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Seismic Analysis of an Irregular Building With Shearwall at Different Locations

Devipriya. J
M Tech Student
Sree Narayana Institute of Technology
Theppupara, Adoor, Kerala

Hariprasad T R
Assistant Professor, Department of Civil Engineering
Sree Narayana Institute of Technology
Theppupara, Adoor, Kerala

Abstract: Buildings with irregular geometry respond badly against seismic force. This structure undergoes greater level of vibrations which may be due to earthquakes or wind. The present work deals with a study on the improvement location of shear wall in an irregular G+9 building and the effect of shear wall on overall seismic response of this building. An irregular E-shaped building is considered for the analysis. This study is to compare various parameters such as story drift, story shear, story displacement of the building under seismic forces based on various position of shear walls. Best position of the shear wall is obtained by response spectrum analysis. Analysis is done by using ETABS.
Keywords: Irregularbuilding,Shearwalll, Response Spectrum Analysis.

I. INTRODUCTION

Earthquake disaster had always considered one of the hazardous natural calamities upon the mankind. Earthquake disasters brings in its wake untold miseries and hardship to the people affected due to collapse of the building. Indian subcontinent considered as earthquake prone and experienced with most severe earthquakes in the world.

The important factors affecting seismic configuration of buildings are its overall geometry, structural systems, and load paths. The aspects like building slenderness ratio and the building core size are the key factors for the efficient structural design of buildings. In this study, response spectrum analysis has been carried out using ETAB software to understand the seismic behavior of high rise irregular building with shear wall. In modern urban infrastructure irregular buildings constitute a large portion due to insufficient space or for aesthetic appearance. The configuration of the buildings is determined by the group of people involved in the construction process. They include the owners, structural engineers, contractors, architects and local authorities involved in overall planning. When these structures are located on high seismic region, the structural engineers play an important role in designing the building as earthquake resistant and to perform well against the earthquake motions. In present study a G+9 high rise building with shear walls at different locations is considered for analysis.

According to IS 1893(Part 1):2002, the irregularities in a building may be plan irregularity or vertical irregularity. Here in this analysis 'E'-shaped building is considered. It is one which has plan irregularity with re-entrant corners.IS code provide the following definition for re-entrant irregularity.

"Plan configurations of a structure and its lateral force resisting system contain re-entrant corners, where both projections of the structure beyond the re-entrant corner are greater than 15 percent of its plan dimension in the given direction."

Shear walls are the structural elements which increase the strength of R.C.C Structure. In high rise buildings the functions of shear wall is to to resist lateral loads that may cause by seismic and wind forces. R.C. Shear wall provide large strength and stiffness to the building which considerably reduces lateral displacement of the building and reduces the damages to the entire building. By attaching or placing a rigid wall like shear wall, inside a R.C. frame maintains its shape and prevents the joint rotation. By providing shear wall the structure become more rigid against the action of lateral forces and thereby make the structure more safe and durable

II. OBJECTIVES

- To suggest appropriate position of shear walls for irregular building.

- To study the effect of parameter like story displacement, story drift and story shear for the models considered in this study.

III. SCOPE

The structural behavior and Comprehensive study using ETAB software for FEA method for seismic evaluation of irregular building with shear wall can be carried out. The results obtained in the present work can be demonstrated, that the presence of shear wall changes the dynamics characteristics of the building and contribute to increase structural resistance against seismic action.

IV. ANALYSIS OF MODELS

The G+9 (10 story) E-shaped building is analyzed by response spectrum method for zone IV for different positions of shear wall. The seismic analysis is carried out by ETABS. Details of the model for analysis are shown in table 1. M_{20} Grade concrete and Fe $_{415}$ steel are used.

TABLE 1.Details of Model

Beam size	300 x 450 mm
Column size	450 x 450 mm
Story height	3m for all floors
Thickness of masonry wall	230mm
Thickness of slab	150mm
Thickness of shear wall	150mm
No: of bays in X direction	4
No: of bays in Y direction	5
Bay width in X and Y direction	5m
Floor finish	1kN/m^2
Roof finish	1kN/m^2
Live load on roof	1.5kN/m^2
Live load on floor	2.5kN/m^2
Seismic zone	IV
Zone factor, Z	0.24
Response reduction factor, R	5
Importance factor, I	1

A. Models For Analysis

Five models were considered for the analysis. Model 1 is building without shear wall (fig 1).Other models have shear walls at different positions (fig 2- 5).From this the model with best position of shear wall is find out.

