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Comparative Study of G+6 Irregular Multistoryed Building of Different Shape of Diaphragm

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Abstract: ***This study investigates the effectiveness of incorporating openings in the roof of re-entrant corner plan irregular buildings at different locations under earthquake loads. Five models with varying degrees of diaphragm discontinuity were analysed using STAAD Pro software. Node displacement, storey shear in X and Z directions, stress values, and maximum bending moment were evaluated to assess structural performance. Results indicate that models with higher diaphragm discontinuity exhibit increased node displacements, storey shear, and stress levels. Model M3, with 17% diaphragm discontinuity, consistently demonstrates superior performance in terms of lower displacements and stress values compared to other models. However, final model selection should consider specific project requirements and design considerations.***
Keywords: ***Plan irregularities, Diaphragm Discontinuity, Re-entrant Corner, Seismic Analysis.***

I. INTRODUCTION

Irregularities in structures are a common characteristic in urban areas. Often, buildings become irregular during the planning phase due to architectural and functional considerations. However, such irregularities have shown increased vulnerability in past earthquakes. Consequently, extensive research has been conducted in this field, primarily in the deterministic domain. The focus of the present study is to evaluate the relative performance of vertically irregular buildings within a probabilistic framework.

Vertical irregularities in buildings can result from a sudden decrease in stiffness or strength in a specific storey. In regions with high seismic activity, these irregularities pose significant challenges for structural engineers. Numerous irregular structures can be found in urban infrastructures today, with open ground storeys and stepped buildings being particularly prevalent in urban areas of India. Figure X illustrates a typical open ground storey and a stepped irregular framed building.

Plan irregularities in building structures pertain to deviations from a regular or symmetrical floor plan. These irregularities can have a significant impact on a building's structural performance during seismic events.

Plan irregularities can compromise the overall seismic performance of a building, making it more susceptible to damage or failure during an earthquake. Engineers and architects need to address these irregularities by applying appropriate design and structural measures. Building codes and seismic standards often include provisions to mitigate the impact of plan irregularities and enhance the safety of structures in earthquake-prone regions.

II. OBJECTIVE

1) Assess the structural behavior of re-entrant plan irregular buildings with varying degrees of diaphragm discontinuity.
2) Analyze node displacement patterns within the building models to understand how different configurations and discontinuity levels affect structural deformations.
3) Compare the node displacement results among different models to identify trends and differences in structural response based on the percentage of diaphragm discontinuity.
4) Contribute to the development of safer building designs by identifying potential vulnerabilities associated with re-entrant plan irregularities and diaphragm discontinuity.
5) Generate data that can inform the development or refinement of building codes and standards related to re-entrant plan irregularities and structural discontinuity.

III. METHODOLOGY

The objective of this thesis is to investigate the effectiveness of opening in roof in re-entrant corner plan irregular building at different locations when subjected to earthquake loads. The earthquake loads are determined based on the guidelines provided in IS 1893 (Part-1). To analyze the structural response, the STAAD Pro software program is selected as the analysis tool.

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In this work, the focus is on seismic analysis using the STAAD Pro program to investigate a specific validation problem. The objective is to analyze the behavior of a G+6-story unconventional residential building during an earthquake event. The building is characterized as multi-story, reinforced concrete-framed, and irregular in design. The analysis is performed using the response spectra method, considering the earthquake intensity of Zone III.

Table no. 1 Structural Data

S.no	Model ID	Value
1	No. of Story	G + 6 Stories
2	Plan Area	36 Meters X 36 Meters
3	Story Height	3 Meters
4	Beam Size	500 millimeters X 500 millimeter
5	Column Size	600 millimeters X 600 millimeters
6	Column Spacing	4 Meters
7	Slab Thickness	150 millimeters
8	Grade of Concrete	M-25
9	Grade of Steel	Fe-550
10	Zone	Zone III
11	Shear Wall Thickness	150 millimeters

Table no. 2 Model Description

S.no	Model ID	Model Description
1	M1	Re-entrant Plan Irregular building with 0% Diaphragm Discontinuity
2	M2	Re-entrant Plan Irregular Building with 15% Diaphragm Discontinuity
3/	M3	Re-entrant Plan Irregular Building with 17% Diaphragm Discontinuity
4	M4	Re-entrant Plan Irregular Building with 30% Diaphragm Discontinuity
5	M5	Re-entrant Plan Irregular Building with 32% Diaphragm Discontinuity

