Seismic Analysis of Braced Reinforced Concrete Building Frame with Effect of Base Isolation

Prof. Ganesh C. Jawalkar[1], Uzma Kausar A. Haranmare[2], Prof. Rameez R.Badeghar[3]

[1]*Lecturer at N.B. Navale Sinhagad College of Engineering, Solapur, Maharashtra, India-413255*
[2]*Research Scholar at N.B. Navale Sinhagad College of Engineering, Solapur, Maharashtra, India-413255*
[3]*Lecturer at N.B. Navale Sinhagad College of Engineering, Solapur, Maharashtra, India-413255*

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Abstract - *Here in this paper we discuss different structural control systems such as bracings and base isolators are employed using ETABS software, with ground motion data assigned as per codes. Various low-rise and mid-rise building frames with low damping and flexibility are analyzed to mitigate unwanted vibrations. The results of the seismic response of each control system and their combinations in low-rise and mid-rise building models are compared with conventional building methods and various other control systems through response spectrum analysis.*

***Key Words*: ETABS software, Base isolator, low rise building, high rise building, Response spectrum analysis, seismic response.**

1.INTRODUCTION

Traditional approaches to seismic design of building structures have long focused on enhancing stiffness, strength, and ductility. However, this often leads to increased structural member size and material consumption, amplifying both building costs and seismic reactions. Consequently, the effectiveness of the standard seismic design method is limited. In response, various vibration-control strategies, categorized as structural controls, have emerged, marking significant advancements in recent years. The field of structural control encompasses diverse techniques, including active, passive, hybrid, and semi-active control systems. Passive vibration control, such as base isolation, operates without external power sources, utilizing structural motion to generate control forces. This method effectively elasticizes buildings, ensuring safety during seismic events. Bracing systems offer substantial compression strength, particularly when integrated with surrounding frames to bolster lateral load resistance. In steel frames, bracings serve as diagonal compression struts, efficiently distributing compressive forces to adjacent joints.

1.1 Bracing Systems

The primary objective of structural systems in construction is to efficiently transfer gravity loads. Gravity loads typically include dead load, active load, and snow load. Lateral loads, such as wind or seismic forces, can induce high stresses, sway movement, and vibration in structures. Therefore, structures must possess both vertical load-bearing capacity and lateral stiffness to withstand these forces effectively.

Various bracing techniques, including concentric, eccentric, and knee bracing, have been utilized over the years to effectively control lateral displacements. Bracing proves to be highly efficient and cost-effective in stiffening framed structures against lateral stresses, thereby reducing the need for large member sizes. Consequently, the bracing system significantly reduces lateral and torsional movements during seismic loading.

1.2 Base Isolation

Base isolation is a smart way to make buildings safer during earthquakes. It separates the building's base from the rest of the structure using flexible joints. These joints, called isolators, absorb a lot of the earthquake's energy, so the building shakes less. Unlike regular buildings, where everything moves together during an earthquake, in base isolated buildings, only the top part moves slightly, which keeps it safer. This means base isolated buildings can stay strong and safe even during big earthquakes without needing any extra help..

2. Response Spectrum Analysis

This approach proves invaluable for analyzing structures where in primary modes exert a significant influence on overall response. It involves determining the response of a multi-degree of freedom system through the superposition of modal responses. Each modal response is derived from spectral analysis of single-degree of freedom systems, which are then integrated to ascertain the total response. Widely utilized across various industries, the Response Spectrum Method represents a linear dynamic technique used to estimate structural response during short, nondeterministic, and transient dynamic events, such as earthquakes and shocks. Estimation is typically achieved through either the Complete Quadratic Combination (CQC) or Square Root of the Sum of the Squares (SRSS) method, with SRSS favored for widely spaced frequencies and CQC for closely spaced ones. This method operates within the linear range to determine the peak structural response of a building and subsequently identify the lateral forces it experiences..

3. AIM & OBJECTIVE

To analyze reinforced concrete building frame in combination with bracing and base isolation.
This proposed paper is focused on
1. Analysis of reinforced concrete multistoried building frame and base isolated reinforced concrete multistoried building frame.
2. Analysis of RC multistoried building frame with bracing at various location.
3. Analysis of base isolated RC multistoried building frame with bracing at various location.
4. Comparative analysis of RC multistoried building frame with and without base isolation.

Table no 1. The model used for validation is described below

Details Of Model	G+6	G+10	G+14
Height of Building(m)	25	39	53
Ground floor height(m)	4	4	4
Storey height (m)	3.5	3.5	3.5
Plan Area (m2)	500	500	500
Plan Dimension (m)	25*20	25*20	25*20
Column Size (mm)	450*600	450*600	450*600
Thickness of Slab (mm)	150	150	150
Beam Size (mm)	450*600	450*600	450*600
Grade Of Concrete	M20	M20	M20
Grade of steel	Fe500	Fe500	Fe500
Seismic zone	V	V	V
Importance Factor	1	1	1
Response Reduction Factor	5	5	5
Soil Type	III	III	III
Unit Weight of concrete (KN/m3)	25	25	25
Live Load on slab (KN/m2)	2	2	2
Bracing size	130*130 *15	130*130 *15	130*130* 15
Bracing material	Fe345	Fe345	Fe345

