

Dynamic Response of RC Frame Building with Plan Irregularity Using Base Isolation

Niranjan G M¹, Pradeep A R², Dharmesh.N³, Sanjith J⁴

P.G. Student, Department of Civil Engineering, SSIT, Tumkuru, Karnataka, India¹

Assistant Professor, Department of Civil Engineering, SSIT, Tumkuru, Karnataka, India²

Assistant Professor, Department of Civil Engineering, EPCET, Bangalore, Karnataka, India³

Research Coordinator, Department of Civil Engineering, Adichunchanagiri Institute of Technology, Chikkamagaluru, India

ABSTRACT: In the present study G+14 storey RC regular plan building and irregular plan building with plan dimension 31 X 35m located in zone 5 with hard soil condition (Type 1) is consider. Four models are considered, out of which two models are regular and two models are irregular plan building. Time history and Response spectrum (IS 1893-2002 Part-1) analysis are carried out for these four models using the software called ETABS, All the structural members are taken based on design criteria as per IS 456-2000. Response quantities are taken for the comparison and results are extracted and tabulated. The Response quantities are mode period, Base shear, Storey displacement and storey acceleration.

Based on analysis results, time history shows better performance both in Base shear and acceleration. Regular plan building increase base shear and acceleration using HDRB compared with irregular building for Response spectrum and Time history respectively.

KEYWORDS: ETABS, Regular plan Building, Irregular plan Building, HDRB, Response spectrum analysis, Time History analysis.

I. INTRODUCTION

In most earthquake, the collapse of structure like homes, historic and public building ends up in the wide unfold loss of lives and harm Past earthquake shows the ninety fifth of the lives lost were thanks to collapse of buildings that weren't earthquake resistant. So, to beat the destroy of building thanks to Earthquake new technique like Base isolation technique is introduced. This has born to completely different style of innovative techniques to avoid wasting the structures from the earthquakes. The technique of base isolation has been developed in a shot to scale back the response on buildings and their contents throughout earthquake attacks and has proved to be one in all the foremost effective ways for a large vary of seismal style issues on buildings within the last twenty years. the foremost necessary purpose in seismal isolation is to scale back significantly the transmission of the earthquake forces and energy into the structure. this is often done by inserting the structure on associate isolation system with substantial horizontal flexibility so solely moderate motions square measure evoked at intervals the structure throughout the earthquake many sorts of isolation systems are developed to realize this perform, like laminated elastomeric rubber bearings, high damping rubber bearings, lead-rubber bearings, yielding steel devices, friction devices and lead extrusion devices, etc Base isolated structures considerably cut back the malleability demands with in the construction compared to fastened structures so it ends up in cheap simplification of the structuraldescription and alternative seismal style concerns needed by the a lot of typical issues.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

II. LITERATURE REVIEW

W H Robinson 1 (1997) has briefly describe the principles of seismic isolation and discuss some of the isolation systems available before giving some examples of the application of seismic isolation to structure in New Zealand. The seismically isolated buildings fall into two board categories fragile structures of historic significance new structures with contents which need to be protected or continue to operate during and immediately after the earthquake. Examples of these structures are hospitals and other emergency canthers. The seismically isolated bridges include both new and old bridges in areas of seismic activity.

Seismic isolation systems developed and used in New Zealand include- sliding bearings or flexible piles with steel or lead dampers providing the damping and lead rubber bearing which, in one unit provides both the isolation and the damping. To date more than fifty bridges and ten buildings have been isolated with most structures being isolated with lead rubber bearing systems.

P N Dubey 7 (2008) has briefly described the behaviour of base isolated buildings under actual earthquakes, two number of three-storied RCC framed buildings have been constructed at IIT, Guwahati campus, one with base isolation using lead plug bearing (LPB) and the other with conventional foundation. Accelerometers are installed at first floor and third floor of the both the buildings in order to record and compare the seismic responses of base isolated and conventional foundation buildings. The experimental buildings experienced earthquake of 5.2 Richter magnitudes on November 06, 2006. A study has been made on the date recorded on both the buildings and a comparison has also been made on the recorded data. Improvements required in the conventional analysis procedures are clearly brought out to obtain realistic structural seismic response in this paper.

