iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** V **Month of publication:** May 2025

DOI: https://doi.org/10.22214/ijraset.2025.71104

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

Seismic Analysis of Multistorey Building for Different Zone: A Review

Mr. Sachin Thengari[1], Mr. Laxmikant C. Tibude[2]
[1]Research Scholar, Civil Engineering Department, Kavikulguru Institute of Technology and Science, Ramtek, Maharashtra, India
[2]Assistant Professor, Civil Engineering Department, Kavikulguru Institute of Technology and Science, Ramtek, Maharashtra, India

Abstract: The vulnerability of multistorey buildings to seismic events has been a significant concern for structural engineers, especially in countries like India, which are seismically active. Different seismic zones require different structural considerations to ensure safety and serviceability. This paper presents a comprehensive review of seismic analysis of multistorey buildings for various seismic zones as per IS 1893 (Part 1): 2016 guidelines. The study examines various structural configurations, analysis methods (linear static, linear dynamic, nonlinear dynamic), and performance parameters like base shear, storey drift, displacement, and fundamental time period. This paper highlights the importance of seismic zone-specific design for achieving efficient and economical structures while ensuring adequate seismic performance.
Keywords: Seismic Analysis, Multistorey Building, Seismic Zones, IS 1893:2016, Response Spectrum Method, Time History Analysis, Storey Drift, Base Shear, Structural Dynamics.

I. INTRODUCTION

The Earthquake is a natural phenomenon that can cause devastating damage to infrastructure, especially multistorey buildings if not designed appropriately. In India, seismic zones are categorized into Zone II, III, IV, and V, based on the severity of seismic risk. The behavior of a multistorey building during an earthquake greatly depends on factors like the building configuration, material properties, structural system, and zone-specific seismic demand. The purpose of seismic analysis is to understand how a building will respond to seismic forces and to ensure that the structure has sufficient strength, stiffness, and ductility to withstand expected earthquake motions without significant loss of function. This paper reviews the methods of seismic analysis and investigates how seismic behavior varies across different seismic zones for multistorey buildings.

A. Seismic Zone of India

The changeable topography across various regions of the nation suggests that the likelihood of damaging seismic tremors varies significantly from one location to another, leading to different seismic zone values assigned to different areas. As a result, it becomes crucial to have a comprehensive seismic zone map so that buildings and other infrastructure situated in diverse locations can be designed to endure varying levels of ground shaking. A seismic zone map serves as a critical reference tool, ensuring that structural designs are appropriately tailored to the seismic risk of a particular area, thereby enhancing safety and resilience. Presently, the seismic zoning map of India, developed based on extensive geological and seismological studies, divides the country into four distinct seismic zones: Zone-II, Zone-III, Zone-IV, and Zone-V. This zoning was formulated by the Bureau of Indian Standards (BIS) after analyzing the past seismic history and the observed intensity of earthquakes across different regions. Among these, Zone-V is classified as the most seismically active area, where the potential for severe earthquakes is the highest, while Zone-II is identified as the least active, where the risk of significant seismic events is relatively minimal. This classification helps engineers, planners, and policymakers implement appropriate earthquake-resistant measures and plan disaster mitigation strategies accordingly.

Table 1: Seismic Zone Intensity in MM Scale

Seismic Zone	Intensity on M.M Scale
Zone-II (Low-Intensity Zone)	6 (or less)
Zone-III (Moderate Intensity Zone)	7
Zone-IV (Severe Intensity Zone)	8
Zone-V (Very Severe Intensity Zone)	9 (and above)

Regions that fall under the Earthquake (seismic) Zones in India:

Zone-V covers entire northeastern India, some parts of Jammu and Kashmir, some parts of Ladakh, Himachal Pradesh, Uttarakhand, Rann of Kutch in Gujarat, some parts of North Bihar and Andaman & Nicobar Islands.

Zone-IV covers remaining parts of Jammu & Kashmir, Ladakh and Himachal Pradesh, Union Territory of Delhi, Sikkim, northern parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan.

Zone-III comprises of Kerala, Goa, Lakshadweep islands, remaining parts of Uttar Pradesh, Gujarat and West Bengal, parts of Punjab, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Odisha, Andhra Pradesh, Tamil Nadu and Karnataka.

