ANALYSIS OF G+15 BUILDING DIFFERENT SEISMIC ZONES OF INDIA

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Abstract - *An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes are among the most powerful events on earth, and their results can be terrifying. Response of structures to earthquake depends on so many factors such as number of stores, soil–structure interaction, stiffness and mass of the structure etc. In this study, to understand the behavior of structure located in various seismic zones like Zone III, Zone IV and Zone V a G+15 storey RC bare frame building model is considered. These models are analyzed using an ETABS software. Response spectrum function is used to study the difference in behavior of the models under three seismic zones (i.e. Zone III, IV & V) and comparison is made on base shear, storey drift, storey displacement and storey stiffness. It was concluded that as the seismicity of the building increases care should be taken by the structural engineers to counter the seismic energy and to safe guard the building.*

Key Words: RC Bare Frame Building, Seismic Zones, ETABS, Response Spectrum Function.

1. INTRODUCTION

In general for design of tall buildings both wind as well as earthquake loads need to be considered. Governing criteria for carrying out dynamic analyses for earthquake loads are different from wind loads. According to the provisions of Bureau of Indian Standards for earthquake load, IS 1893(Part 1):2002, height of the structure, seismic zone, vertical and horizontal irregularities, soft and weak storey necessitates dynamic analysis for earthquake load. The contribution of the higher mode effects are included0in arriving at the distribution of lateral forces along0the height of the building. As per IS 875(Part 3):1987, when wind interacts with a building, both positive and negative pressures occur simultaneously, the0building must have sufficient strength to resist0the applied loads from these pressures to prevent0wind induced building failure. I will be consider for the IS 456:2000. Load exerte on the building envelope are transferred to the structural system and they in turn must be transferred through the foundation into the ground, the magnitude of the wind pressure is a function of exposed basic wind speed, topography, building height, internal pressure, and building shape.

1.1 SEISMIC ZONE

Earthquake shaking is random and time variant. But, most style codes represent the earthquake-induced inertia forces because the internal impact of such random shaking within the sort of style equivalent static lateral force. This force depends on the unstable hazard at the location of the building described by the unstable Zones. Instead, the earthquake demand is calculated by solely supported as of the chance of proof, and therefore the style of earthquake effects is termed as earthquake resistant style against the probable worth of the demand. Seismic zones of India as per IS 1893–Part 1 (2002).

1.2 LINEAR DYNAMIC ANALYSIS

Linear dynamic analysis popularly as response spectrum analysis. The building is modeled as a multi degree of freedom system with a linear elastic stiffness matrix and an equivalent viscous damping matrix. The natural frequencies sand mode shapes are computed through an Eigen value analysis. The coupled equations of motion are then decoupled by modal transformation where in the principle of orthogonality of the mode shapes with respect to mass, damping and stiffness matrices is applied. Each decoupled equation signifies the motion of a single degree of freedom system for which the response is obtained through the use of elastic response spectra. The peak responses of the significant modes are combined using appropriate modal combination rules. The linear dynamic procedure is superior to the linear static procedure because higher modes are considered in the linear dynamic procedure while only the first mode is considered in the linear static procedure. However, since both of these procedures are based on linear elastic response.

2. DATA FOR DEVELOPING THE MODEL

Modeling means nothing but formation of structural body in ETABS and assigning the loads to the members as per loading consideration. There is quite difference in modeling steps of R.C Frame system After accurate modeling we can able to perform analysis of any structural member in ETABS. Modeling procedure for both the systems are summarized in this context. Before analysis we have to assign loads to each structural element and various loading combinations are considered for completion of analysis procedure. Afterword's from analysis data we will able to complete the design.

Table -1: Building Parameters for Analysis

SL NO.	PARAMETERS	REMARKS
1	Plan Dimension	4X5 m
2	No. of Stories	G + 15
3	Story Height	3m
4	Foundation level to ground level	3m
5	Size of Column	500 X 500 mm
6	Size of Beam	230 X 500 mm
7	Slab Depth	150 mm
8	Live load on all floors	$3KN/m^2$
9	Grade of Concrete	M30,M25
10	Grade of Steel	Fe 500, Fe 415

1. Seismic parameters which are used for analyzing the framed structures are considered as per IS 1893-2002 (part 1) are listed below.

