IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 6, May 2026
Impact Factor: 8.2

A Comprehensive Approach to Dynamic Analysis of Multistorey Buildings Utilizing ETABS

[1]Prof. A. R Ghode, [2]Phargade Ajinkya Ramdas
[1, 2] Department of Civil Engineering
Amrutvahini College of Engineering, Amrutnagar, Sangamner, Ahilyanagar

Abstract: *The increasing demand for high-rise buildings in urban areas necessitates accurate seismic analysis to ensure structural safety and resilience. This study presents a comprehensive dynamic analysis of a G+12 reinforced concrete multistorey building using ETABS software. The seismic performance of the building is evaluated under both linear and nonlinear dynamic loading using the Response Spectrum Method (RSM) and Time History Analysis (THA). The analysis incorporates varying soil conditions—hard, medium, and soft—and compares the structural response under fixed and flexible support conditions. Nine structural models are developed to assess the impact of soil flexibility and boundary constraints on key response parameters including base shear, storey displacement, and inter-storey drift.*

Keywords: Linear and Nonlinear Analysis, Response Spectrum Method (RSM), Time History Analysis (THA), ETABS 2017, displacement, storey drifts, base shear.

I. INTRODUCTION

The rapid growth of urbanization and population has significantly increased the demand for multistorey buildings across the world. Modern high-rise structures are designed not only to accommodate large populations but also to optimize land utilization in urban regions. However, as the height of buildings increases, the effect of lateral forces such as earthquakes and wind loads becomes more critical. These dynamic forces can induce vibrations, excessive displacement, and structural instability, making dynamic analysis an essential aspect of structural engineering. Therefore, engineers must adopt advanced analytical methods to evaluate the behavior and performance of multistorey buildings under dynamic loading conditions [1][2].

Dynamic analysis is a structural assessment technique that considers the variation of loads with respect to time. Unlike static analysis, dynamic analysis accounts for inertia effects, damping properties, and natural vibration characteristics of structures. This approach provides a more realistic understanding of structural response during seismic events and strong wind actions. Methods such as Response Spectrum Analysis and Time History Analysis are widely used to determine parameters including storey drift, storey displacement, base shear, and modal participation factors. These parameters are crucial for ensuring the safety and serviceability of high-rise structures subjected to dynamic loads [3][4].

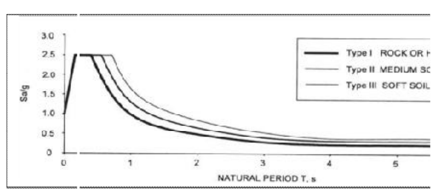

Fig 1: Spectra for Response Spectrum Method as per IS 1893 (Part 1): 2016

With the advancement of computational technology, software applications such as ETABS have become highly effective tools for structural analysis and design. ETABS (Extended Three-Dimensional Analysis of Building Systems) is specifically developed for modeling and analyzing multistorey buildings. The software integrates finite element analysis techniques with user-friendly modeling capabilities, enabling engineers to accurately evaluate structural

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 6, May 2026
Impact Factor: 8.2

behavior under different loading conditions. ETABS supports various analysis methods including linear static analysis, linear dynamic analysis, nonlinear analysis, and performance-based design procedures according to international and Indian standards [5][6].

The application of ETABS in dynamic analysis allows engineers to simulate real structural behavior and identify vulnerable zones in buildings. Through detailed modeling and analysis, the software helps determine structural responses such as lateral displacement, inter-storey drift, stiffness irregularities, and torsional effects. The accurate prediction of these responses assists in improving the seismic resistance and overall stability of multistorey structures. Furthermore, ETABS enables optimization of structural components, leading to economical and safe design solutions for reinforced concrete and steel buildings [7][8].

In recent years, researchers and structural engineers have focused on developing comprehensive approaches for dynamic analysis to improve the performance of buildings in earthquake-prone regions. The integration of advanced analysis techniques with ETABS software has enhanced the reliability and efficiency of structural design practices. By utilizing dynamic analysis methods, engineers can achieve better compliance with codal provisions and ensure that structures remain stable during severe seismic activities. Thus, the use of ETABS for dynamic analysis has become an important part of modern structural engineering practices for designing safe, durable, and efficient multistorey buildings [9][10].

II. PROBLEM STATEMENT

The increasing construction of multistorey buildings in urban areas has created significant challenges in ensuring structural safety and stability under dynamic loading conditions such as earthquakes and wind forces. As building height increases, the structure becomes more flexible and susceptible to lateral vibrations, resulting in higher storey displacement, inter-storey drift, and torsional effects. Conventional static analysis methods are often inadequate for accurately predicting the actual structural behavior of high-rise buildings during seismic events because they do not fully consider inertia forces, damping effects, and time-dependent load variations.

