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DESIGN AND ANALYSIS OF REGULAR AND VERTICAL GENETIC IRREGULAR BUILDING BY USING ETABS

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Abstract*To study building behavior of multi-story structures always depends on its strength, durability, stiffness and adequacy of the regular configuration of the structure. Methods: The analysis always depends on the forces and importance on the cost of analyzing the structure. Creating the 3D building model for both linear and non-linear dynamic method of analyses Understanding the seismic behavior of Setback buildings and Co-relating the seismic behavior of the Setback building with that of a building without Setback finally comparing the regular building behavior of building with a setback at top most 5 stories to that of the building with a setback at each floor level. Study the influence of vertical irregularity in the building when compare to regular building. Findings: The present study is limited to reinforced concrete framed structure designed for setback and regular building of loads (DL, LL & EL).*

The behavior of 20-Storied buildings with and without setbacks was studied. The buildings were analyzed using Time History Analysis and Response Spectrum Method and. Novelty: The effect of Setback is studied considering the parameters such as Time Period, storey drifts, Displacements, Storey Shears, Bending Moments and Shear Forces and correlated with the building without a setback.

Keywords: *3D building, E-tabs, multi-story structures*

1. INTRODUCTION

In multi storeyed surrounded structures, harm from quake ground movement for the most part starts at areas of basic shortcomings show in the parallel load opposing edges. This conduct of multistory encircled structures amid solid tremor movements relies upon the dispersion of mass, firmness, and quality in both the flat and vertical planes of structures. Now and again, these shortcomings might be made by discontinuities in firmness, quality or mass between neighboring stories. Such discontinuities between stories are frequently connected with sudden varieties in the edge geometry along the tallness. There are numerous cases of disappointment of structures in past quakes because of such vertical discontinuities.

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. There are two types of irregularities-

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The component of the building, which resists the seismic forces, is known as lateral force resisting system (L.F.R.S). The L.F.R.S of the building may be of different types. The most common forms of these systems in a structure are special moment resisting frames, shear walls and frame-shear wall dual systems. The damage in a structure generally initiates at location of the structural weak planes present in the building systems. These weaknesses trigger further structural deterioration which leads to the structural collapse.

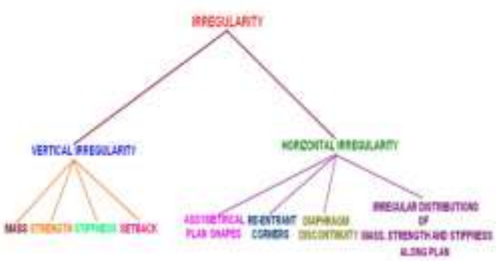

Fig1: Irregularity classification

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 genetic irregularity 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 software using Response spectrum analysis.

Scope of the study

The present examination is constrained to fortified cement (RC) multi-storeyed building outlines with mishaps. Difficulty structures up to 20 stories with various degrees of abnormality are considered. The structures are accepted to have mishap just one way. The arrangement asymmetry emerging out of the vertical geometric abnormality entirely demands an explanation from for three-dimensional investigation legitimately for torsion impacts. This isn't considered in the present examination, which is restricted to investigation of plane misfortune outlines.

Albeit distinctive story numbers (up to 20 stories), cove numbers (up to 10 straights) and anomaly are viewed as, the inlet width is confined, to 6m and story stature to 3m. It will be suitable to consider versatile load design in powerful examination with a specific end goal to incorporate the impact of dynamic basic yielding. Be that as it may, for the present investigation just settled load dissemination shapes are intended to use in powerful examination, with a specific end goal to keep the methodology computationally straightforward and appealing for outline office condition. Soil structure communication impacts are not considered.

2. LITERATURE REVIEWS

RavikanthChittiprolu, Ramancharla Pradeep Kumar, "Significance of Shear Wall in Highrise Irregular Buildings"In this research study on an irregular high rise building with shear wall and without shear wall was studied to understand the lateral loads, story drifts and torsion effects. From the results it is inferred that shear walls are more resistant to lateral loads in an irregular structure.From this research it was concluded that dynamic linear analysis using response spectrum method is performed and lateral load analysis is done for structure without shear wall and structure with shear wall.

