International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 01 | Jan 2024 www.irjet.net p-ISSN: 2395-0072

SEISMIC RESILIENCE ASSESSMENT OF G+14 BUILDINGS: A COMPARATIVE ANALYSIS OF IS 1893 PART-1(2023) DRAFT AND IS 1893 PART-1(2016)

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Abstract - *This meticulous study delves into how a G+14 building responds to earthquakes, utilizing the recently introduced guidelines in IS 1893 Part-1(2023). The focus is on understanding the spectral acceleration response, shedding light on the structure's behavior during seismic events. At its core, the research thoroughly compares these findings with the earlier IS 1893 Part-1(2016), aiming to pinpoint changes in seismic design principles that could impact the building's safety and structural integrity. By exploring shifts in fundamental periods, modal participation factors, and damping ratios, the study provides valuable insights into the evolution of seismic design standards. This exploration illuminates how these standards have adapted over time to enhance buildings' resilience against seismic events. In essence, this comparative approach significantly contributes to comprehending the effectiveness and implications of the updated provisions in the new draft of IS 1893 Part-1(2023). It offers a nuanced understanding of the evolution of seismic design, ultimately strengthening our ability to ensure the safety and stability of structures in the face of seismic challenges.*

Key Words: **Response Spectrum Analysis, G+14 Building, IS 1893 Part-1(2023) Draft, Comparative Study, IS 1893 Part-1(2016), Seismic Design Criteria**

1. INTRODUCTION

This study delves into understanding how a G+14 building responds to earthquakes, utilizing the latest draft rules from IS 1893 Part-1(2023) to assess seismic forces. A key objective is comparing these new rules with the older ones from IS 1893 Part-1(2016) to identify crucial changes in designing earthquake-resistant buildings. The focus includes observing the building's movements during earthquakes, especially relevant for tall structures. The research aims to enhance our knowledge of constructing robust and secure buildings in earthquake-prone regions. In simpler terms, imagine constructing a G+14 structure, ensuring it can safely withstand earthquakes. Government guidelines (IS 1893) were recently updated in 2023, forming the basis of our study. Beyond just understanding how the building performs under the latest rules, we're also comparing with the 2016 guidelines to determine if the updates contribute to building safety. We're evaluating factors like the intensity of building shaking during earthquakes and exploring improved design methods for overall safety. Considering different levels of shaking during an earthquake, the new guidelines in IS 1893 Part-1(2023) provide a precise framework for understanding and calculating seismic forces. Comparing these guidelines with the 2016 ones is akin to examining two sets of instructions for building safety during earthquakes. The investigation seeks to determine if the changes in the new guidelines offer superior strategies for building resilience

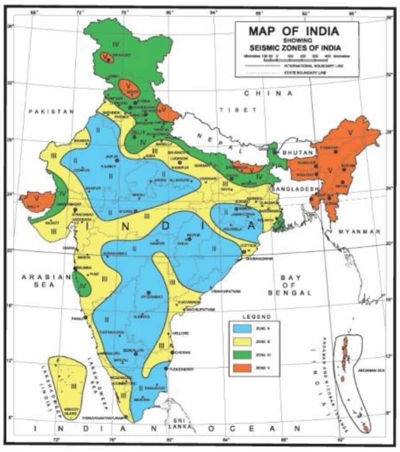

Figure 1 seismic zone as per IS 1893-(2016)

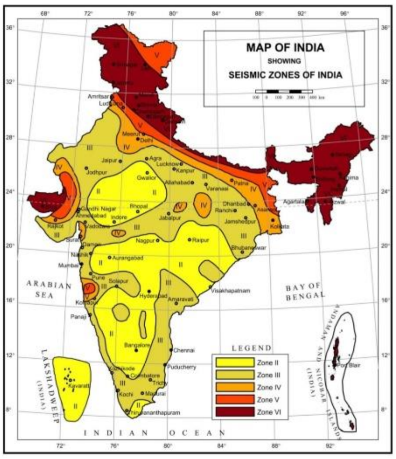

Figure 2 seismic zone as per IS 1893 (2023) Draft

2. AIM OF STUDY

The study aims to compare how well G+14 buildings can withstand earthquakes using two different sets of rules: the new suggested rules from 2023 (IS 1893 Part-1 draft) and the existing rules from 2016 (IS 1893 Part-1). The main goal is to check and compare how these buildings perform under these updated earthquake safety guidelines. This involves looking at things like how the structure responds, how much it moves during an earthquake, and other earthquake-related factors. The idea is to figure out how the changes in the rules might affect the safety and stability of G+14 buildings during an earthquake.