III . OBJECTIVES

- To analyse the dynamic behaviour of a G+12 regular reinforced concrete building subjected to different soil conditions by using response spectrum analysis.
- To evaluate the effects of varying soil conditions on the seismic performance of a G+12 reinforced concrete building by using time history method.
- To compare the results of response spectrum and time history analyses under fixed support conditions in order to enhance the accuracy and reliability of structural assessments.
- To study the seismic performance of a G+12 RC building using response spectrum analysis under both fixed and flexible support conditions, and compare key seismic response parameters.
- To assess the structural behaviour of the building by evaluating storey drift, lateral displacement, and base shear under varying support conditions.

IV. LITERATURE SURVEY

1. Seismic Behaviour of Multi-Storey RC Building Using Response Spectrum Analysis

Author: Shaik Akhil Ahamad et al.

The study focused on evaluating the seismic behaviour of a G+20 reinforced concrete multi-storey building using response spectrum analysis in ETABS 2015 software. Various seismic parameters such as storey drift, base shear, torsional irregularity, and displacement were analysed for all seismic zones defined in IS 1893:2016.

DOI: 10.48175/IJARSCT-35338

2. Seismic Performance of Regular and Irregular RC Frame Buildings
Author: Deekshitha Y. L. et al.
This research investigated the seismic response of G+14 reinforced concrete frame buildings with different irregular configurations including rectangular, L-shape, H-shape, and C-shape plans using ETABS software. Both linear and nonlinear dynamic analyses were carried out while considering soft storey irregularities at the ground floor level. A total of twenty analytical models were developed with different plan and vertical irregularities. The study emphasized the importance of time history analysis, as it provided more accurate and realistic structural responses compared to response spectrum analysis. The research highlighted how plan irregularities and soft storey effects influence displacement, drift, and overall seismic performance of multi-storey structures.

3. Dynamic Analysis of L-Shaped Irregular Building under Earthquake Ground Motions
Author: A. Krishna Srinivas et al.
The study analysed the seismic performance of a G+5 reinforced concrete L-shaped irregular building using ETABS 2016 software. Time history analysis was performed using Bhuj earthquake and El Centro earthquake ground motion records to evaluate the influence of different seismic excitations.

4. Seismic Behaviour of Structures with Shear Walls Using Time History Analysis
Author: Gaurav Kapgate et al.
This study emphasized the significance of shear walls in improving the seismic resistance of high-rise buildings subjected to lateral loads during earthquakes. Nonlinear time history analysis was conducted on a special moment-resisting frame using the El Centro earthquake record in ETABS 2016 software.

V. PROPOSED OF SYSTEM

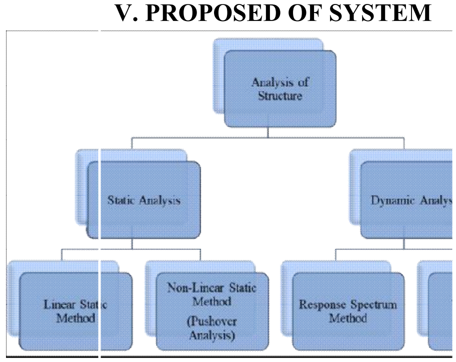

Fig 2: Block Diagram

1. Data Collection and Structural Planning
The proposed system begins with the collection of all necessary structural and architectural data required for modelling and analysis of the multistorey building. Important information such as building dimensions, number of storeys, floor height, material properties, loading conditions, and seismic zone details are gathered according to Indian Standard codes.

2. Three-Dimensional Modelling in ETABS
After collecting the required data, a detailed three-dimensional structural model of the building is developed using ETABS software. The modelling process includes defining grid systems, storey levels, beam sections, column sections, slab thickness, and support conditions

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 6, May 2026
Impact Factor: 8.2

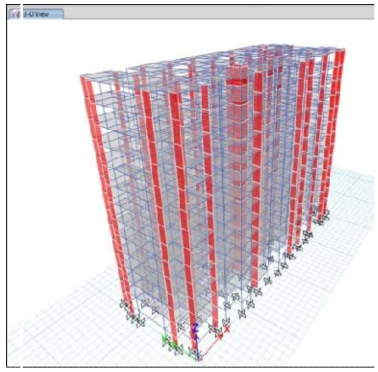

Fig 3: 3D View of G+12 Residential RC Structure

3. Load Definition and Load Combination

The proposed system incorporates all significant loads acting on the structure, including dead loads, live loads, wind loads, and earthquake loads. Dead loads consist of the self-weight of structural and non-structural components, while live loads represent occupancy-related forces.

