



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 7, July 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Response Spectrum Analysis of G+30 Storey Building for Different Seismic Zones Using ETABS

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ABSTRACT: In India with a seismic moderate zone, the equivalent static force method to estimate the seismic force, subsequent vulnerability and behaviour of RC building under seismic load is inadequate. From past seismic tremors, it is seen that on the off chance that the structures are not appropriately examined and developed with required quality, then it may lead to great destruction and loss to human lives. It has been demonstrated that numerous structures are completely or halfway harmed because of the quake. This reality was never disregarded while plan of multi-story structures by the basic specialists, scientists to guarantee wellbeing against tremor powers while erection. ETABS stand for Extended Three Dimensional Analysis of Building Systems. ETABS integrates every aspect of the engineering design process. In the present situations of construction industry, the buildings that are being constructed are gaining significance, in general, those with the best possible outcomes which are referred to members like beams and columns in multi storeys R.C structures. This software mainly used for structures like highrise buildings, steel and concrete structures. The paper aims to analyze a high-rise building of 30 floors (G+30) by considering seismic, dead and live loads. The design criteria for high-rise buildings are strength, serviceability and stability. The version of the software used is ETABS 2016. In the present study, we are mainly determining the effects of lateral loads on moments, shear force, axial force, base shear, maximum displacement and tensile forces on structural system are subjected.

KEYWORDS: ETABS; Seismic Analysis; High-rise buildings, Response Spectrum Methods

I. INTRODUCTION

1.1 General Introduction

India is a developing country, huge construction projects are yet to come as undeveloped cities are needed to develop since so many years. In current century, many construction projects all over the world are going, time delay takes place which in turn affects the growth of the construction of huge projects. To avoid time delay and thereby the growth, economic construction methodology should be adopted. To economize the structure, structural optimization techniques should be used. For large projects, it is necessary to go for structural optimization because it directly affects cost of construction. Many Metropolitan cities are facing vast growth of infrastructure whether it may be in terms of horizontal development or vertical development. Metropolitan cities like Delhi, Bangalore and Mumbai have high population and in forth coming years' land availability problems will increase tremendously which will in turn affect the overall growth of the city, so most of the builders in construction industries prefers vertical development of structures. As we increase number of stories or height of structure, huge lateral forces come into picture which will tend to increase the construction cost of the project in terms of consumption of steel, concrete and such other materials. Hence usually optimization techniques are adopted to economize the structure. New and different approaches to design have become possible through the increased speed of computers and software tools of optimization theory. The optimization exercise commences right from the architectural concept stage. Suggested grid dimensions by architecture usually do not result into most economical structural member sizes and reinforcement consumption. In general optimization includes discretization of a whole structure into a series of sub frames with slab, beams, columns and footings.

The objectives of the present work is to study the behaviour of a multi storied R C building subjected to earth quake load by adopting Linear or equivalent static analysis. The present study is limited to reinforced concrete (RC) multistoried 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 twenty storey's with constant storey height of 3m. Calculation for a high-rise construction manually then it will take extra time in addition to human individual errors possibly will be occurred. Consequently, the use of ETABS (Extended Three-Dimensional Analysis of Building Systems) will make it easy.

Importance of G+30 storey building and its study: Population of India is increasing at alarming rate. This large population not only needs job but also needs housing and infrastructure facilities. With the advent of Industrial Policy most industries are coming in middle level cities and large cities. Hence, large population is migrating to these cities. Thus, the number of structures and buildings required for them is very large in these cities. This massive population increase will put great pressure on agriculture land near big and middle level cities. Medium or high rise would be the only answer to this urbanization. Land will become scarce and therefore, there will be the urgent need to build multistorey structures in greater number in middle level cities also. At present these cities are expanding horizontally in mix manners but with the scarcity of land there is need for vertical expansion. This is especially needed for saving the agriculture land for growing food items. Hence, the concept of multi-storeyed buildings or high-rise buildings comes into existence.

1.2 Response Spectrum Method

Response spectrum analysis is a method to estimate the structural response to short, nondeterministic, transient dynamic events. Examples of such events are earthquakes and shocks. Since the exact time history of the load is not known, it is difficult to perform a time-dependent analysis. Due to the short length of the event, it cannot be considered as an ergodic ("stationary") process, so a random response approach is not applicable either.

The response spectrum method is based on a special type of mode superposition. The idea is to provide an input that gives a limit to how much an eigenmode having a certain natural frequency and damping can be excited by an event of this type.

