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Seismic Analysis of C, L, F, I Shapes Shearwalls Along with the Introduction of Raft Foundation in Different Seismic Zones in Type 3 Soil

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Abstract **Shear wall is a structural member used to resist lateral forces Parallel to the plane of the wall. For slender walls where the bending deformation is more, Shear wall resists the loads due to Cantilever Action. In other words, Shear walls are vertical elements of the horizontal force resisting system. The present work deals with a study on the improvement shape of shear walls in symmetrical high rise building. In symmetrical buildings, the center of gravity and center of rigidity coincide, so that the shear walls are placed symmetrically. In this work a high rise building with different shapes of shear walls is considered for analysis. The multi storey building with 10 storey are analyzed for its storey drift, story displacement and base shear using ETABS software. For the analysis of the building for seismic loading with all Zones (Zone- II, III & IV Zone-V) is considered. The analysis of the building is done by using dynamic method(Response spectrum analysis).**

I. INTRODUCTION

Shear wall is a structural member used to resist lateral forces Parallel to the plane of the wall. For slender walls where the bending deformation is more, Shear wall resists the loads due to Cantilever Action. In other words, Shear walls are vertical elements of the horizontal force resisting system. In building construction, a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Examples are the reinforced-concrete wall. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants, create powerful twisting (torsional) forces. This leads to the failure of the structures by shear. Shear walls are especially important in high-rise buildings subject to lateral wind and seismic forces. Generally, shear walls are either plane or flanged in section, while core walls consist of channel sections. They also provide adequate strength and stiffness to control lateral displacements.

DIFFERENT SHAPES OF SHEAR WALLS

The shape and location of the shear wall have significant effect on the structural behavior under lateral loads. Lateral loads are distributed through the structure acting as the horizontal diaphragm, to the shear walls, parallel to the force of the action. The core eccentrically located with respect to the building shapes has to carry out torsion as well as bending and direct shear. These shear wall resist horizontal forces because their high rigidity as deep beams, reacting to shear and flexure against the overturning. The Shear Wall shapes used in this work are,

(a) C
(b) L
(c) F
(d) I

II. MODELLING OF BUILDING

Building details are selected based design by IS 456-2000 code, building dimensions are selected based on above literature reviews. Based on design, building details are listed in below table

Height of the building	30m
No. of stories	10
Height of each storey	3m
Grade of concrete	FE415
Grade of steel	M30
Depth of slab	300 mm
Size of the beams	400×400 mm
Size of the column	700×800mm
Shear wall thickness	300mm
Plan area	576 m²

In this work, models are considered to understand the seismic analysis of multi storied building with different shapes of shear walls. The models consist of 10 story building

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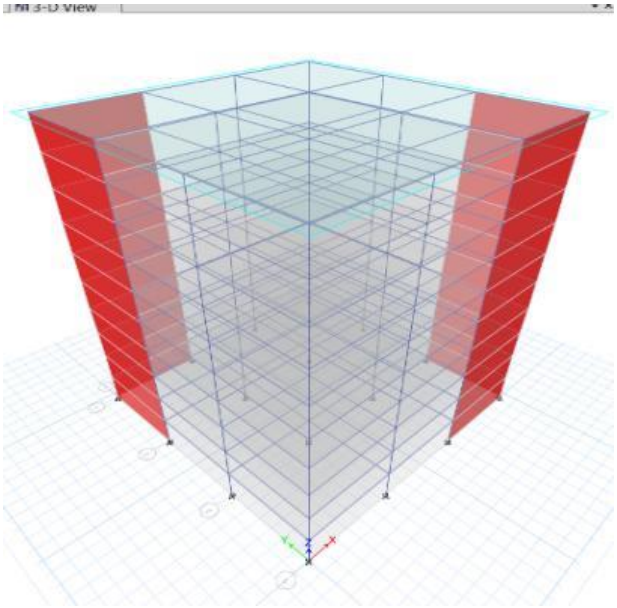
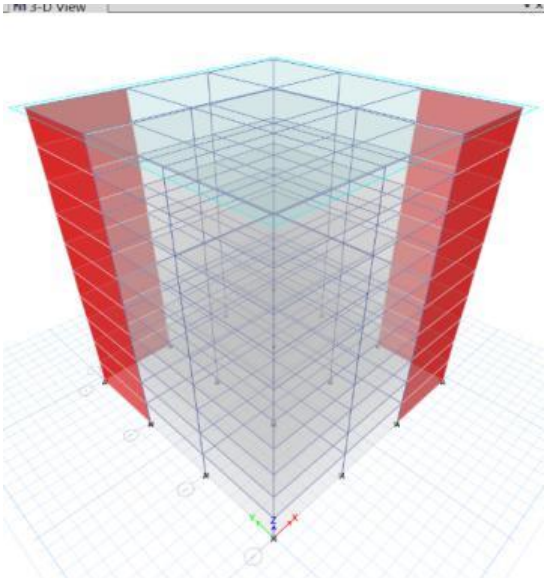
Model 1	**LSHAPE SHEAR WALL COMPARED IN SOIL TYPE 1,2,3AND EARTH QUAKE ZONES 2,3,4,5**
Model 2	**C SHAPE SHEAR WALL COMPARED IN SOIL 1,2,3 AND EARTH QUAKE ZONES 2,3,4,5**
Model 3	**F-SHAPED SHEAR WALL COMPARED IN DIFFERENT SOIL CONDITIONS AND EARTHQUAKE ZONES**
Model 4	**C,L SHEAR WALLS ON SOIL 3 TYPE IS PERFORMED USING RAFT FOUNDATION**
MODEL5	**F SHAPED SHEAR WALL ON SOIL 3 TYPE IS PERFORMED ON RAFT FOUNDATION.**
MODEL 6	**I SHAPE SHEAR WALL is performed on rft foundation**

