IJARST
International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

ANALYSIS OF HIGH RAISED STRUCTURES IN DIFFERENT SEISMIC ZONES WITH DIAGRID AND SHEAR WALLS USING ETABS

[1]Garigipati Vedasri Naidu[2]kelam Mallikharjuna rao

[1] PG scholar, Department of civil, ST.Mary's Group of institutions

[2] Associate professor, Department of civil, ST.Mary's Group of institutions

Abstract: Building tall structures has evolved from "stiffness" to "lightness" due to new structural principles utilising newly adopted high strength materials and construction technologies. The need for earthquake-resistant structures is on the rise due to historical earthquake data. As a result, seismic effects must be taken into account during structural design and analysis. Shear barriers are now commonly employed because of their resistance. Seismic repercussions are minimised in reinforced concrete buildings by utilising the shear wall system. In addition, structural buildings make use of diagrid systems for the same reasons. Despite the fact that both technologies are designed to combat the same problems, they behave differently when subjected to seismic loads. A comparison of seismic analyses of multi-story buildings with diagrid and shear wall systems in various zones is the focus of the current research.

The goal of this research is to better understand how structures can safely withstand high lateral forces exerted on them during an earthquake by earthquake-resistant characteristics. Shear walls and diagrid are excellent in reducing earthquake and wind damage to buildings.

A high rise building's diagrids and shear walls are being compared in this study. The structure is modelled and analysed using the ETABS 2016 programme in various seismic zones and wind conditions. Various IS codes have been referred for analysis, including IS 456:2000 for gravity load combinations and IS1893:2002 (part 1) for seismic load combinations. The dynamic analysis approach is used to examine the buildings' structures. For dynamic analysis, response spectrum functions are specified. Model results are tabulated and graphically depicted, and they are compared to see whether building performs better against lateral stresses.

1 INTRODUCTION

1.1 General

Taller buildings are more desirable these days due to the rapid rise of metropolitan populations and the scarcity and high cost of accessible land. Since the dawn of civilisation, man has been intrigued with tall structures. Ancient towering constructions include the Egyptian Pyramids, one of the seven wonders of the world, which were built about 2600 B.C. Constructing such fortifications was a matter of self-expression and national pride for the people. The increase in modern multi-story building construction, which began in the late nineteenth century, is mostly for commercial and residential use. They've become popular, and they've opened the door to international rivalry in the construction of skyscrapers as a symbol of the country's wealth and technological might. A building's height is a matter of opinion; it cannot be quantified in terms of absolute height or number of stories. However, from the perspective of a structural engineer, a tall or multi-story building can be defined as one that, due to its height, is subject to lateral forces such as wind, earthquakes, machinery vibrations, and other sources of vibration that can cause structural damage or even collapse, and they only play a significant role in structural design. Designing tall buildings requires conceptual planning, approximation analysis, preliminary design, and optimization to safely carry gravity and lateral stresses. The design criteria are robustness, usability, sturdiness, and human comfort.

1.2 Shear walls

Wind, earthquake, and uneven settlement loads create lateral forces that combine with the weight of the structure and its occupants to create severe twisting (torsional) forces. These forces have the ability to rip (shear) a building in half with their sheer force. Side loads exerted on a structure are countered by building shear walls. They can resist significant horizontal loads while also supporting gravity loads due to their high plane stiffness and strength, which makes them an excellent choice for many structural engineering applications. They're typically found between columns, in stairwells, elevator wells, and shafts.

1.3Diagrid system

Diagrids is one of the systems that improves the seismic performance of the frame by improving the lateral stiffness and capacity. Because of its structural efficiency, flexibility in architectural planning, energy absorption capacity, and aesthetic possibilities given by the system's unique geometric configuration, Diagrid– diagonal grid structural systems– are commonly employed for tall buildings of various kinds. As a result, structural effectiveness and aesthetics have reignited interest in the diagrid among tall building architects and structural designers. Diagrids are used to form triangular steel constructions with diagonal support beams in order to build towering buildings. The Diagrids are perimeter structural arrangements with a thin grid of diagonal elements involved both in gravity and in lateral load resistance. It's not new to use structural components in a diagonally oriented fashion to achieve high levels of strength and stiffness. However, in recent years, diagrid has regained popularity and is being used more frequently in huge span and high-rise buildings, particularly those with complicated geometries and curved shapes, sometimes with entirely free forms.

1.4 Objective of the work

1. diagrid and shear wall structure systems with diverse earthquake zones and wind conditions will be studied.
2. The ETABS 2016 software was used to model two buildings, one with a diagrid system and the other with a shear wall.
3. Using response spectrum analysis, examine the modelled structures in various zones.
4. Study of results in terms of storey displacements, drifts, stiffness and overturning moments in storeys.

