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Comparative study on seismic analysis of square and rectangular building with varying heights

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Abstract

The goal of this research is to investigate the seismic behaviour of square and rectangular RC framed constructions of various heights. The study's main goal is to investigate the seismic performance of square and rectangle framed buildings when subjected to combined loads. Only square and rectangular RC framed commercial buildings with G+10, G+20, and G+30 storeys that are located in seismic zone V are included for comparison in this study. The analytical methods employed are equivalent static and linear dynamic. For modelling RC framed buildings, the loading calculations were done according to codal regulations, namely IS:1893(Part I) – 2002, IS:875 (Part III) – 1987, and IS:456 – 2002. On the basis of storey drift, storey shear, storey stiffness storey displacements, storey drift, and overturning moments, the results of seismic analysis in Zone V are compared with square and rectangular buildings using ETABS.

Keywords: Equivalent static method, Linear dynamic method, ETABS.

I.INTRODUCTION

1.1 GENERAL

A structure is made up of a number of different components that are linked in such a manner that the structure can resist the forces that are applied to it. These loads may be caused by earthquakes, wind, gravity, impact, temperature, and a variety of other environmental factors. The built environment is where structures are created. Buildings, bridges, tunnels, storage tanks, highways, and other structures are examples of structures. The discipline of structural engineering is concerned with identifying the loads that a structure may encounter over the course of its entire life, determining a suitable arrangement of structural members, selecting the material and dimensions of the members, defining the assembly process, and finally monitoring the structure while it is being assembled and possibly also over its lifetime. Each structure may be classified based on its specific purpose and component arrangement. When planning or analysing the soundness of a structure, a structural engineer must address this essential problem. The most pressing concern is avoiding failure, particularly a catastrophic failure. Instability is the most common mechanism of failure, followed by material failure and bucking of individual structural components.

1.2 GEOMETRY

The overall geometry of the structure, which comprises a) Plan form, b) Plan aspect ratio, and c) Slenderness ratio, has a considerable impact on the creation of forces based on fundamental oscillatory motion and the ultimate transmission of force via the foundation.

a)Building Shape: Buildings with a former plan shape have direct load channels for transmitting seismic inertia forces to their foundations, but those with a later plan shape need indirect load paths, resulting in stress concentrations where load lines curve. Buildings with convex and simple plan geometries are favoured over those with concave and complicated plan geometries because they perform better in earthquakes.

Rectangular or square columns are excellent at resisting shear and bending moments at axes parallel to their sides in buildings of various forms but the same plan area. Since a result, it is critical that structures oscillate largely along their sides' translation along diagonals, as torsional movements are detrimental to column seismic performance. Further, in a regular structure, the first few modes of oscillation determine the entire motion, with the basic mode being the most important. As a result, pure translation modes at the upper tiers are preferred. These unfavourable modes first appear when there is a lack of symmetry in the plan form of structures, as well as their sides. Buildings with a regular plan form are preferable.

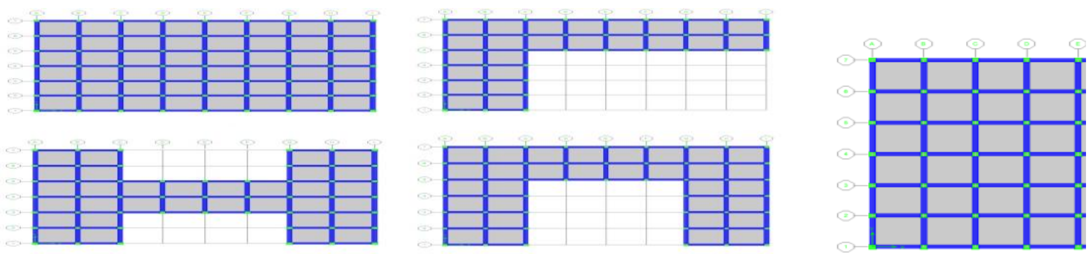

Fig 1.1 Different Plan Shapes

b) Plan Aspect RatioStructures with enormous plan aspect ratios, especially buildings with large projections, are not ideal. During earthquake shaking, the building's inertia force is activated, which is normally at the floor levels with the most mass. After that, the inertia force is divided among several lateral load resisting devices. This lateral inertia force should be distributed according to the lateral load resisting capacity of the different lateral load resisting systems. This is done when the horizontal layout of the floor slabs does not distort too much. The rigid diaphragm action occurs when the floor slab assists in transferring the inertia force to various lateral load resisting systems in accordance to their stiffness. In structures with a large plan aspect ratio, the floor slabs may not offer stiff diaphragm action.

c) Slenderness Ratio: Having a building with a high slenderness ratio is undesirable, just as having a structure with broad projecting arms and a high plan aspect ratio is. Buildings move laterally during earthquake shaking, and excessive lateral displacement is undesirable. Large lateral displacements produce non-structural damage, structural damage, and even second order P-delta effects, which may result in structure collapse. Inter-storey drift under design earthquake pressures should be limited to 0.4 percent of storey height, according to design guidelines.

1.3 CHARACTERISTCS OF BUILDINGS

A building's earthquake-resistant design is based on four parts of the structure that architects and design engineers concentrate on. They are: a) Seismic structural configuration, which includes the building's geometry, form, and scale. Convex-shaped buildings have direct load paths for transferring earthquake-induced inertia forces to their bases in any direction of ground shaking, whereas concave buildings require bending of load paths for ground shaking in certain directions, resulting in stress concentrations at all points where the load paths bend. Buildings are often divided into two categories: basic and complicated. When compared to buildings with setbacks and central openings, those with rectangular layouts and straight elevations have the highest chance of surviving an earthquake.

b) Structural stiffness, strength, and ductility- Lateral stiffness is the structure's initial stiffness, despite the fact that the stiffness of the building decreases as damage increases. The highest resistance that the building gives over its whole history of resistance to relative deformation is referred to as lateral strength. The ratio of lateral deformation to yield deformation is referred to as ductility.

c) Effect of building height-As the height of the building falls, the mass of the structure drops, and the stiffness increases. As a result, the length of the increases as one grows taller. The natural time period will be longer for taller buildings than for lower ones.