4. FLOW WORK

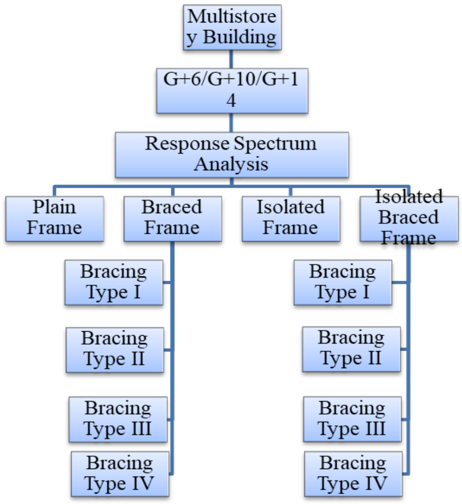


Fig -1 Flow chart of multidtorey building

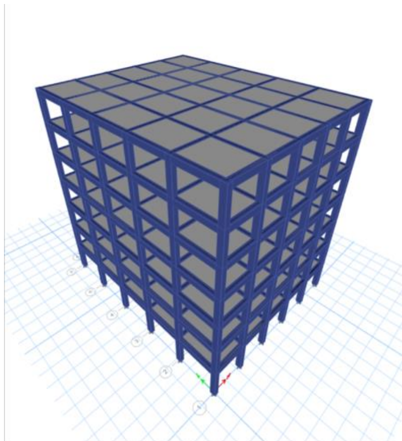


Fig -2 3D view of G+6 Storey building

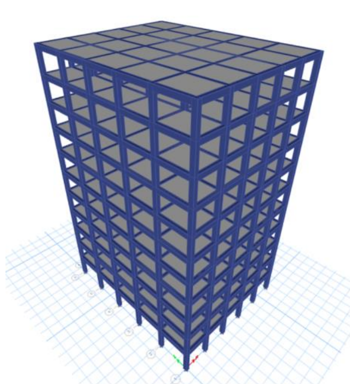


Fig -3 3D view of G+10 Storey building

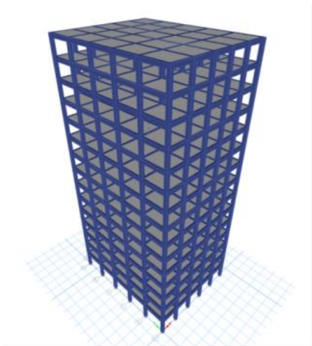


Fig -4 3D view of G+14 Storey building

5. Different Type of Bracing

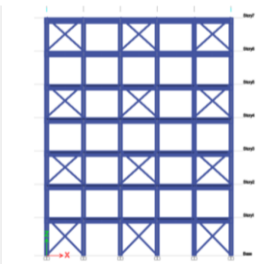


Fig- 5 Type I Bracing at 1,3,5th Bay

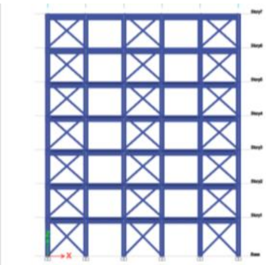


Fig- 6 Type II Bracing at 1,3,5th Bay Continuous

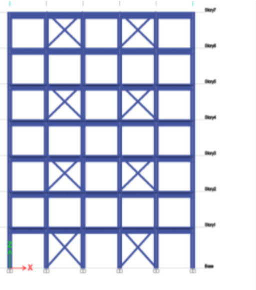


Fig 7-Type I Bracing at 1,3,5th Bay

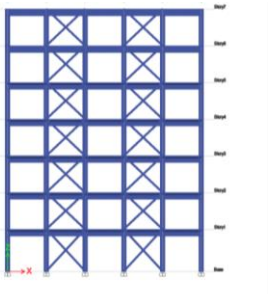


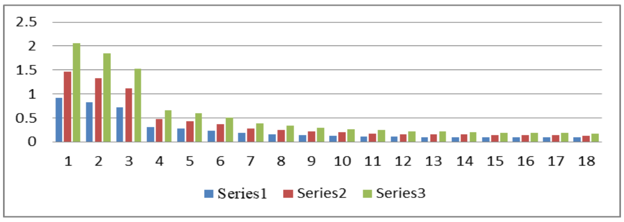
Fig 8- Type II Bracing at 1,3,5th Bay Continuous

6. Results and Discussion

In the present study, linear dynamic analysis is carried out for analysing RCC building frames by using ETABS software. The Response Spectrum analysis is performed on three building frames of different stories with passive damping technologies and their results are compared. The results are shown in form of mode shapes, graphs and tables.

6.1 Restrained Multi-Storey Buildings

1. The time period of multi-storey building increases as the number of Storey increases while it goes on decreasing as mode increases.

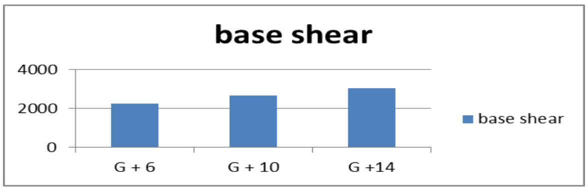


Graph no 1. Time Period v/s storey

2. Base shear in restrained multi-storey building increases as we increase number of storey. There is 16.6% increase of base shear between G+6 and G+10, while 13.475% increase in G+10 and G+14 building

	G + 6	G + 10	G +14
base shear	2252.47	2654.44	3037.98

Table no 2. Values Of Base Shear



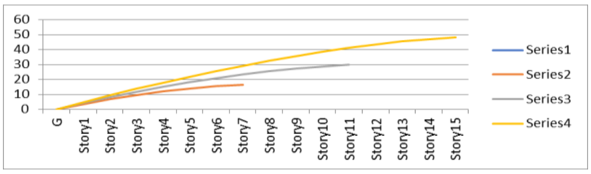
Graph no 2. Base Shear v/s Storey

3. Displacement of building is increasing as we increase the Storey of building.

	G + 6	G+ 10	G +14
G	0	0	0
Storey1	3.596	4.26	4.898
Storey2	6.737	8.077	9.362
Storey3	9.565	11.672	13.677
Storey4	12.007	15.018	17.826
Storey5	13.986	18.093	21.789
Storey6	15.421	20.888	25.555
Storey7	16.251	23.387	29.116
Storey8		25.566	32.46
Storey9		27.378	35.576
Storey10		28.762	38.445
Storey11		29.669	41.043
Storey12			43.34
Storey13			45.295
Storey14			46.863
Storey15			48.014

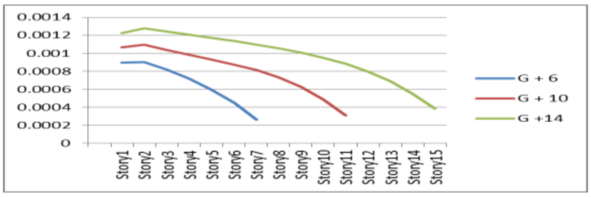
Figure 5.2 Type I Bracing at 1,3,5th Bay. Figure 5.3 Type II Bracing at 1,3,5th Bay Continuous

Table no 3. Values of Displacement



Graph no 3. Storey Vs Displacement

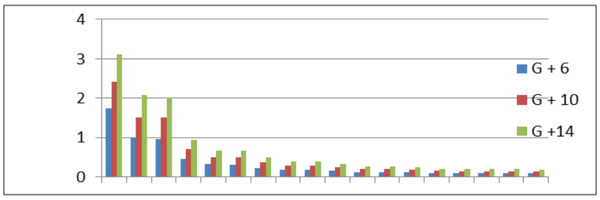
4. Drift has the same effect as displacement in this case.



