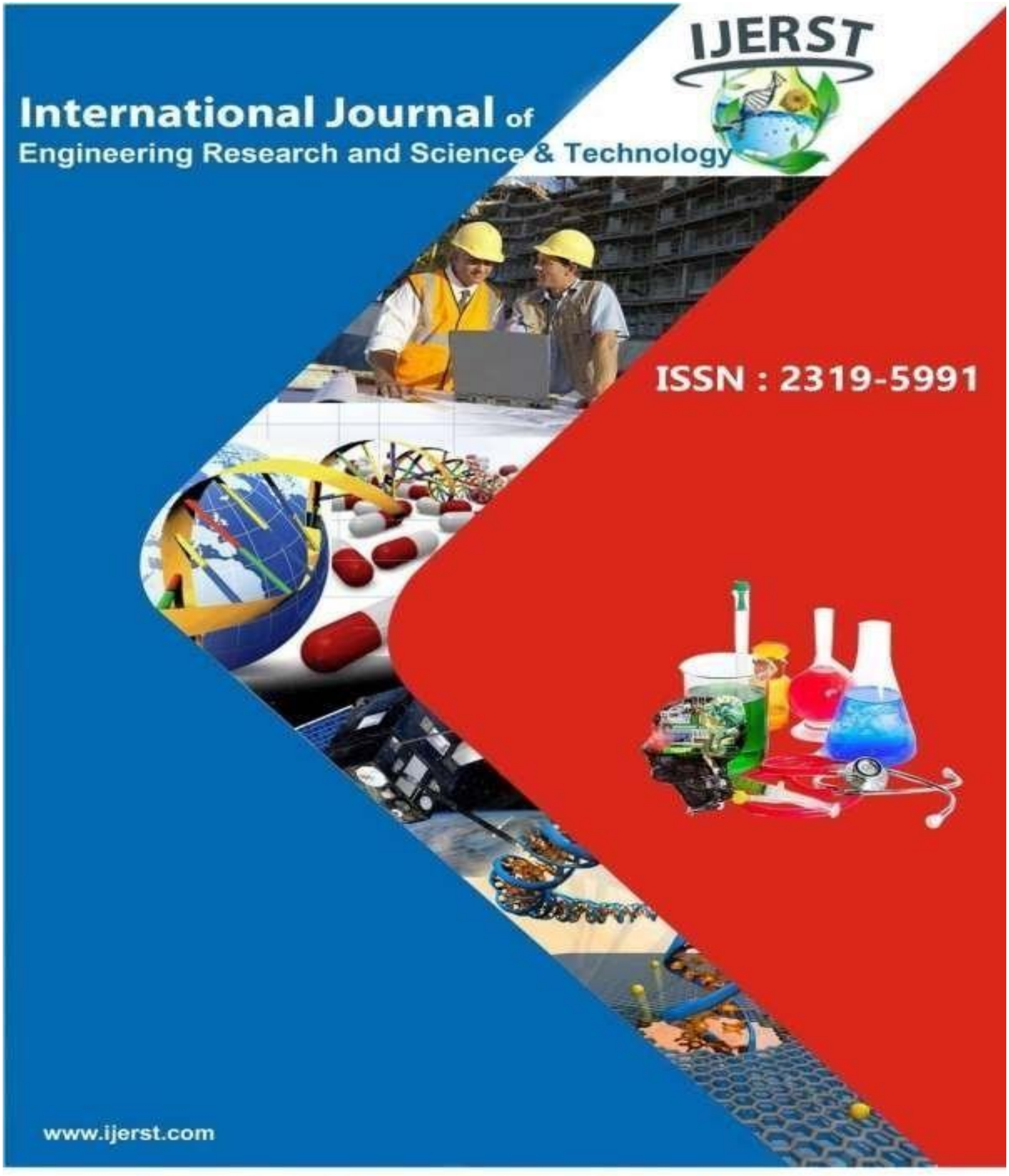

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Analysis of G+15 High Rice Buildings by Using ETABs for Various from Sections in Zone IV & Zone V

