ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN1125

Dynamic Analysis of High-Rise Buildings for Various Irregularities with and without Floating Column

Dr. Pradeep P. Tapkire[1]
[1]H.O.D. Civil Dept., N.B. Navale Sinhgad College of Engineering, Solapur, Maharashtra, India-413255

Prathamesh N Kadam[2]
[2]Research Scholar at N.B. Navale Sinhgad College of Engineering, Solapur, Maharashtra, India-413255

Abstract:- In recent urban developments, the demand for column-free spaces in multi-story buildings has risen due to space constraints, population growth, and aesthetic considerations. To meet these requirements, floating columns are frequently incorporated into building designs. However, these structural elements pose significant risks in seismically active regions, as they disrupt the continuous load transfer path essential for earthquake resilience. This research focuses on the dynamic analysis of high-rise buildings with various irregularities, both with and without floating columns. The study aims to evaluate the seismic performance of these structures by analyzing parameters such as storey displacement, storey drift, and base shear. By using structural analysis software, we model and compare different configurations of high-rise buildings under seismic loads. The findings will provide insights into the impact of floating columns on the structural integrity of high-rise buildings and suggest design improvements for enhanced seismic performance. This research is essential for developing safer building practices in earthquake-prone areas.

Keywords:- *Floating Columns, Seismic Analysis, High-Rise Buildings, Dynamic Performance, Storey Displacement, Storey Drift Base Shear, Structural Irregularities.*

I. INTRODUCTION

In recent years, the design of multi-storey buildings in urban areas has increasingly emphasized the need for column-free spaces. This is driven by space constraints, population growth, and aesthetic as well as functional considerations. To achieve these designs, architects often incorporate floating columns at various levels. While floating columns offer significant architectural benefits, they can be disadvantageous in seismically active regions. Earthquake forces need to be transferred from the top to the ground through the most direct path. Discontinuities in this load path, such as those introduced by floating columns, can lead to poor building performance during seismic events. This was evidenced by the collapse and severe damage of buildings with open ground storeys during the 2001 Bhuj earthquake in Gujarat.

- *What is a Floating Column?*

A floating column is a vertical structural element that terminates at a lower level and rests on a beam, which in turn transfers the load to other columns below. Unlike regular columns that transfer loads directly to the ground, floating columns introduce a discontinuity in the load transfer path.

- *Seismic Vulnerabilities*

However, while floating columns offer architectural and functional benefits, they pose serious structural challenges, particularly in seismically active regions. During an earthquake, forces generated at various floor levels must be transmitted efficiently down to the foundation. The discontinuity in the load transfer path introduced by floating columns can significantly impair this process. Buildings with floating columns often exhibit poor seismic performance due to the interruption in the direct transfer of forces to the ground. This can lead to increased storey displacements, excessive inter-storey drifts, and overall structural instability.

- *Importance of Seismic Analysis*

Given the potential risks, it is imperative to rigorously analyze the seismic behavior of buildings with floating columns. Such analysis helps in understanding how these structures respond to seismic forces and in identifying measures to mitigate associated risks. This study aims to provide a comprehensive dynamic analysis of high-rise buildings with various irregularities, both with and without floating columns, to assess their performance during seismic events.

II. LITERATURE REVIEW

- *Rohan Duduskar, Dr. D. S. Verudkar & Dr. M. Hai Sharma (2011)*

- *"Seismic Analysis of Multi-Storey Building with and without Floating Column and Shear Wall"*

The research compares the seismic performance of four models of a G+20 storey building: a normal structure, a structure with floating columns, a structure with shear walls, and a structure with both floating columns and shear walls. The study uses equivalent static and response spectrum methods per Indian Standard code 1893 (Part-1) 2002 and ETABS-2018 software. The results indicate increased displacements and drifts for the floating column structure and better performance with shear walls.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN1125

➢ *Deepak Jain, Dr. Savita Maru (2021)*

- *"A Literature Review on Seismic Response of Floating Column Building"*

This paper reviews several studies on floating column buildings, highlighting their vulnerability in high seismic zones. The review suggests that ductile detailing of joints can mitigate the risk of immediate failure.