Graph no 4. Values of Displacement v/s storey

6.2 Buildings Subjected to Rubber Base Isolator

1. The time period of multi-storey building increases as the number of Storey increases while it goes on decreasing as mode increases.

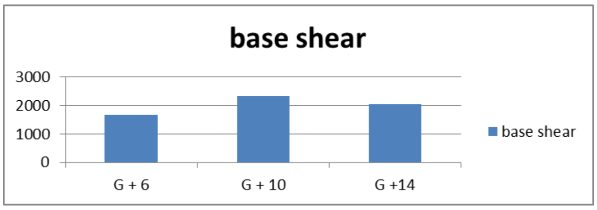


Graph no 1. Time Period v/s storey

2. For restrained and rubber isolated G+6 building the base shear decreases by 34%, For G+10 building it decreases by 14% and for G+14 building it decreases by 49%.

	G + 6	G + 10	G +14
base shear	1671	2316.95	2030

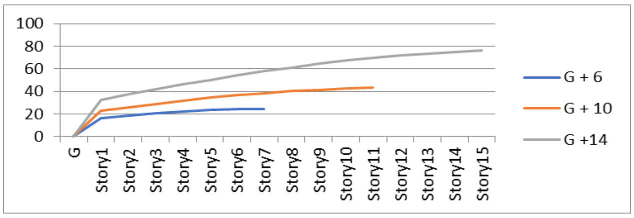
Table no 4. Values Of Base Shear



Graph no 2. Base Shear v/s Storey

	G + 6	G + 10	G +14
Storey1	16.463	22.812	32.5
Storey2	18.656	26.045	37.248
Storey3	20.532	29.03	41.775
Storey4	22.089	31.783	46.111
Storey5	23.305	34.289	50.24
Storey6	24.157	36.53	54.149
Storey7	24.64	38.489	57.819
Storey8		40.147	61.232
Storey9		41.483	64.371
Storey10		42.475	67.215
Storey11		43.122	69.743
Storey12			71.934
Storey13			73.765
Storey14			75.216
Storey15			76.289

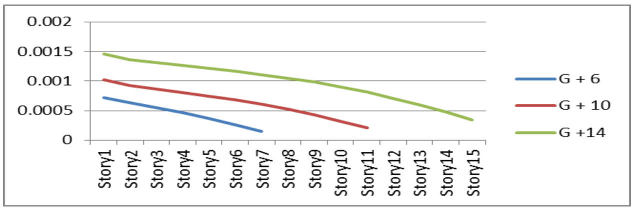
Table no 5. Values of Displacement



Graph no 3. Storey Vs Displacement

3. Comparing the top storey displacement, isolated building having more displacement than restrained building.

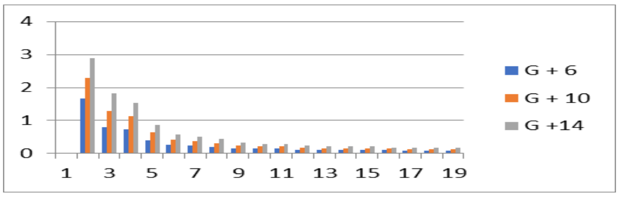
4. G+6 storey building with rubber base isolator have 51.6% increase in displacement than restrained building. For G+10 and G+14 have 45.4% and 58.88% increase in displacement respectively.



Graph no 5. Drift vs Storey

5. Drift of Storey increases as number of Storey increases but
for particular building it decreases as we move above. Here there is decrease in drift of isolated building than restrained buildings.

6.3 6, 10 &14 Storey Building subjected to Bracing Type I

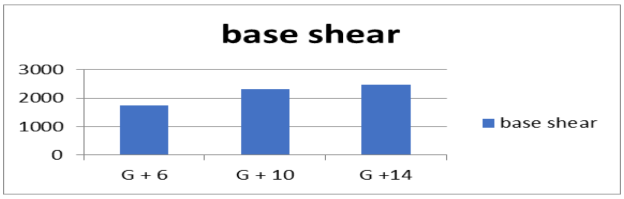


Graph no 6. Time Period v/s Storey

1. Increasing the number of stories in a multi-storey building result in a longer time period, while it decreases with an increase in mode.

	G + 6	G + 10	G +14
base shear	3030.25	3094.06	3134.64

Table no 6. Values Of Base Shear

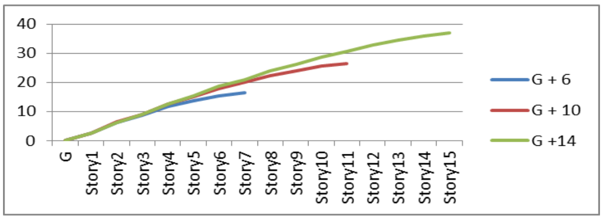


Graph no 7. Base Shear v/s Storey

2. The base shear increases by 34% for restrained and braced G+6 buildings, 16% for G+10 buildings, and 3% for G+14 buildings.

