



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

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 8, August 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 7.569**

9940 572 462

6381 907 438

[ijrset@gmail.com](mailto:ijrset@gmail.com)

[www.ijrset.com](http://www.ijrset.com)



# Comparative Analysis of Irregular Plan Multi-Storeyed Buildings

Malik Mohammed Sameed<sup>1</sup>, Prof. P.J. Salunke<sup>2</sup>

P.G. Student, Department of Civil Engineering, M.G.M.'S College of Engineering and Technology, Navi Mumbai, Maharashtra, India<sup>1</sup>

Professor, Department of Civil Engineering, M.G.M.'S College of Engineering and Technology, Navi Mumbai, Maharashtra, India<sup>2</sup>

**ABSTRACT:** Nowadays, the modern urban infrastructure demands uniqueness, which is often leading to irregular buildings. These irregular buildings are more often prone to earthquake therefore it is very essential to consider earthquake loads while designing these buildings. Hence, in this study we will be analysing the seismic response of such irregular plan buildings using response spectrum analysis on Etabs software. The results obtained from different models will be compared on the basis of seismic parameters such as base shear, storey drift, displacement, etc. After comparing these results, a meaningful conclusion will be made on the effective height and use of irregular plan buildings in various earthquake zones.

**KEYWORDS:** Irregular building, Seismic force, Response spectrum analysis, Base shear, Storey drift, Displacement, Earthquake zone.

## I. INTRODUCTION

In the modern era, most of the structures are delineated by irregularities in both plan and vertical configurations. Moreover, to analyse or design such irregular structures high level of effort is needed. In other words, damages or loss in those structures with irregular options are over those with regular one. Thus, irregular structures would like careful structural analysis to succeed in an acceptable behaviour throughout a devastating earthquake. In most of the situations the shape of the plot for the construction of a structure may not be a regular one. Thus, the shape of the structure may be influenced by the plot configurations. Hence, it will be interesting to study the stability of buildings with different geometry or shape and their behaviour against seismic and other forces. In present study we will analyse such irregular plan buildings using response spectrum analysis on Etabs software.

## II. LITERATURE REVIEW

The present work is aimed at comparative study on analysis of irregular plan buildings. A literature review is carried out on various studies of such types of irregular plan buildings. A review of the work is presented in the following paragraphs.

**Priyanka S V (2019)** carried out seismic analysis of plan regular and irregular buildings of G+14 storey of 7 bays x 9 bays. The building was analyzed considering earthquake zone IV and medium soil using equivalent static analysis and response spectrum analysis. The parameters considered for comparison were storey drift, storey displacement and base shear. The conclusions drawn were that, storey drift and storey displacement were maximum for irregular plan building while base shear was maximum for regular plan building. In regular building the reduction in storey displacement and storey drift was due to the infill action because of lateral stiffness of frame. Plan irregularity increases both storey displacement and storey drift while plan regularity increases base shear.

**Imranullah Khan & S. S. Sanyasi Rao (2017)** performed seismic analysis of irregular L-Shape buildings in various zones. A 10 storied L-Shaped building is modeled in ETABS and response spectrum analysis is done for different zones. After comparing results from static and dynamic analysis, storey drift response along the height of the building shows that, the middle stories are more effected than the lower and upper stories. Displacements gradually increases



from ground storey to top storey. In y-direction the comparison of displacement in various zones is 59.18%, 9.656% and 49.78%. in x-direction the comparison of displacement in different zones is 59.79%, 50.32% and 50.21%. the analysis demonstrates that plan irregularity has a significant effect on seismic response of the building.

**Gaurav Kumar et al. (2018)** analyzed the behavior of different irregular plan buildings during seismic excitation. Most common shape of buildings such as square shape, L-Shape, C-Shape and T-Shape which conform as per clause 7.1 of IS Code 1893:2002 (part 1), are modelled using ETABS software. Comparison of seismic performance of different models was done after using linear time history method considering parameters such as storey drift, storey displacement and torsion (ratio of maximum storey drift to average storey drift). The building plans, which have eccentricity between center of mass and center of rigidity are subjected to more severe damages in comparison to buildings having zero eccentricity. Buildings having zero eccentricity perform well during earthquake.

