



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 6, June 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118



9940 572 462



6381 907 438



ijirset@gmail.com



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Comparative Analysis of G+10 Multi Story Regular and Irregular Building with and Without Shear Wall

P.Neeraja

Assistant Professor, Department of Civil Engineering, MGIT, Hyderabad, India

ABSTRACT: Shear wall systems are one of the most commonly used lateral load resisting systems in buildings. Shear walls are one of the most efficient lateral force resisting elements in buildings. In the seismic design of buildings, reinforced concrete structural walls, or shear walls, act as major earthquake resisting members. 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 advantageous in many structural engineering applications. They are mainly flexural members and usually provided in buildings to avoid the total collapse of the buildings under seismic forces. The properties of these seismic shear walls dominate the response of the buildings, and therefore, it is important to evaluate the seismic response of the walls appropriately.

In this study a G+10 storey regular and irregular building with and without shear wall condition are carried out by using ETABS Software. Results will be obtained from analysis and plotted to compare and to have knowledge of behavior of RCC framed structures with shear walls is subjected to earthquake load in zone II. The parameters like storey drift, storey shear, storey bending, time period are compared for all the buildings.

KEYWORDS: Shear wall, gravity loads, seismic forces, earthquake load, storey drift, shear, bending.

I. INTRODUCTION

Many medium-rise apartment buildings are being constructed, in India, using shear walls to provide earthquake resistance to reinforced concrete frames. These shear walls may have openings for the windows, doors and duct spaces for functional reasons. The number, location and size of openings affect the behavior of a structure as well as stress in the shear wall.

Framed structures with shear wall are frequently adopted as the structural system for high-rise building structures. This structural system would also have many openings for the entrance to elevators or staircases etc. Generally, plane stress elements and beam elements are used to model the shear wall and frames respectively in the analysis of this kind of building. A plan stress element should have drilling degrees of freedom to represent the connection of shear wall core and frames. Otherwise, the bending moment at the end of a beam cannot be transferred to the shear wall.

The openings may be of large size that is in the case where it is like function halls, conference halls, and movie theaters. The number, location, size, and shape of opening affects the behavior of structure in the form of deflection, stress in the members. These openings seriously effect the efficiency and accuracy of the analysis.

II. METHODOLOGY

In the present study, analysis of G+21 stories building in Zone V seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

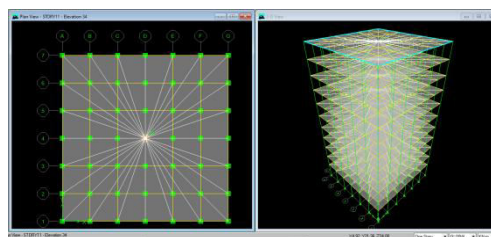
- | | |
|-------------------------------|----------------------|
| 1. Grade of concrete | : M30 |
| 2. Grade of Reinforcing steel | : HYSD Fe500 |
| 3. Dimensions of beam | : 300mmX400mm |
| 4. Dimensions of column | : 500mmX500mm |
| 5. Thickness of slab | : 150mm |
| 6. Shear wall thickness | : 230mm |
| 7. Height of bottom story | : 4m |
| 8. Height of Remaining story | : 3m |
| 9. Live load | : 2KN/m ² |

10. Floor load	: 1.5 KN/m ²
11. Density of concrete	: 25 KN/m ³
12. Seismic Zone	: Zone II
13. Site type	: II
14. Importance factor	: 1.5
15. Response reduction factor	: 5
16. Damping Ratio	: 5%
17. Structure class	: B
18. Basic wind speed	: 38m/s
19. Risk coefficient (K1)	: 1.08
20. Terrain size coefficient (K2)	: 1.14
21. Topography factor (K3)	: 1.36
22. Wind design code	: IS 875: 1987 (Part 3)
23. RCC design code	: IS 456:2000
24. Steel design code	: IS 800: 2007
25. Earth quake design code	: IS 1893 : 2002 (Part 1)