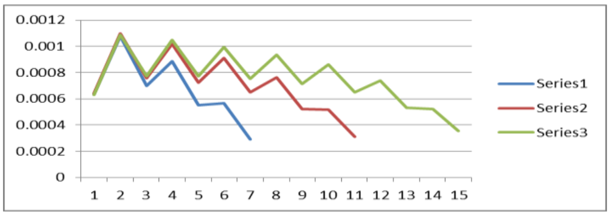
	G + 6	G + 10	G +14
G	0	0	0
Storey1	2.548	2.553	2.516
Storey2	6.306	6.395	6.33
Storey3	8.736	9.027	9.013
Storey4	11.769	12.525	12.631
Storey5	13.625	14.959	15.249
Storey6	15.471	17.947	18.555
Storey7	16.435	20.035	21
Storey8		22.392	23.955
Storey9		24.006	26.177
Storey10		25.541	28.751
Storey11		26.536	30.695
Storey12			32.806
Storey13			34.386
Storey14			35.882
Storey15			36.997

Table no 7. Values sof Displacement



Graph no 8. Storey Vs Displacement

3. Top storey displacement is almost equal in G+6 buildings. While in G+10 and G+14 show decrease of 11.7% and 29.78%, respectively.

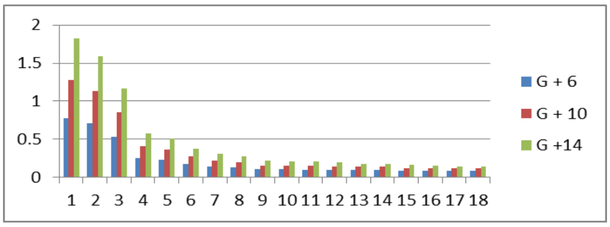


Graph no 9. Drift Vs Storey

4. Drift of the Storey shows fluctuation because of the type I bracing provided at alternate storey but for a particular building, it decreases moving upword.

6.4 6, 10 &14 Storey Building subjected to Bracing Type II

1. The time period of multi-storey building increases as the number of Storey increases while it goes on decreasing as mode increases.



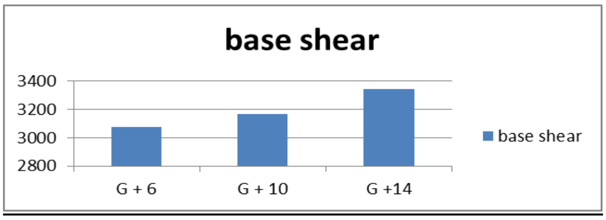
Graph no 10. Time Period v/s storey

2. The base shear increases by 34% form restrained and braced G+6 buildings, 16% for G+10 buildings, and 3% for G+14 buildings.

	G + 6	G + 10	G +14
baseshear	3074.43	3166.87	3342.44

Table no 8. Values Of Base Shear

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 06 | Jun 2024 www.irjet.net p-ISSN: 2395-0072

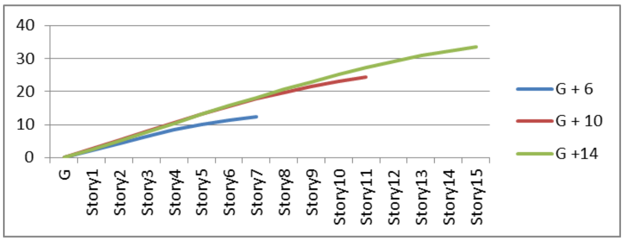


Graph no 11. Base Shear v/s Storey

3. Comparing the top storey displacement, bracing type II building have less displacement than restrained building and Type I braced building.

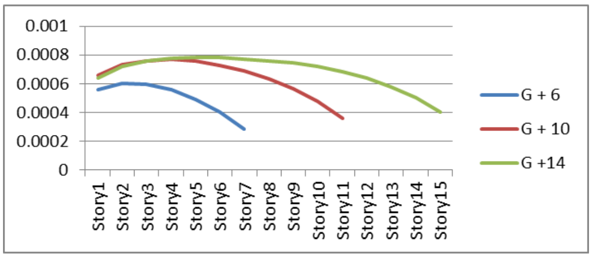
	G + 6	G+ 10	G +14
G	0	0	0
Storey1	2.243	2.641	2.561
Storey2	4.342	5.205	5.075
Storey3	6.401	7.846	7.706
Storey4	8.317	10.483	10.382
Storey5	9.992	13.043	13.042
Storey6	11.347	15.473	15.646
Storey7	12.3	17.73	18.17
Storey8		19.773	20.597
Storey9		21.567	22.916
Storey10		23.076	25.113
Storey11		24.246	27.172
Storey12			29.072
Storey13			30.788
Storey14			32.297
Storey15			33.557

Table no 9. Values of Displacement



Graph no 12. Storey Vs Displacement

4. Building with Bracing type I have decrease in displacement than restrained building while comparing the displacement bracing type I have more values than type II.
5. For type II bracing drift of the Storey shows gradual decrease in values with upword while type I bracing have fluctuation because bracing are provided at alternate storey.



Graph no 3. Drift Vs Storey

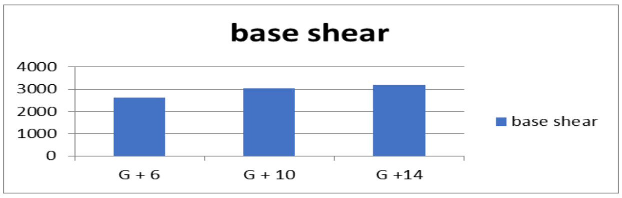
6. Drift decreases as we moves upword.

6.5 6, 10 &14 Storey Building subjected to Bracing Type II

1. The time period of multi-storey building increases as the number of Storey increases while it goes on decreasing as mode increases.
2. The base shear of restrained G+6 building is less than type III bracing i.e16% and 14% for G+10 buildings, 3% for G+14 buildings.

	G + 6	G + 10	G +14
base shear	2613.23	3026.34	3143.18

Table no 10. Values Of Base Shear



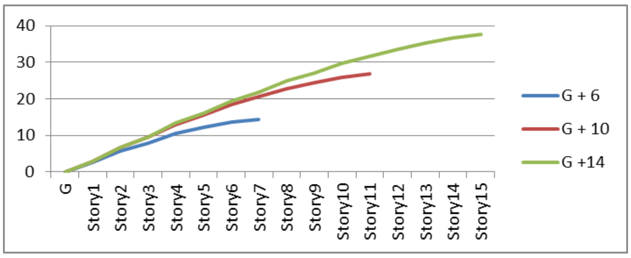
Graph no 13. Base Shear v/s Storey

3. Building with Bracing type I have decrease in displacement than restrained building while comparing the displacement, bracing type III have less values than type II.

