International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

Comparative Study of with & without Shear Wall for Drift & Displacement

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Abstract - *In the seismic design of buildings, shear wall act as a major earthquake resisting members. Shear wall plays a great role for lateral load resistance. The properties of these seismic shear walls give the response of the buildings, and therefore, it is essential to evaluate the seismic response of the walls appropriately. To study the effect of shear wall we have designed two different models. We have designed the Shear wall in Zone IV in Patna City and designed two models i.e. with and Without Shear Wall. An earthquake load is applied to a building of G+14 stories. Important Parameters like Lateral joint displacement and Storey drift required for each floor are calculated in both cases of shear wall. The analysis of this parameter is carried out by using ETABS software.*

Keywords: R.C.C. shear wall, High rise Structure, ETABS, Displacement, and Drift.

1. INTRODUCTION

High rise buildings or Structures are capable for resisting both the vertical, horizontal load and similarly lateral forces. K.G.Patwari, L.G. Kalurkar [2016] investigated that when such building is designed without shear wall, beam and column sizes are quite heavy and there is problem arises at these joint and it is congested to place and vibrate concrete at these places and displacement is quite heavy which induces heavy forces in building member. M. V. Mohod, S. S. Nibhorkar [2017] proposed that shear wall may become essential from the point of view of economy and control of horizontal displacement. Shear wall is a lateral force resisting system which also carries bending moment and shear forces. G.S Hiremath, Md Saddam Hussain [2014] presented that these walls generally start at foundation level and are continuous throughout the building height. Their thickness can be minimum as 150mm, or as maximum 400mm in high rise buildings. Shear walls are usually provided along both length and width of buildings. Shear walls are like vertically-oriented wide beams that carry earthquake loads downwards to the foundation. Shear walls in high seismic regions require special detailing. Vara Prasad, Mrs. Sujatha , Mrs. J Supriya[2014] investigated that shear walls is added to the building interior to provide extra strength and stiffness to the building when the exterior walls cannot provides sufficient strength and stiffness. It is necessary to provide these shear walls when the allowable span-width ratio. The results are presented in tabular and graphical form. The results on the drift and displacement are checked with service ability condition and are compared and presented in tabular form. Mr.K.LovaRaju, Dr.K.V.G.D.Balaji [2015] concluded that RCC Strutures are designed in seismic zones to lateral displacement which are resulted due to lateral forces.. Gauravi M. Munde, Prof. N. K. Meshram [2017] evaluated that the seismic analysis Code based Procedure for Seismic Analysis (IS 1893:2016) is given by Equivalent Lateral Force Seismic analysis of most of the structures remains applied on the premise of lateral force assumed to be equivalent to the particular loading. The bottom shear that is that the total horizontal force on the structure is calculated on the premise of structure mass and elementary amount of vibration and corresponding mode shape. The bottom shear is distributed on the peak of structures in terms of lateral force in line with code formula. This technique is conservative for low to medium height buildings with regular conformation.

2. MATERIALS AND METHODOLOGY

In this Research Paper we had discussed the most important parameters:

1) Displacement
2) Storey Drift

1. Displacement

Due to dynamic forces like exploration of earthquake, shaking of the ground and due to wind blast in nearby area, there is necessity to find Joint displacement as well as Joint drift. These analyses for the simple structures are carried out manually but for complex structure ETABS can be used to calculate this parameter.

2. Storey Drift

Lateral drift or story drift is nothing but the amount of side sway between any two adjacent stories of a building which is caused by lateral loads i.e. wind and earthquake. In case of single-story building, horizontal deflection of a wall is due to horizontal movement between two supports under wind or earthquake loading. While Vertical deflection of a floor or roof structural member is the amount of sag under gravity loading.

A. Building Modeling

For this study, a 14-story building with a 3.1-meters height for each story, regular in plan is model. These buildings were designed in acquiescence to the Indian Code of Practice for Design of Seismic Resistant Buildings .The buildings are assumed to be fixed at the base and the floors acts as rigid diaphragms. The sections of structural elements are square in their dimensions. Storey height of building is assumed to be constant including the ground storey. The buildings are model using ETAB software. Two different models were studied with positioning of shear wall in building at midspan along width of building and without provision of shear wall in building. These Models are compared for lateral displacement, as well as drift calculation.

