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A COMPARATIVE STUDY ON DYNAMIC ANALYSIS OF HIGH RISE STRUCTURE IN DIFFERENT SEISMIC ZONES USING E-TABS

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ABSTRACT: The structural study of a multi-story structure utilising proper structural analysis methods and software (E-TABS). ETABS is an acronym for extended three-dimensional analysis of building systems. This software's main objective is to design multistory buildings in a systematic manner. When it comes to solving the problems associated with earthquake analysis, the response spectra method is the most widely used in ETABS. A building's response can be described as a blend of numerous distinct response modes. To put it another way, the response spectrum is a graph showing the maximum or steady state response to a sequence of accelerators with varied natural frequencies that are set into motion by the same fundamental vibration or shaking. If the input used to calculate the response spectrum is periodic, then the steady state result is recorded. If damping is absent, the response will be endless. Generally, some damping is expected, although even without damping, a value can be calculated. Dynamic analysis employing the response spectrum approach shall calculate the peak modal response for sufficient modes to capture at least 90% of the participating mass of the building in each of the two orthogonal primary horizontal directions of the buildings.

The response spectrum method is used to examine the lateral loading effect of an earthquake on a G+9 multi-story residential building in zones II and IV. To evaluate this project, we used IS 456-2000 and CODES-IS 1893-PART 2:2002. Storey displacements, drifts, shear, stiffness, and base responses are all calculated as a result of the analysis and compared.

1 INTRODUCTION

1.1 General

Building is a noun and a verb, referring to both the structure and the process of constructing it. The noun "building" means "a construction with roof and walls and stands more or less permanently in one place"; "there was a three-story building on the corner"; "it was an imposing edifice." A fence or wall can be considered a building in the broadest sense. Structure, on the other hand, refers to a broader range of things than just a building and can refer to both natural and man-made structures. A fence is more likely to be constructed from structural materials than from natural materials. According to Sturgis' Dictionary, "[building] varies from architecture in excluding the thought of artistic treatment; and it differs from construction in the idea of excluding scientific or highly skilled treatment." To build anything is to engage in the process of constructing something.

1.2 Types of the Building:

In accordance with the number of occupants

The following are some different kinds of structures.

1.2.1 Occupancy-Related Pricing:

Buildings used for residential purposes: -

Residential buildings are those in which there is sleeping accommodation for conventional residential uses.

Buildings used for educational or institutional purposes: -

School, college, or daycare facilities are housed in an education or institution building.

1.3 Objectives of the Study

- Using the E-TABS Software, create a 3D model of the G+9 structure in order to conduct a study of it by means of the response spectra approach.
- Static and dynamic loads such as dead weight, living weight, and earthquake weight are all factors to consider while analysing a building.
- To determine how well a structure will hold up in seismic zones II and IV.

II LITERATURE REVIEW

Abhay Guleria There is a lot of emphasis on structural behaviour of multi-story buildings in this work, including rectangle, C, L, and I-shape configurations. The ETABS software is used to model a 15-story R.C.C. framed building for study. After the structure is investigated, the maximum shear forces, bending moments, and storey displacement are calculated and compared for all the examined scenarios. The examination of the multi-story building revealed that the storey overturning moment varies inversely with storey height. Buildings in the L-shape and I-shape types respond similarly to an overturning moment. The storey drift displacement rose with the storey height up to the sixth storey reaching its maximum value and then began to decrease. Mode forms are formed through dynamic analysis, and it can be deduced that asymmetrical designs deform more than symmetrical layouts.

In the person of Balaji U A and in the person of Mr Selvarasan EM B To determine the earthquake loads of a residential G+13 multi-story building, researchers used the ETABS software. Assuming the material's static and dynamic analysis are both linear in nature. In these non-linear analyses, seismic zones are taken into account, and behaviour is evaluated using soil conditions of type II. Plots of various responses, such as displacements and base shear, can be seen. We can derive the following conclusions: 1. In the first five stories, there is no significant difference between the results acquired using different methodologies. 2. It has been found that the maximum displacement increases from the first to the last floor. Time history study of the two earthquakes yielded the highest centre of mass displacement.