P P Thakare (2011) has in short represented the behaviour of 3-storey RC building that is found in seismic zone IV is employed as check model. Lead plug bearing is employed and depicted victimisation additive force deformation behaviour. There are 2 main parts. the 2 parts are base isolators style and comparative study of the performances of fastened base-isolated condition and base isolated condition. Static analysis on fastened base condition and reanalysis of dynamic analysis on base-isolated condition is employed. Also, response spectroscopy and linear time history analysis ar used on each fastened base and base isolated buildings. The results are base isolation helps in reducing the planning parameter i.e. base shear and bending moment within the structural members on top of the isolation interface by around 4-5 times. Absolutely the displacement will increase however relative displacements are reduced so reducing the harm to the structure once subjected to AN earthquake. The shear and bending moments are reduce dowing to the upper period of the bottom isolated structure which ends in lower acceleration engaged on the structure and conjointly, owing to the magnified damping within the structure owing to the bottom isolation devices. By the dynamic analysis it's been found that the bottom shear reduced 55-60% in Response spectroscopy, whereas Time History Analysis Base shear reduces by 70-80%. Generally, the height displacements obtained by the time history analysis are but those of the response spectrum technique of study. This is often the case as a result of damping owing to the hysteretic result is over the equivalent damping thought-about within the response spectrum technique of study.

III. OBJECTIVES

The objective of study is as follows:

- The principle objective of the study is to compare the structural efficiency of regular and irregular plan building with respect to the results obtained from the analysis in terms of mode period, displacement, base shear and acceleration.
- G+14 storey building with plan 31 x 35 m located in zone V with soil type I modeled and analyzed using ETABS software.
- All the structural members (beams and columns) are taken based on design criteria as per IS 456-2000.
- The regular and irregular plan RC frame building is analyzed using Response Spectrum as per IS 1893-2002 part-1 and Time History analysis using Bhuj EQ data is used to obtain the results.
- Analysis is done for both fixed base and HDRB base Building.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

IV. MODELING DESCRIPTION

4.1.1 Geometric parameters

Two 3D RC frames structures is considered in which first structure regular having the dimension in X-direction is 31m and in Y-direction is 35m and considering 15 storey(G+14) .And the second structure building is considered in irregular plan having same dimension of first structure. This two structures has been taken for seismic analysis.

4.1.2 Geometric Properties

- Special moment-resisting frame (SMRF).
- Building has different spans in both x and y – directions as shown in Fig 4.3.
- The height of each storey is – 3m.
- Live Load as 2.0 kN/m²
- Floor Load as 1.0 kN/m².
- Column size as 600x800mm.
- Beam size as 400 x 500mm.
- Slab thickness as 150mm.
- The soil type is medium - I
- Importance factor is I- 1.5
- Zone factor - V

Note: The Imposed Load is 3.0kN/m² as per code 1893:2002 (Part I) Table No. 8 the percentage of imposed load as to be considers 25% only.

- **Material properties.**

Element	Parameters	Characteristics
Grade of concrete	M40 For Slab, Beam And Column	$f_{ck} = 40 \text{ N/mm}^2$
Density of Concrete		25 kN/m ³
Modulus of Elasticity of concrete	$5000\sqrt{f_{ck}}$	$31.62 \times 10^6 \text{ kN/m}^2$
Density of brick masonry		19.2 kN/ m ³
Grade of Steel	Fe500	500 N/mm^2
Poisson's Ratio	μ	0.2

4.2 Models considered for the study

- Building Type

Case (a) G+14 of Regular plan

Model-1: RC frame building with fixed base.

Model-2: RC frame building with High Damped Rubber Bearing (HDRB).

Case (b) G+14 of Irregular plan

Model-3: RC frame building with fixed base.

Model-4: RC frame building with High Damped Rubber Bearing (HDRB).

Case (a) Regular plan

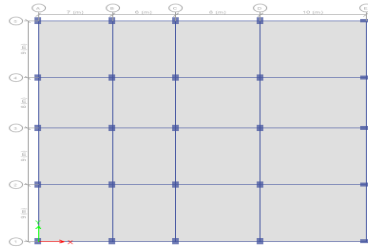


Fig 4.2 G+14 regular plan structure.

Case (b) Irregular Plan

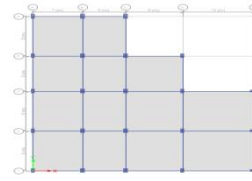


Fig 4.3 G+14 Irregular plan structure.