Table -2: Seismic Parameters for Analysis

SL NO.	PARAMETERS	REMARKS
1	Seismic Zone	III,IV,V
2	Zone Factor	0.16,0.24,0.36
3	Soil Type	TYPE II
4	Importance Factor	1
5	Building Frame System	SMRF
6	Response Reduction Factor	5
7	Damping Ratio	5%

2.1 LOAD CALCULATIONS FOR DEVELOP MODLES

Load on beam:

Loads on Beams are self-weight and wall loads, self weight of the beam is determined automatically by ETABS and wall loads can be assigned by manual calculation results which is calculated below.

Wall load on beam

Height of Floors = 3m

Depth of Beam = 500mm

Clear Span of Brick work= 3-0.5=2.5m

Density of Brick = 20KN/m^3

Thickness of Wall =230mm

Wall load on beam=2.5X0.23X20=11.5KN/m^3

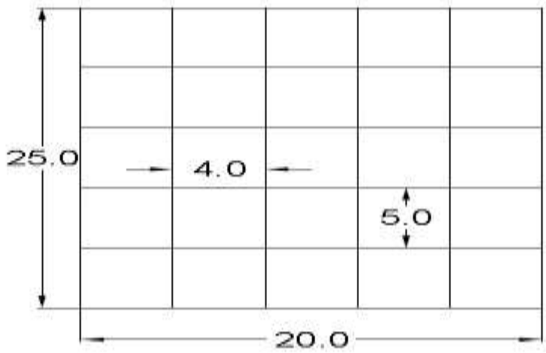


Fig -1: Plan & Elevation for model

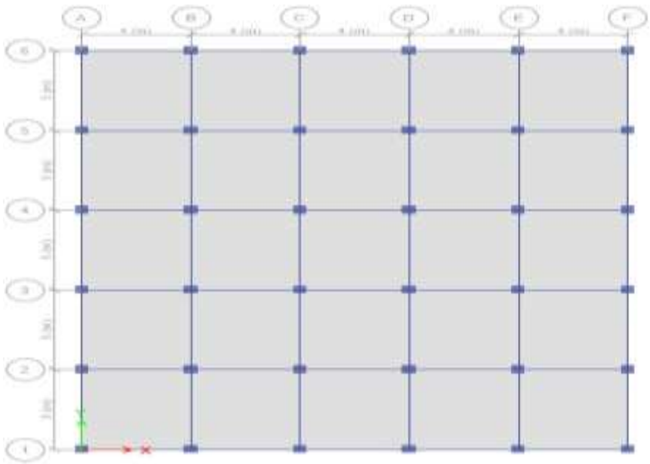


Fig 2: Structural Plan of Model.

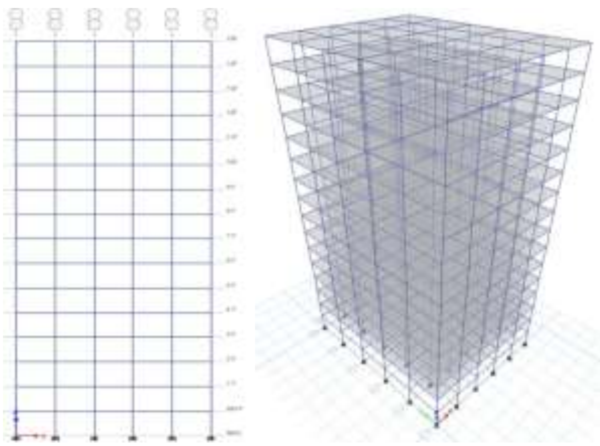


Fig -3 2D Elevation of Model & 3D Elevation of Model

3. RESULTS & DISCUSSION

3.1 STORY SHEAR

It is defined as the lateral force acting on each story in horizontal direction during earthquake, and the maximum lateral shear should always maximum at the base of the building which is termed as the Base shear.

Maximum Story Shear for ESA along X & Y Axis

The Shear force at the base of the structure so obtained is been plotted for all three models in X and Y direction.

