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Comparative Analysis of Linear Static and Linear Dynamic (Response Spectrum) Action on A G+14 Building with Irregularities in Elevation, Located in Zone III, Suart, Gajarat.

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Abstract - With the rapid pace of urban growth and limited land availability, modern cities increasingly rely on vertical development through high-rise buildings to accommodate residential and commercial needs. Such structures often include large unobstructed spaces for amenities like parking, auditoriums, and multipurpose halls, which influence their structural design and dynamic performance. This study focuses on the seismic analysis and design of a 2B+G+14 reinforced concrete frame building situated in Seismic Zone III, analyzed using ETABS software. The building is evaluated under two approaches—Linear Static analysis and Linear Dynamic (Response Spectrum) analysis—following the provisions of IS 1893 (Part 1): 2016 and other relevant Indian standards.The comparative analysis reveals that the Response Spectrum method provides reduced values of base shear, storey drift, displacement, and overturning moments compared to the Equivalent Static method, indicating better seismic performance and stability. Furthermore, the dynamic method captures the realistic behavior of buildings subjected to earthquake-induced ground motions.The research emphasizes that incorporating dynamic analysis in the seismic design of multi-storey buildings ensures more reliable and efficient structural performance, contributing to safer urban development.

Key Words: Response Spectrum, Linear Static, Story Displacement, Story Drift,Overturning Moment, ETABS.

1.OBJECTIVE

This study primarily aims to safeguard occupants and the surrounding community from the impacts of seismic events by analyzing potential structural damage and designing buildings to minimize the risk of collapse or severe impairment.A comprehensive structural model of a 2B+G+14 reinforced concrete building will be developed using ETABS software to evaluate the building's response under seismic conditions.The research will focus on identifying and differentiating critical seismic parameters such as Overturning moment, storey drift, and displacement. Additionally, it will compare the building's performance under static seismic analysis (equivalent lateral force method) and dynamic seismic analysis (response spectrum method).By forecasting structural behavior under varying earthquake intensities, engineers can optimize designs to meet performance objectives, including ensuring structural integrity and functionality following seismic events.Moreover, seismic analysis provides essential insights into the vulnerability of existing structures, guiding the prioritization of retrofit interventions to enhance safety and mitigate risk to life and property.

2. Methodology

Table -1: Data used for modeling in ETABS.

Parameter	Value/Description	Reference Code
Dead Load	As per IS-875:1987 Part-1	IS-875:1987 Part-1
Live Load	As per IS-875:1987 Part-2	IS-875:1987 Part-2
Seismic Zone	III	As per IS-1893:2016 Part-1
Zone Factor (Z)	0.16	
Importance Factor (I)	1.2	
Soil Type	Medium-2	