V. RESULT AND DISCUSSION

5.1 Mode Period

a) G+14 storey of regular plan building

Table 5.1 Comparison of mode period for different Models

Models	Mode Period (sec)		
	Model1	Mode 2	Mode 3
Model 1	2.674	2.577	2.278
Model 2	3.597	3.48	3.116

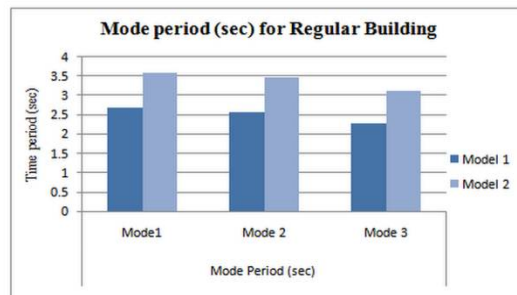


Fig 5.1 Comparison of mode period for different Models

b) G+14 storey of Irregular Plan

Table 5.2 Comparison of mode period for different Models.

Models	Mode Period (sec)		
	Model1	Mode 2	Mode 3
Model 3	2.589	2.476	2.201
Model 4	3.376	3.223	2.953

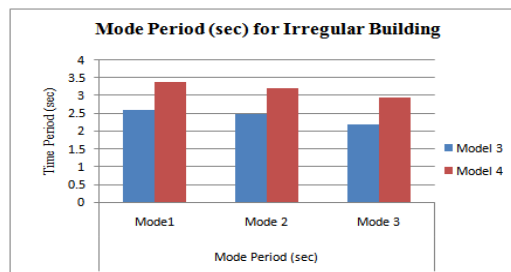


Fig 5.2 Comparison of mode period for different Models

The mode period is maximum in model-1 when compared with mode-2 and mode 3 in all other models. Mode period decreases with increase in mode number.

From fig 5.1, it is observed that , mode period is more i.e 3.597 sec in model-2 when compared with model 1 i.e 2.674 sec for regular plan building.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

From fig 5.2, it is observed that ,mode period is more i,e 3.376 sec in model-4 when compared with model-3 i,e 2.589 sec for irregular plan building.

5.2 Base Shear

a) G+14 Storey of Regular plan:

Table 5.3: Variation of base shear in X & Y direction for bare frame with base isolators.

Models	Base Shear (kN)			
	Response Spectrum		Time History	
	X-direction	Y-direction	X-direction	Y-direction
Model 1	2270.881	2125.852	6140.03	5120.202
Model 2	1796.76	1705.75	2832.377	2747.7

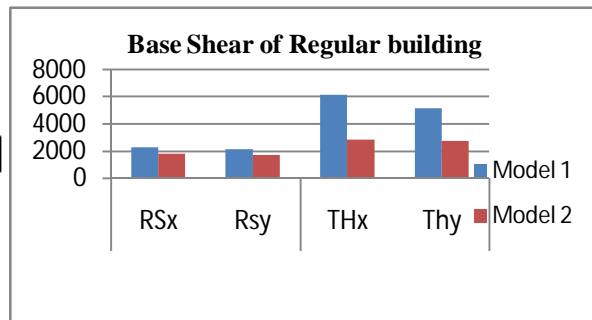


Figure 5.3: Base Shear (kN) in bare frame of G+14 of regular plan with base isolators in X & Y direction.

b)G+14 Storey of Irregular plan:

Table 5.4: Variation of base shear in X & Y direction for bare frame with base isolators.

Models	Base Shear (kN)			
	Response Spectrum		Time History	
	X-direction	Y-direction	X-direction	Y-direction
Model 3	1857.353	1743.89	5462.18	4245.67
Model 4	1521.98	1418.32	2698.8	2476.16

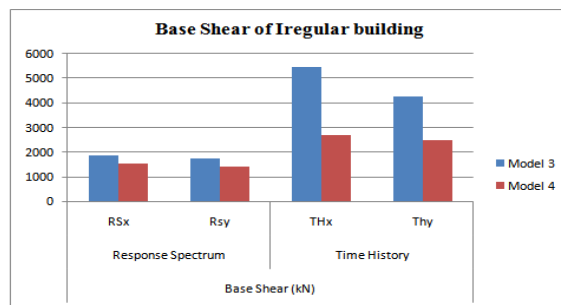


Figure 5.4: Base Shear (kN) in bare frame of G+14 of Irregular plan base isolators in X & Y direction.

From fig 5.3, it was observed that , Base shear decreases by 21% and 20% in model-2 when compared with model-1 along x and y-direction in Response spectrum.

Similarly it was decreased by 54% and 47% in model-2 when compared with model-1 along X and Y-direction in Time History for regular building.

From fig 5.4, it was observed that , Base shear decreases by 18% and 19% in model-4 when compared with model-3 along x and y-direction in Response spectrum.

Similarly it was decreased by 51% and 42% in model-4 when compared with model-3 along X and Y-direction in Time History for irregular building.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

5.3 Storey Displacement

a) G+14 Storey of Regular plan:

Table 5.5: Comparison of maximum displacement for fixed base with response spectrum and time history analysis.