A response spectrum is a function of frequency or period, showing the peak response of a simple harmonic oscillator that is subjected to a transient event. The response spectrum is a function of the natural frequency of the oscillator and of its damping. Thus, it is not a direct representation of the frequency content of the excitation (as in a Fourier transform), but rather of the effect that the signal has on a postulated system with a single degree of freedom (SDOF).

As the peak of the building increases the effect of lateral loads (seismic and wind loads) emerge as very predominant. This chapter will speak about the previous work carried out on this discipline. Many researchers have studied the efficiency of RC frame with exceptional style of bracings, shear walls and so forth. One of the papers is mentioned beneath. Dr. Okay. R. C. Reddy, Sandip A. Tupatet., al. (2014) His research had stated that the wind loads and earthquake masses are estimated for a twelve storied RC framed constitution. Established on the results bought the following conclusions are made. The earthquake and wind loads rises with height of constitution. Wind loads are more valuable for tall structures than the earthquake loads. Constructions will have to be designed for loads obtained in each recommendation independently for important forces of wind or earthquake.. The researchers have studied on the metal bracing in RC frames and also the outriggers. Some of them dealt with extraordinary types of bracing and top-quality area of the bracings and likewise newly adopted mega brace systems. the introduction of Limit state design of structures, the safety and serviceability of the structure has accrued prime importance. The present day scenario witnesses a series of natural calamities like earthquakes, tsunamis, floods etc. Of these the most damaging and recurrent phenomena is the earthquake. The Effective design and the construction of Earthquake resistant structure has gained greater importance all over the world. In this paper the earthquake resistance of a G+30 multi-storey building is analysed using Equivalent static method with the help of E-TABS software. The method includes seismic coefficient method as recommended by IS 1893:2002. The parameters studied were displacement, storey drift and storey shear. Seismic analysis was done by using E-TABS software.

The increase in population by which land deficit occurs and to overcome that, high-rise buildings are opted. These type of high-rise buildings are effected by the natural calamities. Calamities like earthquakes are the most dangerous by means of the damage and chaos caused to the structural components and they cannot be controlled. These natural calamities caused property damage and interruptions in development of the normal lifecycle. Since it's a global concern, most of the analysis should be carried out and provided with the results to prep the structure in order to attain time period. With the technological advancement, man tried combating with these natural calamities through various



ways like developing early warning systems for disasters, adopting new prevention measures, proper relief and rescue measures. But unfortunately it is not true for all natural disasters.

1.3 Seismic Zone of India

The changeable topography at various areas in the nation infers that the probability of harming seismic tremors occurring at various areas is having different seismic zone values for different locations. In this way, a seismic region map is essential so structures and different structures situated in various areas can be intended to withstand distinctive dimension of ground shaking. The current zoning of map divided into four zones in India II, III, IV and V.

Based on the past seismic history, Bureau of Indian Standards grouped the country into four seismic zones namely Zone-II, Zone-III, Zone-IV and Zone-V. Of all these four zones, Zone-V is the most seismic active region whereas Zone-II is the least.

Table 1.1: Seismic Zone Intensity in MM Scale

Seismic Zone	Intensity on M.M Scale
Zone-II (Low-Intensity Zone)	6 (or less)
Zone-III (Moderate Intensity Zone)	7
Zone-IV (Severe Intensity Zone)	8
Zone-V (Very Severe Intensity Zone)	9 (and above)

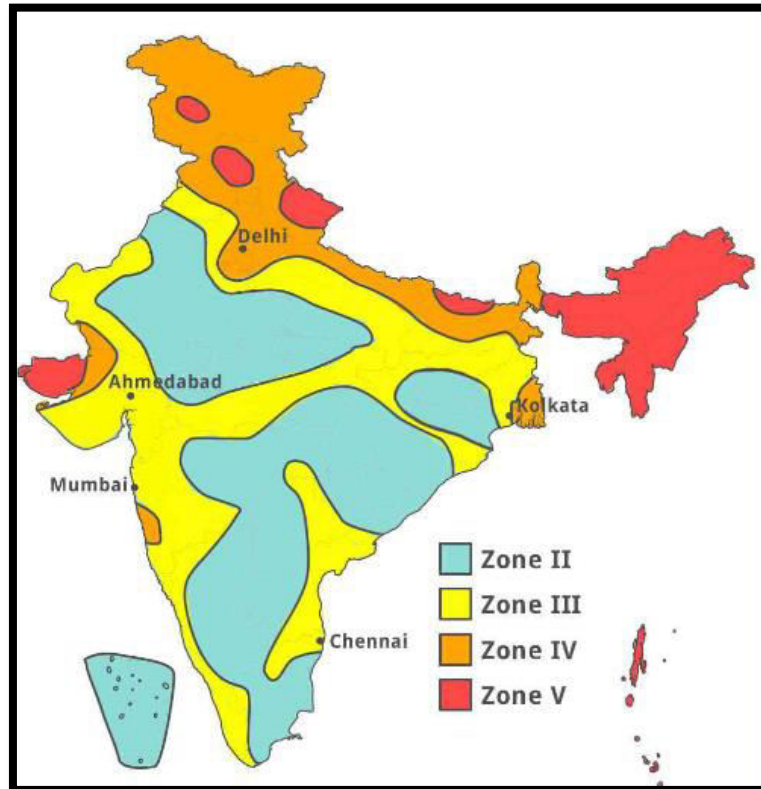
Regions that fall under the Earthquake (seismic) Zones in India-