FIGURES

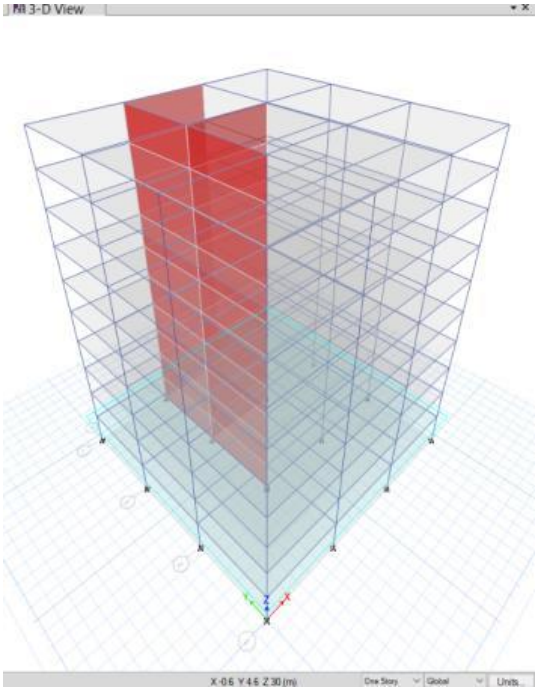
3D VIEW OF THE BUILDING WITH THE L SHAPE SHEAR WALLS



3D VIEW OF THE BUILDING WITH THE L SHAPE SHEAR WALLS



3D VIEW OF THE F SHAPED SHEAR WALL



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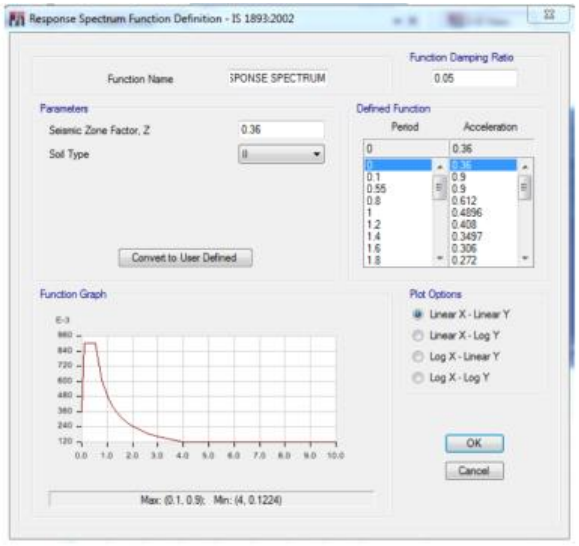
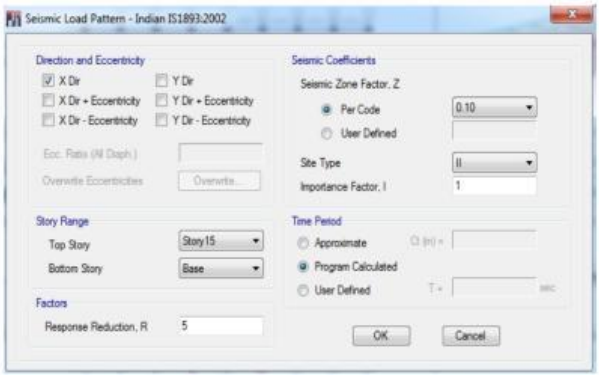
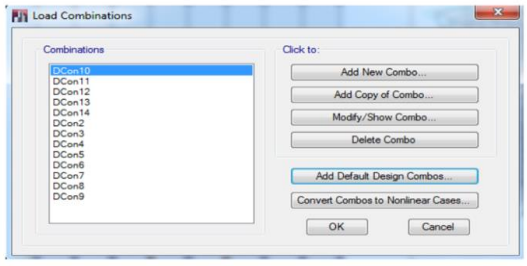
MODAL ANALYSIS