Table 3 Story Shear in X Axis

	Zone 3	Zone 4	Zone 5
Base Shear	458.56	687.83	1031.75

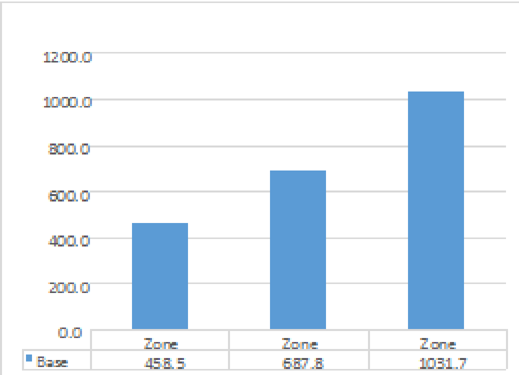
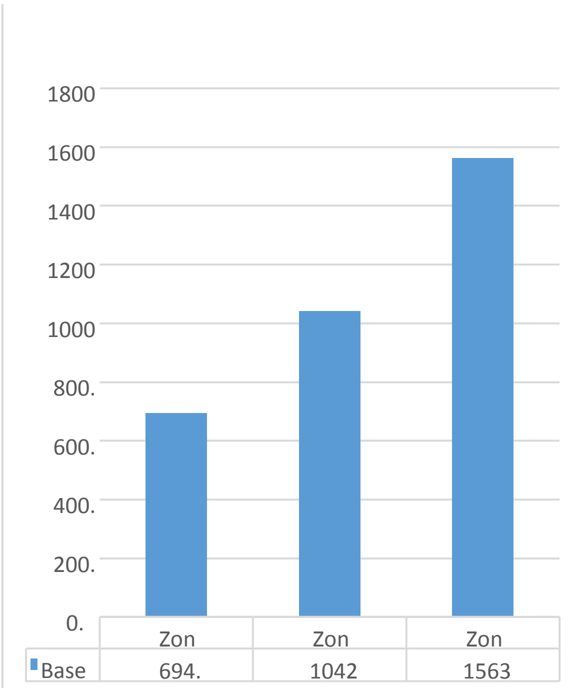


Table 4 Story shear in Y Axis

	Zone3	Zone 4	Zone 5
Base Shear	694.72	1042.07	1563.11

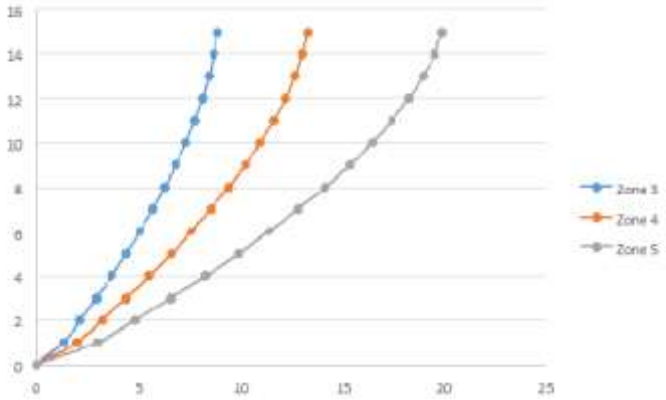


3.2 STORY DISPLACEMENT

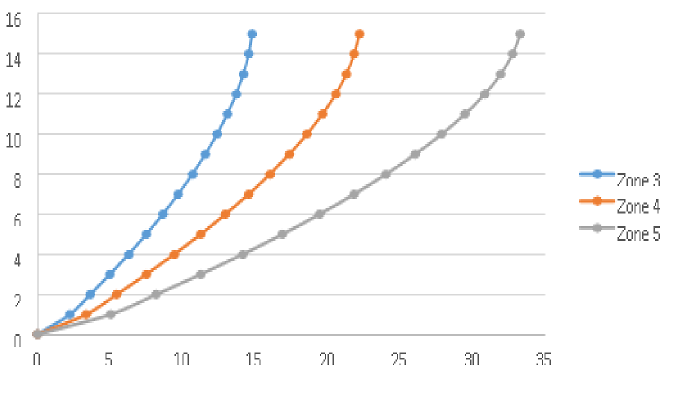
The lateral displacement of each story due to the lateral forces from base of the building or structures is known as story displacement. Story displacement results for the structures with various cases for all the models as tabulated below.

