Modeling and Analysis of Framed Shear Wall In High Rise Building

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Abstract- *For thick populated region there is necessity of high rise buildings. And also there is necessity of huge investment of money. Hence we need to take care of both the things. Earthquake is the type of unexpected load which acts laterally. As we know from the literature, introducing shear wall had reduced the damages to the buildings considerably. So in the present study there is an increment of the frame to shear wall is used in a building and another is purely a shear wall building and variations in the deformation parameters are studied. The building of G+42 is modeled and zone factor corresponding to zone II is taken for analysis. The variation compared in different direction for same model and also the whole variations of one model with another model. IS codes are used for the analysis.*

Keywords- Conventional Building with Framed Shear Wall, Completely Shear Wall Building, Response Spectrum Analysis.

I. INTRODUCTION

Shear wall is component of the building which provides stiffness and strength to the buildings in the direction of which oriented. They significantly reduce lateral sway of the building in turn damage to the structure or its assemblages or components.

The natural well suited locations for shear walls are stair way and elevator cores, serves as vertical shaft providing lateral and axial resistance. But they should be provided along the periphery of the buildings for maximum efficiency and economy.

The overturning moments are large since they carry horizontal forces due to earthquake in high rise buildings.
In olden days after disasters like flood, earthquakes people used stay in a new place and that might not be affected in the future so go on thinking of high rise buildings to protect themselves from the disasters. For the urban clusters of concrete canyons the name high rise buildings have always an admiration.

TYPES OF HIGH-RISE BUILDINGS

High rise buildings are classified according to their primary use.

1. Office buildings. Office building is a structure planned and designed as individual offices or the compartments for shops on lease or rent, including educational institutes, banks, and any private firms.
2. Hotel buildings. Hotel buildings are those which provide food, lodging, beverages and other services.
3. Residential and apartment buildings. A building in which staying is provided regularly with family called as residential building in which a single family in a single floor or more family in a single floor as per the requirement 1BHK, 2BHK etc.
4. Mixed-use buildings. In this type of structures a single building contains residences, hotels, gyms, theatres these may be one's own or share/time type.

In addition to these we have other two types of structures

1. Buildings solely as open parking and
2. All floors above the high rise height limit are used for open parking

II. METHODOLOGY

1. The modeling of structure is carried out using ETABS 2016.

Two types of modeling are incorporated.

a) Conventional building with framed shear wall.
b) Completely shear wall building.

2. Response spectrum analysis is carried out.
3. Parametric study of story drift, displacement and story stiffness are done on the above 2 different models using the above method of analysis.
4. To find the percentage variation in the results obtained in 2 different models

III. MODELING AND ANALYSIS

Modeling of an apartment is done in two different forms as stated in methodology.

PARAMETERS CONSIDERED

For analysis the following parameters are considered:

Table 3 Parameters considered for analysis.

SL. No.	PARAMETER	SPECIFICATION/CODES
1.	Number of storey	42
2.	Seismic zone	II
3.	Zone factor	0.10
4.	Floor area	8050sqft
5.	Height of building	126m
6.	Height of each floor	3m
7.	Slab	250mm
8.	Live load	2kN/m2 ,3kN/m2
9.	Dead imposed	1kN/m2
10.	Floor finish	1kN/m2
11.	Grade of reinforcement	Fe 500
12.	Unit weight of masonry	20kN/m2
13.	Seismic analysis	IS: 1893-2002