1.4 DYNAMIC ACTIONS ON BUILDINGS

Wind and earthquakes can create dynamic movements on structures. However, the wind and earthquake forces are designed differently. The wind force acting on the building has a non-zero mean component and a tiny oscillation component. Thus, the structure may suffer modest oscillations in the stress field due to wind forces, but stress reversal happens only over a long period of time. The ground, on the other hand, moves in a cyclic pattern around the structure's neutral position during an earthquake. As a result, the stresses in the structure caused by seismic events undergo several full reversals throughout the short length of the earthquake. Normal structures should be able to withstand a) Inferior shaking with minimal damage to structural and non-structural materials, according to the earthquake resistant design philosophy.

b) Moderate shaking with less structural and non-structural damage.

c) Severe tremors, with structural parts damaged but no collapse.

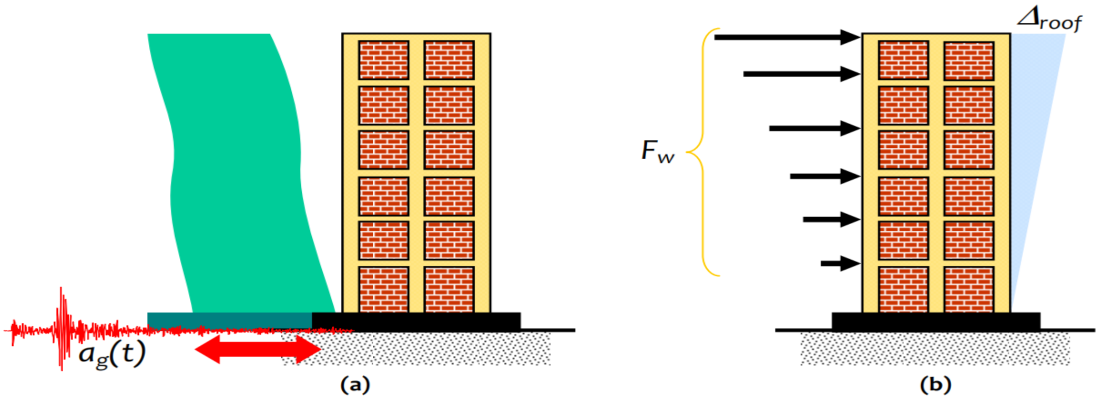

Fig1.2 a) Earthquake ground movement at base b) Wind pressure at exposed area

1.5 Objectives

Principle Objectives of the present study is

1. Under combined loads, compare the seismic behaviour of square and rectangle framed buildings.
2. The study is performed for G+10, G+20, and G+30 for square and rectangular structures.
3. For storey drift, storey displacements, storey shear, overturning moments, storey stiffness, and modal participation ratios, the results of seismic analysis in Zone V are compared to square and rectangular buildings.

II. LITERATURE REVIEW

Dr.Shaik Yajdani[1] and Girum Mindaye examined the seismic analysis of a multistory RC frame structure in various seismic zones. ETABS software is used to analyse the seismic response of a residential G+10 RC frame construction using the Equivalent static lateral force and Response spectrum methodologies. They came to the conclusion that the lateral force derived from the reaction spectrum is larger than that obtained from Equivalent static lateral force for storeys one through five, while the remainder of the upper levels have lower values. They also stated that the Equivalent static lateral force approach produces greater values of forces and moments, making construction uneconomical, and that the reaction spectrum method should be considered as well.

The major goal of Ali Kadhim sallal's research is to construct and analyse a multistory structure with a height of 31 metres that is simulated using etabs. He determined that the analysis findings of a building's structural integrity in the face of design earthquake loadings were done and found to be safe, and that different outcomes such as bending moments, shear force, and deflection results are comparable to manually computed values.

Mahmad Sabeer and D.Gouse Peera[3] used Staad Pro and Etabs software to compare the design outcomes of RCC buildings. The major goal of their research is to do structural analysis and design. Analysis of regular plan with vertical regular and irregular multi storey building using static analysis technique and comparison of simulation implements staad pro and etabs They found that when they compared the findings of the staad pro and etabs software, the results were inconsistent and difficult to interpret. In comparison to staad pro, etabs provided a less amount of necessary steel.

III.METHODOLOGY

3.1 INTRODUCTION TO ETABS SOFTWARE

EABS is a three-dimensional analysis and design application that has been designated as the industry standard for building analysis and design. This programme is used by engineers for structural design and multi-story building analysis, as well as for preliminary to advanced systems under dynamic and static situations. The load application is based on a variety of codes, model tools, and different templated, as well as diverse analysis systems and solution methodologies. The grid kind of construction is what distinguishes the geometry. This programme is also utilised for specialised earthquake behaviour evaluation, modelling, and direct interaction of time history analysis with P-Delta and big displacement performance.

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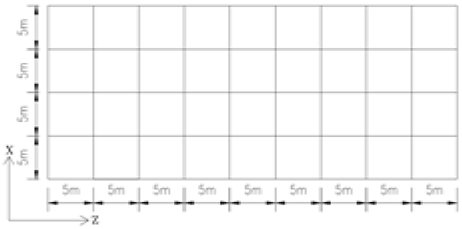
3.2 GENERATION OF MODEL

Table no.1 Generation of model

Plan type	Direction	Length of span	Number of spans
Square	X- direction	5m	6
	Y- direction	5m	6
Rectangle	X- direction	5m	4
	Y- direction	5m	9

In the present study, we have considered the area of square building plan as 30mX30m and rectangular building plan as 45mX20m. And also, the story height building is increased from G+10, G+20, G+30.