1. 5 Scope of the work

The study compares seismic analyses of symmetrical daigrid and shear wall constructions. The model used for the analysis is a 36-story RC building G+ with a plan size of 36mx36m. Building performance is examined in Zones II and IV. ETABS 2016 was used to model and analyse the structure. The software will incorporate the building's shear wall and diagrid system, and it will be studied using the response spectrum approach. A seismic study has been performed in accordance with IS 1893(part 1):2002, and storey displacements, storey drifts, storey stiffness, and storey overturning moments will be compared.

II LITERATURE REVIEW

2.1 Preface

Materials, structural systems, construction technology, and analytical tools for analysis and design have all improved, which has aided in the development of taller structures. Wind and earthquake lateral loads dictate high-rise structural design. As a result, structures must be designed and analysed to account for seismic effects as well as lateral load resistance. Rigid frames, shear walls, diagrid structural systems, wall frames, braced tube systems, outrigger systems, and tubular systems are all examples of resisting systems. Shear wall systems and diagrid structural systems have recently become the most popular lateral load resisting technologies.

2.2 Inference from Literature Review

Kiran andJayaramappa(2017) [1] conducted a comparison of the Hexagrid system with the multi-storey RC frame with shear wall. A 30 storey bare RC building is prepared for research, as is a 30 storey bare RC building with shear wall and a 30 storey bare RC building with shear wall and the Hexagrid system. Analyzing these three models makes use of the linear dynamic response spectrum approach. The RC frame is designed and analysed with the help of ETABS V.13 software. Maximum displacement, maximum drift, maximum storey shear, and maximum overturning moment are used to analyse the structure's behaviour. RC frames with and without Hexagrid bracings and with a shear wall were studied, as were the effects of base shear and displacement. There is a comparison between multiple zones-III models for result characteristics such as maximum storey displacement, maximum storey drift, maximum storey shear, and maximum overturning moment. There was less base shear and more displacement in the present study when comparing the RC bare frame to the other two models, and the structure's resistance to base force decreases with increasing floor count. This leads to an increase in displacement. RC bare frame with shear wall and Hexagrid bracing system effects are evident in high seismic zones, as shown by the drift values when Hexagrid bracing system is used.

III THEORITICAL BACKGROUND

3.1 General

Demand for space in densely populated geographical areas used to be the driving force behind the construction of tall buildings. Skyscrapers, on the other hand, become a status symbol as building heights climb. The height limit has been pushed to new heights thanks to developments in structural engineering and technology. In the middle of the 1800s, Elisha G. Otis invented the vertical elevator safety mechanism, which made the elevator the safest and most efficient way to go vertically in tall structures. Skyscraper development has not only become more significant and viable, but it has also increased the building's maximum height. Nations and huge corporations have been vying for control of the world's highest building title for years.

3.2 Shear wall

In addition to slabs, beams, and columns, reinforced concrete (RC) buildings frequently contain vertical plate-like RC walls called shear walls. These walls usually begin from the foundation and continue to the top of the structure. Thicknesses range from 150 mm to 400 mm in taller structures. Buildings typically have shear walls along the length and width of their perimeters. Therefore, they can withstand lateral wind and earthquake stresses on the wall's plane by buckling and shearing the material. Shear wall is like a beam cantilevered from the base, and its strength comes in part from its depth.

3.3 Diagrid system

The diagrid is a building and roof structure made of diagonally intersecting metal, concrete, or timber beams. The diagrid systems can be viewed as an evolution of braced tube structures, as the perimeter configuration ensures maximum bending resistance and rigidity, while the mega-diagonal members are dispersed over the facade, resulting in closely spaced diagonal elements and eliminating the need for conventional external vertical columns. As a result, diagonal components in diagrid constructions serve as both inclined columns and bracing elements, and they carry both gravity loads and lateral forces. As a result of the triangulated structure, the members see a reduction in shear racking forces. Figure 3.2 shows the diagrids, or diagonally intersecting components.

Figure 3.2 Diagrid system

Diagrid has a striking visual identity that is immediately recognisable. As a structural system, Diagrid adds aesthetic value to a building if that's the architect's goal. As a result of the Diagrid system, the building can have a column-free façade, even if there are no corner columns. Due to the close spacing of vertical columns in a framed tube construction, they often impede the outside view. The Diagrid system's layout and efficiency reduce the amount of structural elements necessary on the building's front, resulting in less blockage to the view from the exterior.

IV METHODS OF ANALYSIS

4.1 General

All structures are built for the combined impacts of gravity loads and seismic loads to verify that appropriate vertical and lateral strength and stiffness are attained to satisfy the structural performance and acceptance deformation levels defined in the governing building code. Because of the intrinsic safety factor utilised in the design specification, most structures are effectively protected from vertical shaking. When designing or analysing structural stability, keep in mind that vertical acceleration should be taken into account for structures with considerable spans.

