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Comparative Study of G+6 Irregular Multistoryed Building of L Shape of Diaphragm Discontinuity

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Abstract: This study investigates the effectiveness of incorporating roof openings in re-entrant corner plan irregular buildings at various locations under earthquake loads. Three models L-shaped diaphragm discontinuity were analyzed using STAAD Pro software. Node displacement and storey shear in both the X and Z directions were evaluated to assess structural performance. The results indicate that models with square diaphragm discontinuity exhibit increased node displacements and storey shear compared to those with L-shaped diaphragm discontinuity. The model with L-shaped diaphragm discontinuity consistently demonstrates superior performance in terms of lower displacements and shear stress values. However, the final model selection should take into account 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

The objectives of this study are as follows:

1) Assess the Impact of Roof Openings: Investigate how the inclusion of roof openings affects the structural behavior of re-entrant corner plan irregular buildings under earthquake loads.
2) Compare Diaphragm Discontinuity Shapes: Analyze the performance of L-shaped diaphragm discontinuity configurations in the context of node displacement and storey shear.
3) Evaluate Structural Performance: Use node displacement and storey shear in both the X and Z directions as indicators to evaluate the structural performance of the analyzed models.
4) Identify Superior Design: Determine which diaphragm discontinuity of L-shaped, offers better structural performance in terms of mitigating displacements and shear stresses.
5) Provide Design Recommendations: Offer insights to designers and engineers regarding the selection of diaphragm discontinuity shapes based on the structural response observed in the analysis.
6) Inform Project-Specific Decisions: Recognize that while one diaphragm discontinuity shape may demonstrate superior performance overall, the final model selection should consider project-specific requirements and design considerations.

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.

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 without Diaphragm Discontinuity
2	M2	Re-entrant Plan Irregular Building with L Shape of Diaphragm Discontinuity