The three dimensional reinforced concrete structures were analyzed by Response Spectrum Analysis using ETABS software. It is a linear dynamic statistical analysis method to indicate the likely maximum seismic response of an elastic structure. A plot of the peak acceleration for the mixed vertical oscillators. A response spectrum is simply a plot of the peak or steady-state response (displacement, velocity or acceleration) of a series of oscillators of varying natural frequency that are forced into motion by the same base vibration or shock. The analysis results will show the performance levels, behavior of the structures.

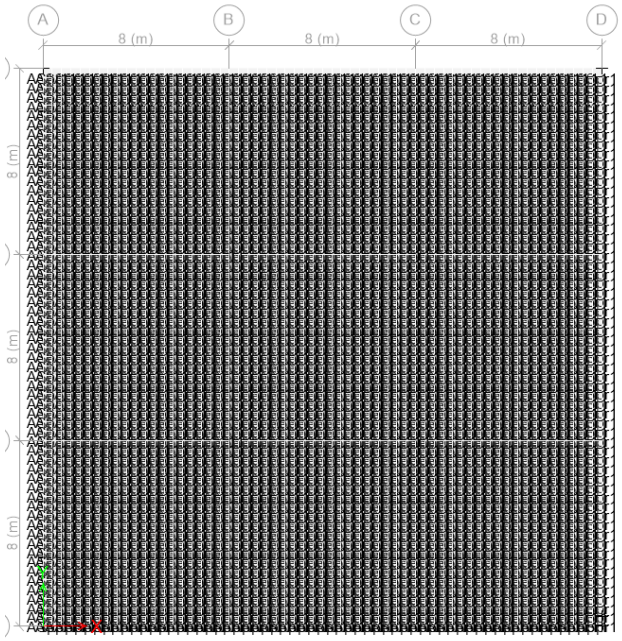






Design of raft foundation in etabs

1. Meshing of the thick slab into the 20×20 quadrilaterals
2. Assigning area springs to the slab with pin supports.
3. Local axes are taken into consideration
4. THICK SLAB OF 450 mm is choosen



3d view of the building with raft foundation

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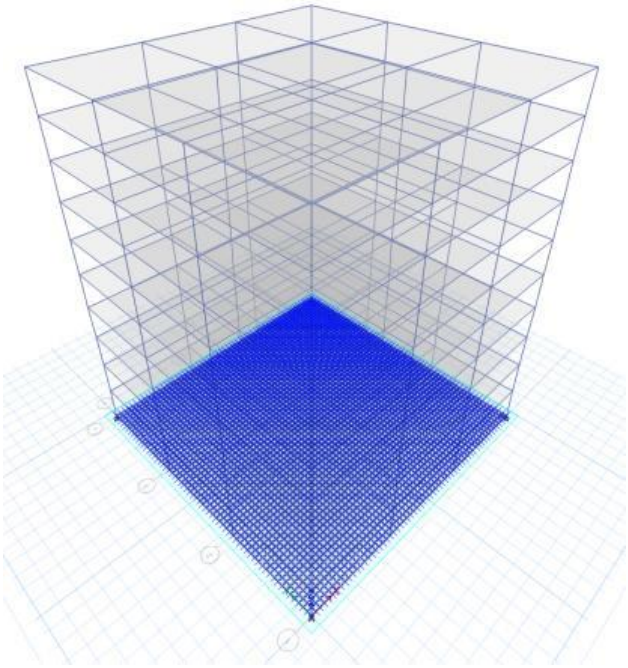

RESULTS AND DISCSSIONS

This chapter deals with the results and discussion of work. A comparison made between building models to know the seismic analysis of multi storied building with different shapes of shear walls. The linear dynamic analysis has done by using response spectrum method to know the maximum response of structure. The response is observed in terms of story displacement, story drift, and story shear. And linear dynamic analysis has done to know the seismic analysis of multi storied building with different shapes of shear walls at particular place. The results are observed for all the zones of models like zone II, III, IV and V. And also comparing the all results and select better shape of shear wall in zones.