III METHODOLOGY

3.1 General

Static or dynamic earthquake analysis can be used to assess the vulnerability of a building to an earthquake. Load carrying capacity, stiffness, damping, and mass are the most important seismic analysis structural parameters. Seismic analysis of multi-story buildings utilises the IS 1893-2002 code, which can be found here. Response spectrum analysis is used in this study to model and examine the structures.

3.2 Earthquake analysis

There are four approaches for analysing a structure. They are: • Static linear analysis (Equivalent static approach) • Static non-linear analysis (Push over analysis)

• Linear dynamic analysis (Response spectrum analysis)

Dynamic nonlinear analysis (Time-history analysis)

IV MODELLING AND ANALYSIS

4.1 General

In this chapter, the structure is modelled and analysed under a variety of loads. ETABS V16.2.1, a finite element programme, was utilised to conduct the analysis. Static and dynamic analyses of the structure will be carried out using a three-dimensional model. The model's ideal representation of the building's three-dimensional (3D) characteristics includes its mass distribution, strength, stiffness, and deformability. It is covered in this chapter how to model the material's properties as well as structural elements, load patterns, and load scenarios and combinations.

4.2 ETABS Software

4.2.1 General

ETABS is a multi-story building analysis and design software tool. There are a variety of modelling strategies and tools that work together with the grid-like geometry that is specific to this structure type, including load prescriptions based on code, analysis methods, and solution approaches. ETABS can be used to analyse simple or complex systems in static or dynamic situations. Modal and direct-integration time-history studies, as well as P-Delta and Large Displacement effects, can be used to measure seismic performance to a high level of sophistication. Material nonlinearity can be captured using nonlinear linkages and focused PMM or fibre hinges when the behaviour is monotone or hysteretic. Application implementations of any complexity are made possible by intuitive and integrated features. ETABS is a coordinated and productive tool for designs ranging from simple 2D frames to intricate modern high-rises because of its interoperability with many design and documentation systems.

4.2.2 Advantages of ETABS

1. ETABS allows the user to input and modify graphic data for the purpose of quickly and easily creating models of any sort of structure.

Using plan views and elevations to construct a 3D model allows the creation of any complicated structure in 3D.

The development of a 3D model is simple and rapid when using a comparable storey concept. Model generation time can be slashed by a factor of ten by using an identical storey approach for all floors.

4.3 Building data

Table 4.1 Description of the Building data

1	**Details of the building**			
i)	Structure		OMRF	
ii)	Number of stories		G+9	
iii)	Type of building		Regular and Symmetrical in plan	
iv)	Plan area		20 m x 16 m	
v)	Height of the building		27 m	
vi)	Storey height- Bottom story Typical story		3.0 m 3.0 m	
vi)	Support		Fixed	
viii)	Seismic zones		II, IV	
2	**Material properties**			
i)	Grade of concrete		M30	
ii)	Grade of steel		Fe415	
iii)	Density of reinforced concrete		25 kN/m^3	
iv)	Young's modulus of M30 concrete, E_c		27386127.87 kN/m^2	
v)	Young's modulus steel, E_s		2 x 10^{8}kN/m^2	
3	**Type of Loads & their intensities**			
i)	Floor finish		1.5 kN/m^2	
ii)	Live load on floors		3 kN/m^2	
iii)	wall load on beams		3.9 kN/m^2	
iv)	Parapet wall load		1 kN/ m^2	
4	**Seismic Properties**			
i)	Zones	II, IV	0.1, 0.24	
ii)	Importance factor (I)		1	
iii)	Response reduction factor (R)		5%	
iv)	Soil type		II	
v)	Damping ratio		0.05	
5	**Member Properties**	**No. of stories**	**Grade**	**Section sizes (mm)**
i)	Column	Base to 9th	M30	900 x 600
ii)	Beam	Base to 9th	M30	450 x 450 for all
iii)	Slab	Base to 9th	M50	175

