iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 Issue: V Month of publication: May 2026

DOI: https://doi.org/10.22214/ijraset.2026.81553

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

Pushover Analysis of Multi Story Building with and Without Lead Rubber Bearing

Mr. Dipak P. Patil[1], Mr. Aniket S. Chavan[2], Mr. Pruthviraj D. Chougule[3], Mr. Harshvardhan S. Desai[4]
[1, 2, 3, 4]*Student at Bharati Vidyapeeth College of Engineering, Kolhapur, Maharashtra, India*

Abstract: This study investigates the seismic performance of multi-story reinforced concrete (RC) buildings with and without base isolation using Lead Rubber Bearings (LRB). Nonlinear static (pushover) analysis is Implemented to evaluate and compare the structural response under seismic loading conditions. Analytical models of G+9-storey and G+14-storey RC buildings are developed and analyzed using ETABS. Key performance parameters such as base shear, roof displacement, and fundamental time period are assessed to understand the influence of base isolation on overall structural behavior.
The results demonstrate that the incorporation of LRB significantly enhances seismic performance by increasing the fundamental time period and reducing Base shear . For instance, in the G+9-storey model, the fundamental period increased from 1.71 s to 2.81 s, indicating reduced structural stiffness and improved energy dissipation. Similarly, in the G+14-storey building, base shear was reduced from 5349.85 kN to 4373.61 kN with the use of LRB. Although base-isolated structures exhibit higher displacements, these are controlled and contribute to minimizing structural damage. The study concludes that LRB-based base isolation is an effective strategy for improving seismic resilience and mitigating damage in multi-storey RC buildings.
Keywords: Pushover Analysis, Base Isolation, Lead Rubber Bearing (LRB), Base Shear, ETABS.

I. INTRODUCTION

The study found that LRB isolation really helps protect buildings from earthquakes. It makes the buildings natural period longer which means its less affected by the earthquake forces. For example in a 9-story building the natural period increased from 1.71 seconds to 2.81 seconds. This makes the building safer. The study also found that the base shear force was reduced in buildings with LRB isolation. For a 14-story building it decreased from 5,349.85 kN to 4,373.61 kN. The roof displacement was a bit higher. The forces were concentrated at the isolation interface, which made the building behave more safely. This means that the beams and columns didn't get damaged much and the building stayed safe.

II. BUILDING DESCRIPTION

SR.No.	Description	Values
1	Materials	M25, Fe500
2	No. of stores	G+9, G+14
3	Plan size	12m x 12 m
4	Size of beam	230 mm x 450 mm ,300 mm x 500 mm
5	Size of column	500 x 500 mm, 450 x450 mm ,750 x750mm, 650 x650
6	Floor height	3.0 m
7	Slab thickness	150 mm
8	Seismic zone V	V
9	Types of analysis	Pushover analysis
10	Zone factor(Z)	0.36
11	Reduction factor (R)	Fixed =3, base isolator =1
12	Importance factor (I)	1.2
13	Type of Soil	medium soil

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

III. MODELING OF RCC BUILDING (ETABS)

A. Material Property

1) Concrete

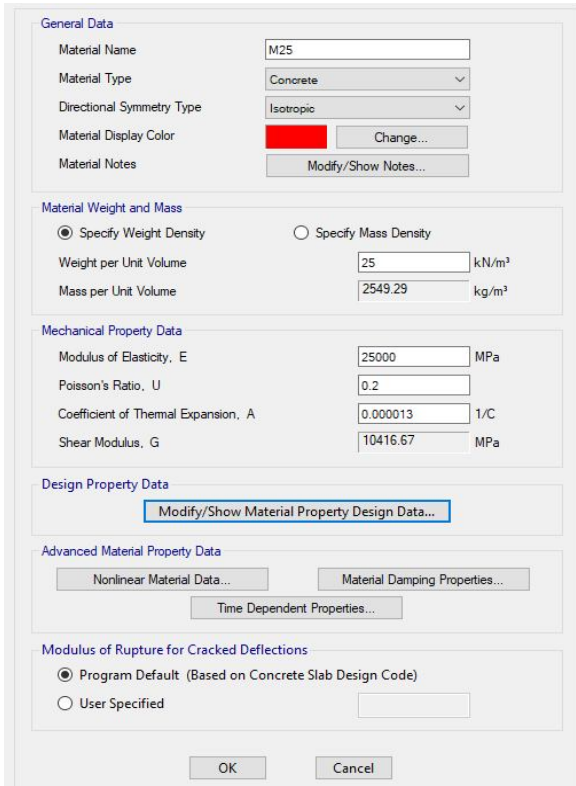


Fig.1 Property Of M25 Grade Of Concrete

2) Rebar

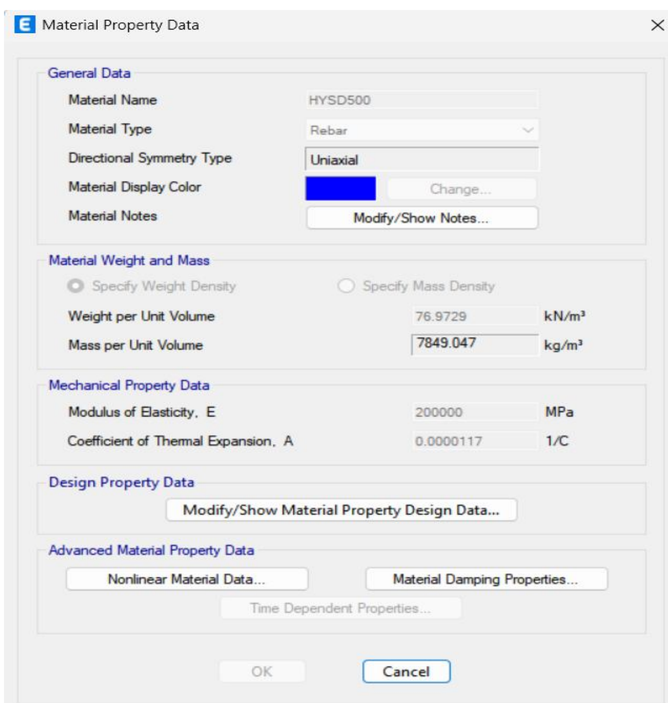


Fig.2 Property Of HYSD500 Grade Of Rebar

To Building Of G+9 And G+14 Are Considered For this study. the building are Situated in zone v the building plan area to buildings is 12M x 12M As Show in fig.3&4.Plinth Height is 1m.
The building is modeled by using ETABS software. Line element having 4 DOF per node is use to model beam & column.

B. Plan And 3D View

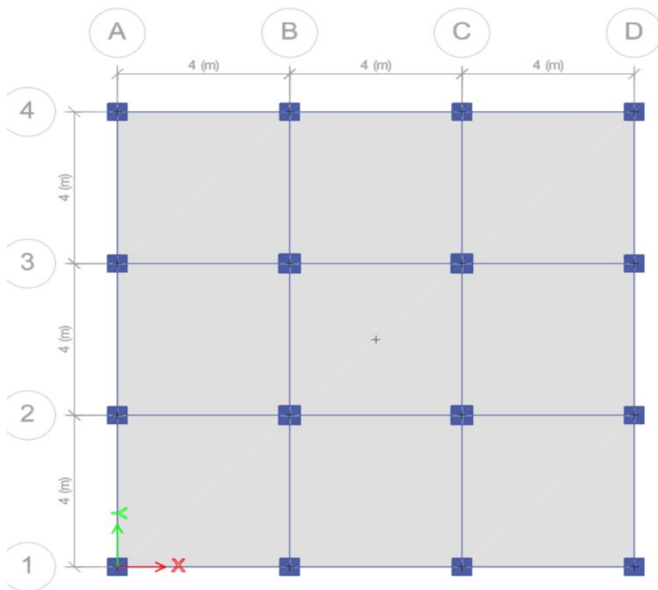


Fig.3 Plan of Building (G+9)