L SHAPE SHEAR WALL RESULTS IN DIFFERENT ZONES

Zones		RSX	RSY
II(0.1 SEISMIC FACTOR)	Displacement	12.432	14.548
	Drift	0.000379	0.000334
	Shear	6904	4123
III(0.16 SEISMIC FACTOR)	Displacement	15.564	18.725
	Drift	0.000088	0.000115
	Shear	21525	19678
IV(0.24 SEISMIC FACTOR)	Displacement	18.164	13.693
	Drift	0.000187	0.000255
	Shear	34564	32120
V(0.36 SEISMICFACTOR)	Displacement	26.563	15.735
	Drift	0.000175	0.000225
	Shear	25654	23458

C SHAPE SHEAR WALL RESULTS IN DIFFERENT ZONES

Zones		RSX	RSY
II	Displacement	10.715	9.740
	Drift	0.000225	0.000232
	Shear	15384	16345
III	Displacement	17.324	15.960
	Drift	0.000146	0.000167
	Shear	24345	25678
IV	Displacement	24.774	36.466
	Drift	0.000757	0.000878
	Shear	10651	14614
V	Displacement	30.765	32.456
	Drift	0.000245	0.000225
	Shear	23876	19667

F SHAPE SHEAR WALL RESULTS IN DIFFERENT EARTHQUAKE ZONES

Zones		RSX	RSY
II	Displacement	26.546	25.808
	Drift	0.000167	0.000210
	Shear	4089	3478
III	Displacement	30.562	34.945
	Drift	0.000253	0.000156
	Shear	13450	14500
IV	Displacement	35.456	38.325
	Drift	0.000744	0.000869
	Shear	6450	9089
V	Displacement	40.564	43.562
	Drift	0.000123	0.00358
	Shear	26667	25678

I SHAPE SHEAR RESULTS IN DIFFERENT ZONES

Zones		RSX	RSY
II	Displacement	12.545	15.768
	Drift	0.000167	0.000210
	Shear	4089	3478
III	Displacement	15.675	18.987
	Drift	0.000253	0.000156
	Shear	12451	13506
IV	Displacement	19.657	24.564
	Drift	0.000744	0.000869
	Shear	36666	34678
V	Displacement	24.564	73.268
	Drift	0.000999	0.00293
	Shear	52244	55732

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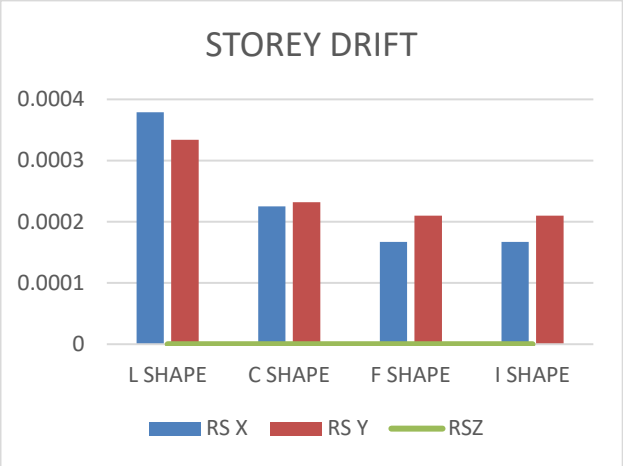
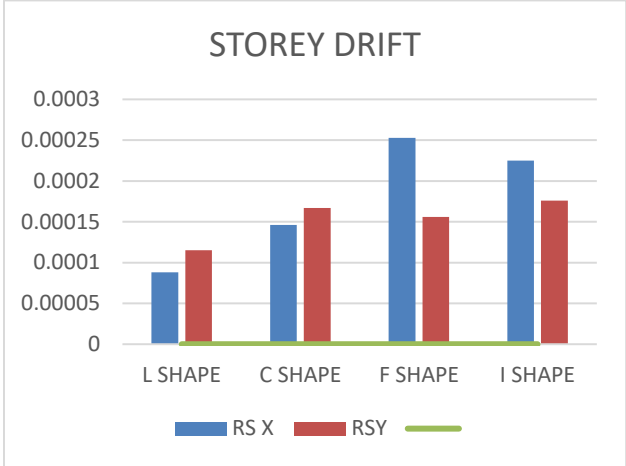
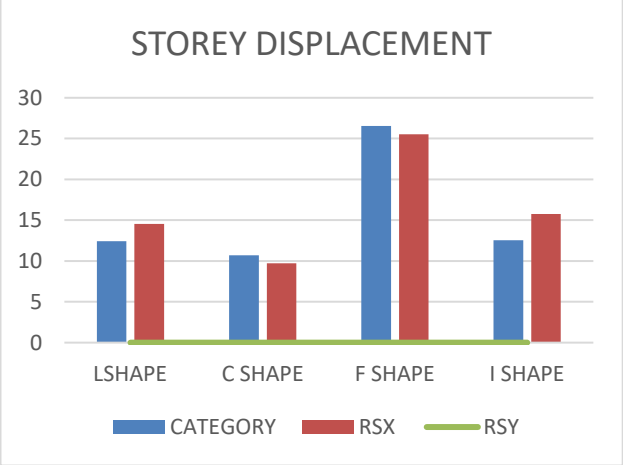
STOREY DRIFT GRAPH OF ALL THE SHAPES OF THE SHEAR WALLS IN ZONE II