No of Storey	Displacement (mm) -Model 1			
	Response spectrum		Time History	
	RSx	Rsy	THx	THy
Storey 15	47.7	39.1	144.9	111.4
storey 14	46.8	38.2	139.7	106.8
Storey 13	45.4	36.9	132.3	100.6
Storey 12	43.6	35.4	122.6	93
Storey 11	41.4	33.5	111.5	84.1
Storey 10	38.7	31.3	101.4	74.4
Storey 9	35.7	28.7	93.2	65.1
Storey 8	32.3	25.8	85.9	58.3
Storey 7	28.6	22.7	78.9	52.8
Storey 6	24.5	19.2	70.9	46.5
Storey 5	20.2	15.6	61	39.1
Storey 4	15.6	11.8	48.7	30.6
Storey 3	10.8	8	34.6	21.2
Storey 2	6.1	4.3	19.8	11.7
Storey 1	2	1.4	6.6	3.7

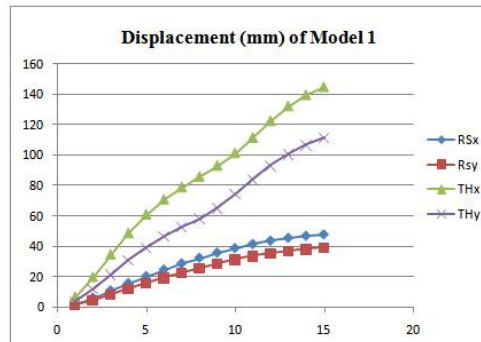


Figure 5.5: Maximum Displacement (mm) in bare frame of G+14 for fixed base with response spectrum and time history.

Table 5.6: Comparison of maximum displacement for HDRB with response spectrum and time history analysis.

No of Storeys	Displacement (mm) -Model 2			
	Response spectrum		Time History	
	RSx	Rsy	THx	THy
Storey 15	59.8	52.1	85.7	89.5
storey 14	59.1	51.4	84.5	88.9
Storey 13	58.2	50.6	82.9	88
Storey 12	56.9	49.4	80.7	86.7
Storey 11	55.3	48	78	85
Storey 10	53.4	46.2	76.2	82.9
Storey 9	51.1	44.2	75.3	80.2
Storey 8	48.5	41.9	74	77.1
Storey 7	45.7	39.4	72.2	73.5
Storey 6	42.6	36.6	69.7	69.3
Storey 5	39.2	33.5	66.6	64.4
Storey 4	35.5	30.2	62.5	58.9
Storey 3	31.5	26.6	57.3	52.6
Storey 2	27.1	22.6	50.6	45.3
Storey 1	22	18.1	41.8	36.7

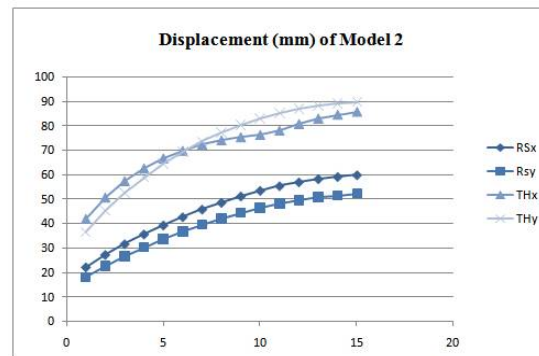


Figure 5.6: Maximum Displacement (mm) in bare frame of G+14 for HDRB with response spectrum and time history.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

Table 5.7: Comparison of maximum displacement for fixed base with response spectrum and time history analysis.

No of Storey	Displacement (mm) -Model 3			
	Response spectrum		Time History	
	RSx	RSy	THx	THy
Storey 15	49.1	38.4	145.6	93.6
storey 14	48.1	37.5	140.9	90
Storey 13	46.7	36.3	134.2	85.3
Storey 12	44.8	34.8	126.1	79.4
Storey 11	42.5	32.9	117.9	72.4
Storey 10	39.8	30.7	109.9	64.5
Storey 9	36.7	28.2	101.6	58
Storey 8	33.2	25.3	93.5	53.4
Storey 7	29.3	22.2	85.6	48.6
Storey 6	25.2	18.9	76.7	43.1
Storey 5	20.7	15.3	65.5	36.5
Storey 4	16	11.6	52	28.6
Storey 3	11.1	7.9	36.6	19.8
Storey 2	6.2	4.3	20.8	10.9
Storey 1	2.1	1.3	6.9	3.4