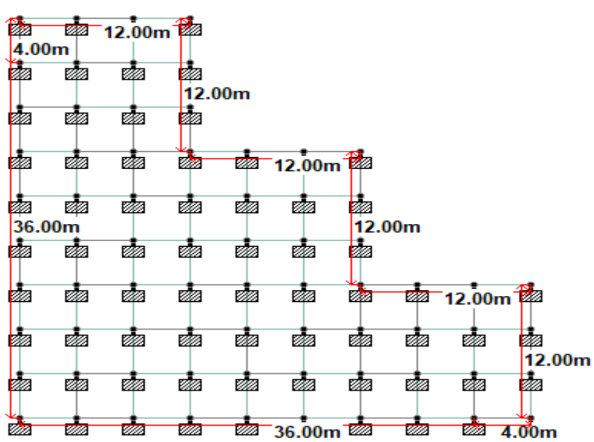


Fig. 1 Re-entrant Plan Irregular building without Diaphragm Discontinuity

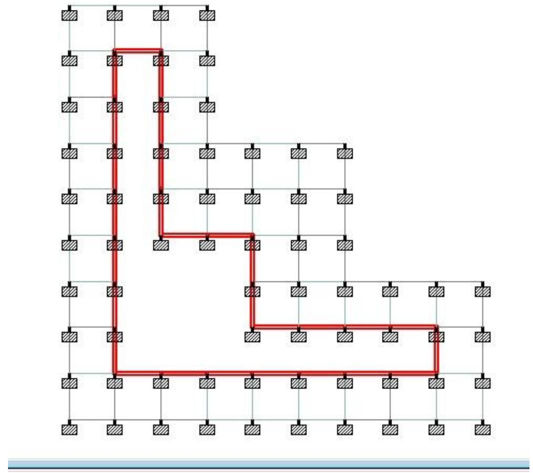
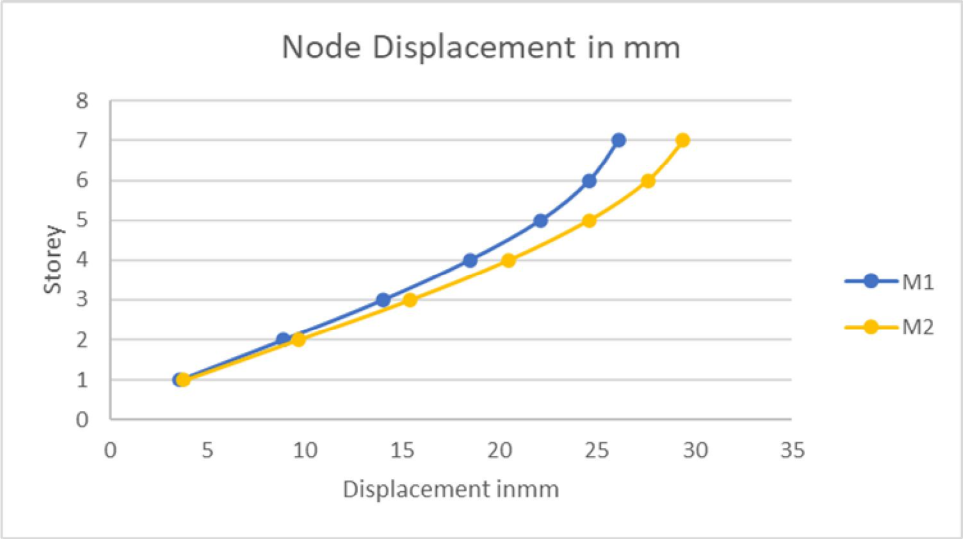
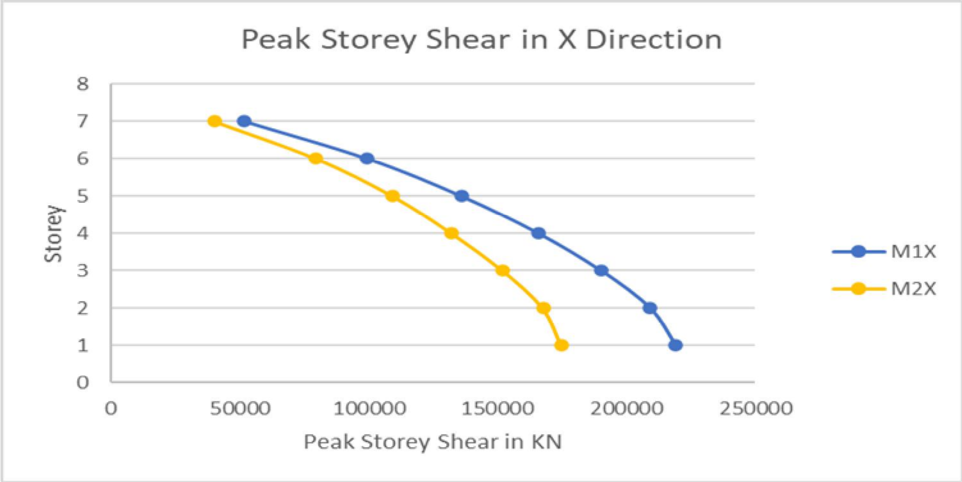


Fig.2 Re-entrant Plan Irregular Building with L Shape of Diaphragm Discontinuity

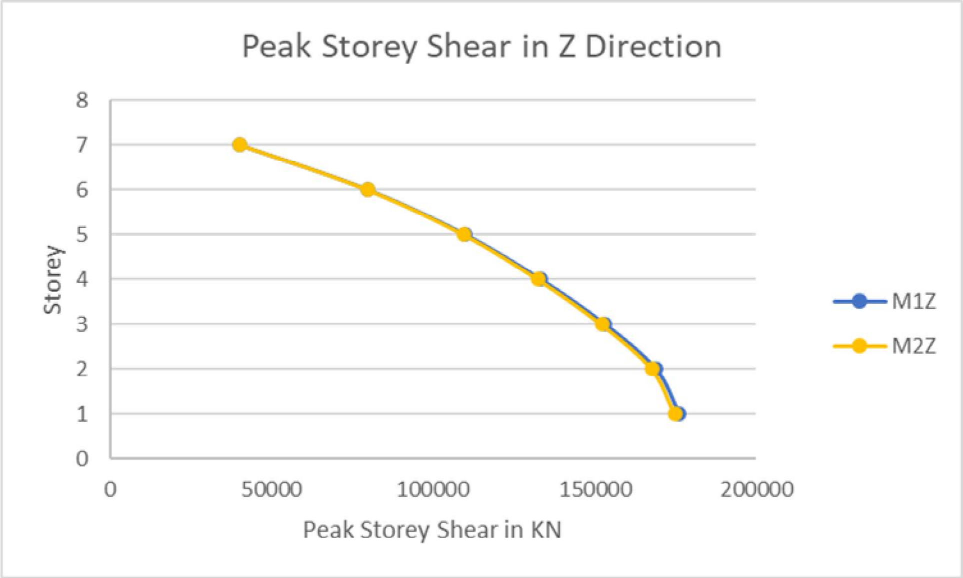
III. RESULT



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

IV. CONCLUSION

Considering the data available, it is evident that -

1) Model M2, (Re-entrant Plan irregular L Shape of Diaphragm Discontinuity) consistently displays better overall performance in terms of lower node displacements and stress values.
2) 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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