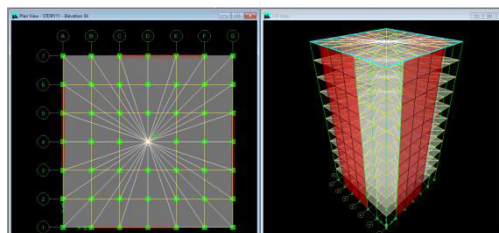
MODELING OF BUILDING IN ETABS:

Regular Buildings

Without Shear walls

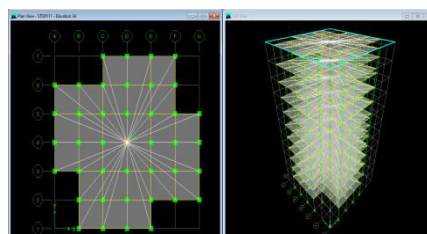


With shear walls

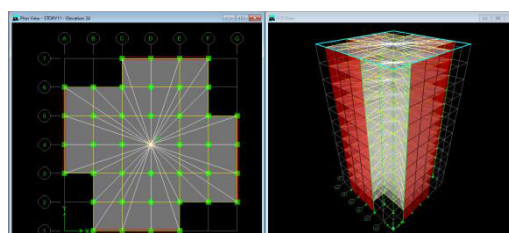


Irregular Buildings

Without Shear walls



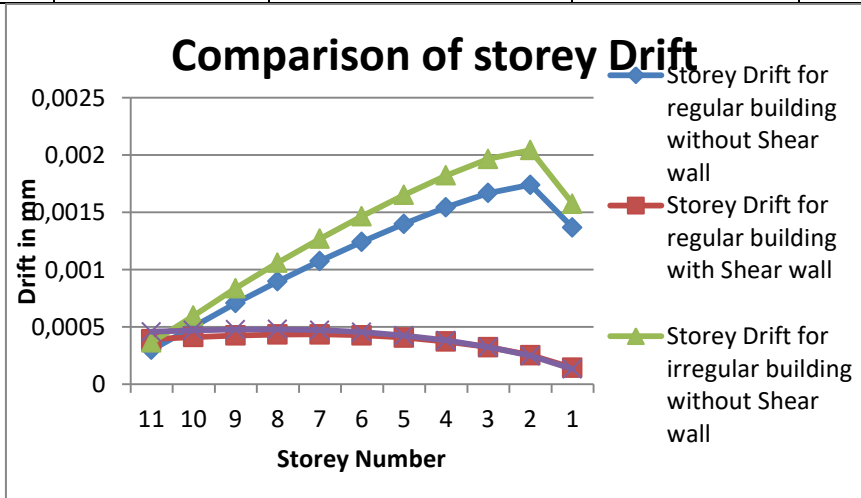
With shear walls



IV. RESULTS AND ANALYSIS

Comparison of storey Drift

Storey Number	Load	Storey Drift for regular building without Shear wall	Storey Drift for regular building with Shear wall	Storey Drift for irregular building without Shear wall	Storey Drift for irregular building with Shear wall
11	RSA	0.000301	0.000394	0.00037	0.00046
10	RSA	0.000503	0.000413	0.0006	0.00047
9	RSA	0.000708	0.000426	0.00084	0.00048
8	RSA	0.000899	0.000435	0.00106	0.00048
7	RSA	0.001076	0.000436	0.00127	0.00047
6	RSA	0.001243	0.000428	0.00147	0.00046
5	RSA	0.0014	0.000408	0.00165	0.00043
4	RSA	0.001545	0.000374	0.00182	0.00038
3	RSA	0.001669	0.000324	0.00197	0.00033
2	RSA	0.00174	0.000255	0.00204	0.00025
1	RSA	0.001367	0.000144	0.00158	0.00013