3. SCOPE OF STUDY

We're studying two sets of earthquake safety rules for G+14 buildings – one from 2016 and a newer draft from 2023. Our goal is to compare them and figure out if the 2023 rules make buildings safer during earthquakes. We'll test buildings, look at materials, find any weaknesses, suggest improvements, and consider how it all affects people and building functionality. The end result will be a report with insights and recommendations for better earthquake resilience.

4. OBJECTIVES OF STUDY

The study is like comparing old and new safety rules for earthquakes – the ones from 2016 and the ones being thought about for 2023. We're also testing how buildings with 14 floors handle earthquakes under both sets of rules. We're checking the stuff used to build these buildings and how they're put together to find any weak points. Once we figure all this out, we'll give suggestions to make the 2023 rules better, thinking about how it affects people in the buildings. Finally, we'll write a report that tells everything we found and suggest ways to make buildings safer during earthquakes.

5. LITERATURE REVIEW

[1] Ravikant Singh, Vinay Kumar Singh "Analysis of Seismic Loads acting on multi-storey Building as per IS: 1893-2002 and IS: 1893-2016-A comparative Study" Journal of Civil Engineering and Environmental Technology

In the last few years, there have been important improvements in how we design buildings to withstand earthquakes. This progress is seen in the updated Indian seismic code, IS 1893, which was revised in 2016, a significant update after nearly 14 years. The paper looks closely at seismic loads for a four-storey reinforced concrete framed multi-storey building. It compares the recommendations from the older IS 1893-2002 to the latest IS 1893-2016. The study focuses on a specific building designed using the older code. The main aim is to predict how vulnerable this structure is to earthquakes and assess its safety, considering the changes in the updated IS code.

[2 Rita Debnath, Lipika Halder "A Comparative Study of the Seismic Provisions of Indian Seismic Code IS 1893 2002 and Draft Indian Code IS 1893:2016" Advances in Structural Engineering, Volume 2

This paper examines earthquake design guidelines in the current Indian Seismic Code (IS 1893: 2016) and compares them to the 2002 version. It investigates variations in building design recommendations for earthquakes. The study identifies significant differences in calculations, such as building shaking duration, structural importance, and other factors. The updated code introduces more information on building irregularities, the influence of masonry walls, and simplifies certain earthquake design rules. The findings are presented through easy-to-understand tables and graphs, highlighting both similarities and differences between the two code versions.

[3] Jitendra Gudainiyan, Hemant Singh Parihar "Analysis of the Tensional Irregularity as per IS 1893 (Part 1): 2016 and IS 1893 (Part 1): 2002" Materials Science and Engineering

This paper addresses earthquake safety in building design, emphasizing factors like structure type, weight distribution, and materials. Buildings with regular shapes tend to withstand earthquakes better than irregular ones. The updated Indian Seismic Code, IS 1893(Part): 2016, has modified criteria for irregularities. The study specifically explores tensional irregularities, comparing criteria in the new code with the 2002 version. Computer software simulated various building shapes, revealing that the new code offers more detail and simplicity. It provides clearer guidelines for identifying tensional irregularities in building models. This research contributes to enhancing earthquake-resistant design practices; ensuring structures are safer and more resilient.

[4] Vikas Siddesh1, Praveen J V2, Dr. T V Mallesh, S R Ramesh "codal comparison of is-1893 (part 1)2002 and is-1893 (part 1) 2016 for seismic analysis of high rise building with raft foundation using tabs and safe software" International Research Journal of Engineering and Technology (IRJET)

This research compares the earthquake response of a 12-story high-rise building using two Indian seismic codes: IS 1893 (Part 1) 2002 and the latest IS 1893 (Part 1) 2016, which set the standards for earthquake-resistant design in India. The study, conducted using software like ETABS and SAFE, analyzes and designs the building under seismic loads according to both code versions. By applying loads separately based on each code, the study evaluates the building's behavior. Additionally, the foundation design is carried out using axial loads from the superstructure. The research aims to understand how the building responds to seismic forces under different code specifications, contributing insights for effective earthquake-resistant design practices in India.

