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Analysis of G+30 Building Structure Using Etabs in Zone IV and Zone V

B.Harsha Vardan Reddy[1], S.Haneef[2]

[1,2]Assistant Professor, Department Of Civil Engineering, CVRT Engineering college, Tadipatri

ABSTRACT

Since the beginning of time, we have known that earthquakes can result in disasters. Buildings of today are becoming ever more slender and prone to sway, making them more dangerous during an earthquake. In the past, engineers and scientists came up with ways to make buildings more resistant to earthquakes. The ETABS software package's use of lateral load resisting techniques in the building configuration has significantly improved the structure's earthquake resistance, according to a number of practical studies. Shear walls and bracings were used in various situations for the work, and the highest level taken into consideration for the purpose of the study is 93.5 meters.

The modeling is finished with an eye toward how certain conditions and specific heights will be affected by seismic factors like story drift, shear force, building torsion, bending moment, and time. The acquired knowledge has been implemented for Zone IV in Soil Type II (medium soils) in accordance with IS 1893-2002.

KEYWORDS: Seismic load, ETABS software, storey shear values, medium soil, analysis, drift, shear

1. INTRODUCTION

The number of residential and commercial tall buildings has skyrocketed recently, and the current trend is toward taller buildings. Tall structures are a typical sight in both created and creating economies today. Multi-story buildings are becoming increasingly common as a result of population growth and a lack of open space. Because of this, the dynamic nature of wind and earthquake must be taken into account when analyzing these structures. As a consequence of this, lateral stresses such as seismic and wind forces are gaining prominence at an ever-increasing rate. As a result, virtually every designer faces the challenge of providing sufficient strength and stability against lateral pressures. The prediction of the wind load and the seismic loading is necessary for the design of high-rise buildings.

A tall building or high-rising building (HRB) can be defined from the perspective of a structural engineer as one that is affected by lateral forces like wind or earthquake, or both, to the point where they each play a very important role in the type of structure. Since the beginning of time, tall structures have been grouped together. The Egyptian Pyramids, one of the world's seven wonders and one of these ancient tall structures, were built around 2600 B.C. These structures were built for safety and enjoyment. When designing tall buildings, wind loads and earthquake loads must generally be taken into account. The guidelines for conducting dynamic assessments for wind loads and earthquake loads differ.

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The study's primary objectives were to use response spectrum analysis to calculate the design lateral forces for structures with G+30 storeys and compare Zones 4 and 5's results in terms of seismic zones. To determine how structures would respond to various ground motions, including low, middle, and high frequency ground motion, using the IS 1893:2002 code.

2. LITERATURE SURVEY

A.Pavan Kumar Reddy, R.Master Praveen Kumar, et al.1, (2017) In the past, engineers and scientists came up with ways to make buildings more resistant to earthquakes. Now that the modeling is finished, we can examine how seismic properties like base shear, lateral displacements, and lateral drifts would change under specific conditions and at particular heights. The learned information has been implemented for Zone IV and Zone V in Soil Type II (medium soils) in accordance with IS 1893-2002. It was discovered through this investigation that zone 5 had a higher drift value than zone 4.
Narla Mohan, A. Mounika Vardhan, et al. (2017) Only multi-story commercial buildings constructed of reinforced concrete (RC) that fall into one of FOUR distinct zones are included in this study: II, III, IV, or V. ETabs from FEM software are used to complete the analysis. Each of the 20 stories in the study's building model has a constant story height of 3 meters. Each of the FOUR models used to analyze data with varying bay lengths maintains a constant number of bays and bay width in two horizontal directions for ease of use. The findings of this investigation revealed that a structure's base shear rises with the elevation of seismic zones.
Strength, serviceability, stability, and human comfort are the design characteristics of tall structures, according to **J.chiranjeevi yadav, I. Ramaprasad reddy, et al.3** Accordingly, sidelong loads, for example, wind loads and seismic powers are turning out to be increasingly huge, and for all intents and purposes each creator should now consider how to give adequate strength and security against horizontal burdens. Zone 2 and zone 5 results are also compared to see how lateral loads affect moments, axial forces, base shear, maximum storey drift, and tensile forces in structural systems. According to table 2, graph 1, and table 3, respectively, this study concluded that the story drift x and story drift y are greater in earthquake than spectrum in zone 2 soils. Zone5 has a greater tale drift than zone2 when compared to zone2 (see graph 19, table 21, and graph 20).