	G + 6	G + 10	G +14
G	0	0	0
Storey1	2.49	2.91	2.904
Storey2	5.704	6.747	6.769
Storey3	7.92	9.544	9.658
Storey4	10.471	12.989	13.284
Storey5	12.102	15.504	16.036
Storey6	13.621	18.42	19.331
Storey7	14.396	20.533	21.864
Storey8		22.813	24.799
Storey9		24.403	27.075
Storey10		25.861	29.62
Storey11		26.771	31.587
Storey12			33.66

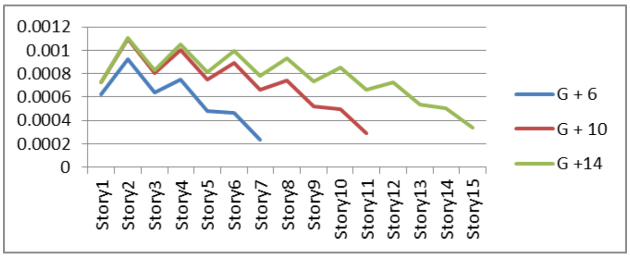
Storey13			35.224
Storey14			36.673
Storey15			37.721

Table no 11. Values of Displacement



Graph no 14. Storey Vs Displacement

4. type III bracing have fluctuation because bracing are provided at alternate storey.



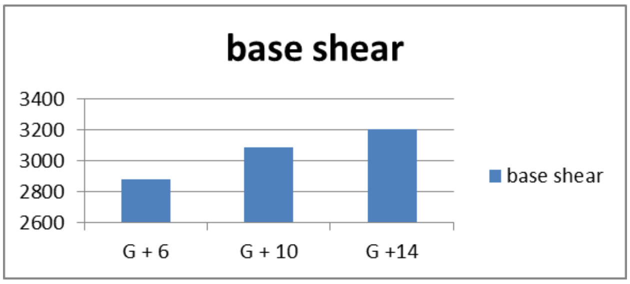
Graph no 15. Drift Vs Storey

6.6 6, 10 &14 Storey Building subjected to Bracing Type IV

1. The time period of multi-storey building increases as the number of Storey increases while it goes on decreasing as mode increases.
2. The base shear increases by 27% form restrained to braced type IV G+6 building, 16% for G+10 buildings, and 5% for G+14 buildings.

	G + 6	G + 10	G +14
base shear	2878.88	3090	3201.87

Table no 12. Values Of Base Shear



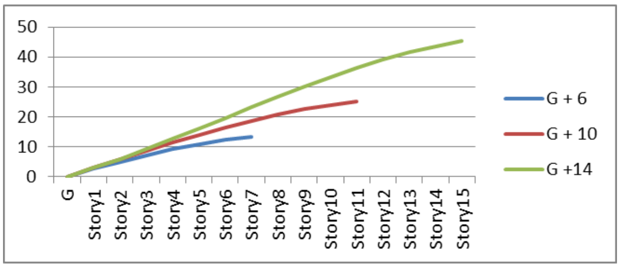
Graph no 16. Base Shear v/s Storey

3. Comparing the top storey displacement, bracing type II building have less displacement than restrained building and Type IV braced building.

	G + 6	G + 10	G +14
G	0	0	0
Storey1	2.597	2.999	2.993
Storey2	4.954	5.812	5.983
Storey3	7.203	8.633	9.204
Storey4	9.246	11.394	12.604
Storey5	10.987	14.033	16.116
Storey6	12.348	16.503	19.68
Storey7	13.243	18.767	23.243
Storey8		20.789	26.749
Storey9		22.531	30.145
Storey10		23.954	33.377
Storey11		25.002	36.392
Storey12			39.136
Storey13			41.561
Storey14			43.619
Storey15			45.246

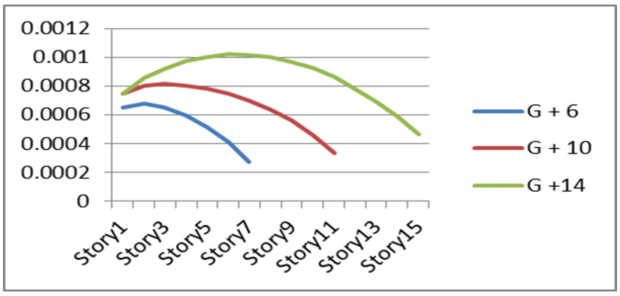
Table no 13. Values of Displacement

4. G+6 building with Bracing type IV have 25% lower displacement than restrained building while 16% less for G+10 and 6% less for G+14 storey building.]



Graph no 17. Storey Vs Displacement

5. For type IV bracing drift of the Storey shows gradual decrease in values as we go upword while type I and type III bracing have fluctuation because bracing are provided at alternate storey.

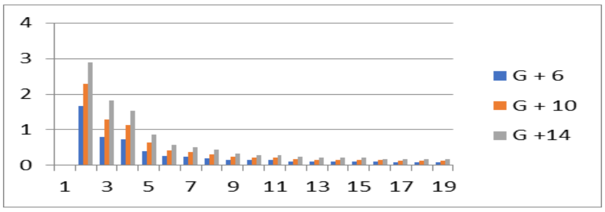


Graph no 18. Drift Vs Storey

6. Drift decreases as we moves upword

6.7 6, 10 &14 Storey Building subjected to Rubber Base Isolator & Bracing Type I

1. Increasing the number of stories in a multi-storey building result in a longer time period, while it decreases with an increase in mode.

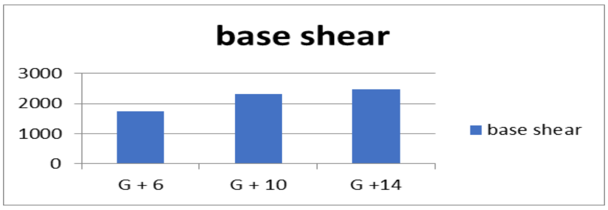


Graph no 19. Time Period v/s storey

2. The base shear increases by 4% for restrained and braced G+6 buildings, 1% for G+10 buildings, and 5% for G+14 buildings.