Zone-V covers entire northeastern India, some parts of Jammu and Kashmir, some parts of Ladakh, Himachal Pradesh, Uttarakhand, Rann of Kutch in Gujarat, some parts of North Bihar and Andaman & Nicobar Islands.

Zone-IV covers remaining parts of Jammu & Kashmir, Ladakh and Himachal Pradesh, Union Territory of Delhi, Sikkim, northern parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan.

Zone-III comprises of Kerala, Goa, Lakshadweep islands, remaining parts of Uttar Pradesh, Gujarat and West Bengal, parts of Punjab, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Odisha, Andhra Pradesh, Tamil Nadu and Karnataka.

Zone-II covers remaining parts of the country



(Figure 1.1: Earthquake (seismic) Zones in India (Map))
Effect of Earthquakes on High Rise Buildings-

Precisely when a building is shown to the seismic tremor vibrations its establishment will move to and from with the ground. These vibrations can be incredibly marvelous, making stresses and deformation all through the structure making the upper edges of the building swing from a few mms to different inches' reliant on their stature size and mass. This is reliably material for structures everything being equivalent, paying little heed to whether single storied or multi-storied in high-chance seismic tremor zones. A building ought to be barely versatile and have fragments, which can withstand or counter the nerves caused in various bits of the working as a result of level advancements realized by tremors. It was seen that structures of various sizes and statures vibrated with various frequencies. Where these were made nearby each other they made stresses in both the structures and subsequently weakened each other and when in doubt caused the failure of both the structures. Master of Indian Standards gives in its code IS 4326 that a Separation Section is to be given between structures. Division Section is portrayed as an opening of demonstrated width between neighboring structures or parts of a comparative building, either left uncovered or verified fittingly to enable improvement to avoid beating considering the seismic tremor. Further, it communicates that for structures of height more vital than 40 meters, it will charm total model or dynamic examination of the structures to figure the buoy at each story, and the opening width between the adjoining structures won't be not actually the total of their dynamic evasions at any measurement.

Therefore, it is urged to give a tasteful opening between two structures more unmistakable than the sum of the typical bowing of both the structures taking care of business, with the objective that they have enough space to vibrate. This circumstance is likewise intensified when the section estimation of one building is close to the mid-estimation of the dividers and parts of the neighboring building, the dividers and segments are typically not proposed for taking this extra shear propel acknowledged by the measurement control starting from the neighboring piece. This causes catching of the areas and dividers every so often of over the best stresses at the mid centers (amiability your neighboring building) and thusly the breakdown of the structures onto each other starting a chain reaction. Since one can't predict how one's neighbor is going to build his home at the period of plan it is more intelligent to stay away from potential hazard, for instance, keeping up a hole. On record of high rise, multi storied private and business structures advancement joints are given when the length of the building outperforms a length controlled by code.

This augmentation joint is suited moderating anxieties caused in view of advancement or pressure of improvement material inferable from temperature changes. Presently, the structures are totally separated and a gap of 1 to 2" is outfitted which is stacked up with a versatile material. In any case, this is causing an essential issue for instance the shirking of these self-sufficient structures during the seismic tremor is significantly more in raised structures than the expansion joint and since now these structures are detached and of the varying size, they would swing and hammer with each other and cripple the structures. Assistant fragments around the augmentation joint would be truly hurt and there will be a chain reaction of forces in the complete structure for which the structure has not been arranged. In regions where highpower tremors are depended upon the wellbeing measures are to be taken: Due to bowing/development, Expansion joints legitimate hole as required in two pieces of the working, because of quake gave in all structures.