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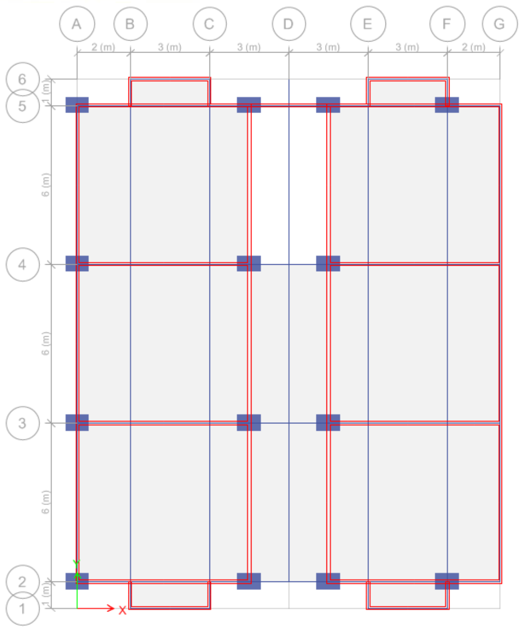

Fig. 4.1 Plan of the building

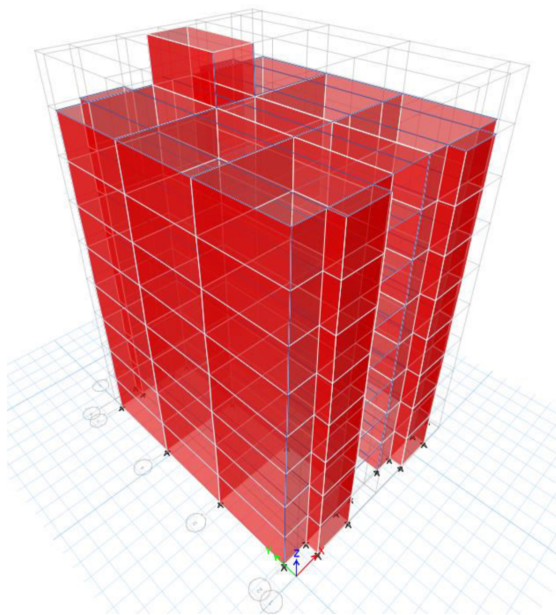

Fig. 4.3 3D view of the building

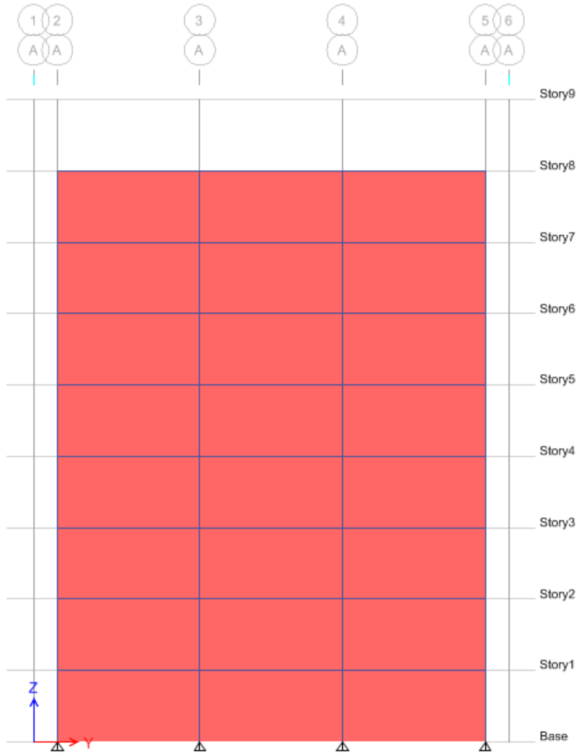

Fig. 4.2 Elevation of the building

V RESULTS AND DISCUSSION

In this chapter, the results of an examination of a G+9 multi-story building are provided. Response spectrum approach is used in ETABS for the analysis. Two distinct areas of the structure are being scrutinised. It's important to note that the data are broken down into six categories: base reactions, base displacement, base drifts, base shears and storey stiffness.

