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Analysis of Flat Slab Resting on Shear Walls

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Abstract— Shear Walls are specially designed structural walls included in the buildings to resist horizontal forces that are induced in the plane of the wall due to wind, earthquake and other forces. They are mainly flexural members and usually provided in high rise buildings to avoid the total collapse of the high rise buildings under seismic forces. This paper aims to investigate the performance of flat slab building structure completely resting on shear walls instead of columns. In this study, a building model is compared in different aspects such as storey drift, story displacement etc. for flat slab with columns and flat slab resting on shear walls.

Index Terms—Flat slab resting on shear walls instead of columns, storey drift, base shear, storey displacement, mode periods, static analysis, response spectrum analysis.

1 INTRODUCTION

INFRASTRUCTURE development is aimed to utilize the available resources to their optimum levels, may the resources be in terms of economy or in terms of space. Thus flat slabs give an economical alternative in utilizing the internal space to maximum extent. But frame action provided by a flat slab–beam and column interaction is generally insufficient to provide the required strength and stiffness for buildings taller than about 10 stories. So there are two option either to increase size of columns or to introduce lateral force resisting system. Increase in column sizes creates offsets inside rooms and also reduces the carpet area. Shear walls are specially designed structural walls incorporated in building to resist lateral forces that are produced in the plane of the wall due to wind, earthquake forces. It is always advisable to. incorporate them in buildings built in regions likely to experience earthquake of large intensity or high winds. Their thickness can as low as 150mm, or as high as 400mm in high rise buildings. Shear walls could be placed such that the they are merged with internal walls and there are no offsets hence increase the carpet area, provide lateral strength and also look asthetic.

2 METHODOLOGY

This study includes the structural behaviour of building which is completely resting on shear wall under static and lateral loading. A G+15 building is modeled on ETABS-13, model 1 with flat slabs with columns and model 2 as building with flat slab resting on shear walls. The main aim of study has been to identify which system; the column or shear wall Causes minimum displacement such contributes to greater lateral stiffness to the structure.

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Objective of research is to study the vulnerability of flat-slab resting on shear wall, different factors such as Storey drift, lateral displacement, time period and base shear have been obtained for SPECX (EX) and SPECY (EY) in zone 3 for both models on ETABS.

Table 1: Input parameters to software

Name of parameter	Value	Unit
Number of stories	16	Nos.
Story height	3	m
Total height of the structure(above GL)	63	m
Length in long direction	64	m
Length in short direction	24.9	m
Grade of Concrete	M40	
Grade of steel	Fe 500	
Size of columns	800X800	mm
Size of Beams	300X600	mm
Thickness of shear wall	300	mm
Thickness of Deck	250	mm
Dead Load (1) Wall	12.144	Kn/m
(2) Floor finish	3	Kn/m²
Live load	5	Kn/m²
Importance factor (I)	1.5	-
Seismic Zone	III	-
Response Reduction factor	5	-
Soil Type	Hard	-

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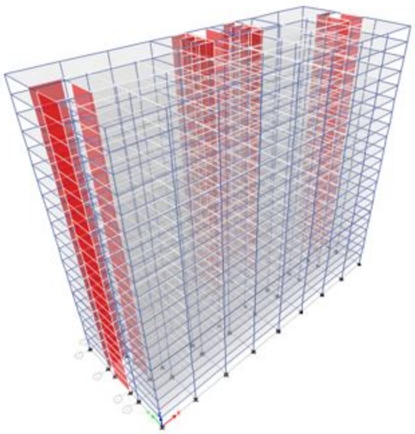

Figure 1: 3d view of building

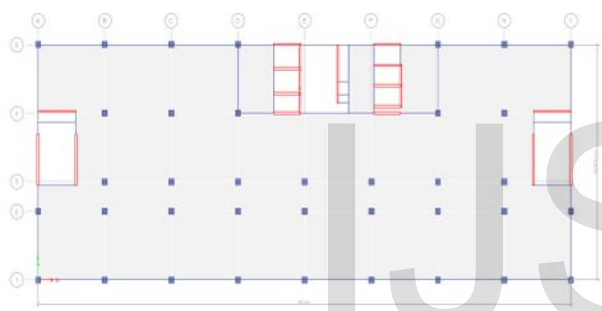

Figure 2: Plan (with columns)

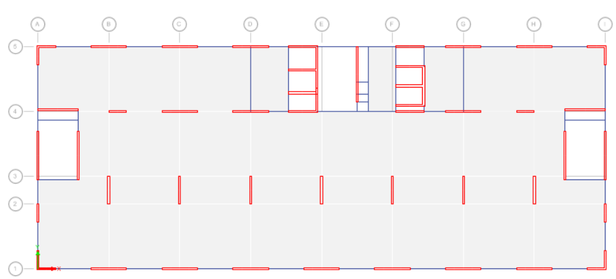

Figure 3: Plan (with shear walls)

Model Description
Model 1: Building resting on columns.
Model 2: Building completely resting on shear walls.

