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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

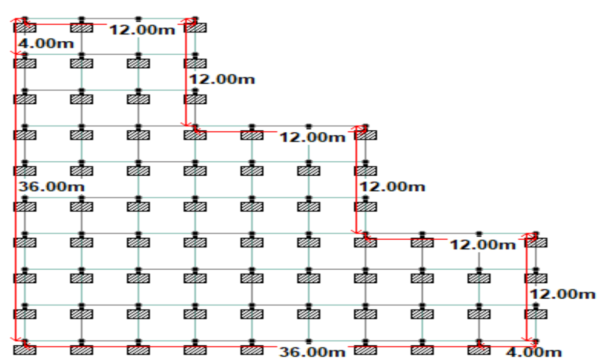

Fig. 1 Plan of G+6 structural model M1 with 0% Diaphragm Discontinuity

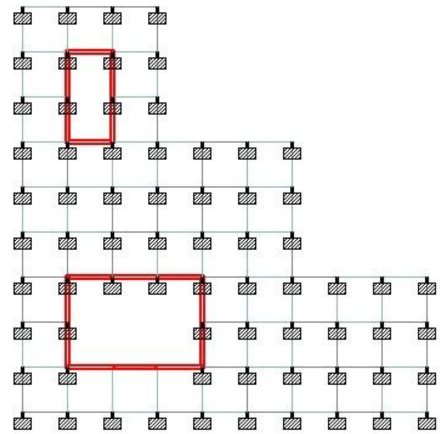

Fig. 2 Plan of G+6 Irregular Structural Model M2 with 15% Diaphragm Discontinuity in Centre and Side Corners

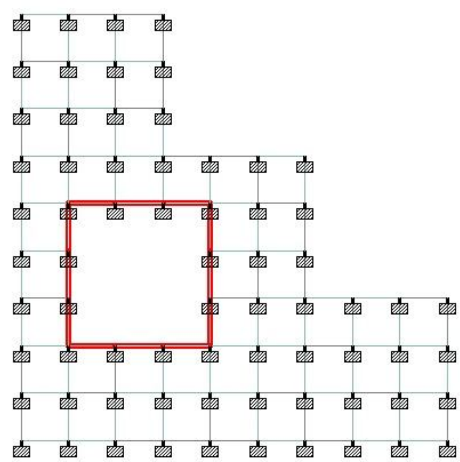

Fig. 3 Plan of G+6 Irregular Structural Model M3 with 17% Diaphragm Discontinuity in Centre

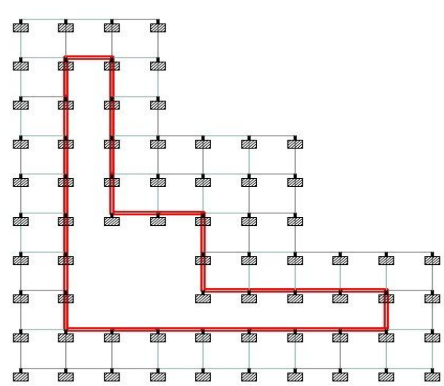

Fig.4 Plan of G+6 Irregular Structural Model M4 with 30% Diaphragm Discontinuity in L- Shape in Centre