Zone-II covers remaining parts of the country

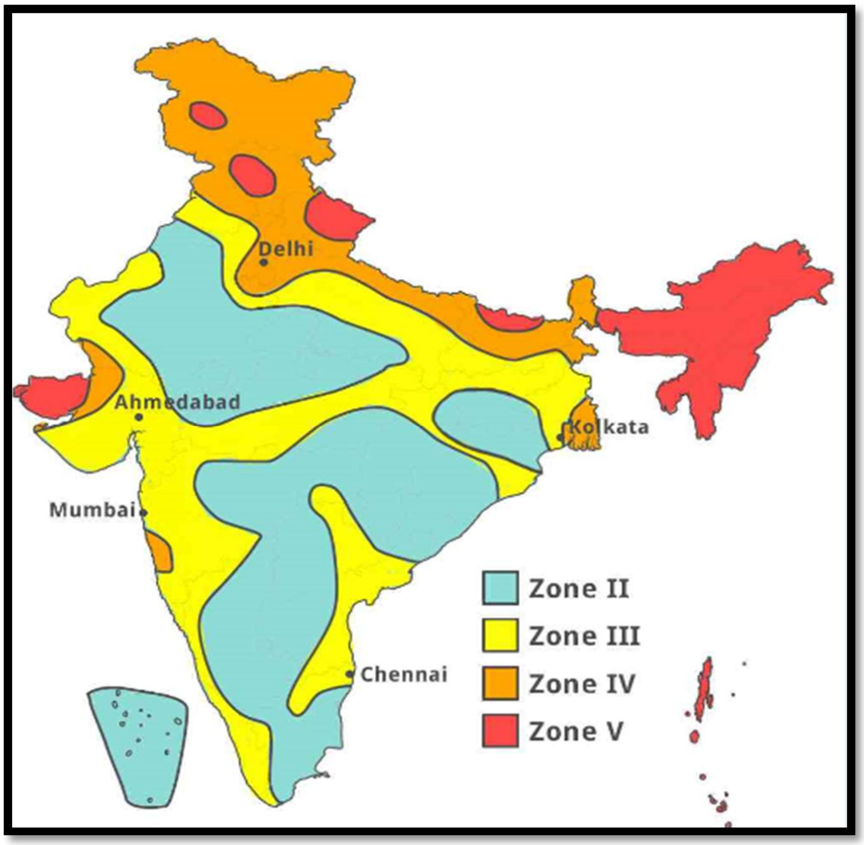


Figure 1: Earthquake (seismic) Zones in India (Map

B. *Effect of Earthquakes on High Rise Buildings*

When a building is subjected to seismic tremor vibrations, its foundation moves back and forth along with the ground. These vibrations can be extremely intense, causing stresses and deformations throughout the structure, making the upper portions of the building sway from a few millimeters to several inches, depending on their height, size, and mass. This phenomenon is applicable to structures of all types, whether single-storied or multi-storied, especially in high-risk earthquake zones. Therefore, it is essential for a building to be adequately flexible and incorporate components capable of withstanding or countering the stresses induced in various parts of the structure due to the lateral movements caused by earthquakes. It has been observed that structures of different sizes and heights vibrate at different natural frequencies, and when such structures are built adjacent to each other without sufficient separation, they can interact adversely, resulting in the amplification of stresses in both structures, often leading to their mutual failure. Recognizing this critical issue, the Bureau of Indian Standards, through its code IS 4326, mandates the provision of a "Separation Section" between structures. A Separation Section is defined as an opening of specified width between adjacent buildings or different parts of the same building, which may either be left exposed or suitably covered, allowing for relative movement without collision during an earthquake.

Furthermore, the code stipulates that for buildings taller than 40 meters, it is advisable to carry out a complete modal or dynamic analysis to accurately determine the drift at each floor level, and the separation gap between adjacent structures should not be less than the sum of their dynamic displacements at any floor level. This careful consideration ensures that adjacent structures do not pound against each other during seismic events, thus significantly enhancing the safety and performance of buildings in earthquake-prone regions. Therefore, it is urged to give a tasteful opening between two structures more unmistakable than the sum of the typical bowing of both the structures taking care of business, with the objective that they have enough space to vibrate. This circumstance is likewise intensified when the section estimation of one building is close to the mid-estimation of the dividers and parts of the neighboring building, the dividers and segments are typically not proposed for taking this extra shear propel acknowledged by the measurement control starting from the neighboring piece. This causes catching of the areas and dividers every so often of over the best stresses at the mid centers (amiability your neighboring building) and thusly the breakdown of the structures onto each other starting a chain reaction. Since one can't predict how one's neighbor is going to build his home at the period of plan it is more intelligent to stay away from potential hazard, for instance, keeping up a hole. On record of high rise, multi storied private and business structures advancement joints are given when the length of the building outperforms a length controlled by code. This augmentation joint is suited moderating anxieties caused in view of advancement or pressure of improvement material inferable from temperature changes. Presently, the structures are totally separated and a gap of 1 to 2" is outfitted which is stacked up with a versatile material. In any case, this is causing an essential issue for instance the shirking of these self-sufficient structures during the seismic tremor is significantly more in raised structures than the expansion joint and since now these structures are detached and of the varying size, they would swing and hammer with each other and cripple the structures. Assistant fragments around the augmentation joint would be truly hurt and there will be a chain reaction of forces in the complete structure for which the structure has not been arranged. In regions where highpower tremors are depended upon the wellbeing measures are to be taken: Due to bowing/development, Expansion joints legitimate hole as required in two pieces of the working, because of quake gave in all structures. At the season of authorizing of building plan, we should submit basic illustrations and declaration from the authorized auxiliary specialist.

