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Analysis and Comparison of High Rise Structure with Base Isolation and Dampers

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ABSTRACT

As a consequence of building collapses and other structural damage, the number of lives lost due to earthquakes has risen dramatically over the last several decades across the globe. Such destruction during earthquakes is undeniable proof of the dangers posed by such events to buildings and other facilities, including homes, hospitals, and schools. It was crucial to conduct this research to ensure the efficacy of technology like base isolation and dampers in preventing damage to buildings during tremors.

The goal is to ensure the structure doesn't collapse when subjected to lateral pressures. The readings are recorded, compared, and analyzed using response spectra. Recent years have seen extensive focus on enhancing the wind and seismic responses of buildings and bridges via the study and development of structural control systems including passive control system, active control system, and semi active control system. There is no need for electricity to operate a passive control system. Active control systems rely on internal sensors and a constant supply of external electricity. Both methods are suitable for usage against earthquakes and high wind speeds. There is no way to completely prevent natural catastrophes from happening.

Applying a base isolator and different dampers such a friction pendulum, fluid viscous, or visco elastic significantly reduced the displacement and drift values by 20-30% and 10-20%, respectively. Such measures prevent damage to the building and save lives during earthquakes and other events with high lateral stresses.

Keywords: Base shear, Seismic zone, Storey displacement, Storey drift.

I. INTRODUCTION

1.1 General

Seismic waves traveling through the Earth's crust produce the abrupt shaking of the ground that is characteristic of earthquakes. Quake, tremor, and temblor are all names for earthquakes. Seismic waves are the outcome of an earthquake, which is the sudden release of energy in the Earth's crust. Potential sources of crustal energy include mass motion, chemical processes, elastic strain, and gravity. As the only kind of energy that can be stored in the ground in sufficient amount to create substantial dis-turbances, the energy released owing to the elastic strain is the most important cause. In India, almost all buildings are quite modest in height (no more than four floors). The re-sponse spectrum from IS 1893 shows that low-rise buildings experience high levels of earthquake force because to their short duration. Despite this, most design engineers downplay the seriousness of the issue, putting residents at greater danger in the event of an earthquake. Damage to and loss of life in buildings constructed before the adoption of modern seismic standards is widespread.

Contrasting seismic activity with the structural weaknesses is crucial. When an earthquake of moderate to severe magnitude strikes, the bulk of the city's structures, since they were built according to earlier architectural rules, put their owners at danger. To address these issues, pushover anal-ysis has become standard practice for predicting how buildings would react during strong earthquakes.

Numerous disastrous earthquakes have struck throughout the globe in recent decades, leading to an increase in the number of casualties from the collapse of buildings and other structural damage. Such destruction after earthquakes is a stark reminder of just how dangerous earthquakes can be, and highlights the need of taking extra precautions when designing buildings like homes, utilities, museums, and factories. The practice of incorporating seismic response management into structural design is becoming commonplace in Civil Engineering. Recent years have seen extensive focus on bettering the reactions of buildings and bridges to wind and seismic forces, leading to the development of structural control approaches as passive control system, active control system, and semi active control system. There is no need for electricity to operate a passive control system. Active control systems rely on sensors mounted within buildings and need an external power source to function. An external power source is required for semi-active control systems, and they get their information from sensors installed inside the structures themselves. Passive control systems are used to regulate the trembling of buildings when electricity is unavailable. Both methods are suitable for usage against earthquakes and high wind speeds. As a result of dedicated research and development, structural control technology is already in use.

1.2 Need of the study

In designing buildings to withstand earthquakes, the seismic zone is crucial since the zone factor varies from mild to severe earthquakes. If you want your building to withstand an earthquake, you need to take the soil type into account. Therefore, we must build the structure extremely specifically to accommodate all lateral pressures so that the structure can endure for the greatest time period without causing any damage to society.

1.3 Objectives of the Study

The objectives of this study are shown below

- To look into a damper that is more compatible in terms of storey displacement, drift, shear, & overturning moment than other Dampers and Bare frame.
- Construct a three-dimensional model with the following components: a bare frame, a base isolation system, a friction pendulum bearing, a viscoelastic damper, & fluid viscous damper, and then conduct a seismic analysis.
- Storey Displacement, Drifts, Shear, and Overturning Moment in Relation to Bare frame, Base Isolation, FPB, VED, and FVD in Multi-Story Buildings.
- Find out whether allowed displacement is lower than maximum displacement.
- Determine whether computed values are within acceptable parameters.

1.4 Scope of the Study

Including lateral load resisting technologies in the building's design has greatly improved the building's seismic performance. This research was conducted for G+18 high-rise structures with base isolators, friction pendulum bearings, fluid viscous dampers, and viscoelastic dampers installed at the building's corners, and utilizing the program ETABS 2016.2.1. Seismic parameters such as base shear, lateral displacements, and lateral drifts may be analyzed with the use of the constructed models. Zone V is the focus of the investigation.

II. LITERATURE REVIEW

Naziya Ghanchi, Shilpa Kewate, (2015), Twenty-five story reinforced concrete (RCC) building dynamics with & without viscous dampers, The building is up to date with regards to IS standards, and it is located in seismic zone III. In recent years, passive dampers have become more popular as a means to better new-building seismic performance and design. The primary goal of the research is to evaluate the effectiveness of the viscous damper devices in enhancing the structural response. Energy from powerful earthquakes may cause structural damage. Dissipating this energy in a way that is not reliant on the building itself will greatly boost its seismic performance and reaction. The 25-story RCC structure, whose future purpose is commercial, underwent a response spectrum study. The building has a concrete shear wall core and an average floor space of 735 square meters. We use ETABS, a finite element tool, to create a model of the structure and conduct a response spectrum analysis on it.

