COMPARATIVE ANALYSIS OF BEHAVIOUR OF HORIZONTAL AND VERTICAL IRREGULAR BUILDINGS WITH AND WITHOUT USING SHEAR WALLS BY ETABS SOFTWARE

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Abstract *Present day private design are going increasingly high nowadays. The performance of these structures is significantly affected by the impact of lateral loads such as wind or earthquakes. Shear walls are frequently utilized in place of columns by structural engineers on a regular basis.*

Reinforced concrete buildings with high rises frequently feature shear walls. High-rise reinforced concrete irregular buildings with shear walls are the subject of this study's comparative analysis. The special RC moment resisting frame is used for the proposed building's frame type. Because it is in seismic zone 2, seismic forces are largely taken into account in the building's analysis, and shear walls are also provided to resist seismic forces.

The design of structural members follows IS456-2000. The software ETABS v 9.7.1 is used to analyze the structure. The Indian code is used to account for loads. Shear walls and frame analyses take into account all necessary load combinations. Furthermore wind load, seismic burden is considered as outer sidelong burden in the powerful examination. Analyzing dynamic data; The Response Spectrum approach is utilized.

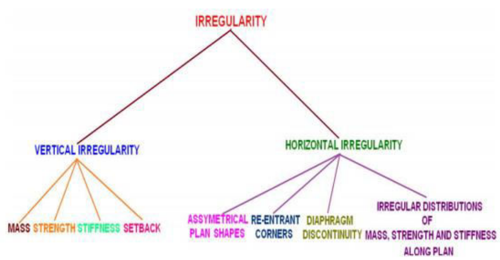
In order to accomplish this, four multi-story building plans—horizontal irregular and vertical irregular models—with and without shear walls were examined for zone II. Modal Period with various building configurations, Storey Displacement of structure with various building configurations, and Storey Drift with various building configurations were examined and compared.

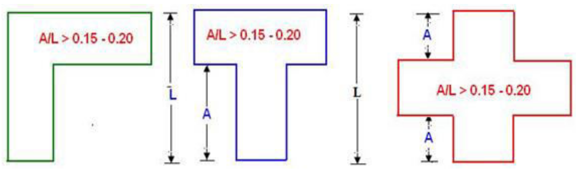
1 INTRODUCTION

In order to design a structure to resist wind and earthquake loads, the forces on the structure must be specified. The exact forces that will occur during the life of the structure cannot be anticipated. Most National Building Codes identify some factors according to the boundary conditions of each building considered in the analysis to provide for life safety. A realistic estimate for these factors is important; however the cost of construction and therefore the economic viability of the project are essential. Owing to lack of earthquake and wind forecasting centers the Egyptian Codes 1993 and 2003 give more concentration on calculating these lateral loads and the corresponding additional stresses to be taken into account in the design of the structures.

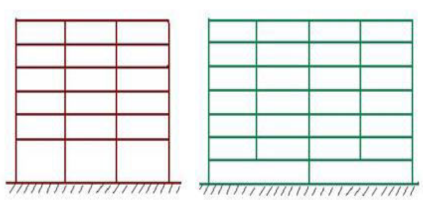
During an earthquake, failure of structure starts at points of weakness. This weakness arises due to discontinuity in mass, stiffness and geometry of structure. The structures having this discontinuity are termed as Irregular structures. Irregular structures contribute a large portion of urban infrastructure. Vertical irregularities are one of the major reasons of failures of structures during earthquakes. For example structures with soft storey were the most notable structures which collapsed. So, the effect of vertically irregularities in the seismic performance of structures becomes really important. Height-wise changes in stiffness and mass render the dynamic characteristics of these buildings different from the "regular‘ building. IS 1893 definition of Vertically Irregular structures:

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.





Re-entrant corner irregularity



Irregular distribution of stiffness in the building

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 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. However torsion may also develop in building symmetrical featuring of shear wall arrangements when wind acts on the facades of direct surface textures (i.e, roughness) or when wind does not act through the center of building's mass (schueller, 1977).