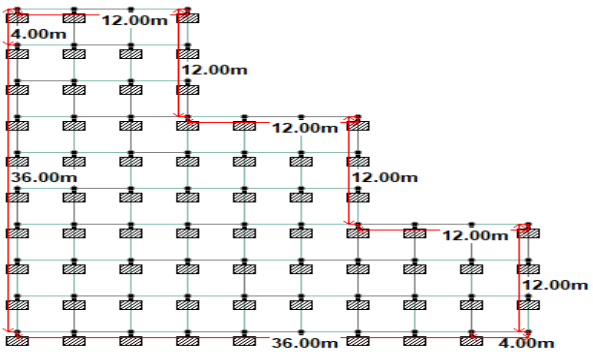

Fig. 1 Plan of G+6 structural model M1 with 0% Diaphragm Discontinuity

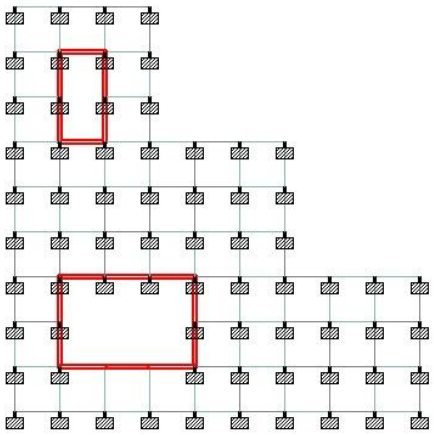

Fig. 2 Plan of G+6 Irregular Structural Model M2 with 15% Diaphragm Discontinuity in Centre and Side Corners

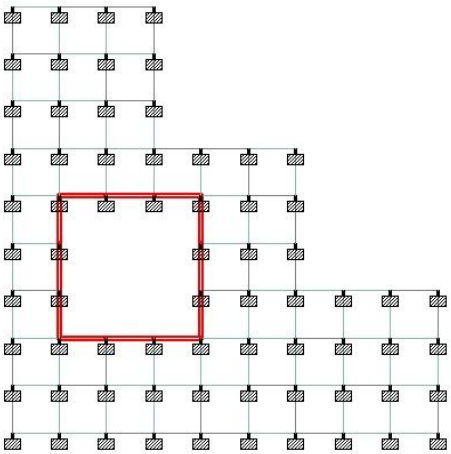

Fig. 3 Plan of G+6 Irregular Structural Model M3 with 17% Diaphragm Discontinuity in Centre

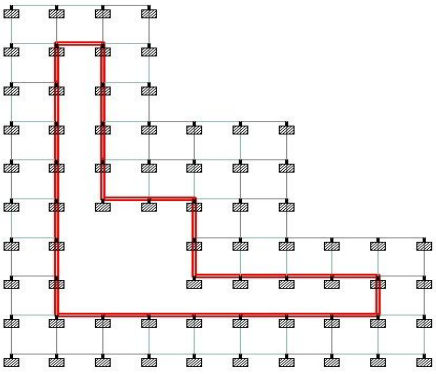

Fig.4 Plan of G+6 Irregular Structural Model M4 with 30% Diaphragm Discontinuity in L- Shape in Centre