We do a response spectrum study on four replicas of 25-story RCC structures. AL0 is a standard building model without dampers, while AL1, AL2, and AL3 are modified versions of the same structure with the varying damper parameters shown in Table 1. There is an examination of how each of the four building types responds to environmental stimuli. Table 1 shows that compared to a building without viscous dampers, the application of the first damper property reduces story shear in the X direction by -1%. Table 1 shows that compared to a structure without viscous dampers, the employment of the second set of damper parameters results in a -1% reduction in story shear in the X direction. The third damper properties shown in table 1 reduce the amount of shear in the X direction by 1% compared to a structure without viscous dampers. Given these findings, it's obvious that installing viscous damp-ers in a structure significantly lowers the structure's responsiveness. When analyzing the spectrum of responses in the X and Y directions, it becomes clear that the structural responses, such as story drift and storey displacement, attenuate more than story shear. There is a 29%-30% decrease in narrative drift, a 20%-23% reduction in narrative displacement, and a 0%-2% reduction in narrative shear.

U.P.Vijay, P.R.Kannan Rajkumar and P.T.Ravichandran,(2015) Controlling the Seismic Reaction of Reinforced Concrete Buildings using Viscoelastic Dampers",, This research looks at the impact of ViscoElastic (VE) dampers on the global performance of dynamically sensitive structures by considerably increasing the damping ratio of the RCC structure. The projected VE damper–equipped hospital building in Delhi is the subject of a parametric analysis. Since it will serve as a vital lifeline, the facility may be built in an area prone to earthquakes. We used ETABS 9.7.2 to do finite element analysis. This paper presents an analytical research comparing the lateral load resisting behavior of naked (without damper) and damped buildings in order to demonstrate the efficacy of damper. ViscoElastic dampers have a parallel configuration of a linear spring and dash-pot, simulating the brace type damping mechanism. This research has put the earthquakes to use as a kind of spectrum acceleration in response studies. Multiple evaluations were performed to learn how best to position the dampers in this building to produce the highest possible damping ratio. This research shows that the damping ratio is 2% better with the ViscoElastic damper than with the RCC construction, thanks to the damper's dynamic properties. The addition of a ViscoElastic damper effectively reduced the seismic response (drift, displacement, shear, and overturning moment) of the structures by about 4 to 20%, and control of seismic responses facilitated the optimum design of shear wall without increasing the size of walls, resulting in a net floor area increase of about 0.5%.

Ashish R. Akhare, Tejas R.Wankhade,(2016) International Journal of Engineering Sciences and Research Technology, "Seismic Performance of RC Structure Using Different Base Isolator," After an earthquake or other natural disaster, hospital buildings become crucial. After an earthquake, the building's structural and non-structural parts should continue to function normally and safely. As a result, the base isolation method is the most effective option as a seismic protection system for reducing the building's vulnerability to earthquake damage. By lengthening the structure's fundamental period, base isolation systems aim to lessen the inertia pressures caused by earthquakes. The purpose of this research is to employ a High density rubber bearing (HDRB) and a friction pendulum system (FPS) as an isolation device and then use SAP2000v14 software to compare different parameters between a fixed base condition and an isolated base condition. This research makes use of a (G+12) story hospital structure as a proving ground. Both the fixed base and the isolated base undergo a nonlinear time history analysis. The obtained result demonstrates that the base-isolated structure experiences a decrease in shear in both directions, an increase in displacement, and a lengthening of the time period.

In terms of earthquake safety, the base separation technique has shown to be effective. The study demonstrates that High Density Rubber Bearing (HDRB) and Friction Pendulum System (FPS) isolators may lessen the structural reaction. HDRB reduces the X-direction base shear by 70%, while FPS cuts it by 94%. In the Y-axis, HDRB achieves a 71% reduction while FPS achieves an 85% reduction. When compared to the fixed base structure, the time periods of both the HDRB and the FPS, which are based on their own isolated bases, rise. In both the HDRB and FPS situations, the base isolation results in greater vertical displacement between floors. The results reveal that compared to a typical construction, utilizing base isolation devices significantly reduces storey drift in both the X and Y dimensions. The results reveal that compared to a standard construction, utilizing base isolation devices significantly reduces storey acceleration in both the X and Y dimensions.

Puneeth Sajjan , Praveen Biradar,(2018) Research on the role of viscous dampers in rcc frame construction",, Many other forms of loading situations, including earthquakes, wind, and snow, are common throughout the life of a structure. Structures in earthquake-prone regions are built with seismic forces in mind. Due to the increased risk of damage or collapse, buildings in high-risk earthquake zones sometimes undergo retrofitting or have materials added to them in order to better withstand seismic pressures. Cost is a factor whether or not retrofitting techniques are used, and depending on the methods used, some existing space may have to be sacrificed. Later on, when various protection measures have been created, the structure may be reinforced by adding external materials to transmit the lateral stresses. Damping devices play an important role in contemporary seismic design, since they mitigate seismic energy and allow for the regulation of the structural response to an earthquake's excitation. In this research, we use ETABs 2015 to model and evaluate an 8-story building with a symmetrical floor plan. IS1893-2002 (Part 1) defines the earthquake loads. Static and dynamic analysis techniques are used to examine the building. When doing a dynamic analysis, the response spectrum function must be specified. Adding a viscous damper to a building may reduce its seismic reactivity, as well as enhance its stiffness. The model and analysis of the structure include the viscous damper. This research makes use of a viscous damper with the following me-chanical properties: damping coefficient Cd= 810 kN-s/m; exponent = 0.3. Comparing the outcomes in the forms of displaced text, drifted text, and sheared text.

The current research makes use of the ETABs 2015 program for both modeling and analytic purposes. An 8-story symmetrical reinforced concrete building is being explored. ETABs 2015 models and analyzes the structure without a damper. This model falls within the category of gravity loads. For zone 3 structures, first apply the Earthquake loads specified in IS1893-2002, Part-1. The X and Y axes undergo dynamic evaluations using the response spectrum approach, with 5% damping and the scale factor evaluated in accordance with the IS code. The viscous damper is there to absorb or transmit the lateral loads of the structure and to moderate the seismic response of the building. ETABs includes a model of a viscous damper. The current research uses viscous dampers to mitigate the shaking of a building under an earthquake's toll. The study models the frames (with and without viscous damper) based on the characteristics of the structure. The models undergo analysis for both dead and live loads (also known as gravity loads) and seismic loads. The ETABs 2015 program does the dynamic analysis based on the response spectrum approach and the Indian Standards codes. The symmetry of the model guarantees that the values in both directions will be identical. Displacement, story drift, and story shear are some of the characteristics used to evaluate the seismic behavior of a Reinforced Concrete building.