Shear walls are much stiffer than horizontal rigid frames. Therefore shear walls are economical up to 35 stories. If, in low to medium rise buildings, shear walls are combined with frames, it is reasonable to assume that the shear walls attract all the lateral loading so that frame may be designed for gravity loads only.

Resistance of a shear wall increases linearly with its thickness. However, the effect of width is much higher.

A coupled shear wall structure is a particular, but very common, form of shear wall structure. It consists of two or more shear walls in the same plane, or almost the same plane, connected at floor levels by means of stiff beams or slabs. These results in a horizontal stiffness very much greater than if the walls acted as a set of separate uncoupled cantilevers.

Objectives 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 for regular and irregular buildings.
3. To compare the results of Story Drift, Shear force, Bending moment, Building torsion of buildings with and without shear wall for regular and irregular buildings.
4. To study the buildings in ETABS V9.7.4 in Time history analysis.

2. LITERATURE STUDIES

Vishal N, Ramesh Kannan M, Keerthika L, et al.,(2020), "Seismic Analysis of Multi-Storey Irregular Building with Different Structural Systems"

Most of the multi-storey buildings are analysed based on an assumption that the structure is subjected to whole load after modelling the entire structure. From this study it was concluded that the response spectrum in X-direction, maximum displacement at top storey is decreased by 49% for dual system and by 30% for braced system similarly for response spectrum in Y-direction, maximum displacement at top storey is decreased by 55% for dual system and by 24% for braced system when compared with moment frame system.

Chaitra H N, Dr B Shivakumara Swamy, et al.,(2016), "Study On Performance Of Regular And Vertically Irregular Structure With Dampers, Shear Wall And Infill Wall"

This project work is concerned about analyzing and studying the behavior of regular building and different models of vertically irregular building when subjected to seismic loads. From this study it was concluded that the time period and storey displacement was found to be reduced as compared to that of bare frame with the addition of dampers, shear wall and infill wall.

Pradeep Pujar, Amaresh, et al.,(2017), "SEISMIC ANALYSIS OF PLAN IRREGULAR MULTI-STORIED BUILDING WITH AND WITHOUT SHEAR WALLS"

In this thesis work three states of structures are considered are I shape, L-shape, C-shape all are of ten stories, add up to six models are taken three models of bare frame and three models with shear walls all are often storied, the area of Shear walls are at corners of the structures and L-segment Shear walls are utilized. From this study it was concluded that the Shear walls building is having high effectiveness of decreasing story uprooting because it diminished 50-70% with contrasting exposed edge structures.

Suruchi Mishra , Rizwanullah, et al.,(2017), "Comparative Analysis of Regular and Irregular Buildings With and Without Shear Wall",

In the present study the comparison of seismic behaviour of G+10 storey buildings having horizontal irregularity with the regular building of similar properties with and without shear wall by using ETAB software was done. For this purpose four multi storey building plans are considered that are symmetric plan, L shape, T shape, and + shape. For

3. METHODOLOGY USED

Time History Analysis

Once damping ratios of the visco elastically damped structure are evaluated, seismic response analyses can be carried out using available dynamic analysis programs. Figure 6 shows a typical time history response prediction and test result of a five story model under 0.6g Hachinohe earthquake (Chang et al. 1995). In this study, the VE damper assemblies are modelled as truss elements in the modified computer program ETABS with the inclusion of modal strain energy method. Similar studies have been carried out extensively and the results conclude that the elastic time-history response of visco elastically damped structures can be well predicted if damping ratios of the structure can first be accurately predicted.