These should give refinements of

a) soil condition and bearing point of confinement.

b) Seismic tremor zone for which the building has been organized.

c) I.S. Codes utilized for structure

No relaxations should be permitted, and no alterations to the approved structural design should be made after obtaining the necessary permissions. The submission of a structural certification from the engineer to the governing municipal body should be made mandatory after the casting of foundations and at each floor level. At the time of granting approval, it should be clearly stated that the reinforcement and RCC (Reinforced Cement Concrete) work have been inspected, verified, and are in strict accordance with the structural design previously submitted to the authority. Moreover, the adoption of a regular and straightforward form for the building layout should be preferred to ensure better seismic performance. The concept of a common wall system between adjoining structures must be completely abolished to prevent any distortion or damage during an earthquake. Each structure should be independent, separated adequately to allow movement without collision, and constructed strictly as per the approved seismic-resistant design. This strict adherence to proper procedures and verification at every stage will significantly enhance the safety, stability, and resilience of buildings in earthquake-prone areas.

C. Important of Seismic Design Codes

Ground vibrations during an earthquake generate forces and deformations in structures, which can lead to significant damage if not properly accounted for in the design. It is essential that structures are planned and constructed to withstand these forces and deformations to ensure their safety during seismic events. Seismic codes play a vital role in enhancing the performance of structures, ensuring that they can endure the effects of an earthquake without causing significant loss of life or property damage. These codes establish comprehensive guidelines and best practices for the planning, designing, detailing, and construction of earthquake-resistant buildings. They provide a standardized approach to addressing seismic risks, helping engineers and architects incorporate essential measures such as reinforcement, flexibility, and energy dissipation systems into their designs. Countries around the world have developed their own seismic codes, tailored to the unique seismic risks they face, to guide the safe construction of buildings and infrastructure in earthquake-prone regions. By following these guidelines, structures are better equipped to absorb seismic forces, minimizing damage and protecting both human lives and assets.

The Bureau of Indian Standards (BIS) the accompanying Seismic Codes:

- IS 1893 (PART 1) 2002, Indian Standard Criteria for Earthquakes Resistant of Design Structures (5the update).
- IS 4326, 1993, Indian Standard Code of training for Earthquake Resistant Design and Construction of Buildings. (second update).
- IS 13827, 1993, Indian Standard Guidelines for improving Earthquake Resistant of Earthen structures.
- IS 13828, 1993 Indian Standard Guidelines for improving Earthquake Resistant of Low Strength Masonry Buildings.
- IS 13920, 1993, Indian Standard Code for training for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces. The directions in these gauges don't guarantee that structures endure no harm amid the tremor of all greatness. In any case, to the degree conceivable, they guarantee that structures can react to tremor shaking of moderate forces without auxiliary harm and of substantial powers without all out breakdown.

II. LITERATURE REVIEW

B. Ramakrishna et al. (2021) carried out an analysis of a G+5 multistorey building using STAAD Pro software, considering different seismic zones of India. In their study, they applied all major types of loads like dead load, live load, wind load, and seismic load based on Indian Standards. The seismic analysis was performed for Zone II, Zone III, Zone IV, and Zone V as per IS 1893:2002 (Part-1). They included important parameters such as self-weight, member weight, floor loads, damping ratio, importance factor, and response reduction factor. By observing the results like shear force, bending moment, and deflection, they found that the building's behavior changes significantly from one seismic zone to another. Their study highlights that in higher seismic zones, the forces acting on the building increase, which requires careful design. They concluded that to ensure the safety and stability of buildings under earthquake forces, it is very important to properly consider all loads, zone factors, and structural parameters during the design stage.

Umamaheswara Rao Tallapalem et al. (2019) studied the effect of earthquakes on a G+7 multistorey building by analyzing it in different seismic zones of India using STAAD Pro software. In their work, they considered all important earthquake-related parameters and applied different load combinations. They analyzed the structure in Seismic Zones II, III, IV, and V as per IS 1893:2002. Their study focused on important results like base shear, floor displacements, support reactions, and changes in the quantity of steel used from one zone to another. They pointed out that while the IS 1893-2002 code provides guidelines for earthquake design, it does not mention how steel requirements vary between zones, and their study fills this gap. Their analysis shows that when the seismic zone changes, the base shear and displacement increase, and more reinforcement (steel) is needed to ensure the structure's safety. Their research highlights the importance of careful earthquake analysis and design, especially for tall buildings in high-risk zones.

P. Rajeswari and A. Koti Neelakantam (2019) carried out a study on the seismic analysis and design of a G+10 multistorey residential building using ETABS software. They focused on making the structure earthquake-resistant by analyzing both static and dynamic behavior. In their work, they used the static equivalent method to understand how the structure responds to earthquake forces and calculated all important factors like support reactions and joint displacements. They considered various seismic zones (Zone II, III, IV, and V) of India and included the effect of wind loads and seismic loads during the design. Their study emphasized that proper design and detailing of structural members help to achieve ductile behavior during earthquakes, reducing the chances of sudden failure. Their analysis ensures that the building is safe against lateral forces like earthquakes and wind, and highlights the importance of considering both static and dynamic loading in structural design.