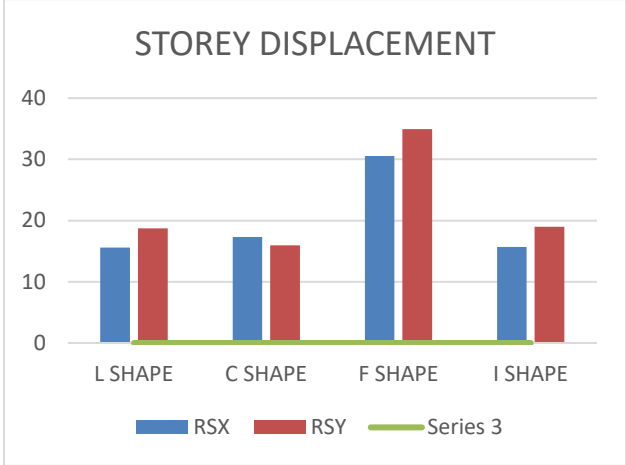


NOW GRAPHS ON ZONE III

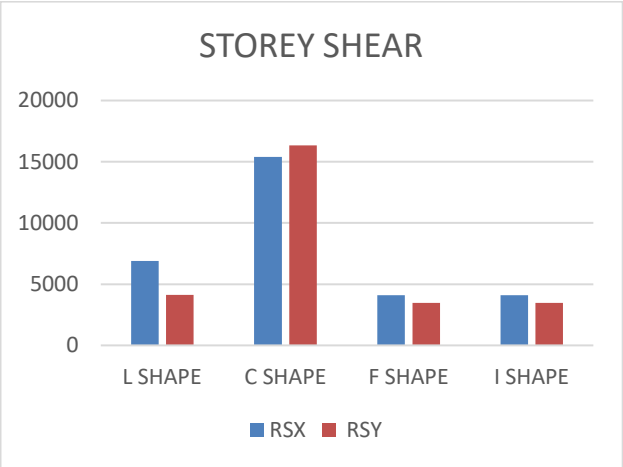


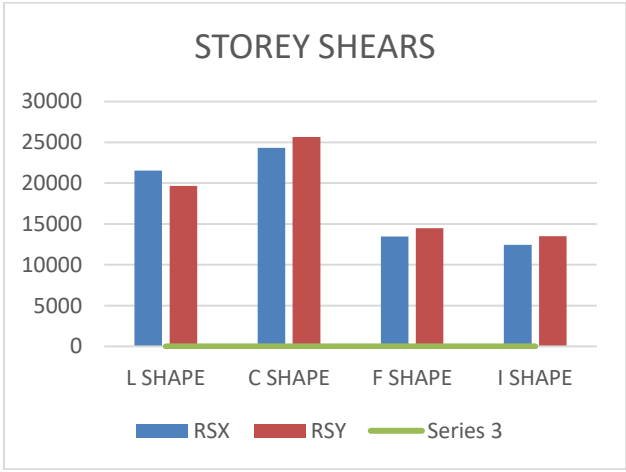
STOREY DISPLACEMENTS IN ZONE II





3 STOREY SHEAR IN ZONE II