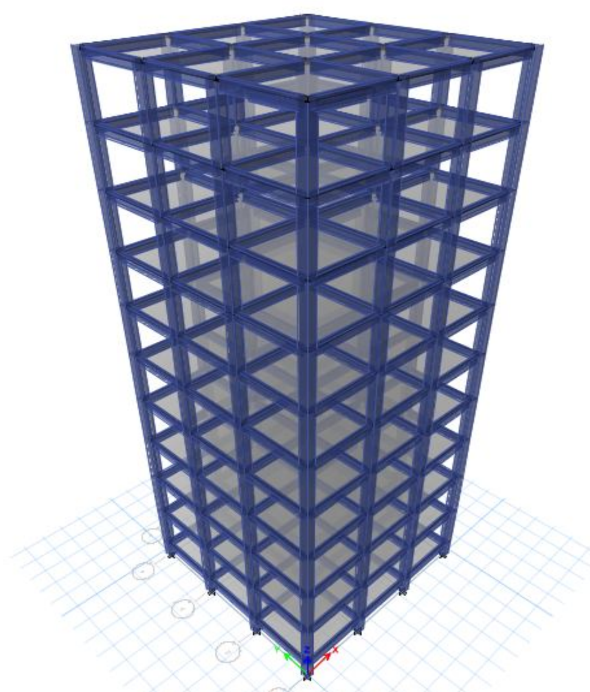


Fig.5 3D View of Building (G+9)

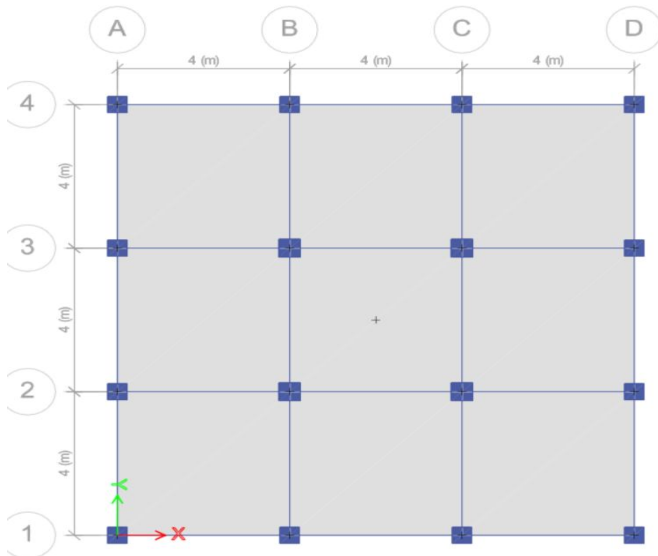


Fig.4 Plan of Building (G+14)

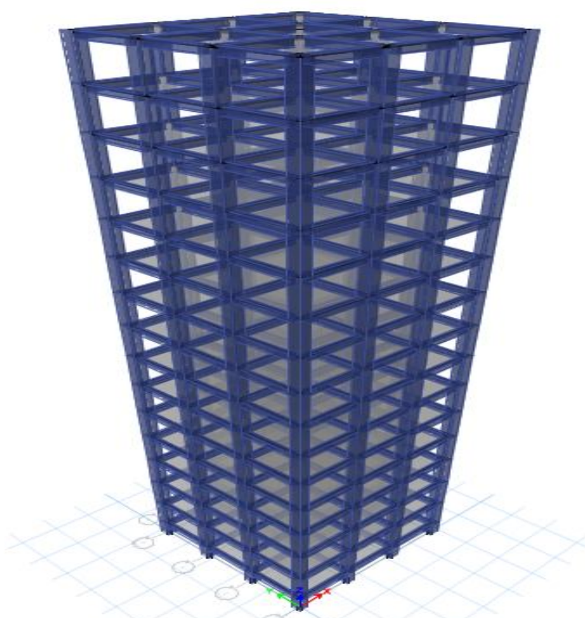


Fig.6 3D View of Building (G+14)

IV. ANALYSIS PROCEDURE

We are testing how well a building stands up to earthquakes.
The study uses computer models to see how a multi-story building behaves with and without base isolation.
We use ETABS, a tool for modeling buildings and analyzing earthquakes.

1) Step 1: Create Building Model

First we create a multi-story building model.
We define the grid size, story height, beams, columns and slabs.
We also add material properties like steel grade following Indian Standard codes.
The section properties are defined to ensure the structure has stiffness and strength.

2) Step 2: Define Loads

Next we define loads on the building: load, live load and earthquake load.
These loads follow IS 875 and IS 1893 rules.
We create load combinations for analysis.
We prepare two models: one with a fixed base and another with Lead Rubber Bearings (LRB) at the base.

3) 3: Model LRB System

The LRB system is modeled with stiffness and damping properties.
This simulates its behavior in isolating the building from earthquakes.

4) 4: Analyze Building Performance

We assign nonlinear hinge properties to beams and columns.
This captures their behavior during earthquakes.
We perform analysis by applying increasing lateral loads.
The goal is to reach a target displacement.
We compare results for both models: base shear, roof displacement, capacity curves and hinge formation.
This helps us see how effective base isolation is, in improving performance.

V. THE DESIGN OF LEAD RUBBER BEARING:

Steps are as follows
Calculate design displacement :- Assume Design Time Period T_D=2 sec

$$\Delta_{SD} = \left[Z \left(\frac{S_a}{g} \right)_{T_{eff.max}} \beta \right] g \frac{T^2_{eff.max}}{4\pi^2}$$

All values are mentioned above and put in formula we get D_D = 0.67 m
Effective stiffness (K_{eff})

$$K_{eff} = \frac{W}{g} \times \left(\frac{2\pi}{T_D} \right)^2$$

= (2320/9.81) X $(2\pi/2)^2$
= 2324.09 KN/M

Energy dissipated per energy cycle $W_D = 2\pi \text{ X } K_{eff} \text{ X } D_D^2 \text{ X } \beta^2$
= 2 X π X 2324.09X 0.67 X 0.05
= 327.75 KN-M

Force at design displacement Q = $W_D/4D_D$
= 372.75/(4 X 0.67)
= 139.08 KN

Stiffness in rubber $K_2 = K_{eff}-(Q/D_D)$
= 2324.09-(139.08/0.67)
= 2116.50 KN/M

Yield displacement (Dγ) Dγ = Q/(K_1-K_2)
As we have $K_1=10K_2$
= 139.08/(9 x 2116.50)
= 0.007 m

Recalculation of Q to Q_R $Q_R = W_D/4(D_D-D\gamma)$
= 327.75 / 4(0.67-0.007)
= 123.58 KN

Calculation of area and diameter of lead plug
Yield strength of lead is around 10 MPa The area of lead plug needed
$A_{PB} = Q_R/10X10^3$
$= 123.58/10^4$
$\Pi X d^2 /4 = 0.0125$
d = 125 mm

Revising rubber stiffness K_{eff} to $K_{eff(R)}$ (after revising Q to Q_R)
Keff(R) = Keff - QR/DD
= 2324.09 – 123.58/0.67
= 2139.64 KN/M
Total thickness of rubber layer $t_\gamma = D_D/\gamma$
Where γ = 100 % (maximum shear strain of rubber)
= 0.67/1
= 0.67 m
Area of bearing
ALRB = Keff(R) X tγ / G
= 2324.09 X 0.67 / (0.7 X 1000)
= $2.22M^2$

Where shear modulus is 0.7 MPa Diameter of bearing
= 16.81 mm
Shape Factor
$S= (1/2.4) X (fv/f_H)$
Where, fv is vertical frequency f_H is horizontal frequency
$f_H = ½ = 0.5H_Z$
fv = 10 Hz
S = 1 X 10 / (2.4 X 0.5)
= 8.33
Also we have,
$t=\Phi_{LRB}/4$ S
= 16.81 / (4 X 8.336)
= 50.45 mm

Number of rubber layers = tγ/t
= 0.67/0.0504
= 13.29
Provide 40 mm thick 8 rubber layers
1Dimensions of lead rubber bearing Let thickness of shim plates = 2.8 mm
No. of shim plates = (14-1) = 13
End plate thickness varies between 19.05 mm to 38.1 mm
Adopt thickness of end plate as 30 mm
Total height of LRB = (14 X 40) + (13 X 2.8) + (2X 30)
= 389.6 mm
= 0.389 m