Models specifications

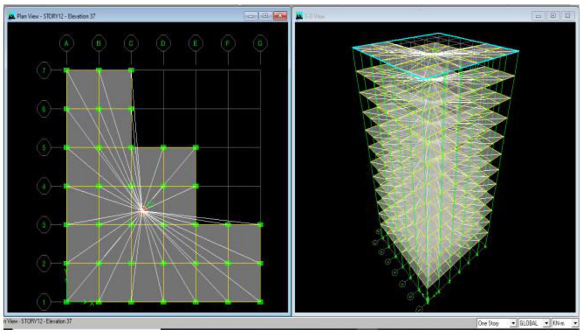
In the present study, analysis of G+12 multi-story commercial building in zone 2 is considered in ETABS. Building has a typical size of

Basic parameters considered for the analysis are

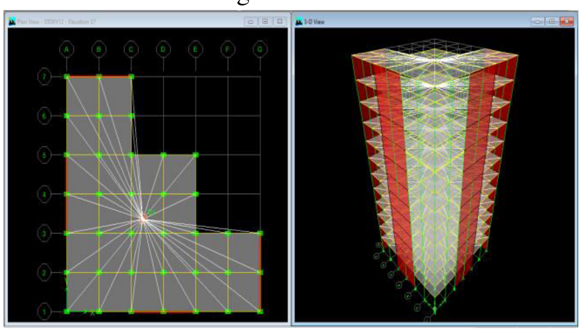
1. Utility of building : Residential building
2. Number of stories : G+11
3. Shape of building : Regular and irregular
4. Geometric details
    a. Ground floor : 3 m
    b. floor to floor height : 3m
    c. Height of the building : 36m
5. Material details
    a. Concrete Grade : M40 (COLUMNS AND BEAMS)
    b. All Steel Grades : HYSD reinforcement of Grade Fe600
    c. Bearing Capacity of Soil : 200 KN/m^2
6. Type Of Construction : R.C.C FRAMED structure
7. Column : 0.5m X 0.3m
8. Beams : 0.3m X 0.3m

9. Slab : 0.150m
10. Special considerations
    - Shear wall : Thickness 125mm
11. Concrete code : IS 456-2000
12. Seismic code : IS 1893:2015
13. Wind code : IS 875:1987