At the season of authorizing of building plan, we should submit basic illustrations and declaration from the authorized auxiliary specialist.

These should give refinements of

- a) soil condition and bearing point of confinement.
- b) Seismic tremor zone for which the building has been organized.
- c) I.S. Codes utilized for structure

No relaxations ought to be allowed, and no progressions made that auxiliary structure after authorization. Accommodation of Structural authentication from the architect to the overseeing city body subsequent to throwing of establishments and at each floor level ought to be made necessary. At the season of assent This should express that the support and R.C.C standing have been confirmed and are according to his basic structure submitted to the body. the ordinary shape must be favored at the Common divider framework between abutting structures should be completely abrogated distortion.

Important of Seismic Design Codes-

Ground vibrations during earthquake cause forces and deformations in structures. Structures should be planned withstand such powers and disfigurements. Seismic codes help to improve the conduct of structures so that may withstand the quake impact without huge death toll and property. Nations around the globe have techniques laid out in the seismic code to help configuration builds in the arranging, planning, enumerating and developing of structures.

a. A tremor safe has four ethics in it, specifically:

- i) Good Structural Configuration: its size, shape and a basic framework conveying loads are to such an extent that they guarantee an immediate and smooth stream of latency powers to the ground.
- ii) Lateral Strength: The most extreme sidelong (even) compel that it can oppose is with the end goal that the harm initiated in it doesn't result in breakdown.
- iii) Adequate Stiffness: Its sidelong burden opposing framework is to such an extent that the seismic tremor – in fact distortions in it don't harm its substance under low-to-direct shaking.
- iv) Good Ductility: Its ability to experience extensive disfigurements under extreme seismic tremor shaking even in the wake of yielding is improved by positive structure and itemizing procedures.

b. Indian Seismic Codes:

Seismic codes are extraordinary to an area or nation. They think about the nearby seismology, acknowledged dimension of seismic hazard, structures typologies, and materials and strategies utilized in development.

The Bureau of Indian Standards (BIS) the accompanying Seismic Codes:

- IS 1893 (PART 1) 2002, Indian Standard Criteria for Earthquakes Resistant of Design Structures (5th update).
- IS 4326, 1993, Indian Standard Code of training for Earthquake Resistant Design and Construction of Buildings. (second update).
- IS 13827, 1993, Indian Standard Guidelines for improving Earthquake Resistant of Earthen structures.
- IS 13828, 1993 Indian Standard Guidelines for improving Earthquake Resistant of Low Strength Masonry Buildings.

• IS 13920, 1993, Indian Standard Code for training for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces. The directions in these gauges don't guarantee that structures endure no harm amid the tremor of all greatness. In any case, to the degree conceivable, they guarantee that structures can react to tremor shaking of moderate forces without auxiliary harm and of substantial powers without all out breakdown.

1.4 OBJECTIVES:

- To study the structural analysis and design of G+30 storey building as per IS (1893-2016) by using Etabs software.
- Determination of displacements subjected to earthquake loading from zone to zone
- To find out bending moment and shear force for various seismic zone.
- To study the Economy and durability of structure.

II. LITERATURE REVIEW

(1)Ali KadhimSallal (2018): The main purpose of this software is to design and analysis multi-Storeyed building in a systematic process. This paper present a building where designed and analyzed under effect of earthquake and wind pressure by using ETABS software. In this case, (18m x 18m) and eight stories structure are modeled using ETABS

software. Ten story is taken as (3m) height and making the total height of the structure (31m).

(2)PushkarRathod and Rahul Chandrashekar (2017): With the help of seismic analysis, the structure can be designed and constructed to withstand the high lateral movement of earth's crust during an earthquake. Any type of basic or a highly advanced structure which maybe under static or dynamic conditions can be evaluated by using ETABS. ETABS is a coordinated and productive tool for analysis and designs, which range from a simple 2D frames to modern high-rises which makes it one of the best structural software for building

(3)systems.Pardeshi Sameer and Prof. N. G. Gore (2016): This paper is concerned with the effects of various vertical irregularities on the seismic response of a structure. The objective of the project is to carry out Response spectrum analysis (RSA) of regular and irregular RC building frames and Time History Analysis (THA) of regular RC building frames and carry out the ductility based design using IS 13920 corresponding to response spectrum analysis. Comparison of the results of analysis of irregular structures with regular structure is done.