	G + 6	G + 10	G +14
base shear	1745.56	2302.44	2466.72

Table no 14. Values Of Base Shear

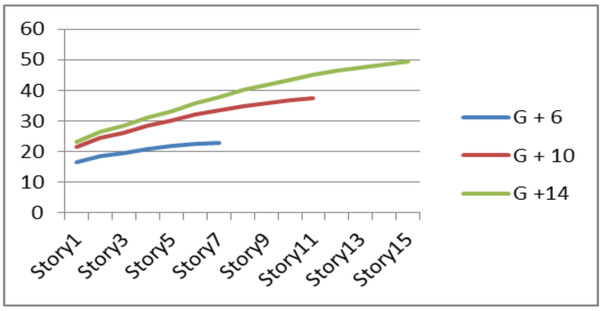


Graph no 20. Base Shear v/s Storey

3. Top storey displacement is almost equal in G+6 buildings. while G+10 and G+14 show decrease of 13% and 35%, respectively with respect of restrained building.

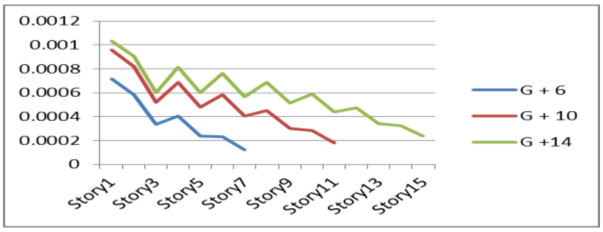
	G + 6	G + 10	G +14
Storey1	16.422	21.647	23.195
Storey2	18.467	24.517	26.369
Storey3	19.628	26.314	28.455
Storey4	21.009	28.659	31.254
Storey5	21.822	30.265	33.286
Storey6	22.598	32.196	35.842
Storey7	23.001	33.517	37.728
Storey8		34.961	39.979
Storey9		35.932	41.649
Storey10		36.824	43.538
Storey11		37.412	44.939
Storey12			46.412
Storey13			47.502
Storey14			48.508
Storey15			49.273

Table no 15. Values of Displacement



Graph no 21. Storey Vs Displacement

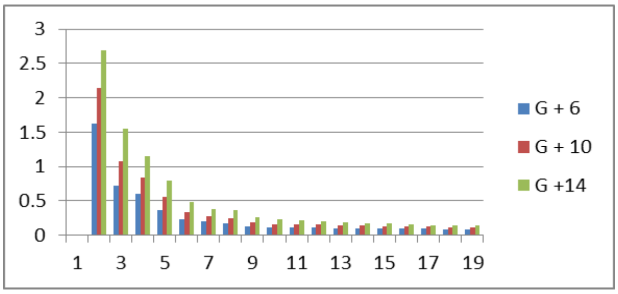
4. Drift of the Storey shows fluctuation because of the type I bracing provided at alternate storey but for a particular building, it decreases moving upword.



Graph no 22. Drift Vs Storey

6.8 6, 10 &14 Storey Building subjected to Rubber Base Isolator & Bracing Type II

1. The time period of multi-storey building increases as the number of Storey increases while it goes on decreasing as mode increases.

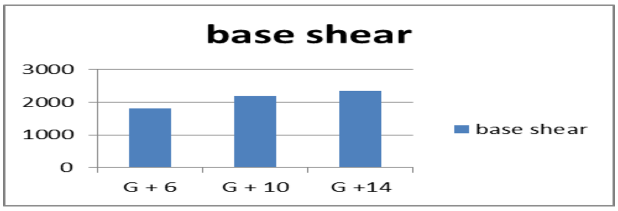


Graph no 23. Time Period v/s storey

2. The base shear increases by 7% form restrained to braced G+6 buildings, 6% for G+10 buildings, and less than 1% for G+14 buildings.

	G + 6	G + 10	G +14
base shear	1801.51	2178.66	2344.41

Table no 16. Values Of Base Shear

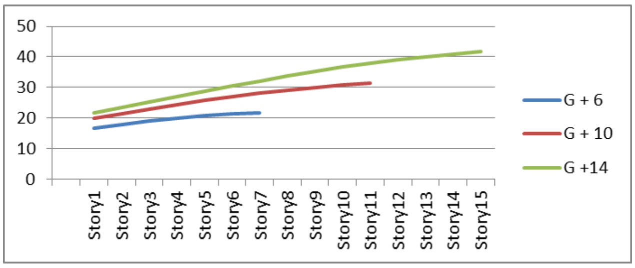


Graph no 24. Base Shear v/s Storey

3. Comparing the top storey displacement, bracing type II building have less displacement than restrained building and Type I braced building.

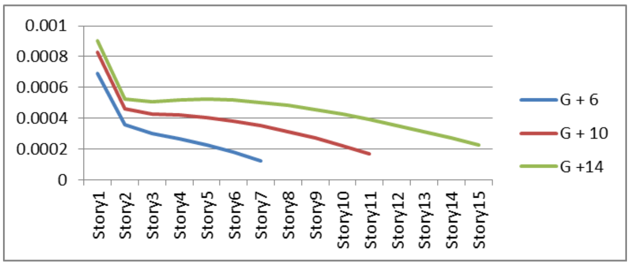
	G + 6	G + 10	G +14
Storey1	16.742	19.851	21.56
Storey2	17.99	21.46	23.393
Storey3	19.033	22.935	25.145
Storey4	19.958	24.378	26.931
Storey5	20.733	25.751	28.709
Storey6	21.342	27.026	30.449
Storey7	21.765	28.181	32.128
Storey8		29.201	33.726
Storey9		30.075	35.226
Storey10		30.798	36.616
Storey11		31.358	37.886
Storey12			39.027
Storey13			40.035
Storey14			40.908
Storey15			41.639

Table no 17. Values of Displacement



Graph no 25. Storey Vs Displacement

4. For type II bracing drift of the Storey shows gradual decrease in values with upword while type I bracing have fluctuation because bracing are provided at alternate storey.

