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Torsion Analysis of RCC Symmetric and Asymmetrical Building Using Different Analysis Method

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ABSTRACT -It is very essential to identify the behavior and damages of buildings, which initiate at locations of the structural weak planes present in the building systems, due to various shape of building i.e., Rectangular, Square, L-Shape And T- Shape building. The contribution of lateral load resisting system, number of stories, type and different type of analysis method has to be properly assessed and evaluated in order to avoid torsional effect and collapse of the structure. The behavior of building during earthquake depends critically on its overall shape, size and geometry. The aim of present study is to compare seismic performance of Equivalent Static Method, Response Spectrum Analysis Method using medium soil. The G+24 story structures situated in earthquake zones III. All frames are designed under same gravity loading. Response spectrum method is used for seismic analysis. ETABS software is used and the results are compared.

The results were obtained in the form of Earthquake Displacement, Story Force, Base Shear and Modal Mass Participations.

Key Words: ETABS, Earthquake Load, Torsion, Response Spectrum, Push Over Modal Mass Participation.

I. INTRODUCTION

Most recent earthquakes have shown that the irregular distribution of mass, stiffness and strengths may cause serious damage in structural systems Due to several reasons structures acquire asymmetry. Asymmetry in structures makes analysis of the seismic behavior very complicated. Seismic demand in peripheral elements is enhanced. Uniformity in load distribution gets disturbed. Torsional behavior of asymmetric building is one of the most frequent causes of structural damage and failure during strong ground motions Torsion responses in structures arise from two sources: Eccentricity in the mass and stiffness distributions, causing a torsion response coupled with translation response; and torsion arising from accidental causes, including uncertainties in the masses and stiffness, the differences in coupling of the structural foundation with the supporting earth or rock beneath and wave propagation effects in the earthquake motions that give a torsion input to the ground, as well as torsion motions in the earth itself during the earthquake.

1.1 Research Objectives

Based on the literature review presented in Chapter, the salient objectives of the Present study have been identified as follows,

1) Analysis of G+24 story building with IS456-2007 Design of Concrete structure using ETABS 2016.
2) To study behavior of RCC building G+24 story with different shape of plan using equivalent statics method and response spectrum method.
3) To study the effect torsional analysis of symmetrical and asymmetrical building, study on the influence of the torsional moment effects on the behavior of structure is done by using Response spectrum method.

1.2 Methodolgy

The study will give more knowledge which result into benefits for future implementation with the help of RCC building actual design. To study the effect of shape and position of shear wall on structural behavior.

1.Equivalent Statics Analysis

Equivalent Static Analysis is done according to IS 1893:2016 part 1:Along any principal direction, the total design lateral force or design base shear is given in terms of design horizontal seismic coefficient and seismic weight of the structure.

2.Response Spectrum Method

A response spectrum is simply a plot or steady-state response (displacement, velocity or acceleration) of a series of oscillators of varying natural frequency that are forced into motion by same base vibration. The resulting plot can then be used to pick off the response of any linear system, given its natural frequency of oscillation. One such use is in assessing the peak response of building to earthquake. The science of strong ground motion may use some values from the ground response spectrum for correlation with seismic damage. In technical terms it can be said that it is the representation of the maximum response of idealized single degree of freedom having certain period and damping during earthquake ground motion. The maximum response is plotted against the undammed natural period and for various damping values can be expressed in terms of maximum relative velocity or maximum relative displacement. The characteristics of seismic ground vibrations expected at any location depends upon the magnitude of earthquake, its depth of focus, distance from the epicenter, characteristics of the path through which the seismic waves travel, and soil strata on which the structure stands. The random earthquake ground motions, which cause the structure to vibrate, can be resolved in any three mutually perpendicular directions.

II. PROBLEM FORMULATION

Multistoriedferroconcrete, moment defying space frame are anatomized using professional.softw areETABS2016. Model G+24of erecting frame witht hree kudos in vertical andthree kudos in side directio n is anatomized by Response spectrum method.The p lan confines of structures are shown in table below.T he plan view of structure, elevation of colorful frame s is shown in numbers below.

