ANALYSIS OF G+6 BUILDING FOR DIFFERENT SEISMIC ZONES IN INDIA

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ABSTRACT- When a structure is subjected to earthquake, it responds by vibrating. An earthquake force can be resolved into three mutually perpendicular directions-the two horizontal directions (x and y). This motion causes the structure to vibrate or shake in all three directions; the predominant direction of shaking is horizontal. It is very essential to consider the effects of lateral loads induced from wind and earthquakes in the analysis of reinforced concrete structures, especially for high-rise buildings. The basic intent of analysis for earthquake resistant structures is that buildings should be able to resist minor earthquakes without damage. It resists moderate earthquakes without structural damage but sometimes non-structural damage will resist major earthquakes without collapse the major structure.

The present study is limited to reinforced concrete (RC) multi-storied commercial building with FOUR different zones II, III, IV & V .The analysis is carried out the help of FEM software's ETABS. The building model in the study has 7 storeys with constant storey height of 3m. Four models are used to analyze with different bay lengths and the number of Bays and the bay-width along two horizontal directions are kept constant in each model for convenience. Different values of SEISMIC ZONE FACTOR are taken and their corresponding effects are interpreted in the results.

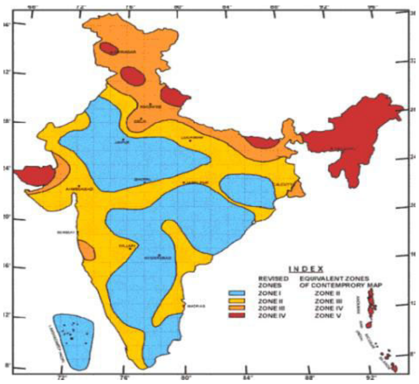
Key words: *Earthquake, High-rise buildings, Reinforced concrete, Different zones, seismic zone factor.*

1. INTRODUCTION

Dynamic actions are caused on buildings by both wind and earthquakes. But, design for wind forces and for earthquake effects are distinctly different. The intuitive philosophy of structural design uses force as the basis, which is consistent in wind design, wherein the building is subjected to a pressure on its exposed surface area; this is force type loading. However, in earthquake design, the building is subjected to random motion of the ground at its base, which induces inertia forces in the building that in turn cause stresses; this is displacement-type loading. Another way of expressing this difference is through the loaded formation curve of the building – the demand on the building is force(i.e., vertical axis) in force-type loading imposed by wind pressure, and displacement(i.e., horizontal axis) in displacement type loading imposed by earthquake shaking.

Seismic Zones in INDIA

The Indian subcontinent has a history of devastating earthquakes. The major reason for the high frequency and intensity of the earthquakes is that the Indian plate is driving into Asia at a rate of approximately 47 mm/year.



Seismic zone map in india

The earthquake zoning map of India divides India into 4 seismic zones (Zone 2, 3, 4 and 5) unlike its previous version, which consisted of five or six zones for the country.

Zone V

Zone 5 covers the areas with the highest risks zone that suffers earthquakes of intensity MSK IX or greater. The IS code assigns zone factor of 0.36 for Zone 5. The region of Kashmir, the Western and Central Himalayas, North and Middle Bihar, the North-East Indian region, the Rann of Kutch and the Andaman and Nicobar group of islands fall in this zone.

Zone IV

This zone is called the High Damage Risk Zone and covers areas liable to MSK VIII. The IS code assigns zone factor of 0.24 for Zone 4.

Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, the parts of Indo-Gangetic plains (North Punjab, Chandigarh, Western Uttar Pradesh, Terai, North Bengal, Sundarbans) and the capital of the country Delhi fall in Zone 4.

Zone III

This zone is classified as Moderate Damage Risk Zone which is liable to MSK VII and also 7.8 The IS code assigns zone factor of 0.16 for Zone 3.

Zone II

This region is liable to MSK VI or less and is classified as the Low Damage Risk Zone. The IS code assigns zone factor of 0.10 (maximum horizontal acceleration that can be experienced by a structure in this zone is 10% of gravitational acceleration) for Zone 2.

Objectives of the study

From this study the following conclusions were made

1) To calculate the design lateral forces on G+6 stories buildings using response spectrum analysis and to compare the results.
2) To study the building by using Zone 2, Zone 3, Zone 4 and Zone 5 seismic zones.
3) To calculate the response of buildings subjected to various types of ground motions namely low, intermediate and high frequency ground motion.
4) To carry out study by using as per IS 1893:2002 code.

2. LITERATURE REVIEW

A.Pavan Kumar Reddy , R.Master Praveen Kumar, et al[1] .,(2017)

From this study it was concluded that the story drift increases from top story to bottom story in both zone4 and zone5 at story 31 the drift is maximum as compared to other stories. The zone5 has higher value of drift as we compared the drift values in zone4 and zone5.