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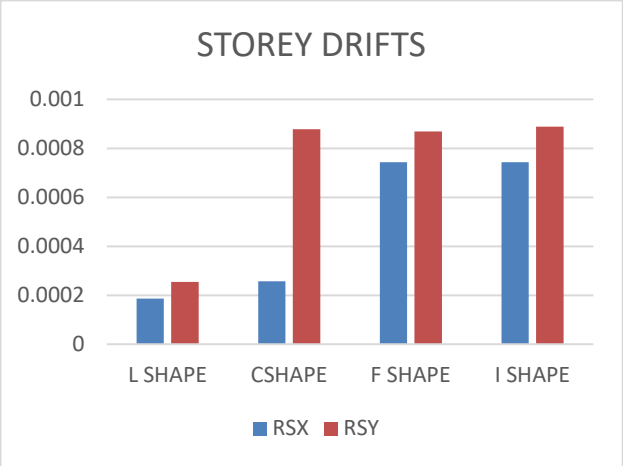
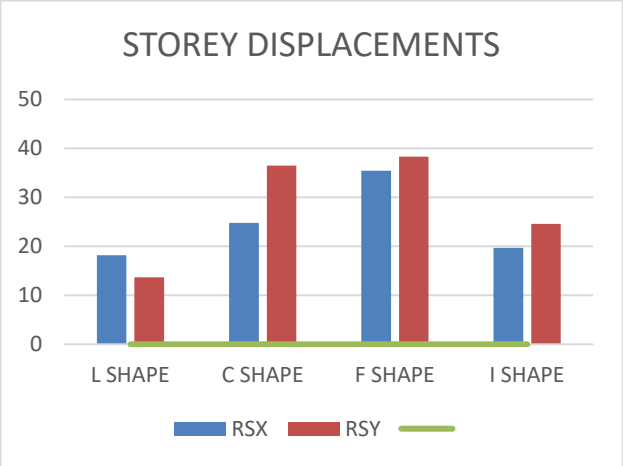
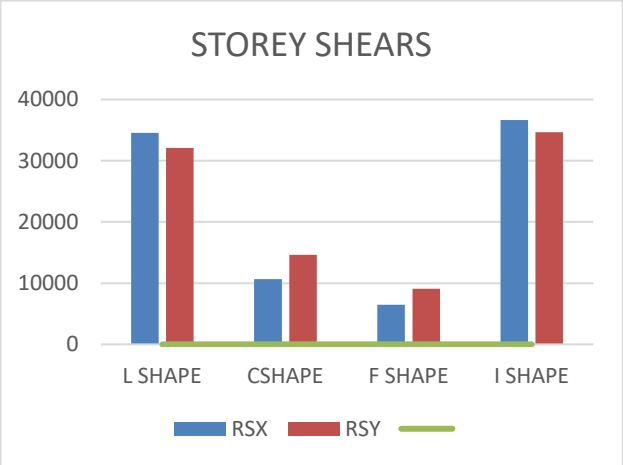
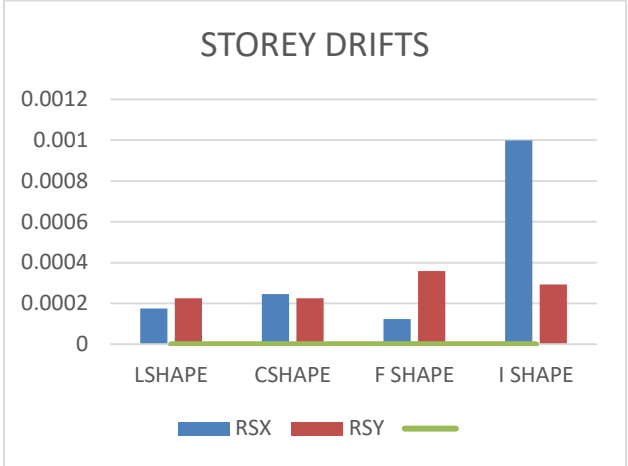
NOW THE GRAPHS ON ZONE IV