Diamter Of Rubber Layer

Φ= N X t
= 14 X 40
= 560 MM
= 0.56 M

Area = π X Φ^2 / 4
= 0.24 M^2

13. Compression Modulus Ec

Ec = 6GS2(1-(6GS^2/K))
Where, K = bulk modulus = 2000 MPa
G = shear modulus = 0.7 MPa
Ec = 248.96 X 10^3 KN/M^2

Horizontal stiffness K_H = G X $A_{LRB}/t\gamma$
= 0.7 X 10^3 X 2.22 / 0.67
= 2319.40 KN/M
Vertical stiffness K_v = Ec X $A_{LRB}/t\gamma$
= 248.96 X 10^3 X 2.22 / 0.67
= 824.91 X10^3KN/M

Size of End plate = 1300 mm X 1300 mm X 25 mm

Pedestal Size = 1400MM X 1400MM

We are talking about the placement of LRB.
The base isolators are put above the base level.
You will find isolators above every footing.
The properties of LRB that were calculated are listed in the table.

A. Etabs Softwear Input

Link/Support Directional Properties	G+9			
	LRB (3600kN)		LRB (2320kN)	
Direction	U1	U2/U3	U1	U2/U3
Effective Stiffness	1185.34 KN/M	1185.34 KN/M	824.91 KN/M	824.91 KN/M
Effective Damping	510.77 KN-M	510.77 KN-M	327.75 KN-M	327.75 KN-M
Nonlinear Properties				
Stiffness		3334.72 KN/M		2139.64 KN/M
Yield Strength		192.39 KN		123.58 KN
Post Yield Stiffness Ratio		0.1		0.1

Table no.2 Etabs softwear Input for G+9

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

Link/Support Directional Properties	G+14			
	LRB (6686.95kN)		LRB (4385.01kN)	
Direction	U1	U2/U3	U1	U2/U3
Effective Stiffness	2389.27 KN/M	2389.27 KN/M	1568.07 KN/M	1568.07 KN/M
Effective Damping	948.76 KN-M	948.76 KN-M	622.15 KN-M	622.15 KN-M
Nonlinear Properties				
Stiffness		6194.18 KN/M		4061.88 KN/M
Yield Strength		357.37 KN		234.34 KN
Post Yield Stiffness Ratio		0.1		0.1

Table no.2 Etabs softwear Input for G+9

VI.PUSHOVER CURVES AND SEISMIC PERFORMANCE LEVEL OF BUILDING

1) Pushover Curve : (G+9)

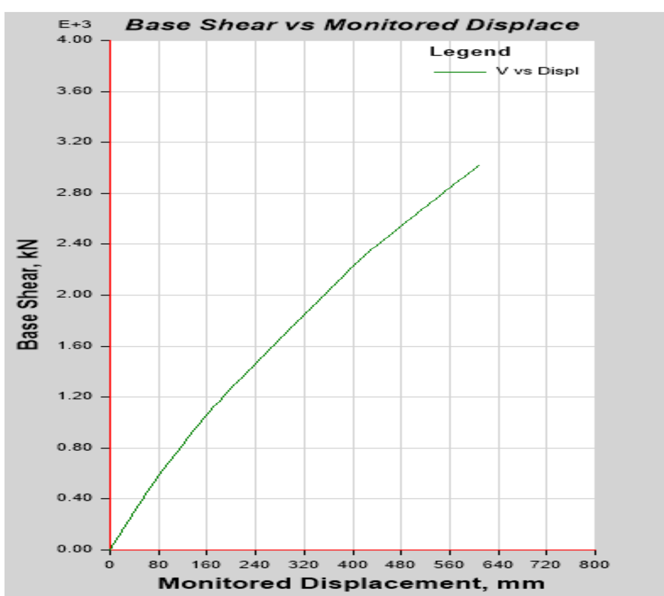


Fig. 7 Pushover curve in X Directions (fixed base)

Higher base shear

Lower displacement

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

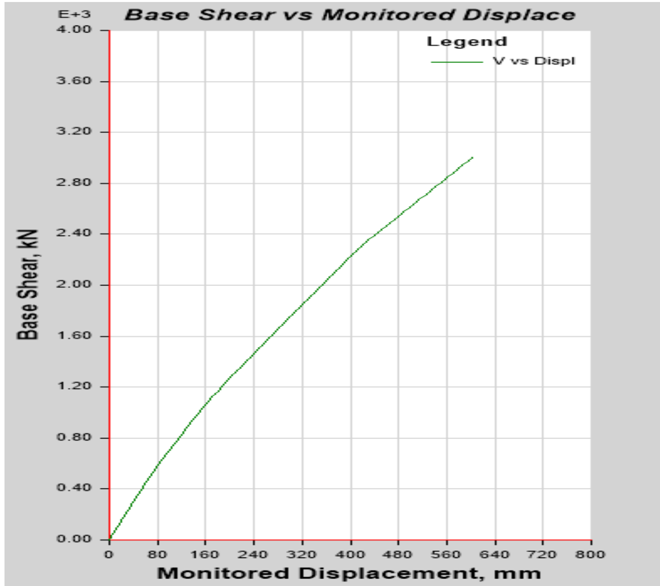


Fig.8 Pushover curve in Y Directions (fixed base)
Higher base shear
Lower displacement

The graphs in Figures 7 and 8 show how the fixed-base model behaves.The lines for Push-X and Push-Y go up quickly which means the model is very strong against forces, from the side.These results are what we use to figure out how well the Lead Rubber Bearing isolation system works.The Lead Rubber Bearing isolation system is supposed to reduce the force of earthquakes on the model.We use the results from Figures 7 and 8 to see how much the Lead Rubber Bearing isolation system actually helps.