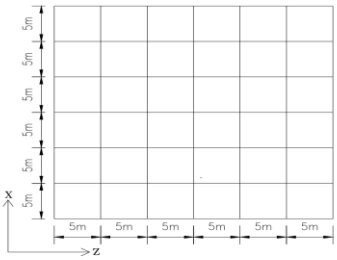


Fig 3.1 Square **Fig 3.1** Rectangular Plan

3.3 Variation of Heights

Due to different variation of heights in buildings. Short structures are more affected by high frequency seismic waves and high raise structures are more affected by low frequency seismic waves.

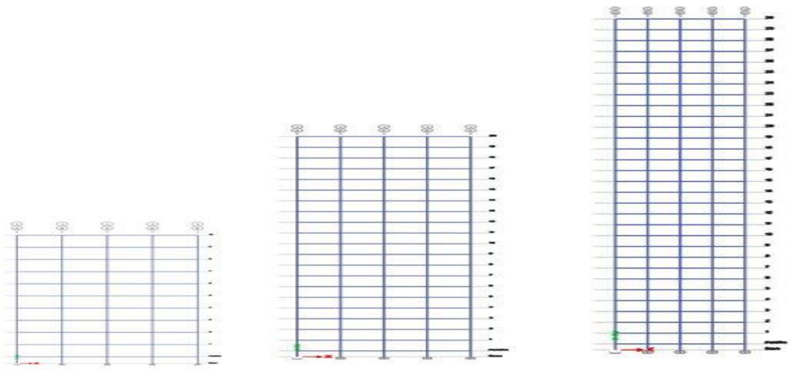


Fig 3.3 G+10, G+20, G+30 Building's elevation

3.4 Structural Parameters

3.4.1 Grade of concrete:

Concrete mixes are graded according to their particular crushing strength measured in standard size cubes after 28 days, i.e., the grade of concrete corresponds to its compressive strength. We used M35 as the normal concrete grade for this job.

3.4.2 Grade of steel:

Steel yield strength is used as an example. Specific yield strength is defined as characteristic yield strength, according to IS 456:2000. (fy). In this project, we used Fe550 steel as the grade of steel.

3.5. Member properties:

Member Properties of Structure				
Floor bifurcation	**Size of column**		**Size of beam**	
	x-direct., m	z-direct., m	x-direct., m	z-direct., m
Foundation - ground floor	0.6	0.6	0.35	0.5
1st - 30th floor	0.5	0.5	0.35	0.5

Table no 3.1 Member Properties of structure

Thickness of slab = 0.15m

3.6 Supports:

The base supports of the structure were assigned as **fixed**. The supports were generated using the ETABS software generator.

3.7 Load cases:

The load scenarios were developed in part manually and in part using the ETABS load generator. Dead load, Live load, Wind load, Seismic load, and Load combinations were used to characterise the loading scenarios.

IV.RESULTS AND DISCUSSIONS

4.1 GENERAL

The structural variance between square and rectangular structures, as well as height variations for G+10, G+20, and G+30 buildings, were investigated in this research. Maximum shear force, bending moments, and maximum deformations have been calculated, as have dynamic analysis characteristics such as maximum storey drift, maximum shear, maximum displacements, maximum stiffness, storey shear, centre of mass, and rigidity. The following graphs and tables show the comparison of parameters for square and rectangular structures.

4.2 Parameters for static analysis

4.2.1 The shear force is the algebraic total of all forces, including reactions operating normal to the axis of the beam from either the left or right of the section. The values are presented below, with the results collected from each beam for each storey. For G+10, G+20, and G+30 structures, the shear values are highest at the top stories, and as the storey height drops, the shear values decrease as well.

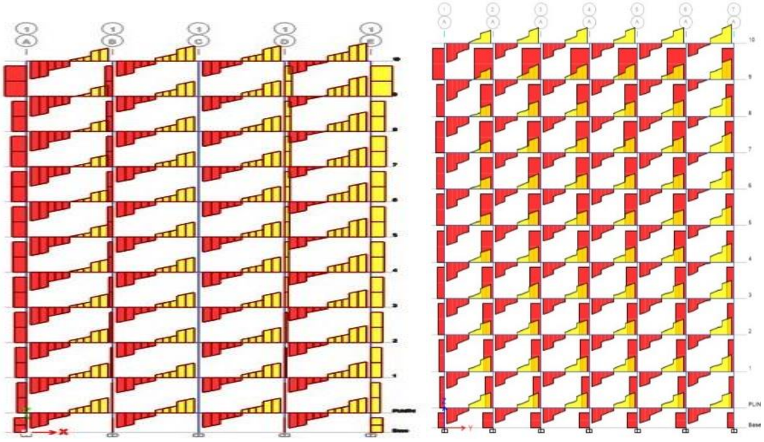


Fig4.1 Shear Force Diagrams of Square and Rectangular for G+10 Story building.

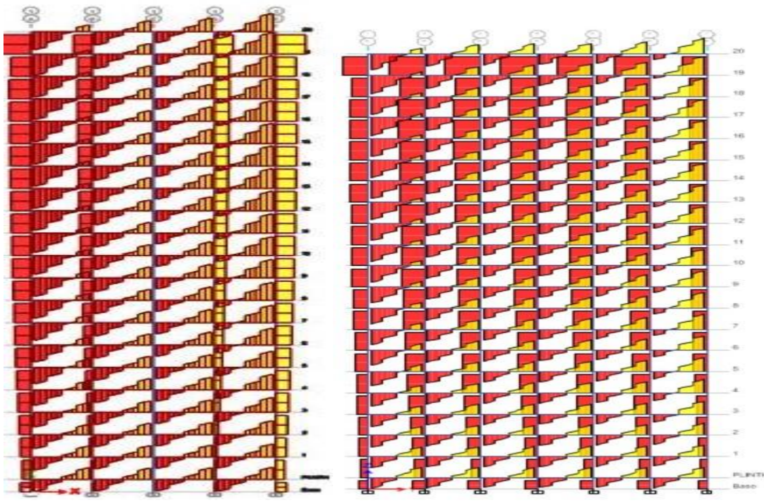


Fig4.2 Shear Force Diagrams Square and Rectangular for G+20 Story building.