3 RESULTS AND DISCUSSION

Table 2: Comparison of mode period for different modes

NO. OF MODES	MODE PERIOD (sec)	
	Model 1	Model 2
1	3.246	2.135
2	2.786	1.985
3	2.209	1.543
4	0.917	0.568
5	0.666	0.528
6	0.586	0.434
7	0.434	0.274
8	0.303	0.236
9	0.269	0.207
10	0.252	0.162
11	0.18	0.139
12	0.167	0.123

Table 3: Comparison of Base shear(KN) along both directions

MODELS	Directions	
	X	Y
M1	7513.215	7355.27
M2	6869.61	7119.57

Table - 4: Maximum lateral displacements in X direction

Analysis	Models	Displacements (mm)	% Reduction in displacement
Response Spectra	Model 1	29.1	-
	Model 2	9.3	68.05

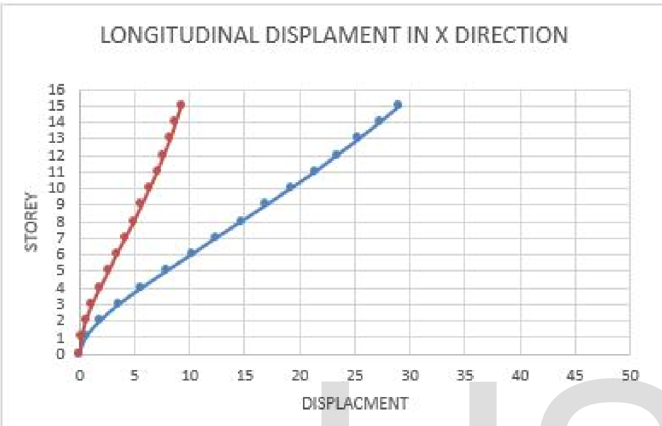

Figure 4.: Comparison of lateral displacement in X direction

This graph (figure 4) shows 68.05% reduction in lateraldis-placementin X direction for model 2 as compared to Model 1

Table - 5: Maximum lateral displacements in Y direction

Analysis	Models	Displacements (mm)	% Reduction in displacement
Response Spectra	Model 1	20.6	-
	Model 2	10.8	47.58

Figure 5: Comparison of lateral displacement in Y direction

This graph (figure 5) shows 47.58% reduction in lateraldis-placementin Y direction for model 2 as compared to Model 1

Table - 6: Maximum storey drift in X Direction

Analysis	Models	Drift	% Reduction in Drift
Response Spectra	Model 1	0.653	-
	Model 2	0.259	60.34

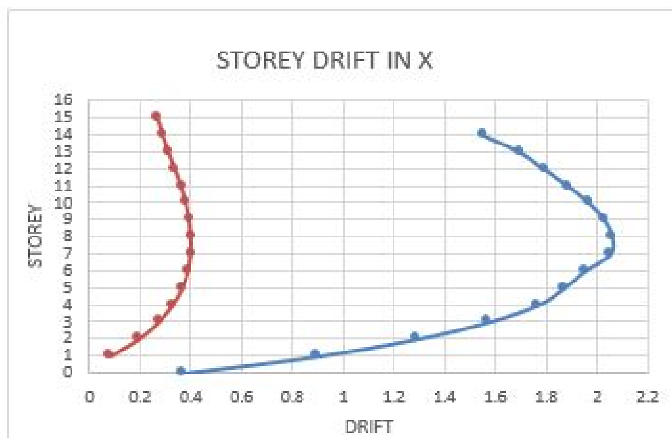

Figure 6: Comparison of storey drift in X-direction

Table - 7: Maximum storey drift in Y Direction

Analysis	Models	Drift	% Reduction in drift
Response Spectra	Model 1	0.527	-
	Model 2	0.359	31.88

Figure 7: Comparison of storey drift in Y Direction

3.1Lateral Displacement

After observing the lateral displacement results from analysis it has been found that lateral storey displacement is greatly reduced by the shear walls. For Model 2 lateral displacement in X and Y direction is reduced by nearly 65 % and 45 % respectively for G+15 floors. Therefore, it can be said that shear walls structure is effective.

3.2 Mode Period

It can be observed that mode period is maximum at mode-1. It gradually decreases from mode-1 to mode-12. In comparison of the Flat slab building with columns, the mode period is more for model 1 than building resting on shear walls.

3.3 Storey drift

It is observed that storey drift is greatly reduced in model with shear walls than in comparison with buildings with columns for G+15 building. For model 2 storey drift is reduced by 60% and 30% in X & Y directions respectively.

4 Conclusions

1. Flat slab with shear wall is advantageous concept to be used in a high rise building as shear walls are model according to plan which increases the carpet area.
2. Lateral story displacements are reduced by the use of shear walls. For Model 2 lateral displacement in X and Y direction is reduced about 65 & 45% for G+15 floors.
3. Storey drift for model 2 is reduced by 60% and 30% nearly in X & Y directions respectively.
4. For Lateral stiffness slab resting on shear walls is found most suitable one under the present study.

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