Siva Naveen, Nimmymiryam Abraham, et al.,(2018), "Analysis of Irregular Structures under Earthquake Loads"In this study a nine-storeyed regular frame is modified by incorporating irregularities in various forms in both plan and elevation to form 34 configurations with single irregularity and 20 cases with combinations of irregularities. Along with the regular configuration, 54 irregular configurations are analyzed and compared. From this study it was concluded that the structural behaviour of multi-storey frames with single and combinations of irregularities is studied.

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Dileshwar Rana, Prof. Juned Raheem, et al.,(2015), "Seismic Analysis of Regular & Vertical Geometric Irregular RCC Framed Building**"**This work shows the performance & behavior of regular & vertical geometric irregular RCC framed structure under seismic motion. Five types of building geometry are taken in this project: one regular frame & four irregular frames. From this study it was concluded that the amount of setback increases, the critical shear force also increases.

3. METHODOLOGY USED

Response spectrum analysis

This method is also known as modal method or mode superposition method. It is based on the idea that the response of a building is the superposition of the responses of individual modes of vibration, each mode responding with its own particular deformed shape, its own frequency, and with its own modal damping.

According to IS-1893(Part-l):2002, high rise and irregular buildings must be analyzed by response spectrum method using design spectra shown in Figure 4.1. There are significant computational advantages using response spectra method of seismic analysis for prediction of drifts and member forces in structural systems. The method involves only the calculation of the maximum values of the drifts and member forces in each mode using smooth spectra that are the average of several earthquake motions. Sufficient modes to capture such that at least 90% of the participating mass of the building (in each of two orthogonal principle horizontal directions) have to be considered for the analysis. The analysis is performed to determine the base shear for each mode using given building characteristics and ground motion spectra. And then the Storey forces, accelerations, and drifts are calculated for each mode, and are combined statistically using the SRSS combination.

However, in this method, the design base shear (V_B) shall be compared with a base shear (V_b) calculated using a fundamental period T. If V_B is less than V_b response quantities are (for example member forces, drifts, Storey forces, Storey shears and base reactions) multiplied by V_B/V_b Response spectrum method of analysis shall be performed using design spectrum. In case design spectrum is specifically prepared for a structure at a particular project site, the same may be used for design at the discretion of the project authorities. Figure 4.1 shows the proposed 5% spectra for rocky and soils sites.

4. PROBLEM STATEMENT AND MODELS USED

In the present study, analysis of G+ 20 stories building in Zone V seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

1. Grade of concrete : M40
2. Grade of Reinforcing steel : HYSD Fe500
3. Dimensions of beam :690mmX300mm
4. Dimensions of column :690mmX690mm
5. Thickness of slab :150mm
6. Height of bottom story : 3m
7. Height of Remaining story : 3m
8. Methodology Used :Response Spectrum Analysis
9. Live load : 4 KN/m^2
10. Dead load : 2 KN/m^2
11. Density of concrete : 25 KN/m^3
12. Seismic Zone : Zone 5
13. Site type : II
14. Importance factor : 1.5
15. Response reduction factor : 5
16. Damping Ratio : 5%
17. Structure class : B
18. Basic wind speed : 44m/s
19. Risk coefficient (K1) : 1.08

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20. Terrain size coefficient (K2) : 1.14
21. Topography factor (K3) : 1.36
22. Wind design code : IS 875: 1987 (Part 3)
23. RCC design code : IS 456:2000
24. Steel design code : IS 800: 2007
25. Earth quake design code : IS 1893 : 2002 (Part 1)