Charts

3. RESULTS

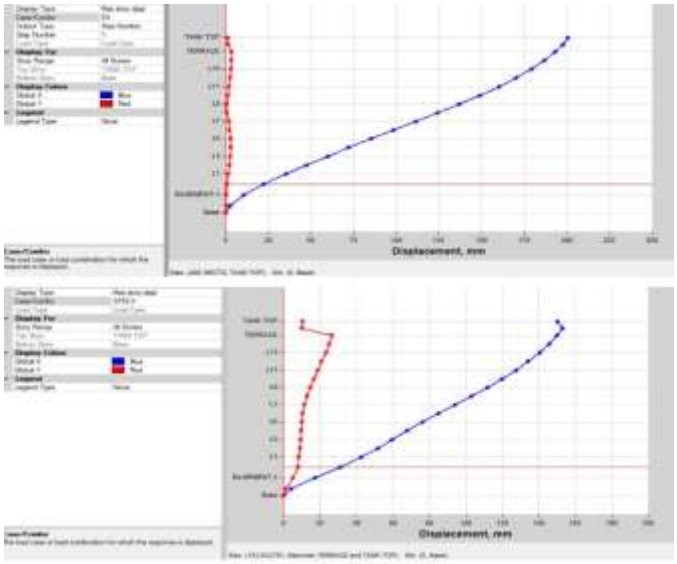

Fig -1: Displacement in X direction

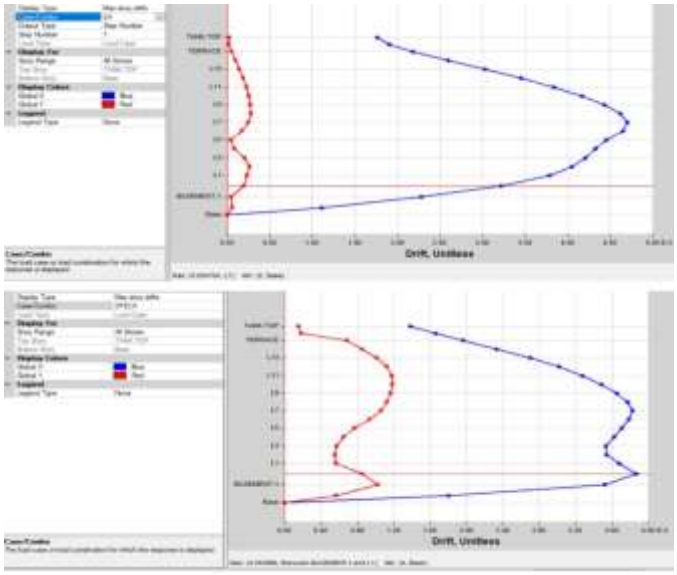

Fig -2: Storey Drift in X direction

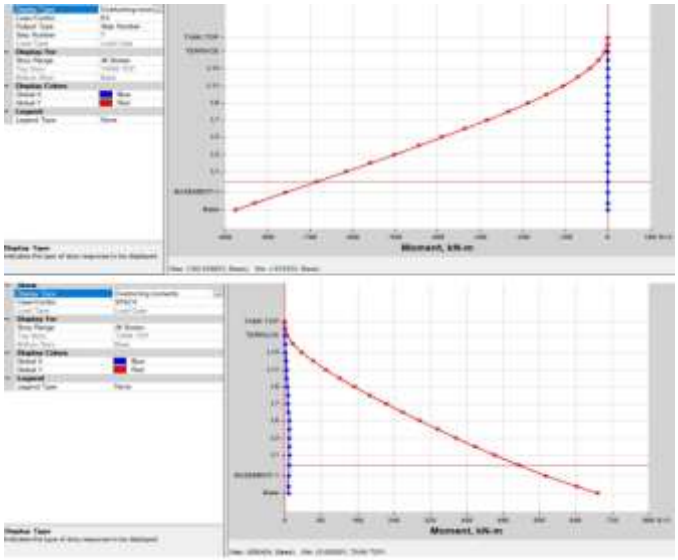

Fig -3: Overturning Moment in X direction

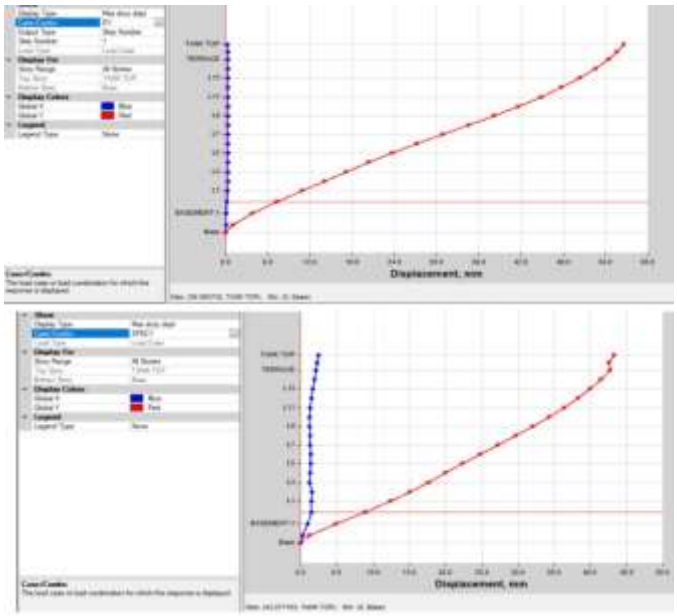

Fig -4: Displacement in Y direction

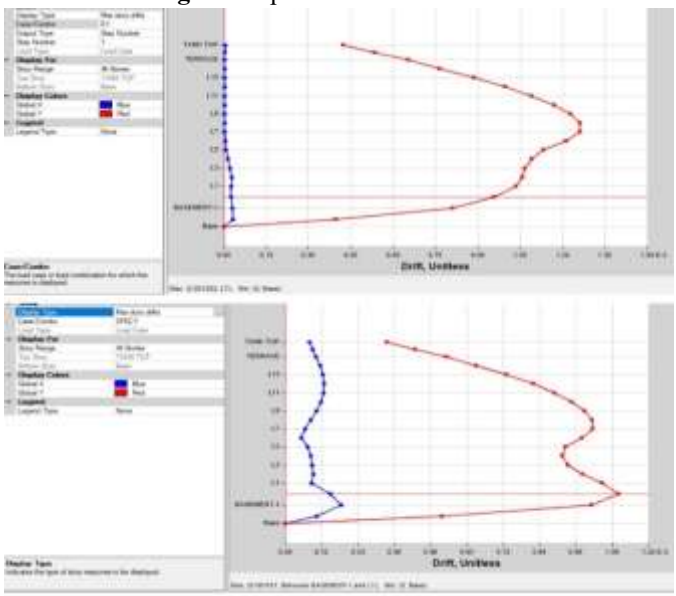

Fig -5: Storey Drift in Y direction

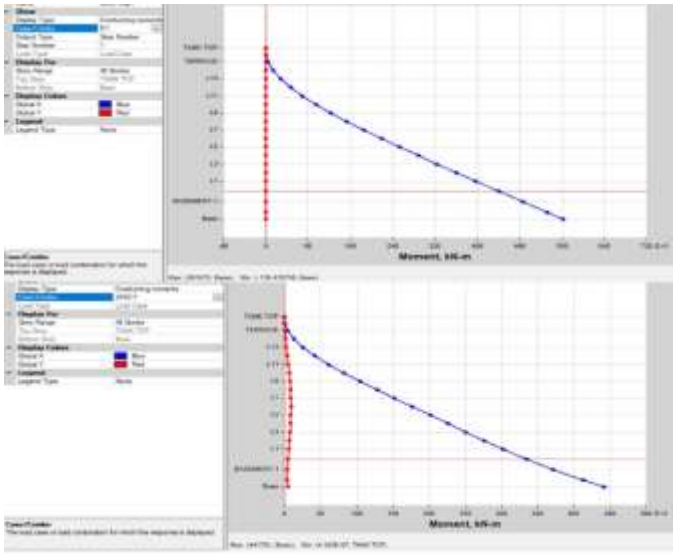

Fig -6: Overturning Moment in Y direction

Table -2: Results of analysis.

Remarks	Description	Linear Static	Response Spectrume
Fig. -1	Displcement in X direction	200.396 mm	153.033 mm
Fig. -2	Storey Drift in X direction	0.004704	0.003866
Fig. -3	Overturning Moment in X direction	192.0386 KN.m	688404 KN.m
Fig. -4	Displcement in Y direction	56.565 mmm	43.277 mm
Fig. -5	Storey Drift in Y direction	0.001262	0.001101
Fig. -6	Overturning Moment in Y direction	561675 KN.m	441781 KN.m

4. CONCLUSIONS

The results show that the response spectrum (dynamic) analysis generally gives lower values of displacement, storey drift, and overturning moment compared to the linear static method.This indicates that dynamic analysis provides a more refined structural response under seismic loading conditions.Majorly, the dynamic analysis affects the model in both X and Y directions, particularly reducing displacements and drifts.