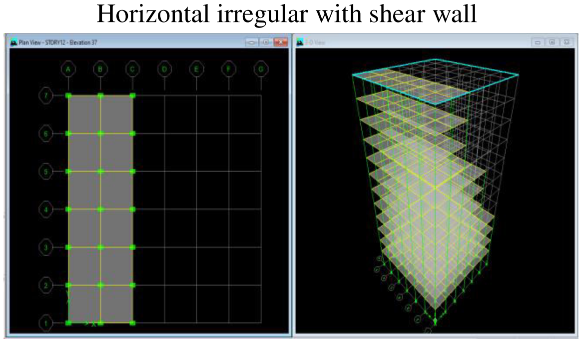
Models in ETABS



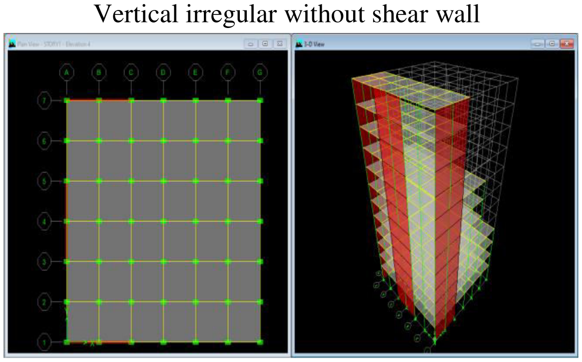
Horizontal irregular without shear wall



Horizontal irregular with shear wall



Vertical irregular without shear wall

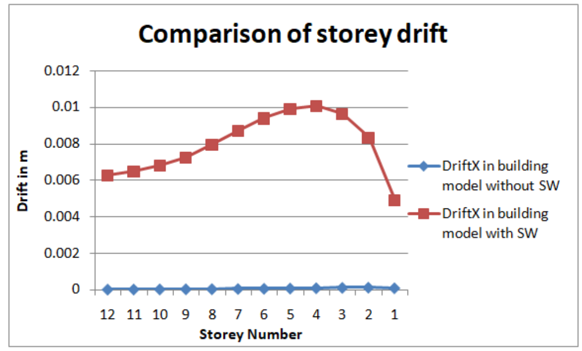


Vertical irregular with shear wall

RESULTS AND ANALYSIS

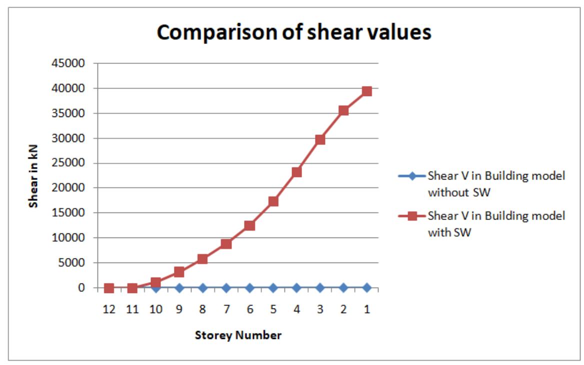
Horizontal irregularity

Storey drift



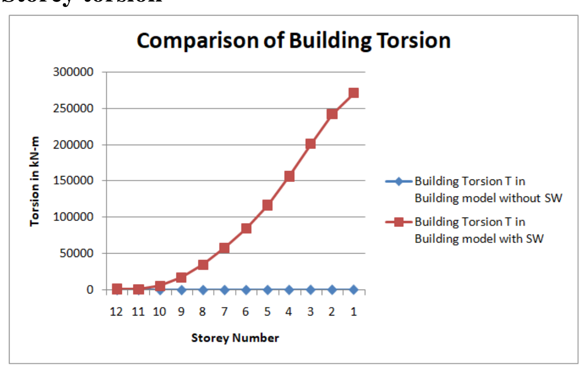
Comparison of storey drift for horizontal irregularity

Storey shear



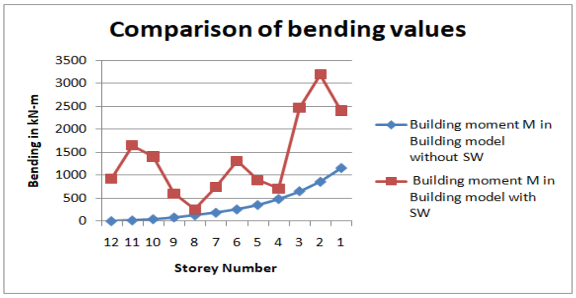
Comparison of storey shear for horizontal irregularity

Storey torsion



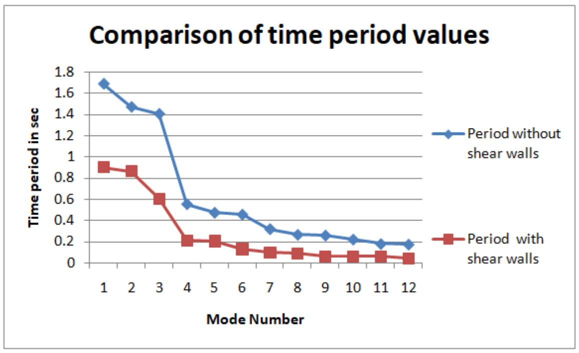
Comparison of storey torsion for horizontal irregularity

Story bending



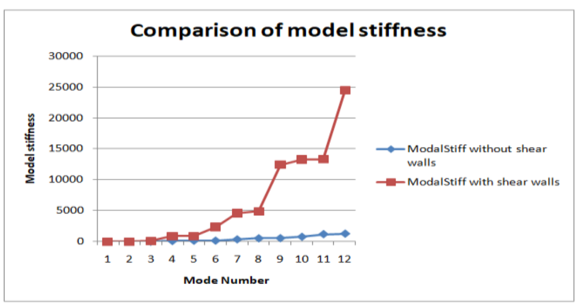
Comparison of storey bending for horizontal irregularity