Talikoti.R.S, Vinod R.Thorat, **(2019)**, Anti-seismic buildings, or those that can endure seismic dangers and provide some ground resistance during earthquakes, have been the subject of much study and development, although their results have so far been disappointing. Many construction elements have discovered new solutions to cope with structural dangers following decades of research and application of sophisticated planning, execution, and maintenance techniques in high rise buildings, however issues about seismic hazards remain generally found unaddressed. In earthquake-prone areas, often known as seismic zones, these seis-mic dangers are a major cause for worry.

The fundamental premise of base isolation is to physically separate the building from its foundation, allowing the structure to remain unaffected by earthquake ground motion. In other words, the structure will ideally move as a stiff body rather than collapse, even if the ground underneath it is violently shifting. This lessens floor speeding and storey gliding, protecting the building's structural components from unnecessary wear and tear. While there is complete isolation in the model, in practice there is a connection between the foundation and the structure that allows for adaptation. The lifespan of every rigid structure is limited. There will be no separation between the building and the ground since the acceleration imparted to the building is equal to the acceleration of the ground. That is to say, both the earth and the building will move at the same rate.

When compared to other systems, a base isolator's little effect on movement and drift in any direction is particularly striking. The LBR and HDRB both take longer to complete than the fixed base structure, although they are both accelerated by the addition of bracing. There was a 10% reduction in building displacement compared to the construction without the base isolator.

III. METHODOLOGY

3.1 General

All the buildings are built to withstand the combined impacts of gravity and seismic loads, and their strength and stiffness have been tested to ensure they meet the standards for structural performance and acceptable deformation set by the local building code. The intrinsic safety factor in the design standard allows most buildings to accommodate for vertical shaking. Stability analysis should take into account both horizontal and vertical acceleration in large-span constructions.

3.2 Modeling information

We used ETABS Nonlinear 2015 for our modeling and numerical analysis.We designed a real building with 18 stories and gave it all the qualities we could think of. To efficiently restrict the displacements of all the points making up each level, the floors and roof were modeled as rigid diaphragms, and the lateral loads are distributed according to the relative stiffness of the resisting parts. The outside walls' weights were cal-culated and translated into masses to account for the residential building's dead weight. Diaphragms received the weights as extra area mass. We also had to distribute live cargoes.

The ETABS models relied on the following presumptions:

- The only part of the structure that counts is the main lobby. Stairs are an afterthought during the planning phase. The intended use of the structure is as a dwelling.
- In the basement, there are no slabs, thus the floor is lying straight on the dirt.
- Lack of planning for the foundation. The supports for a building may be either permanently installed (for a fixed basis) or temporarily installed (for an isolated base).
- Considering solely horizontal (X, Y) seismic stresses and ignoring vertical (Z) ones is a common practice when dealing with earthquakes.

India is divided into four seismic zones (II, III, IV, and V) that are used as a starting point for calculating the design seismic forces. The fifth iteration of the code combines Zones I and II into a single Zone II, when there were previously five. To calculate the horizontal seismic force coefficient Ah for a building's design, one must use equation 3.1.

$$\mathbf{A_h = ZISa/2Rg} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{Eqn.no 3.1}$$

Z = service life of a building and the maximum significant earthquake (MCE) zone factor. Putting a 2 in the denominator will make the MCE for the DBE less.

I = Hazardous implications of its collapse, post-earthquake functional demands, historical worth, and economic relevance all contribute to the building's significance, which in turn relies on its functional purpose.
R = Whether the structure exhibits ductile or brittle deformation during seismic loading will determine the response reduction factor (I/R), although the ratio should never exceed 1.
S_a /g = average response acceleration coefficient (refer. IS 1893 (part 1):2002)

3.3 Response Spectrum Method

3.3.1 General Codal Provisions

The following structures need a dynamic study to determine design seismic force & its distribution across multiple levels across height of building and to various lateral load resisting elements:
Typical structures are those that are at least 40 meters in height in zones IV and V, and at least 90 meters in height in zones II, III, and IV.
Uneven structures—any framed building taller than 12 meters in Zones IV and V, or 40 meters in Zones II and III.
Both the time history approach and the response spectral method are available for dynamic analysis. In any case, however, the calculated base shear Vb' using a fundamental period Ta must be compared to the design base shear Vb. Multiplying all response values by Vb'/Vb when Vb is less than the threshold value. For the purposes of dynamic analysis, steel and reinforced concrete structures may use damping values of 2% and 5% of the critical, respectively.

3.3.2 Modes to be considered

The analysis's mode count must be high enough that the sum of all modes' modal masses is more than or equal to 90% of the overall seismic mass, with the missing mass adjustment exceeding 33%. We recommend just combining modes up to 33 Hz in order to take into account higher-frequency natural modes.

3.3.3 Computation of Dynamic Quantities

It is possible to describe buildings with either a regular or nominally irregular plan arrangement as a system of masses aggregated at the floor levels, where each mass has one degree of freedom, that of lateral displacement in the direction under discussion. The following equations for calculating different amounts hold under these conditions.

IV. RESULTS AND DISCUSSIONS

4.1 General

An 18-story building's seismic study, including the effects of its Base Isolation, Friction Pendulum Bearing, Visco Elastic Damper, and Fluid Viscous Damper, is detailed in this chapter.
Storey displacement, Storey drift, and Base shear in seismic zone IV are the characteristics under investigation. There is a comparison of the various models.

4.2 Analysis of the Building

The following topics are useful for discussing the key differences between the modeled structures with and without dampers:

- Storey Displacement
- Storey Drift
- Storey shear of structures
- Overturning moment

4.3 Storey Displacement

In contrast to the fixed base model, the base isolated model has far less fluctuation in the maximum displacement of stories. The isolated building has a steeper graph because the overall maximum displacement is greater, but the inter-storey displacement is less. By limiting their movement, the columns will be better equipped to withstand earthquakes without succumbing to buckling.