4.2 Linear static analysis

It's also called the static approach, the equivalent static method, or the seismic coefficient method when trying to figure out lateral force. The static technique is the easiest to use because it relies on a formula from the International Standard ISO 1893:2002. (part-1). The comparable linear static approaches must be taken into account when designing for seismic loads. A rough estimate of the base shear force and distribution on each storey is needed, and these will be generated using a formula in the code.

4.3 Linear dynamic analysis

Response spectrum method is a technique known as linear dynamic analysis. The peak response of a structure during an earthquake is calculated using this method straight from the seismic response, which is quite accurate when used in structural design.

4.4 Non-linear static analysis

To assess the deformation and damage pattern of a structure, this practical method performs analysis under constant vertical and progressively rising lateral loads. Seismic non-linear static analysis uses a capacity curve to illustrate the relationship between the base shear force and the displacement of the roof to describe the structure's behaviour. It's sometimes referred to as the "Pushover Analysis."

4.5 Non-linear dynamic analysis

Non-Linear Time History Analysis is the term used to describe it. It's a critical tool for structural seismic analysis, especially when the response of the studied structure is not linear. A representative earthquake time history for the structure under consideration is needed to do this study. When a structure's dynamic response changes over time, it's done through time history analysis, which takes a step-by-step look at how the structure reacts. The seismic response of a structure under dynamic loading of a representative earthquake can be determined via time history analysis.

V MODELING AND ANALYSIS

5.1 General

In this chapter, the structure is modelled and analysed under a variety of loads. We utilised ETABS V16.2.1.0 as our finite element software package. Static and dynamic analyses of the structure will be carried out using a three-dimensional model. The model's ideal representation of the building's three-dimensional (3D) characteristics includes its mass distribution, strength, stiffness, and deformability. It is covered in this chapter how to model the material's properties as well as the structure's elements, loads, and combinations of loads.

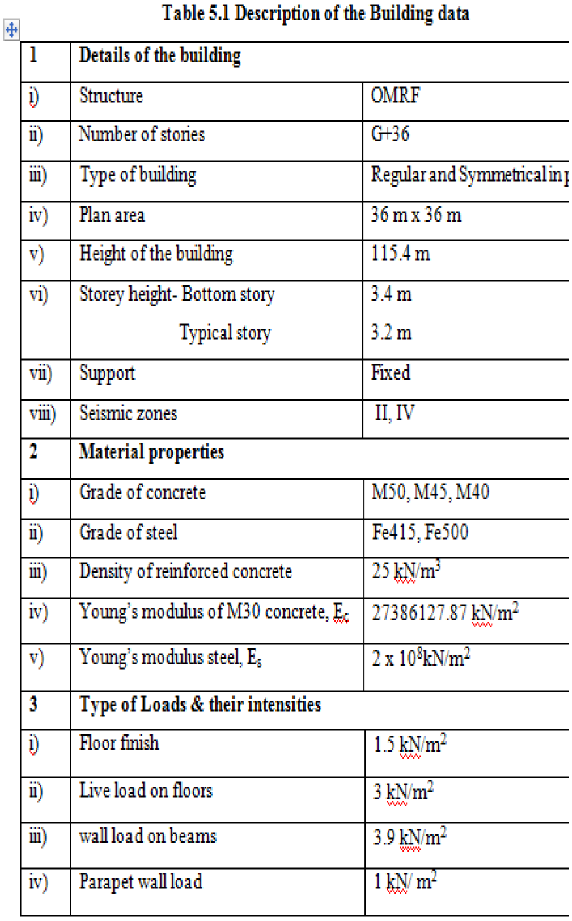
5.2 ETABS Software

ETABS It is a multi-story building analysis and design software programme. There are a variety of modelling strategies and tools that work together with the grid-like geometry that is specific to this structure type, including load prescriptions based on code, analysis methods, and solution approaches. ETABS can be used to analyse simple or complex systems in static or dynamic situations. Modal and direct-integration time-history studies, as well as P-Delta and Large Displacement effects, can be used to measure seismic performance to a high level of sophistication. Material nonlinearity can be captured using nonlinear linkages and focused PMM or fibre hinges when the behaviour is monotone or hysteretic. Application implementations of any complexity are made possible by intuitive and integrated features. ETABS is a coordinated and productive tool for designs ranging from simple 2D frames to intricate modern high-rises because of its interoperability with many design and documentation systems.