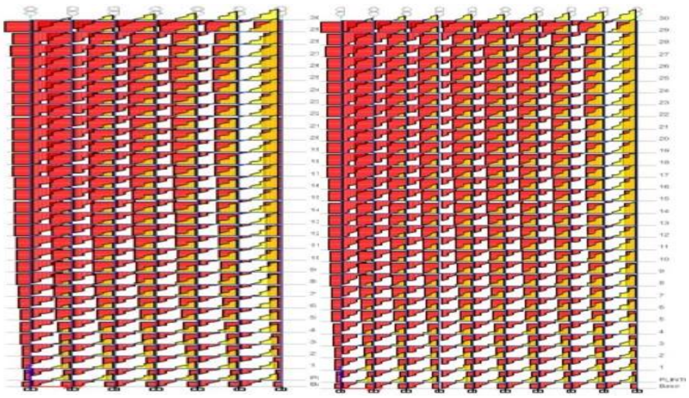


Fig4.3 Shear Force Diagrams Square and Rectangular for G+30 Story building.

Table 4.1 Shear force for G+10, G+20, G+30 story building

SHEAR FORCE						
G+10 Building			G+20 Building		G+30 Building	
BEAMS	SQ	REC	SQ	REC	SQ	REC

1	-15.613	-14.34	-24.68	-24.37	-30.98	-29.63
25	-10.28	-9.78	-16.71	-16.48	-21.24	-20.23
49	-11.06	-10.63	-18.05	-17.81	-22.93	-21.87
73	-10.57	-9.87	-17.61	-17.37	-22.5	-21.46
97	-10.3	-9.73	-17.44	-17.21	-22.44	-21.41
121	-9.75	-8.54	-17.17	-16.95	-22.28	-21.26
145	-9.19	-8.2	-16.86	-16.65	-22.11	-21.11
169	-8.5	-7.6	-16.5	-16.3	-21.91	-20.93
193	-7.83	-6.7	-16.1	-15.9	-21.69	-20.73
217	-6.73	-5.3	-15.63	-15.45	-21.43	-20.51
241	-8.65	-7.75	-15.1	-14.94	-21.15	-20.25
265			-14.53	-14.37	-20.84	-19.97
289			-13.88	-13.74	-20.5	-19.66
313			-13.17	-13.05	-20.12	-19.31
337			-12.39	-12.29	-19.71	-18.94
361			-11.54	-11.45	-19.26	-18.53
385			-10.61	-10.53	-18.77	-18.08
409			-9.58	-9.52	-18.24	-17.59
433			-8.53	-8.49	-17.67	-17.06
457			-7.04	-7.03	-17.04	-16.48
481					-16.37	-15.85
505					-15.64	-15.17
529					-14.86	-14.44
553					-14	-13.64
577					-13.1	-12.78
601					-12.1	-11.85
625					-11.06	-10.84
649					-9.9	-9.7
673					-8.7	-8.6
697					-7.13	-7.01

4.2.2 Bending moment: It's the algebraic sum of all the moments around the section of all the forces operating on the beam, from either the left or right side. The values are presented below, with the results collected from each beam for each storey. For G+10, G+20, and G+30 structures, the bending moment values are highest at the top floors, and as the storey height drops, the bending moment values decrease as well.

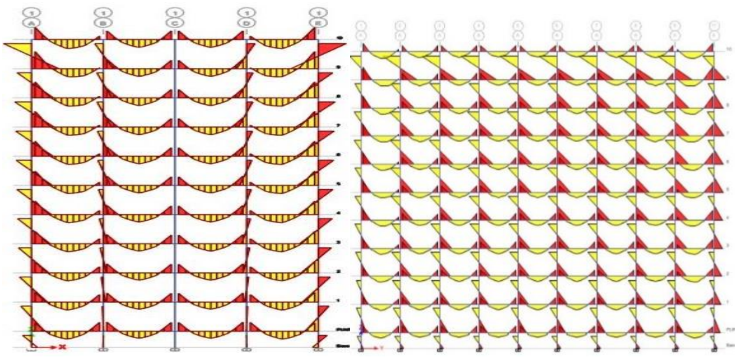


Fig4.4 Bending Moment Diagrams Square and Rectangular for G+10 Story building.

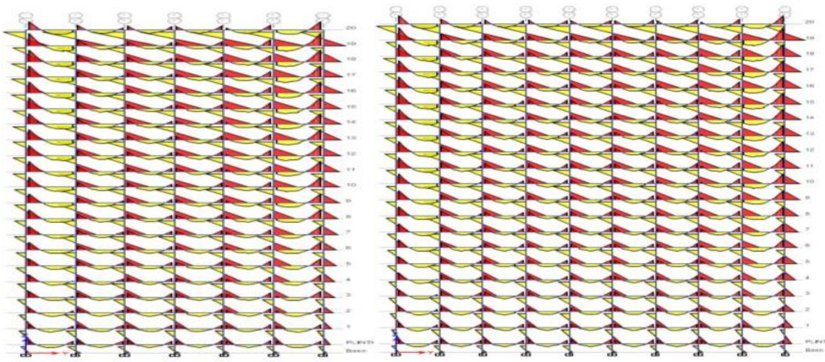


Fig 4.5 Bending Moment Diagrams Square and Rectangular for G+20 Stoy building.