Table 1 provides information on structural displacement for several configurations, including those with a friction pendulum bearing, fluid viscous damper, vis-co elastic damper, base isolation, and a bare frame.

Table 1 Displacement Values (in mm)

Storey Level	BARE	FPB	FVD	VED	LRB
Storey18	98.569	70.624	81.361	82.542	72.054
Storey17	94.178	68.598	78.002	79.254	70.745
Storey16	91.293	65.001	76.059	77.982	67.512
Storey15	87.881	60.652	73.632	75.624	62.365
Storey14	83.982	55.883	70.369	72.361	57.265
Storey13	79.55	50.521	67.264	68.954	52.951
Storey12	74.617	44.328	64.655	65.987	46.951
Storey11	69.441	39.254	60.964	61.549	41.625
Storey10	63.441	34.369	55.197	57.621	36.354
Storey9	57.291	29.632	50.369	54.621	32.61
Storey8	50.825	24.362	45.364	50.644	25.415
Storey7	44.089	20.002	40.009	45.796	23.785
Storey6	37.129	18.326	34.264	39.951	19.251
Storey5	29.995	15.362	22.364	24.641	15.321
Storey4	22.749	12.354	20.995	12.364	13.251
Storey3	15.472	6.852	20.995	8.621	7.851
Storey2	8.325	4.35	5.621	5.901	4.985
Storey1	2	0.010	0.044	0.283	0.015
Base	0	0	0	0	0

The graph pertaining displacement values in mm vs storey are given in following
fig 1,

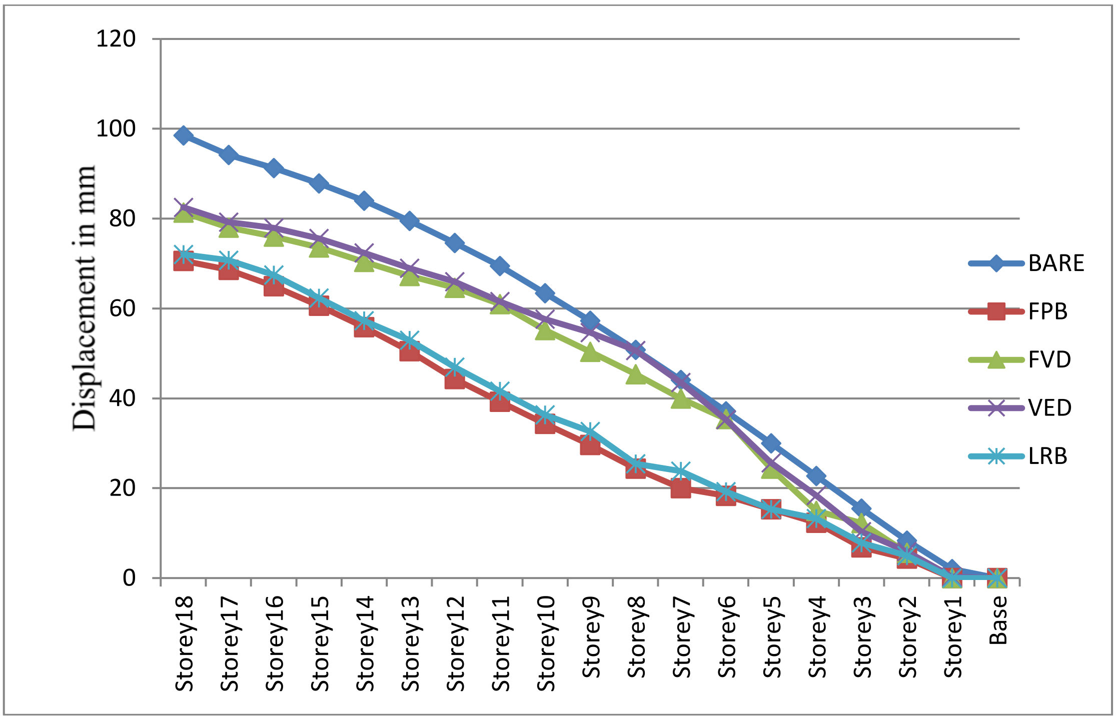

Fig 1: Storey Displacement

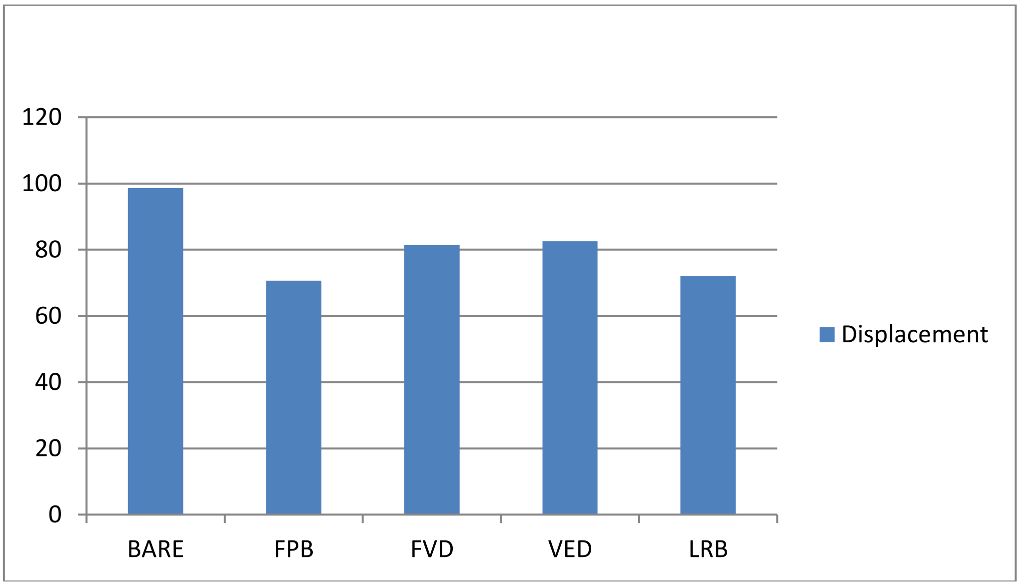

Fig 2 Maximum displacement (mm) vs Models

The use of base isolation and dampers has resulted in much lower displacement values, as shown by the following findings:
As can be seen in the figure above, the displacement has been reduced by 28.985% due to the use of friction pendulum bearings compared to the bare frame, and by 26.89%, 15%, and 16% due to the use of base isolation, visco elastic, and fluid viscous dampers, respectively.