Models used

Without irregularity

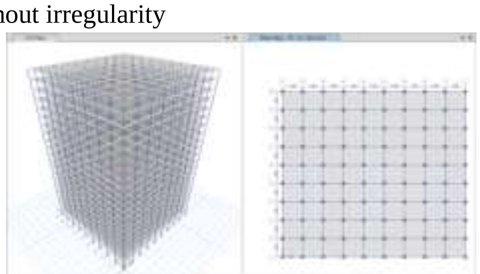


Fig 2: Building Without irregularity

Vertical irregular building 1

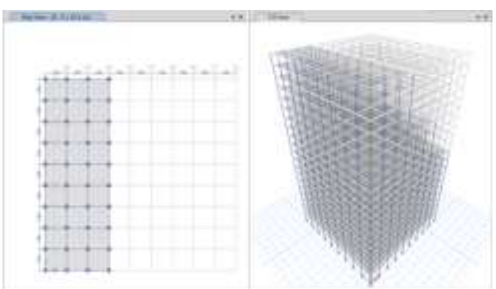


Fig 3: Building With irregularity 1

Vertical irregular building 2

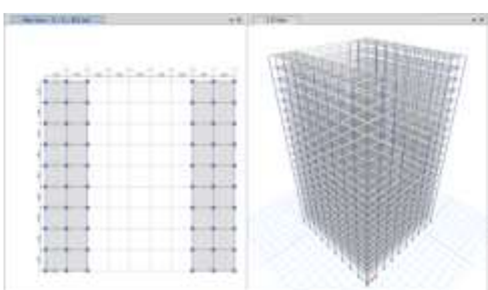


Fig 4: Building With irregularity 2

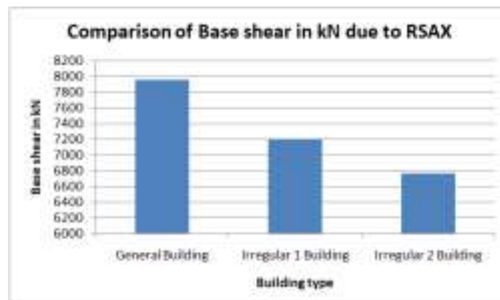
5. RESULTS AND ANALYSIS

RSAX Results

Storey drift

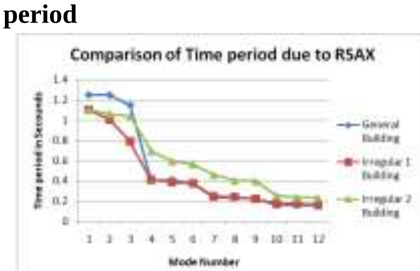
Graph 1: Comparison of storey drift due to RSAX

Base shear



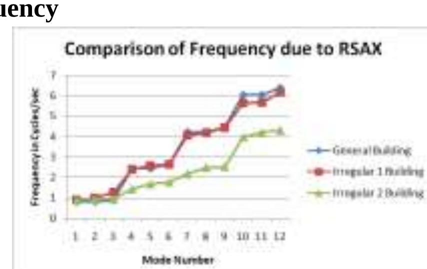
Graph 2: Comparison of base shear due to RSAX

Time period



Graph 3: Comparison of Time period due to RSAX

Frequency

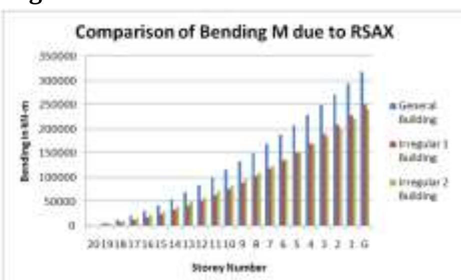


Graph 4: Comparison of Frequency due to RSAX

Shear Values

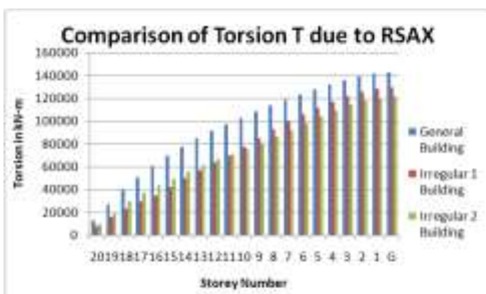
Graph 5: Comparison of Shear V values due to RSAX