5.1 Analysis results of G+9 building in zone II

Table 5.1 Storey displacements of G+9 in zone II

Story	Elevation m	Location	For EQ X		For EQ Y	
			X-Dir (mm)	Y-Dir (mm)	X-Dir (mm)	Y-Dir (mm)
Story9	27	Top	3.131E-02	2.646E-03	7.536E-05	4.264E-0
Story8	24	Top	1.293E-02	1.982E-03	2.6E-04	7.875E-0
Story7	21	Top	1.089E-02	1.421E-03	2.139E-04	7.267E-0
Story6	18	Top	8.824E-03	1.018E-03	1.771E-04	5.77E-0
Story5	15	Top	6.775E-03	8.171E-04	1.482E-04	4.392E-0
Story4	12	Top	4.836E-03	6.105E-04	1.211E-04	3.159E-0
Story3	9	Top	3.098E-03	4.059E-04	9.408E-05	2.092E-0
Story2	6	Top	1.721E-03	2.435E-04	7.705E-05	1.208E-0
Story1	3	Top	6.904E-04	1.906E-04	5.753E-05	5.194E-0
Base	0	Top	0	0	0	0

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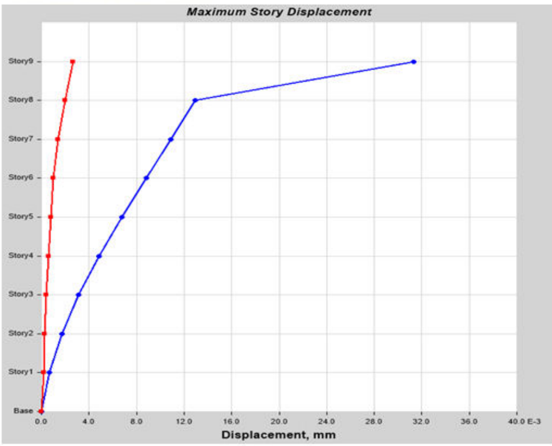

Fig: 5.1 Maximum storey displacements of structure for EQ X in zone II

Fig: 5.2 Maximum storey displacements of structure for EQ Y in zone II

Table 5.2 Storey drifts of G+9 in zone II

Story	Elevation m	Location	For EQ X		For EQ Y	
			X-Dir	Y-Dir	X-Dir	Y-Dir
Story9	27	Top	0.000007	2.595E-07	3.724E-08	1.377E-07
Story8	24	Top	0.000001	1.868E-07	1.851E-08	3.58E-07
Story7	21	Top	0.000001	1.465E-07	1.416E-08	4.989E-07
Story6	18	Top	0.000001	1.198E-07	1.244E-08	4.591E-07
Story5	15	Top	0.000001	1.017E-07	1.216E-08	4.11E-07
Story4	12	Top	0.000001	8.123E-08	1.287E-08	3.559E-07
Story3	9	Top	4.819E-07	6.521E-08	1.179E-08	2.972E-07
Story2	6	Top	3.553E-07	5.708E-08	1.497E-08	2.299E-07
Story1	3	Top	2.301E-07	6.355E-08	1.918E-08	1.728E-07
Base	0	Top	0	0	0	0