**Md Shehzad Choudhary et al. (2018)** presented a paper addressing the difference between a building without diaphragm discontinuity and a building with diaphragm discontinuity. Regular 15 and 20 storied RC buildings with shear wall were modelled with and without diaphragm discontinuity on ETABS (2013). After analysis it was observed that, for 15 and 20 storied buildings, when there is an increase in percentage area of slab openings it is found that there is a decrease in storey displacement, storey drift, storey shear and modal period in both x and y directions. The study shows that variation in slab thickness reduces the performance of the building during earthquake. It was also found that, slab openings in a building having shear wall gives better performance during earthquakes.

### III.METHODOLOGY

The study to be conducted for this project will mostly be done using ETABS software. Modelling the building in the software and carrying out subsequent analysis for obtaining results will be done. A detailed step by step procedure of the methodology is as follows. 1. In present research we have used different models of irregular plan multi-storied buildings. 2. Model the structures in ETABS. 3. Seismic analysis will be done as per IS 1893-2016. 4. Running the models in ETABS. 5. Obtaining seismic parameters like base shear, storey drift and displacement. 6. Comparing results of these parameters. 7. Conclusion

### IV.STRUCTURAL MODELLING

In this study a comparative analysis of irregular plan buildings of C, L, I and T shape is done. Different height of buildings, that is G+10, G+20 and G+30 storeys is also considered. Modeling and analysis done to obtain seismic parameters such as base shear, storey drift and displacement. Modelling and analysis of these building structures is done using Etabs software. The study has been carried out for different zones as specified in IS 1893-2016.

### V. PRELIMINARY DATA

Following are the data assumed for carrying out this study. 1. Shapes: C, L, I and T. 2. Length in X direction = 20m. 3. Length in Y direction = 20m. 4. Typical storey height = 3m. 5. Ground storey height = 3.5m. 6. No of stories:20, 30 and 40. 7. Height of buildings = 30.5m, 60.5m and 90.5m. 8. Bay spacing in X direction = 4m. 9. Bay spacing in Y direction = 4m.

### VI.MODELS

C, L, T and I shape models are considered for 20, 30 and 40 storeys in seismic zones III, IV and V as per IS-1893 2016.

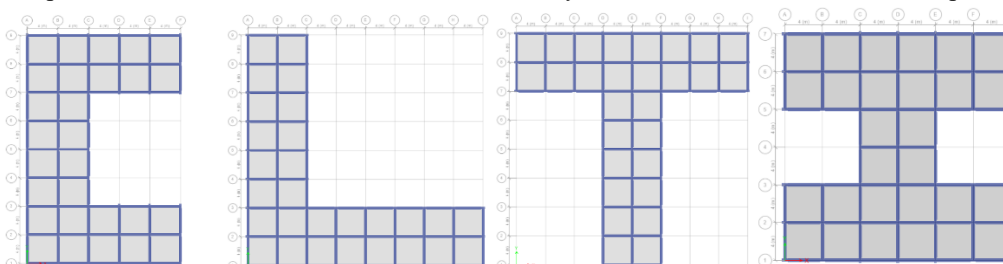


Figure 1. C-Shape Plan Figure 2. L-Shape Plan Figure 3. T-Shape Plan Figure 4. I-Shape Plan