4.4 Storey Drift

Calculating storey drift is as simple as subtracting the vertical distance moved between the top and bottom floors and dividing by the number of floors involved. As a consequence of the base isolation system's key feature, the superstructure is able to move with a degree of rigidity, which indicates a reduction in the relative storey drift of structural elements. Listed in table 2 below are the drift values for a bare frame, friction pendulum bearing, fluid viscous damper, visco elastic damper, and a base isolation.

Table 2 Storey Drift Values (in mm)

Storey Level	BARE	FPB	FVD	VED	BIS
Storey18	0.000112	0.00007	0.000121	0.00009	0.00008
Storey17	0.000114	0.000112	0.000116	0.000110	0.000112
Storey16	0.000116	0.000154	0.000118	0.000112	0.000114
Storey15	0.000118	0.000292	0.000292	0.00012	0.00023
Storey14	0.00018	0.000304	0.000304	0.00018	0.000261
Storey13	0.000241	0.000317	0.000317	0.000239	0.000284
Storey12	0.000295	0.00033	0.00033	0.00029	0.000305
Storey11	0.000339	0.00034	0.00034	0.000333	0.000322
Storey10	0.000375	0.000346	0.000346	0.000367	0.000335
Storey9	0.000404	0.000347	0.000347	0.000395	0.000342
Storey8	0.000426	0.000341	0.000341	0.000415	0.000342
Storey7	0.000441	0.000327	0.000327	0.00043	0.000336
Storey6	0.000451	0.000303	0.000303	0.000439	0.000323
Storey5	0.000456	0.000269	0.000269	0.000443	0.000301
Storey4	0.000455	0.000222	0.000222	0.000441	0.00027
Storey3	0.00044	0.000162	0.000162	0.000427	0.000229
Storey2	0.000371	8.60E-05	8.60E-05	0.000362	0.000185
Storey1	0.000158	2.20E-05	2.20E-05	0.000156	0.000137
Base	0	0	0	0	0

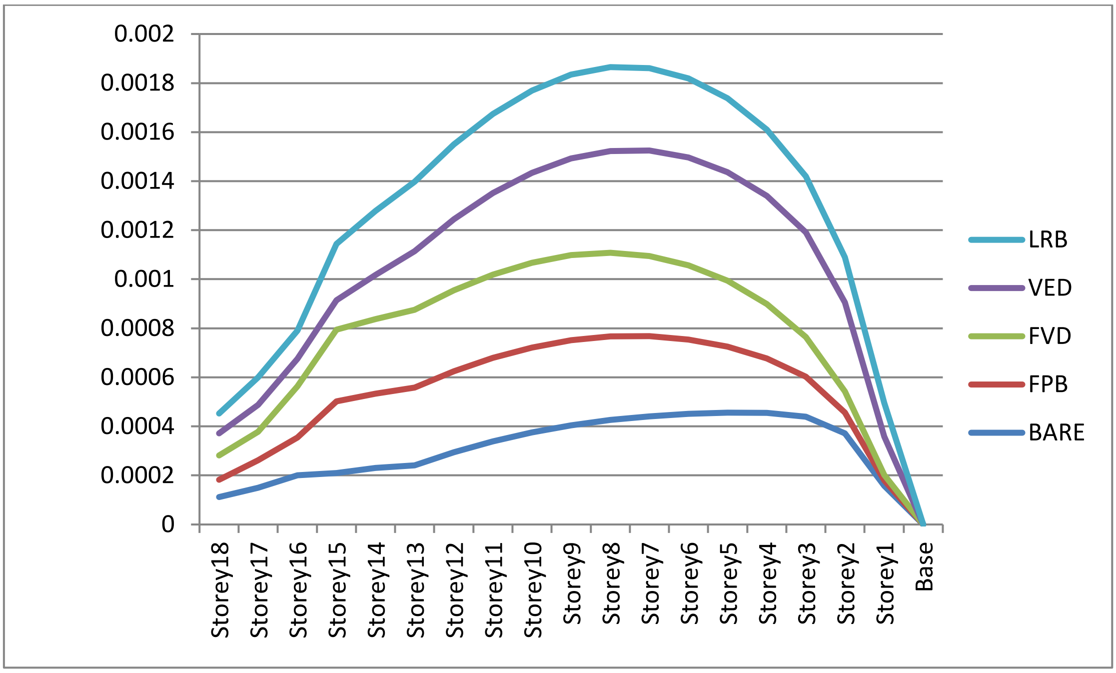

Fig 3 Storey Drift (in mm)