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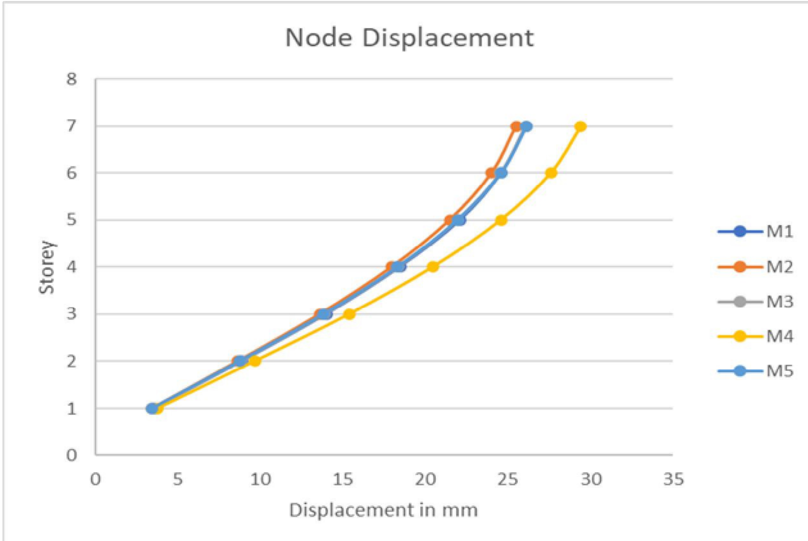
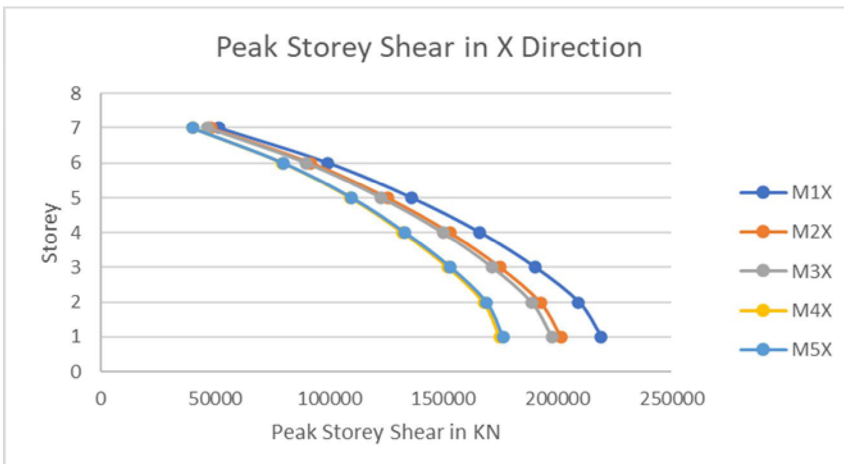
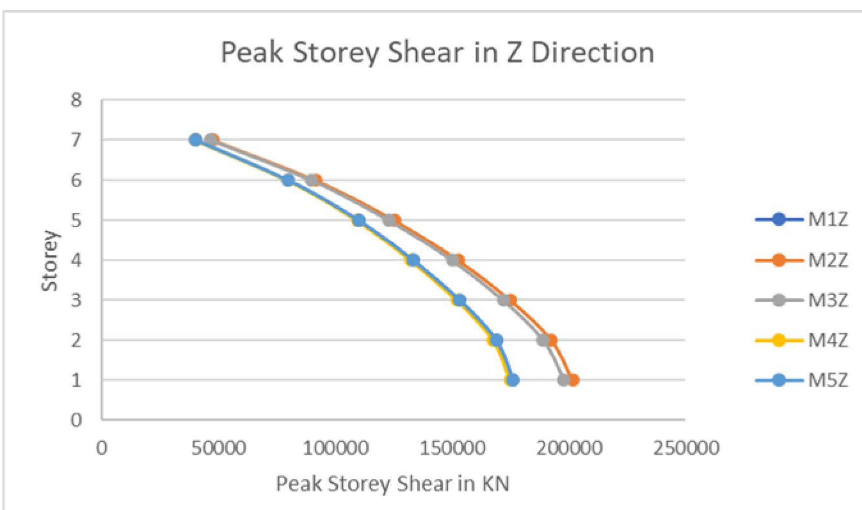
IV. RESULT



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.