3. METHODOLOGY

Response spectrum method
The ideal maximum reaction of a single-degree-of-freedom system during earthquake ground movements, with a particular period and damping. In accordance with part 1 of code IS 1893-2002, this analysis was carried out. The type of soil and seismic zone factor should be entered from IS 1893-2002 (part 1) here. The building for the study is subjected to the typical response spectra used by the ETABS 2013 program for the type of soil under consideration. The typical response spectrum for medium soil can be expressed as time period versus spectral acceleration coefficient (Sa/g) in the image below.

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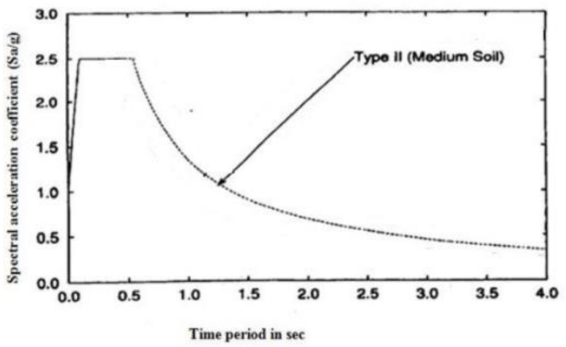

Fig 1: Response spectrum for medium soil type for 5% damping

Types of loads acting on the building

The loads related to dead load, live load, floor load, earth quack load and wind loads are considered for the analysis of Buildings using shear walls and bracings.

DESIGN CONSIDERATIONS AND MODELING OF BUILDING

Problem statement

The following specifications of the building are considered in both zone IV and zone V seismic conditions by using ETABS software.

The basic specifications assumed for the current study are

1. Concrete grade : M30 grade
2. Reinforced steel bars grade : HYSD bars of Fe500
3. Cross section dimensions of beams (Rectangular) : 450mmX650mm
4. Cross section dimensions of columns (Rectangular) : 800mmX500mm
5. RCC slab thickness : 230mm
6. Ground floor height : 4meters
7. Other floors height :3m
8. Live load intensity in KN/ m^2: 5
9. Dead load intensity in KN/ m^2: 5
10. Concrete density value : 25 KN/m^3
11. Seismic zones considered as per IS 1893 code : Zone 4 and Zone 5
12. Soil condition type : II
13. Importance factor value : 1.5
14. Response reduction factor value : 5
15. Damping value : 5%
16. Class of the structure : C
17. Wind speed value as per IS 875 code : 55m/s
18. Wind load specifications code : IS 875: 1987 (Part 3)
19. Concrete design code : IS 456:2000
20. Steel specifications code : IS 800: 2007
21. Seismic load specifications code: IS 1893 : 2002 (Part 1)

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Building model in ETABS Software

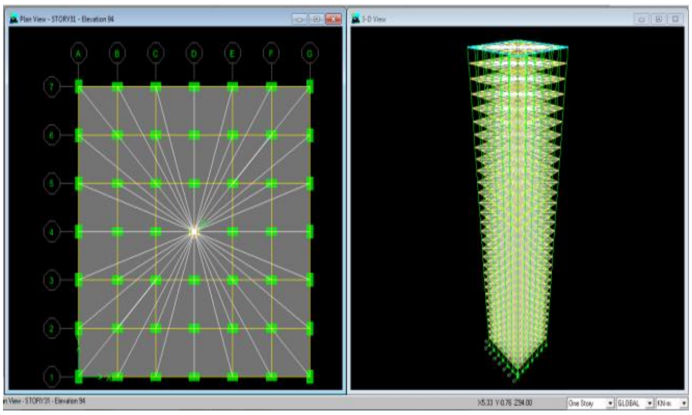
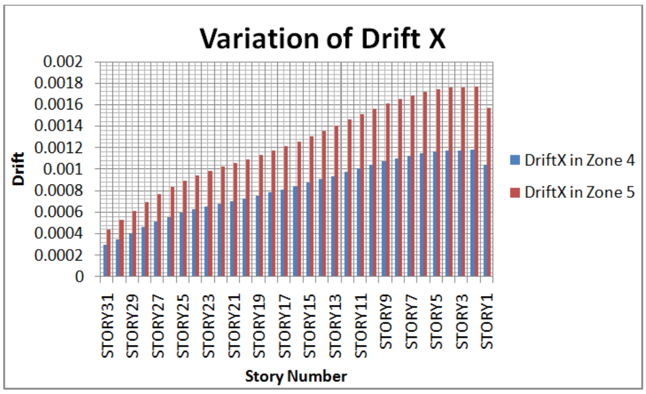