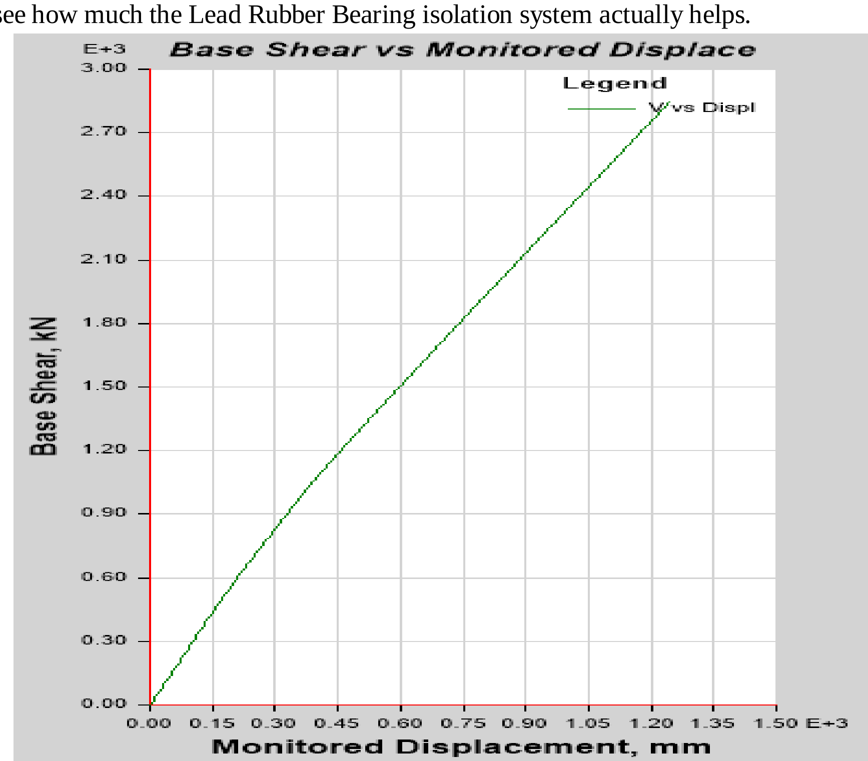


Fig. 9 Pushover curve in X Directions (LRB)
Lower base shear
Higher displacement

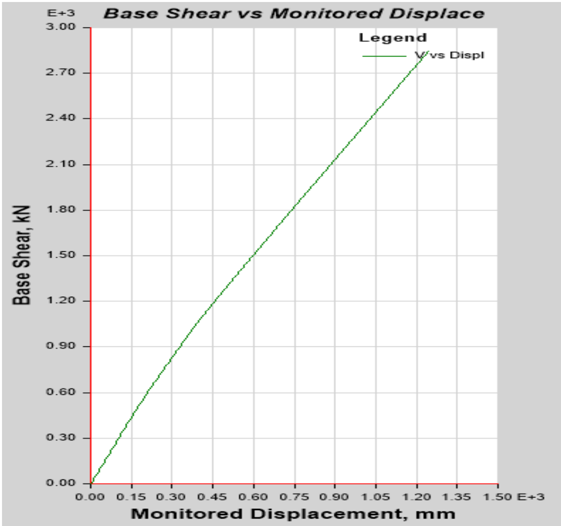


Fig.10 Pushover curve in Y Directions (LRB)
Lower base shear
Higher displacement

Fig. 9 and 10 show what happens to the structure after we use Lead Rubber Bearings. This really helps with isolation. The Lead Rubber Bearings make the structure less stiff so it does not get much force from the ground. This means the building is safer. The Lead Rubber Bearings also help to absorb the energy from the earthquake so the building itself does not get damaged. This is very important for buildings like houses and apartments. They help to keep the building safe by reducing the force of the earthquake on the parts of the building. Lead Rubber Bearings are very good,

2) Pushover Curve : (G+14)

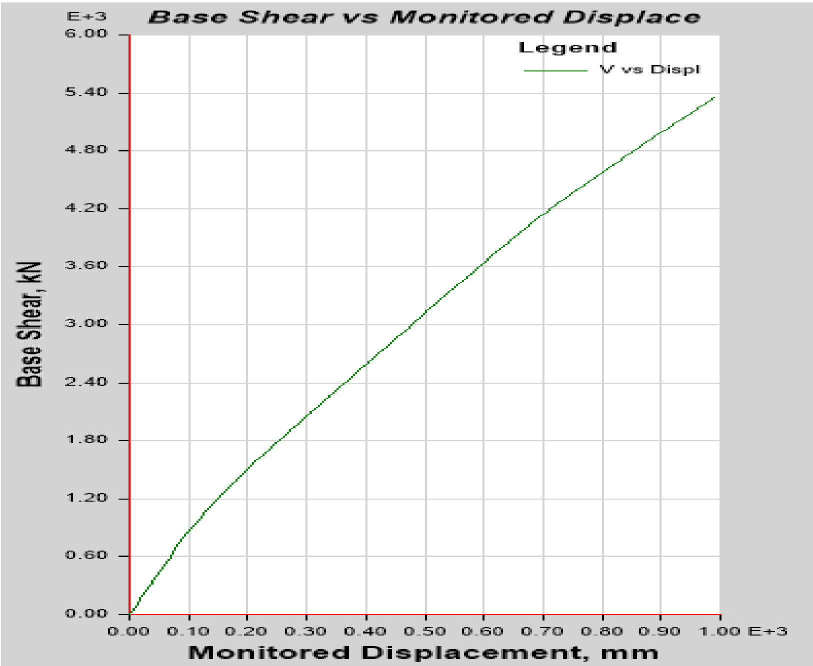


Fig. 11 Pushover curve in X Directions (fix base)
Higher base shear
Lower displacement

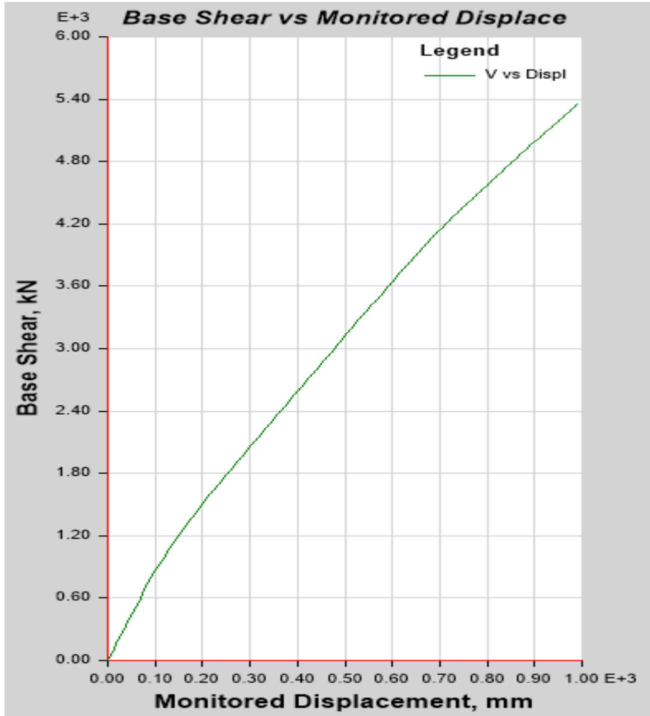


Fig. 12 Pushover curve in Y Directions (fix base)
Higher base shear
Lower displacement

The graphs in Figures 11 and 12 show how the fixed-base model behaves. The lines for Push-X and Push-Y go up quickly which Indicate the model is very strong against forces, from the Both side. These results are what we use to figure out how well the Lead Rubber Bearing isolation system works. The Lead Rubber Bearing isolation system is supposed to reduce the force of earthquakes on the model. We use the results from Figures 7 and 8 to see how much the Lead Rubber Bearing isolation system actually helps to Improve Seismic Performance.

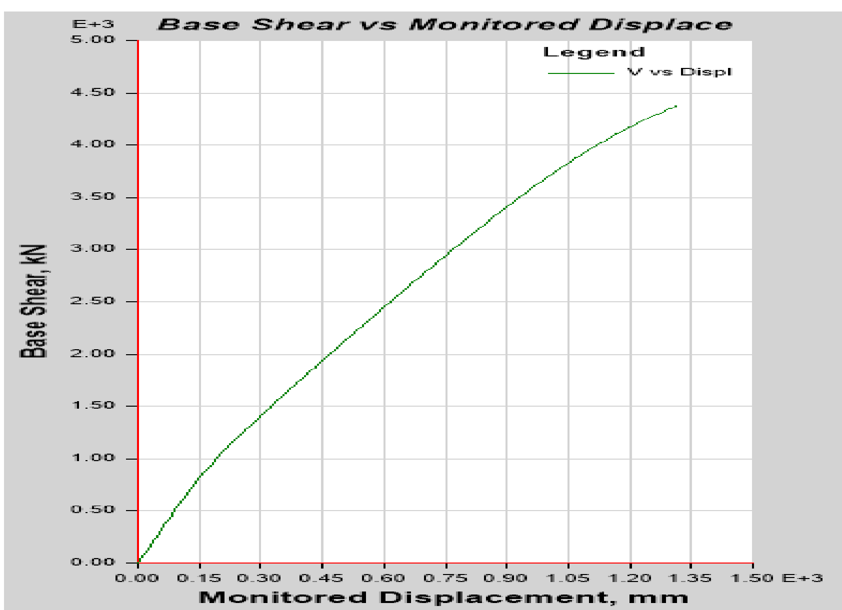


Fig. 13 Pushover curve in X Directions (LRB)
Lower base shear
Higher displacement

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

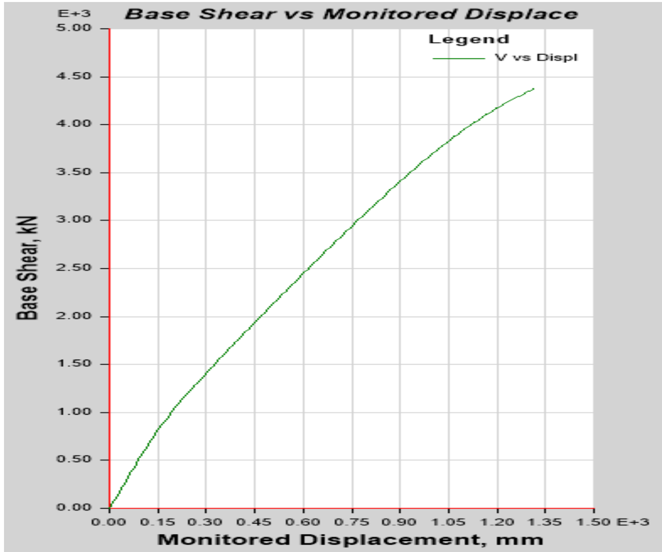


Fig. 14 Pushover curve in Y Directions (LRB)
Lower base shear
Higher displacement

Fig. 13 and 14 show what happens to the structure after we use Lead Rubber Bearings. This really helps with isolation. The Lead Rubber Bearings make the structure less stiff so it does not get much force from the ground. This means the building is safer. The Lead Rubber Bearings also help to absorb the energy from the earthquake so the building itself does not get damaged. This is very important for buildings like houses and apartments. They help to keep the building safe by reducing the force of the earthquake on the parts of the building.

