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Comparative Study of Reinforced Concrete Frame Structure with And Without Shear Wall

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Abstract- India at present is fast growing economy, which brings about demands in increase of infrastructure facilities along with the growth of population. To cater the land demand in these regions, vertical development is the only option. This type of development brings challenges to counteract additional lateral loads due to wind and earthquake. Recent days, structures are becoming more and more slender and susceptible to sway and hence dangerous in the earthquake. Many reinforced concrete buildings in urban regions lying in active seismic zone ,may suffer moderate to severe damages during ground motions After many practical studies it has shown that use of lateral load resisting systems in the building configuration has tremendously improved the performance of the structure in earthquake. Shear walls are mainly flexural members and usually provided in high rise buildings to avoid the total collapse of the building. Shear walls are extensively used in the buildings to resist lateral loads induced by earthquake.[2] In the present study an unsymmetrical (G+15) RC structure were analyzed using ETAB 2016, without and with shear wall at FireDuct-Lift, Shear wall at Corners and Shear Wall at FireDuct-Lift-Corners for parameters viz Maximum Storey Displacement and Drift. The structure with shear wall at FireDuct-Lift-Corners was found to be more stable and maximum percentage reduction in story displacement and drift was found out 59.24, 29.58, 62.15 and 35.70, 29.09, 100 percent respectively as compared with other positions of shear wall.

Indexed Terms- Maximum Displacement, Maximum Story Drift, Shear Wall

I. INTRODUCTION

I.General-

India has had several the world's greatest earthquakes in the last century. Earthquake causes the shaking of the ground. Earthquake creates horizontal pressure on building causing them to collapse. Due to earthquake shaking of the ground results the motion of the base of the building. To prevent sway motion structure with seismic members or seismic structures are constructed. Seismic structure design is an important process of structural analysis while designing a building, which is subjected to Earthquake, such that the structure continues to function and serve its purpose even after an Earthquake. Shear wall systems are commonly used as lateral load resisting systems in high-rise buildings to resist lateral forces due to wind and seismic. Shear walls have very high in-plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite efficient in many structural engineering applications. It is easier to design or analyze the model of such seismic structure using various software like ETABS.[4]

1.1 Aim and objective of work -The aim of this study is

- To compare the behavior of G+15 story RC structure with or without shear wall
- To find optimum location of shear wall
- Objectives are
- To study various structural concepts.
- To analyze the multi-storey building with and without shear wall using ETABS Software.
- To study behavior of the structure under different location of shear wall.

- To investigate the optimum position of shear wall.

II. MATERIAL AND METHODOLOGY

Preliminary data required for Analysis.

Type of Building: RC (G+15)

Zone of Earthquake: IV

Steel: HYSD500

Concrete:M25

Beam Size:
1. 230*450 (Concrete Rectangular)
2. 150*450 (Concrete Rectangular)

Column Size:
1. 230*600 (Concrete Rectangular)

Slab thickness:150mm
Thickness of Shear Wall: 150mm

AG+15 RC structure
1) Without shear wall
2) With shear wall at lift-FireDuct
3) Shear wall at corners
4) Shear wall at corners-FireDuct-Lift as shown in Fig 1 to 4 under IS 456 2000 and IS 1893 2002 was analyzed using ETAB 2016.

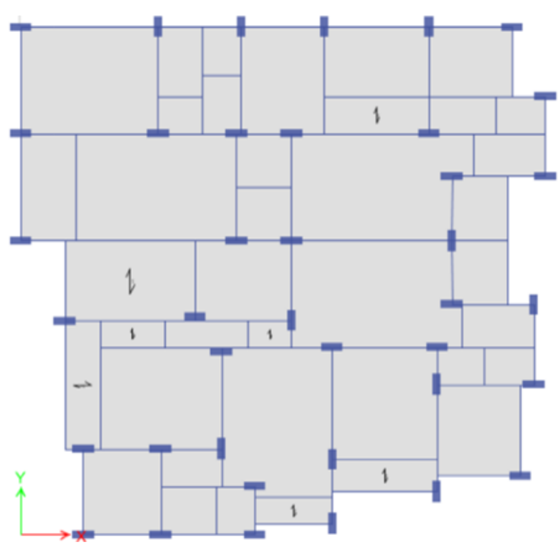

Fig 1-Plan of building without shear wall.