Tejaswini Wagh et al. (2021) studied the seismic analysis and design of a G+9 reinforced concrete (RCC) building using STAAD-Pro software. They emphasized the importance of designing structures that can safely withstand earthquakes by ensuring proper detailing for ductile behavior. Their project involved applying dead loads and live loads, and designing structural elements like beams, columns, slabs, and footings. The seismic analysis was done using the Equivalent Static Method, a commonly used approach in STAAD-Pro for earthquake resistance design. The study highlighted that STAAD-Pro is highly effective for evaluating the earthquake behavior of multistorey buildings and for designing structures that perform better during seismic events compared to conventional methods. Their results showed how the building responded to seismic forces and helped understand the role of seismic design in preventing major structural damage.

Mahanthesh Naik K.P and Dr. H. Eramma (2023) studied the seismic analysis of a G+12 RCC multistorey building constructed on sloping ground. Due to the increasing scarcity of flat land, construction on sloped terrains has become more common, making seismic analysis for such conditions very important. In their study, buildings with ground slopes of 0°, 5°, 10°, and 15° were analyzed under earthquake loads using ETABS software. The analysis was performed using both the response spectrum method and time history method, considering seismic zones II and V.

Their results showed significant differences in building behavior, including variations in base shear, bending moments, and storey displacements depending on the slope and seismic zone. This study highlights the importance of considering slope angles in seismic design to ensure the safety and stability of structures.

Anamika Singh, Rajeev Singh Parihar, Abhay Kumar Jha, Barun Kumar, and Rajesh Misra (2022) conducted a study on the seismic analysis of a G+14 multistorey reinforced concrete building using STAAD Pro software. The structure, built with M30 grade concrete and Fe415 steel, was analyzed with and without different bracing systems across seismic Zones III, IV, and V. The study compared several models: a bare frame RCC building, and frames with various bracing arrangements such as along the X-direction, Y-direction, both directions, and at corners. The introduction of metallic bracing significantly improved the seismic performance of the structure by reducing the building's response to lateral forces. The building was modeled as a 3D space frame with six degrees of freedom at each node. Their findings emphasized that bracing systems are a simple and effective way to enhance the seismic resistance of multistorey structures.

Kiran Devi and Subhankar Petal (2023) carried out a comparative study on the seismic analysis of G+8 storey reinforced concrete structures located in different seismic zones. The research emphasized the necessity of designing multi-storey buildings to resist lateral forces generated by earthquakes, especially given the increasing urban population and limited land availability. The study considered both regular and special moment-resisting frames, examining the structural behavior in seismic Zones III, IV, and V following IS 1893 (Part 1): 2016 guidelines. Parameters such as the percentage of longitudinal reinforcement, reinforcement detailing, and base shear were compared across zones. The findings revealed that base shear values significantly increased as the seismic zone intensity increased from Zone III to Zone V, highlighting the critical influence of seismic zone on structural design requirements.

Pardeshi Sameer and Prof. N. G. Gore (2016) focused on the seismic analysis and design of multi-storey symmetrical and asymmetrical buildings using ETABS software. The study was motivated by the requirements outlined in IS 1893-2002, which mandates that multi-storey buildings be analyzed as three-dimensional systems due to seismic risks, especially in hilly regions of India. The research involved creating 3D models for G+15 storey buildings, both symmetric and asymmetric, to assess their seismic responses. The study emphasized the significance of mass and stiffness in determining the dynamic behavior of buildings and explored the impact of various vertical irregularities, including foundation types and soil conditions. By conducting Response Spectrum Analysis (RSA) and Time History Analysis (THA) on regular and irregular RC buildings, the study aimed to evaluate the effects of structural irregularities on seismic performance. The results of the comparison between regular and irregular buildings highlighted the importance of addressing irregularities in structural stiffness and mass distribution for earthquake-resistant design.

Gupta Arvind Kumar and Baig Mirza Aamir (2017) presented a comprehensive study on the seismic analysis and design of multi-storey reinforced concrete buildings across different seismic zones in India. The objective was to compare the design outcomes of a G+21 multi-storey building, modeled as a 3-dimensional frame, under varying seismic conditions using STAAD Pro software. The analysis considered various parameters including economic factors, material requirements, stability under seismic loads, construction supervision levels, and the need for special tools and equipment. The design adhered to the Limit State Design approach, following Indian Standard Codes IS 456, IS 1893, IS 13920, and IS 875. The building was subjected to various loads such as self-weight, dead load, live load, wind load, and seismic loads. The seismic load calculations were based on IS 1893-2005, while wind load values were generated according to IS 875. The results focused on evaluating the structure's bending moment, shear force, and deflection under the specified loading conditions. This study emphasizes the importance of adhering to minimum safety requirements outlined in Indian Standards to ensure the structural integrity of multi-storey buildings under seismic conditions.