Bending values



Graph 6: Comparison of Bending M due to RSAX

Torsion values



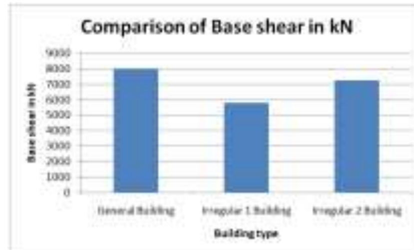
Graph 7: Comparison of Torsion T due to RSAX

RSAY Results

Storey drift

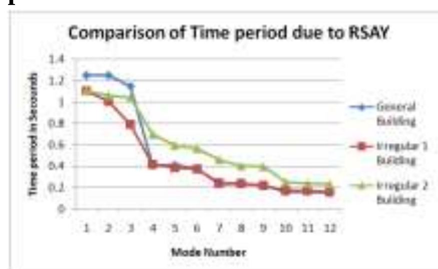
Graph 8: Comparison of storey drift due to RSAY

Base shear



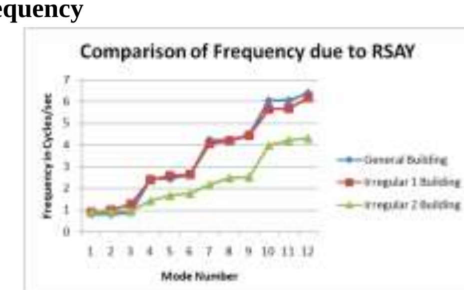
Graph 9: Comparison of base shear due to RSAY

Time period



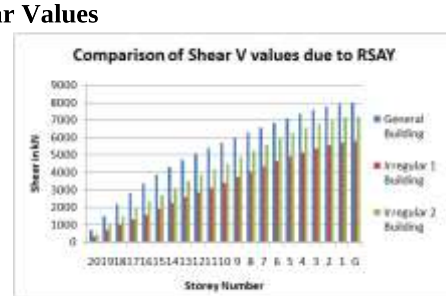
Graph 10: Comparison of Time period due to RSAY

Frequency



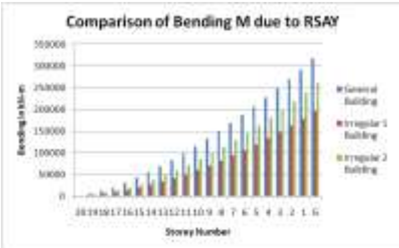
Graph 11: Comparison of Frequency due to RSAY

Shear Values



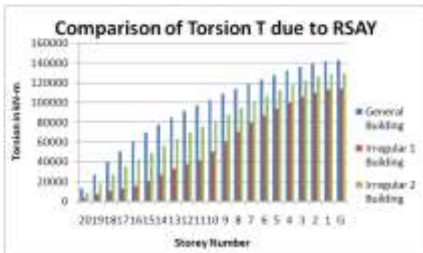
Graph 12: Comparison of Shear V values due to RSAY

Bending values



Graph 13: Comparison of Bending M due to RSAY

Torsion values



Graph 14: Comparison of Torsion T due to RSAY

6. CONCLUSIONS

From this study the following conclusions were made

1. The storey drift values are observed high in case of building without irregularity and it has less value for irregular model 2.
2. The base shear values are observed high in case of building without irregularity and it has less value for irregular model 2.
3. The values related to the shear values has less values for building model related to irregularity 2.
4. The values related to the bending and torsion values has less values for building model related to irregularity 2.
5. Time period vales decrease from node 1 to node 12 and it has less value made with irregular building model 2 than irregular building model 1 and general building.
6. Time frequency vales increases from node 1 to node 12 and it has less values made with irregular building model 2 than irregular building model 1 and general building.
7. 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.
8. Earthquake prone zones ranging from 2 to 5 are present in India depending upon its geographical conditions and hence this parameter cannot be neglected at all.
9. A detailed literature review on setback buildings conclude that the displacement demand is dependent on the geometrical configuration of frame and concentrated in the neighborhood of the setbacks for setback structures.
10. The higher modes significantly contribute to the response quantities of setback structure. Also conventional pushover analysis seems to be underestimating the response quantities in the upper floors of the irregular frames.

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