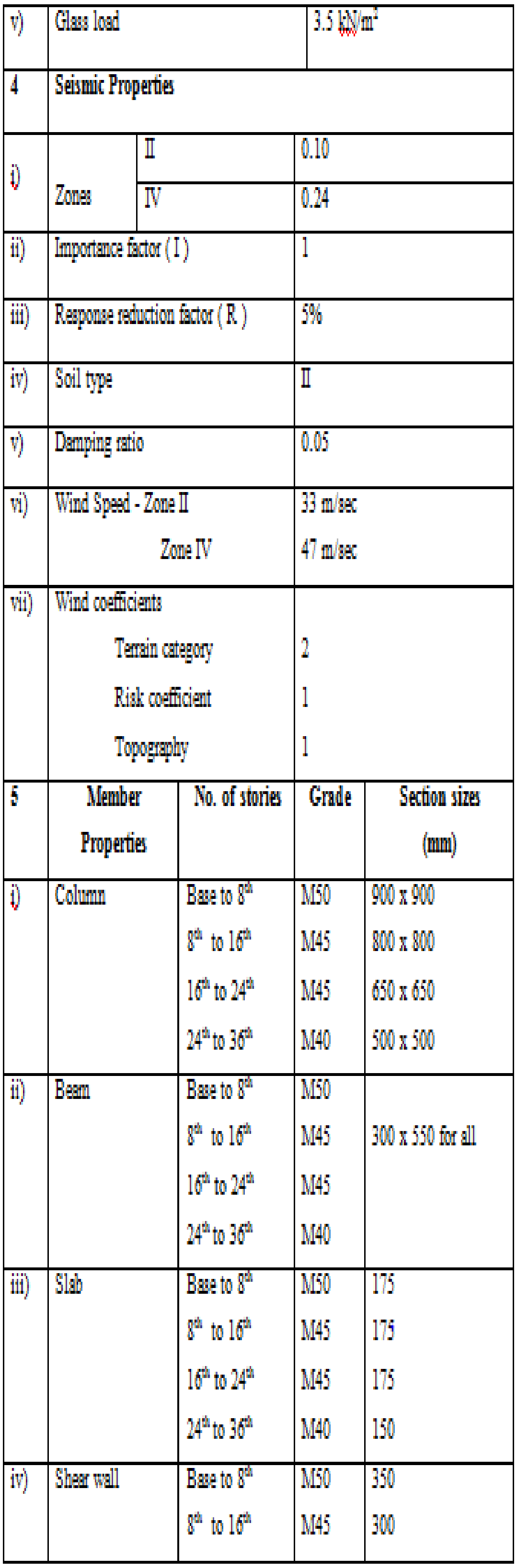
5.3 Problem Formulation

The ETABS V16.2.1.0 package analyses two 36-story structures with a plan area of 36mx36m to estimate the buildings' dynamic control. Dynamic analyses are carried out in accordance with IS: 1893-2002 code using bhuj, Gujarat earthquake data as input for wind and earthquake factors. The two constructions are analysed to determine their respective Time History, Time Period, Storey Displacement, Storey Drift, and base shear. Table 5.1 provides a general explanation of the structure.

Table 5.1 Description of the Building data



1	**Details of the building**	
i)	Structure	OMRF
ii)	Number of stories	G+36
iii)	Type of building	Regular and Symmetrical in
iv)	Plan area	36 m x 36 m
v)	Height of the building	115.4 m
vi)	Storey height- Bottom story Typical story	3.4 m 3.2 m
vii)	Support	Fixed
viii)	Seismic zones	II, IV
2	**Material properties**	
i)	Grade of concrete	M50, M45, M40
ii)	Grade of steel	Fe415, Fe500
iii)	Density of reinforced concrete	25 kN/m³
iv)	Young's modulus of M30 concrete, E_c	27386127.87 kN/m²
v)	Young's modulus steel, E_s	2 x 10^8kN/m²
3	**Type of Loads & their intensities**	
i)	Floor finish	1.5 kN/m²
ii)	Live load on floors	3 kN/m²
iii)	wall load on beams	3.9 kN/m²
iv)	Parapet wall load	1 kN/ m²



v)	Glass load	3.5 kN/m²		
4	**Seismic Properties**			
i)	Zones	II	0.10	
		IV	0.24	
ii)	Importance factor (I)	1		
iii)	Response reduction factor (R)	5%		
iv)	Soil type	II		
v)	Damping ratio	0.05		
vi)	Wind Speed - Zone II Zone IV	33 m/sec 47 m/sec		
vii)	Wind coefficients Terrain category Risk coefficient Topography	 2 1 1		
5	**Member Properties**	**No. of stories**	**Grade**	**Section sizes (mm)**
i)	Column	Base to 8th	M50	900 x 900
		8th to 16th	M45	800 x 800
		16th to 24th	M45	650 x 650
		24th to 36th	M40	500 x 500
ii)	Beam	Base to 8th	M50	300 x 550 for all
		8th to 16th	M45	
		16th to 24th	M45	
		24th to 36th	M40	
iii)	Slab	Base to 8th	M50	175
		8th to 16th	M45	175
		16th to 24th	M45	175
		24th to 36th	M40	150
iv)	Shear wall	Base to 8th	M50	350
		8th to 16th	M45	300