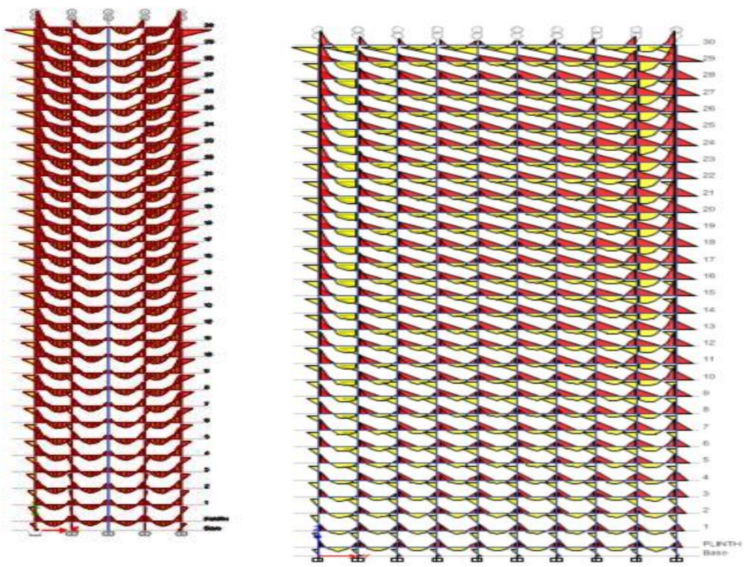


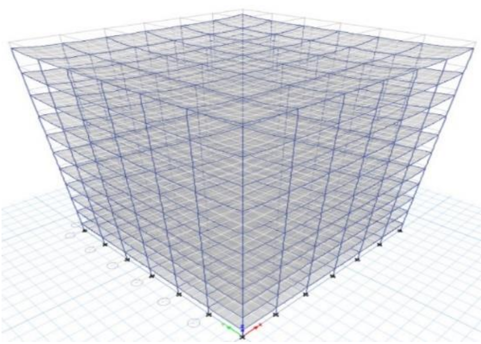
Fig 4.5 Bending Moment Diagrams Square and Rectangular for G+30 Story building.

Table 4.2 Bending moments for G+10, G+20, G+30 story building

BENDING MOMENTS								
G+10 Building			**G+20 Building**			**G+30 Building**		
BEAM	**SQ**	**REC**	**BEAM**	**SQ**	**REC**	**BEAM**	**SQ**	**REC**
1	14.01	13.75	401	38.25	37.75	515	47.81	45.8

2	12.49	11.56	402	20.62	20.32	516	26.25	24.98
3	12.68	11.75	403	23.73	23.41	517	30.1	28.71
4	12.58	11.74	404	22.91	22.6	518	29.24	27.89
5	12.57	11.77	405	22.76	22.48	519	29.22	27.88
6	12.54	11.39	406	22.41	22.12	520	29.01	27.69
7	12.49	11.97	407	22.03	21.75	521	28.8	27.5
8	12.44	11.47	408	21.58	21.31	522	28.55	27.27
9	12.38	11.82	409	21.08	20.8	523	28.27	27.05
10	12.33	11.29	410	20.48	20.23	524	27.95	26.73
			411	19.82	19.59	525	27.59	26.41
			412	19.08	18.87	526	27.2	26.05
			413	18.26	18.08	527	26.76	25.66
			414	17.36	17.19	528	25.19	25.23
			415	16.37	16.23	529	24.57	24.74
			416	15.29	15.16	530	23.89	24.22
			417	14.1	14	531	23.16	23.65
			418	12.8	12.72	532	22.36	23.03
			419	11.43	11.36	533	21.5	22.35
			420	9.77	9.74	534	20.58	21.62
						535	19.58	20.82
						536	18.5	18
						537	17.35	16.9
						538	16.07	15.71
						539	14.72	14.43
						540	13.26	13.04
						541	11.72	11.54
						542	9.92	9.84
						543	7.8	7.85
						544	6.9	5.1