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ABSTRACT

Earthquake is the shaking of the ground caused by the sudden breaking and shifting of large sections of earth's rocky outer shell. Earthquakes are among the most powerful events on earth, and their results can be terrifying. Earthquake is general does not kill people directly. Instead, many deaths and injuries result from the collapse of buildings, bridges and other structures. We cannot prevent natural disasters from striking, but we can prevent or limit their impact by making buildings strong enough to resist their destructive forces. This can be achieved by earthquake resistant structures. In the case of earthquakes, it is possible to neutralize their harm by applying basic engineering and planning principles that are in expensive. This project deals with the explanation of basic engineering and planning to be taken into account during the construction of earthquake resistant structures. The present study is to find the seismic effect on building and its performance under earthquake loads. A building of height G+15 RCC structure is modeled with material properties M30 grade for concrete and Fe500 for reinforcing steel and structures dimensions of length 21m, width 17.5m and height of G+15 is 51.5m from the plinth level, the support conditions are chosen to be fixed base and foundation depth is considered as 1.5m below the ground level. Structures are modeled using ETABS in seismic zones III, IV, V as per IS 1893-2002 methods by using response spectrum method. The results are shown in terms of graphs and tables.

Keywords: Fly ash, stress, Concrete Aggregate, ETABS, G+15 & etc.

1. INTRODUCTION

The term building in Civil Engineering is used to mean a structure having various components like foundation, walls, columns, floors, roofs, doors, windows, ventilators, stairs lifts, various types of surface finishes etc. Structural analysis and design are used to produce a structure capable of resisting all applied loads without failure during its intended life. Prior to the analysis and design of any structure, necessary information regarding supporting soil has to be collected by means of geotechnical investigation. A geotechnical site investigation is the process of collecting information and evaluating the conditions of the site for the

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purpose of designing and constructing the foundation for a structure. Structural engineers are facing the challenges of striving for most efficient and economical design with accuracy in solution while ensuring that the final design of a building and the building must be serviceable for its intended function over its design life time As the height of building increases, the behavior of the structure becomes more complex, these are more sensitive to wind and earthquake loads and hence, we need to be very careful to design them. Reinforced concrete is the best suited for multi-storey buildings. It has occupied a special place in the modern construction due to its several advantages. Owing to its flexibility in form and superiority in performance, it has replaced the earlier materials like stone, timber and steel. It has helped the engineers and architects to build pleasing structures. However, its role in several straight-line structural forms like, multi-storey building and bridges etc. is enormous. The unsymmetrical buildings require great attention in the analysis and design under the action of seismic excitation.

2. SURVEY OF PAPER

P. R. Patil, M. D. Pidurkar, R. H. Mohankar studied in general Analysis of portal frames involves lot of complications and tedious calculations by conventional methods. To carry out such analysis is a time-consuming task. The rotation contribution method i.e. Kani's Method & Moment Distribution Method for analysis of portal frames can be handy in approximate and quick analysis so as to get the detailed estimates ready. In this work, these two methods have been applied only for vertical loading conditions. This paper presents the analysis of portal frame, considering mainly the case of single bay portal frame, which is the most common in practice. The Kani's method is self-correcting, that is, the error, if any, in a cycle is corrected automatically in the subsequent cycles. The checking is easier as only the last cycle is required to be checked. The convergence is generally fast. It leads to the solutions in just a few cycles of iterations.

Balaji.U, Mr. Selvarasan M: In this project they proposed a journal on a residential of G+13 multi-story building which is studied for earth quake loads using ETABS . Assuming that material property is linear static and dynamic analysis is performed. These non-linear analyses are carried out by considering severe seismic zones and the behavior is assessed by taking types II soil condition. Different response like, displacements, base shear are plotted.

Siva KiranKollimarla, Chadalawada Jagan Mohan in the context of seismic analysis and design of structures, in earthquake

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engineering, a verity of methods are available. Standard codes provide provisions for certain methods for the analysis of wide range of structures of engineering interest. In this paper an attempt is made to present the provision of IS 1893:2002, Part-1 for the analysis of structure and its suitability.