[5] Ajay Kumar "a comparative study of static analysis (as per is: 1893-2002) & dynamic analysis (as per is: 1893-2016) of a building for zone v" International Journal of Civil Engineering and Technology (IJCIET)

This research utilized Staad.Pro software to model and analyzes buildings of varying heights (4, 8, and 11 stories). Seismic analysis was conducted based on two Indian codes: IS: 1893-2002 and IS: 1893-2016. For buildings up to 39.6m tall, static seismic analysis followed the old code, while dynamic seismic analysis adhered to the new code. The evaluation considered parameters such as axial force, bending moment, displacement, and material quantities. Cost analysis for concrete and steel was also undertaken. Findings revealed that buildings designed with dynamic seismic analysis incurred costs 1.06 to 1.1 times higher than those designed with static seismic analysis. This insight contributes to understanding the cost implications associated with seismic design methods outlined in the respective Indian codes

[6] M. Bello, A.A Adedeji, R.O. Rahmon,and M.A. Kamal "Dynamic Analysis of Multi-Storey Building under Seismic Excitation by Response Spectrum Method using ETABS" Journal of Research Information in Civil Engineering

This study aimed to understand how buildings, particularly reinforced concrete (RC) structures, respond to earthquakes. Using the computer program ETABS, a 3D model of a building was created to analyze its behavior during an earthquake. Following specific standards, the analysis revealed that the maximum movement and deformation of the building occurred at the fourth floor in one direction (Y direction). This information is crucial for comprehending how structures react to seismic activity, providing insights that can aid in designing buildings more resilient to earthquakes. In simpler terms, the study investigated how a building shakes during an earthquake, offering valuable knowledge for creating safer structures in regions prone to such events.

[7] Pooja Manoj Kale, Dr. B. H. Shinde "Seismic Response Of RCC Multistoried Building By Using New Codes IS 1893:2016, IS 16700:2017 and It's Comparison with IS 1893:2002" International Research Journal of Engineering and Technology (IRJET)

The latest updates in seismic design codes, IS 1893 (Part 1): 2016, and the new IS 16700: 2017 code for tall buildings, focus on ensuring the earthquake resistance of structures, particularly tall concrete buildings. These revised codes align with both international and Indian standards.

In a research dissertation, 12 and 16-story buildings constructed with reinforced concrete (RCC) were investigated. The study employed two evaluation methods to assess their earthquake performance: one assuming a constant force (equivalent static analysis) and another considers various shaking patterns (response spectrum analysis).

The research specifically analyzed how well these buildings would fare in earthquake-prone areas (seismic zones II to V). Using mathematical 3D models created with the ETABS Version 17 computer program, designed for such analyses, the study aimed to understand the buildings' responses to seismic forces in detail.

6. CONCLUSIONS

These research findings collectively assure that buildings, evaluated under Indian seismic codes, adhere to safety standards without the need for additional modifications for earthquake vibrations. Comparing seismic codes from 2002 to 2016 reveals the latter as a more advanced and practical approach to designing earthquake-resistant buildings in India. Delving into tensional irregularity clarifies the updated code and proposes international comparisons for enhanced safety designs. Dynamic analysis in different studies consistently supports the safety of the newer seismic code (2016), suggesting foundation thickness adjustments for improved resilience. The impact of seismic analysis on displacement and construction cost across diverse building types is emphasized, offering valuable insights for cost-effective and secure structures. Additionally, the recommendation of response spectrum analysis for moderate seismic events and caution regarding specific building types underscore the nuanced considerations in seismic design practices. In using advanced software like ETABS 17, the significant influence of the updated seismic code on understanding and designing multi-story buildings is highlighted, with a specific emphasis on dynamic analysis for structures over 15m in seismic Zone II.

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