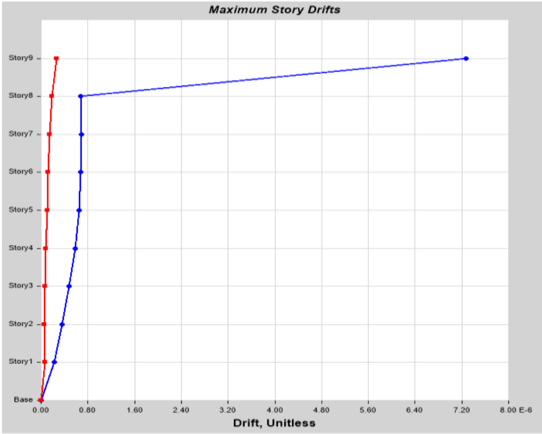

Fig: 5.3 Maximum storey drifts of structure for EQ

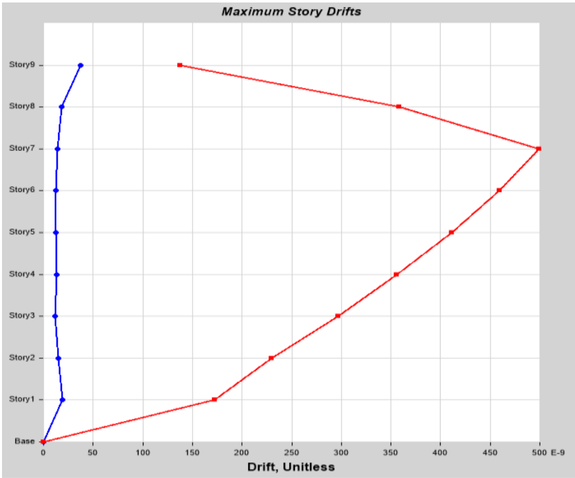

Fig: 5.4 Maximum storey drifts of structure for EQ

Table 5.3 Lateral loads on G+9 in zone II

Story	Elevation m	Location	X-Dir kN	Y-Dir kN
Story9	27	Top	31.2157	31.2157
Story8	24	Top	366.4407	366.4407
Story7	21	Top	349.0087	349.0087
Story6	18	Top	256.4146	256.4146
Story5	15	Top	178.0657	178.0657
Story4	12	Top	113.962	113.962
Story3	9	Top	64.1036	64.1036
Story2	6	Top	28.4905	28.4905
Story1	3	Top	7.1226	7.1226
Base	0	Top	0	0

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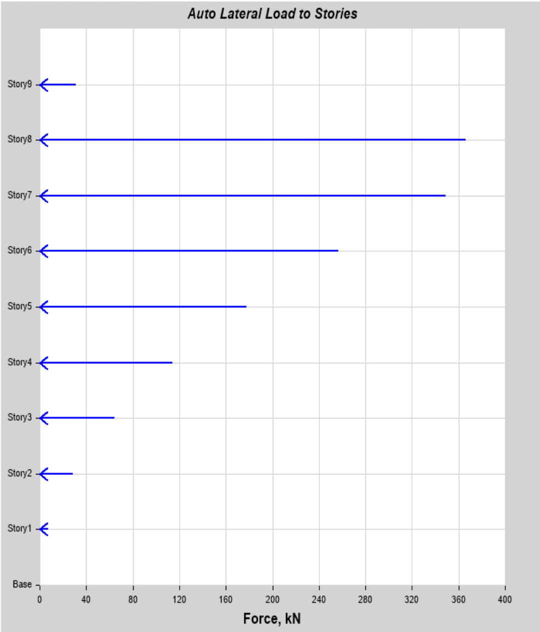

Fig: 5.5Lateral seismic load distribution in

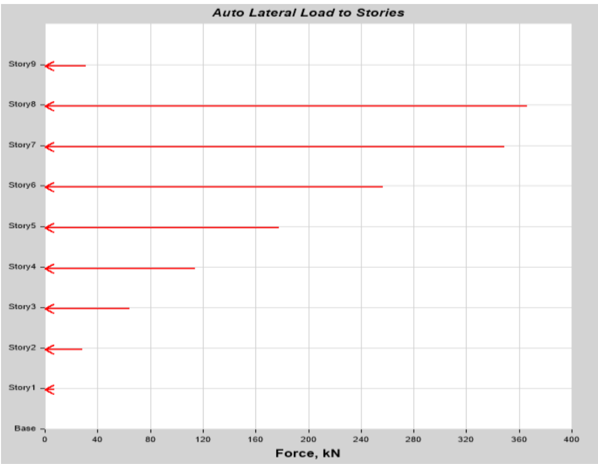

Fig: 5.6Lateral seismic load distribution in Y

CHAPTER 6
CONCLUSIONS

6.1 Conclusions

- As a result of the analysis the displacements, drifts, shears, lateral loads, and stiffness of the storeys in zones II and IV are all compared. The following conclusions can be derived by contrasting the data.
- There is an inverse relationship between the storey displacements and storey drifts in X-direction and Y-direction in both zones as the zone rises.
- In Zone IV, the number of storeys displaced is 70% more than in Zone II.
- Storey drifts in Zone IV are 60% higher than in Zone II.
- Zone IV's storey shears are 55% more expensive than Zone II's storey shears.
- Zones II and IV have the identical X and Y storey shears.
- The structure's storey stiffness values are the same and safe in both zones.
- Zone IV's base shears are larger than zone II's.
- Zone II has 40% lower lateral loads on structures than zone IV.

6.2 Future Scope

- Residential apartments are being built in a variety of shapes for a more aesthetically pleasing appearance. The quake's impact on variously shaped structures will be unique. As a result, we can examine the impact of an earthquake on various building kinds.
- For example, we can look at how seismic effect reduction elements such as shear walls, bracings, outrigger and belt truss systems affect the buildings we're looking at.

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