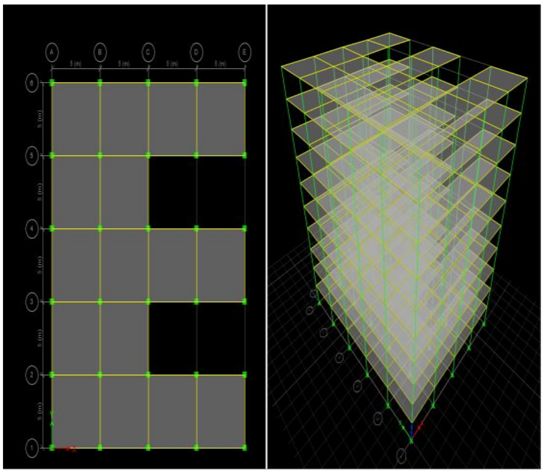

Fig.1. Model 1

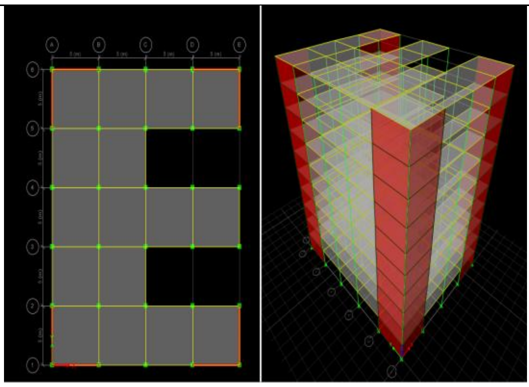

Fig.2. Model 2

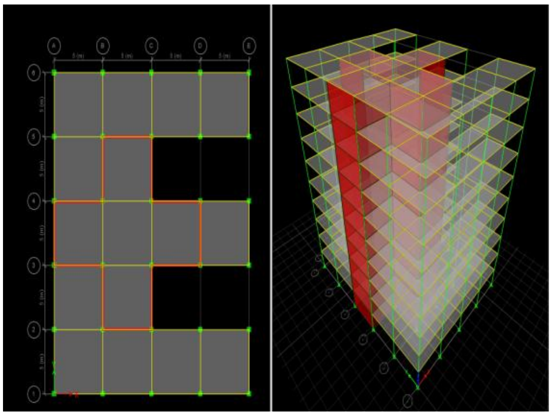

Fig.3. Model 3

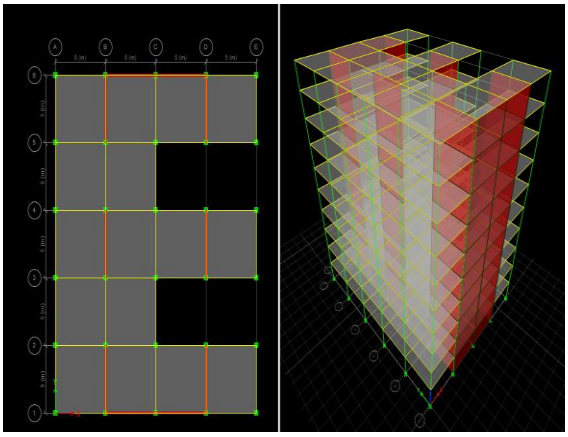

Fig.4. Model 4

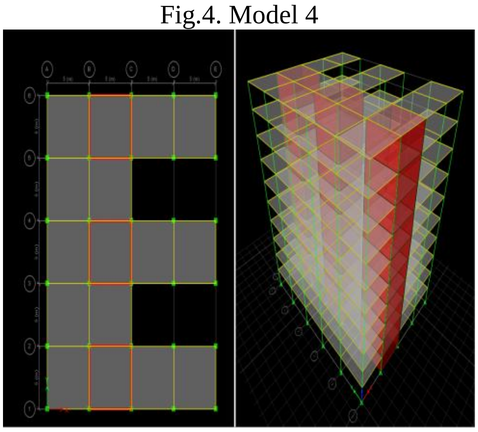

Fig.5. Model 5

V. RESULTS AND DISCUSSION

Based on the results obtained, comparison was made for story displacement; Story drift and story shear for response spectrum analysis considering the models with and without shear wall. The tables and graphs are shown below.

TABLE 2.Story Displacement for Building by Response Spectrum Analysis (mm)

Story No:	Model 1	Model 2	Model 3	Model 4	Model 5
Story 10	15.646	8.007	2.831	6.532	6.182
Story 9	15.031	7.042	2.633	5.727	5.467
Story 8	14.113	6.049	2.399	4.905	4.724
Story 7	12.889	5.045	2.13	4.077	3.966
Story 6	11.388	4.049	1.83	3.259	3.207
Story 5	9.641	3.087	1.508	2.471	2.467
Story 4	7.674	2.188	1.172	1.743	1.77
Story 3	5.522	1.389	0.835	1.101	1.142
Story 2	3.27	0.727	0.511	0.572	0.615
Story 1	1.163	0.245	0.217	0.19	0.219
Base	0	0	0	0	0

The graph (fig.6.) below shows the story displacement at different story levels. The model without shear wall has maximum story displacement than other models. Model 3 has minimum story displacement than all other models.

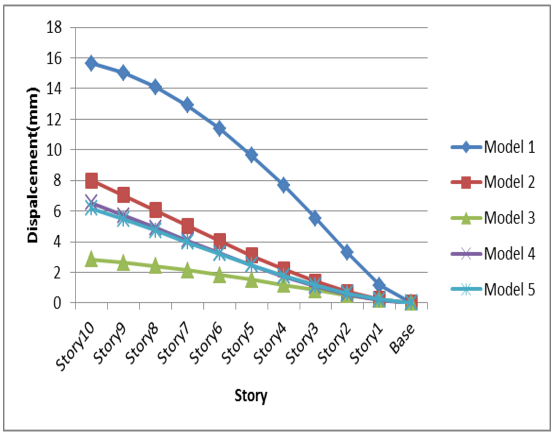

Fig.6. Story Displacement

As per IS1893 (Part 1):2002, the permissible limit for the story displacement is H/500.where H is the total story height.
i.e. 30000/500 =60. Therefore obtained results are within the permissible limit

TABLE 3.Story Drift for Building by Response Spectrum Analysis

Story No:	Model 1	Model 2	Model 3	Model 4	Model 5
Story10	0.000243	0.000326	0.000068	0.000269	0.000239
Story9	0.000361	0.000334	0.000080	0.000275	0.000249
Story8	0.000467	0.000337	0.000091	0.000277	0.000254
Story7	0.000553	0.000333	0.000101	0.000274	0.000254
Story6	0.000621	0.000322	0.000109	0.000263	0.000248
Story5	0.00068	0.0003	0.000113	0.000244	0.000233
Story4	0.000729	0.000267	0.000113	0.000216	0.00021
Story3	0.000754	0.000221	0.000108	0.000177	0.000176
Story2	0.000703	0.000161	0.00009.8	0.000127	0.000132
Story1	0.000388	0.000082	0.0000720	0.0000630	0.000073
Base	0	0	0	0	0

The graph (fig.7.) below shows the story drift at different story levels. The model without shear wall has maximum story drift than other models. Model 3 has minimum story drift than all other models.

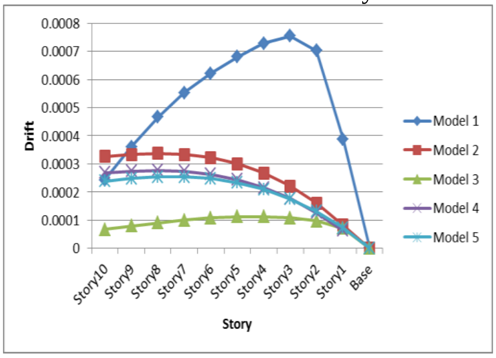

Fig.7. Story Drift

As per IS1893 (Part 1):2002, the permissible limit for the story drift is 0.004h.where h is the story height.
i.e.0.004 x 3000 =12 mm. Therefore obtained results are within the permissible limit

TABLE 4. Storey Shear For Building By Response Spectrum Analysis (kN)

Story No:	Model 1	Model 2	Model 3	Model 4	Model 5
Story10	101.2551	270.5966	268.5342	267.8477	301.5249
Story9	186.3435	525.1701	546.1673	538.8337	595.6963
Story8	249.6405	727.5804	780.9386	764.8135	830.3687
Story7	299.5332	890.5585	978.1169	951.5673	1018.59
Story6	339.8967	1023.882	1142.705	1106.006	1171.639
Story5	376.2537	1134.059	1278.891	1233.965	1297.5
Story4	411.3786	1223.581	1388.644	1338.558	1399.513
Story3	444.0494	1291.539	1471.341	1419.721	1476.877
Story2	471.6223	1336.018	1525.454	1475.068	1527.532
Story1	485.0021	1355.453	1549.797	1501.702	1550.084
Base	485.0021	1355.453	1549.797	1501.702	1550.084

The graph (fig.8.) below shows the story shear at different story levels. The model without shear wall has minimum story shear than other models. Model 3and 5has approximately equal story shear values than all other models.

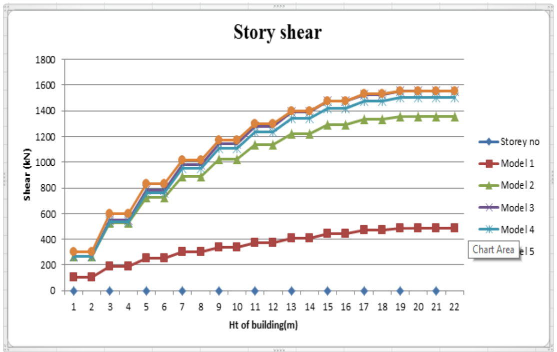

Fig.8. Story Shear

As the base shear of the structure increases it make the structure more stable against lateral forces. So the deformations caused in the building also reduced.

VI. CONCLUSIONS

- The model without shear wall experiences high story displacement and story drift than the models with shear wall.
- Model 3 has comparatively less story displacement and story drift and high base shear than other ones.
- The base shear of the structure increases rapidly and makes the structure more stable against lateral loading.
- Hence we can conclude that model 3 can be taken as the building with best positioned shear wall.
- In model 3 the shear wall connects the two re-entrant corners. Therefore the torsional effect and stress concentration at these points can be reduced.
- The story displacement and story drifts are within the permissible limits.

FUTURE SCOPE

- This analysis can be carried out in other irregular buildings.
- Composite shear walls can be can be used instead of R.C.C shear walls.
- This work can be performed on composite structures.
- Results can be compared with time history analysis.
- Results can be compared using other software.

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REFERENCES

[1] Abdul Vajid P, Dr. Abhay sharma, "Seismic Analysis of Ground Open RC Buildings Strengthened with Masonry Infill Walls, ShearWalls and Steel Bracings", International Journal of Science Engineering and Technology,2016

[2] Anushri C, Dr B Shivakumara Swamy, " Study on Performance of Regular and L-Shape Plan Irregular Building with Dampers, Shear Wall and Infill Wall ", International Research Journal of Engineering and Technology (IRJET) ,2016

[3] Narendra A. Kaple, S.D.Malkhede, "Seismic Analysis Of RC Frame Structure With And Without Masonry Infill Walls", International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT) – 2016

[4] Mohammed Rizwan Sultan, D. Gouse Peer, "Dynamic analysis of multi-storey building for different shapes" International Journal of Innovative Research in Advanced Engineering, August 2015

[5] Prof. N Murali Krishna, Md Masihuddin Siddiqui "Non Linear Time History Analysis of Building with Seismic Control Systems" IJSTE - International Journal of Science Technology & Engineering , February 2015.

[6] Sachin.P.Dyavappanavar, Dr. K.Manjunatha, "Seismic Analysis Of Rc Multi-storied Structures With Shear Walls At Different Locations" International Research Journal of Engineering and Technology , 2015

[7] Hrushikesh, Prof. Lokesh, "Study on Effect of Infill Walls in Multistorey Irregular R.C. Framed Structure with Shear Wall", International Journal for Scientific Research & Development,2015

[8] Ashok Thakur, Arvinder Singh, "Comparative Analysis of a Multistoried Residential Building with and without Shear Wall using STADD Pro" International Journal of Recent Research Aspects, June 2014

[9] Mr. Gururaj B.Katti, Dr. Basavraj S. Balapgol "Seismic Analysis of Muiltistoried RCC Buildings Due to Mass Irregularity By time history analysis" , International Research Journal of Engineering and Technology (IRJET,July 2014.

[10] Bahador Bagheri, Ehsan Salimi Firoozabad, Mohammadreza Yahyaei, "Comparative Study of the Static and Dynamic Analysis of Multi-Storey Irregular Building", International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering, May 2012

[11] IS 1893 (Part 1): (2002),"Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards, New Delhi 110002.

[12] IS 13920:1983, "Ductile detailing of reinforced concrete structures subjected to seismic forces-code of practice", Bureau of Indian standards, New Delhi.

[13] IS 456 : 2000, "Plain and reinforced concrete-code of practice,Bureauof Indian standards", New Delhi..

[14] IS-875 (Part-1)-1987 code of practice for design loads (other than earthquake loads) for buildings and structures: part-1 for dead loads

[15] IS-875 (Part-2)-1987 code of practice for design loads (other than earthquake loads) for buildings and structures: part-2 for imposed loads

[16] IS-875 (Part-3)-1987 code of practice for design loads (other than earthquake loads) for buildings and structures: part-2 for wind load