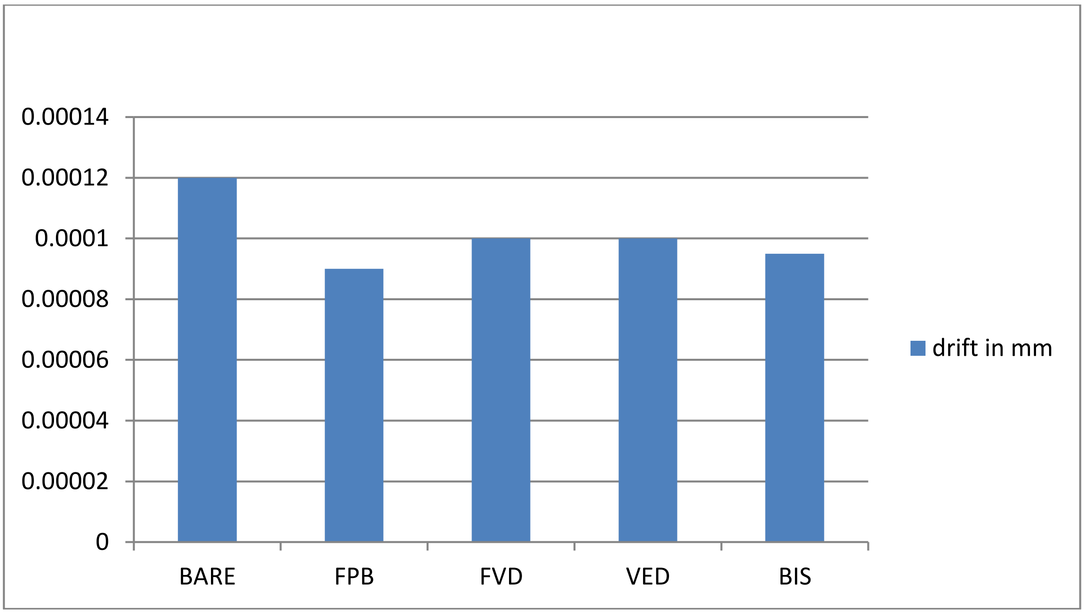

Fig 4 Maximum Storey Drift vs models (in mm)

The following findings were made on the relationship between dampers and base isolation and the reduction of drift values:
As a percentage reduction in drift, the friction pendulum showed 38.18 percent, the base isolation gave 27.2 percent, the visco elastic damper showed 18.18 percent, and the fluid viscous damper showed 9.09 percent.

4.5 Storey Shear

The ETABS program provides a world-based report on Storey shear. The forces are recorded at four different heights along the storey: at the very top, directly above the storey level, directly below the storey level, and at the very bottom. In addition to reducing storey shear, base isolation strengthens the superstructure of a building above the isolation plane. These structures experienced about half a story more shear than those with a stable basis. Table 3 displays the obtained data.

Table 3 Tabular values of Storey shear (in kn)

Storey Level	BARE	FPB	FVD	VED	BIS
Storey 18	0	0	0	0	0
Storey 17	806.267	538.9331	750.2678	700.7968	550.3487
Storey 16	2006.486	1608.514	1406.486	1857.278	1642.585
Storey15	3688.496	3133.929	2688.4963	3396.107	3200.311
Storey14	4806.267	538.9331	3806.2678	4509.796	550.3487
Storey13	5406.486	1608.544	3006.486	3157.278	1642.585
Storey12	6988.496	3133.929	4088.4963	4203.107	3200.311
Storey11	7549.105	5046.044	5549.1054	6767.564	5152.983
Storey10	10893.31	7281.41	7893.311	8765.552	7435.642
Storey9	14634.69	9782.255	11634.69	12119.59	9989.462
Storey8	18695.31	12496.51	15695.317	16759.83	12761.18
Storey7	23005.77	15377.75	19005.772	20624.03	15703.62
Storey6	27505.13	18385.24	22505.132	24657.59	18774.61
Storey5	32140.97	21483.94	21140.975	28813.49	21939.02
Storey4	36869.38	24644.58	32869.382	33052.38	25166.55
Storey3	41654.93	27843.83	35654.932	37342.49	28433.54
Storey2	46470.70	31062.38	40470.707	41659.70	31720.34
Storey1	51298.28	34289.27	44298.289	45987.49	35015.54
Base	54517.88	36441.31	50517.887	48873.78	37213.22