4.2.4 Structural deformation



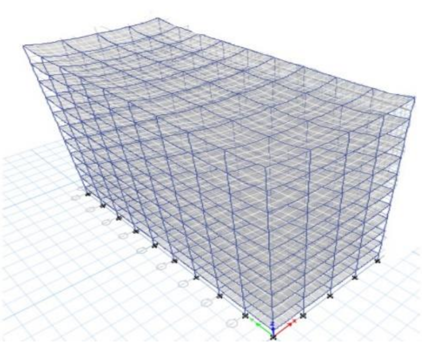


Fig4.9 Structural deformation of Square and Rectangular for G+10 Story building

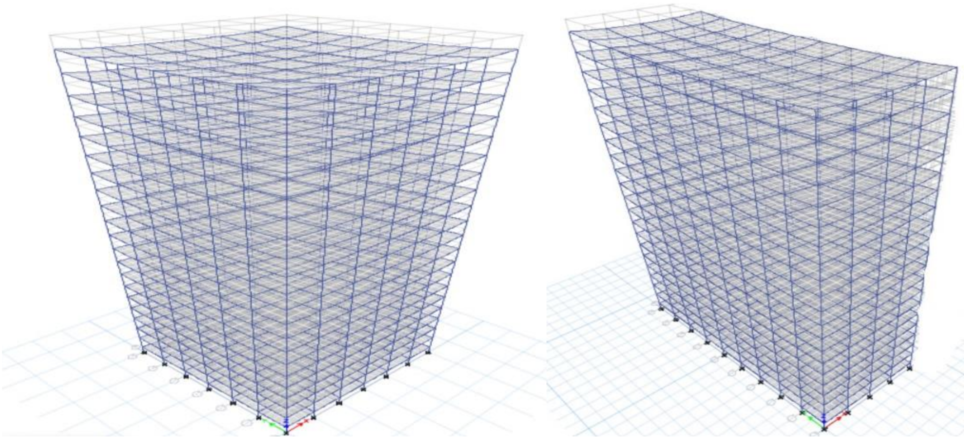


Fig4.10 Structural deformation of Square and Rectangular for G+20 Story building

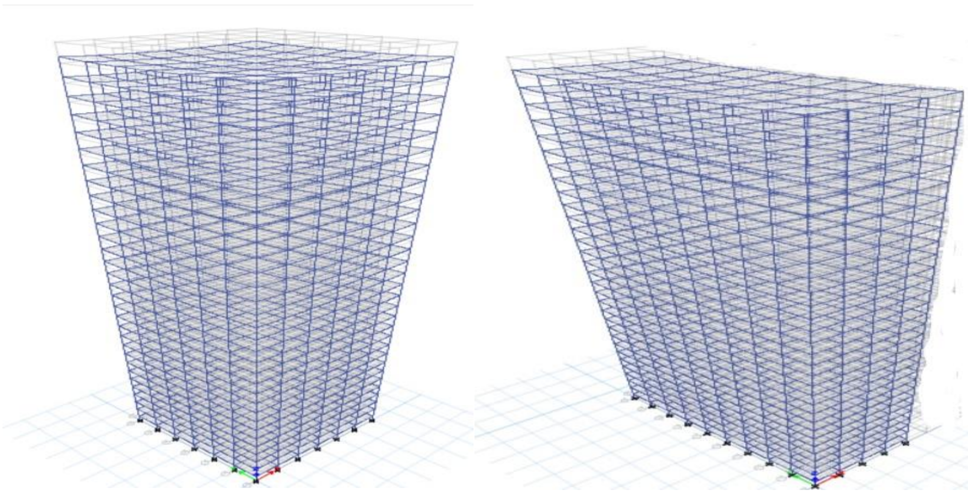


Fig4.11. Structural deformation of Square and Rectangular for G+30 Story building

4.3 Dynamic analysis parameters

4.3.1 Maximum storey displacements:

It is the displacement of the storey with respect to base when subjected to ground motion. It has been decreased for Rectangular structure compared to Square structure. With increase in storeys of the building, the displacement increases.

Table 4.4 Comparison of Storey Displacements for G+10, G+20, G+30

STOREY DISPLACEMENT									
G+10 Building				G+20 Building			G+30 Building		
STORY	SQ	REC	% (dec)	SQ	REC	% (dec)	SQ	REC	% (dec)
PLINTH	0	0		0	0		0	0	
STORY 1	45.25	38.1	16%	45.96	38.74	16%	46.27	39.24	15%

STORY 2	89.07	75.29	15%	91.61	77.67	15%	92.64	79.177	15%
STORY 3	131.7	111.7	15%	138.02	117.58	15%	140.4	120.76	14%
STORY 4	171.5	145.8	15%	184.18	157.58	14%	188.6	163.22	13%
STORY 5	207.5	176.8	15%	229.69	197.3	14%	237	206.33	13%
STORY 6	238.9	204	15%	274.26	236.46	14%	285.5	249.9	12%
STORY 7	265	226.8	14%	317.6	274.8	13%	333	293.7	12%
STORY 8	285.2	244.6	14%	359.05	312	13%	382.1	337.8	12%
STORY 9	299	257	14%	399.55	348.07	13%	429.8	381.85	11%
STORY 10	306.6	264.2	14%	437.66	382.54	13%	477.7	425.73	11%
STORY 11				473.56	415.28	12%	523.5	469.34	10%
STORY 12				507.02	446.07	12%	569.1	512.52	10%
STORY 13				537.84	474.74	12%	613.8	555.15	10%
STORY 14				565.83	501.08	11%	657.3	597.09	9%
STORY 15				590.8	524.94	11%	699.6	638.21	9%
STORY 16				612.6	546.15	11%	740.6	678.4	8%
STORY 17				631.06	564.5	11%	780.1	717.53	8%
STORY 18				646.07	580.04	10%	818	755.48	8%
STORY 19				657.53	592.52	10%	854.2	792.15	7%
STORY 20				665.73	602.22	10%	888.7	827.41	7%
STORY 21							921.2	861.17	7%
STORY 22							951.7	893.3	6%
STORY 23							980.1	923.7	6%
STORY 24							1006	952.42	5%
STORY 25							1030	979.18	5%
STORY 26							1052	1004	5%
STORY 27							1071	1026.7	4%
STORY 28							1088	1047.4	4%
STORY 29							1102	1065.9	3%
STORY 30							1115	1082.42	3%

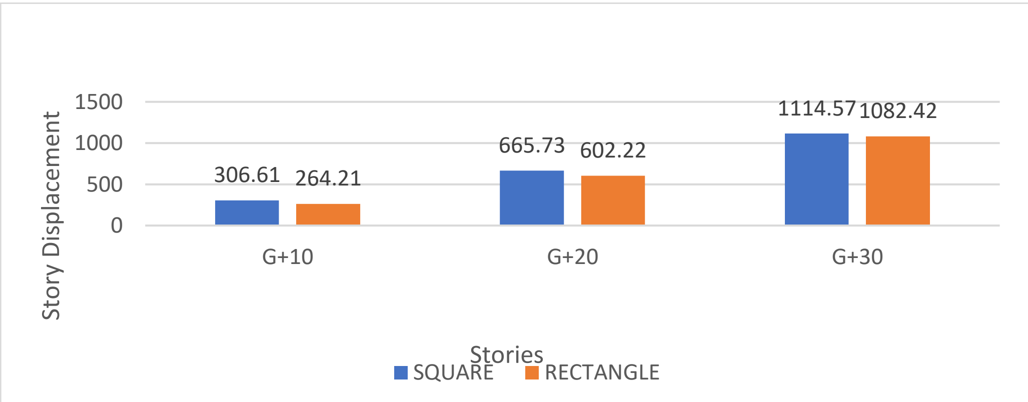


Fig 4.12 Storey Displacements

4.3.2 Maximum storey drift

Story drift is ratio of the story displacement of consecutive floors. The story drift was decreased for rectangular structure compared to Square structure which has exceeded the permissible limit of 0.012.