4. Dynamic Analysis of the Structure

Dynamic analysis is performed to evaluate the response of the multistorey building under earthquake excitation. The proposed system utilizes advanced analysis methods such as Response Spectrum Analysis and Time History Analysis in ETABS software.

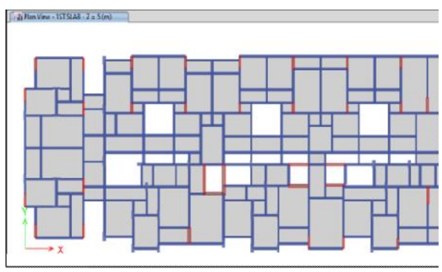

Fig 4: Extruded View of G+12 Residential RC Structure

5. Evaluation of Structural Response

After completing the analysis, the structural responses obtained from ETABS are carefully evaluated to determine the safety and stability of the building. Important parameters including maximum displacement, inter-storey drift, torsional irregularity.

Fig 5: Typical Floor Plan of G+12 Residential RC Structure in ETABS

Copyright to IJARSCT
www.ijarsct.co.in
DOI: 10.48175/IJARSCT-35338

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 6, May 2026 Impact Factor: 8.2

6. Structural Optimization and Design Improvement

Based on the analytical results, necessary modifications are introduced to improve the structural performance of the building.

VI. SYSTEM DESIGN

1. Overall System Architecture

The system design for dynamic analysis of multistorey buildings is developed to provide a systematic approach for modelling, analysing, and evaluating structural performance under seismic loading conditions.

2. Input Data Design

The input design stage involves collecting and organizing all parameters required for structural analysis. This includes geometric dimensions of the building, number of storeys, beam and column sizes, slab thickness, material properties, support conditions, and loading details.

Fig 6: Column Section Properties

3. Structural Modelling Design

The structural modelling design focuses on developing a three-dimensional representation of the multistorey building in ETABS. Grid lines and storey levels are first defined to establish the building layout. Structural components including beams, columns, slabs, and shear walls are then modelled with appropriate sectional properties and material characteristics.

4. Load and Load Combination Design

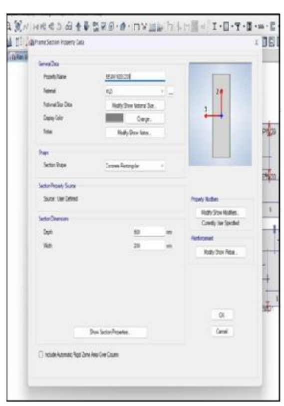

Fig 7: Beam Section Properties

Copyright to IJARSCT

DOI: 10.48175/IJARSCT-35338

ISSN: 2581-9429
Volume 6, Issue 6, May 2026
Impact Factor: 8.2

The load design section defines all external forces acting on the structure. Dead loads, live loads, floor finish loads, wall loads, wind loads, and seismic loads are assigned according to relevant Indian Standard codes.

5. Dynamic Analysis Design

The dynamic analysis design module is responsible for evaluating the structural response under earthquake excitation. Modal analysis is first performed to determine the natural frequencies and mode shapes of the building. Response Spectrum Analysis is then conducted to estimate maximum seismic response based on codal response spectra.

Fig 8: Typical Column Layout Plan of G+12 Building

6. Output and Result Design

The output design module presents the analysis results generated from ETABS in graphical and numerical formats. Important outputs include storey displacement, storey drift, base shear, bending moments, shear forces, and modal participation factors.