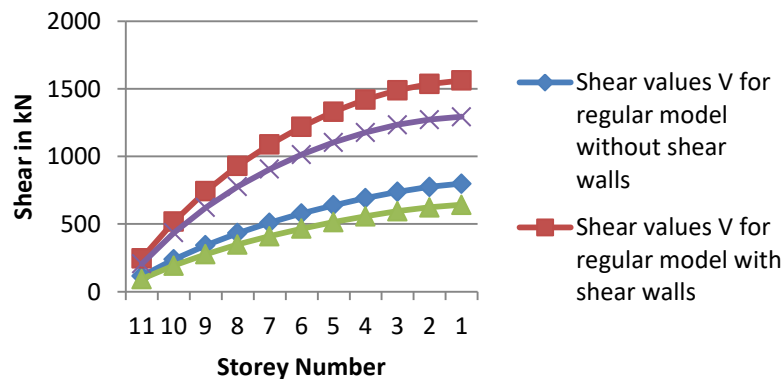


Comparison of storey shear

Storey Number	Load	Shear values V for regular model without shear walls	Shear values V for regular model with shear walls	Shear values V for irregular model without shear walls	Shear values V for irregular model with shear walls
11	RSA	116.44	247.49	93.63	206.35
10	RSA	239.15	518.47	192.81	434.93
9	RSA	343.27	743.73	276.77	622.85
8	RSA	432.7	931.23	348.74	777.56
7	RSA	510.37	1088.3	411.16	906.07
6	RSA	578.29	1220.35	465.7	1013.71
5	RSA	638.93	1330.85	514.38	1103.84
4	RSA	692.83	1420.84	557.67	1177.5

3	RSA	738.95	1489.69	594.72	1234.02
2	RSA	775.5	1536.39	624.06	1272.36
1	RSA	798.67	1562.22	642.62	1293.61

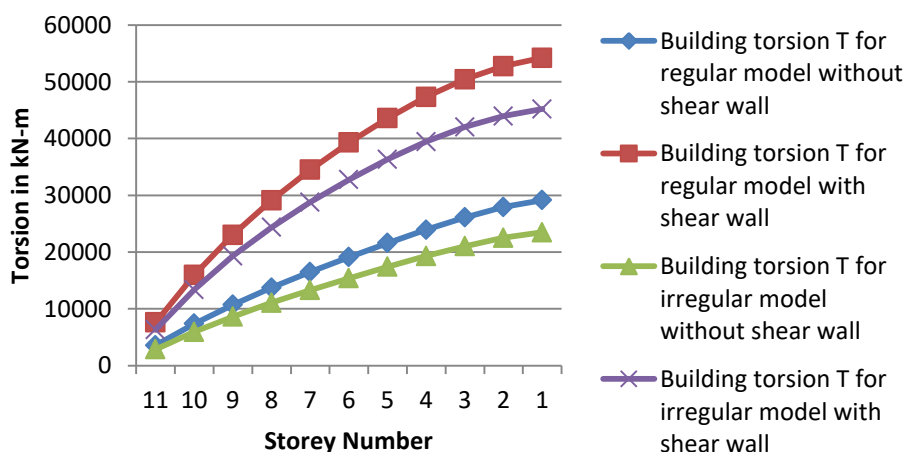
Comparison of storey Shear



Comparison of Torsion

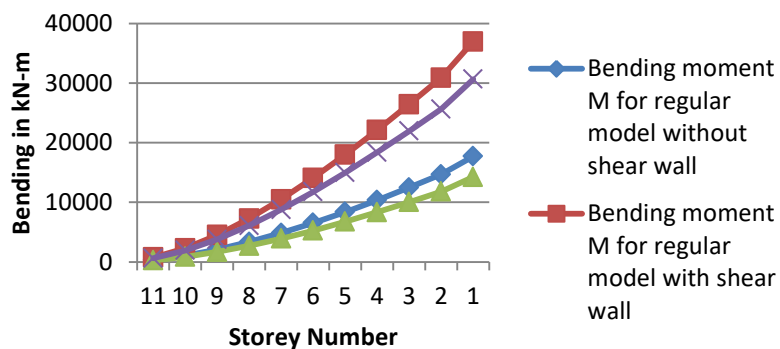
Storey Number	Load	Building torsion T for regular model without shear wall	Building torsion T for regular model with shear wall	Building torsion T for irregular model without shear wall	Building torsion T for irregular model with shear wall
11	RSA	3577.874	7608.132	2877.002	6343.279
10	RSA	7372.856	15966.35	5944.448	13394.19
9	RSA	10699.73	23036.99	8628.271	19297.54
8	RSA	13716.45	29127.01	11059.05	24341.73
7	RSA	16486.6	34495.38	13289.79	28776.31
6	RSA	19094.42	39300.47	15390.38	32755.4
5	RSA	21598.43	43591.38	17408.61	36324.9
4	RSA	23942.11	47335.27	19298.13	39449.55
3	RSA	26092.51	50424.07	21031.78	42027.81
2	RSA	27931.55	52744.39	22512.76	43957.87
1	RSA	29138.84	54219.53	23483.25	45186.52