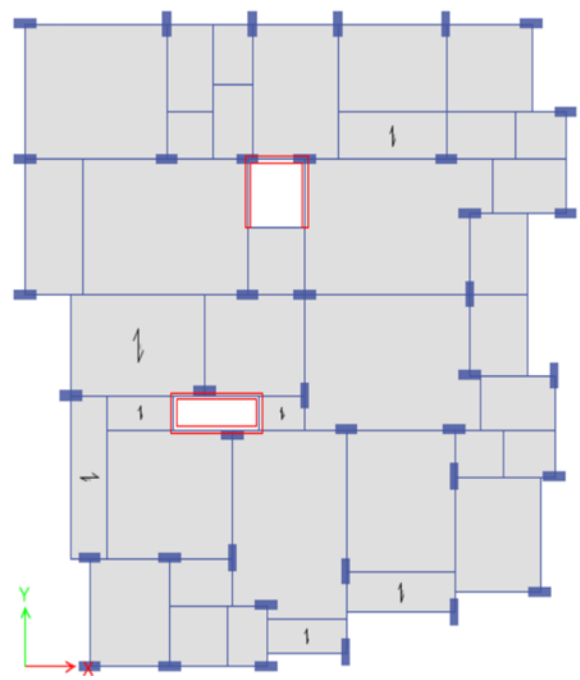

Fig 2-Plan of building with shear wall at Fire Duct-Lift.

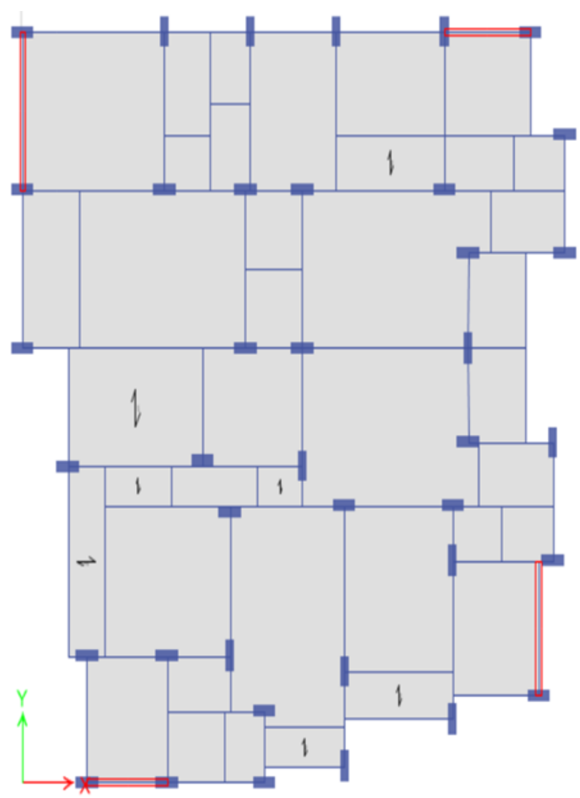

Fig 3-Plan of building with shear wall at Corners.