Fig 2: 3D building model in ETABS Software package

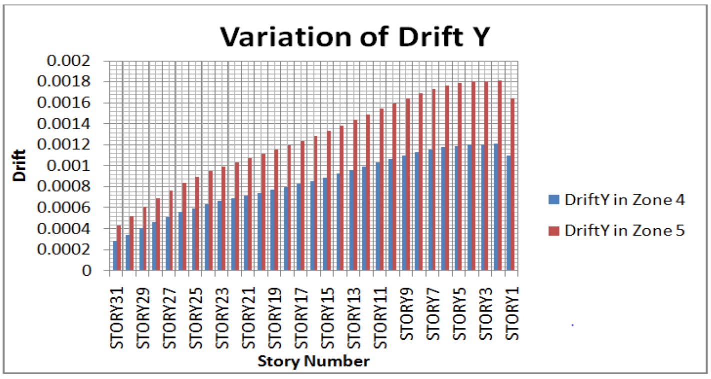
4. RESULTS AND ANALYSIS

Variation of Drift X



Graph 1: Comparison of storey drift X values in both zone 4 and zone 5 condition

Variation of Drift Y



Graph 2: Comparison of storey drift X values in both zone 4 and zone 5 condition

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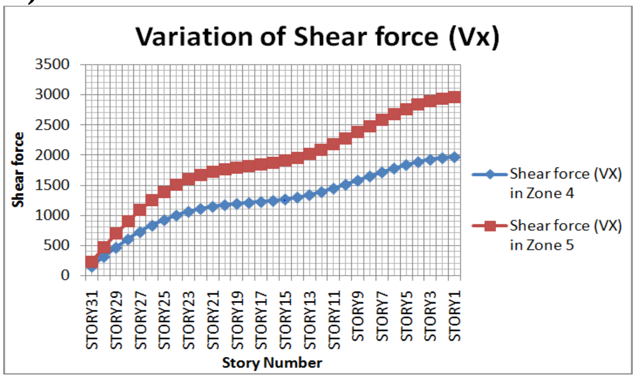
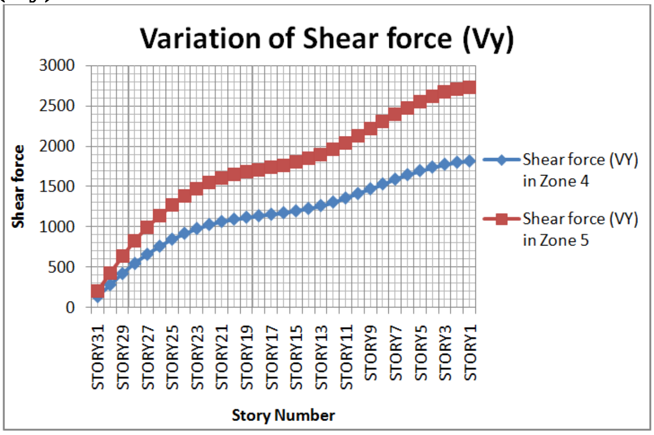
Variation of Shear (Vx)



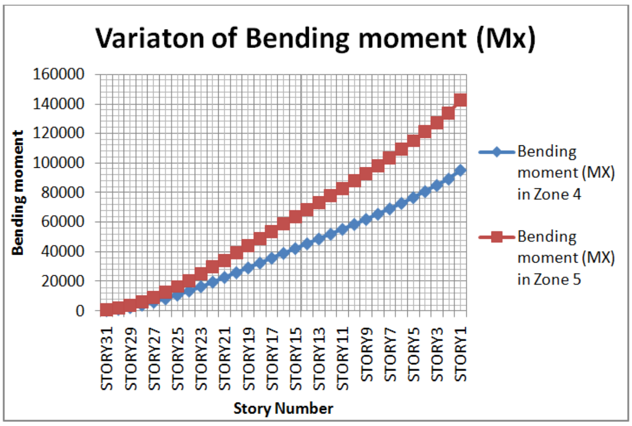
Graph 3: Comparison of shear Vx values in both zone 4 and zone 5 condition

Variation of Shear (Vy)



Graph 4: Comparison of shear Vy values in both zone 4 and zone 5 condition

Bending (Mx)