Varalakshmi V et.al (2014) analyzed a G+5 storey residential building and designed the various components like beam, slab, column and foundation. The loads namely dead load and live load were calculated as per IS 875(Part I & II)-1987 and HYSD bars i.e. Fe 415 are used as per IS 1986- 1985. They concluded that the safety of the reinforced concrete building depends upon the initial architectural and structural configuration of the total building, the quality of the structural analysis, design and reinforcement detailing of the building frame to achieve stability of elements and their ductile performance.

Chandrashekar et.al (2015) analyzed and designed the multi-storeyed building by using ETABS software. A G+5 storey building under the lateral loading effect of wind and earthquake was considered for this study and analysis is done by using ETABS. They have also considered the chances of occurrence of spread of fire and the importance of use of fire proof material up to highest possible standards of performance as well as reliability. They suggested that the wide chances of ETABS software which is very innovative and easier for high rise buildings so that time incurred for designing is reduced.

Balaji. U and Selvarasan M.E (2016) worked on analysis and design of multi- storeyed building under static and dynamic loading conditions using ETABS. In this work a G+13 storey residential building was studied for the earth quake loads using ETABS. They assumed that material property to be linear, static and dynamic analyses were performed. The non-linear analysis was carried out by considering severe seismic zones and the behaviour was assessed by considering type II soil condition. Different results like displacements, base shear was plotted and studied.

Geethu et.al (2016) made a comparative study on analysis and design of multi storied building by STAAD. Pro and ETABS software's. They provided the details of both residential and commercial building design. The planning was made in accordance with the national building code and drafted using Auto CAD software. They concluded that while comparing both software results, ETABS software shows higher values of bending moment and axial force.

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Harshitha M N ,Binod Kumar,Rajiv Kumar Chaudray,Saurabh Singh,Shivam Shivhar "Study on Analysis and Design of a Commercial Building". This paper investigates about the Analysis and Design of a Commercial Building by using ETABS software and also gain sufficient knowledge in complete Analysis and Design Procedure. In this research they checked on G+4 Commercial Building frame made up of Reinforced Concrete. Providing with all necessary specifications. This project mostly stressed on Indian Standard Code Books and National Building Code (NBC) because planning and design of any building will be recognized as per the standards by these design aids. This paper provides information about the design procedure Analysis Results i.e. Shear Force, Bending Moment, Deflections etc. and various IS Code books.

Rohith kumar B.R, Sachin P.Dyavappanavar, Sushmita N.J, Sunitha.V, Vinayak. Yadavad " Analysis and design of Multi Storey Structure using E-tabs" This project investigates that most buildings are of straight forward geometry with horizontal beams and vertical columns. Although any building configuration is possible with ETABS in most cases, a simple rigid system defined by horizontal floors and vertical columns lines can establish building geometry with minimum effort, most of the floors level in buildings are similar. This can reduce the modeling and design time. The main aim of this project is to complete a multi storey building and to ensure that the structure is safe against gravity loading conditions and to fulfill the function for which the structures have been built for the design of structure dead loads and live loads have been considered. The analysis and design of the structure is done by using Etabs Software and also with the confirmation of IS 456-2000.

3. METHODOLOGY

Earthquake and its occurrence and measurements, its vibration effect and structural response have been continuously studied for many years in earthquake history and thoroughly documented in literature. Since then the structural engineers have tried hard to examine the procedure, with an aim to counter the complex dynamic effect of seismically induced forces in structures, for designing of earthquake resistant structures in a refined and easy manner. This re-examination and continuous effort has resulted in several revisions of Indian Standard: 1893: (1962, 1966, 1970, 1975, 1984, and 2002) code of practice on the "Criteria for Earthquake Resistant Design of Structures" by the Bureau of Indian Standards (BIS), New Delhi. In order to properly interpret

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the codes and their revisions, it has become necessary; that the structural engineers must understand the basic design criteria and procedures for determining the lateral forces. Various approaches to seismic analysis have been developed to determine the lateral forces, ranging from purely linear elastic to non-linear inelastic analysis. Many of the analysis techniques are being used in design and incorporated in codes of practices of many countries. However, this chapter is restricted to the method of analysis described or employed in IS 1893 (Part I): 2002 of "Criteria for Earthquake Resistant Design of Structures" essentially to buildings although in some cases that may be applied to other types of structures as well.