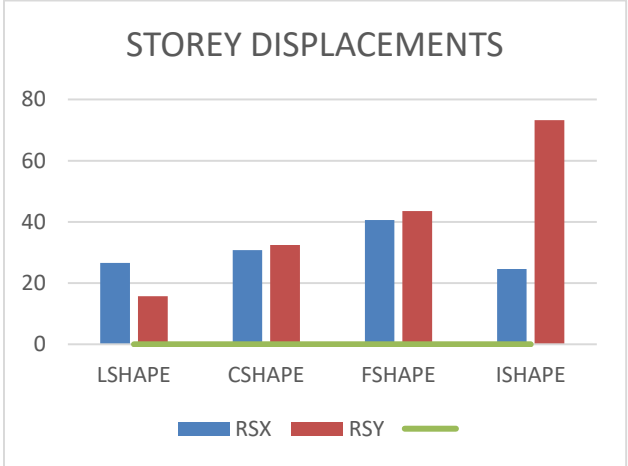


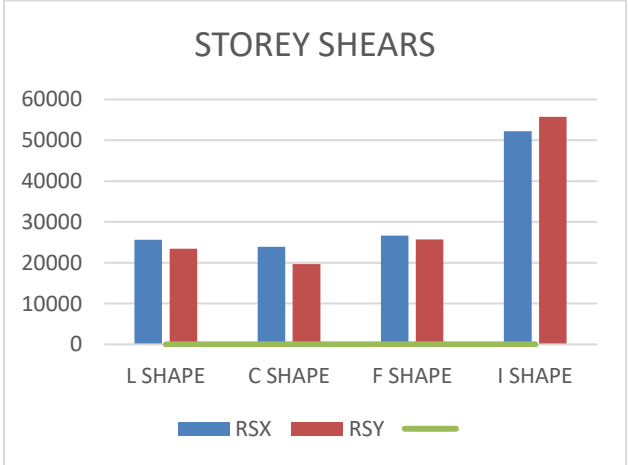




NOW THE GRAPHS ON ZONE V







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COMPARISION WITH RAFT FOUNDATION

Results of the analysis of all the described shapes of the shear walls are discussed in the below table: zone factor 0.36,zone 5,type 3 soil conditions in which the building is analysed

C shape wall	RSX	RSY
Displcement(mm)	26	17.5
Storey drift(%)	0.006727	0.027346
Storey shear(kN)	22724	38508

L shape shear wall	RSX	RSY
Displacement(mm)	8	3.5
Storey drift(%)	0.00237	0.001438
Storey shear(kN)	15232	6000

F shape shear wall	RSX	RSY
Displacement(mm)	55.5	42.4
Storey drift(%)	0.020853	0.015571
Storey shear(KN)	38597	48981

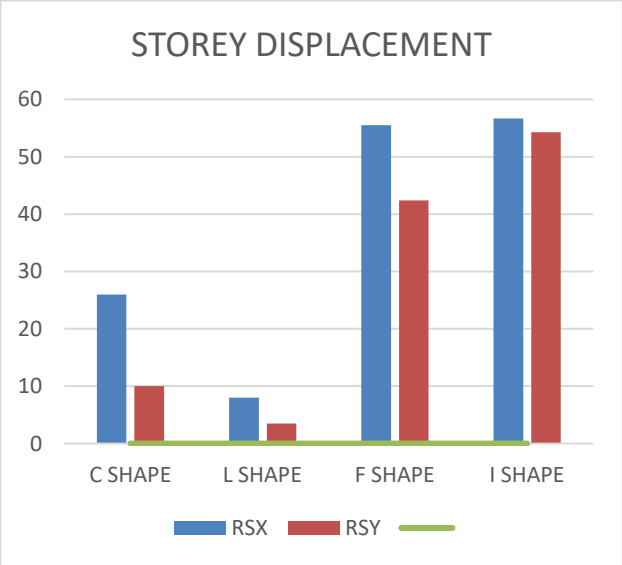
I shape shear wall	RSX	RSY
Displacement(mm)	56.7	54.3
Storey drift(%)	0.025045	0.025071
Storey shear(kN)	45108	45123

GRAPHS OF THE GIVEN RESULTS:

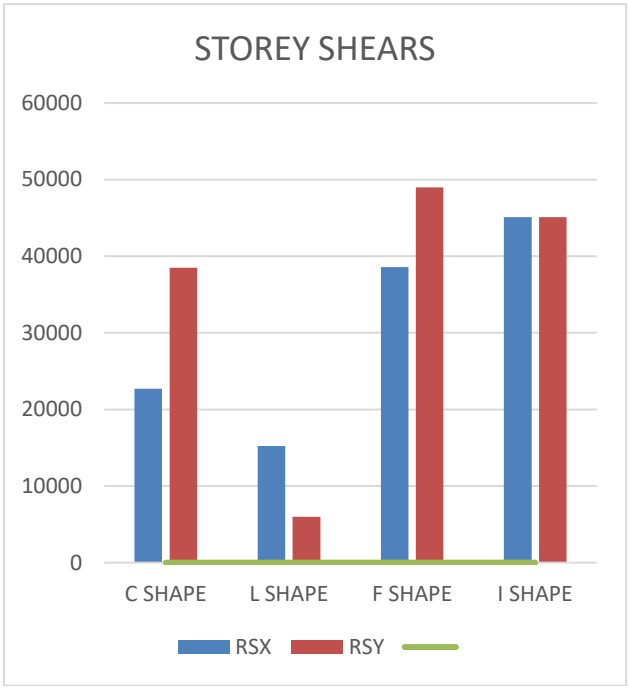
1. ZONE FACTOR 0.36
2. ZONE 5
3. SOIL TYPE -TYPE 3