VII. METHODOLOGY

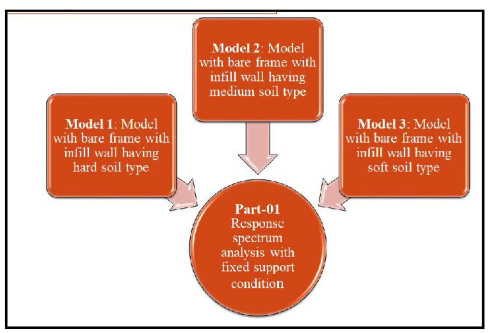

Fig 9: Model 1

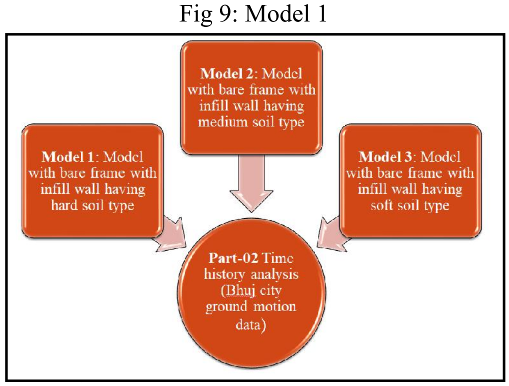

Fig 10: Model 2

DOI: 10.48175/IJARSCT-35338

ISSN: 2581-9429
Impact Factor: 8.2

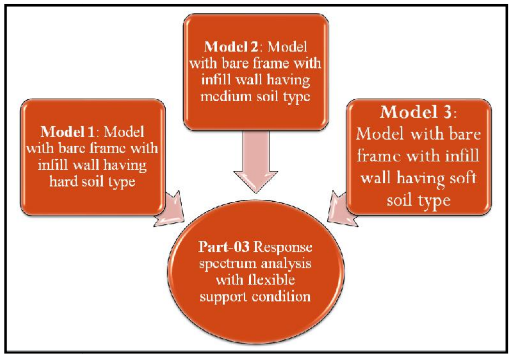

Fig 11: Model 3

VIII. RESULTS

Maximum Storey Displacement Results

The following table and graph represent the variation of maximum storey displacement in both the X and Y directions for the models from Part 1 and Part 2, considering only EQX and EQY load cases. The results are extracted from ETABS analysis and reflect the lateral movement of the structure under seismic loading in both directions.

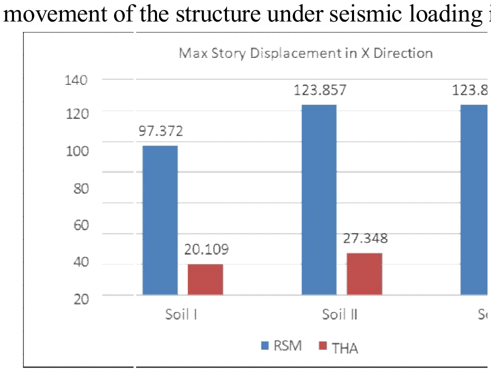

Fig 12: Graph 1

	Soil I	Soil II	Soil III
RSM	97.372	123.857	123.857
THA	20.109	27.348	33.581

Variation of Storey Displacement in Y-Direction under EQY Load Case

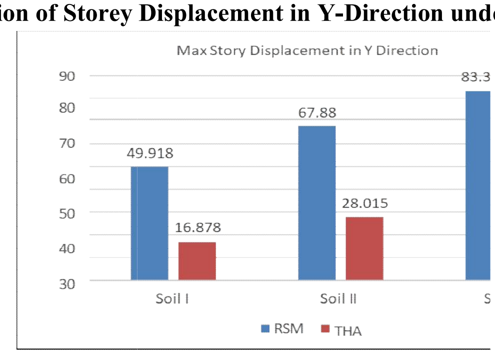

Fig 13: Graph 2

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 6, May 2026
Impact Factor: 8.2

	Soil I	Soil II	Soil III
RSM	49.918	67.888	83.363
THA	16.878	28.015	34.947

Base shear calculations

The following table and graph represent the variation of base shear in both the X and Y directions for the models from Part 1 and Part 2, considering only EQX and EQY load cases. The values are obtained from ETABS analysis and indicate the total lateral force acting at the base of the structure due to earthquake loads in both directions. This comparison helps assess the effect of different soil conditions and analysis methods on seismic force distribution.

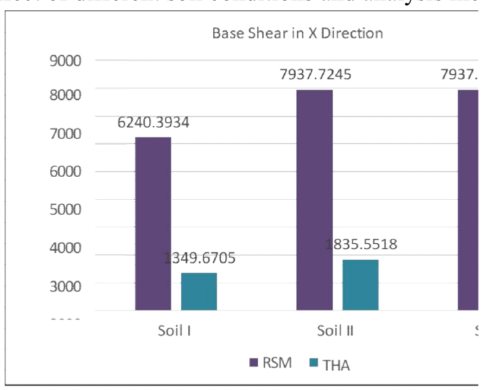

Fig 14: Graph 3

	Soil I	**Soil II**	**Soil III**
RSM	6240.3934	7937.7245	7937.7245
THA	1349.6705	1835.5518	2253.9497

IX. CONCLUSION

The dynamic analysis of multistorey buildings plays a vital role in ensuring structural safety, stability, and performance under seismic loading conditions. In this study, a comprehensive approach for analysing multistorey structures using ETABS software was presented to evaluate the behaviour of buildings subjected to earthquake forces. The use of advanced dynamic analysis methods such as Response Spectrum Analysis and Time History Analysis helped in understanding important structural parameters including storey displacement, storey drift, base shear, modal participation, and overall structural response.