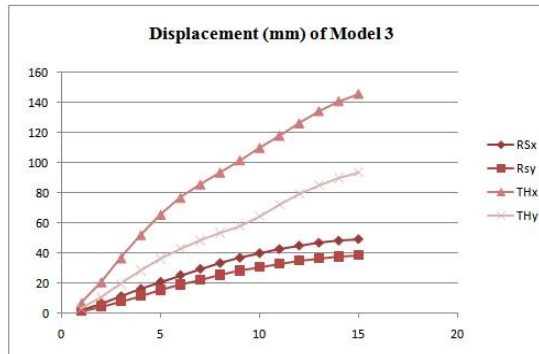


Figure 5.7: Maximum Displacement (mm) in bare frame Of G+14 for fixed base with response spectrum and time history

Table 5.8: Comparison of maximum displacement for HDRB with response spectrum and time history analysis

No of Storeys	Displacement (mm) -Model 4			
	Response spectrum		Time History	
	RSx	RSy	THx	THy
Storey 15	61	48.4	97.1	82.2
storey 14	60.3	47.7	96.1	81.3
Storey 13	59.3	46.9	94.7	80
Storey 12	57.9	45.7	92.8	78.2
Storey 11	56.1	44.2	90.2	76
Storey 10	54	42.5	87	73.1
Storey 9	51.6	40.5	83.3	69.7
Storey 8	48.8	38.2	78.9	65.8
Storey 7	45.7	35.7	73.9	61.5
Storey 6	42.3	32.9	68.5	58.3
Storey 5	38.7	29.8	62.6	54.3
Storey 4	34.7	26.5	56.1	49.3
Storey 3	30.4	22.9	49.2	43.2
Storey 2	25.7	19	41.4	36.2
Storey 1	20.2	14.6	32.5	28.1

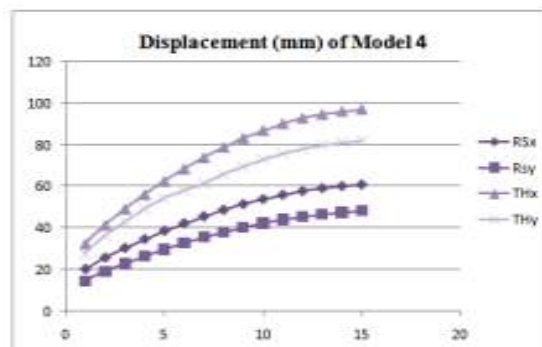


Figure 5.8: Maximum Displacement (mm) in bare frame of G+14 for HDRB with response spectrum and time history.

From fig 5.5, it is observed that displacement increases with increase in number of storey. Storey-15 displacement is more when compared with lower storey's. It is increased by 95.8% and 96.4% in storey-15 compared to storey-1 in Response Spectrum along X and Y-direction in model-1. Similarly, 95.44% and 96.67% in Time History along X and Y-direction in model-1. From fig 5.6, it is observed that displacement increases with increase in number of storey. Storey-15 displacement is more when compared with lower storey's. It is increased by 63.21% and 65.25% in storey-15 compared to storey-1 in Response Spectrum along X and Y-direction in model-1. Similarly, 51.22% and 59% in Time History along X and Y-direction in model-2. From fig 5.7, it is observed that displacement increases with increase in number of storey. Storey-15 displacement is more when compared with lower storey's. It is increased by 95.72% and 111.077% in storey-15 compared to storey-1 in Response Spectrum along X and Y-direction in model-1. Similarly, 95% and 96% in Time History along X and Y-direction in model-3. From fig 5.8, it is observed that displacement increases with increase in number of storey. Storey-15 displacement is more when compared with lower storey's. It is increased by 67% and 70% in storey-15 compared to storey-1 in Response Spectrum along X and Y-direction in model-1. Similarly, 67% and 66% in Time History along X and Y-direction in model-4.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

a) G+14 Storey:

Table 5.9: Comparison of maximum storey acceleration for fixed base with response spectrum and time history analysis.