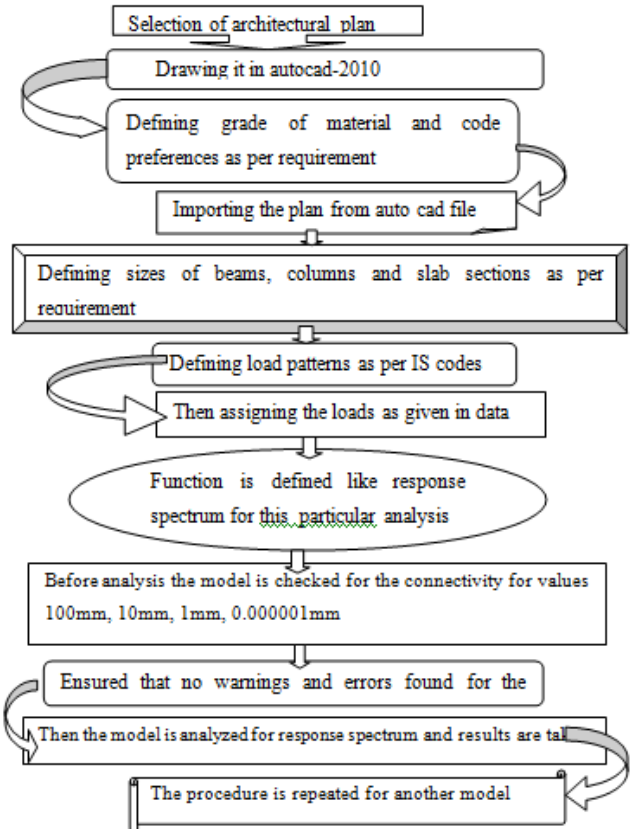
Table 3.1 Sections used for the structure.

PARAMETER	SL. NO.	SECTION (mm)	GRADE OF CONCRETE
Column	1.	230X230	M 40
	2.	230X450	
	3.	230X600	
	4.	230X700	
	5.	230X750	
	6.	230X800	
Beam	1.	150X300	M30
	2.	150X800	
	3.	200X700	
	4.	200X800	
	5.	250X700	
	6.	250X800	
	7.	300X450	
	8.	300X800	
	9.	300X1300	
	10.	300X1500	
Shear wall	1.	150	M40
	2.	200	
	3.	250	
	4.	300	
	5.	400	

For the analysis default load combination in ETABS is used.

USING ETABS PROCEDURE FOR STRUTURAL ANALYSIS

The steps followed while modeling and analyzing are as follows,



MODELS

The structure of G+42 storey building is analyzed by modeling the same in two different forms as below:

1. Conventional building with framed shear wall.
2. Completely shear wall building.

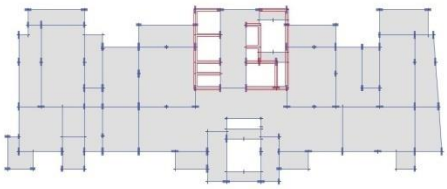


fig.3.0 Plan of the conventional building with framed shear wall in ETABS.

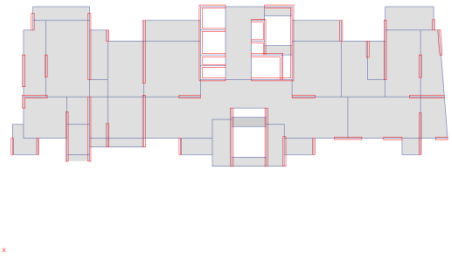
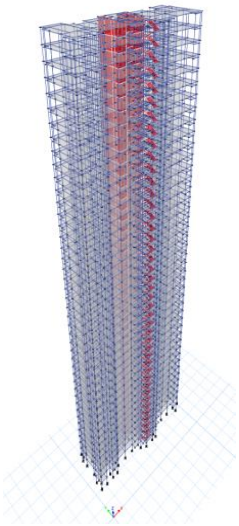


fig 3.1 Plan of the completely shear wall Building in ETABS.



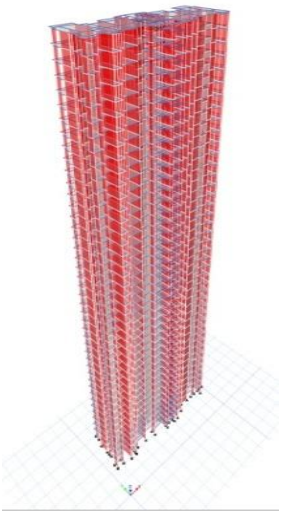


fig.3.2Conventional Building fig.3.3 Shear Wall Building

IV. RESULTS AND DISCUSSION

4.1CONVENTIONAL BUILDING RESULTS

The results of analysis of the conventional building for story displacement, story drifts, overturning moments and story stiffness are stated as below:

4.1.1 Maximum story displacement

Values of maximum story displacement of each story for response spectrum analysis are tabulated. And these displacements are due to the effect of seismic and wind forces on the structure.