B. Preliminary data

- G + 14Storey R.C Public building (Hospital building)
- Zone factor, Zone - IV, Z = 0.24
- Building frame system- (SMRF) - Reduction factor, R = 0.5
- Hospital building - Importance factor - I = 1.5
- Floor to floor height = 3.1m
- Roof and floor slab thickness = 200 mm
- Beams dimension = 500 x 500 mm
- Column size = 700 x 700 mm
- Grade of concrete = M20 and steel Fe-415
- Shear wall thickness = 250 mm

The plan of the building model are given below

Model 1 – Floor plan of the structure without shear wall.

Model 2 – Floor plan of the dual system with shear wall on side of the structure.

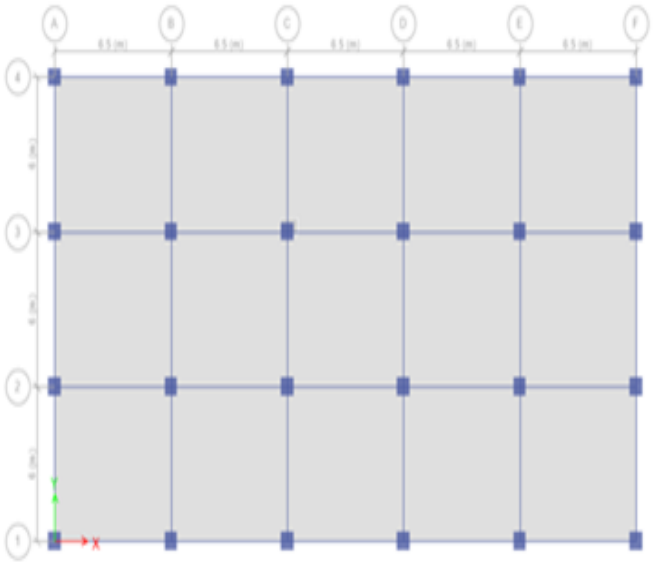

Fig.1 Model 1 – Floor plan of the structure without shear wall.

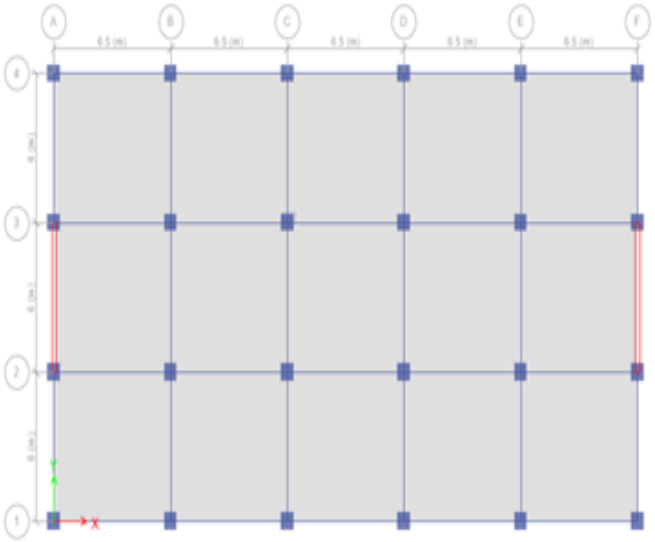

Fig.2 Model 2 – Floor plan of the dual system with shear wall on side of the structure.

3. RESULTS AND DISCUSSIONS

After drawing the model of G+14 Storey in ETAB software we want to find the resistance strength of the building by finding the Storey drift and lateral displacement. We know that Shear wall has large amount of Stiffness and it can resist the horizontal forces.