3.2 General Terms

- Natural Period (T): Natural period of a structure is its time period of undamped free vibration.
- Fundamental Natural Period (T1): It is the first (longest) modal time period of vibration.
- Diaphragm:It is a horizontal or nearly horizontal system, which transmits lateral forces to the vertical resisting elements, for example, reinforced concrete floors and horizontal bracing systems.
- Seismic Mass: It is the seismic weight divided by acceleration due to gravity.
- Seismic Weight (W): It is the total dead load plus appropriate amounts of specified imposed load.
- Centre of Mass: The point through which the resultant of the masses of a system acts. This point corresponds to the centre of gravity of masses of system.
- Storey Shear: It is the sum of design lateral forces at all levels above the storey under consideration.
- Zone Factor (Z):It is a factor to obtain the design spectrum depending on the perceived maximum seismic risk characterized by Maximum Considered Earthquake (MCE) in the zone in which the structure is located. The basic zone factors included in this standard are reasonable estimate of effective peak ground acceleration.
- Response Spectrum Analysis: It is the representation of the maximum response of idealized single degree freedom system shaving certain period and damping, during earthquake ground motion. The maximum response is plotted against the undamped natural period and for various damping

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values, and can be expressed in terms of maximum absolute acceleration, maximum relative velocity, or maximum relative displacement.

- Time History Analysis: It is an analysis of the dynamic response of the structure at each increment of time, when its base is subjected to a specific ground motion time history.

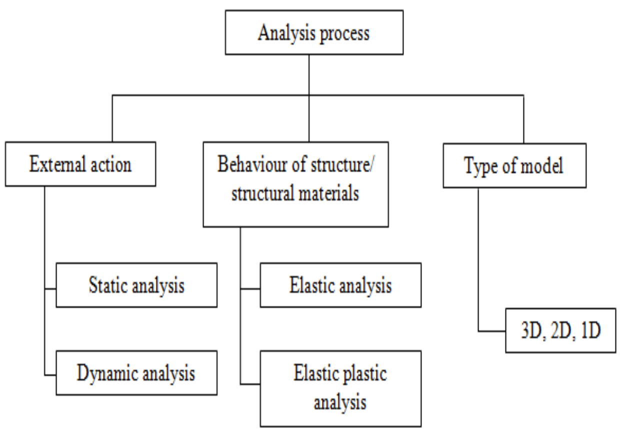

Fig.1: Work Flow.

ETABS is simple to use and user-friendly and it is unique in its ability to address the full spectrum of tasks involved in the process of structure analysis and design. ETABS is a very suitable package for, multi-storied building analysis. The entire input data may be generated either graphically or by typing simple English language-based commands. It is equipped with the sophisticated algorithms and state of the art graphics, residing in an extremely user-friendly environment**.**

The input, output and numerical solutions technique of ETABS are specifically designed to take advantage of the unique physical and numerical characteristics associated with building type structures.

- ♣ The need for the special purpose program has never been more evident as structural engineers put nonlinear dynamic analysis into practice and use the greater computer power available today to create a larger analytical model.

- ♣ Over the past decades, ETABS as numerous mega projects to its credit and as established itself as the standard of the industry. ETABS software is clearly recognized as the most practical efficient tool for the static and dynamic analysis of multi-storey frame and shear wall buildings

4.1: Modeling of structures

In the present study three G+15 structure models with foundation depth of 1.5m and bay widths in length and width directions of 3m and 3.5m each respectively, support conditions are assumed to

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be fixed at the bottom or at the supports/footings. The structures having length = 7x3 = 21m, width = 5x3.5 = 17.5m and height = 51.5m. The structureis modeled in ETABS (structural analysis and design software) by considering various loads and load combinations by their relative occurrence are considered the material properties considered are M30 grade concrete and Fe500 reinforcing steel bars. Methods of analysis considered are response spectrum method.