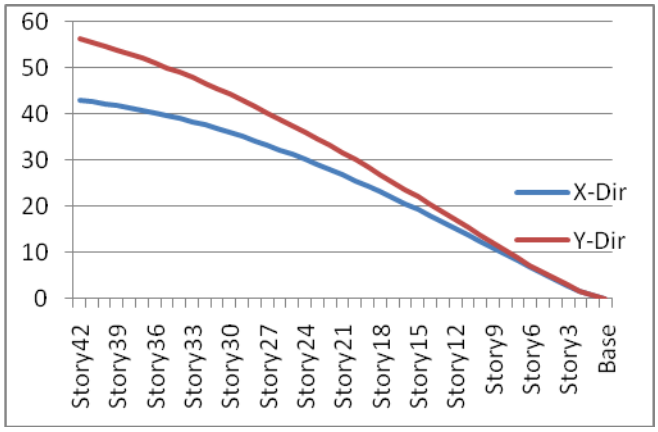


Fig 4.0 Graphical representations of maximum story displacements of all stories of conventional building

DISCUSSION:

From fig 4.0 it is observed that story displacements are high in top story. And the story displacement varies proportionally with the height of the structure.

4.1.2 Maximum story drift

This can be defined as the difference between the stories displacements divided by stories heights. For each story the drift value is different and it is almost having highest value in the middle of the structure.

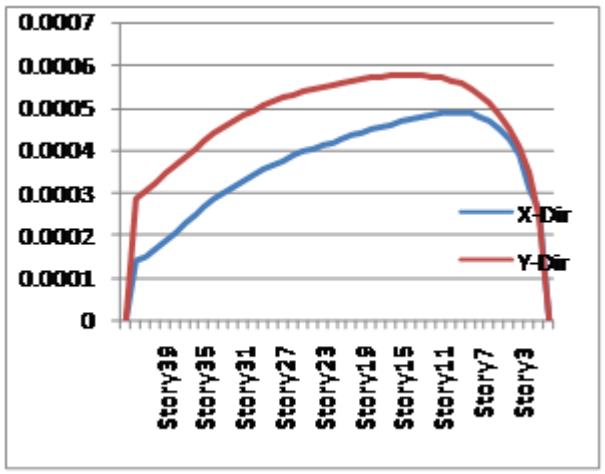


Fig 4.1Graphical representations of maximum story drift of all stories of conventional building.

DISCUSSION:

From fig 4.1 story drift varies linearly in top and bottom story and is maximum at the 9th and 10th story of the structure.

4.1.3 Story overturning moments

The overturning moment varies proportionally as the arm of force, the amount of applied load and is having inverse relation with the ability of the wall to resist the overturning load. The similar effects can be viewed in case of retaining walls acted by earth pressure and dam by hydraulic pressure.

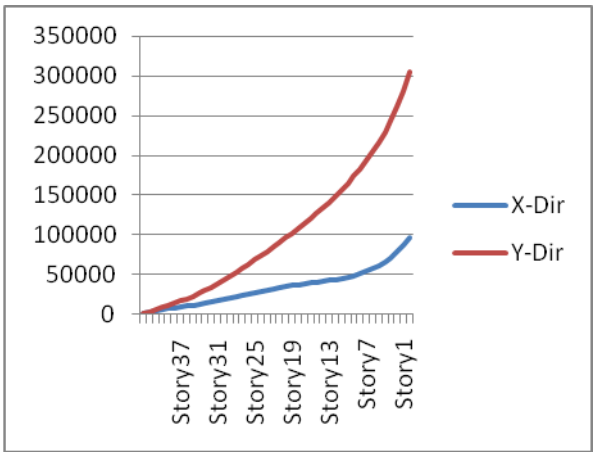


Fig 4.2 Graphical representations of maximum overturning moment of all stories of conventional building.