v)	Diagrids	Base to 20th	M45	700 x 700
		20th to 36th	M45	600 x 600

In this research, two distinct models of 36-story reinforced concrete skyscrapers are compared. Both models have shear walls around the perimeter of the building, with diagrids running along the perimeter of the building in the first. The earthquake zones II and IV in India, which have medium-stiff soil, are taken into account when modelling the constructions. diagrids, and the shear wall are shown in Figures 5.1 and 5.2 in both plan and 3D.

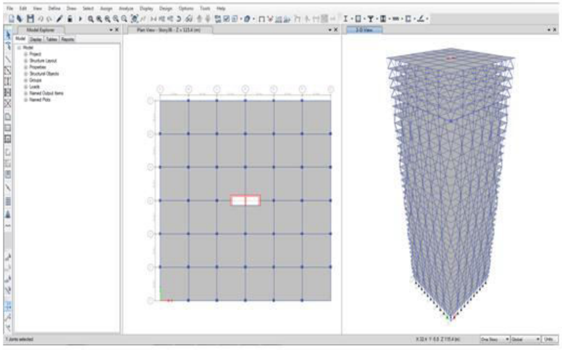


Figure 5.1 Plan and 3D view of the structure with diagrids

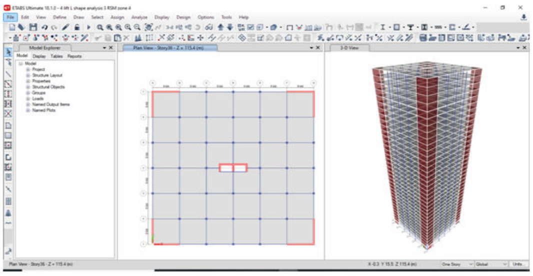


Figure 5.2 Plan& 3D view of the structure with shear walls

Loading definitions are provided in the following figures: 5.3 and 5.4. Several loads are applied to the structure, including the self-weight dead load, the super dead load applied dead load, the live load imposed load, the wind load applied in two directions X and Y, the earthquake load applied in two directions X and Y, and the cladding load, which is a super dead load on the structure's façade. In accordance with IS: 1893-2002, the combination of loads is carried out..

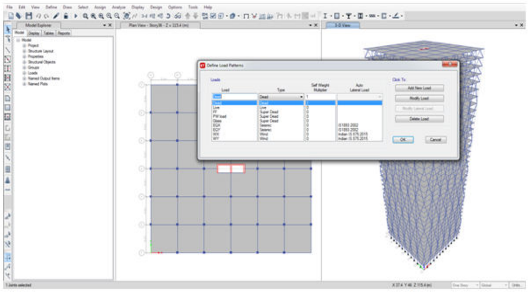


Figure 5.3 Loading patterns in diagrid structure

VI RESULTS AND DISCUSSIONS

6.1 General

The seismic analysis of the modelled structures with shear walls and diagrids spanning in two directions is done with ETABS software, and the findings are presented in the following sections. Seismic zones II and IV are evaluated for storey displacement, storey drifts, storey stiffness, and storey overturning moments. The seismic behaviour of constructions with shear walls versus diagrids is compared. Response Spectrum technique was used to make the comparison.

6.2 Story displacement

a) Zone II

It's the entire change in height of the storey in relation to the ground. Zone II response spectrum technique displacements in X-direction are shown in Table 6.1 for the modelled structures.