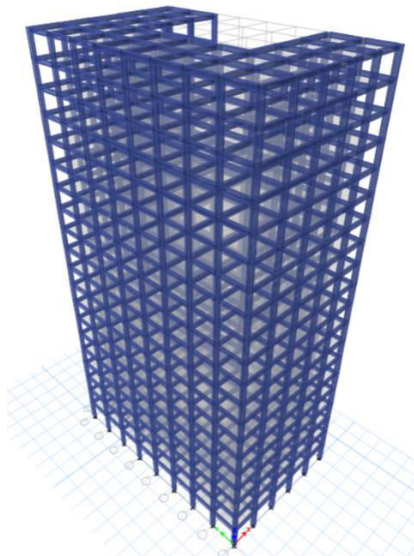


Figure 5. 3D View of C-Shape

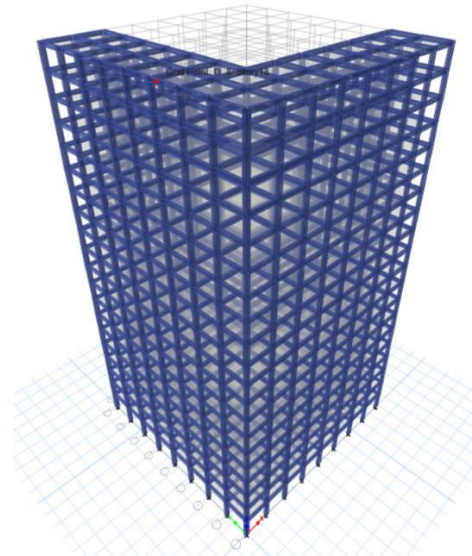


Figure 6. 3D View of L-Shape

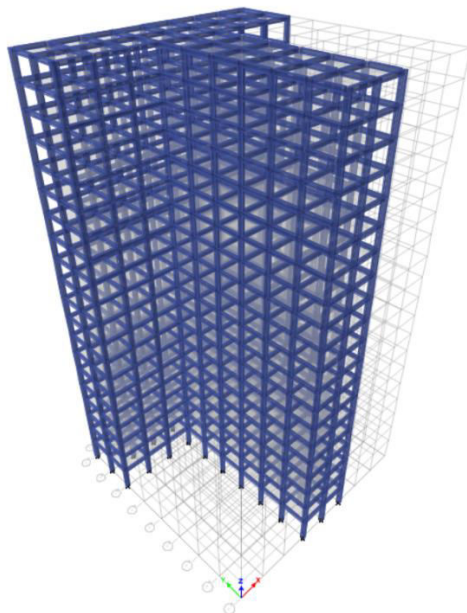


Figure 7. 3D View of T-Sha

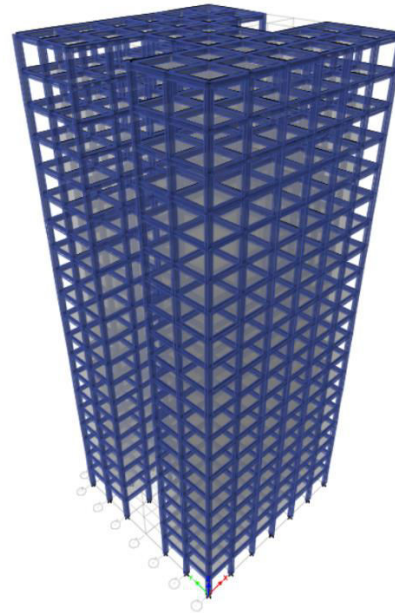


Figure 7. 3D View of I-Shape

## VII. RESULTS AND DISCUSSIONS

1. After comparing it was observed that base shear values of C-Shape buildings were highest for all heights and seismic zones, however those of L-Shape and T-Shape were almost similar to the former, but I-Shape was observed to be considerably lesser than all the others.
2. When considering same shape, base shear results show very little change with change in height, but huge increase is observed as we move from seismic zone III to V.
3. Maximum displacement was compared for both X and Y directions and comparisons show that I-Shape buildings show least displacement in both directions. C-shape buildings have high displacement values but are within permissible limits.
4. L-Shape buildings even exceed permissible limits in zone V for 30 and 40 storey buildings. T-Shape buildings also show high displacement values, exceeding permissible limit for 40 storey building in zone IV as well as 30 and 40 storey buildings in zone V.



5. Displacement increases steadily with increase in building height but even faster as seismic load increases due to change in seismic zone.
6. Maximum storey drift values remain within permissible limits for buildings of all shapes. But I-Shape buildings show very small storey drift values as compared to others, followed by T-Shape and C-Shape, where L-Shape gives highest storey drift.
7. Storey drift values show small increase with increase in height, but considerable increase is observed with the increase in seismic zone.

### VIII. CONCLUSION

Conclusions made below are based on extensive analysis and comparison of results of said models on the basis of seismic parameters, namely base shear, displacement and storey drift.