Table -1: Detail Features of Building G+24 Story

Type of structure	Frame structure
Moment-Resisting frame	SMRF
Type of soil	Medium
No of Stories	G+24
Height of each story	3m
Height of ground story	1.2 m
Thickness of slab	150mm
Thickness of outer wall	150mm
Thickness of inner wall	150mm
Grade of reinforcing steel	Fe 415
Concrete Poisons ratios	0.2
Density of concrete	25 kN/m3
Density of wall	20 kN/m3
Grade of concrete in slab	M35
Response reduction factor	5
Damping	5%
Grade of concrete in beam	M35
Grade of concrete in column	M40
Grade of concrete in footing	M35
Seismic zone	3
Seismic intensity	0.16
Analysis type	Statics and Dynamics Analysis

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Different building shape plan

A. Rectangular shape building

Fig. G+24 Story Rectangular Building Plan

B. Square Shape Building Plan:

Fig. G+24 Story Square Shape Building

C. T-shape building

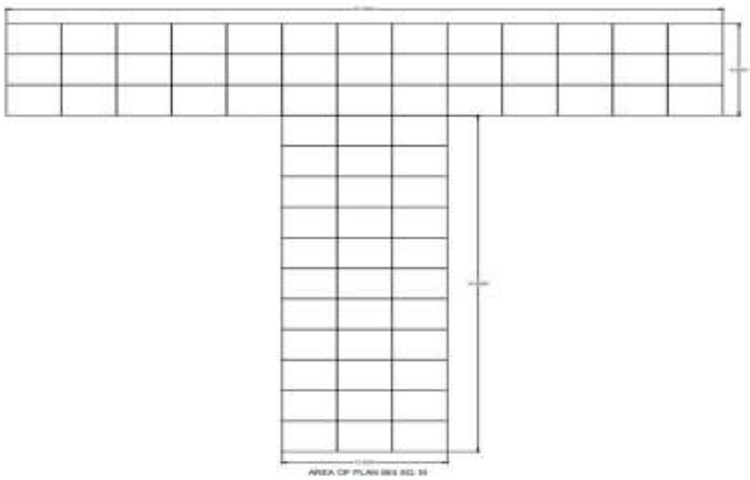

Fig. G+24 Story T-Shape Building Plan

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D. L- Shape Building Plan:

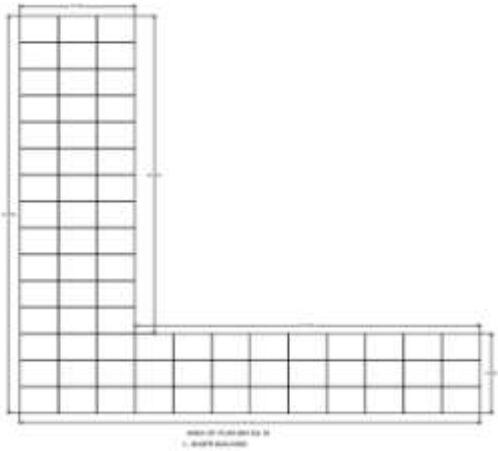


Fig. G+24 Story L- Shape Building

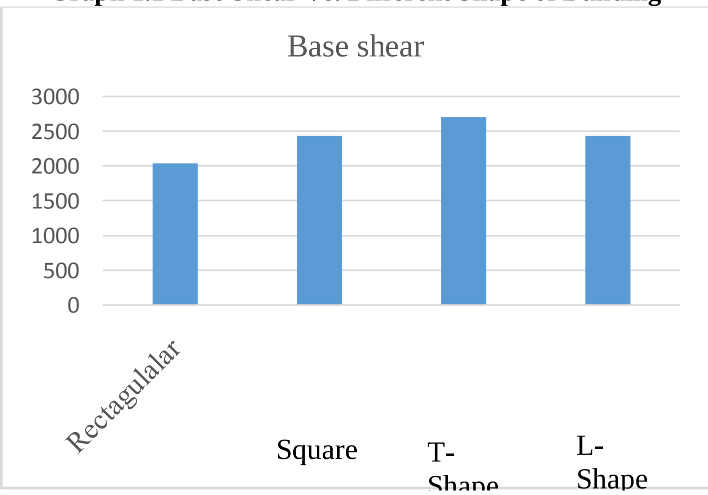
III. RESULTS

i. Base Shear Results

Table 1. Base Shear Different Shape of Building in Equivalent and Response Spectrum Analysis method

TABLE: Load Pattern Definitions - Auto Seismic - IS 1893 2002				
Name	Base Shear (KN)	Base Shear (KN)	Base Shear (KN)	Base Shear (KN)
	Rectangular	Square	T-shape	L-shape
EQ+X	2044.7012	2435.2058	2706.8163	2441.5662
EQ+Y	1623.2175	2321.9512	2356.4383	2336.0909
EQ-X	2044.7012	2435.2058	2706.8163	2441.5662
EQ-Y	1623.2175	2321.9512	2356.4383	2336.0909