Verma Kavita and Rabbani Ahsan (2018) conducted a study focusing on the seismic analysis of a G+6 multi-storey building using static analysis under different seismic zones in India. The primary objective of the study was to understand the behavior of reinforced concrete (RCC) structures subjected to seismic forces, particularly in the context of regions prone to earthquake damage. The building was modeled and analyzed in three dimensions using STAAD Pro software, with load calculations performed for various seismic zones as per IS 1893:2002. The Limit State Method of design was adopted for the entire analysis. The study highlights the importance of considering seismic loads in structural design to ensure the safety and stability of buildings, as evidenced by the damages caused by recent earthquakes, not only to non-engineered structures but also to engineered ones. The paper emphasizes the need for structural detailing and analysis in different seismic zones to mitigate earthquake damage. The focus was on static analysis, particularly examining lateral forces and the structural behavior under seismic conditions.

Ahirwar S.K., Jain S.K., and Pande M.M. (2008) conducted a comparative study on earthquake loads for multistorey buildings based on the Indian seismic codes IS: 1893-1984 and IS: 1893-2002. Their research aimed to assess the improvements in earthquake-resistant design that have occurred over the years, particularly with the revision of IS: 1893 in 2002.

The study considered four multistorey reinforced concrete (RC) buildings ranging from three to nine storeys, analyzing the seismic forces based on both the earlier and revised versions of the seismic code. The findings revealed that the seismic loads calculated according to IS: 1893-2002 were significantly higher than those computed using the 1984 code, with the difference varying depending on the structure's properties. The study emphasized the importance of conducting individual seismic vulnerability assessments for buildings designed under previous codes, as changes in the codal provisions might render older designs unsafe. This paper highlights the critical need to revise earthquake load calculations in line with updated seismic codes to ensure the safety of multistorey buildings.

Tondon Brajesh Kumar and Dr. S. Needhidasan (2018) performed a seismic analysis of a multi-storied (G+8) building located in different seismic zones of India, specifically Zone 2 and Zone 4. Their study aimed to evaluate the seismic performance of buildings by analyzing key parameters such as storey drift and base shear. Using STAAD Pro software, the building was modeled and analyzed according to the provisions of IS 1893 (Part 1): 2002. The paper emphasized the critical role of seismic loads, given their extreme adverse effects on structural safety compared to other loads such as dead and live loads. Their findings demonstrated how the seismic response of a structure significantly changes depending on the seismic zone, highlighting the importance of detailed seismic analysis during the design and planning stages of multi-storey buildings. This study underscores the need for careful consideration of seismic factors to enhance the safety and durability of constructions in earthquake-prone regions.

Sekar T. and Kadappan P.L. (2015) conducted an analytical study to assess the seismic behavior of multi-storey buildings resting on both normal and sloping grounds across different seismic zones of India, with and without the use of seismic base isolators. Using STAAD Pro and employing the response spectrum method of dynamic analysis, the researchers analyzed 160 building models varying from 1 to 10 storeys, placed in seismic Zones II, III, IV, and V. The study compared dynamic response quantities such as fundamental time period, base shear, top floor displacement, and inter-storey drift. Results showed that introducing base isolators significantly increased the natural time period while reducing the base shear, top floor displacement, and inter-storey drift, leading to improved seismic performance. Additionally, it was observed that as the seismic intensity zone increases, the seismic effects such as base shear and displacements also increase, irrespective of the terrain condition. The study strongly emphasized that the use of base isolation systems helps multi-storey structures behave more rigidly under seismic excitations, improving their overall seismic resilience.

Pushplata Armo and Bhavesh Kumar Jha (2022) carried out a seismic analysis and design of a G+4 multi-storey building located in Seismic Zone II using STAAD Pro software. The study emphasized the importance of considering seismic effects due to the detrimental impact earthquakes can have on structural integrity. The researchers followed IS 1893 (Part 1): 2002 guidelines for seismic load considerations. Base shear and story drift were the main dynamic response parameters evaluated to understand the behavior of the building under seismic excitation. The analysis demonstrated that story drift is a crucial indicator of seismic performance, and base shear plays a vital role in determining the seismic vulnerability of a structure. Their findings highlighted the effectiveness of STAAD Pro in conducting detailed seismic analysis for low-rise buildings in moderate seismic zones, ensuring that structures can be appropriately designed to withstand lateral loads caused by earthquakes.

Donthuri Venkatesh and M. Saravanan (2022) investigated the design and analysis of RCC-framed buildings located in different seismic zones and subjected to wind loads using STAAD Pro V8i. The study highlighted the impracticality of designing structures to entirely eliminate earthquake damage, given the rarity and unpredictability of seismic events. The researchers applied the equivalent static method for estimating wind loads and analyzed the effects of varying seismic zones on structural behavior. Their results demonstrated that as seismic intensity increases from Zone II to Zone V, there is a notable rise in steel percentage requirement, maximum shear force, maximum bending moment, and maximum deflection. The findings emphasized that wind and seismic loads significantly affect the structural design parameters, and thus must be considered carefully during the design process. The study also reinforced the importance of IS 1893 (Part 1): 2002 standards for ensuring the safety and stability of tall structures under dynamic loads.

