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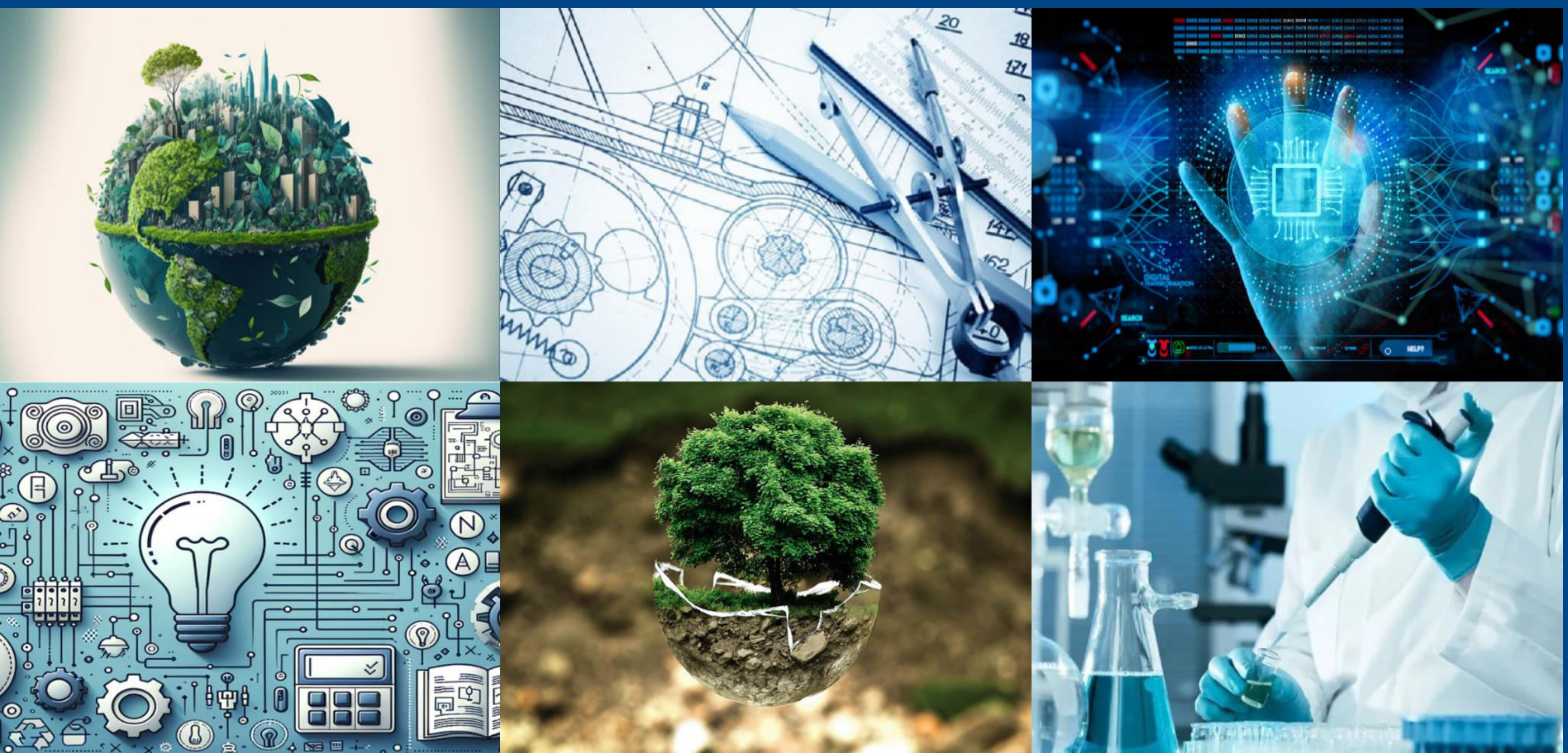

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A Review on Comparison of Time History Analysis of Regular and Irregular Shape Buildings

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ABSTRACT: This study compares the seismic performance of regular and irregular-shaped multi-storey buildings using time history analysis in ETABS. The buildings are modeled using the finite element method and subjected to real earthquake ground motions. The analysis focuses on comparing maximum displacement, acceleration, and inter-story drift between the two building types.

Sensitivity and statistical analyses are performed to understand the impact of different parameters on structural response. The main goal is to gain insights into how geometric irregularities affect seismic behavior and to support the design of earthquake-resistant buildings.

KEYWORDS: Multi-Storey Building, Non-Linear Seismic Analysis, Time History Method and ETABS

I. INTRODUCTION

Time History Analysis is a dynamic method used in structural engineering to study how buildings respond to time-varying loads such as earthquakes, wind, and blasts. Unlike static methods, it simulates real-life conditions using recorded ground motion data to evaluate displacements, accelerations, stresses, and inter-story drifts.

- **Regular vs. Irregular Buildings:**
- **Regular Buildings** have symmetric and uniform geometry (e.g., square or rectangular).
  - Their response to dynamic loads is simpler and more predictable.
  - Stress and strain are evenly distributed.

- **Irregular Buildings** have asymmetric shapes (e.g., L-shape, T-shape).
  - Their complex geometry leads to stress concentrations and localized failures.
  - Require more detailed analysis due to unpredictable response behavior.