3) Performance point

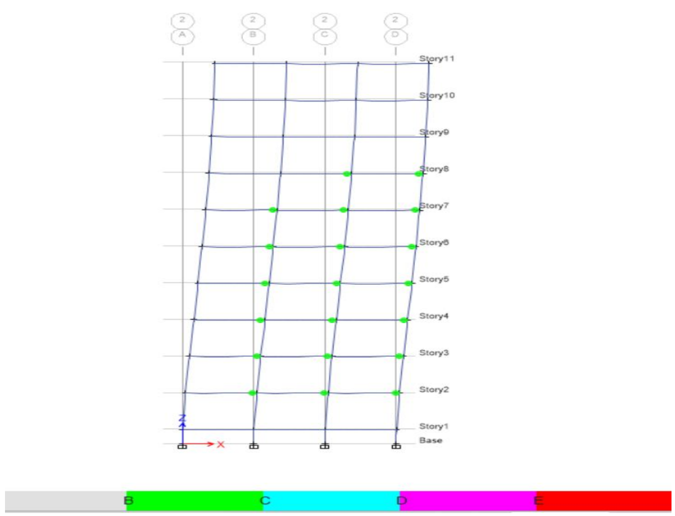


Fig.15 Hinge formation at performance point in x direction for G+9 fixed base building.

Fig.15 shows the elevation you can see that the beam elements have a lot of hinge formation across many floor levels mostly from Stories 2 to 8. The green hinges show that the superstructure is deforming in a way that's not elastic to get rid of seismic energy. In this situation the structural members have to deal with a lot of demands going from a safe range to a range where we are worried about Life Safety performance levels.

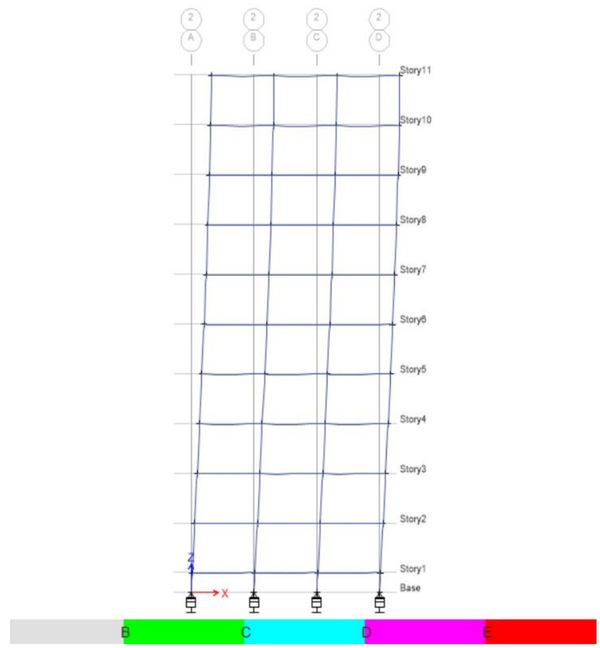


Fig.16 Hinge formation at performance point in x direction for G+9 building with (LRB)

Fig.16 show that When we use the Lead Rubber Bearing system the superstructure does not have plastic hinges forming. The frame mostly stays in a range and you can tell this because there are no hinge markers, in the beams and columns.

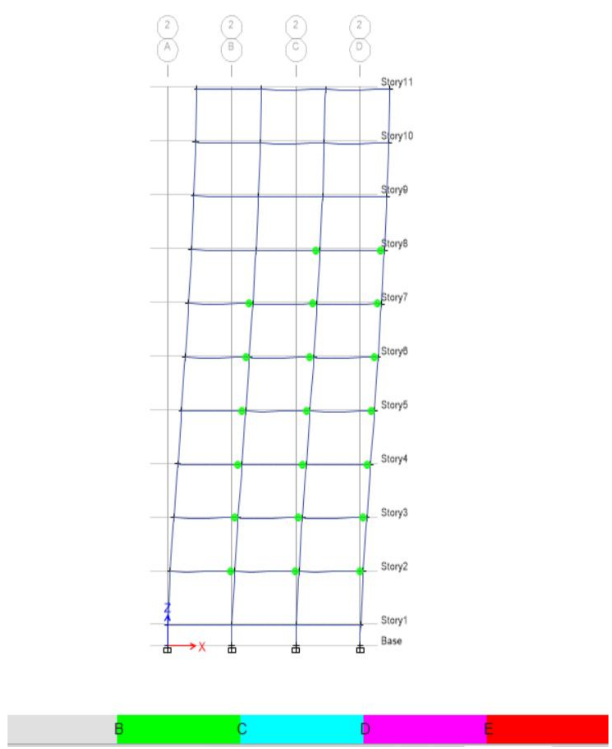


Fig.17 Hinge formation at performance point in y direction for G+9 fixed base building.

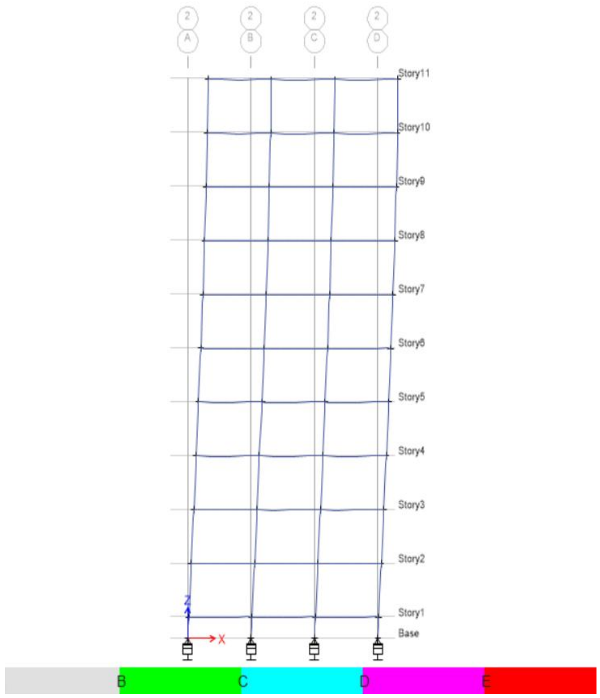


Fig.18 Hinge formation at performance point in y direction for G+9 building with (LRB)