Time period



Comparison of time period for horizontal irregularity

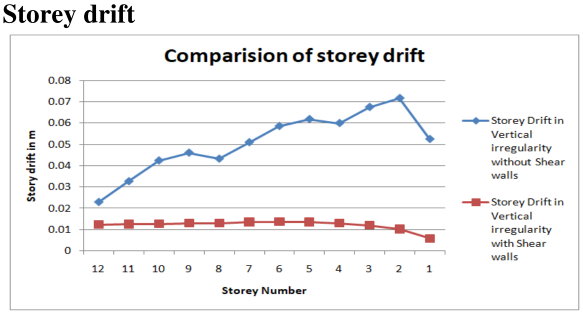
Model stiffness



Comparison of model stiffness for horizontal irregularity

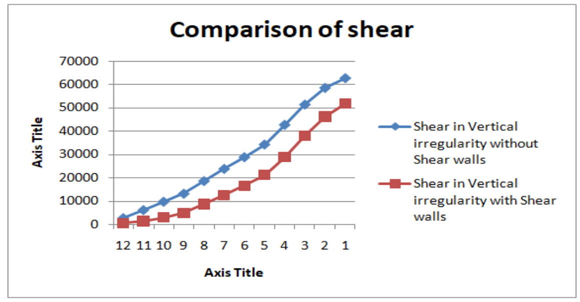
Vertical irregularity

Storey drift



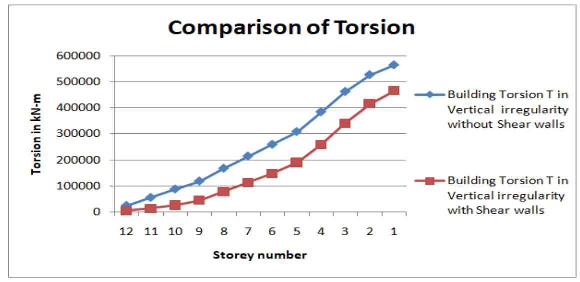
Comparison of storey drift for vertical irregularity

Storey shear



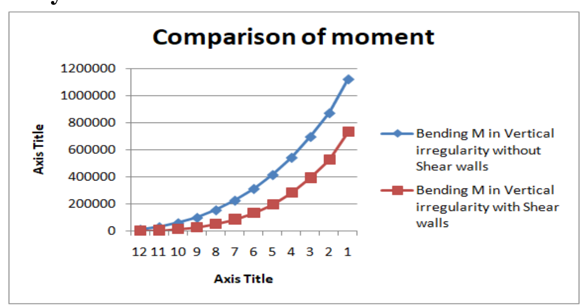
Comparison of storey shear for vertical irregularity

Storey torsion



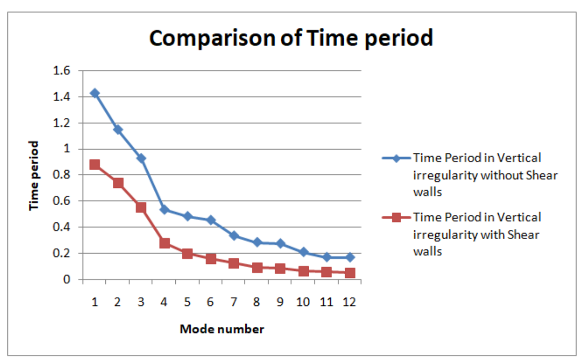
Comparison of torsion for vertical irregularity

Story mment



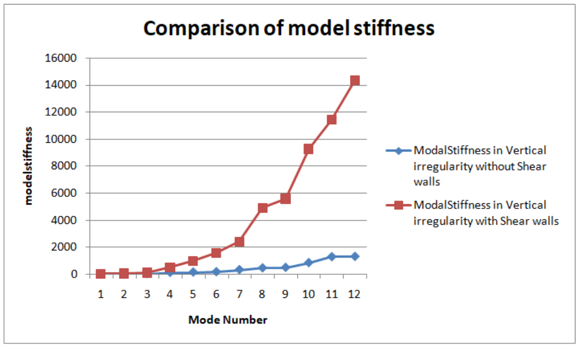
Comparison of storey moment for vertical irregularity