No of Storey	Acceleration (m/sec ²) -Model 1			
	Response spectrum		Time History	
	RSx	Rsy	THx	THy
Storey 15	0.6622	0.7127	2.4897	1.8978
storey 14	0.4734	0.4975	1.6602	1.6518
Storey 13	0.3696	0.3876	1.5796	1.4862
Storey 12	0.4234	0.451	1.4861	1.2755
Storey 11	0.4736	0.5034	1.4792	1.209
Storey 10	0.4541	0.4808	1.168	1.1957
Storey 9	0.4338	0.4592	1.1958	1.1814
Storey 8	0.4548	0.48	1.487	1.3454
Storey 7	0.4559	0.4784	1.7431	1.5124
Storey 6	0.422	0.4438	1.665	1.4842
Storey 5	0.4397	0.467	1.4659	1.2964
Storey 4	0.5124	0.5422	1.7444	1.4447
Storey 3	0.5141	0.5378	1.7935	1.4733
Storey 2	0.3754	0.3875	1.3211	1.081
Storey 1	0.146	0.1482	0.7709	0.7912

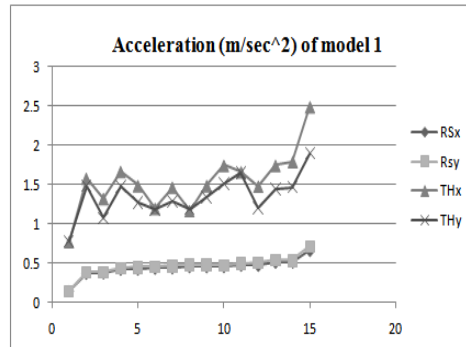


Figure 5.9: Maximum Acceleration in bare frame of G+14 for fixed base with response spectrum and time history.

Table 5.10: Comparison of maximum storey acceleration for HDRB with response spectrum and time history analysis.

No of Storeys	Acceleration (m/sec ²) -Model 2			
	Response spectrum		Time History	
	RSx	Rsy	THx	THy
Storey 15	0.3109	0.3383	0.7329	0.7539
storey 14	0.27	0.2873	0.6463	0.6637
Storey 13	0.2351	0.2463	0.5279	0.6156
Storey 12	0.222	0.2338	0.4393	0.5276
Storey 11	0.2243	0.239	0.427	0.4128
Storey 10	0.2234	0.2387	0.3744	0.3789
Storey 9	0.2158	0.2299	0.3475	0.3878
Storey 8	0.2124	0.226	0.3768	0.4188
Storey 7	0.217	0.2321	0.4327	0.5123
Storey 6	0.2193	0.2355	0.5287	0.6325
Storey 5	0.213	0.2283	0.5514	0.6841
Storey 4	0.2089	0.223	0.6238	0.6541
Storey 3	0.2202	0.2356	0.743	0.7655
Storey 2	0.2366	0.2557	0.8114	0.8225
Storey 1	0.2349	0.2566	0.7717	0.7761

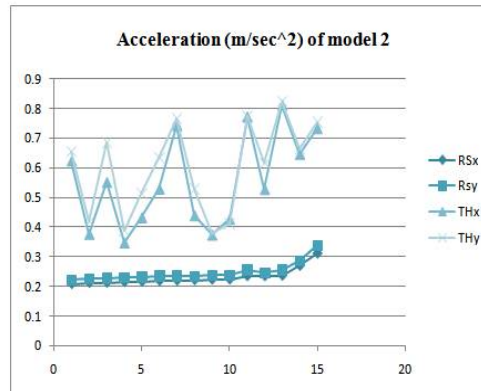


Figure 5.10: Maximum Acceleration in bare frame of G+14 for HDRB with response spectrum and time history.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

Table 5.11: Comparison of maximum storey acceleration for fixed base with response spectrum and time history analysis

No of Storeys	Acceleration (m/sec ²)-Model 3			
	Response spectrum		Time History	
	RSx	Rsy	THx	THy
Storey 15	0.7006	0.7797	2.8074	3.0141
storey 14	0.5093	0.5437	1.9434	2.0375
Storey 13	0.3992	0.4224	1.6533	1.8093
Storey 12	0.445	0.4875	1.6203	1.6134
Storey 11	0.4957	0.5448	1.4096	1.5365
Storey 10	0.4811	0.5244	0.9819	1.247
Storey 9	0.4622	0.5017	1.2444	1.3854
Storey 8	0.479	0.5188	1.596	1.6768
Storey 7	0.478	0.5146	1.968	1.8718
Storey 6	0.4483	0.4822	1.8481	1.782
Storey 5	0.4701	0.512	1.5461	1.671
Storey 4	0.5394	0.5892	1.7358	1.9899
Storey 3	0.5341	0.578	1.7884	1.9387
Storey 2	0.387	0.4128	1.3366	1.3966
Storey 1	0.1499	0.1564	0.8197	0.8298

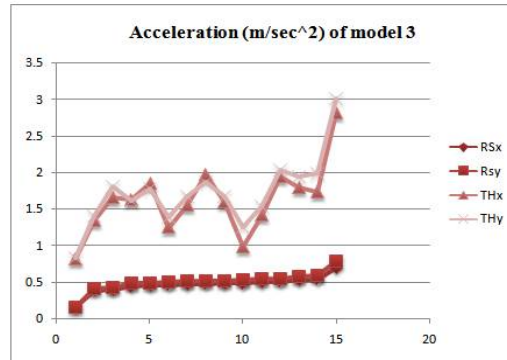


Figure 5.11: Maximum Acceleration in bare frame of G+14 for fixed base with response spectrum and time history.

