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Comparative Analysis of Irregular Plan Multi-Storeyed Buildings

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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.

Imrullah 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 is 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: 10, 20 and 30. 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. CONCLUSION

Reading previous research papers, summarizing the literature work and finding the gaps in them has given us a good idea about irregular buildings. This will help us in conducting our study that follows the research conducted by our predecessors in the respective topic. Summarizing the literature has given us an insight of what more can be done in the study of irregular buildings. Hence, in the following stages modelling and analysis of the abovementioned, building structures will be done using Etabs software and results thus obtained will be compared for drawing a meaningful conclusion.



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