USE OF RAFT FOUNDATION

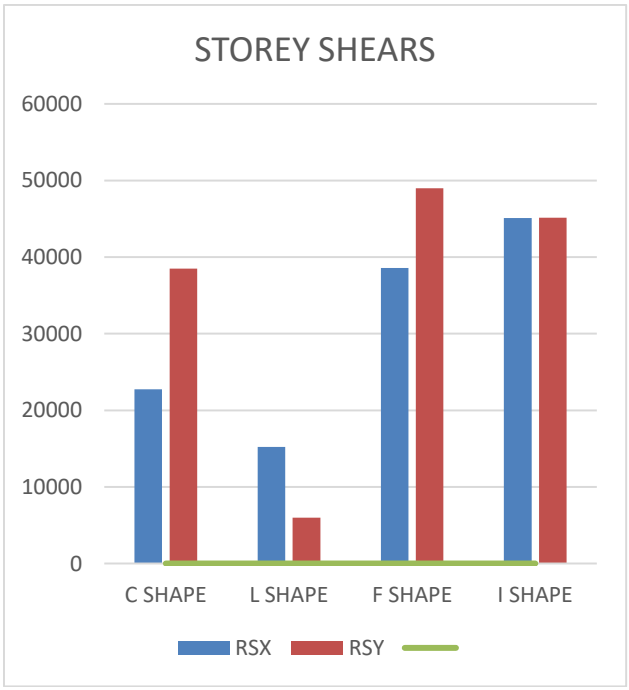
GIVEN GRAPH SHOWS STOREY DISPLACEMENTS OF ALL THE SHAPES OF THE SHEAR WALL IN 10 STOREY BUILDING



GIVEN GRAPH SHOWN IS THE STOREY DRIFTS OF ALL THE SHAPES OF SHEAR WALLS



GIVEN GRAPH INDICATES THE STOREY SHEARS OF ALL THE TYPES OF SHEAR WALLS IN 10 STOREY BUILDING DISCUSSED ABOVE



CONCLUSION

In this work, in the present study, an attempt is made to study the seismic Behavior of building with shear walls of four different shapes. First part of study included the dynamic analysis of building. The storey drift and base shear were obtained. A comparative table of these results for

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all the shapes of shear wall has also been presented. In the next section conclusions obtained from the study is presented. a study on After analyzing the results obtained then it will be compared and find the seismic performance of the building.

From the graphical representations the following conclusions can be of :

PRIMARY OBSERVATION

a) In zone 2 ,in the case of storey drift F AND shows the similar results.
b) In the case of storey displacement ,C shape shear wall shows the better performance.
c) In the zone3 ,case of storey drift L SHAPE has better performance.
d) In the case of displacement,L and C has similar performances.
e) In the case of zone 4 ,L SHAPE has shown the good results in the storey drifts and displacements.

f) In the case of storey displacement ,L shape shows the better performance.
g) In the zone 5,also L SHAPE has good performance in both the storey drifts and the storey displacements.

Final conclusion in primary observations:

L SHAPE SHEAR WALL HAS THE BETTER PERFORMANCE IN THE ZONE 3, ZONE 4, ZONE 5.

SECONDARY OBSERVATIONS:

From the analysis of in which the shear walls of different shapes l,c,f,i which are analysed on the weak soil with the design of the raft foundation in zone 5 ,the conclusions are:

a) From the storey drift point of view, L shape indicates good results.
b) From the storey displacement point of view L shape shows the good results.
c) From the storey shear point of view, L shape shows the good results.

Overall conclusion from the secondary observations:

L SHAPE SHEAR WALL SHOW BETTER PERFORMANCES IN THE ZONE 5 ON THE WEAK SOIL WITH THE INTRODUCTION OF RAFT FOUNDATION ALSO.

FUTURE SCOPE FOR THIS STUDY

1. Changing the size and thickness.
2. Changing the orientation of the shear wall position and with the other shapes of them
3. This can be extended to other irregular buildings.
4. Other methods of the analysis can be performed.

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