X. FUTURE SCOPE

The future scope of high-strength concrete research with diverse additives is highly promising due to the increasing demand for durable, sustainable, and high-performance construction materials. Further studies can be carried out to investigate the combined effect of multiple additives in different environmental and loading conditions. Advanced optimization techniques can be used to determine the ideal proportions of additives for achieving maximum strength and durability while minimizing construction costs.

REFERENCES

1. P. Dinakar, P. K. Sahoo, and G. Sriram, "Effect of Metakaolin Content on the Properties of High Strength Concrete," International Journal of Concrete Structures and Materials, vol. 7, no. 3, pp. 215–223, 2013.
2. M. Neville, Properties of Concrete, 5th ed., Pearson Education, London, 2011.
3. M. S. Shetty, Concrete Technology: Theory and Practice, S. Chand Publications, New Delhi, 2019.
4. P. K. Mehta and P. J. M. Monteiro, Concrete: Microstructure, Properties, and Materials, 4th ed., McGraw-Hill Education, New York, 2014.
5. Wei Xiaosheng, Zhu Hongping, Li Guowei, Zhang Changqing, and Xiao Lianzhen, "Properties of High Volume Fly Ash Concrete Compensated by Metakaolin or Silica Fume," Journal of Wuhan University of Technology – Materials Science Edition, vol. 21, no. 3, pp. 88–91, 2006.
6. B. Sabir, S. Wild, and J. Bai, "Metakaolin and Calcined Clays as Pozzolans for Concrete: A Review," Cement and Concrete Composites, vol. 23, no. 6, pp. 441–454, 2001.
7. H. F. W. Taylor, Cement Chemistry, 2nd ed., Thomas Telford Publishing, London, 1997.
8. M. Collepardi, "Modern Concrete," Materials Journal, vol. 99, no. 5, pp. 563–571, 2002.
9. V. M. Malhotra and P. K. Mehta, High-Performance, High-Volume Fly Ash Concrete, Supplementary Cementing Materials for Sustainable Development Inc., Ottawa, Canada, 2005.
10. K. H. Khayat and J. Assaad, "Use of Viscosity-Modifying Admixture to Enhance Stability of Fluid Concrete," ACI Materials Journal, vol. 99, no. 4, pp. 332–340, 2002.
11. A. M. Neville and J. J. Brooks, Concrete Technology, 2nd ed., Pearson Education, 2010.
12. R. Siddique and J. Klaus, "Influence of Metakaolin on the Properties of Mortar and Concrete: A Review," Applied Clay Science, vol. 43, no. 3–4, pp. 392–400, 2009.
13. Lothenbach, K. Scrivener, and R. D. Hooton, "Supplementary Cementitious Materials," Cement and Concrete Research, vol. 41, no. 12, pp. 1244–1256, 2011.
14. M. I. Khan and C. J. Lynsdale, "Strength, Permeability, and Carbonation of High-Performance Concrete," Cement and Concrete Research, vol. 32, no. 1, pp. 123–129, 2002.
15. A. Bentur and S. Mindess, Fibre Reinforced Cementitious Composites, 2nd ed., Taylor & Francis, 2007.
16. N. Bouzoubaa and M. Lachemi, "Self-Compacting Concrete Incorporating High Volumes of Class F Fly Ash," Cement and Concrete Research, vol. 31, no. 3, pp. 413–420, 2001.
17. M. Nili and V. Afroughsabet, "Combined Effect of Silica Fume and Steel Fibers on the Impact Resistance and Mechanical Properties of Concrete," International Journal of Impact Engineering, vol. 37, no. 8, pp. 879–886, 2010.
18. R. Madandoust and M. Mousavi, "Fresh and Hardened Properties of Self-Compacting Concrete Containing Metakaolin," Construction and Building Materials, vol. 35, pp. 752–760, 2012.
19. S. A. Rizwan and T. A. Bier, "Blends of Limestone Powder and Fly Ash Enhance the Response of Self-Compacting Mortars," Construction and Building Materials, vol. 27, no. 1, pp. 398–403, 2012.
20. Iswarya Gowram and Beulah M., "Experimental and Analytical Study of High-Strength Concrete Containing Natural Zeolite and Additives," Civil Engineering Journal, vol. 8, no. 5, pp. 1012–1025, 2022..