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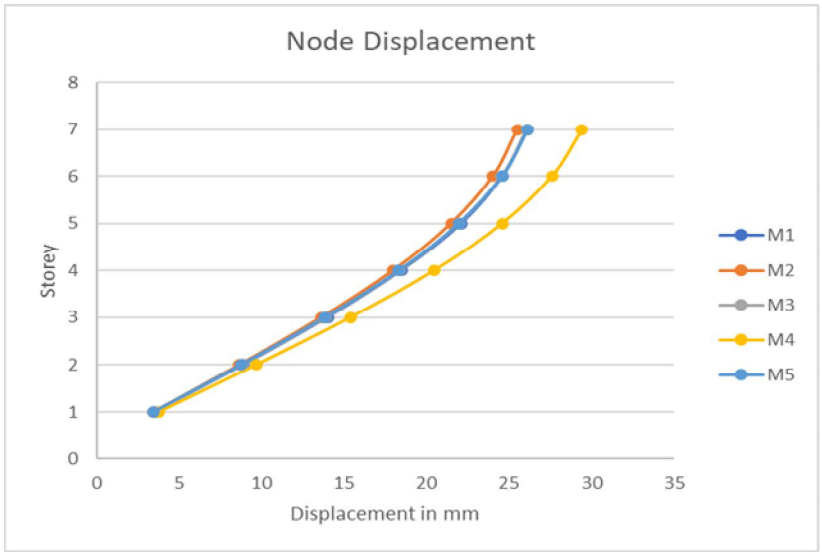
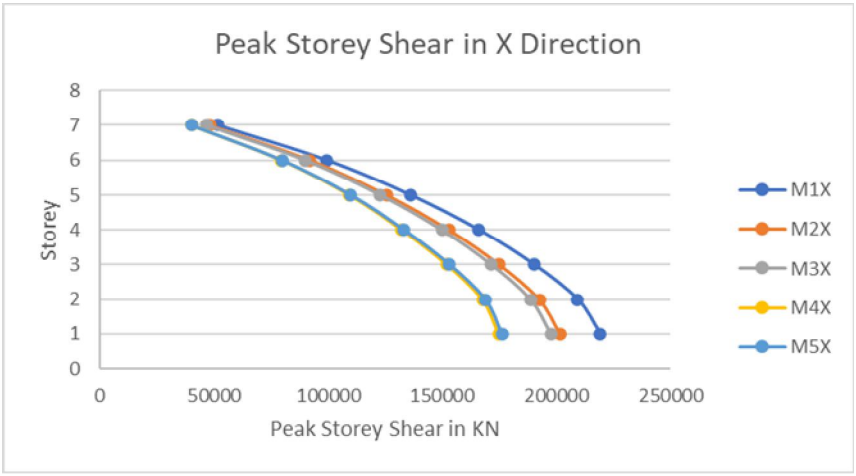
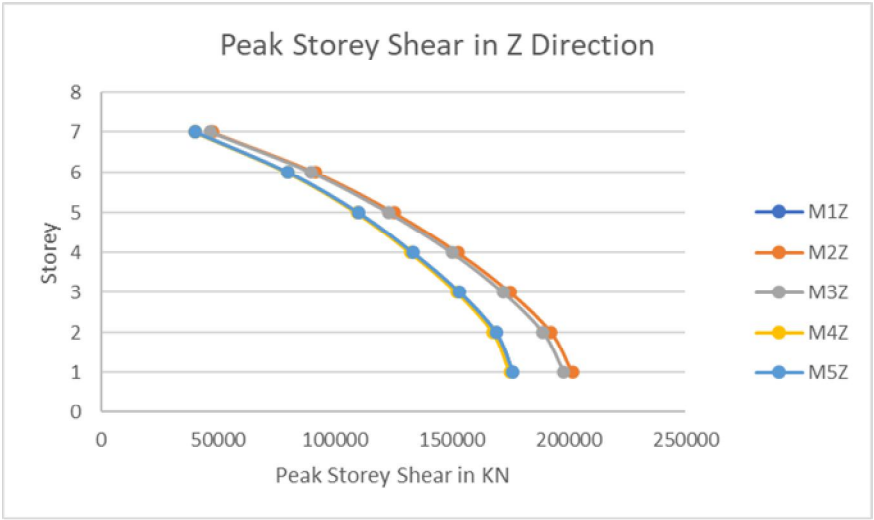
IV. RESULT



Graph No.1 Resultant Node Displacement for All Model



Graph No.2 Peak Storey Shear in all model in X direction



Graph No.3 Peak Storey Shear in all model in Z direction

V. CONCLUSION

Considering the data available, it is evident that Model M2 consistently exhibits higher stress levels, larger node displacements, and higher storey shear values, indicating that it might be more susceptible to structural deformation and less stable under lateral loads. Model M3, (Re-entrant Plan irregular Building with 17% Diaphragm Discontinuity) on the other hand, consistently displays better overall performance in terms of lower node displacements and stress values.