DISCUSSION:

From fig 4.2 story over turning moment is maximum at the bottom story because of the weight of the structure.

4.1.4. Storey Stiffness

The extent of ability to resist the deformation due to applied load is called as stiffness of the structure. For an engineer to have a good design should concentrate on the individual properties of the materials used for construction. And the stiffness of any material can be calculated by multiplying second moment of inertia and Young's modulus of them.

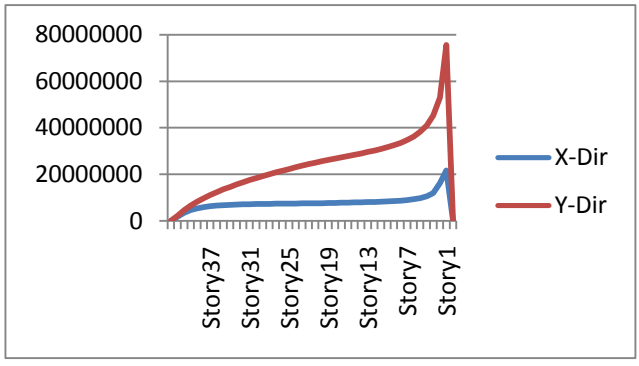


Fig 4.3 Graphical representations of maximum story stiffness of all stories of conventional building.

DISCUSSION:

From fig 4.3 it is observed that the story stiffness is maximum in the 1st story level.

From the above tables 4.0, 4.1, 4.2 and 4.3. It is observed that the values of the parameters in Y-direction are greater than in X-direction because numbers of framed shear walls are less in Y- direction compared to X-direction for the conventional building considered here.

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4.2 SHEAR WALL BUILDING RESULTS

The building is provided with shear wall with different thicknesses and following are results by introducing the shear wall.

4.2.1. Maximum Storey displacement

The maximum storey displacement is the displacement in which the structure is acts like a cantilever beam and the structure gets displaced maximum at the top of the structure. The following are the table and graphs gives the results of maximum storey displacement by providing the shear wall to the structure.

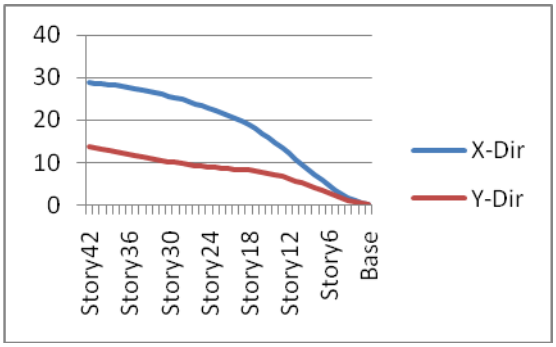

Fig 4.4 Graphical representations of Maximum story displacements of all stories shear wall building.

DISCUSSION:

The table and graphs gives the results of story displacement and its maximum at the top in X as well as Y direction but in X direction it gives higher displacement values than in Y direction.

4.2.2. Storey drift

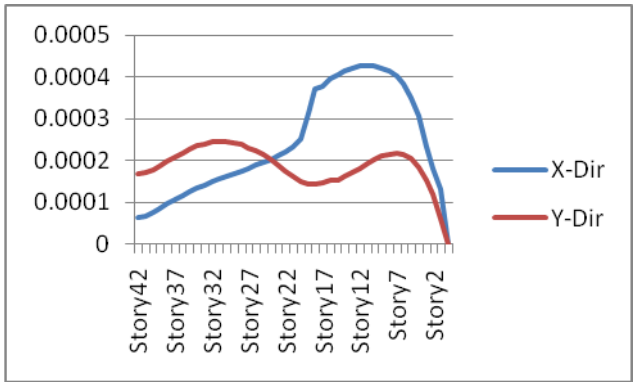

Fig 4.5 Graphical representations of maximum story drift of all stories shear wall building.