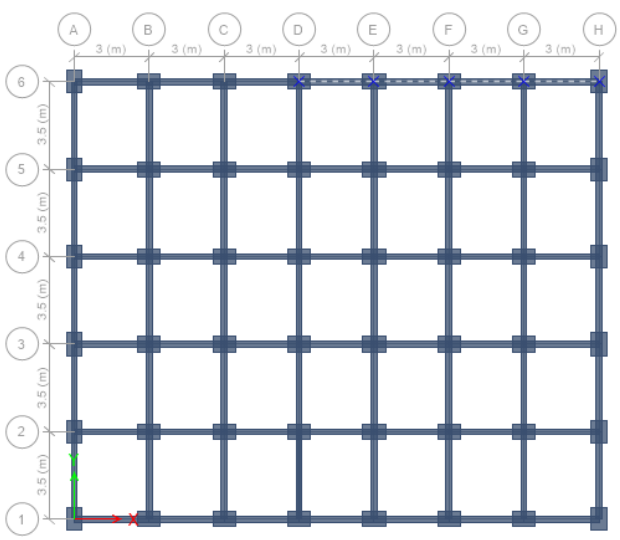

Fig.2. Floor plan of G+15 building.

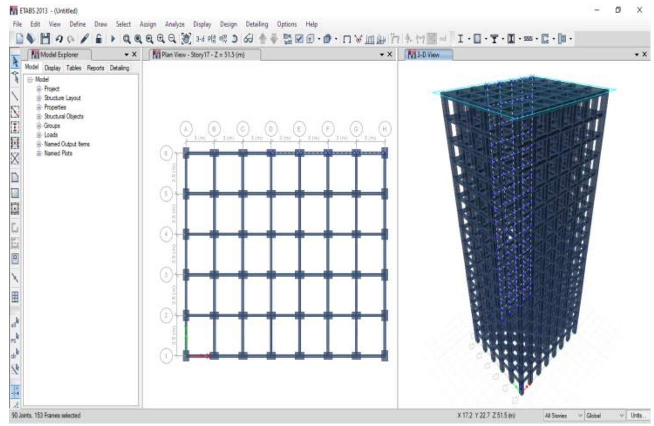

Fig.3. Three-dimensional view of G+ 17 structure.

RESULTS AND DISCUSSION

In this chapter analysis results of G+15 building in seismic zones III, IV and V are listed in tables and graphs. The parameters studied are storey displacements, storey drifts, storey shears, lateral loads, base reactions, bending moments, shear forces and axial forces.

Story	Elevation m	Location	For EQ X		For EQ Y	
			X-Dir (mm)	Y-Dir (mm)	X-Dir (mm)	Y-Dir (mm)
Story17	51.5	Top	11.8	2.542E-02	1.369E-02	13.1
Story16	48.5	Top	11.6	2.548E-02	1.515E-02	12.8
Story15	45.5	Top	11.2	2.483E-02	1.492E-02	12.5
Story14	42.5	Top	10.8	2.398E-02	1.452E-02	12
Story13	39.5	Top	10.4	2.299E-02	1.421E-02	11.5
Story12	36.5	Top	9.8	2.184E-02	1.381E-02	10.9
Story11	33.5	Top	9.2	2.056E-02	1.329E-02	10.2
Story10	30.5	Top	8.6	1.916E-02	1.265E-02	9.5
Story9	27.5	Top	7.9	1.767E-02	1.191E-02	8.7
Story8	24.5	Top	7.1	1.61E-02	1.108E-02	7.9
Story7	21.5	Top	6.4	1.448E-02	1.016E-02	7.1
Story6	18.5	Top	5.6	1.281E-02	9.149E-03	6.3
Story5	15.5	Top	4.9	1.111E-02	8.062E-03	5.4
Story4	12.5	Top	4.1	9.374E-03	7.37E-03	4.6
Story3	9.5	Top	3.3	7.614E-03	7.471E-03	3.7
Story2	6.5	Top	2.5	5.76E-03	4.756E-03	2.8
Story1	3.5	Top	1.5	3.502E-03	1.342E-02	1.8
Base	0	Top	0	0	0	0