It's important to note that the selection of the best model may depend on specific project requirements, safety standards, and design considerations. Engineers would typically conduct a more comprehensive analysis, taking into account additional factors, such as cost, construction feasibility, and project objectives, to make a final decision on the most suitable model for a particular application.

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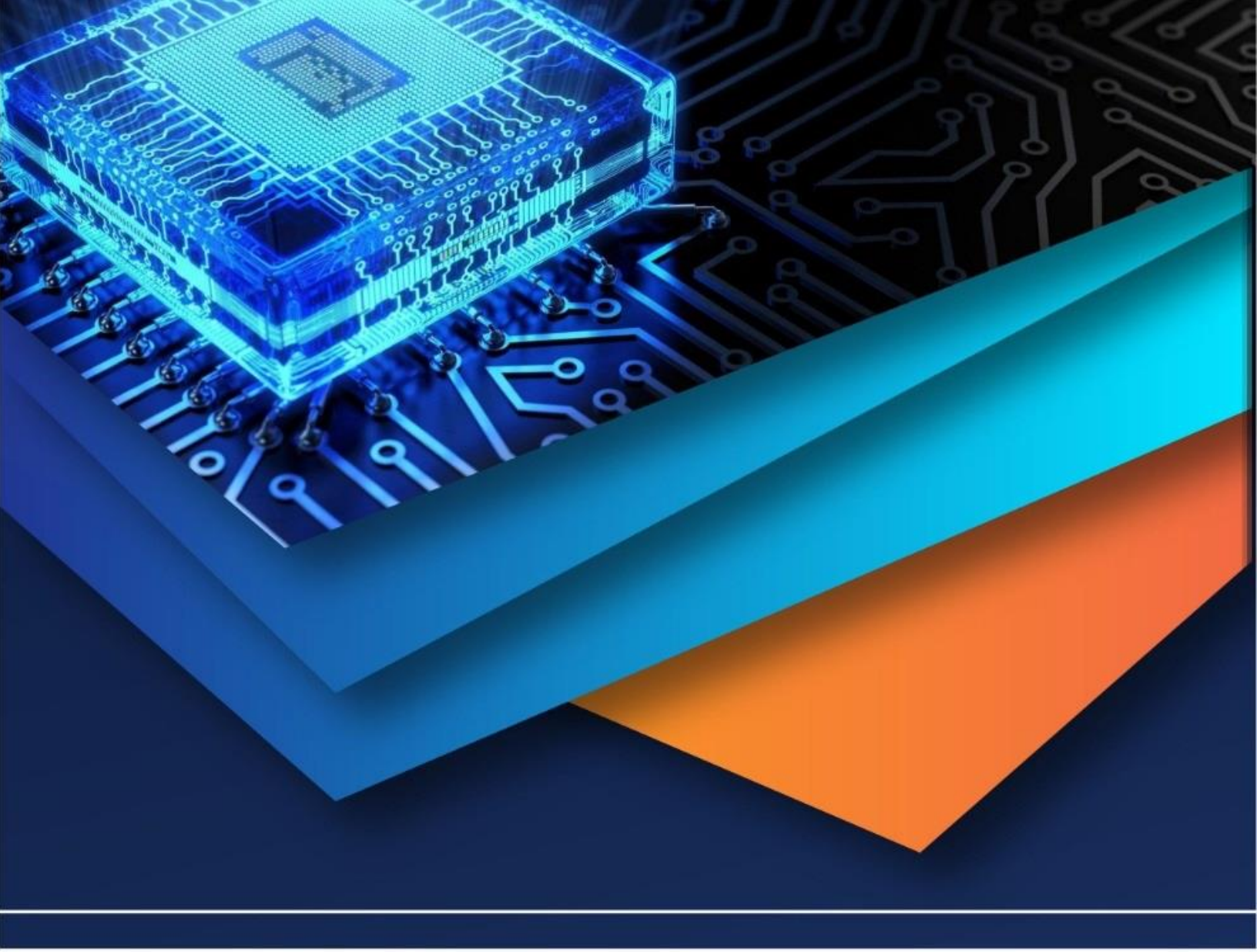

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