Tatheer Zahra, Yasmeen Zehra, Noman Ahmed, et al, (2015)

In this investigation, a study was conducted to compare the design of a high rise reinforced concrete building in different seismic zones. A 30 storied building was modelled in ETABS software and analysis was done for forces in low (seismic zone 1), moderate (seismic zone 2a, 2b) and high (seismic zone 3, 4) categories and applied forces were compared. The building had a dual frame comprising of shear walls interacting with moment resisting frame to provide lateral resistance.

3. Building consideration and modeling

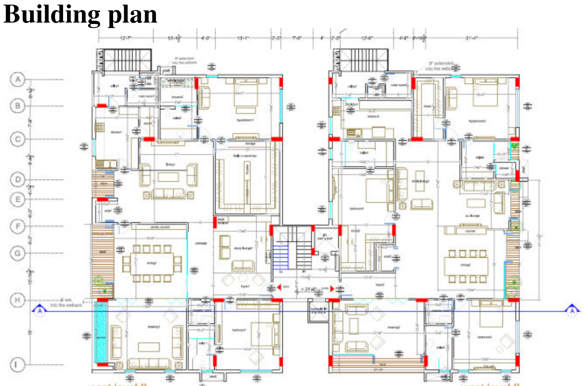
In the present study, analysis of G+6 multi-story building in Zone III, Zone IV, Zone V seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

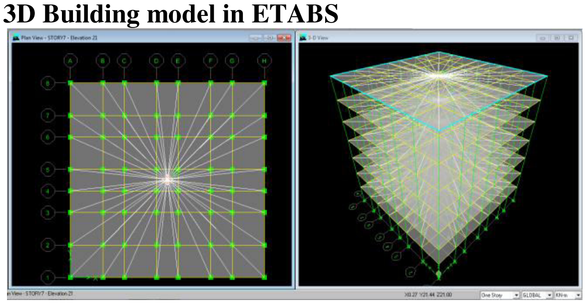
1. Grade of concrete : M35

2. Grade of Reinforcing steel : HYSD Fe500
3. Dimensions of beam : 320mmX450mm
4. Dimensions of column : 450mmX550mm
5. Thickness of slab : 120mm
6. Height of bottom story : 4m
7. Height of Remaining story : 3m
8. Live load : 5 KN/m^2
9. Dead load : 2 KN/m^2
10. Density of concrete : 25 KN/m^3
11. Seismic Zones : Zone 1, Zone 2, Zone 3 and Zone 5
12. Site type : II
13. Importance factor : 1.5
14. Response reduction factor : 5
15. Damping Ratio : 5%
16. Structure class : C
17. Basic wind speed : 35m/s
18. Risk coefficient (K1) : 1.08
19. Terrain size coefficient (K2) : 1.14
20. Topography factor (K3) : 1.36
21. Wind design code : IS 875: 1987 (Part 3)
22. RCC design code : IS 456:2000
23. Steel design code : IS 800: 2007
24. Earth quake design code : IS 1893 : 2002 (Part 1)

