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Comparative Seismic Analysis of Vertically Geometric Irregular Multi- Storeyed Buildings

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ABSTRACT: Structures nowadays are advancing in terms of its planning and construction technologies due to the rise in demand of aesthetics and uniqueness in the ever-developing world. This development has also given rise to the planning of irregular buildings to achieve the desired aesthetics and functions in the structure. With such developments, these buildings due to their irregularities are becoming more prone to earthquakes and hence it has become essential to consider earthquake loads while designing these buildings. Therefore, in the course of this study, we shall be analysing the seismic response of such vertically irregular buildings using response spectrum analysis on Etabs software. The results obtained from different models with different forms of vertical irregularities will be compared on the basis of seismic parameters such as base shear, storey drift, displacement, etc. After obtaining the results, a comparison will be made to draw out a meaningful conclusion with respect to the effective height and use of vertically irregular buildings in various earthquake zones.

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

I. INTRODUCTION

In today's times, most of the structures are delineated by irregularities in both plan and vertical configurations. Thus to analyse or design such irregular structures an extra level of attention and effort is required. The repercussions of failure in such buildings would be greater than those with regular ones. Hence, irregular structures require detailed structural analysis to succeed in an acceptable behaviour throughout a devastating earthquake. There might be cases where shape of the plot for the construction of a structure may not be a regular one, may also have topographical variations because of which the structure might be influenced due to the configuration of the plot. 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 vertically irregular regular plan buildings using response spectrum analysis on Etabs software.

II. LITERATURE REVIEW

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

Girish Deshmukh & Shaikh Abdul Aijaj Abdul Rahman (2013) The seismic analysis performed on G+10 vertical irregular building of two frame with similar dimension but having the stiffness irregular in 2nd frame. The dynamic analysis is analysed by Etabs software as per IS: 18931-2002. The dynamic response result to compare the both frame. The frame-1 (vertically irregular) develops least storey drifts while the building with stiffness irregularity on vertically irregular building (frame-2) shows maximum storey drift on the respective storey levels. The building was modeled as a simplified lump mass model having stiffness irregularity at fourth floor. The response parameters like storey drift, storey deflection and storey shear of the building were evaluated. The results show that, stiffness irregularity causes instability in the building and attracts huge storey shear.



Bansal and Gagandeep (2014) carried out response spectrum analysis (RSA) and time history analysis (THA) of vertically irregular RC building frames. They considered mass, stiffness and vertical geometric irregularity. They found that mass irregular building experience larger base shear than similar regular building. The stiffness irregular building experienced lesser base shear and has larger inter storey drifts.

Mahesh and Rao (2014) studied the behavior of regular and irregular G+11 residential building under seismic motion. They considered different seismic zones and three different types of soils namely hard, medium and soft. The analysis was done by two softwares ETABS and STAAD PRO.

Rana and Raheem (2015) studied the performance of vertical geometric irregular RC frame structures under seismic motion. A comparative study between one regular frame & four irregular building frames were carried out. Various seismic responses like shear force, bending moment, storey drift, storey displacement etc. were obtained. It was concluded that regular building frames possess very low shear force compared to setback irregular frames.

Oman Sayyed, et.al. (2017) carried out the seismic performance & behaviour of 8 models of G+10 regular and vertical with soft irregular building is analysed by Response spectrum analysis method with the help of Etabs 2015 software. By the different seismic response to compare the regular and irregular building. The storey displacement and storey drift in case of stiffness irregular buildings is more than that of the regular building. The result remarks the conclusion that, a building structure with stiffness and setback irregularity provides instability during seismic loading. To control the instability, a proportionate amount of stiffness is beneficial in RC building.

Shaikh Abdul Aijaj Abdul Rahman & Ansari Ubaidurrahman Salik (2018) The seismic response of G+10 storey of two frames having the same dimension with mass and the vertical irregular building has been analyzed by linear static and dynamic method with the help of Etabs software as per IS:1893-2002. The dynamic response of the structure frame-1 (vertically irregular) develops least storey drifts while the building with mass irregularity on vertically irregular building (frame-2) shows maximum storey drifts on the respective storey levels. Hence, this is the most vulnerable to damages.

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 vertically irregular 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.

In this study, structure will be modeled for the following cases 1. 30 storeyed building with geometric irregularity at 10th 20th & 25th storey on 3 sides. 2. 30 storeyed building with geometric irregularity at 10th & 15th storey. 3. 30 storeyed building with geometric irregularity on all sides at 10th & 20th storey. 4. 30 storeyed building with geometric irregularity at 10th storey. 5. 40 storeyed building with geometric irregularity at 10th & 30th storey on different sides. 6. 40 storeyed building with geometric irregularity at 10th & 30th storey on same sides. 7. 40 storeyed building with geometric irregularity on ALL sides at 10th, 20th & 30th storey. All the above cases will also be modelled for seismic zone III, IV & V as specified in IS:1893 2016

V. PRELIMINARY DATA

Following are the data assumed for carrying out this study. 1. Length in X direction = 40m. 2. Length in Y direction = 32m. 3. Typical storey height = 3m. 4. Ground storey height = 3.5m. 5. No of stories: 30 and 40. 6. Height of buildings = 90.5m & 120.5m. 7. Bay spacing in X direction = 4m. 8. Bay spacing in Y direction = 4m. 9. Plan Area = 1280 sq.m. 10. Size of beams = 300*450 mm. 11. Size of columns = 400*800 mm. 12. Grade of concrete = M40. 12. Grade of steel = Fe500 mm. 13. Type of support – fixed. Seismic Zone: I, II, III.



VI. CONCLUSION

The previous research papers help in understanding how irregularities in buildings are unavoidable many a times and that necessary attention is to be given while designing such buildings. Earthquake prone zones ranging from 1 to 5 are present in India depending upon its geographical conditions and hence this parameter cannot be neglected at all. Summarizing the literature has given us an insight of what more can be done in the study of irregular buildings. Thus, in the upcoming stages, modelling and analysis of the above mentioned building structures will be done using Etabs software and results thus obtained will be compared for drawing a meaningful conclusion.

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