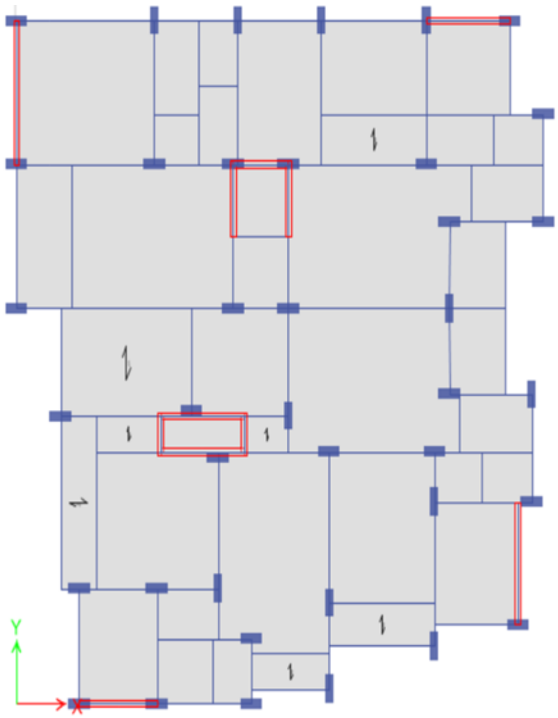

Fig 4-Plan of building with shear wall at Corners-FireDuct-Lift

Table 1- Storey Data

Name	Height(mm)	Elevation(mm)
Water Tank	3000	52950
Terrace	3000	49950
15 Floor	3000	46950
14 Floor	3000	43950
13 Floor	3000	40950
12 Floor	3000	37950
11 Floor	3000	34950
10 Floor	3000	31950
9 Floor	3000	28950
8 Floor	3000	25950
7 Floor	3000	22950
6 Floor	3000	19950
5 Floor	3000	16950
4 Floor	3000	13950
3 Floor	3000	10950
2 Floor	3000	7950
1 Floor	3000	4950
Pl	1950	1950
Base	0	0

Table 2-Load Cases

Name	Type
Dead	Linear Static
Live	Linear Static
SIDL	Linear Static
EQX	Linear Static
EQY	Linear Static
WX	Linear Static
WY	Linear Static

Table 3-Mass source (Multiplier to Load Pattern)

Load Pattern	Multiplier
Dead	1
Live	0.25
SIDL	1

Table 4- Load Combination

Name	Load Case/Combo	Scale Factor	Type
UDCon3	Dead	1.5.	Linear add
UDCon3	SIDL	1.5	
UDCon4	Dead	1.5	Linear Add
UDCon4	Live	1.5	
UDCon4	SIDL	1.5	

III. RESULTS

Four models were analyzed using ETAB 2016 for different parameters vizmaximum storey displacement and drift.

Maximum Storey Displacement

It is the lateral displacement of the story relative to the base. Excessive lateral displacement of the building can be limited by the lateral force-resisting system. Maximum storey displacement is the maximum displacement value of a certain storey in mm.

Table 5- Maximum displacement of structure without Shear Wall and with Shear wall at FireDuct-Lift.

Type of Loads	Maximum Displacement mm	
	Without Shear Wall	With Shear Wall atFireDuct-Lift
Dead	7.19	2.822
Live	2.96	1.39
WX	57.34	35.58
WY	99.1	61.08
SIDL	8.344	4.08
EQX	109	71.25
EQY	133.63	89.01
Total	417.564	262.912

Table 6-Maximum displacement of structure without Shear Wall and with Shear wall at Corners

Type of Loads	Maximum Displacement mm	
	Without Shear Wall	With Shear Wall Corners
Dead	7.19	6.181
Live	2.96	2.41
WX	57.34	43.97
WY	99.1	62.251
SIDL	8.344	6.39
EQX	109	81.61
EQY	133.63	92.23
Total	417.564	295.042

Table 7-Maximum displacement of structure without Shear Wall and with Shear wall at Corners-FireDuct-Lift.

Type of Loads	Maximum Displacement mm	
	Without Shear Wall	With Shear Wall at Corners-FireDuct-Lift
Dead	7.19	4.88
Live	2.96	2.35
WX	57.34	30.89
WY	99.1	44.92
SIDL	8.344	5.61
EQX	109	62.32
EQY	133.63	7.061
Total	417.564	158.031

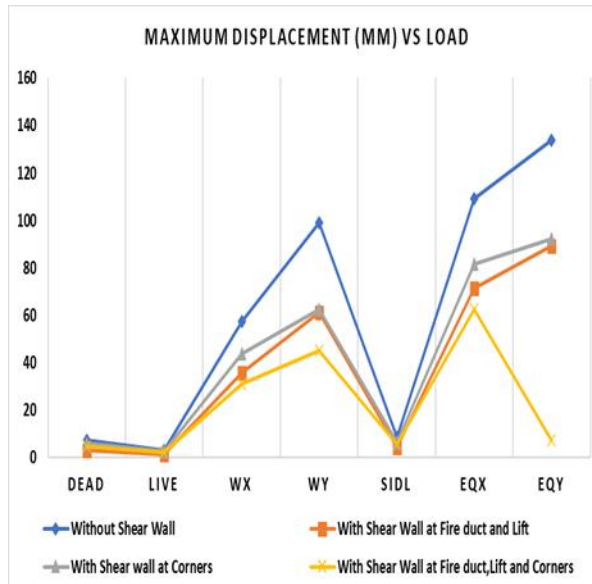

Fig 5: Maximum Displacement in mm vs Load

Maximum Storey Drift:

It is defined as ratio of displacement of two consecutive floors to height of that floor. It is very important term used for research purpose in earthquake engineering.