Kusuma S and Dr. E. Ramesh Babu (2020) conducted a comparative seismic analysis of a multi-storey building using the Response Spectrum Method (RSM) and the Time History Method (THM) with ETABS software. The study focused on a structure located in Bangalore (seismic zone II) consisting of ground plus ten floors. In the analysis, seismic loads were considered along with dead and live loads, following IS 1893:2002 guidelines. Time History Analysis utilized real earthquake data from the 1940 El Centro earthquake, allowing for the evaluation of non-linear dynamic responses. Two primary parameters—base shear and maximum storey deflection—were compared between the two methods.

The results revealed that the base shear obtained from the Response Spectrum Method was slightly higher than that from the Time History Method, while storey deflections were also greater in RSM than in THM. This study emphasized the importance of method selection in seismic design for accurate prediction of structural behavior under dynamic loading conditions.

M. V. Naresh and K. J. Brahma Chari (2019) studied the static and dynamic seismic responses of a multi-storey (G+10) residential RC frame building located in different seismic zones of India. Recognizing that traditional equivalent static methods may not accurately capture the complex behavior of RC structures under seismic loads, the authors employed both the Equivalent Static Lateral Force Method and the Response Spectrum Method using ETABS Ultimate software as per IS 1893 (Part 1):2002. The study focused on evaluating key seismic performance parameters including lateral forces, storey drift, displacements, and base shear. Comparative results between static and dynamic analysis approaches were plotted and analyzed. Their findings highlighted that dynamic analysis methods, particularly the Response Spectrum Method, provide a more realistic and detailed understanding of structural performance under seismic excitations compared to the equivalent static method, thus emphasizing the importance of adopting dynamic procedures for accurate seismic design in moderate to severe seismic zones.

Rohan Suresh Duduskar, Dr. D. S. Yerudkar, and Dr. M Rai Sharma (2021) conducted a seismic analysis of a G+20 storey building with varying structural configurations to evaluate the behavior under earthquake loads. Four models were considered: a normal structure, a structure with floating columns, a structure with shear walls, and a structure incorporating both floating columns and shear walls. Using ETABS-2018 software and following IS 1893 (Part 1):2002 standards, they analyzed the buildings with both Equivalent Static and Response Spectrum methods for seismic zone IV. Critical parameters like storey displacements, storey drift, storey shear, and time period were assessed. The results indicated that the model with floating columns showed increased displacements and drifts, while the models with shear walls demonstrated improved performance with reduced displacements and increased strength. Among the four, the structure with shear walls (Model III) exhibited the best seismic performance, highlighting the importance of shear walls in enhancing the stability of high-rise buildings.

III. PROPOSED METHODOLOGY

1) Selection of Building Model:
   - Regular and irregular building models (G+10)
   - Reinforced Concrete frame structure.
2) Modeling Software:
   - Use of STAAD Pro for modeling and analysis.
3) Seismic Zones Considered:
   - Zone II, Zone III, Zone IV, and Zone V as per Indian seismic map.
4) Load Considerations:
   - Dead Load, Live Load (as per IS 875 Part 2), and Seismic Load (as per IS 1893:2016).
5) Analysis Methods:
   - Linear Static Analysis (Equivalent Static Method).
   - Linear Dynamic Analysis (Response Spectrum Method).
   - Nonlinear Dynamic Analysis (Time History Method).
6) Parameters for Comparison:
   - Base Shear.
   - Fundamental Time Period.
   - Storey Drift and Displacement.
   - Storey Shear Distribution.
   - Inter-storey Drift Ratio.
7) Result Interpretation:
   - Comparison of structural behavior across different seismic zones.
   - Recommendation of suitable design considerations for each zone.

IV. CONCLUSION

Seismic analysis is crucial for ensuring the stability and safety of multistorey buildings in different seismic zones. The reviewed literature emphasizes that buildings located in higher seismic zones experience greater seismic forces, requiring more robust structural design strategies. Dynamic analysis methods such as Response Spectrum and Time History analysis provide more accurate results than static methods, particularly for taller and irregular structures. Future research must focus on advanced modeling techniques, consideration of soil-structure interaction, and performance-based design to enhance the resilience of multistorey buildings against seismic events.

V. ACKNOWLEDGMENT

The authors are grateful to the Civil Engineering Department of Kavikulguru Institute of Technology and Science, Ramtek, for providing the necessary facilities and environment to carry out this review study.

REFERENCES

[1] Anamika Singh, Rajeev Singh Parihar, Abhay Kumar Jha, Barun Kumar, and Rajesh Misra, "Seismic Analysis for Zone III, IV, V of (G+14) Multistorey Building with Bracings System Using Staad Pro Software," International Journal for Research in Applied Science and Engineering Technology (IJRASET), DOI: 10.22214/ijraset.2022.48391.