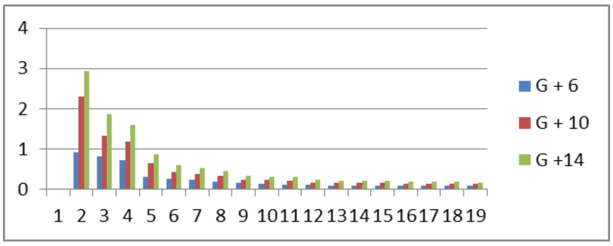


Graph no 18. Drift Vs Storey

5. Drift decreases as we moves upword

6.9 6, 10 &14 Storey Building subjected to Rubber Base Isolator & Bracing Type III

1. Increasing the number of stories in a multi-storey building results in a longer time period, while it decreases with an increase in mode

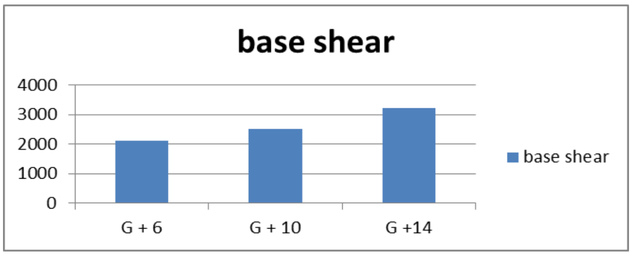


Graph no 27. Time Period v/s storey

2. The base shear of restrained G+6 building is less than type III bracing i.e20%, 8% for G+10 buildings and 27% for G+14 buildings.

	G + 6	G + 10	G +14
base shear	2613.45	2304.55	3207.89

Table no 19. Values Of Base Shear

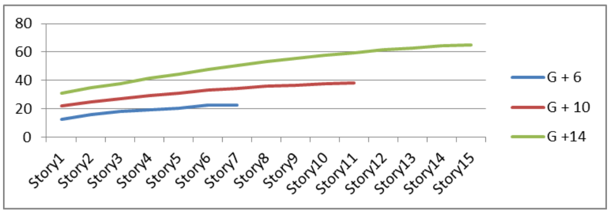


Graph no 28. Base Shear v/s Storey

2. Comparing the displacement, bracing type III have more values than type II.

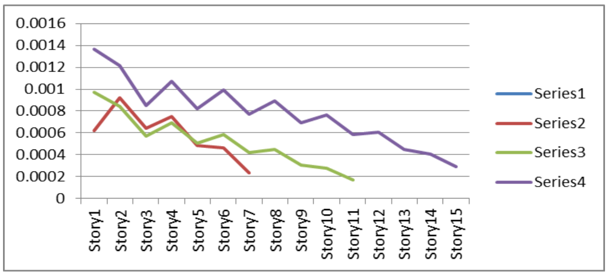
	G + 6	G + 10	G +14
Storey1	12.49	22.034	30.668
Storey2	15.704	24.983	34.901
Storey3	17.92	26.948	37.849
Storey4	18.971	29.328	41.533
Storey5	20.102	31.036	44.329
Storey6	22.621	32.978	47.666
Storey7	22.396	34.353	50.219
Storey8		35.792	53.144
Storey9		36.773	55.379
Storey10		37.646	57.824
Storey11		38.195	59.674
Storey12			61.569
Storey13			62.979
Storey14			64.257
Storey15			65.197

Table no 20. Values of Displacement



Graph no 29. Storey Vs Displacement

3. Building with Bracing type I have decrease in displacement by 9% than G+6 restrained building while displacement decrease by11% for G+10 and 16% for G+14
storey building.

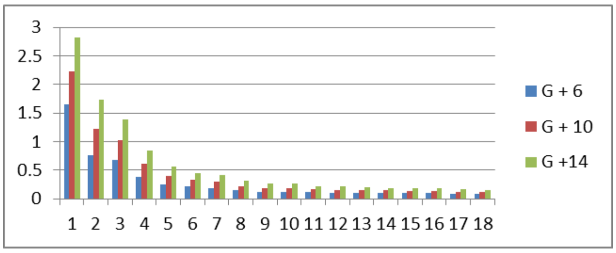


Graph no 30. Drift Vs Storey

4. Type III bracing have fluctuation because bracing are provided at alternate storey.

6.10 6, 10 &14 Storey Building subjected to Rubber Base Isolator & Bracing Type IV

1. The time period of multi-storey building increases as the number of Storey increases while it goes on decreasing as mode increases.

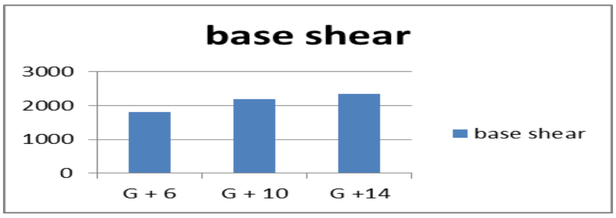


Graph no 31. Time Period v/s storey

2. The base shear increases by 5% form restrained to braced type IV G+6 building, 1% for G+10 buildings, and 27% for G+14 buildings.

	G + 6	G + 10	G +14
base shear	1772.83	2297.66	3192.96

Table no 21. Values Of Base Shear

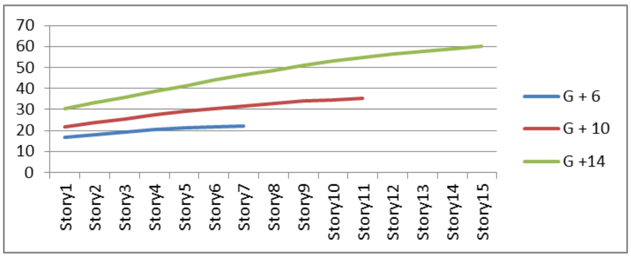


Graph no 32. Base Shear v/s Storey

3. G+6 building with Bracing type IV have 9% lower displacement than restrained building while 18% less for G+10 and 22% less for G+14 storey building.