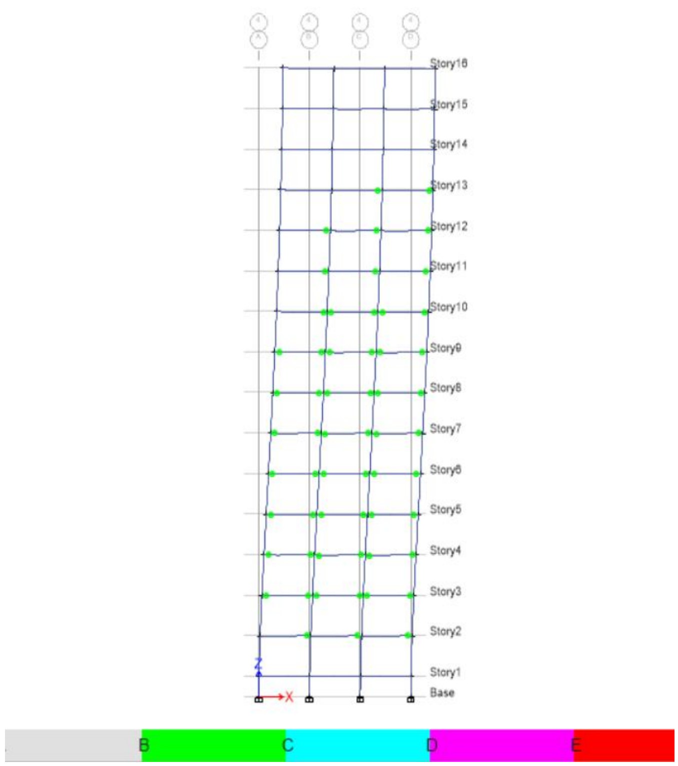


Fig.19 Hinge formation at performance point in x direction for G+14 building with (fix base)

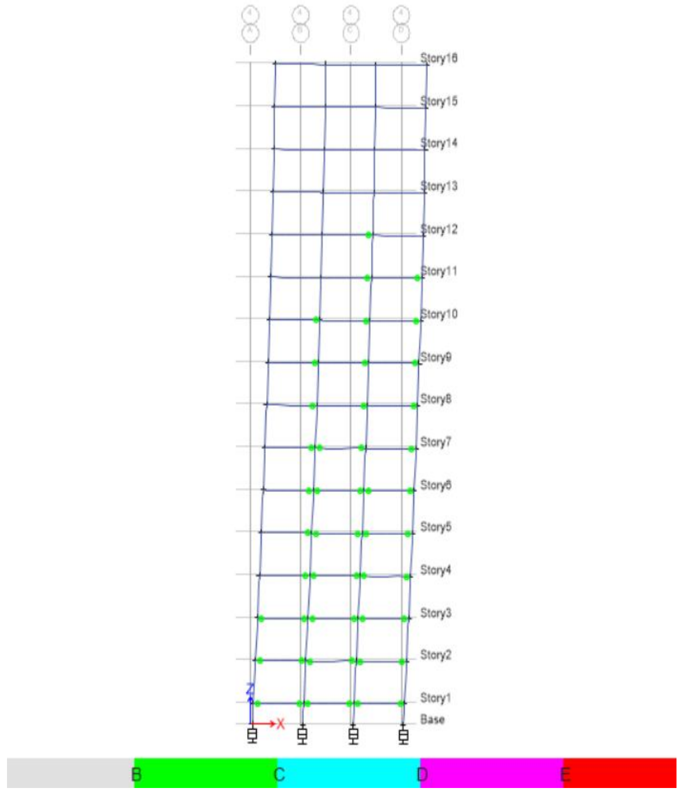


Fig.20 Hinge formation at performance point in x direction for G+14 fixed base building.

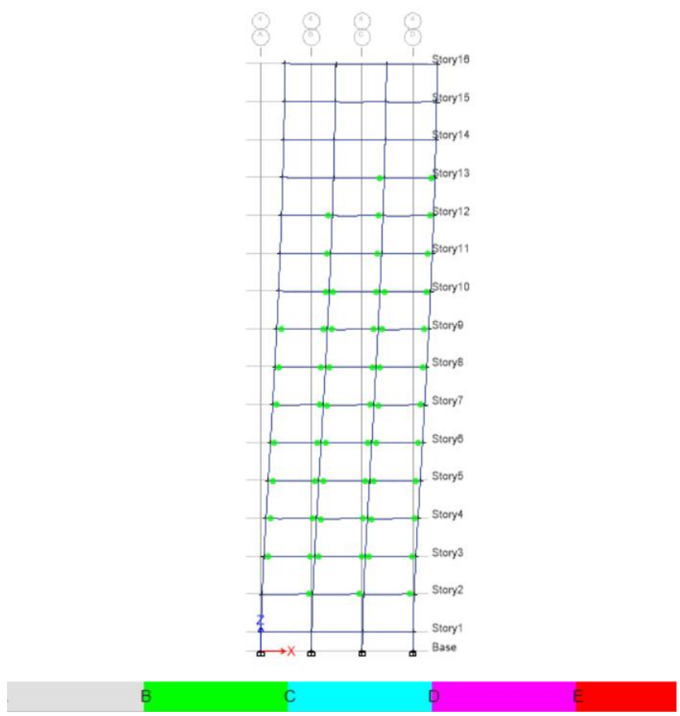


Fig.21 Hinge formation at performance point in xdirection for G+14 building with (LRB)

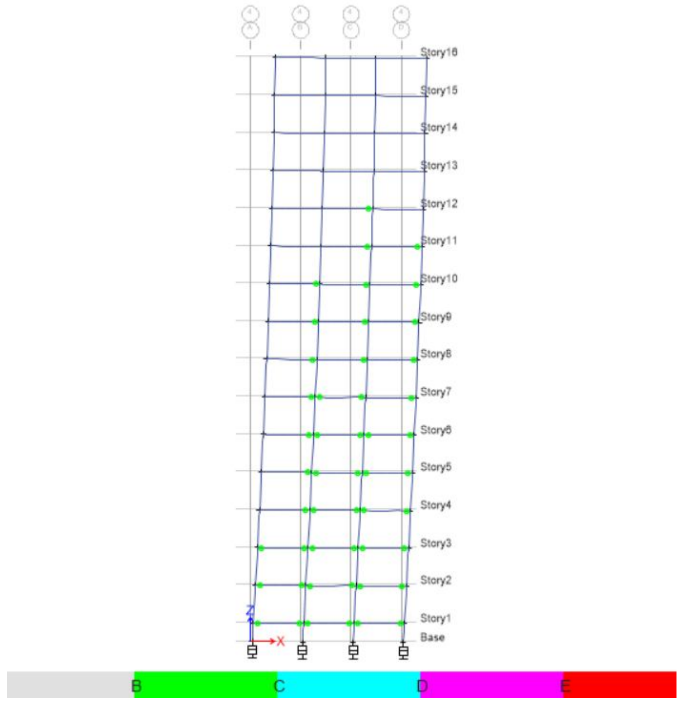


Fig.22 Hinge formation at performance point in y direction for G+14 fixed base building.

Fig. 17 to 22 show how plastic hinges are distributed at the performance point. This shows that base isolation helps protect the superstructure.In a G+14 building with a fixed base the seismic force is reduced through the frame bending a lot with plastic hinges in the beam elements on almost every floor.This means the frame has to bend a lot and's close to the Life Safety performance level.The Lead Rubber Bearing system works differently. It separates the structure from the ground movementso the lateral force is mainly at the isolation level.This greatly reduces hinge formation in the superstructure with many members not bending much. By reducing the forces and rotations the LRB system helps the G+14 building stay safe and stable at a level, like Immediate Occupancy, and reduces damage during an earthquake The LRB system helps protect the building.The base isolation system works well.

Table No 2: Base shear and roof displacement in x direction

Building	X Direction		Performance Level
	Base shear KN	Roof Displacement MM	
G+9 Fixed Base	3115.26	608.01	Io-IS
G+9 Base isolation (LRB)	2847.26	1244.74	Io-IS
G+14 Fixed Base	5349.85	989.93	Io-IS
G+14 Base isolation (LRB)	4373.61	1311.18	Io-IS

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

Table No 3: Base shear and roof displacement in x direction

Building	Y Direction		Performance Level
	Base shear KN	Roof Displacement MM	
G+9 Fixed Base	3115.26	608.01	Io-IS
G+9 Base isolation (LRB)	2847.26	1244.74	Io-IS
G+14 Fixed Base	5349.85	989.93	Io-IS
G+14 Base isolation (LRB)	4373.61	1311.18	Io-IS

This decrease is more noticeable in the G+14 structure.
The force demand drops from 5349.85 kN to 4373.61 kN.
This shows that LRB works better as the building gets heavier.
The reduction in force happens because the LRB system stretches out the time it takes for the structure to respond to an earthquake.
This is clear from the roof displacement.
The structures response moves away from the part of the earthquake spectrum with acceleration.
Both models perform within a range called IO–LS.
However using LRB provides protection.
It reduces the forces on the structures parts.
This is done by allowing controlled movement at the base of the structure.
The Lead Rubber Bearing (LRB) system helps to protect the structure.
The base-isolated models with LRB are better, at handling earthquake forces.