Comparison of Building Torsion

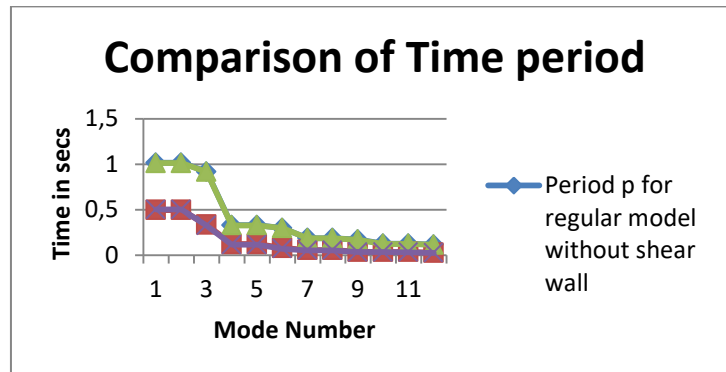


Comparison of storey Bending

Storey Number	Load	Bending moment M for regular model without shear wall	Bending moment M for regular model with shear wall	Bending moment M for irregular model without shear wall	Bending moment M for irregular model with shear wall
11	RSA	349.311	742.883	280.884	619.377
10	RSA	1065.351	2296.288	858.145	1922.433
9	RSA	2087.442	4518.343	1682.128	3783.132
8	RSA	3365.339	7288.697	2711.885	6095.529
7	RSA	4860.839	10508.64	3916.363	8774.2
6	RSA	6542.678	14097.81	5270.236	11751.39
5	RSA	8385.981	17989.13	6753.474	14972.3
4	RSA	10370.58	22123.64	8349.947	18389.91
3	RSA	12476.65	26446.22	10043.84	21960.66
2	RSA	14681.92	30903.27	11817.33	25641.93
1	RSA	17726.04	36969.54	14265.42	30653.78

Comparison of Storey Bending**Comparison of Time period**

Mode	Period p for regular model without shear wall	Period p for regular model with shear wall	Period p for irregular model without shear wall	Period p for irregular model with shear wall
1	1.015644	0.497253	1.012753	0.502846
2	1.015644	0.497253	1.012753	0.502846
3	0.916644	0.334878	0.915901	0.323936
4	0.329497	0.121846	0.327986	0.115413
5	0.329497	0.121846	0.327986	0.115413
6	0.298672	0.080957	0.297884	0.071793
7	0.186627	0.057157	0.185059	0.053075
8	0.186627	0.057157	0.185059	0.053075
9	0.171482	0.037846	0.170362	0.033995
10	0.125918	0.03677	0.124643	0.033995
11	0.125918	0.03677	0.124643	0.032789
12	0.116143	0.027245	0.115056	0.025158



V. CONCLUSIONS

From the above study the following conclusions were made

1. For regular building and irregular buildings the values of drift are less for building using shear wall than building without shear wall. The storey drift values decreases up to 70% averagely for regular building case and 85% for irregular building case.
2. The values of storey Shear has high for regular building with shear wall than without shear for irregular model. The value of shear can be reduced as 59.38% with and without shear wall.
3. The values of Building Torsion (T) has high for regular building with shear wall than without shear for irregular model. The value of torsion can be reduced as 57.31% with and without shear wall.
4. From bending moment(M) has high for regular building with shear wall than without shear for irregular model. The value of bending moment can be reduced as 61.76% with and without shear wall.
5. As per the drift values the building with shear wall condition for irregular building model will give better results than other models.
6. By providing the shear walls for regular and irregular building models the load acting on the building has higher intensity than without shear wall due to this reason the values are obtained high for buildings with shear walls.

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