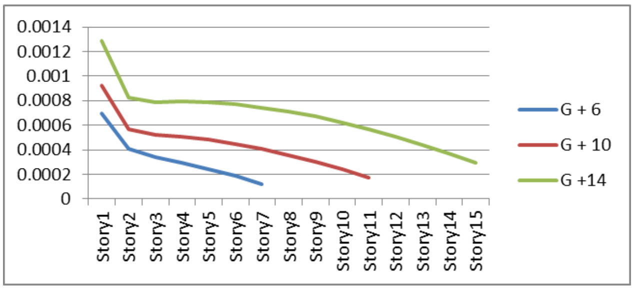
	G + 6	G + 10	G +14
Storey1	16.751	21.811	30.307
Storey2	18.168	23.803	33.193
Storey3	19.342	25.609	35.917
Storey4	20.359	27.342	38.642
Storey5	21.192	28.968	41.318
Storey6	21.821	30.457	43.909
Storey7	22.23	31.79	46.388
Storey8		32.949	48.729
Storey9		33.922	50.913
Storey10		34.702	52.922
Storey11		35.276	54.742
Storey12			56.361
Storey13			57.77
Storey14			58.963
Storey15			59.93

Table no 22. Values of Displacement



Graph no 33. Storey Vs Displacement

4. For type IV bracing drift of the Storey shows gradual decrease in values as we go upword while type I and type III bracing have fluctuation because bracing are provided at alternate storey.



Graph no 34. Drift Vs Storey

5. Drift decreases as we moves up storey.

7. Conclusions

The main observations and conclusions drawn are summarized below:

1. The application of bracings increases the seismic weight of the structure, potentially resulting in higher base shear during earthquakes.
2. LRB increases the time period, potentially leading to lower spectral acceleration values
3. Base isolation reduces storey displacement during earthquakes. Consequently, LRB is employed as an alternative to avoid increasing the seismic weight of the structure.

7.1 Behaviour of G+6 storey building

1. The base shear increases by 34% form restrained to bracing type I of G+6 buildings, 36% for type II, 16% for type III and 27% for type IV bracing.
2. Comparing the base shear of restrained building of bracings, type III have less increase in base shear.
3. For the isolated building base shear has decreases by 29% form isolated to bracing type I of G+6 buildings, 25% for type II, 13.81% for type III and 27% for type IV bracing.
4. Comparing the base shear of isolated building of bracings, type III have less decrease in base shear.
5. The displacement has reduced by 33% form restrained to bracing type II of G+6 buildings, 14% for type III and 23% for type IV bracing.
6. Comparing the displacement of restrained building of bracings, type III have less displacement.
7. For the isolated building displacement has increases by 30% form isolated to bracing type I of G+6 buildings, 23% for type II, 21.13% for type III and 27% for type IV bracing.
8. Comparing the displacement of isolated building of bracings, type III have less increase in displacement value.
9. Comparing the top storey displacement isolated building have more displacement than restrained building but less storey drift.
10. It shows the zig-zag pattern in storey drift of building when bracing placed at alternate position comparing to the building when bracing are continuously placed.

7.2 Behaviour of G+10 storey building

1. The base shear increases by 14% form restrained to bracing type I of G+6 buildings, 16% for type II, 12% for type III and 14% for type IV bracing.
2. Comparing the base shear of restrained building with braced building, type III have less increase in base shear.
3. For the isolated building base shear has decreases by 15% form isolated to bracing type I of G+10 buildings, 21.8% for type II, 15% for type III and 15% for type IV bracing.
4. Comparing the base shear of isolated building of bracings, type III have less decrease in base shear.
5. The displacement has reduced by 16% form restrained to bracing type I of G+6 buildings, 20% for type II, 11% for type III and 16% for type IV bracing.
6. Comparing the displacement of restrained building of bracings, type III have less displacement.
7. For the isolated building displacement has increases by 21.6% form isolated to bracing type I of G+6 buildings, 6% for type II, 23% for type III and 17% for type IV bracing.
8. Comparing the displacement of isolated building of bracings, type III have less increases in displacement values.

9. Comparing the top storey displacement isolated building have more displacement than restrained building but less storey drift.
10. It shows the zig-zag pattern in storey drift of building when bracing placed at alternate position comparing to the building when bracing are continuously placed.

7.3 Behaviour of G+14 storey building

1. The base shear increases by 3% form restrained to bracing type I of G+6 buildings 10% for type II, 3% for type III and 5% for type IV bracing.
2. Comparing the base shear of restrained building of bracings, type I and type III have less increase in base shear.
3. For the isolated building base shear has decreases by 18% form isolated to bracing type I of G+6 buildings, 22% for type II, 5.5% for type III and 5% for type IV bracing.
4. Comparing the base shear of isolated building of bracings, type III and IV have less decrease in base shear.
5. The displacement has reduced by 71% form restrained to bracing type I of G+14 buildings, 45% for type II, 29.7% for type III and 6% for type IV bracing.
6. Comparing the displacement of restrained building of bracings type IV having less displacement.
7. For the isolated building displacement has increases by 21% form isolated to bracing type I of G+14 buildings, 17.07% for type II, 26.15% for type III and 18.64% for type IV bracing.
8. Comparing the displacement of isolated building of bracings, type II have less decrease in base shear.
9. Comparing the top storey displacement isolated building have more displacement than restrained building but less storey drift.
10. It shows the zig-zag pattern in storey drift of building when bracing placed at alternate position comparing to the building when bracing are continuously placed.

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Biography

	**Prof. Ganesh C. Jawalkar** Working as Assistant Professor in N. B. Navale Sinhgad College of Engineering Solapur. Graduated in Civil Engineering from Shivaji University Kolhapur and Post Graduation in Structural Engineering from Solapur University and UGC approved. Having a total Teaching Experience of 17 years. Guided more than 10 students for Post Graduation.
	**Miss. Uzma Kausar A. Haranmare** B.E(Civil), MTech (Civil-Structure)(Persuing) Research Scholar at N.B. Navale Sinhagad College of Engineering, Solapur, Maharashtra, India
	**Prof. Rameez R. Badeghar** Working as Assistant Professor in N. B. Navale Sinhgad College of Engineering Solapur. Graduated in Civil Engineering from Shivaji University Kolhapur and Post Graduation in Structural Engineering from Solapur University. Having a total Teaching Experience of 16 years. Guiding more than 4 students for Post Graduation. Worked for a semester in STES University Kigali, Rawanda, East Africa