VII. TIME PERIOD

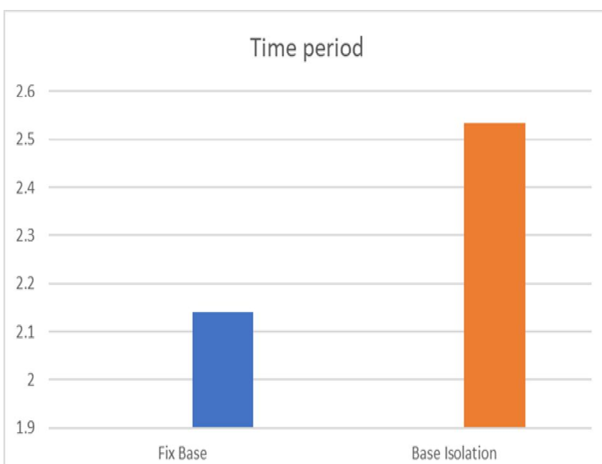


Chart no.1 time period G+14

The bar chart shows us the change in the period for the G+14 structure when we use base isolation. The natural period for the G+14 structure goes up from about 2.14 seconds when it is not isolated to 2.53 seconds when it is isolated. This change happens because the base isolation system makes the building less stiff at the base. This means the upper part of the building does not feel the ground movements as much.

The isolation system changes how the building responds to earthquakes by moving its response, to a range where the ground movementsre slower. This reduces the force of the earthquake on the building. Lowers the loads that the building frame has to handle.

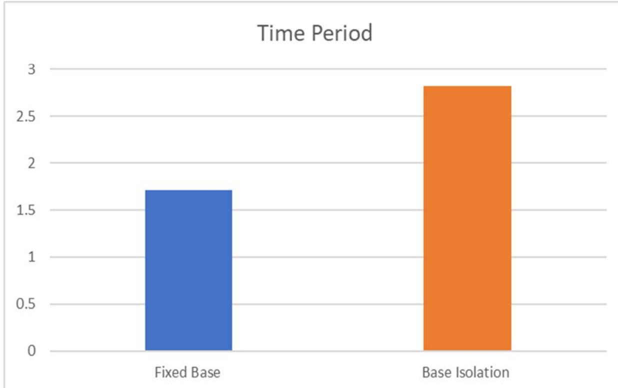


Chart no.2 time period G+9

The bar chart for the G+9 structure shows that the natural period gets longer when base isolation is used.
The natural period goes up from around 1.71 seconds when the base is fixed to 2.81 seconds for the model with base isolation.
This change happens because the base isolation makes the whole structure less stiff against forces.
By making the structure respond like a longer-period system it reduces the acceleration it experiences during an earthquake.
This reduction in acceleration lowers the force at the base of the structure, which helps protect the rest of the structure from forces.
The base isolation helps to keep the superstructure safe by reducing the impact of the earthquake.
The natural period and base isolation are factors in making the structure safer.
The G+9 structure benefits, from this design.

VIII. STORY DISPLACEMENT

A. Max story displacement G+14 with fixed

Table no. 4 shows the maximum story displacement in X & Y direction

TABLE: Story Response				
Story	**Elevation**	**Location**	**X-Dir**	**Y-Dir**
	m		mm	mm
Story16	46.2	Top	1053.51	1053.51
Story15	43.2	Top	1028.57	1028.57
Story14	40.2	Top	996.04	996.04
Story13	37.2	Top	954.29	954.29
Story12	34.2	Top	903.05	903.05
Story11	31.2	Top	842.75	842.75
Story10	28.2	Top	774.20	774.20
Story9	25.2	Top	698.37	698.37
Story8	22.2	Top	616.32	616.32
Story7	19.2	Top	529.24	529.24
Story6	16.2	Top	438.40	438.40
Story5	13.2	Top	345.34	345.34
Story4	10.2	Top	252.06	252.06
Story3	7.2	Top	161.43	161.43
Story2	4.2	Top	78.03	78.03
Story1	1.2	Top	10.54	10.54
Base	0	Top	0.00	0.00

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

B. Max story displacement G+9 with Fixed

Table no. 5 shows the maximum story displacement

TABLE: Story Response				
Story	**Elevation**	**Location**	**X-Dir**	**Y-Dir**
	m		mm	mm
Story11	31.2	Top	608.01	608.01
Story10	28.2	Top	585.68	585.68
Story9	25.2	Top	550.94	550.94
Story8	22.2	Top	503.45	503.45
Story7	19.2	Top	444.98	444.98
Story6	16.2	Top	377.91	377.91
Story5	13.2	Top	304.64	304.64
Story4	10.2	Top	227.55	227.55
Story3	7.2	Top	149.29	149.29
Story2	4.2	Top	73.70	73.70
Story1	1.2	Top	8.31	8.31
Base	0	Top	0.00	0.00

C. Max story displacement G+14 with LRB

Table no. 6 shows the maximum story displacement in X & Y direction

TABLE: Story Response				
Story	**Elevation**	**Location**	**X-Dir**	**Y-Dir**
	m		mm	mm
Story16	46.2	Top	1358.79	1358.79
Story15	43.2	Top	1330.20	1330.20
Story14	40.2	Top	1295.34	1295.34
Story13	37.2	Top	1252.80	1252.80
Story12	34.2	Top	1202.26	1202.26
Story11	31.2	Top	1143.98	1143.98
Story10	28.2	Top	1078.49	1078.49
Story9	25.2	Top	1006.44	1006.44
Story8	22.2	Top	928.50	928.50
Story7	19.2	Top	845.28	845.28
Story6	16.2	Top	757.34	757.34
Story5	13.2	Top	665.09	665.09
Story4	10.2	Top	568.80	568.80
Story3	7.2	Top	468.55	468.55
Story2	4.2	Top	364.18	364.18
Story1	1.2	Top	255.21	255.21
Base	0	Top	217.22	217.22

D. Max story displacement G+9 with LRB

Table no. 7 shows the maximum story displacement in X & Y direction

TABLE: Story Response				
Story	**Elevation**	**Location**	**X-Dir**	**Y-Dir**
	m		mm	mm
Story11	31.2	Top	1244.74	1244.74
Story10	28.2	Top	1199.48	1199.48
Story9	25.2	Top	1133.32	1133.32
Story8	22.2	Top	1044.80	1044.80
Story7	19.2	Top	936.19	936.19
Story6	16.2	Top	811.05	811.05
Story5	13.2	Top	673.08	673.08
Story4	10.2	Top	525.76	525.76
Story3	7.2	Top	372.25	372.25
Story2	4.2	Top	215.72	215.72
Story1	1.2	Top	60.15	60.15
Base	0	Top	0.00	0.00

In the fixed-base models, the displacement profile follows a traditional cantilever distribution, characterized by zero base displacement and peak magnitudes of 608.01 mm (G+9) and 1053.51 mm (G+14). Upon the implementation of Lead Rubber Bearings (LRB), both structures exhibit significant period elongation, resulting in increased global lateral displacement—reaching 1244.74 mm and 1358.79 mm, respectively. Technically, the LRB system facilitates a rigid-body translation of the superstructure by concentrating lateral deformation at the isolation interface, evidenced by the substantial base/lower-story displacements (e.g., 217.22 mm at the base of the G+14 model). This decoupling effectively shifts the structural response into a lower-acceleration region of the seismic response spectrum. While absolute roof displacement is higher in the isolated models, the inter-story drift and corresponding internal stress on beams and columns are drastically reduced, ensuring the superstructure remains largely within the elastic range during a seismic event.