Table 5.12: Comparison of maximum storey acceleration for HDRB with response spectrum and time history analysis

No of Storeys	Acceleration (m/sec ²)-Model 4			
	Response spectrum		Time History	
	RSx	Rsy	THx	THy
Storey 15	0.375	0.4156	0.8918	0.9788
storey 14	0.3222	0.3461	0.7384	0.8296
Storey 13	0.277	0.2913	0.6177	0.6931
Storey 12	0.2608	0.2765	0.6236	0.5657
Storey 11	0.2655	0.2866	0.5824	0.4605
Storey 10	0.2667	0.2893	0.4824	0.4617
Storey 9	0.2592	0.28	0.5561	0.628
Storey 8	0.2555	0.2754	0.5765	0.6849
Storey 7	0.26	0.2815	0.6406	0.6151
Storey 6	0.2609	0.2834	0.7628	0.7436
Storey 5	0.2526	0.2735	0.7663	0.8073
Storey 4	0.2497	0.2689	0.7391	0.9134
Storey 3	0.2657	0.2876	0.7736	0.9563
Storey 2	0.284	0.3119	0.8033	0.9824
Storey 1	0.2761	0.3089	0.8305	0.9841

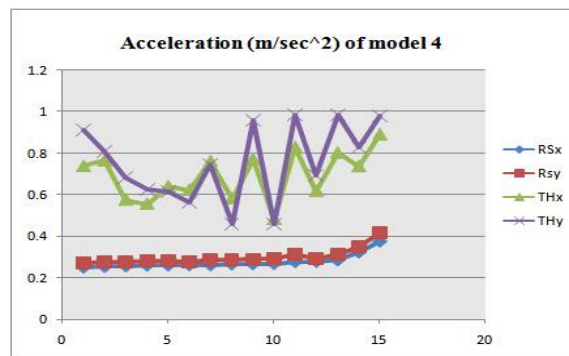


Figure 5.12: Maximum Acceleration in bare frame of G+14 for HDRB with response spectrum and time history.

From fig 5.9, it is observed that , acceleration is more in storey-15 when compared with bottom storeys in all models along X and Y-directions both in Response Spectrum and Time History respectively. Acceleration is increases by 80% and 79% in storey-15 compared to storey-1 in model-1 for RS analysis along X and Y-directions. Similarly, 69% and 58% in storey-15 compared to storey-1 in model-1 for TH analysis along X and Y-direction. From fig 5.10 , it is observed that , acceleration is more in storey-15 when compared with bottom storeys in all models along X and Y-directions both in Response Spectrum and Time History respectively. Acceleration is increases by 25% and 24% in storey-15 compared to storey-1 in model-2 for RS analysis along X and Y-directions. Similarly, 5% and 3% in storey-15 compared to storey-1 in model-2 for TH analysis along X and Y-direction. From fig 5.11, , it is observed that , acceleration is more in storey-15 when compared with bottom storeys in all models along X and Y-directions both in Response Spectrum and Time History respectively. Acceleration is increases by 79% and 80% in storey-15 compared to storey-1 in model-3 for RS analysis along X and Y-directions. Similarly, 71% and 72% in storey-15 compared to storey-1 in model-3 for TH analysis along X and Y-direction. From fig 5.12, it is observed that , acceleration is more in storey-15 when compared with bottom storeys in all models along X and Y-directions both in Response Spectrum and Time History respectively. Acceleration is increases by 24% and 25% in storey-15 compared to storey-1 in model-4 for RS analysis along X and Y-directions. Similarly, 10% and 2% in storey-15 compared to storey-1 in model-4 for TH analysis along X and Y-direction.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

VI. CONCLUSION

Following conclusions can be made from the analysis

Mode period

- Mode period increases in High Damped Rubber Bearing when compared with fixed base building both in regular and irregular plan building. Because, flexibility is more in High Damped Rubber Bearing compared to fixed base.
- Plan Irregular building mode period is less when compared with regular plan building. Because mass participates less in irregular when compared to regular plan building.
- Mode period is directly proportion to the mass of the structure, the mass of the structure increases, the mode period also increases.