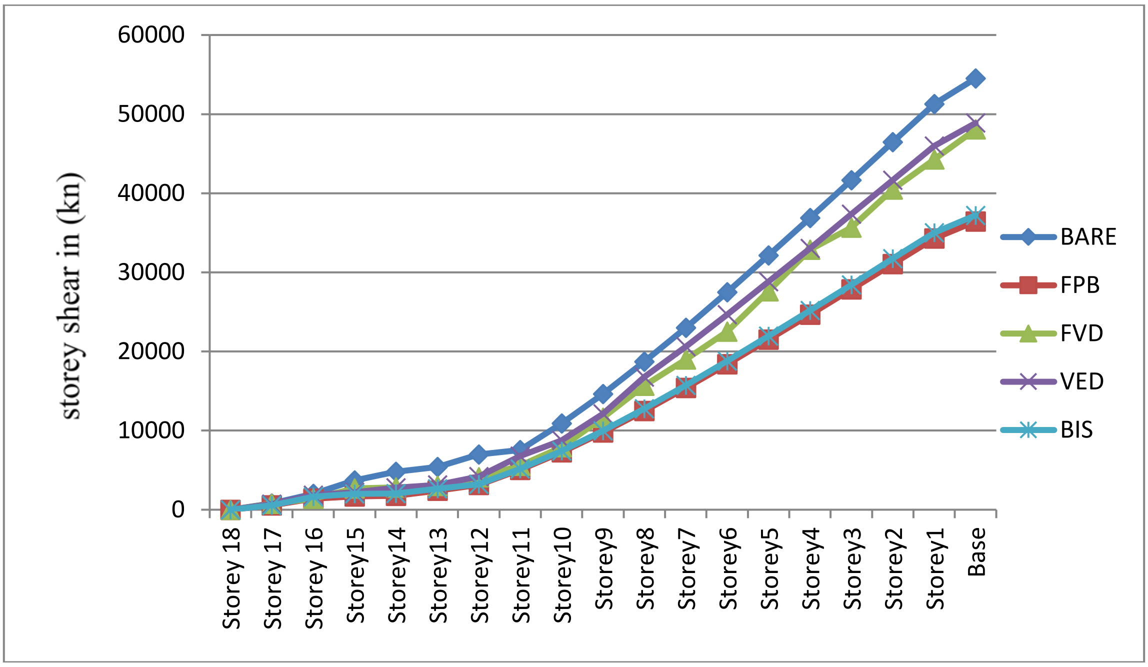

Fig. 5 Storey shear of each floor

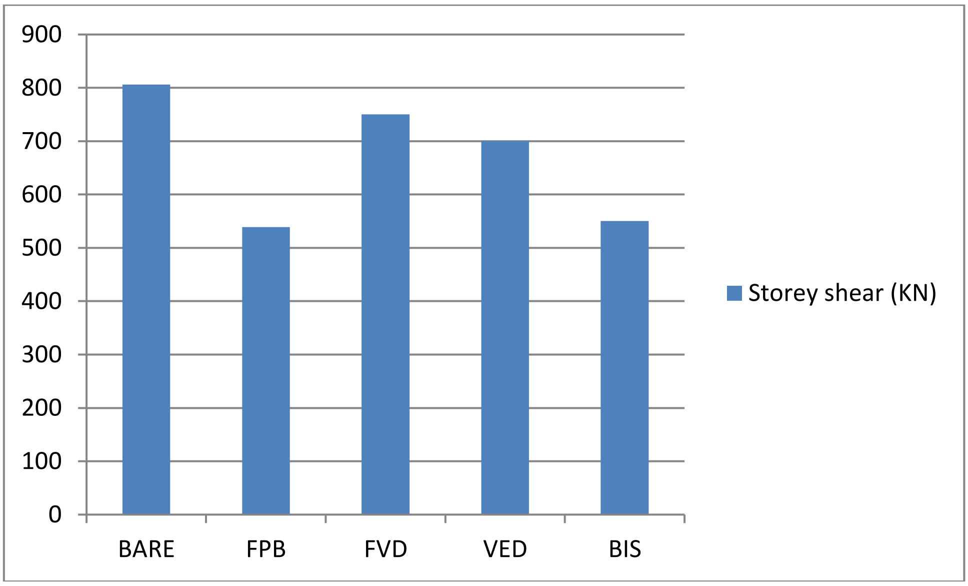

Fig.6 Maximum Storey shear vs Models

Friction pendulum bearing reduces the storey shear moment by 33.15 percent, as seen in the figure. As a comparison to the bare frame, the gains from using the base isolation approach were 31.74 percent, from using visco elastic, 13.08 percent, and from using fluid viscous dampers, 6.94 percent.

4.6 Storey Overturning Moment

There is little to no change in the overturning moment of a structure based on its isolation level. Thus, it is reasonable to conclude that the use of an FPB base isolation sys-tem for a (G+17)-story structure makes either no difference in the values of moments or a very little change.Table 4 displays the overturning moments.

Table 4 Tabular values of Overturning moments in all models (Kn-m)

Storey Level	BARE	FPB	FVD	VED	LRB
Storey 18	-215.89	-139.274	-195.266	-210.64	-145.45
Storey 17	-250.93	-146.927	-205.793	-215.96	-151.079
Storey 16	-320.83	-160.372	-220.594	-220.93	-165.242
Storey 15	-468.862	-179.644	-258.966	-240.93	-183.45
Storey 14	-533.47	-356.527	-503.38	-478.161	-364.079
Storey 13	-760.836	-508.472	-700.696	-681.943	-519.242
Storey 12	-953.705	-637.372	-903.536	-854.819	-650.872
Storey 11	-1114.33	-745.122	-1014.74	-999.329	-760.905
Storey 10	-1247.47	-833.616	-1207.13	-1118.01	-851.273
Storey 9	-1353.82	-904.748	-1303.54	-1213.41	-923.912
Storey 8	-1437.73	-960.412	-1406.82	-1288.07	-980.755
Storey 7	-1500.52	-1002.5	-1409.79	-1344.52	-1023.74
Storey 6	-1545.55	-1032.91	-1505.28	-1385.3	-1054.79
Storey 5	-1576.15	-1053.54	-1506.14	-1412.96	-1075.85
Storey 4	-1595.66	-1066.27	-1505.18	-1430.04	-1088.85
Storey 3	-1605.43	-1073	-1565.26	-1439.07	-1095.73
Storey 2	-1609.79	-1075.63	-1589.19	-1442.6	-1098.42
Storey 1	-1610.84	-1076.04	-1589.8	-1443.14	-1098.83
Base	0	0	0	0	0

Negative sign indicates hogging moments

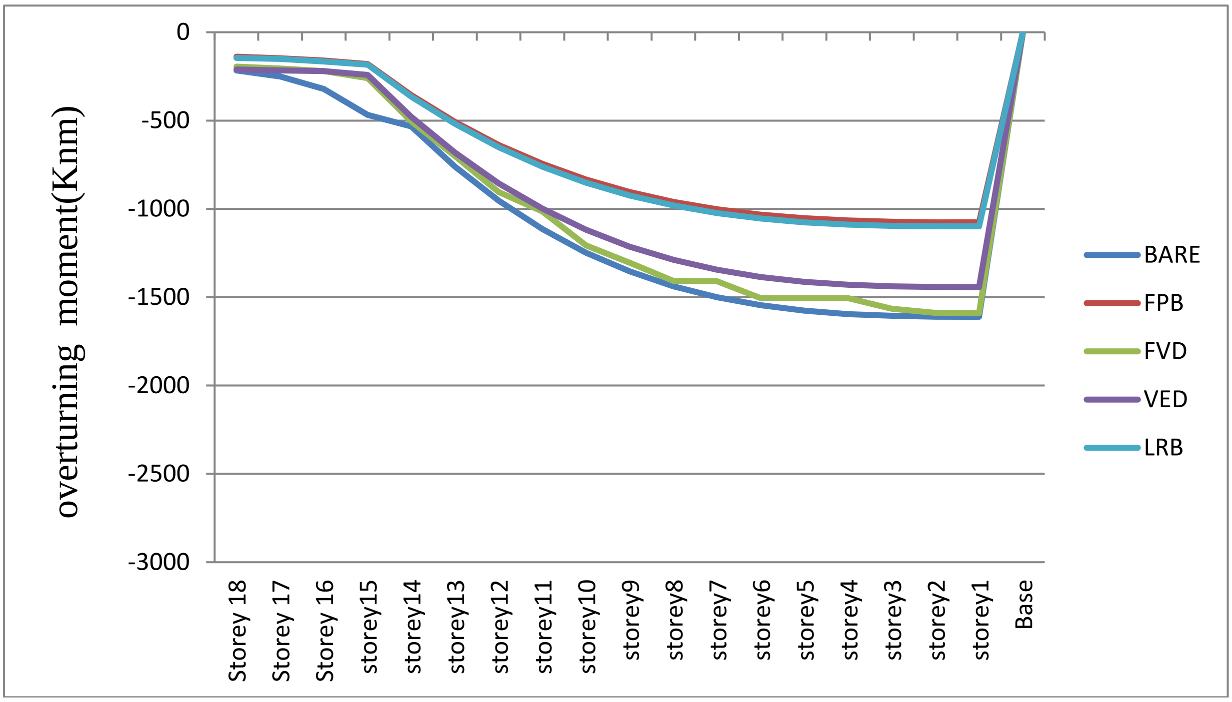

Fig 7 Overturning Moments (in KN-m)