➢ *Sreadha A R, C. Pany (2020)*

- *"Seismic Study of Multistory Building using Floating Column"*

This study focuses on the performance of multi-storey buildings with floating columns under seismic loads, using ETABS for analysis. It finds that buildings with floating columns exhibit significant discontinuities in load transfer paths, leading to poor seismic performance.

➢ *Prof. Sharmila HC, Yashaswini Adav (2020)*

- *"Analysis of RC Structure with Floating Column in Different Seismic Zones using ETABS"*

The study models G+10 RC buildings with and without floating columns in different seismic zones. It analyzes parameters such as storey displacement, shear, and drift, finding that floating columns negatively impact the structural behavior under seismic loads.

➢ *Ms. Waykule S. B, Dr. C. P. Pise (2017)*

- *"Comparative Study of Floating Column of Multi-Storey Building by Using Software"*

This comparative study shows that floating columns, while meeting functional requirements, lead to poor seismic performance due to load transfer discontinuities.

➢ *Hardik M. Bhensdadia, Dr. Siddharth G. Shah (2015)*

- *"Pushover Analysis of RC Frame Structure with Floating Column and Soft Storey in Different Earthquake Zones for Retrofitting"*

Using pushover analysis, this paper reveals that floating columns and soft storeys significantly affect the seismic performance of buildings. The analysis suggests higher displacements and base shears in high seismic zones.

III. PROBLEM FORMULATION

The problem addressed in this study is the seismic performance of high-rise buildings with floating columns, particularly how these structures behave in different seismic zones and with various structural irregularities. The research aims to identify the impact of floating columns on storey displacement, storey drift, base shear, and storey shear, and to compare these parameters with those of buildings without floating columns.