Table 6.1 Story displacements of the diagridstructure in zone II

Story	Elevation (m)	For EQ X		For EQ Y	
		X-Dir mm	Y-Dir mm	X-Dir mm	Y-Dir mm
Story36	115.4	15.919	0.382	0.393	16.156
Story35	112.2	15.715	0.368	0.382	15.963
Story34	109	15.502	0.361	0.377	15.762
Story33	105.8	15.278	0.355	0.372	15.551
Story32	102.6	15.044	0.335	0.354	15.33
Story31	99.4	14.743	0.336	0.359	15.064
Story30	96.2	14.383	0.334	0.357	14.703
Story29	93	13.959	0.328	0.347	14.253
Story28	89.8	13.546	0.326	0.343	13.831
Story27	86.6	13.117	0.32	0.339	13.413
Story26	83.4	12.647	0.311	0.33	12.962
Story25	80.2	12.186	0.305	0.326	12.531
Story24	77	11.701	0.297	0.319	12.058
Story23	73.8	11.173	0.286	0.305	11.507
Story22	70.6	10.641	0.276	0.292	10.955
Story21	67.4	10.126	0.266	0.283	10.4
Story20	64.2	9.61	0.255	0.273	9.9
Story19	61	9.142	0.246	0.266	9.5
Story18	57.8	8.683	0.237	0.258	9.0
Story17	54.6	8.194	0.226	0.245	8.5
Story16	51.4	7.7	0.215	0.233	8.0
Story15	48.2	7.232	0.205	0.224	7.6
Story14	45	6.762	0.194	0.215	7.1
Story13	41.8	6.305	0.184	0.206	6.7
Story12	38.6	5.85	0.173	0.196	6.3
Story11	35.4	5.367	0.161	0.183	5.8
Story10	32.2	4.885	0.148	0.169	5.3
Story9	29	4.423	0.138	0.16	4.9
Story8	25.8	3.933	0.125	0.149	4.4
Story7	22.6	3.403	0.108	0.136	3.9
Story6	19.4	2.864	0.092	0.121	3.4
Story5	16.2	2.311	0.075	0.102	2.8
Story4	13	1.718	0.055	0.075	2.1
Story3	9.8	1.109	0.035	0.046	1.3
Story2	6.6	0.591	0.02	0.024	0.7
Story1	3.4	0.199	0.008	0.008	0.2
Base	0	0	0	0	0

