.
8. Assignment of Live Loads are assigned separately for the roof and floor of the entire structure.
9. Assign wind loads are defined and assigned as per IS 875 1987 PART 3 by giving windspeed and wind angle.
10. By giving the zone, soil type, and response reduction factor in X and Y directions, seismic loads are defined and assigned according to IS 1893: 2002.
11. Assigning load combinations Using the load combinations command in the define menu automatically generates load combinations for eachcode chosen.
12. Analysis After we have completed the above steps, we have run an analysis and checked for errors comparison graphs are formed.

The LRB parameters are derived from the isolation design procedure and assigned to the required fields ofLRB formulation. After an analysis with a fixed base, the LRB technique isolates the base to make thestructure earthquake resistant. Hence its LRB parameters are found from the isolation designprocedure and assigned to the required fields of LRB formulation.

RESULT:

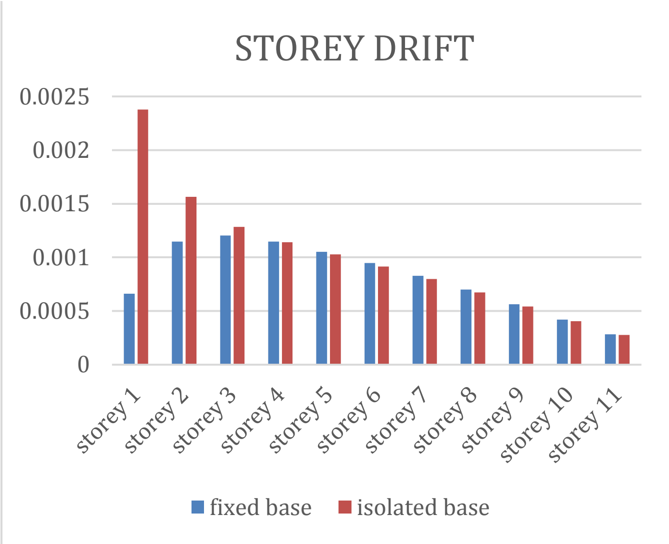


FIG NO 1. Storey Drift

Fig no 1 shows the variation of story drift at the different story levels.

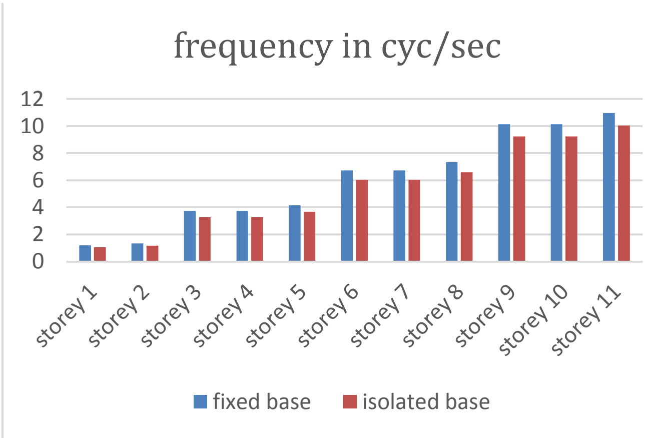


Fig no 2. Modal periods and frequencies

Fig no.2 shows the frequency (cyc/sec) mode shape graph its seen the frequency has reduced due to the insertion of the base isolator of the building.

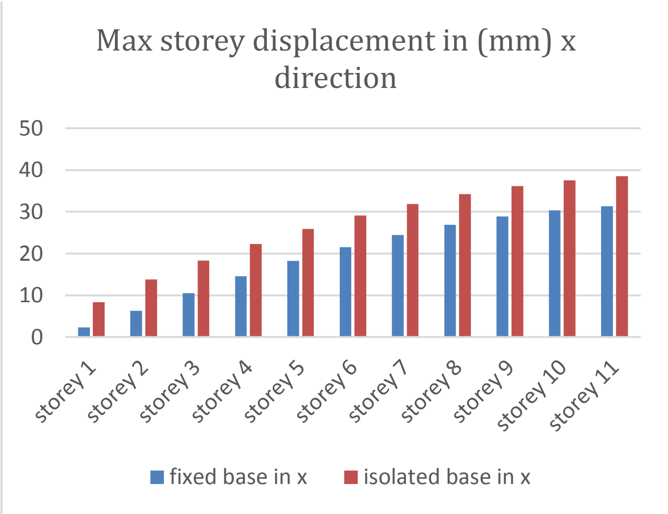


Fig no. 3 Maximum story displacement in (mm)in the x-direction

Fig no. 3 shows the value of displacement at a different story for isolated and non-isolated buildings.

CONCLUSION:

a. Analysis of the structure is done using a fixed base and a different base isolator. This study compares different parameters such as frequency, base shear, displacement, and story drift with and without base isolation.
b. When compared to fixed base models, story drift is reduced at the highest floors of the building with baseisolators.
c. In comparison with fixed base buildings, the frequency ofbase-isolated buildings has decreased.
d. As the height of the structure is increased, the displacement of the base isolator increases compared tothe fixed base.
e. This data indicates that the damage to the base-isolated structure will be less than the damage to the fixed base structure. As a result, the structure can beoccupied immediately after the earthquake.
   The isolated base structure will be less damaged than a fixed base structure based on the above data. This allows immediate occupation of the building.
f. Comparing isolated and non-isolated buildings, wecan conclude that isolated buildings perform better.

REFERENCES:

[1] Donato Cancellara, Fabio de Angelis," assessment and dynamic nonlinear analysis of different base isolation systems for a multi-story RC building irregular in plan"Elsevier, computers, and structures, (2016).

[2] S.d.darshale and n.l.shelke," seismic response control of

[3] r.c.c. structure using base isolation", international journal of research in engineering science and technology, vol.2, no.1, (2016).

[4] J. Enrique luco," effects of soil-structure interaction on seismic base isolation "elsevier, soil dynamics and earthquake engineering, pp166-167, (2014).

[5] Y. Li and j. Li," base isolator with variable stiffness and damping: design, experimental testing, and modeling", 23rd australasian conference on the mechanics of structures and materials (acmsm23) (2014).

[6] M.k. shrimali1, s.d. bharti2, s.m. dumne3 arumairaj2, "seismic response analysis of coupled building involving Mr damper and elastomeric base isolation", ain shams engineering journal 6,pp457–470, (2015).