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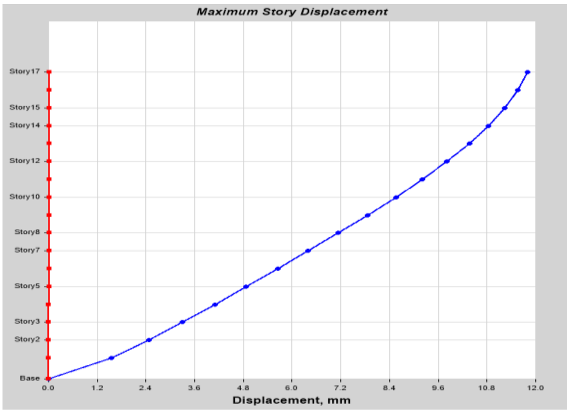

Fig: 4. Maximum storey displacements of structure for EQ X in zone III

Fig.5. Maximum storey displacements of structure for EQ Y in zone III

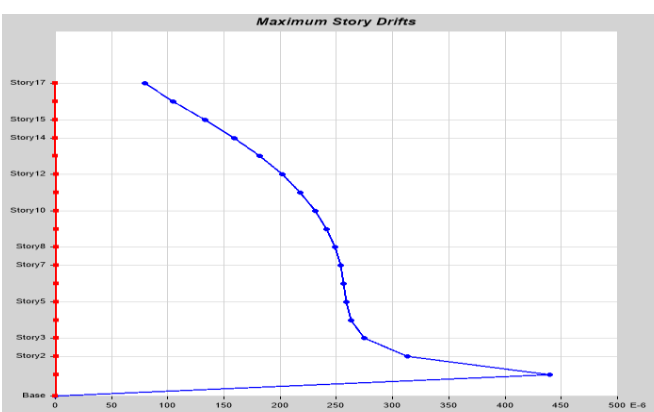

Fig: 6. Maximum storey drifts of structure for EQ X in zone III

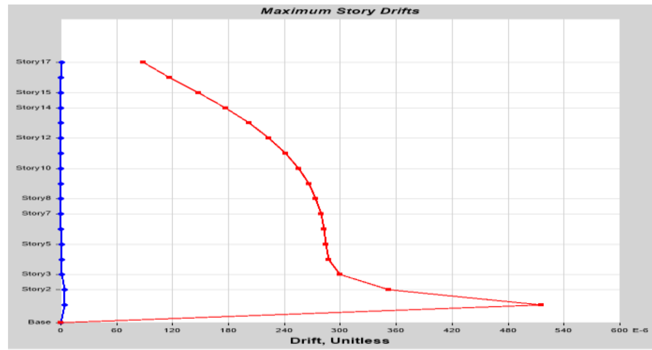

Fig: 7. Maximum storey drifts of structure for EQ Y in zone III

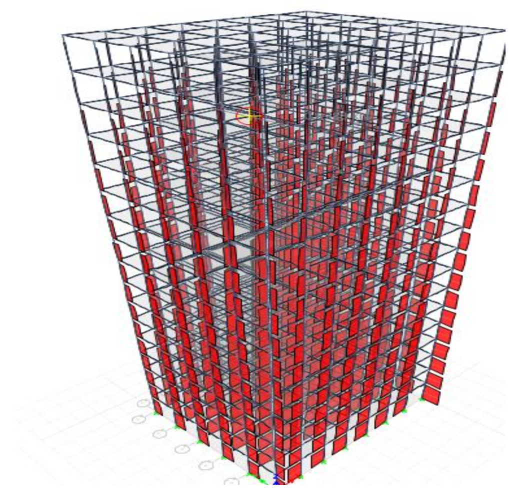

Fig.8. Axial load variation in columns in zone V

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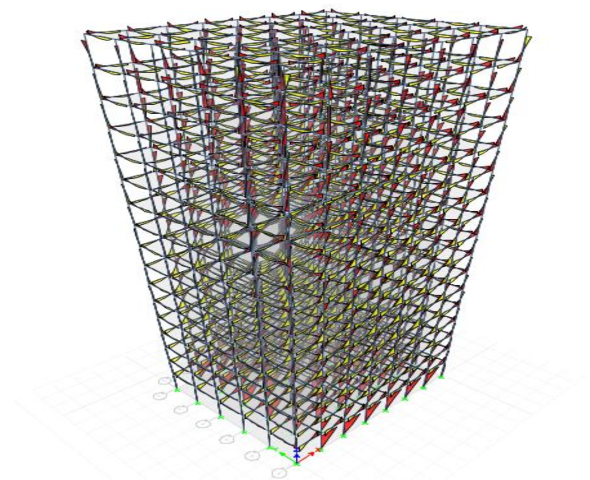

Fig.9. Bending moment variation in beams in zone V

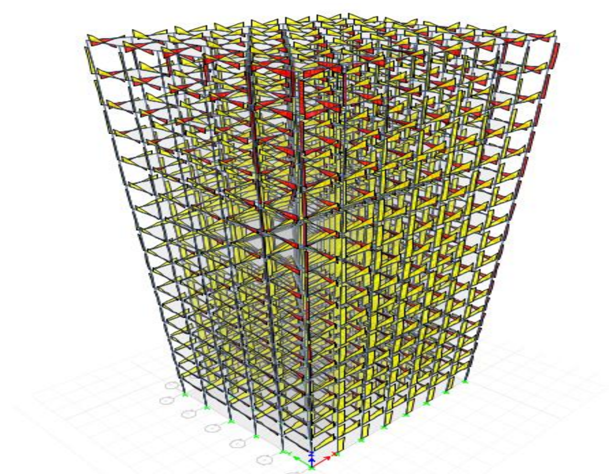

Fig.10. Shear force variation in beams in zone V

CONCLUSION

The following are the results drawn from the analysis of G+15 building in zones III, IV and V by using response spectrum under seismic loads applied parallel to x and y directions.

1. As the storey increases displacement increases, drift decreases, storey shear increases and lateral loads increases.
2. As the zone increases the storey displacement, storey drifts, lateral loads and storey shears are increasing.
3. Lateral loads in X-direction are greater than Y-direction for every zone. The max lateral load in every zone is at storey 16 and those values are as follows
   - In zone III lateral load is 179.1233 KN
   - In zone IV lateral load is 268.685 KN
   - In zone V lateral load is 403.0275 KN
4. The storey displacements, storey drifts and storey shears in X-direction increase with respect to Y-direction.
5. The storey displacement is more in Y-direction at storey 17, storey drift is more in Y-direction at storey 1 and storey shear is more in X-direction at storey 1. Those values are as follows for different zones
   - In zone III displacement is 13.1 mm, drift is 0.000515 and shear is -1209.98 KN
   - In zone IV displacement is 19.6 mm, drift is 0.000773 and shear is -1814.97 KN
   - In zone V displacement is 29.5 mm, drift is 0.001159 and shear is -2722.45KN
6. Maximum Support reactions at the base is 222957.867 KN

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7. Shorter columns are observed to be stiffer than longer columns and are subjected to higher storey forces.
8. It is observed that with the increase in the seismic zones the parameters such as axial loads, bending moments, shear forces and deflections are increasing.

Further Scope of Study:

- Analysis and Design can be done for the same building by increasing the number of stories.
- The same building can further be modelled in Revit Architecture for Architectural and Aesthetic looks.

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