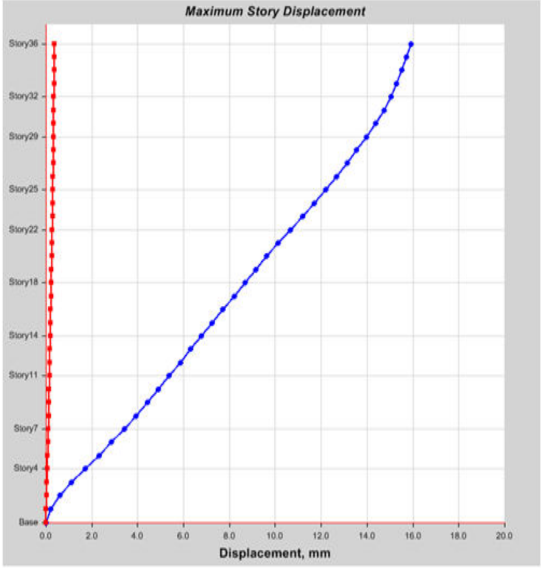


Figure 6.1 Story displacements of diagrid structure in zone II for EQ X

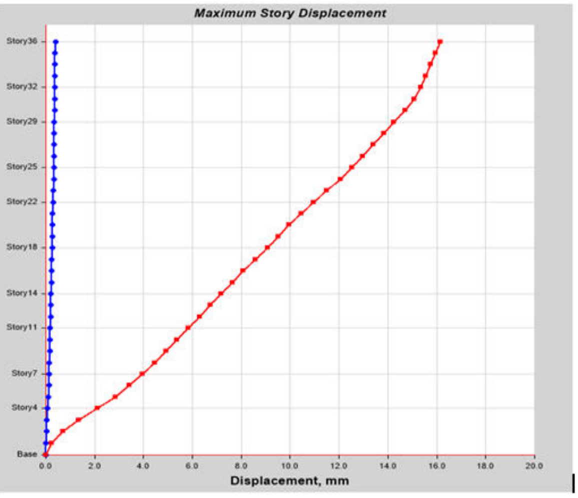


Figure 6.2 Story displacements of diagrid structure in zone II for EQ Y

Table 6.2 Story displacements of the shear wall structure in zo

Story	Elevation (m)	For EQ X		For EQ Y	
		X-Dir mm	Y-Dir mm	X-Dir mm	Y-Dir mm
Story36	115.4	61.66	2.287	2.697	71.038
Story35	112.2	59.851	2.194	2.582	69.04
Story34	109	58.013	2.114	2.488	67.009
Story33	105.8	56.157	2.044	2.409	64.948
Story32	102.6	54.269	1.969	2.32	62.844
Story31	99.4	52.349	1.896	2.236	60.697
Story30	96.2	50.391	1.822	2.15	58.502
Story29	93	48.395	1.747	2.063	56.256
Story28	89.8	46.362	1.67	1.974	53.961
Story27	86.6	44.293	1.593	1.884	51.618
Story26	83.4	42.192	1.515	1.793	49.23
Story25	80.2	40.064	1.436	1.7	46.804
Story24	77	37.912	1.356	1.607	44.342
Story23	73.8	35.758	1.276	1.513	41.871
Story22	70.6	33.592	1.196	1.419	39.382
Story21	67.4	31.424	1.116	1.325	36.883
Story20	64.2	29.257	1.036	1.232	34.38
Story19	61	27.099	0.957	1.138	31.881
Story18	57.8	24.957	0.878	1.046	29.395
Story17	54.6	22.838	0.801	0.955	26.931
Story16	51.4	20.749	0.725	0.865	24.496
Story15	48.2	18.706	0.651	0.778	22.111
Story14	45	16.711	0.579	0.693	19.777
Story13	41.8	14.776	0.51	0.611	17.508
Story12	38.6	12.912	0.444	0.532	15.318
Story11	35.4	11.13	0.381	0.457	13.221
Story10	32.2	9.443	0.321	0.386	11.23
Story9	29	7.864	0.266	0.32	9.363
Story8	25.8	6.406	0.216	0.26	7.637
Story7	22.6	5.079	0.17	0.205	6.062
Story6	19.4	3.874	0.129	0.156	4.628
Story5	16.2	2.804	0.093	0.112	3.353
Story4	13	1.882	0.062	0.075	2.253
Story3	9.8	1.124	0.037	0.045	1.346
Story2	6.6	0.546	0.018	0.022	0.653
Story1	3.4	0.163	0.005	0.007	0.194
Base	0	0	0	0	0

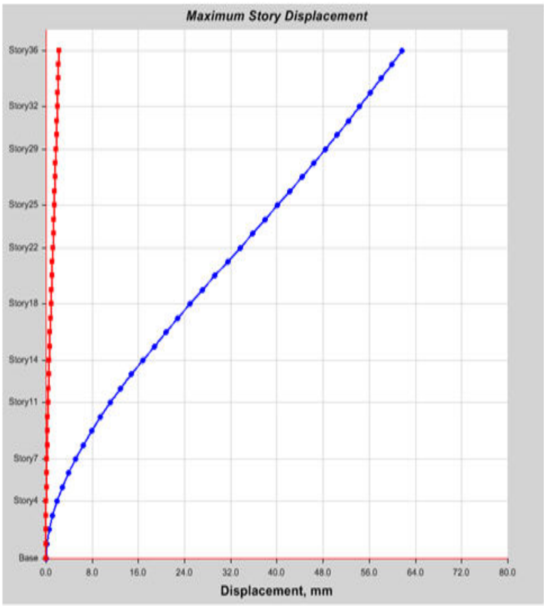


Figure 6.3 Story displacements of shear wall structure in zone II for EQ X

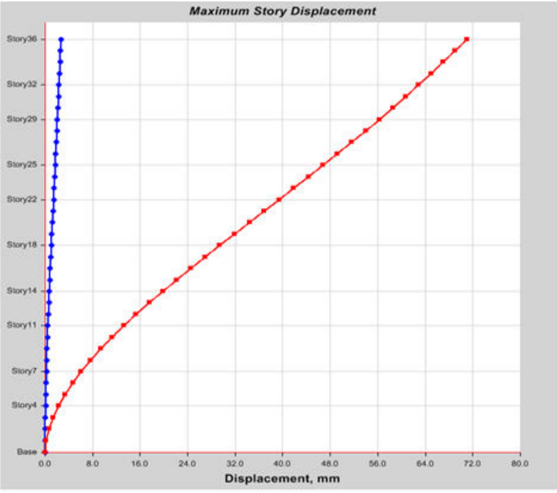


Figure 6.4 Story displacements of shear wall structure in zone II for EQ Y

VII CONCLUSIONS

7.1 General

- In the previous chapter, the seismic behaviour of the modelled structures, i.e. storey displacement, storey drifts, storey stiffness and storey overturning moments in seismic zones II and IV, was discussed and comparison of seismic behaviour was made between diagrids and shear walls structures in response spectrum method. This chapter discusses in depth the findings of the research that was conducted.

- If the shear wall structure is compared in the X and Y directions, the maximum displacement of diagrids is lowered to 80% and 85% in zone IV, respectively. diagrids' maximum storey displacement is 75 percent less in zone II than the shear wall structure.
- Zone II diagrids have a 54 percent lower maximum storey drift than zone I shear walls in both X and Y directions.
- When diagrids are compared to shear walls in X and Y directions, the maximum storey drift is lowered to 60% Zone IV.
- Zones II and IV have digrid structures because they are stiffer than shear walls.
- When comparing the shear wall construction in X and Y directions to the diagrid structure, the maximum overturning moments are reduced by 40% in zone II.
- When comparing the shear wall construction in X and Y directions to the diagrid structure, the maximum overturning moments are reduced by 33% in zone IV.
- It is found that in all seismic zones, the constructions with diagrids have higher base shears than those with shear walls. Structures using diagrids are therefore more rigid than those with shear walls.