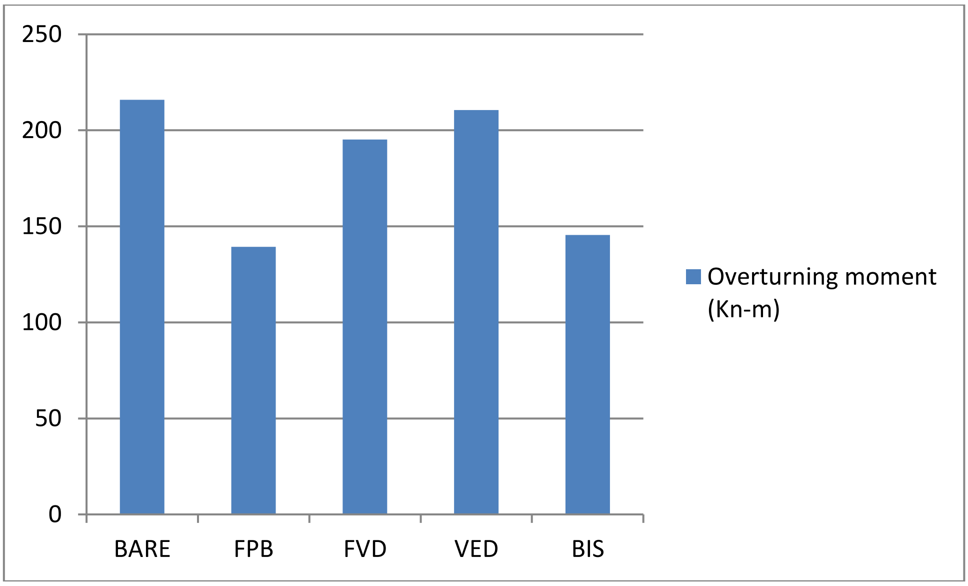

Fig. 8 Maximum overturning moment vs Models

Overturning moment is reduced by 35.49 percent for friction pendulum bearing, as shown in the above diagram. Base isolation method 32.62%, viscoelastic 5%, and fluid viscous dampers 9.55% were all improvements over the bare frame.

V. CONCLUSIONS

5.1 Conclusions

Story displacement, storey drifts, storey shear, and overturning moments are some of the seismic characteristics measured in this investigation..

- When compared to a building's bare frame, one may see a substantial reduction in movement after installing friction pendulum bearings.

- Compared to the model with friction, the bare frame produces less displacements (by 28.31%, BIS by 26.89%, FVD by 17.45%, and VED by 16.25%, respectively).
- Storey drift values measured for FPB were 38.18%, BIS was 27.27%, VED was 18.1%, and FVD was 9.09% less than Bare frame structure, demonstrating the superior performance of the dampers technology.
- Friction pendulum bearing reduced storey shear by 33.15%, the Base isolation system by 31.74%, visco elastic damper by 13.08%, and fluid viscous dampers by 6.94%, according to the research.
- The overturning moments for the FPB were 35.49 percent lower, the BIS were 32.62 percent lower, the FVD were 9.55% lower, and the VED were 4.7 percent lower than the bare frame model.
- The variant with friction pen-dulum bearings has the smallest displacements, at 70.62 mm, compared to the bare frame's 98.56 mm.
- Modeling with Friction Pendu-lum bearings has also shown to provide the lowest overturning moments. In this condition, the studied structural models are secure.
- Maximum Drifts is less than or equal to the desired drift of 12 mm. To withstand lateral loads, the structure's behavior is crucial.

5.2 Future Scope

- Analyzing the buildings in mountainous areas will help take the project ahead.
- The installation of shear walls and bracings to dampers as a contributing resource.
- Also taken into account are variations in soil hardness (from mild to medium to hard).

REFERENCES

1. Naziya Ghanchi, Shilpa Kewate,(2015) “Dynamic analysis of 25 storey RCC building with and without viscous dampers”, International Journal of Scientific & Engineering Research, Volume 6, Issue 12, December-2015
2. Vijay.U.P,Kannan Rajkumar.P.U and Ravichandran.P.T,(2015)” Seismic Response Control of RC Structure using Visco Elastic Dampers”, Indian Journal of Science and Technology, Vol 8(28), DOI: IPL0847, October 2015
3. Ashish R. Akhare, Tejas R.Wankhade,(2016)” Seismic Performance of RC Structure Using Different Base Isolator”, International Journal Of Engineering Sciences & Research Technology (IJESRT) Research, (vol. 3), pp. 135-142., 2013
4. Eben .C. Thomas,(2017)” Seismic Response of Soft Storey Buildings with Viscoelastic Dampers”, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181
5. Puneeth Sajjan , Praveen Biradar,(2018)’’ Study on the effect of viscous damper for rcc frame structure”, IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163
6. Abhishek Kumar Maurya, V.K. Singh,(2018)” Analysis of building using viscous dampers in seismic zone-v”, International Journal of Advances in Mechanical and Civil Engineering, ISSN: 2394-2827, Volume-5, Issue-3, Jun.-2018
7. Talikoti.R.S, Vinod R.Thorat, (2019) “Base Isolation In Seismic Structural Design”, International Journal of Engineering Research & Technology (IJERT) IJERT ISSN: 2278-0181 www.ijert.org Vol. 3 Issue 7, July - 2014
8. Chandra Kumar, Ramendra Kumar Singh,(2020)” Seismic Analysis of Different Shape of RC Building by Using the Viscous Damper”, International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 04 Apr 2020

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