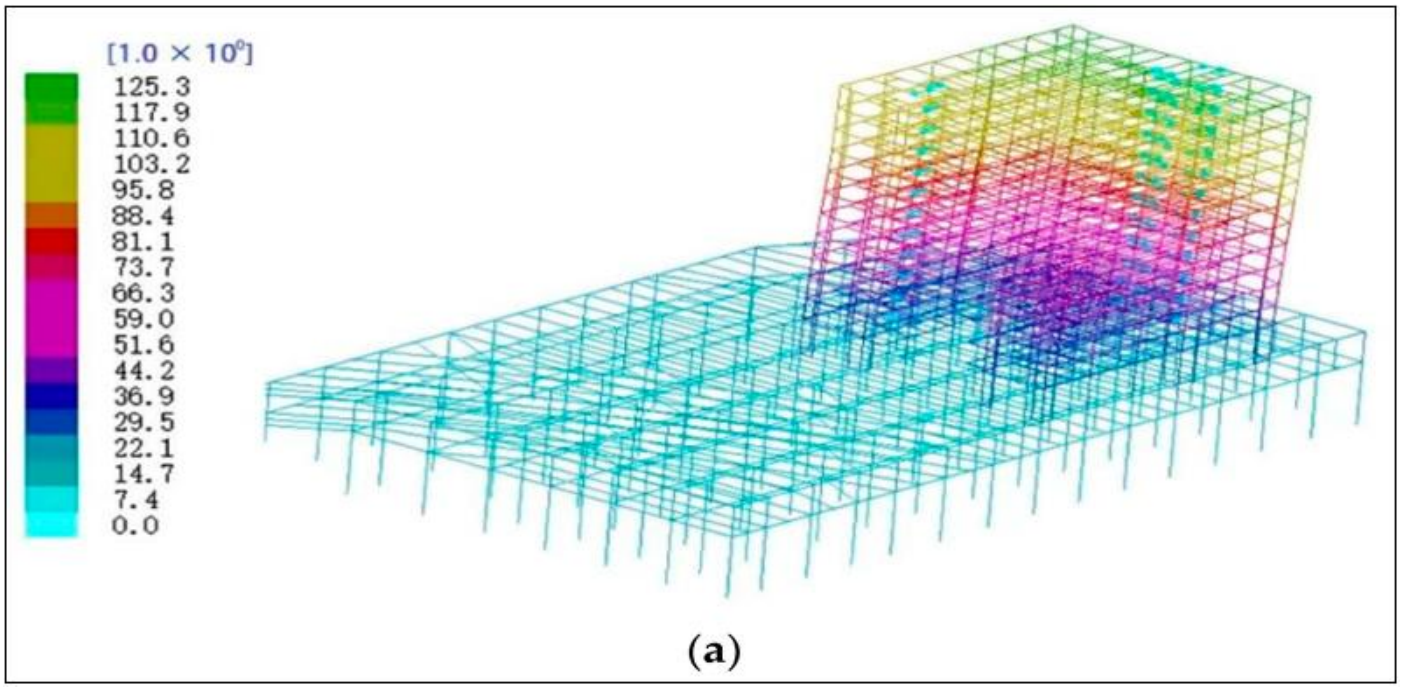

Fig 1 Seismic Performance Evaluation of a High-Rise Building with Structural Irregularities

IV. RESEARCH METHODOLOGY

The methodology involves the dynamic analysis of high-rise buildings with a constant floor-to-floor height. The study uses ETABS software to model and analyze buildings with different irregularities and in different seismic zones. The models include:

- Regular rectangular high-rise buildings with and without floating columns.
- High-rise buildings with various horizontal irregularities, with and without floating columns.
- High-rise buildings with various vertical irregularities, with and without floating columns.
- Validation of Problem Solution by Software.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN1125

The structural analysis will be validated using ETABS software, ensuring that the models accurately represent the behaviour of real buildings under seismic loads.

V. RESULTS

➢ *Parameters Considered for Research Work*

The study focuses on the following parameters:

- Storey displacement
- Storey drift
- Base shear
- Storey shear

➢ *Variation of Weight and Height Ratio*

The results will include an analysis of how the weight and height ratios of buildings affect the seismic performance of structures with and without floating columns.

VI. CONCLUSION

The study aims to provide insights into the dynamic performance of high-rise buildings with floating columns under seismic loads. By comparing buildings with different irregularities, the research will highlight the critical factors that influence seismic behavior and offer recommendations for improving the design and safety of these structures in seismically active areas.

REFERENCES

[1]. Rohan Duduskar, Dr. D. S. Verudkar, & Dr. M. Hai Sharma (2021). Seismic Analysis of Multi-Storey Building with and without Floating Column and Shear Wall. International Journal of Engineering Research & Technology (IJERT), 10(07), July 2021.

[2]. Deepak Jain & Dr. Savita Maru (2021). A Literature Review on Seismic Response of Floating Column Building. International Journal of Emerging Technology and Advanced Engineering (IJETAE), 11(03), March 2021.

[3]. Sreadha A R & C. Pany (2020). Seismic Study of Multistory Building using Floating Column. International Journal of Emerging Science and Engineering (IJESE), 6(09), April 2020.

[4]. Sharmila HC & Yashaswini Adav (2020). Analysis of RC Structure with Floating Column in Different Seismic Zones using ETABS. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 8(VII), July 2020.

[5]. Ms. Waykule S.B & Dr. C.P. Pise (2017). Comparative Study of Floating Column of Multi Storey Building by Using Software. International Journal of Engineering Research and Application (IJERA), 7(01), January 2017.

[6]. Priyanka D. Motghare (2016). Numerical Studies of RCC Frame with Different Positions of Floating Column. International Journal of Progresses in Engineering, Management, Science and Humanities (IJPEMSH), 2(01), 2016.

[7]. Hardik M. Bhensdadia & Dr. Siddharth G. Shah (2015). Pushover Analysis of RC Frame Structure with Floating Column and Soft Storey in Different Earthquake Zones. International Journal of Research in Engineering and Technology (IJRET), 4(04), April 2015.