Graph 1.1 Base Shear Vs. Different Shape of Building



i. Earthquake Displacement Results

Table 2. Earthquake Displacement Vs. Different Shape of Building in Response Spectrum Analysis Method

TABLE: Diaphragm Center of Mass Displacements					
Story	Load Case/Combo	UX (mm)	UX (mm)	UX (mm)	UX (mm)
		Rect.	Square	T-shape	L-shape

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Story25	EQ+X	39.633	45.59	53.997	44.777
Story24	EQ+X	39.277	45.147	53.157	44.225
Story23	EQ+X	38.73	44.439	52.115	43.494
Story22	EQ+X	37.964	43.441	50.735	42.491
Story21	EQ+X	36.983	42.164	49.031	41.219
Story20	EQ+X	35.805	40.622	47.023	39.693
Story19	EQ+X	34.447	38.808	44.721	37.906
Story18	EQ+X	32.927	37.031	42.45	36.137
Story17	EQ+X	31.263	35.139	40.053	34.256
Story16	EQ+X	29.473	33.123	37.525	32.257
Story15	EQ+X	27.571	30.989	34.869	30.146
Story14	EQ+X	25.575	28.75	32.101	27.935
Story13	EQ+X	23.496	26.418	29.24	25.637
Story12	EQ+X	21.349	24.008	26.31	23.268
Story11	EQ+X	19.142	21.533	23.327	20.843
Story10	EQ+X	17.075	19.02	20.363	18.378
Story9	EQ+X	14.985	16.536	17.504	15.949
Story8	EQ+X	12.876	14.048	14.673	13.521
Story7	EQ+X	10.759	11.573	11.904	11.112
Story6	EQ+X	8.648	9.138	9.232	8.75
Story5	EQ+X	6.566	6.785	6.711	6.476
Story4	EQ+X	4.555	4.574	4.413	4.349
Story3	EQ+X	2.689	2.604	2.439	2.464
Story2	EQ+X	1.114	1.029	0.93	0.968
Story1	0	0	0	0	0.093
Story0	0	0	0	0	0

Graph: 1.2 Earthquake Displacement Vs. Different Shape of Building in Response Spectrum Analysis