Table 4.5 Comparison of Storey Drift for G+10, G+20, G+30

STORY DRIFT									
	G+10 Building			G+20 Building			G+30 Building		
STOREY	SQ	REC	%(dec)	SQ	REC	%	SQ	REC	%(dec)
PLINTH	0	0		0	0		0	0	
STOREY 1	0.011	0.009	16%	0.013	0.009	28%	0.011	0.009	16%
STOREY 2	0.012	0.01	14%	0.013	0.011	16%	0.013	0.011	14%
STOREY 3	0.012	0.01	15%	0.013	0.011	14%	0.013	0.012	13%
STOREY 4	0.011	0.01	14%	0.013	0.011	12%	0.013	0.012	12%
STOREY 5	0.011	0.009	22%	0.012	0.011	11%	0.013	0.012	11%
STOREY 6	0.009	0.008	14%	0.012	0.011	12%	0.013	0.012	10%
STOREY 7	0.007	0.006	12%	0.012	0.011	12%	0.013	0.012	10%
STOREY 8	0.006	0.005	12%	0.012	0.01	10%	0.013	0.012	10%
STOREY 9	0.004	0.004	10%	0.011	0.01	11%	0.013	0.012	10%
STOREY 10	0.002	0.002	5%	0.011	0.01	9%	0.013	0.012	8%
STOREY 11				0.01	0.009	8%	0.013	0.012	5%
STOREY 12				0.009	0.009	9%	0.013	0.012	5%
STOREY 13				0.009	0.008	7%	0.012	0.012	2%
STOREY 14				0.008	0.007	6%	0.012	0.012	2%
STOREY 15				0.007	0.007	6%	0.011	0.012	-6%
STOREY 16				0.006	0.006	3%	0.011	0.012	-5%
STOREY 17				0.005	0.005	0%	0.011	0.011	-2%
STOREY 18				0.004	0.004	2%	0.01	0.011	-10%
STOREY 19				0.003	0.004	-9%	0.01	0.01	-1%
STOREY 20				0.002	0.003	-17%	0.009	0.01	-10%
STOREY 21							0.009	0.01	-6%
STOREY 22							0.008	0.009	-14%
STOREY 23							0.008	0.009	-8%
STOREY 24							0.007	0.008	-16%
STOREY 25							0.006	0.008	-25%
STOREY 26							0.006	0.007	-17%
STOREY 27							0.005	0.006	-28%
STOREY 28							0.004	0.006	-45%
STOREY 29							0.004	0.005	-30%
STOREY 30							0.003	0.005	-53%

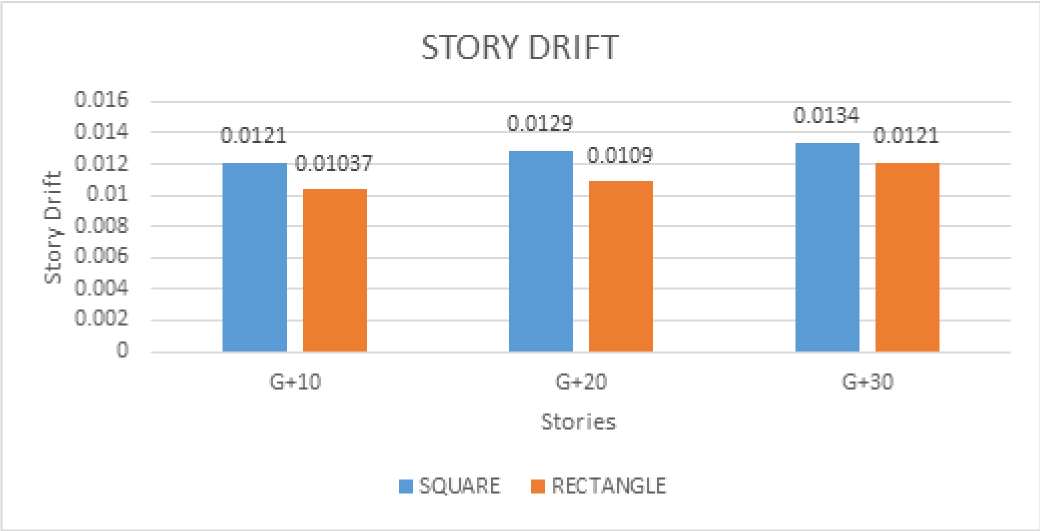


Fig 4.12 Storey Drift

4.3.6 Mode shapes

Mode shape of oscillation is combination of natural period of building with deformed shape of the building when shaken at the natural period. Therefore, a building consists of many mode shapes as number of natural periods. Regular buildings have pure mode shapes and irregular buildings have mode shape combination with pure mode shapes. The overall response of building is summation of responses of all its modes.