E. Result

The study looked at G+9. G+14 buildings with and without Lead Rubber Bearings. Here are the main points:

1) Seismic Force Reduction: The base shear force goes down in both models when using Lead Rubber Bearings. This decrease is more noticeable in the G+14 structure, where the force demand drops from 5349.85 kN to 4373.61 kN with Lead Rubber Bearings.
2) Time Period Elongation: Adding base isolation increases the period of the building. For example in the G+9 structure it increases from 1.71 seconds to 2.81 seconds. This moves the response away from high-acceleration areas.
3) Displacement Profile: Lead Rubber Bearings increase the roof displacement. For instance in G+9 it rises from 608.01 mm to 1244.74 mm. However it allows for a rigid-body movement. This means the lateral force is concentrated at the base isolation level, not on the structural members.
4) Plastic Hinge Formation: In the model without Lead Rubber Bearings many plastic hinges form in beams between Stories 2 and 8. With Lead Rubber Bearings formation, in the superstructure is almost eliminated. This keeps the frame within the elastic range reducing damage.

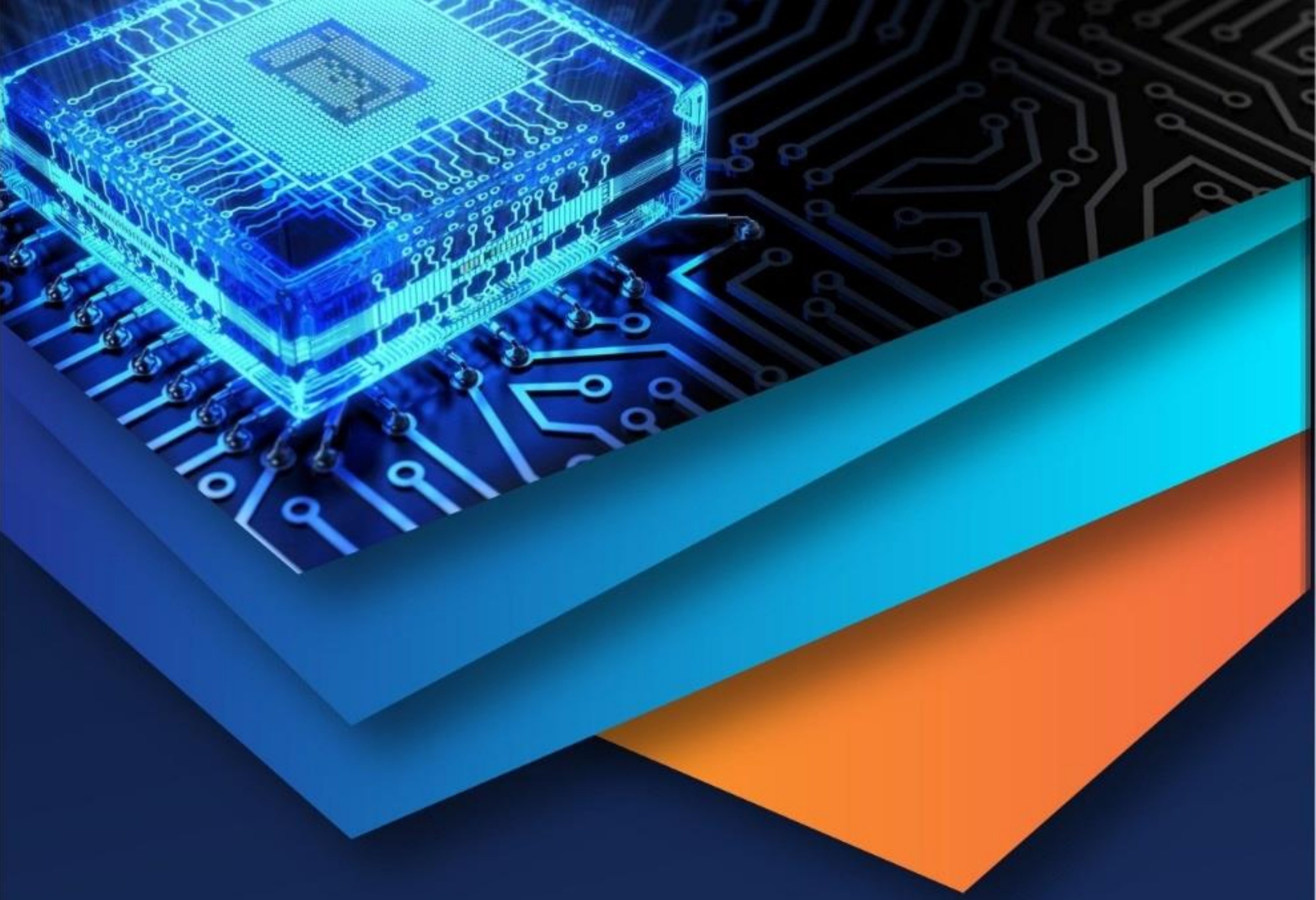
IX. CONCLUSIONS

1) Seismic Energy Dissipation: The LRB system enhances structural resilience by providing lateral flexibility and high levels of hysteretic damping. The lead core undergoes plastic deformation during seismic loading, effectively dissipating kinetic energy and reducing the impact of ground motion.
2) Superstructure Decoupling: By implementing base isolation, the system decouples the superstructure from the horizontal components of ground acceleration. This significant reduction in seismic demand ensures that structural members, such as beams and columns, remain within the elastic range. Consequently, the building maintains structural integrity and achieves "Immediate Occupancy" performance levels with negligible residual damage.

3) Displacement Control and Rigid-Body Response: Although the isolation layer increases the fundamental period and overall lateral displacement, these movements are concentrated at the isolation interface. This reduces inter-story drift and promotes a rigid-body response in the upper floors, protecting both the structural frame and sensitive non-structural components from high-frequency vibrations.

REFERENCES

[1] Daniel, D. M., & John, S. T. (2016). Pushover Analysis of RC Building. International Journal of Scientific & Engineering Research, 7(10), 88-92.
[2] Madhukumar, M., Helen Santhi, M., & Vasugi, V. (2023). Performance analysis of lead rubber bearing isolation system
[3] Jain, R. K., & Patil, M. M. (2014). Seismic Response of Base Isolated Building with Varying Thickness of Lead Rubber Bearing. International Journal of Science and Research (IJSR).
[4] Abhilash R. Biju V. Rahul Leslie. "Effect of lateral load patterns in pushover analysis", 10th National Conference on Technological Trends (NCTT09), pp. 138-142, Nov.2009.
[5] Prakash Vipul. "Whether performance-based engineering in INDIA?", ISET Journal of Earthquake Technology, Paper No. 447, Vol. 41. No. 1, March 2004, pp. 201-222.2004.
[6] Mulgund G. V. and Kulkarni A. B. "Seismic assessment of RC frame buildings with brick masonry infills", International journal of advanced engineering sciences and technologies Vol No. 2, Issue No. 2, ISSN: 2230-7818, pp. 140-147, 2011.
[7] Peter Fajfar. "Capacity spectrum method based on inelastic demand spectra", Earthquake Engineering and Structural Dynamics, vol.33. pp. 979-993, 1999.
[8] Manoj M More. Ajeet N. Nikam, Mayur.M.More. "Seismic Evaluation of Retrofitted RC Frame Building Using Shear Wall and Steel Braces", International Journal of Innovative Research in Science, Engineering and Technology, Volume 5, Issue 8, Pages 15688-1698,2016.
[9] FEMA 356. "Prestandard and commentary for the seismic rehabilitation of buildings" American society of civil engineers, Reston, Virginia, Nov.2000.
[10] Satish S. Kotwal, Vidyanand S. Kadam, Mayur M. More. Effect of Zone Factor on Seismic Parameters of RC Building International Journal for research and development in technology International Journal of Advance Research In Science and Engineering. Volume-12, Issue-1, 2019



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)