(4)VijayaBhaskarreddy.S et. al. (2015): This paper presents illustration of a comparative study of static loads for 5 and 10 storey multi storeyed structures. The significance of this work is to estimate the design loads of a structure. They conclude that deflection of the members is high with an increase in no. of floors. It can be observed that axial force is high in

(5)storey compared to 5-storey building.AbhayGuleria (2014): The case study in this paper mainly emphasizes on structural behavior of multi-storey building for different plan configurations like rectangular, C, L and I-shape. Modelling of 15- storeys R.C.C. framed building is done on the ETABS software for analysis. Post analysis of the structure, maximum shear forces, bending moments, and maximum storey displacement are computed and then compared for all the analyzed cases. The analysis of the multistoried building reflected that the storey overturning moment varies inversely with storey height. From dynamic analysis, mode shapes are generated and it can be concluded that asymmetrical plans undergo more deformation than symmetrical plans.

(6) J.P Annie Sweetlin (2016): The present day scenario witnesses a series of natural calamities like earthquakes, tsunamis, floods etc. Of these the most damaging and recurrent phenomena is the earthquake. The Effective design and the construction of Earthquake resistant structure has gained greater importance all over the world. In this paper the earthquake resistance of a G+20 multi-storey building is analysed using Equivalent static method with the help of ETABS 9.7.4 software. The method includes seismic coefficient method as recommended by IS 1893:2002. The parameters studied were displacement, storey drift and storey shear. Seismic analysis was done by using E-TABS software and successfully verified manually as per IS 1893:2002. Drift is within the limits for the building (0.004 times of the height of the storey) $0.004 \times 3.2 = 12.8\text{mm}$. Earthquake Base shear is greater than Wind Base shear. Complete guideline for the use of E-TABS 9.7.4 for seismic coefficient analysis is made available by this paper.

(7) **anchal D. Rand Marathi P.M (2011):** The paper involves the comparative study of RCC, steel and composite (G+30) stories structures under the seismic effect. For the analysis equivalent static method has been used and modelling of structures has done by ETABS. From this study they conclude that the steel structures are better than RCC structures for low rise buildings but for high rise buildings the composite option is best suited among all three options. In addition, the reduction in self weight of steel structure is 32% less than RCC structures and the self weight of composite structure is 30% less than RCC structures. And also they suggest that, in steel structure the bending moment of secondary beam increased by average 83.3% and reduced by 48% in composite structure as compare to RCC.

(8) **Abhay Guleria (2014):** Abhay Guleria presents the analysis of the multi-storeyed building using ETABS reflected that the storey overturning moment varies inversely with storey height. Moreover, L-shape, I-shape type buildings give almost similar response against the overturning moment. Storey drift displacement increased with storey height up to 6th storey reaching to maximum value and then started decreasing. From dynamic analysis, mode shapes are generated and it can be concluded that asymmetrical plans undergo more deformation than symmetrical plans. Asymmetrical plans should be adopted considering into gap.

III. PROPOSED METHODOLOGY

3.1 General:

In the present study, response spectrum analysis of G+30 multi-storey building in different zones using ETABS, which meets the basic requirements such as safety, durability, economy, aesthetic appearance, feasibility, practicability and acceptability. It has been proposed to follow the following methodology.

- Structural planning
- Modeling and analysis in ETABS

Analysis of G+30 multi-story building in all seismic zones for wind and earthquake forces is carried out. 3D model is prepared for G+30 multi-story building using ETABS. Methods of analysis of structure: The seismic analysis should be carried out for the buildings that have lack of resistance to earthquake forces. Seismic analysis will consider seismic effects hence the exact analysis sometimes become complex. However for simple regular structures equivalent linear static analysis is sufficient one. This type of analysis will be carried out for regular and low rise buildings and this method will give good results for this type of buildings. Dynamic analysis will be carried out for the building as specified by code IS 1893-2002 (part 1). Dynamic analysis will be carried out either by Response spectrum method.

3.2 Loads Acting on Multi-Storey G+30 Building:

Loading on tall buildings is different from low-rise buildings in many ways such as large accumulation of gravity loads on the floors from top to bottom, increased significance of wind loading and greater importance of seismic effects. Thus, multi-storied structures need correct assessment of loads for safe and economical design. Except dead loads, the assessment of loads cannot be done accurately. Live loads can be anticipated approximately from a combination of experience and the previous field observations. Wind and earthquake loads are random in nature and it is difficult to predict them. They are estimated based on a probabilistic approach. The following discussion describes some of the most common kinds of loads on multi-storied structures.