Graph 5: Comparison of Bending Mx values in both zone 4 and zone 5 condition

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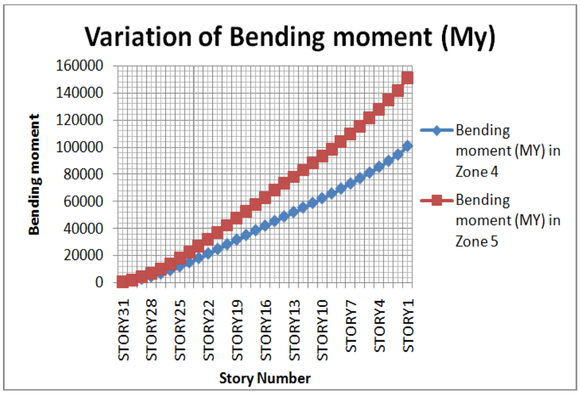
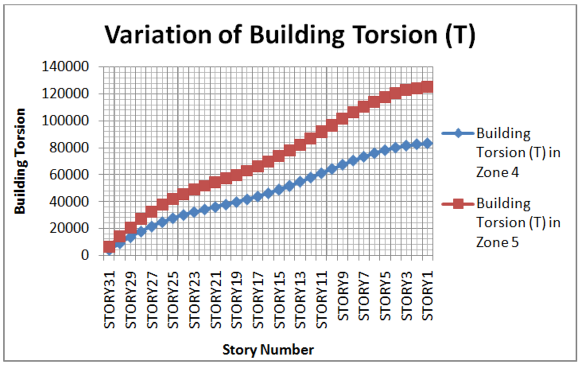
Bending (My)



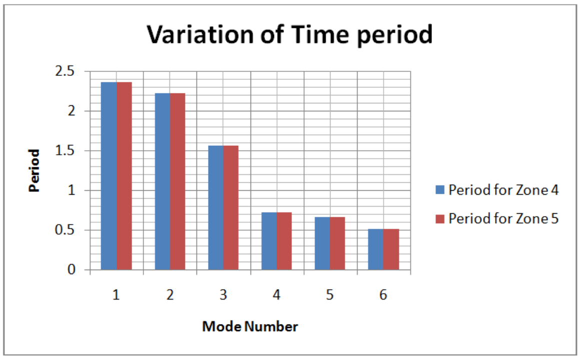
Graph 6: Comparison of Bending My values in both zone 4 and zone 5 condition

Building Torsion (T)



Graph 7: Comparison of Torsion T values in both zone 4 and zone 5 condition

Variation of time period



Graph 8: Comparison of Torsion T values in both zone 4 and zone 5 condition

5. CONCLUSION

From this study the following conclusions were made as per the analysis

1. The values of story Drift grow from the top story (31st story) to the bottom story (1st story), and the values of Drift (Lateral Displacement point of view) are higher for seismic zone V than zone IV.

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2. Shear force values are higher for seismic zone V than zone IV in both the X and Y directions, and they rise from the top story (the 31st story) to the bottom story (1st story).
3. From the top story (the 31st story) to the bottom story (1st story), the values of the building moment grow in both the X and Y directions. According to bending moment theory, seismic zone V has a larger bending value than seismic zone IV.
4. The time period values for the G+30 Stories building in Zones IV and V are identical. This led to the conclusion that seismic zones had no impact on the time duration for construction.
5. Building torsion values grow from the top floor (31 stories) to the bottom story (1 stories), with Zone V showing the highest torsion values compared to Zone IV.
6. Due to the action of seismic forces in both the X and Y directions for G+30 storeys buildings, it was discovered that the values of shear force, bending moment, and building torsion were higher for Zone V than Zone IV.
7. For G+30 buildings, zone 5 has the highest value of forces and moments compared to zone 4.
8. Designing with software like ETABS may save you a tonne of time. ETABS will learn more about each and every member.
9. The software will collect the complete list of failed beams and will also provide the upper section. Utilising software increases accuracy.

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AUTHORS DETAILS:

[1]**MOHAMMAD LATHIF UR RAHIMAN,** currently Pursuing, M.Tech in the stream of structural engineering in Brindavan Institute of Technology and Science, Kurnool, Andhra Pradesh, India, 518218

[2]**Y. VENKATA ARCHAN,** At present he is working Assistant Professor in Department of Civil Engineering in Brindavan Institute of Technology and Science, Kurnool.