REFERENCES

[1] Raagavi and Sidhardhan "A Study on Seismic Performance of Various Irregular Structures.", International Journal of Research in Engineering and Science (IJRES), Volume-9 (Issue-5), pp 12-19. (2021).
[2] Khazaei et al. "Optimal Location of Multiple Tuned Mass Dampers in Regular and Irregular Tall Steel Buildings Plan. Shock and Vibration", Volume 2020 (2020).
[3] Prasad et al. "Seismic Response Analysis of Symmetrical and Asymmetrical High-Rise Structures in Seismic Zone II", International Journal of Engineering Research and Applications, Volume-10 (Issue-10) (Series-III), pp 36-49. (2020).
[4] Ilerisoy "Discussion of the Structural Irregularities in the Plan for Architectural Design within the Scope of Earthquake Codes", Periodica Polytechnica Architecture, Volume-50 (Issue-1), pp 50–62. (2019).
[5] Krishna and Sankar "Seismic Analysis of Multi Storied Buildings with Floating Columns", International Journal of Innovative Research in Science, Engineering and Technology, Volume-8 (Issue-5), pp-6063. (2019).
[6] Ahirwal, Gupta, and Singh "Effect of Irregular Plan on Seismic Vulnerability of Reinforced Concrete Buildings", In Proceedings of the International Conference on Sustainable Materials and Structures for Civil Infrastructures (AIP Conf. Proc. 2158, AIP Publishing. (2019).
[7] Saglıyan and Yon "Assessment of Earthquake Behaviour of Reinforced Concrete Buildings with Slab Discontinuity", Turkish Journal of Science & Technology, Volume-13 (Issue-1), pp 87-92. (2018).
[8] Sanjay and Rao "Effect of Diaphragm Discontinuity in the Seismic Response of Multi-Storeyed Building", International Journal of Research Sciences and Advanced Engineering (IJRSAE), Volume-2 (Issue-20), pp 182-187. (2018).
[9] Sarojini and Kumar "Diaphragm Discontinuity Consequence with The Seismic Performance of RC Building", International Journal of Innovative Technology and Research, Volume-6 (Issue-3), pp 8159-8161. (2018).
[10] Sahu and Dwivedi "Seismic Analysis of RC Frame with Diaphragm Discontinuity", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume-14 (Issue-4) (2017).
[11] Chacko and Eliyas "Seismic Analysis of Fixed Base and Base Isolated RC Buildings Having Diaphragm Discontinuity", International Research Journal of Engineering and Technology (IRJET), Volume-04 (Issue-06), pp-1966. (2017).
[12] Soni, Rawat, and Kushwah "Wind Analysis of Tall Building with Floor Diaphragm", International Research Journal of Engineering and Technology (IRJET), Voulme-04 (Issue-03), pp-1095. (2017).
[13] Bagawan and Patel "Seismic Performance Study of RC Framed Building with Diaphragm Discontinuity", International Research Journal of Engineering and Technology (IRJET), Volume-04 (Issue-09), pp 103. (2017).
[14] Kusuma "Seismic Analysis of a High-rise RC Framed Structure with Irregularities", International Research Journal of Engineering and Technology (IRJET), Volume-04 (Issue-07), pp-1338. (2017).
[15] Kadiyala and Kota "Effect of Diaphragm Discontinuity of the Building", International Journal of Research in Engineering, IT and Social Sciences, Volume-06 (Issue-09), pp 33-40. (2016).
[16] Habib et al. "Effect of Plan Irregularity on RC Buildings due to BNBC-2006 Earthquake Load", International Journal of Scientific & Engineering Research, Volume-7 (Issue-1), pp-761. (2016).
[17] Sawarkar and Nandurkar "Critical Analysis of Column Displacement and Forces in Selected Column for a Structure with Diaphragm at Different Levels", International Journal of Science Technology & Engineering (IJSTE), Volume-2 (Issue-10), pp-806. (2016).
[18] Abdlebasset et al. "Seismic Analysis of High-Rise Buildings with Transfer Slabs", State-of-the-Art Review. Electronic Journal of Structural Engineering, Volume-16 (Issue-1). (2016).
[19] Scarry "Floor Diaphragms and a Truss Method for Their Analysis. Bulletin of the New Zealand Society for Earthquake Engineering", Volume-48, No. 1, March 2015. Structural Engineer, Auckland. (Submitted May 2014; Reviewed August 2014; Accepted December 2014). (2015).
[20] Monish and Karuna "A Study on Seismic Performance of High-Rise Irregular RC Framed Buildings", International Journal of Research in Engineering and Technology (IJRET), Volume-04 (Issue-05), pp 340. (2015).
[21] Divyashree, M., et al. (2014). Comparison Of Bracings and Shear Walls as Seismic Strengthening Methods to Buildings with Plan Irregularities: International Journal of Research in Engineering and Technology, 3(6), 205-210.
[22] Ahmed, J. A. K., & Sreevalli, Y. (2014). Influence of bracing location on the fundamental time period of high-rise buildings under seismic and wind loads. Journal of Earthquake Engineering, 18(4), 589-603.
[23] Suresh, M. R., & Badami, S. (2014). Structural configuration suitability for buildings of different heights under gravity and wind loads. Journal of Constructional Steel Research, 94, 46-56.
[24] Ozturk "A study of the effects of slab gaps in buildings on seismic response according to three different codes", Scientific Research and Essays, Volume-6 (Issue-19), pp 3930-3941. (2011).
[25] Gonzalez Herrera and Gomez Soberon "Influence of Plan Irregularity of Buildings", In Proceedings of the 14th World Conference on Earthquake Engineering, October 12-17, 2008, Beijing, China. (2008).