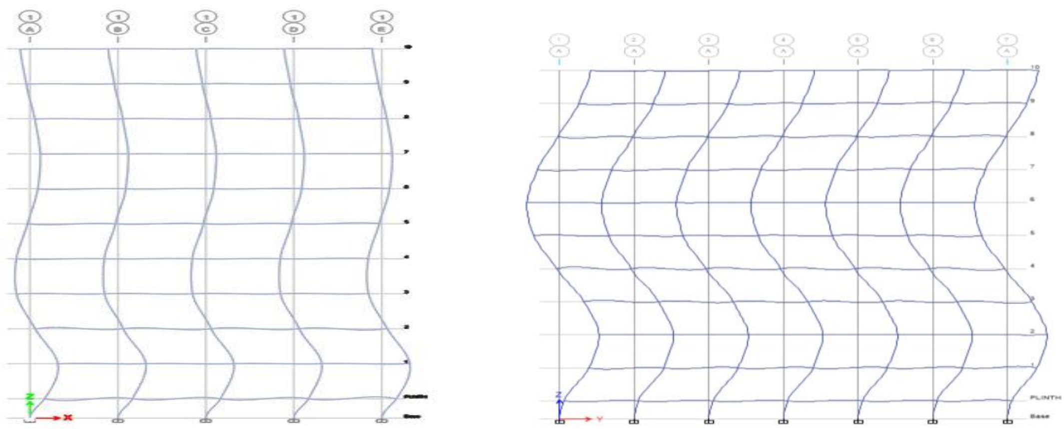


Fig4.16 Mode shapes for Square and Rectangular for G+10 Storey building

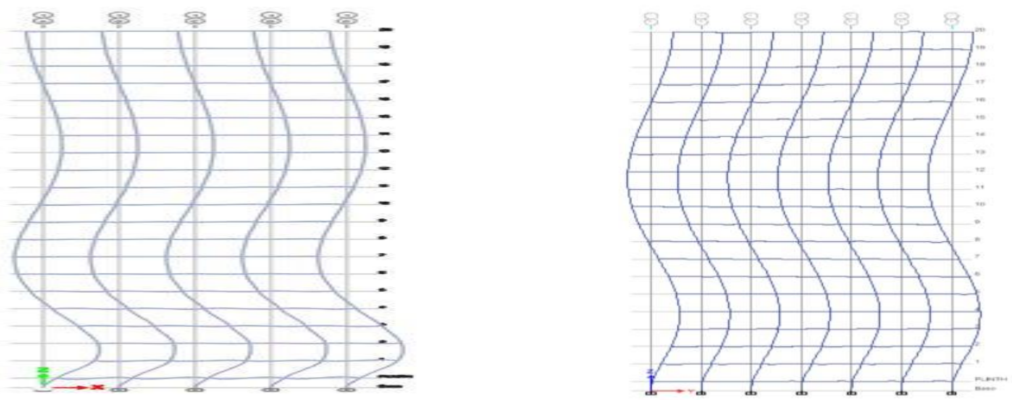


Fig4.17 Mode shapes for Square and Rectangular for G+20 Story building

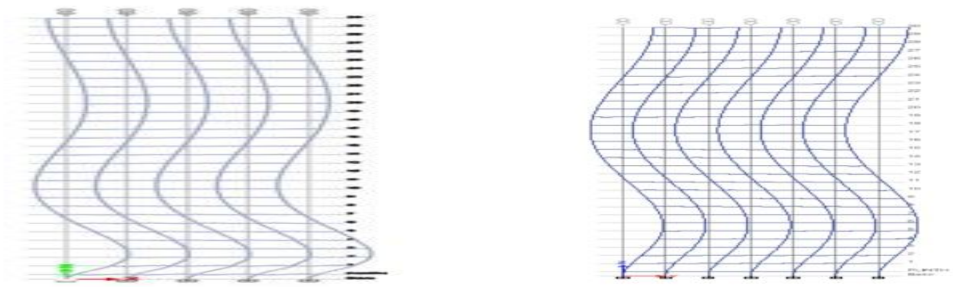


Fig4.18 Mode shapes for Square and Rectangular for G+30 Story building

4.3.7 Mass participation ratios

Table 4.8 Mass Participating Ratios of square G+10, G+20, G+30 story buildings

Mass Participating Ratios for Square Building											
G+10 Story				**G+20 Story**					**G+30 Story**		
MODE	**UX**	**UY**	**RZ**	**MODE**	**UX**	**UY**	**RZ**	**MODE**	**UX**	**UY**	**RZ**
1	0.77	0	0	1	0.78	0	0	1	0.77	0	0
2	0	0.77	0	2	0	0.78	0	2	0	0.77	0
3	0	0	0.78	3	0	0	0.79	3	0	0	0.79
4	0.09	0	0	4	0.10	0	0	4	0.11	0	0
5	0	0.09	0	5	0	0.10	0	5	0	0.11	0
6	0	0	0.09	6	0	0	0.09	6	0	0	0.09
7	0.04	0	0	7	0.04	0	0	7	0.04	0	0
8	0	0.04	0	8	0	0.04	0	8	0	0.04	0
9	0	0	0.04	9	0	0	0.04	9	0	0	0.04
10	0.05	0	0	10	0.04	0	0	10	0.04	0	0
11	0	0.05	0	11	0	0.04	0	11	0	0.04	0
12	0	0	0.05	12	0	0	0.04	12	0	0	0.04
SUM	0.96	0.96	0.96	SUM	0.96	0.96	0.96	SUM	0.96	0.96	0.97

Table 4.9 Mass Participating Ratios for rectangular G+10, G+20, G+30 story buildings

Mass Participating Ratios for Rectangular Building											
G+10 Story				G+20 Story					G+30 Story		
MODE	UX	UY	RZ	MODE	UX	UY	RZ	MODE	UX	UY	RZ
1	0.77	0	0	1	0.77	0	0	1	0.76	0	0
2	0	0.77	0	2	0	0.78	0	2	0	0.78	0
3	0	0	0.77	3	0	0	0.78	3	0	0	0.78
4	0.10	0	0	4	0.11	0	0	4	0.12	0	0
5	0	0.09	0	5	0	0.10	0	5	0	0.10	0
6	0	0	0.09	6	0	0	0.10	6	0	0	0.10
7	0.04	0	0	7	0.04	0	0	7	0.04	0	0
8	0	0.04	0	8	0	0.04	0	8	0	0.04	0
9	0	0	0.04	9	0	0	0.04	9	0	0	0.04
10	0.05	0	0	10	0.04	0	0	10	0.04	0	0
11	0	0.05	0	11	0	0.04	0	11	0	0.04	0
12	0	0	0.05	12	0	0	0.04	12	0	0	0.04
SUM	0.96	0.96	0.96	SUM	0.96	0.96	0.96	SUM	0.96	0.96	0.96

V.CONCULSIONS

1. When rectangular model buildings are compared to square model structures, seismic metrics such as storey shear, storey displacements, storey drift, and overturning moments decrease.

2. When a rectangle model building is compared to a square model structure, the storey stiffness rises.

3. It was discovered that when the storey height increased, the values of seismic parameters dropped for all of the models studied.

4. Because of the particular and nonlinear distribution of force, static analysis is insufficient for seismic zone areas with high-rise structures, and dynamic analysis is required.

5. When compared to square buildings, rectangle structures are more efficient.

5.1 Future scope of the present study

i. The research may be expanded by designing for all three different heights.

ii. While the current research is limited to frame-resisting models, it may be expanded in the future by include seismic-resistant structures such as shear walls and dampers.

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