Time period



Comparison of time period for vertical irregularity

Model stiffness



Comparison of model stiffness for vertical irregularity

CONCLUSIONS

From this study the following conclusions were made

1. Earth quake resistant building design is carried out in this study for the both plan as well as vertical irregularities by considering shear walls.
2. Shear walls are the vertical members which are generally used to reduce the intensity of the lateral loading conditions related to the seismic loads and wind loads.
3. The storey drift values are observed high in case of building with shear wall condition in case of horizontal irregularity building.
4. The values related to the shear bending torsion in Horizontal irregularity buildings is high for the with shear wall case than without shear wall case.
5. Time period vales decrease from node 1 to node 12 and it has higher values in without shear wall model than with shear wall model.
6. Model stiffness increases from node 1 to node 12 and it has higher values for building without shear wall case than with shear wall case.
7. The story drift values has higher intensities for without shear walls than with shear walls in case of vertical irregular structures.
8. The values related to the shear bending torsion in vertical irregularity buildings is high for the without shear wall case than with shear wall case.
9. Time decreases from node 1 to node 12 and it has higher values for without shear wall condition than with shear wall case.
10. Model stiffness increases from node 1 to node 12 and it has higher values for building with shear wall case than without shear wall case.
11. The vertical stiffness building is more earth quake resistant than the horizontal irregularity buildings

REFERENCES

[1]. Ravikanth Chittiprolu, Ramancharla Pradeep Kumar, “Significance of Shear Wall in Highrise Irregular Buildings”, IJEAR Vol. 4, Issue Spl-2, Jan - June 2014.

[2]. Siva Naveen, Nimmy miryam Abraham, et al.,(2018), “Analysis of Irregular Structures under Earthquake Loads”, Procedia Structural Integrity 14 (2019) 806–819

[3]. Dileshwar Rana, Prof. Juned Raheem, et al.,(2015), “Seismic Analysis of Regular & Vertical Geometric Irregular RCC Framed Building”, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 02 Issue: 04 | July-2015.

[4]. Hema Mukundan , S.Manivel, et al.,(2015), “Effect of Vertical Stiffness Irregularity on Multi-Storey Shear Wall-framed Structures using Response Spectrum Analysis”, International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 3, March 2015.

[5]. Rakesh Sakale, R K Arora1 and Jitendra Chouhan, et al.,(2014), “SEISMIC BEHAVIOR OF BUILDINGS HAVING HORIZONTAL IRREGULARITIES”, Int. J. Struct. & Civil Engg. Res. 2014, Vol. 3, No. 4, November 2014

[6]. Vishal N, Ramesh Kannan M, Keerthika L, et al.,(2020), “Seismic Analysis of Multi-Storey Irregular Building with Different Structural Systems”, International Journal of Recent Technology and Engineering

(IJRTE) ISSN: 2277-3878, Volume-8 Issue-6, March 2020.

[7]. Chaitra H N, Dr B Shivakumara Swamy, et al.,(2016), "Study On Performance Of Regular And Vertically Irregular Structure With Dampers, Shear Wall And Infill Wall", "International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 10 | Oct - 2016.

[8]. Pradeep Pujar, Amaresh, et al.,(2017), "SEISMIC ANALYSIS OF PLAN IRREGULAR MULTI-STORIED BUILDING WITH AND WITHOUT SHEAR WALLS" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 04 Issue: 08 | Aug -2017

[9]. Suruchi Mishra , Rizwanullah, et al.,(2017), "Comparative Analysis of Regular and Irregular Buildings With and Without Shear Wall",