1. Irregular plan buildings show more susceptibility to failure than regular ones in case of earthquakes. However, studying more about their behavior to seismic forces can reduce the chances of failure.
2. After analysis and comparison, it was observed that I-Shape buildings show best results when under lateral loading, particularly seismic loads.
3. They perform very well in all the seismic zones for storey height atleast upto 40 storeys, as they show least results for displacement and storey drift in both directions.
4. On the other hand, T-Shape buildings are most susceptible to failure due to earthquakes, they even exceed permissible limits for displacement in zone V for 30 and 40 storey buildings and hence should not be considered in that seismic zone without additional lateral supporting systems such as shear wall, bracing, belt truss, etc for story height above 20 storeys.
5. C-Shape buildings perform moderately in all seismic zones upto height of atleast 40 storeys and can be considered if planning requires that particular shape only.
6. T-Shape buildings show susceptibility to failure due to exceeding permissible limits in Y-direction particularly for seismic zone IV and V for 30 storeys and above, hence should be constructed in support with a lateral supporting system.
7. Having analysed and compared all the shapes and models of different heights in varying seismic zones, the results indicate I-Shape model to be a highly effective irregular plan which can be used for construction in high rise buildings atleast upto 40 storeys even in high seismic zones without lateral support system.
8. However, designing such buildings may show some variation in results when actual complex plans of such shapes are considered.
9. Therefore, it is highly advisable to design high rise buildings of irregular plan in higher seismic zones in combination of atleast one lateral support system like shear wall, bracings, belt truss, etc. to avoid risk of failure.

### IX. FUTURE SCOPE

The topic chosen for research has many more fields to explore and can yield useful results. As we are well aware of the increasing population and due to urbanisation there is decrease in area of development land. This sometimes more often than not these days give little option but to plan an irregular plan building. Hence intensive research in this topic can be very helpful. Some avenues that can be considered for further research are listed below.

- Studies can be done for irregular plan with vertical irregularity as well.
- Design of actual buildings of such irregularity can yield meaningful results.
- Analysis can be carried out for such buildings with a lateral support system or combinations.
- Research can be carried out for construction of such buildings on sloping land in hilly terrains.
- Analysis can be done for buildings with other irregularities such as diaphragm discontinuity or combination of irregularities.



#### RERERENCES

- [1] Akshay Ahirwal, Kriti Gupta and Vaibhav Singh “Effect of Irregular Plan on Seismic Vulnerability of Reinforced Concrete Building” AIP Conference Proceedings, 2019, 2158, 020012.
- [2] Anju Nayas and Minu Antony “*Pushover Analysis of Plan Irregular RC Buildings with Special Columns*” International Journal of Engineering Research & Technology, Vol. 6, Issue 5, May 2017.
- [3] Arvind Reddy, R. J. Fernandes, “*Seismic Analysis of RC Regular and Irregular Frame Structures*”, IJERT, Vol.2, Issue: 5, Aug-2015.
- [4] Gaurav Kumar and V. R. Singh, “*Effect of Irregular Configurations on Seismic Behavior of RC Buildings*” International Journal of Engineering Research in Mechanical and Civil Engineering, 2018, 3(4), 2456-1290.
- [5] Imranullah Khan and Shri Satya Eswar Sanayasi Rao “*Seismic Analysis of Irregular L-Shape Building in Various Zones*” International Journal of Innovative Research in Science, Engineering and Technology, vol. 6, Issue 8, Aug 2017, 2319-8753, 2347-6710.
- [6] Laxmi Chandran “*Effect of Floating Columns in Multi-Storey building of Regular and Irregular Plan*” International Journal of Engineering Research & Technology, Special Issue, July 2019.
- [7] Md Shehzad Choudhary, Syed Arfath, Md Mansoor Ahmed and Nadeem Pasha, “*Comparative Study on Seismic Analysis of Building Having Diaphragm Discontinuity using ETABS*” International Journal of Research in Advent Technology, 2018, 6(5).
- [8] Prathamesh Musale, Shivkumar Hallale, Vaishnavi Mahajan, Tanushri Mahajan, Snehal Baraparte and Rohan Shinde “*Seismic Analysis of Plan and Vertical Irregularity of Building with and without Infill Action using ETABS*” International Journal of Advance Research, Ideas in Technology, Vol. 4, Issue 3, 2018, 2454-132X.
- [9] Prof. Sujeet Patil, Pooja Matnalli, Priyanka S. V., Rooparani and Rajamma “*Seismic Analysis of Plan Regular and Irregular Buildings*” International Research Journal of Engineering and Technology, Vol. 6, Issue 5, May 2019, 2395-0056, 2395-0072.
- [10] Sherin G. Ponnachen and Archana Sukumaran “*Comparison of Seismic Performance of Solid and Hollow Reinforced Concrete Members in RCC Framed Building with Plan Irregularity*” International Journal of Engineering Research & Technology, Vol. 6, Issue 6, June 2017.





**Impact Factor:  
7.569**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details