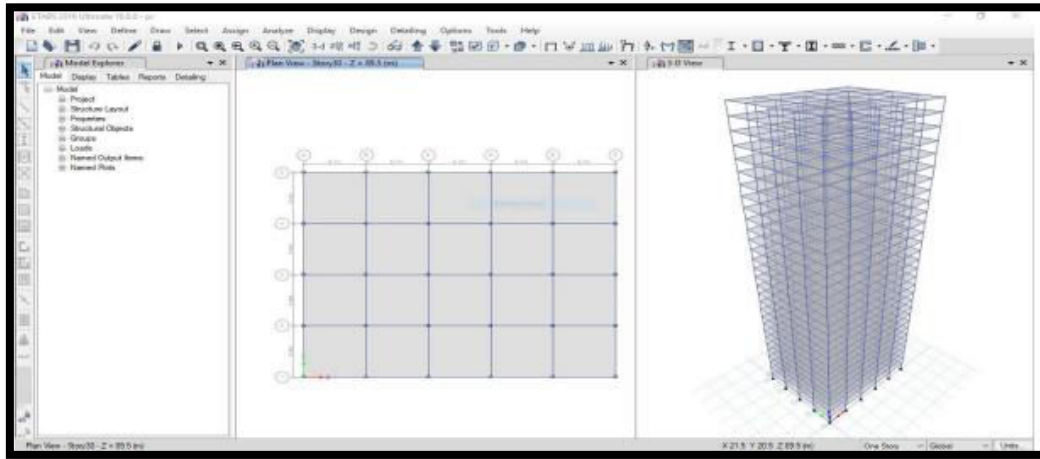
- Dead loads
- Live loads
- Earthquake loads

3.3 Design data:

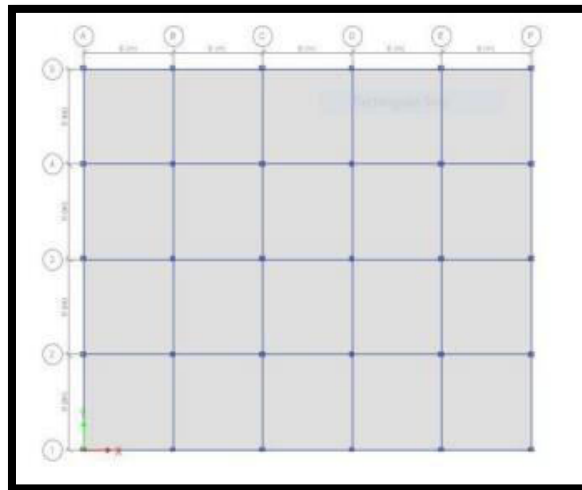
1. Building type : Residential building
2. No. of storeys : G+30
3. Building shape : Rectangular
4. Geometrical details
 - a. Ground floor : 2.5m
 - b. Floor – Floor height : 3m
5. Material details

- a. Concrete grade : M30
- b. Steel grade : HYSD reinforcement of Fe415
- c. Bearing capacity of soil : 200 KN/m²
- 6. Type of construction : R.C.C Framed structure

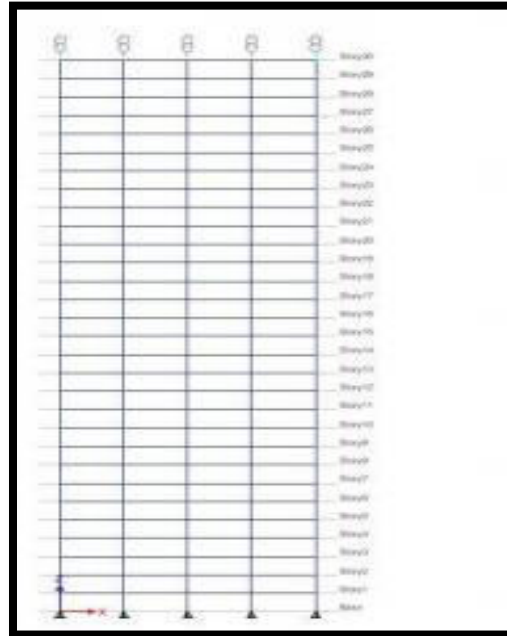
3.4 Analysis using ETABS:



(Fig.3.1 : G+30 Building Design using ETABS 2016)



(Fig.3.2 :Plan of G+30 Building)



(Fig.3.3 : Elevation of G+30 Building)

IV. RESULTS AND DISCUSSIONS

For every seismic zone the software gives six possible seismic load cases and two combination load cases i.e., maximum and minimum. The six possible load cases depends upon the loads acting on the structure.