Table no 1. Model no 1 & 2 with Lateral Displacement without Shear wall and with Shear Wall

Sr no	Storey no	Displacement without shear wall (mm)	Displacement with shear wall (mm)
1	Terrace	87.021	45.096
2	Slab 14	83.81	42.83
3	Slab 14	81.32	41.45
4	Slab 14	77.63	39.36
5	Slab 14	73.15	36.8
6	Slab 14	68.001	33.86
7	Slab 14	62.31	30.59
8	Slab 14	56.19	27.089
9	Slab 14	49.75	23.395
10	Slab 14	43.088	19.568
11	Slab 14	36.26	15.662
12	Slab 14	29.36	11.726
13	Slab 14	22.37	7.829
14	Slab 14	15.24	4.128
15	Ground level	7.28	0.999

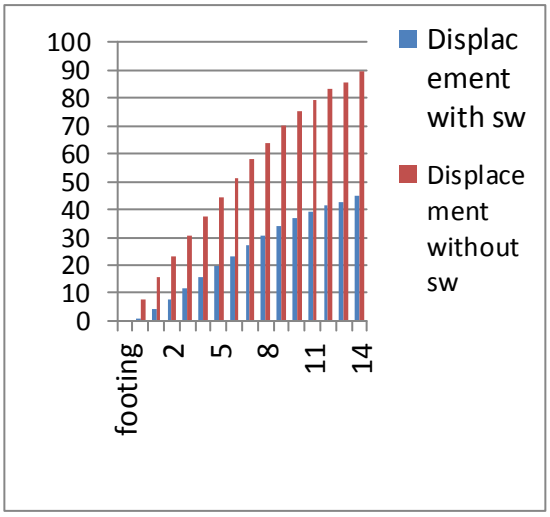

Fig.3 Joint Displacement for model 1 & 2

Table no 2. Model no 1 & 2 with Storey Drift without Shear wall and with Shear Wall

Sr no	Storey no	Drift without shear wall (mm)	Drift with shear wall (mm)
1	Terrace	0.0059	0.0034
2	Slab 14	0.0083	0.0047
3	Slab 14	0.0111	0.0063
4	Slab 14	0.0135	0.0077
5	Slab 14	0.0155	0.0089
6	Slab 14	0.0172	0.0098
7	Slab 14	0.0185	0.0204
8	Slab 14	0.0194	0.011
9	Slab 14	0.020	0.0115
10	Slab 14	0.0206	0.0604
11	Slab 14	0.0209	0.0119
12	Slab 14	0.0211	0.0118
13	Slab 14	0.02166	0.0112
14	Slab 14	0.0234	0.0093
15	Ground level	0.0284	0.0042

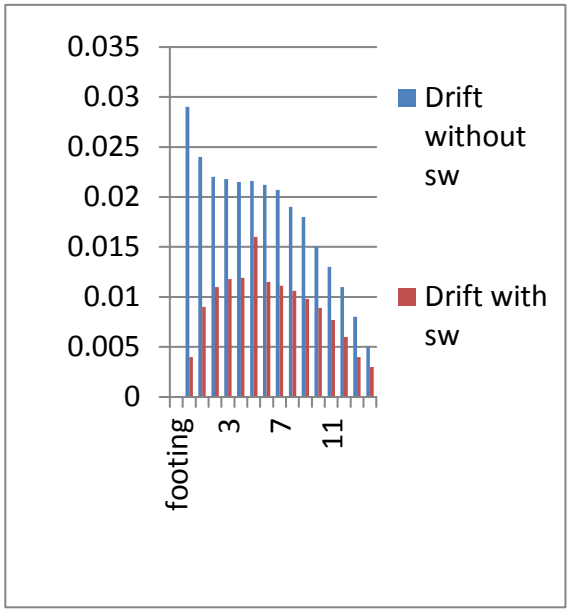

Fig.4 Joint Drift for model 1& 2

4. CONCLUSIONS

This report focuses on improving the resistance and stability of high rise building against the different loads and forces (mainly seismic forces) it is subjected to during its life time.

From all the above analysis, it is observed that in 14 story building, constructing with shear wall along short span at middle (model 2) is effective in resisting seismic forces as compare to building without shear wall. It is also observed that the shear wall is economical and effective in high rise building.

From the above graphical results it is evident that shear wall should be provided in high rise buildings as the performance of these structures when subjected to different forces is not satisfactory.

Also observed that

- If the dimensions of shear wall are large then major amount of horizontal forces are taken by shear wall.
- Joint Drift and Joint Displacement is minimum when shear wall is used

- From above Software analysis it is indicated that joint drift and joint displacement is also reduced by 42.66 % and 48.178%.

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