REFERENCES

1. Kirtan T and Jayaramappa N, “Comparative study of multi-storey RC frame with shear wall and hexagrid system”, Indian Journal of Research, Volume: 06, Issue: 01, January 2017, pp. 814-817, ISSN 2250-1991.
2. JayeshVenkolath and Rahul Krishnan K, “Optimal diagrid angle of high-rise buildings subjected to lateral loads”,International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 09, September 2016, (pp. 841-846).
3. Abhinav V, SreenathaReddy, Vasudeva Naidu and Madan Mohan, “Seismic analysis of multi-story RC building with shear wall using STAAD.Pro”,International Journal of Innovative Technology and Research (IJITR), Volume: 4, Issue: 5, August 2016, pp. 3776-3779, ISSN 2320 – 5547.
4. Nandeesh K C and Geetha K, “ Comparative study of hyperbolic circular diagrid steel structure rehabilitated at core with shear wall and steel braced frames”,International Journal of research in Engineering and technology (IJRET), Volume: 05, Issue: 07, July 2016, pp. 317- 323, eISSN: 2319-1163, p-ISSN: 2321-7308.
5. Md. Samdani Azad and Syed HazniAbdGani, “Comparative study of seismic analysis of multi-story buildings with shear walls and bracing systems”, International Journal of Advanced Structures and Geotechnical Engineering (IJASGE), Volume: 05, Issue: 03, July 2016 pp. 72-77, ISSN 2319-5347.
6. HarshitaTripathi and SaritaSingla, “Diagridstructural system for RC framed multi-storey building”,International Journal of Scientific & Engineering Research (IJSER), Volume: 7, Issue: 6, June 2016, pp. 356-362, ISSN 2229-5518.
7. PriyankaSoni, PurushottamLalTamarkar and VikkyKumhar, “Structural analysis of multi-storey building of different shear walls location and

heights",International Journal of Engineering Trends and Technology (IJETT), Volume: 32, February 2016.

8. Shubham RKasat, Sanket R Patil, Akshay S Raut and Shrikant RBhuskade, "Comparative study of multi- storey building under the action of shear wall using ETAB software",International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), 2016.
9. Alkuntel C V, Dhimate M V, Mahajan M B, Shevale S Y, Shinde S K and Raskar A, "Seismic analysis of multi-storey building having infill wall, shear wall and bracing",Imperial Journal of Interdisciplinary Research (IJIR), Volume: 02, Issue: 06, 2016, pp. 1522-1524, ISSN: 2454-1362.
10. SaketYadav and VivekGarg, "Advantage of steel diagrid building over conventional building," International Journal of Civil and Structural Engineering Research (ISSN), Volume: 03, Issue: 01, September 2015, pp. 394-406.
11. Anil Baral and Yajdani S K, "Seismic analysis of rc framed building for different positions for shear wall",International Journal of Innovative Research in Science (IJIRSET), volume: 04, Issue: 05, May 2015, pp. 3346-3353, e- ISSN: 2319-8753, p-ISSN: 2347-6710.
12. SuchitaTuppad and Fernades R J, "Optimum location of shear wall in a multi-storey building subjected to seismic behaviour using genetic algorithm",International Research Journal of Engineering and Technology (IRJET), Volume: 02, Issue: 04, 2015, pp. 236- 240, e-ISSN: 295-0056, p-ISSN: 2395-0072.
13. MohdAtif, LaxmikantVairagade and Vikrant Nair, "Comparative study on seismic analysis of multi-storey building stiffened with bracing and shear wall",International Research Journal of Engineering and Technology (IRJET), Volume: 02, Issue: 05, 2015, pp. 1158- 1170, e-ISSN: 2395-0056, p-ISSN: 2395-0072.
14. Rohit Kumar Singh, VivekGarg, Abhay Sharma, "Analysis and design of concrete diagrid building and its comparison",International Journal of Science, Engineering and Technology (IJSET), Volume: 02, Issue; 06,August 2014, pp. 1330-1337, ISSN: 2348-4098.
15. Sanjay Sengupta "Study of shear walls in multi-storied buildings with different thickness and reinforcement percentage for all seismic zones in India",International Journal of Research in Engineering and Technology (IJRET), Volume: 03, Issue: 11, November 2014,pp. 197-204, e-ISSN: 2319-1163, p-ISSN: 2321-7308.
16. Nishith B Panchal and Vinubhai R Patel, "Diagridstructural system: strategies to reduce lateral forces on high-rise buildings",International Journal of Research in Engineering and Technology (IJRET), Volume: 03, Issue: 04, April 2014, pp. 374-378.