Table - 5 Story Displacement X &Y Axis

ZONE 3	ZONE 4	ZONE 5
8.847	13.27	19.906
8.679	13.018	19.527
8.438	12.657	18.986
8.125	12.187	18.28
7.745	11.617	17.425



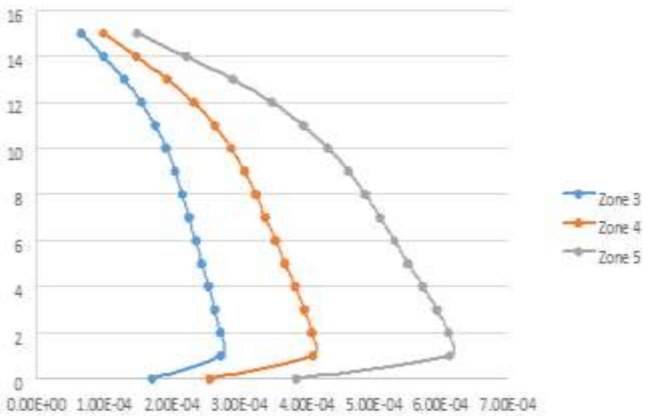
Zone 3	Zone 4	Zone 5
6.60E-05	9.90E-05	0.000149
9.90E-05	0.00015	0.000222
0.00013	0.00019	0.000291
0.00016	0.00023	0.000349
0.00018	0.00026	0.000395



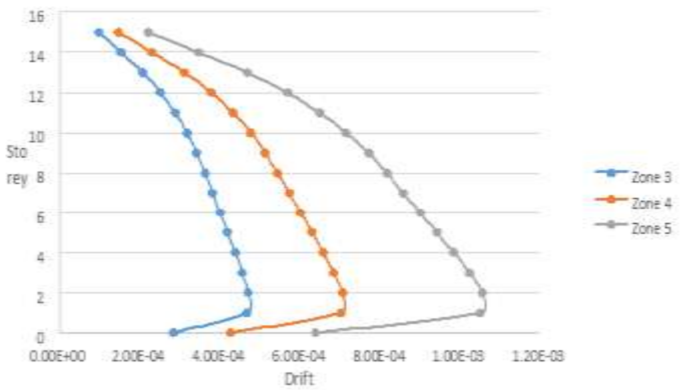
3.3 STORY DRIFT

It is defined as the drift of the one story with respect to the below story of the building and story drift limitation as per IS 1893-2002 is 0.004 times the story height. The story drift results for the structures with various cases for all the models as tabulated below. **Table -6:** Maximum Story Drift along X & Y Axis

Zone 3	Zone 4	Zone 5
6.60E-05	9.90E-05	0.000149
9.90E-05	0.00015	0.000222
0.00013	0.00019	0.000291
0.00016	0.00023	0.000349
0.00018	0.00026	0.000395



Zone 3	Zone 4	Zone 5
9.80E-05	0.000147	0.000221
0.00015	0.000231	0.000347
0.00021	0.000312	0.000468
0.00025	0.000379	0.000568
0.00029	0.000433	0.000649



3. CONCLUSIONS

In the thesis a structural model is considered where in a model is subjected to different seismic zones along with their corresponding behaviors and results are extracted and interpreted. Various parameters such as displacements, storey drifts, storey acceleration, storey force, storey Stiffness, and base shear have been considered. Hence from the obtained results the following conclusions are drawn,

1. Maximum lateral storey displacement occurs at terrace floor level for all types of structure model.
2. Maximum Storey drift usually occurs at mid height level and goes on decreasing from mid height towards roof level.
3. As the height of the building increases storey acceleration also increases and is also directly proportional to the seismic intensity.
4. The seismic forces are more concentrated at the base of the building hence the resistive Storey force by the building will be more at the lower storey.
5. As the seismic intensity increases the base shear of the building also increases correspondingly.
6. It is clear that as the seismic intensity increases the response of the building varies accordingly.
7. The seismicity/ the resistive force of the building against the seismic force is directly proportional to the intensity of the quake, i.e., as the intensity increases seismicity of the building increases proportionally.
8. As the seismicity of the building increases care should be taken by the structural engineers to counter the seismic energy and to safe guard the building.

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