[2] Ahirwar, S.K., Jain, S.K., and Pande, M.M., "Earthquake Loads on Multistorey Buildings as Per IS: 1893-1984 and IS: 1893-2002: A Comparative Study," The 14th World Conference on Earthquake Engineering, October 12-17, 2008, Beijing, China.

[3] B. Ramakrishna, G. Swetha, S.K. Amreen Shazia, K. Sai Kiran, and S. Durga Venkata Dinesh, "Analysis of Multi-Storied Building in Different Seismic Zones using STAAD Pro," IOP Conference Series: Earth and Environmental Science, Volume 982, 2022, 012074. DOI: 10.1088/1755-1315/982/1/012074.

[4] Brajesh Kumar Tondon | Dr. S. Needhidasan "Seismic Analysis of Multi Storied Building in Different Zones" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-2 | Issue-2, February 2018, pp.683-688, URL: https://www.ijtsrd.com/papers/ijtsrd9490.pdf

[5] Devi, K., & Petal, S. (2023). A Comparative Study on Seismic Analysis of Multistorey Buildings in Different Seismic Zones. Journal of Smart Buildings and Construction Technology, 5(2), 9–16. https://doi.org/10.30564/jsbct.v5i2.5673.

[6] Kusuma, S., & Ramesh Babu, E. (2020) "Seismic Analysis of Multistory Building Using ETABS with Comparison of Response Spectrum Method and Time History Method," Journal of Emerging Technologies and Innovative Research (JETIR), Volume 7, Issue 5, pp. 711-717.

[7] Gupta Arvind Kumar and Baig Mirza Aamir, "Comparison and Analysis of Multistoried R.C.C. Building in Different Seismic Zones," International Journal of Advance Research, Ideas and Innovations in Technology (IJARIIT), Volume 3, Issue 4, 2017, ISSN: 2454-132X, Impact Factor: 4.295.

[8] IS: 1893: 2002, Criteria for Earthquake Resistant Design of Structures, Part 1: General Provisions and Buildings [Internet]. Available from: https://law.resource.org/pub/in/bis/S03/is.1893.1.2002.pdf

[9] IS 13920: 2016, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces-Code of Practice [Internet]. Available from: https://docs.bentley.com/LiveContent/web/STAAD.Pro%20Help-v18/en/GUID-C7639074-0B02-4FE2-976D-1BCE0A76FEA1.html

[10] IS-875(PART-1): 1987, Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structure. Part 1: Dead Loads-Unit Weight of Building Material and Stored Materials [Internet]. Available from: https://civilbuzz.yolasite.com/resources/is.875.1.1987.pdf

[11] IS-875(PART-2): 1987, Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structure. Part 2: Imposed Loads [Internet]. Available from: https://www.cracindia.in/admin/uploads/IS-875---2.pdf

[12] Mahanthesh Naik K.P and Dr. H. Eramma,"Seismic Analysis of Multi-Storey Building in Zone II and Zone V by Considering Different Angles of Slope Ground," International Journal of Advances in Engineering and Management (IJAEM), Volume 5, Issue 9, September 2023, pp. 518–532. DOI: 10.35629/5252-0509518532

[13] Naresh, M. V., & Brahma Chari, K. J. (2019) "Study on Static and Dynamic Analysis of Multi-storied Building in Seismic Zones," International Journal of Recent Technology and Engineering (IJRTE), Volume 7, Issue 6C2, April 2019 ISSN: 2277-3878.

[14] P. Rajeswari and A. Koti Neelakantam, "Seismic Analysis and Design of Multistorey Building in Different Seismic Zones by Using ETABS," International Research Journal of Engineering and Technology (IRJET), Volume 6, Issue 9, September 2019, pp. 1–6.

[15] Pushplata Armo , Bhavesh Kumar Jha, 2022, Seismic Analysis and Design of Multi – Storey Building in STAAD Pro for Zone II, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 11, Issue 05 (May 2022).

[16] Pardeshi Sameer and Prof. N. G. Gore, "Study of Seismic Analysis and Design of Multi-Storey Symmetrical and Asymmetrical Building," International Research Journal of Engineering and Technology (IRJET), Volume 03, Issue 01, Jan 2016, e-ISSN: 2395-0056, p-ISSN: 2395-0072, Impact Factor: 4.45.

[17] Rohan Suresh Duduskar , Dr. D. S. Yerudkar , Dr. M Rai Sharma, 2021, Seismic Analysis of Multi-Storey Building with and without Floating Column and Shear Wall, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 10, Issue 07 (July 2021).