Table 8-Maximum storey drift of structure without Shear Wall and with Shear wall at FireDuct-Lift.

Type of Loads	Maximum Storey Drift	
	Without Shear Wall	With Shear Wall at FireDuct-Lift

Dead	0.00232	0.000856
Live	0.00065	0.000432
WX	0.0174	0.011207
WY	0.0324	0.02
SIDL	0.00265	0.00113
EQX	0.0323	0.022
EQY	0.0439	0.029
Total	0.13162	0.084625

Table 9- Maximum storey drift of structure without Shear Wall and with Shear wall at Corners

Type of Loads	Maximum Storey Drift	
	Without Shear Wall	With Shear Wall Corners
Dead	0.00232	0.0015
Live	0.00065	0.00064
WX	0.0174	0.013239
WY	0.0324	0.02049
SIDL	0.00265	0.001551
EQX	0.0323	0.0259
EQY	0.0439	0.03
Total	0.13162	0.09332

Table 10-Maximum storey drift of structure without Shear Wall and with Shear wall at Corners-FireDuct-Lift.

Type of Loads	Maximum Storey Drift	
	Without Shear Wall	With Shear Wall at Corners-FireDuct-Lift
Dead	0.00232	0
Live	0.00065	0
WX	0.0174	0
WY	0.0324	0
SIDL	0.00265	0
EQX	0.0323	0
EQY	0.0439	0
Total	0.13162	0

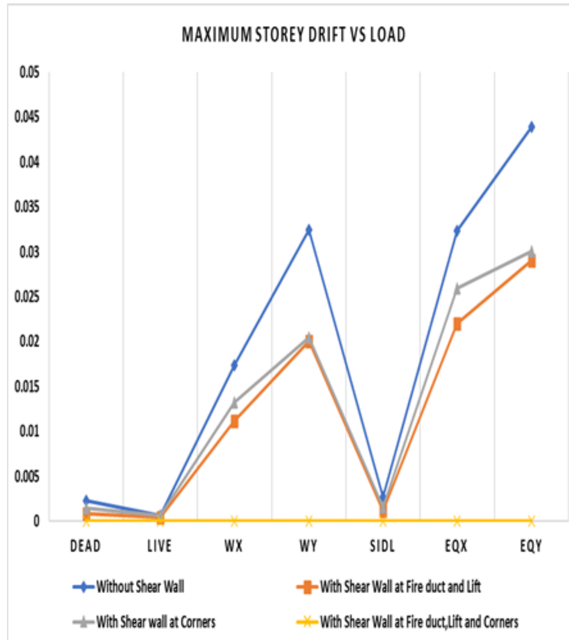

Fig 6: Maximum Storey Drift vs Load

Table 10. Percentage Reduction in Maximum Displacement and Storey Drift

Case No.	Position of Shear Wall	Maximum percentage reduction in Displacement mm	Maximum percentage reduction in Storey Drift
1	Shear Wall at FireDuct-Lift	39.09	62.56
2	Shear Wall at Corners	28.58	42.38
3	Shear Wall at Fire-Duct-Lift-Corners	56.87	100

CONCLUSION

From the analysis it was concluded that-

1. G+15 Storied structure with and without shear wall was analyzed by using ETAB software and structural parameters Viz Storey Displacement and drift was investigated.
2. Percentage reduction in storey displacement and drift for shear wall at FireDuct-Lift, Shear wall at Corners and Shear wall at FireDuct-Lift-Corner was 59.24, 29.58, 62.15 mm and 35.70,29.09, 100 respectively was found out.
3. Structure with shear wall is more stable than that a structure without shear wall.
4. Optimum position of Shear Wall was found out for Shear Wall at FireDuct-Lift-Corners because the structure is more stable than Shear Wall at FireDuct-Lift and Shear Wall at Corners.

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