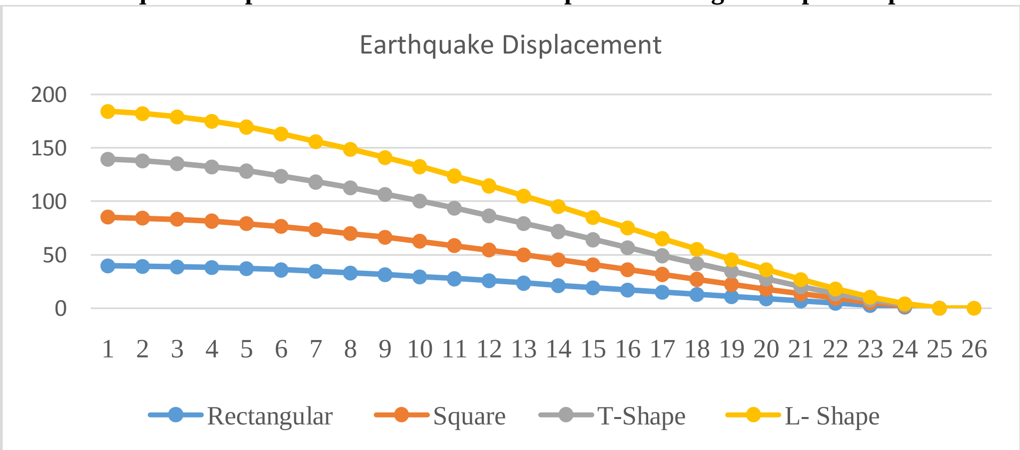

Table 3 Story Force Results Response Spectrum Analysis Method

TABLE: Story Forces					
Story	Load Case/Combo	P (kN)	P (kN)	P (kN)	P (kN)
		Rect.	Square	T-shape	L-shape
Story25	1.5(DL+LL)	7827.995	11392.21	9473.724	8006.3687
Story24	1.5(DL+LL)	25057.66	32066.3	29004.89	28494.0274
Story23	1.5(DL+LL)	42287.33	52740.38	48536.06	48981.6862
Story22	1.5(DL+LL)	59516.99	73414.46	68067.23	69469.3449
Story21	1.5(DL+LL)	76746.66	94088.55	87598.4	89957.0036
Story20	1.5(DL+LL)	93976.32	114762.6	107129.6	110444.6623
Story19	1.5(DL+LL)	111206	136676	128042.4	132314.7681
Story18	1.5(DL+LL)	128435.7	158589.3	148955.3	154184.8738
Story17	1.5(DL+LL)	145665.3	180502.7	169868.2	176054.9796
Story16	1.5(DL+LL)	162895	202416	190781	197925.0853
Story15	1.5(DL+LL)	180124.6	224329.3	211693.9	219795.1911
Story14	1.5(DL+LL)	197354.3	246242.7	232606.7	241665.2968
Story13	1.5(DL+LL)	214584	268156	253519.6	263535.4026
Story12	1.5(DL+LL)	231813.6	290069.4	274432.5	285405.5083
Story11	1.5(DL+LL)	250147.7	311298.4	295079.9	306734.451
Story10	1.5(DL+LL)	268481.7	334108.7	318522.4	330018.0955
Story9	1.5(DL+LL)	286815.8	356919	341964.9	353301.7338
Story8	1.5(DL+LL)	305149.8	379729.3	365407.5	376585.3802
Story7	1.5(DL+LL)	323483.8	402539.6	388850	399869.0226
Story6	1.5(DL+LL)	341817.9	425349.9	412292.5	423152.665
Story5	1.5(DL+LL)	360151.9	448160.3	435735	446436.3073
Story4	1.5(DL+LL)	378486	470970.6	459177.5	469719.9497
Story3	1.5(DL+LL)	396820	493780.9	482620	493003.5921
Story2	1.5(DL+LL)	415154	516591.2	506062.5	516287.2345
Story1	1.5(DL+LL)	423865.3	525913.6	516387.6	529506.2011

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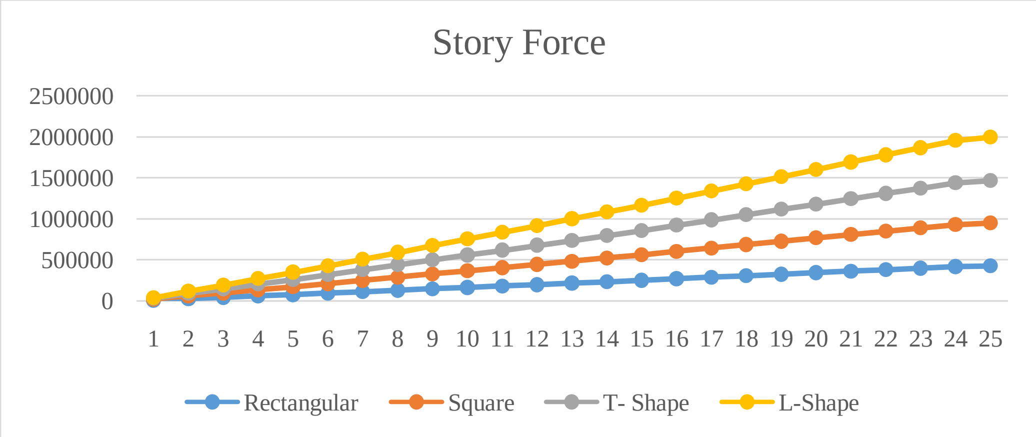
Graph 1.3 Story Force Vs. Story in Response Spectrum Analysis



IV. CONCLUSION

In the present study, Relative Analysis of RCC structure with different shape of building i. e Rectangular, Square, T- Shape and L-shape building with G+24 story building.

The structures are analyses for earthquake zone III with medium soil and Results Compare. It has been made on different structural parameters viz. base shear, Earthquake displacement, story force and modal mass participations etc. Grounded on the analysis results following conclusions are drawn.

1. Analysis of RCC building with different shape of structure i.e. Rectangular, Square, T- shape and L- shape with medium soil condition at zone III. the base shear in x- direction, square, T- shape and L- shape building structure base shear is increased 1.2435, 1.2706,1.24 and 1.24 times increased as compare to rectangular shape building.
2. The Structure, Square, T-shape and L- shape structure with analysis at zone III. but results indicate that variation of base shear in crease or drop in Square, T- shape and L-shape nearly close as compare to rectangular shape building.
3. Comparing The modal mass participating results in Response spectrum analysis method with rectangular shape building in 1st mode shape mass participant 73% and 2nd mode shape in z-direction means building are in torsion, rectangular shape building failed in mass participant check as compare to Square And L-Shape building, Square and L-shape building 1st and 2nd mode are translation and 3rd mode shape are in torsion as compare to rectangular shape and T- shape building, but Square and T-shape building are good performance torsion

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