Zone 5 results-

TABLE 1 STORY DRIFT IN X DIRECTION FOR TOP 10 FLOORS			
STORY	LOAD CASE/COMBO	DIRECTION	DRIFT
Story 30	Seismic	x	0.000515
Story 29	Seismic	x	0.000681
Story 28	Seismic	x	0.000850
Story 27	Seismic	x	0.001008
Story 26	Seismic	x	0.001155
Story 25	Seismic	x	0.001290
Story 24	Seismic	x	0.001414
Story 23	Seismic	x	0.001528
Story 22	Seismic	x	0.001630
Story 21	Seismic	x	0.001723



TABLE 2
STORY DRIFT IN Y DIRECTION FOR TOP 10 FLOORS

STORY	LOAD CASE/COMBO	DIRECTION	DRIFT
Story30	seismic	y	0.000647
Story29	seismic	y	0.000835
Story28	seismic	y	0.001025
Story27	seismic	y	0.001008
Story26	seismic	y	0.001366
Story25	seismic	y	0.001516
Story24	seismic	y	0.001655
Story23	seismic	y	0.001780
Story22	seismic	y	0.001894
Story21	seismic	y	0.001997

Base Reactions:

TABLE 3
BASE REACTIONS OF ZONE 5

Load Case/Combo	Force in x direction Fx kN	Force in y direction Fy kN	Force in z direction Fz kN	Moment in x direction Mx kN m	Moment in y direction My kN m	Moment in z direction Mz kN m
Dead	0	0	113873.4502	1366481	-1708102	0
Live	0	0	44100	529200	-661500	0
Seismic 1	-1326.4762	0	0	6.118E-06	-90389.3333	15917.7145
Seismic 2	0	-1326.4762	0	90389.3332	-6.986E-06	-19897.1431
Seismic 3	-1326.4762	0	0	6.118E-06	-90389.3333	15917.7145
Seismic 4	0	-1326.4762	0	90389.3332	-6.986E-06	-19897.1431
Seismic 5	-1326.4762	0	0	6.118E-06	-90389.3333	15917.7145
Seismic 6	0	-1326.4762	0	90389.3332	-6.986E-06	-19897.1431
Comb1 Max	0	0	157973.4502	1895681	-2369602	0
Comb1 Min	0	0	157973.4502	1895681	-2369602	0

Zone 4 Results:

TABLE 4 STORY DRIFT IN Y DIRECTION FOR TOP 10 FLOORS

STORY	LOAD CASE/COMBO	DIRECTION	DRIFT
Story30	seismic	y	0.000432
Story29	seismic	y	0.000557
Story28	seismic	y	0.000683
Story27	seismic	y	0.000801
Story26	seismic	y	0.000910
Story25	seismic	y	0.001011
Story24	seismic	y	0.001103
Story23	seismic	y	0.001187
Story22	seismic	y	0.001263
Story21	seismic	y	0.001331



Base Reactions:

TABLE 5 BASE REACTIONS OF ZONE 4

Load Case/Combo	Force in x direction Fx kN	Force in y direction Fy kN	Force in z direction Fz kN	Moment in x direction Mx kN m	Moment in y direction My kN m	Moment in z direction Mz kN m
Dead	0	0	113873.4502	1366481	-1708102	0
Live	0	0	44100	529200	-661500	0
Seismic 1	-884.3175	0	0	4.078E-06	-60259.5555	10611.8097
Seismic 2	0	-884.3175	0	60259.5555	-4.657E-06	-13264.7621
Seismic 3	-884.3175	0	0	4.078E-06	-60259.5555	10611.8097
Seismic 4	0	-884.3175	0	60259.5555	-4.657E-06	-13264.7621
Seismic 5	-884.3175	0	0	4.078E-06	-60259.5555	10611.8097
Seismic 6	0	-884.3175	0	60259.5555	-4.657E-06	-13264.7621
Comb1 Max	0	0	157973.4502	1895681	-2369602	0
Comb1 Min	0	0	157973.4502	1895681	-2369602	0

Zone 3 Results:

TABLE 6 STORY DRIFT IN X DIRECTION FOR TOP 10 FLOORS

STORY	LOAD CASE/COMBO	DIRECTION	DRIFT
Story30	seismic	x	0.000229
Story29	seismic	x	0.000303
Story28	seismic	x	0.000378
Story27	seismic	x	0.000448
Story26	seismic	x	0.000513
Story25	seismic	x	0.000573
Story24	seismic	x	0.000629
Story23	seismic	x	0.000679
Story22	seismic	x	0.000725
Story21	seismic	x	0.000766

Base Reactions:

TABLE 7 BASE REACTIONS OF ZONE 3

Load Case/Combo	Force in x direction Fx kN	Force in y direction Fy kN	Force in z direction Fz kN	Moment in x direction Mx kN m	Moment in y direction My kN m	Moment in z direction Mz kN m
Dead	0	0	113873.4502	1366481	-1708102	0
Live	0	0	44100	529200	-661500	0
Seismic 1	-589.545	0	0	2.72E-06	-40173.037	7074.5398
Seismic 2	0	-589.545	0	40173.037	-3.11E-06	-8843.1747
Seismic 3	-589.545	0	0	2.72E-06	-40173.037	7074.5398
Seismic 4	0	-589.545	0	40173.037	-3.11E-06	-8843.1747
Seismic 5	-589.545	0	0	2.72E-06	-40173.037	7074.5398
Seismic 6	0	-589.545	0	40173.037	-3.11E-06	-8843.1747
Comb1 Max	0	0	157973.4502	1895681	-2369602	0
Comb1 Min	0	0	157973.4502	1895681	-2369602	0



Zone 2 results :

TABLE 8 STORY DRIFT IN X DIRECTION FOR TOP 10 FLOORS

STORY	LOAD CASE/COMBO	DIRECTION	DRIFT
Story30	seismic	X	0.000143
Story29	seismic	X	0.000189
Story28	seismic	X	0.000236
Story27	seismic	X	0.000280
Story26	seismic	X	0.000321
Story25	seismic	X	0.000358
Story24	seismic	X	0.000393
Story23	seismic	X	0.000424
Story22	seismic	X	0.000453
Story21	seismic	X	0.000479

Base Reactions:

TABLE 9 BASE REACTIONS OF ZONE 2

Load Case/Combo	Force in x direction Fx kN	Force in y direction Fy kN	Force in z direction Fz kN	Moment in x direction Mx kN m	Moment in y direction My kN m	Moment in z direction Mz kN m
Dead	0	0	113873.4502	1366481	-1708102	0
Live	0	0	44100	529200	-661500	0
Seismic 1	-368.4656	0	0	1.699E-06	-25108.1481	4421.5874
Seismic 2	0	-368.4656	0	25108.1481	-1.941E-06	-5526.9842
Seismic 3	-368.4656	0	0	1.699E-06	-25108.1481	4421.5874
Seismic 4	0	-368.4656	0	25108.1481	-1.941E-06	-5526.9842
Seismic 5	-368.4656	0	0	1.699E-06	-25108.1481	4421.5874
Seismic 6	0	-368.4656	0	25108.1481	-1.941E-06	-5526.9842
Comb1 Max	0	0	157973.4502	1895681	-2369602	0
Comb1 Min	0	0	157973.4502	1895681	-2369602	0

V. CONCLUSION

- A high-rise building of 30 floors subjected to seismic, wind and live loads were analyzed using ETABS 2016 software.
- Behavior of the high rise building was shown clearly using the graphs and lateral displacements.
- It is found that the lateral displacements or drifts are more in zone 5 when compared to the zones 4, 3&2.
- It is also found that from the base reactions of structure obtained in zone 5, the story shear is higher in zone 5 than in zone 2.
- All members were designed using ETABS.
- The members which are not appropriate will be obtained and suitable sections are recommended by the software.
- Better accuracy of the analysis can be obtained by using this software.

FUTURE SCOPE

- Analysis for various structure can be done by using this technology.
- Using this software, you can view and manipulate the analytical model with great accuracy. Plans and elevation views are auto-generated at every grid line.
- The design of same building for different wind zone can be possible.
- The maximum no. of floors should increases in building, it is very economical for construction of high rise building.
- The construction of high rise building by using Pile raft foundation.
- Design of columns by giving uniform reinforcement without using boundary condition.
- Time history analysis is done by using this technology.
- It is possible of Design of same building with initially by adding 5 to 6 floors of commercial and then residential.

ACKNOWLEDGMENTS

The authors are grateful to the GURU NANAK INSTITUTE OF TECHNOLOGY, NAGPUR, MAHARASHTRA, INDIA, for providing guidances and resources to carry out this work.

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**Impact Factor:
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