- **Analytical Techniques:**
- **Time History Analysis**: Simulates dynamic load application over time.
- **Response Spectrum Analysis**: Plots peak structural responses over various frequencies.
- **Nonlinear Analysis**: Captures the complex interaction of structural components under extreme conditions.
- **Finite Element Method (FEM)**: Used to build accurate structural models for simulation.

- **Shape Factor:**
- Quantifies building irregularity as the ratio of the perimeter of the building to that of a circle with the same area.
- Helps compare buildings' geometric irregularities numerically.

- **Key Comparison Parameters:**
- Maximum Displacement
- Maximum Acceleration
- Inter-Story Drift
- Peak Floor Responses

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- **Methodology:**
- Selection of both regular and irregular building models.
- Modeling with real-world dimensions and materials.
- Application of actual earthquake ground motion data.
- Execution of time history analysis using FEM.
- Comparison of structural responses under identical conditions.

- **Seismic Codes & Safety:**
- Seismic design codes demand stricter parameters for irregular buildings due to stress concentration.
- Time history analysis helps ensure compliance and optimize design for safety and durability.

- **Advantages of Time History Analysis:**
- Realistic and detailed simulation of dynamic behavior.
- Assesses safety under extreme events.
- Aids in optimization and retrofitting strategies.
- Complies with modern seismic codes.

- **Mitigation Strategies:**
- Retrofitting existing irregular buildings.
- Designing with better structural layouts and reinforcements.
- Using time history results to improve dynamic performance and reduce failure risks.

II. LITERATURE REVIEW

S. No.	Author(s)	Title of Study	Key Findings
1	Shwetha et al.	Comparison of Seismic Response of Regular and Irregular Plan Buildings Using Time History Analysis	Irregular buildings exhibited higher lateral displacement and inter-story drift than regular buildings.
2	Sandeep et al.	Time History Analysis of Regular and Irregular Shaped RC Buildings	Irregular RC buildings showed greater maximum displacement and inter-story drift.
3	Kumari et al.	Comparative Analysis of Regular and Irregular Shaped RC Buildings under Seismic Loads	Irregular buildings had higher peak acceleration and shorter fundamental time period.
4	Xu et al.	Seismic Analysis of Regular and Irregular Shaped Buildings with Different Heights	Height increased seismic response; irregular buildings had higher peak acceleration and damage index.
5	Roy et al.	Seismic Analysis of Regular and Irregular Shaped Buildings with Different Aspect Ratios	Larger aspect ratios led to higher inter-story drift and damage index in irregular buildings.
6	Wang et al.	Seismic Performance of Regular and Irregular Shaped Buildings Considering Soil-Structure Interaction	Soil-structure interaction increased peak acceleration and drift in irregular buildings.
7	Sharma et al.	Comparative Study of Regular and Irregular Shaped Tall Buildings under Seismic Loads	Irregular tall buildings experienced greater inter-story drift and damage.
8	Karandikar et al.	Seismic Performance of Regular and Irregular Shaped Steel Structures	Irregular steel structures had greater drift and damage index.
9	Singh et al.	Comparative Study of Seismic Performance of Regular and Irregular Shaped Buildings with Varying Floor Heights	Irregular buildings with varying floor heights had higher peak acceleration and inter-story drift.
10	Kumar et al.	Comparison of Seismic Response of Regular and Irregular Shaped Concrete Shear Walls	Irregular shear walls showed higher drift and greater structural damage.

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S. No.	Author(s)	Title of Study	Key Findings
11	Dogan et al.	Seismic Performance Evaluation of Regular and Irregular Shaped Masonry Buildings Using Time History Analysis	Irregular masonry buildings were more vulnerable, with higher drift and damage index.
12	Raja et al.	Comparative Analysis of Seismic Response of Regular and Irregular Shaped Buildings with Different Plan Configurations	Irregular plans (L-, T-, U-shape) increased drift and peak acceleration.
13	Ali et al.	Seismic Response Analysis of Regular and Irregular Shaped Buildings with Varying Aspect Ratios	Larger aspect ratios in irregular buildings led to increased drift and structural damage.
14	Niu et al.	Comparison of Seismic Response of Regular and Irregular Shaped Buildings with Varying Floor Heights	Taller floor heights in irregular buildings resulted in higher acceleration and drift.
15	Park et al.	Seismic Response of Regular and Irregular Shaped Buildings with Different Lateral Force Resisting Systems	Irregular buildings with eccentrically braced frames performed worse than regular buildings with moment-resisting frames.

Summary

The literature review focused on the comparison of time history analysis of regular and irregular shaped buildings in the context of seismic performance. The review identified several key findings from various research studies that were conducted in this area. The studies consistently showed that irregular shaped buildings tend to experience higher levels of seismic response compared to regular shaped buildings. This is due to the fact that irregular shaped buildings often have complex plan configurations and non-uniform distribution of mass and stiffness, which can lead to higher peak accelerations, larger inter-story drifts, and greater damage index.

The review also highlighted the importance of considering other factors such as aspect ratio, floor height, and lateral force resisting systems when analysing the seismic response of buildings. These factors can further influence the dynamic behaviour of the building and contribute to the overall seismic performance. Overall, the literature review emphasizes the significance of considering the shape and configuration of buildings in the design process to ensure their resilience under dynamic loads, particularly in earthquake-prone regions.

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