DISCUSSION:

The table and graphs gives the results of story drift and its values are higher at the range 9 to 13 story in X and in Y direction its range from 5-10 and 30-35 but in X direction it gives higher displacement values than in Y direction.

4.2.3. Storey Overturning Moment

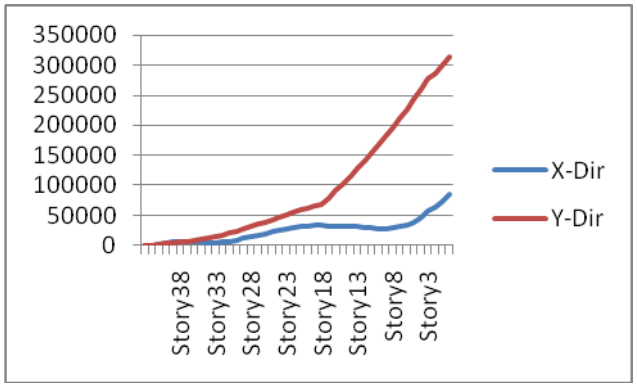

Fig 4.6 Graphical representations of maximum story overturning moment of all stories shear wall building.

DISCUSSION:

The table and graphs gives the results of story overturning moment of all stories and its values are higher at the bottom of the structure in X and in Y direction. But in Y direction it gives higher moment values than in X direction.

4.2.4. Storey Stiffness

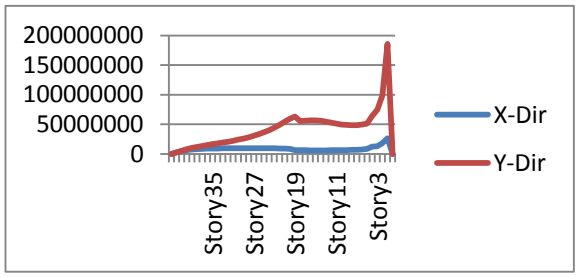

Fig 4.7 Graphical representations of maximum story stiffness of all stories shear wall building

DISCUSSION:

The table and graphs gives the results of story stiffness and its maximum at the 2nd story in X as well as Y direction. But in Y direction it gives higher stiffness values than in X direction.

From tables and figures 4.4, 4.5, 4.6 and 4.7 parameters such as displacement and drifts are higher in X direction. Overturning moment and stiffness are higher in Y direction.

In X direction percentage variation as follows

Table 4.8 Percentage variation of parameters in X direction.

In Y direction percentage variation as follows

Parameters	Conventional building with the framed shear wall	Completely shear wall building	Percentage variation (%)
Displacement (mm)	42.857	28.899	32.56
Drift	0.000486	0.000426	12.34
Overturning moment	95859.8647	85874.4232	10.41
Stiffness	21597581.54	26158167.04	17.43

Table 4.9 Percentage variation of parameters in Y direction.

Parameters	Conventional building with the framed shear wall	Completely shear wall building	Percentage variation (reduction) (%)
Displacement (mm)	56.446	13.762	75.62
Drift	0.000575	0.000244	57.56
Overturning moment	304162.7868	312913.4472	2.79
Stiffness	75498911.38	185853785	59.73

From tables 4.8 and 4.9 we can say that use of completely shear wall building can have more strength than the conventional building considered herein this study.

But only the parameter overturning moment increases with the more numbers of shear walls in the building as the weight of the building increases with it.

V. CONCLUSION

From the response spectrum analysis the following conclusions are made

1. The displacement is maximum at the top of the structure and it depends on the building dimensions.
2. Story drift is high at 1/4th of the height of the structure.
3. The overturning moment of the structure increases compared to conventional building.
4. The stiffness of the structure increase by the use of shear wall instead of columns.
5. The use shear wall can reduce the deformations 2 to 3 times more than conventional method.

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