Base shear

- Base shear is directly proportional to the weight of the building. Base shear is more along x-direction when compared with y-direction both in Response spectrum and Time History respectively. Because mass participation factor more in x-direction.

High Damped Rubber Bearing (Model-2 & Model-4) base shear is less both in Response Spectrum and Time History when compared with fixed base building (Model-1 & Model-3). Base shear is more in regular plan building along x and y-direction when compared with irregular both in Response Spectrum and Time History. Because mass participation factor is more in regular plan building.

Time History analysis shows, maximum reduction in Base Shear (model-2 & model-4) both in regular and irregular plan building along x and y-direction when compared with Response Spectrum analysis for model-1 and model 3 (Fixed base building).

Displacement

- Displacement has increased with increase in number of storeys for all models (both regular and Irregular plan building)..
- Displacement is maximum at the top storey when compared with bottom storeys both in Response Spectrum and Time History for regular and Irregular plan building along x and y-direction.
- Displacement is more in Time History analysis in all models when compared with Response Spectrum analysis.
- Displacement is increases in model-2 and model-4 (HDRB) when compared with model-1 and model-3 (fixed base) for both in Response Spectrum and Time History because of flexibility is present in HDRB along x and y-direction.
- Displacement is less in y-direction when compared with x-direction because stiffness participates more along y-direction.

Acceleration

- Acceleration is maximum in storey-15 when compared to storey-1 in all other models along x and y-direction but in Response Spectrum and Time History respectively.
- Acceleration is maximum in irregular plan building when compared with regular plan building because displacement is more in irregular along x and y-direction.
- Acceleration is less in model-2 and model-4 (HDRB) when compared with model-1 and model-3 (fixed base) both in RS and TH. This shows using HDRB reduce the acceleration.
- Time History analysis acceleration is maximum when compared with Response Spectrum in all other models.

Based on above conclusions it was observed that using HDRB there is a decrease or reduces in base shear and acceleration both in RS and TH for regular and irregular building. Time History analysis shows the better performance both in base shear and acceleration compared with Response spectrum in regular and irregular building. Regular building shows good result or reducing in base shear and acceleration using HDRB compared with irregular plan building for RS and TH respectively.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

REFERENCES

1. A.N Lin and H.W Shenton, "Seismic performance of fixed-base and base-isolated steel frames", ASCE, Vol. 118, No.5, ISSN 0733-9399, May, 1992.
2. A.Sharma and R.S Jangid, "Behavior of Base Isolated Structure with High Initial Isolator Stiffness", Journal of World Academy of Science Engineering and Technology, No.50, pp. 186-191, (2009).
3. . A.B.M Saiful islam et al, "Simplified design guidelines for seismic base isolation in multistorey buildings for BNBC", international journal of the physical sciences, Vol. 6 (23), pp.5467- 5486, 9 October, 2011.
4. A.B.M Saiful islam et al, "Seismic isolation for buildings in regions low to moderate seismicity: Practical alternative design", ASCE, Vol. 17, No.1, ISSN 1084-0680, 1 February, 2012.
5. . Desai Amit R, Dr.R.K.Gajjar, "Structural Control system for mid-rise building", International Journal of Advanced Engineering Technology, EISSN 0976-3945.
6. . Dr. Hadi Nasir Ghadhban AL-Maliki, "Analytical Behavior of Multi-Storied Building with Base Isolation Subjected to Earthquake Loading", Journal of Engineering and Development, Vol. 17, No.2, 2013, ISSN 1813- 7822.
7. H.W.Shenton and A.N.Lin, "Relative performance of fixed base and base isolated concrete frames".
8. M. Qamaruddin (1998), "A state of the -art review of seismic isolation scheme for masonry building", ISET journal of Earthquake Technology.
9. Hadj Mohamed ounis (2011), "Effect of the damping on the seismic response of a base isolated building", world young research.
10. Shirulepravin Ashok, Niraj Mehta, Rahul wagh, Mayer padhijas, Ankesh samera and Yogeshpatil (2012), "Base response spectrum analysis of multistoried base-isolated building", IJCSIARD.
11. P.N Dubey, G.R.Reddy, K.K.Veze, A.K.Ghosh, H.S.Kushwaha, S.K.Deb,(2008), "Performance of base isolated RCC framed building under actual earthquake",Journal of structure engineering.
12. IS 1893 (part 1):2002, Criteria for earthquake resistant design of structures.
13. IS 456:2000, Code of practice for plain and reinforced concrete.