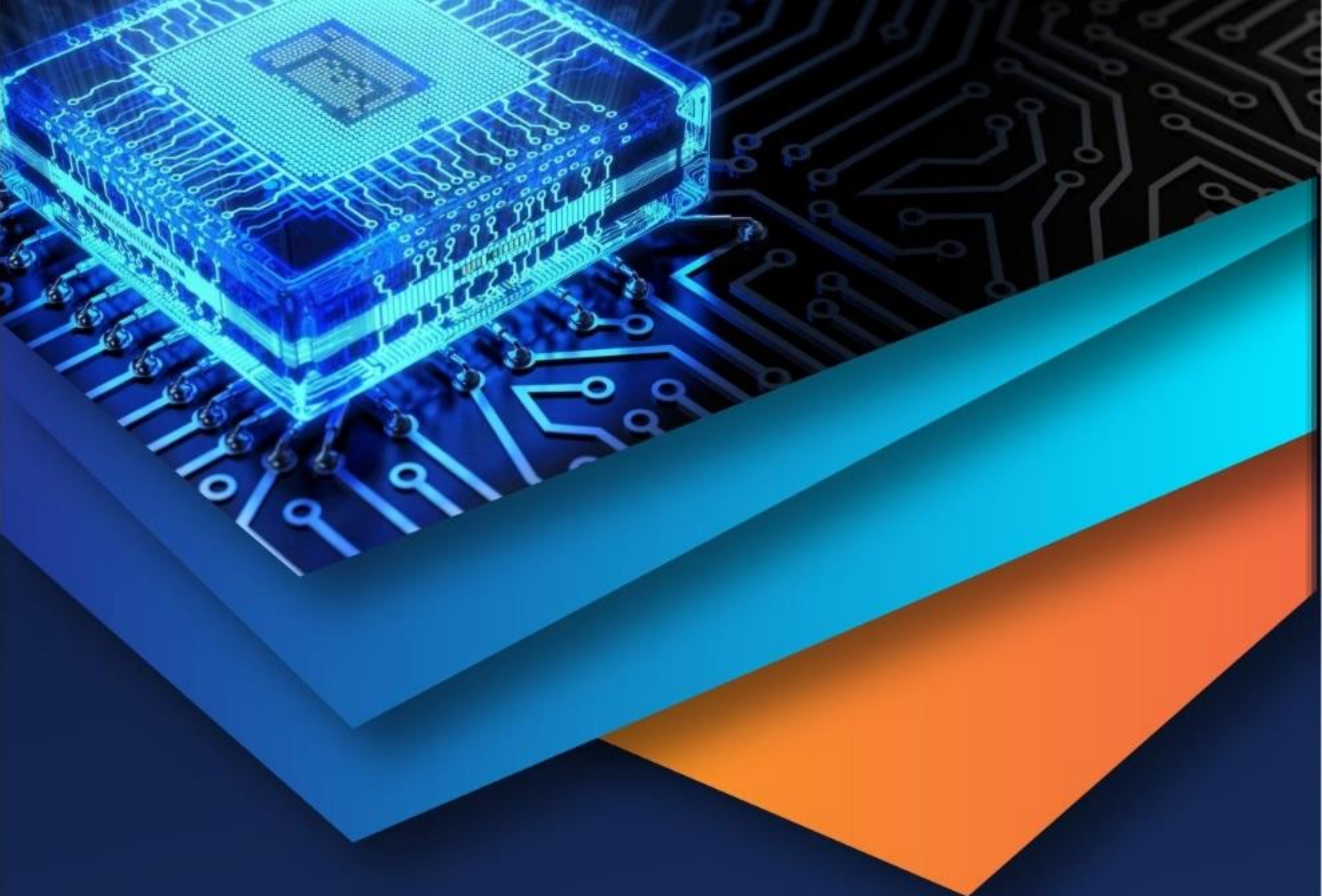
[18] Sekar, T., and Kadappan, PL. (2015). Seismic Analysis of Multi-Storey Buildings Resting on Normal and Sloping Grounds in Different Seismic Zones with and without Base Isolator. i-manager's Journal on Structural Engineering, 4(1), 9-18. https://doi.org/10.26634/jste.4.1.3463

[19] Tejaswini Wagh, Disha Patel, Krupa Phakatkar, Dipti Yenegure, and Tejashri S. Gulve, "Seismic Analysis of Multistorey Building (G+9) by Using STAAD-PRO," International Journal of Advance Scientific Research and Engineering Trends (IJASRET), Volume 6, Issue 6, June 2021, pp. 230–235. DOI: 10.51319/2456-0774.2021.6.0054

[20] Umamaheswara Rao Tallapalem, Nurulla Shaik, and Gopi Pagidimarry, "Analysis of Multi-Storey Building in Different Seismic Zones of India," International Journal of Research in Advent Technology (IJRAT), Vol. 7, No. 5, May 2019, pp. 488–493.

[21] Verma, Kavita, and Ahsan Rabbani, "Analysis of G+6 Building in Different Seismic Zones of India Using Method of Static Analysis," International Journal of Creative Research Thoughts (IJCRT), Volume 6, Issue 2, April 2018, ISSN: 2320-2882.

[22] Venkatesh, D., & Saravanan, M. (2022). "Design and analysis of building in different seismic zone & wind," Materials Today: Proceedings, Volume 62, Part 6, Pages 4065-4072. DOI: https://doi.org/10.1016/j.matpr.2022.04.625



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY