

DYNAMIC RESPONSE OF REGULAR AND IRREGULAR HIGH RISE BUILDINGS UNDER THE INFLUENCE OF SHEAR WALLS BY USING ETABS SOFTWARE

C Naga Raju¹, S Ramesh Reddy²

P.G. Student, Department of Civil Engineering, Brindavan Institute of Technology & Science, Kurnool, A.P., India¹
Nagaraju.c91@gmail.com

Professor, Department of Civil Engineering, Brindavan Institute of Technology & Science, Kurnool, A.P., India and
Research Scholar, JNTUA college of Engineering, Anantapuram, A.P., India²

ABSTRACT

This study presents the procedure for seismic performance estimation of high-rise buildings based on a concept of the capacity spectrum method. In 3D analysis, a model of 21 storied buildings have been generated for regular and irregular buildings and analyzed using structural analysis tool ETABS. To study the effect of concrete core wall & shear wall at different positions during earthquake, seismic analysis using both linear static, linear dynamic and non-linear static procedure has been performed. The deflections at each storey level have been compared by performing Response spectrum method to determine capacity, demand and performance level of the considered building models. From the below studies it has been observed that non-linear Response spectrum method provide good estimate of global as well as local inelastic deformation demands and also reveals design weakness that may remain hidden in an elastic analysis and also the performance level of the structure. In this study regular and irregular building was studied for G+21 story building to check the Deflection, Shear Force, Bending Moment and Building Torsion by using Response spectrum method under influence of shear walls.

Keywords: High rise buildings, regular building, irregular building, ETABS, G+21, Deflection, Force, Bending Moment, Building Torsion.

1.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 plane 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.

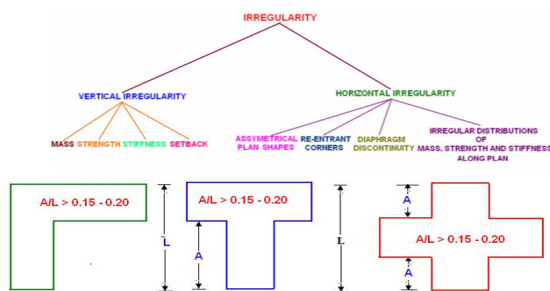
The openings may be of large size i.e., in the case of function halls, conference halls, and movie theaters. The number, location, size, and shape of opening affect the behavior of structure in the form of deflection, stress in the members. These openings seriously effect the efficiency and accuracy of the analysis.

REGULAR BUILDINGS

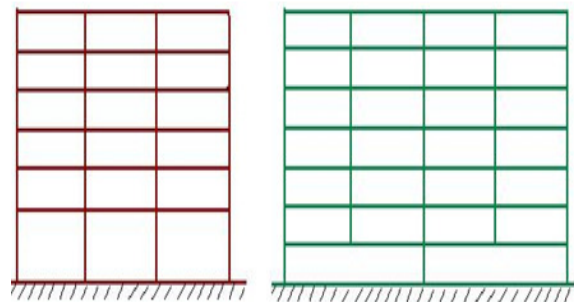
The buildings which are Symmetry about X and Y direction are called Regular buildings. Generally for this buildings the length of building is equal to width of building. The load distribution is uniform in vertical direction.

IRREGULAR BUILDINGS

The irregularity in the building structures may be due to irregular distributions in their mass, strength and stiffness along the height of building. When such buildings are constructed in high seismic zones, the analysis and design becomes more complicated. There are two types of irregularities. a) Vertical Irregularity b) Horizontal Irregularity.



Re-entrant corner irregularity



Irregular distribution of stiffness in the building system

SHEAR WALL

Shear walls are vertical stiffening elements designed to resist lateral forces exerted by wind or earthquake. The shape and location of shear wall have significant effect on their structural behavior under lateral loads. Lateral loads are distributed through the structure acting as a horizontal diaphragm to the shear walls, parallel to the force of action. These shear wall resist horizontal forces because of their high rigidity as deep beams, reacting to shear and flexure against overturning. A core eccentrically located with respect to the building shapes has to carry tension as well as bending and direct shear.

OBJECTIVE OF THE STUDY

The following are the main objectives of the project

1. To study the seismic behavior of multi story building by using IS 1893:2002

2. To compare the multi story buildings with and without shear wall at different locations on multi story Building with regular and irregular shapes.
3. To compare the results of Story Drift, Shear force, bending moment, Building torsion of buildings without shear wall at different locations on multi story Building with regular and irregular shapes.
4. To study the buildings in ETABS V9.7.4 in Response spectrum analysis.

2. LITERATURE REVIEW

Ehsan Salimi Firoozabad, Dr. K. Rama Mohan Rao, Bahador Bagheri.,et al¹ (2012) main focus is to determine the effect of shear wall configuration on seismic performance of buildings. From this study, it was concluded that different position of shear walls can reduce the top story drift at least twice, which means the drift of building is reduced 100 percent from highest value to lowest one.

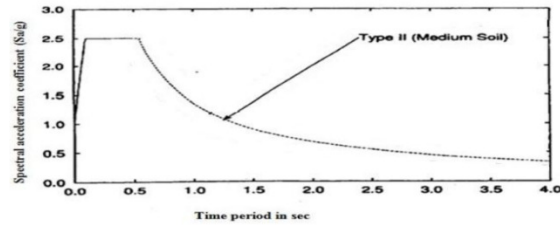
Shahzad Jamil Sardar and Umesh. N. Karadi., et al² (2013) has a study of 25 storey building in zone V is presented with some investigation which is analyzed by changing various location of shear wall for determining parameters like storey drift, storey shear and displacement is done by using standard package ETAB. From this study it was concluded that the seismic analysis of reinforced concrete frame structure is done by both static and dynamic analysis to determine and compare the base shear; it has been found that maximum base shear in model-5 along longitudinal and transverse direction as compared to the other models.

Najma Nainan., et al³ (2012) concluded that the analytical study on the dynamic response of seismo-resistant building frames was done. The storey displacements for various heights of shear wall in the dynamic response of building frames are obtained. From the study, the following conclusion can be drawn out.

3.METHODOLOGY AND MODELLING OF BUILDING

RESPONSE SPECTRUM METHOD:

The Response Spectrum Method can be stated by the representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2002 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-2002 (part1). The standard response spectra for type of soil considered is applied to building for the analysis in ETABS 2013 software. Following diagram shows the standard response spectrum for medium soil type and that can be given in the form of time period versus spectral acceleration coefficient (S_a/g).



Response spectrum for medium soil type for 5% damping

Different types of loads acting on the structure

Types of loads acting on the structure are:

- Dead loads
- Imposed loads
- Wind loads
- Snow loads
- Earthquake loads
- Special loads

PROBLEM STATEMENT

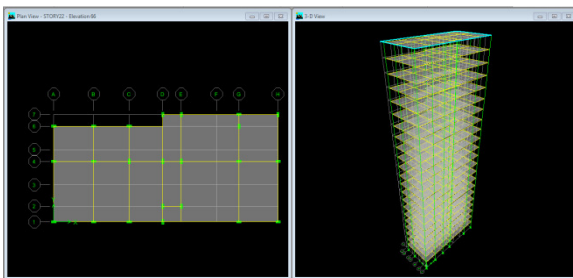
In the present study, analysis of G+21 stories building in Zone V seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

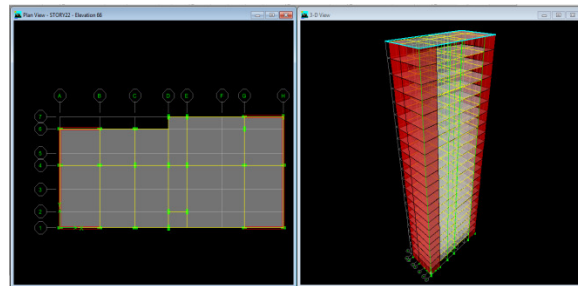
- | | |
|-------------------------------|---|
| 1. Grade of concrete | : M ₄₀ |
| 2. Grade of Reinforcing steel | : HYSD Fe500 |
| 3. Dimensions of beam | : 230X300(mm) |
| 4. Dimensions of column | : 230X400(mm), 230X450(mm), 230X480(mm) |
| 5. Thickness of slab | : 120mm |
| 6. Height of bottom story | : 3m |
| 7. Height of Remaining story | : 3m |
| 8. Live load | : 3.5 KN/m ² |
| 9. Floor load | : 1.5 KN/m ² |
| 10. Density of concrete | : 25 KN/m ³ |
| 11. Seismic Zone | : Zone 5 |
| 12. Site type | : II |
| 13. Importance factor | : 1.5 |
| 14. Response reduction factor | : 5 |
| 15. Damping Ratio | : 5% |
| 16. Structure class | : B |
| 17. Basic wind speed | : 39m/s |

- 18. Risk coefficient (K1) : 1.08
- 19. Terrain size coefficient (K2) : 1.14
- 20. Topography factor (K3) : 1.3
- 21. Wind design code : IS 875: 1987(Part 3)
- 22. RCC design code : IS 456:2000
- 23. Steel design code : IS 800: 2007
- 24. Earth quake design code : IS 1893 : 2002(Part 1)

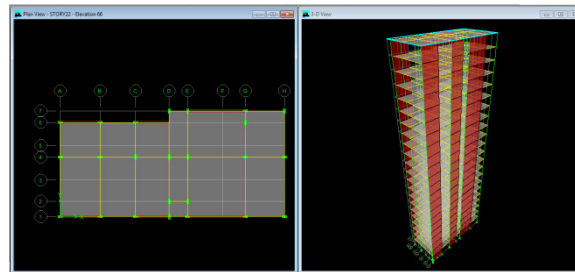
MODELS IN ETABS V 9.7.4



Building without Shear wall



Building with Shear wall at corner



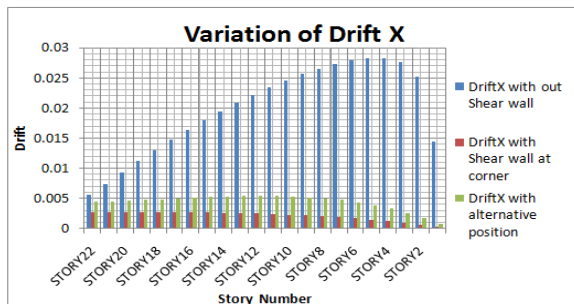
Building with Shear wall at alternative position

4. RESULTS AND ANALYSIS

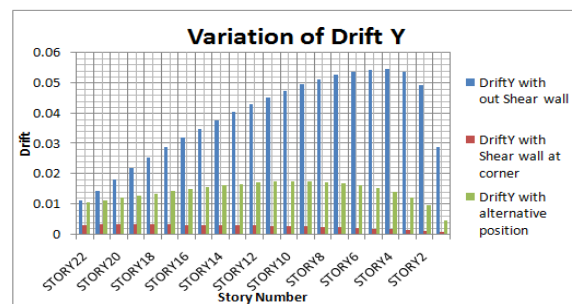
Irregular Building

Story Drift

X Direction

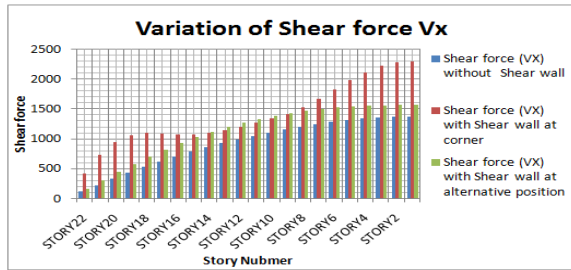


Y Direction

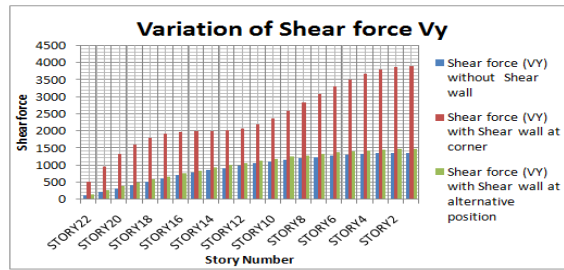


Shear Force

X Direction

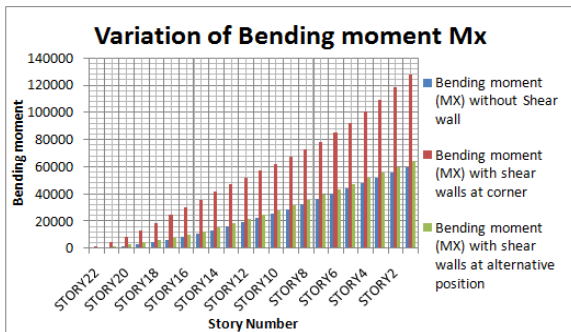


Y Direction

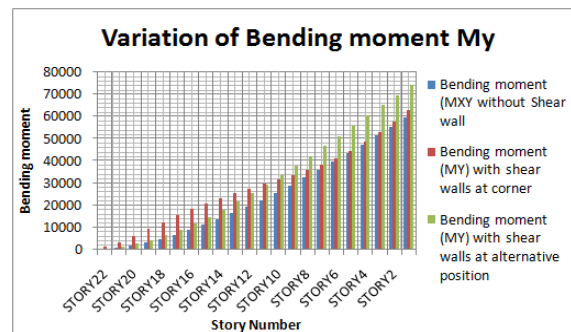


Bending Moment

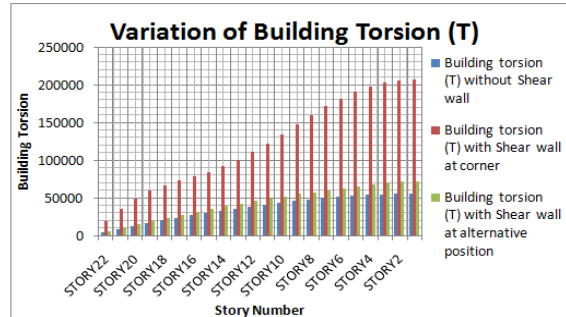
X Direction



Y Direction



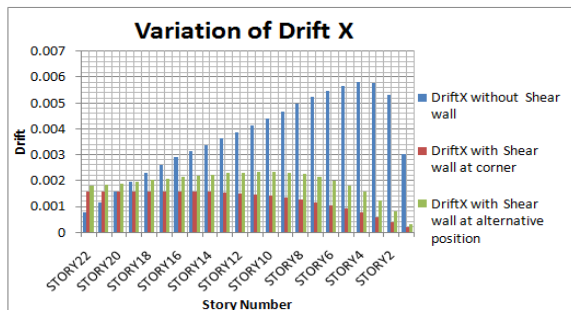
Building Torsion



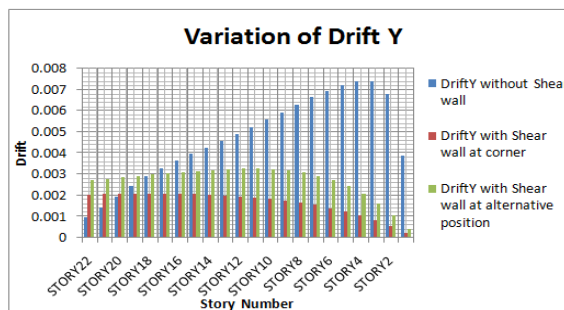
Regular Building

Story Drift

X Direction

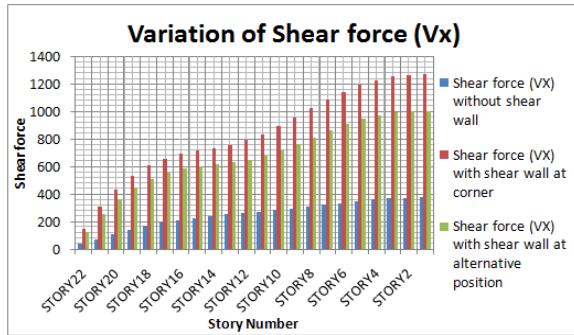


Y Direction

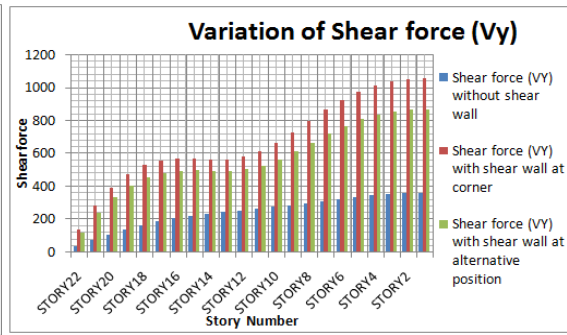


Shear Force

X Direction

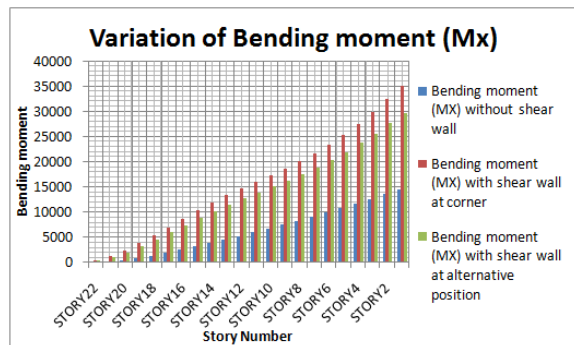


Y Direction

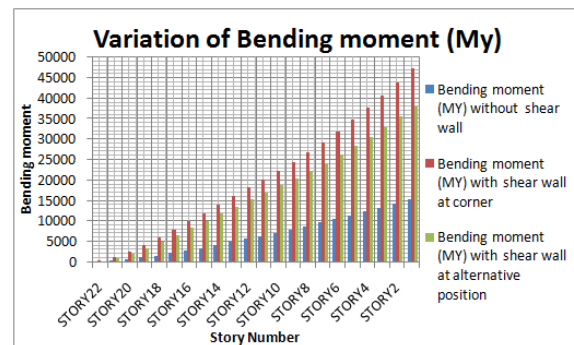


Bending Moment

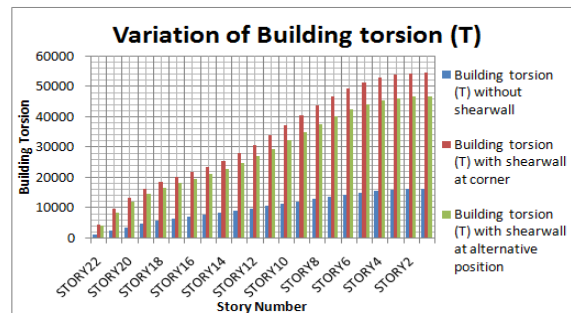
X Direction



Y Direction



Building Torsion



5. CONCLUSIONS

From the above study the following conclusions were made

1. The values of drift in both X and Y direction are found less for building using shear wall than building without shear wall. And the shear walls at corner will give better results than shear walls at alternative position.
2. The values of Shear force in both X and Y-direction are found less for building without shear wall at alternative position and shear wall at corner. And the shear wall at alternative position has higher values than shear wall at corner position.

3. The values of Building Torsion (T) are found lesser for building without shear wall at alternative position and shear wall at corner. And the shear wall at alternative position has higher values than shear wall at corner position.
4. The values of bending moment are found less for the building with shear wall at alternative position than building with shear wall at corner.
5. Opening in the shear walls lead to a significant increase in the bending moment and shear force in the columns connected to that shear wall.
6. From this study it was concluded that increase in the percentage of Shear wall results in decrease in the drift and increases the Shear force, Bending moment, Building Torsion.
7. From this study it was concluded that the building with shear wall is economical & efficient than building without shear wall in high seismic zone.

REFERENCES:

- [1]. Ehsan Salimi Firoozabad, Dr. K. Rama Mohan Rao, Bahador Bagheri, Effect of Shear Wall Configuration on Seismic Performance of Building, Proc. of Int. Conf. on Advances in Civil Engineering 2012
- [2]. Shahzad Jamil Sardar and Umesh. N. Karadi, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 9, September 2013.
- [3]. Najma Nainan, Alice T V, Dynamic Response Of Seismo resistant Building Frames, International Journal of Engineering Science and Technology (IJEST) ISSN : 0975-5462 Vol. 4 No.05 ,May 2012.
- [4]. Mr.K.LovaRaju, Dr.K.V.G.D.Balaji, Effective location of shear wall on performance of building frame subjected to earthquake load, International Advanced Research Journal in Science, Engineering and Technology, ISSN 2394-1588 Vol. 2, Issue 1, January 2015.
- [5]. Varsha R. Harne, Comparative Study of Strength of RC Shear Wall at Different Location on Multi-storied Residential Building, International Journal of Civil Engineering Research. ISSN 2278-3652 Volume 5, Number 4 (2014), pp. 391- 400
- [6]. Syed Khasim Mutwalli1 , Dr. Shaik Kamal Mohammed Azam2, "Dynamic Response of High Rise Structures Under The Influence of Shear Walls", Int. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 9(Version 6), September 2014, pp.87-96.
- [7]. R.S.Mishra1, V.Kushwaha2, S.Kumar3, "A Comparative Study of Different Configuration of Shear Wall Location in Soft Story Building Subjected to Seismic Load.", International Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 07 | Oct-2015.
- [8]. Zeeshan Baseer and Syed Farrukh Anwar," EFFECT OF PERFORATION OF SHEAR WALL ON VARIOUS DESIGN PARAMETERS OF A HIGH RISE BUILDING", GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES.
- [9]. IS 456-2000 Plain and reinforced Concrete – Code of Practice is an Indian Standard Code of Practice for general structural use of plain and reinforced concrete.
- [10] IS 1893 (Part 1) 2002 earthquake resistant design code of India.
- [11] IS 875 (Part 3) 2002 Wind Loads on Buildings and Structures.

[13] ETABS V 9.7.4 By CSI (Computers and Structures, Inc) is a Structural and Earthquake Engineering Software Company founded in 1975