- Lateral displacement in the X direction is reduced by approximately 23.6% under dynamic analysis compared to static analysis. In the Y direction, the reduction is about 23.5%.
- Storey drift in the X direction is reduced by about 18%, and in the Y direction by about 12.8% when dynamic analysis is carried out.
- Overturning moment in the X direction increases significantly by over 3585 times from static to dynamic analysis, reflecting the realistic amplification of dynamic forces. Conversely, in the Y direction, the overturning moment decreases by approximately 21.3% under dynamic analysis.

From the above results, dynamic (response spectrum) analysis yields a more stable and stiff building configuration and captures critical dynamic effects not reflected in static analysis. For future high-rise or seismic-prone designs, linear dynamic (Response Spectrumr) analysis is recommended for more accurate and safer performance assessments.

REFERENCES

1. Polu Mahadev and J Saibaba: Comparative analysis of multi storey building with Seismic Static and Dynamic (Response Spectrum) actions: Review. International Journal for Modern Trends in Science and Technology, Volume 9, Issue 08, pages 06-10 ISSN: 2455-3778 online

2. Ahsan Musadique, Zaheer Ahmed Almani, Rabinder Kumar: COMPARATIVE ANALYSIS OF RESPONSE SPECTRUM METHOD WITH EQUIVALENT STATIC METHOD FOR A MULTI-STORY BUILDING: Review. International Research Journal of Modernization in Engineering Technology and Science, Volume:04, Issue:10/October-2022, e-ISSN: 2582-5208

3. Ganesh Chandapure Pranavkale Under the Guidance of Mr.Alurward.R.R: A Project Report on "seismic Analysis of Vertical Irregular Frames" : Review. International Journal of Engineering Research & Technology (IJERT), Volume 12, Issue 12, December 2023, ISSN: 2278-0181

4. Sahil M Kathiriya, Mili Sankhla: Analysis And Design of High Rise Buildings With Vertical Irregularities Located at Seismic Zone-III. : Review. International Research Journal of Engineering and Technology (IRJET), Volume: 10 Issue: 06 | Jun 2023, e-ISSN: 2395-0056

5. Kurapati Manasa, A Srikanth: Comparison of Equivalent Static Analysis and Response Spectrum Analysis on G+10 Storied Building in All Seismic Zones and Soil Types: Review. International Journal of Advanced Research in Science, Engineering and Technology, Vol. 4, Issue 5 , May 2017, ISSN: 2350-0328

6. JAIN PRITAM ANIL, VAIBHAV. V. SHELAR: Effect of Vertical Irregularity in Multistoried Building under Seismic Loading: Review. International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Volume 9, Issue 7, July 2020, e-ISSN: 2319-8753

CODES

1. IS-456 (2000), Indian standard of code and practice for plain and reinforced concrete for general building construction.
2. IS-1893 2016, Criteria for Earthquake Resistant Design of Structures, [Part1: General Provisions and Buildings, Bureau of Indian Standard].
3. IS 13920: 2016, Ductile design and detailing of reinforced concrete structures subjected to seismic forces.
4. IS-875 (Part 1 Dead Loads)-1987, Code of practice for design loads (other than earthquake) for building and structures.
5. IS-875 (Part 2 Impose Loads)-1987, Code of practice for design loads (other than earthquake) for building and structures.
6. IS-16700: 2023, Criteria for structural safety of tall concrete buildings

BOOK

1. Reinforced Concrete Vol. I Part II, By DR. H. J. SHAH.
2. Illustrated Design of Reinforced Concrete Buildings (Design og G+3 Storeyrd office / Residential Buildings) 11th Edition, Dr. V. L. Shah & Dr. S. R. Karve