Building plan



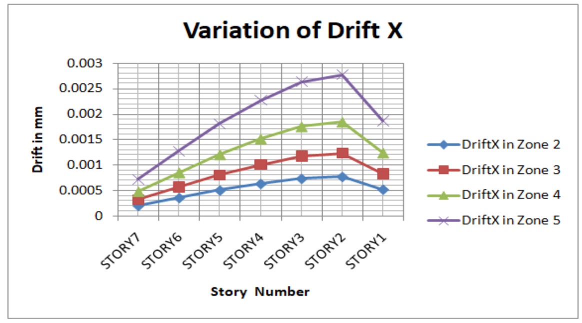
3D Building model in ETABS



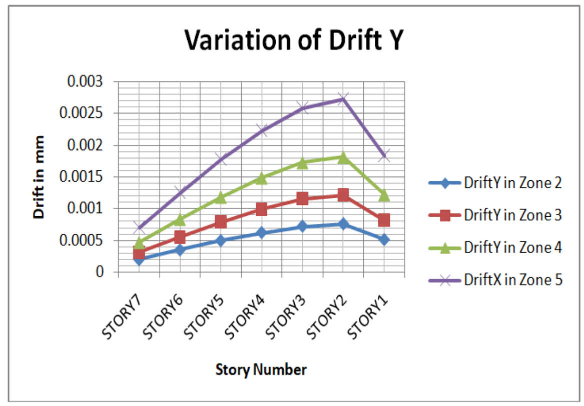
4. RESULTS AND ANALYSIS

Drift

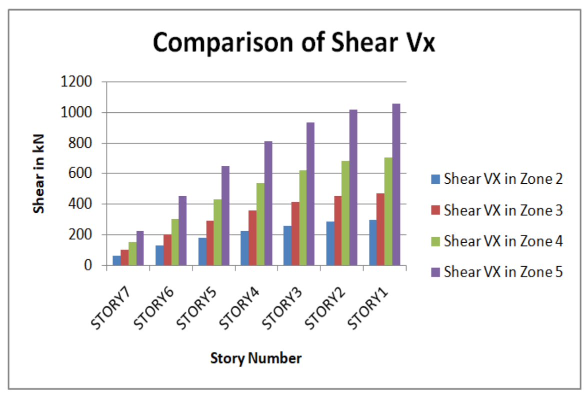
X Direction



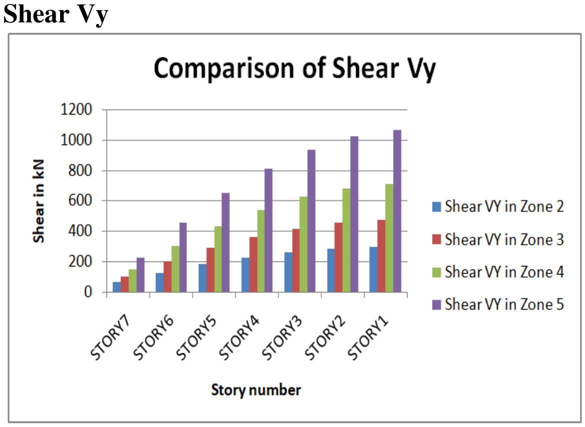
Y Direction



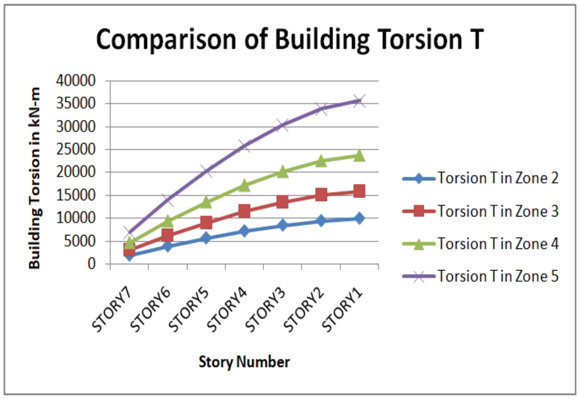
Shear Vx



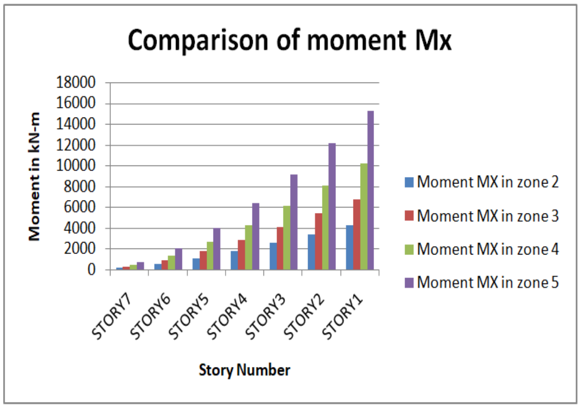
Shear Vy



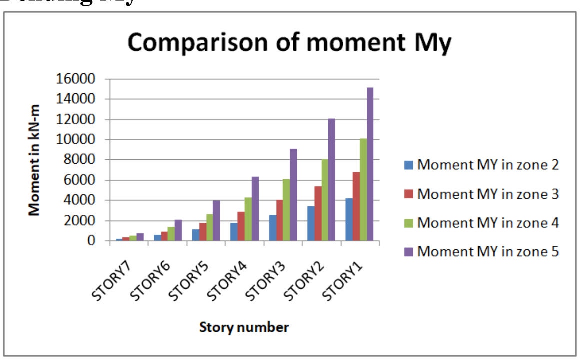
Building Torsion T



Bending Mx



Bending My



5. CONCLUSIONS

From the above study the following conclusions were made

1. The values of Drift in both X and Y-Direction are found higher value for building with Zone 5 seismic zone than remaining zones (Zone 2, Zone 3, Zone 4). The value of drift increases from Top story to bottom story.
2. The values of Shear force in both X and Y-Direction are found higher value for building with Zone 5 seismic zone than remaining zones (Zone 2, Zone 3, Zone 4). The value of Shear force increases from Top story to bottom story.
3. The values of Building Torsion (T) found higher value for building with Zone 5 seismic zone than remaining zones (Zone 2, Zone 3, Zone 4). The value of Building Torsion increases from Top story to bottom story.
4. The values of Bending moment in both X and Y-Direction are found higher value for building with Zone 5 seismic zone than remaining zones (Zone 2, Zone 3, Zone 4). The value of Shear force increases from Top story to bottom story.
5. By using shear walls, dampers, rubber pads, spring we can reduce damage of seismic effect of an R C building resting on high seismic zone.
6. From this study it was concluded that Seismic zone from zone V to zone I will results in the decrease in the drift and increases the Shear force, Bending moment, Building Torsion.

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