Solid State Technology
Volume: 63 Issue: 2s
Publication Year: 2020

Analysis Of G+20 Rc Building In Different Zones Using E-Tabs

[1] J. Rex, [2] P. Yugesh Reddy, [3]J Selwyn Babu

[1,] Associate Professor, Department of Civil Engineering, Malla Reddy Engineering College (Autonomous), Secunderabad, India

[2,] PG – Research Scholar, Structural Engineering, Malla Reddy Engineering College (Autonomous), Secunderabad, India

[3] Professor, Department of Civil Engineering, Malla Reddy Engineering College (Autonomous), Secunderabad, India

Abstract – The race towards new heights and architecture was not without difficulties. The stiffness of the structure becomes more important as the building grows in height. Because of dominating lateral loads, tall structures began to ascend higher and higher facing odd loading effects and very high loading values. Power, serviceability, stability, and human comfort are the design requirements for tall buildings. Therefore, the effects of lateral loads such as wind loads and earthquake forces are becoming increasingly significant and almost every designer faces the problem of providing sufficient strength and stability against lateral loads.The goal of this research is to study the behavior of a multi-storey R C building subjected to earthquake load through the adoption of a linear static analysis. The current research is restricted to multi-storey reinforced concrete (RC) commercial buildings with FOUR distinct zones II, III, IV & V. The review is carried out using the ETABS of FEM software. In the analysis, the building model has twenty-one levels with a constant floor height of 3 m. The effects of lateral load on moments, axial forces, shear force, base shear force, maximum floor drift and tensile forces on the structural structure are analyzed and the findings of zone 2, zone 3, zone 4 also zone 5 are also compared. Various seismic zone factor values are taken with their subsequent results be interpreted in the findings. The parameters of the construction model, such as base shear, displacements, floor drifts and floor shear, were studied and interpreted in this project

Keywords : G+20 RC tall building, Displacement, Base shear, Storey drift, Storey shear

Introduction

India is a creating nation; gigantic development ventures are yet to come as lacking urban areas are expected to create since endless years. In current century, numerous development extends everywhere on the world are going; time postpone happens which thus influences the development of the development of gigantic undertakings. To keep away from time delay and subsequently the development, financial development approach ought to be embraced. To conserve the structure, auxiliary advancement methods ought to be utilized.

In any case, plan for wind forcesalsopro seismic tremor impacts are particularly extraordinary. The instinctive way of thinking of elementary plan uses power as the premise, which is steady in wind plan, wherein the structure is exposed to a weight on its uncovered surface zone; this is power type stacking. Notwithstanding, in seismic tremor plan, the structure is exposed to irregular movement of the ground at its base, which incites latency powers in the structure that thus cause focuses on; this is relocation type stacking. Another method of communicating this distinction is through the heap twisting bend of the structure – the interest on the structure is force (i.e., vertical hub) in power type stacking forced by wind pressure, and displacement (i.e., flat pivot) in dislodging type stacking forced by quake shaking. Wind power on the structure has a non-zero mean segment superposed with a generally little wavering segment. Hence, under wind powers, the structure may encounter little changes in the pressure field, however inversion of stresses happens just when the bearing of wind turns around, which happens just over a huge span of time. Then again, the movement of the ground during the tremor is cyclic about the nonpartisan situation of the structure. In this way, the worries in the structure because of activities go through inversions plus to little length about tremor.

The targets of the current work is to consider the conduct of a multi celebrated R C building exposed to earth shake load by receiving Linear or proportionate static examination. The current investigation is restricted to strengthened cement (RC) multistoried business working with FOUR distinct zones II, III, IV and V. The investigation is completed the assistance of FEM programming's ETABS. The structure model in the examination has twenty stories with consistent story stature of 3m. Count for a skyscraper development physically then it will require some investment notwithstanding human individual blunders conceivably will be happened. Therefore, the utilization of ETABS (Extended Three-Dimensional Analysis of Building Systems) will make it simple.

Figure 1: Earthquake-Resistant Philosophy for Building

In this paper, an investigation is finished by utilizing ETABS for (G+ 20) story RC working under seismic burdens for zone III and Zone V areas. Various burden blends are seen as per IS 1893 (Part 1):2002. An examination is never really out powerful investigation of four unique states of structure: Rectangular, L-formed and so forth and contrasting outcomes for various sorts of minutes, powers and relocations. The estimations of joint uprooting are most extreme for L-molded structure and least in rectangular formed structure. An examination is never really out seismic investigation of multi-celebrated structures utilizing ETABS. The various boundaries taken are mass inconsistency, distinctive structure shapes and so forth. As story number abatements, twist inconsistency coefficients increments. A structure with various statures is examined for wind and quake loads. In the event that horizontal frameworks are given, the removal, shear, second reductions which brings about expanding the solidness of the structure to oppose sidelong loads.

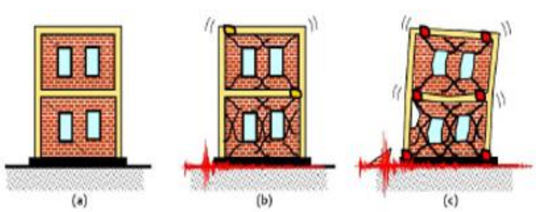
Aim of the Study

The analysis and design of G+20 through the use of ETABS is the main objective of this report.

Objective of Current Study

The goal of the present work is to discuss the following objectives:

1. How a building's seismic assessment should be done.
2. To examine a construction's actions underneath operation of seismic loads plus wind loads.
3. Using ETABS Tools to compare different research products of structure in Zone II , III, IV also Zone V.
4. Different zone factor standards be occupied with subsequent results remain interpreted now findings.
5. For wind analysis, different values of wind speeds are taken and their related building structure effects are interpreted in the results.
6. To research the structural activity in different seismic zones.
7. To research variations in parameters such as SF, BM and Displacement, as per IS: 1893-2002, in all seismic areas.
8. For a G+20 structural devices, the objective is to examine forces, stress, strain, deflection and bending time.
9. The goal is to use ETABS to design the G+20 building (structural system).
10. To design the construction against the impact of seismic forces or to make the earthquake structure resistant.



Scope of the Study

- Research was carried out on the basis of the project now instruction to evaluate greatness about possible changes inside seismic activity about RC Structure Models.
- Firstly, RC enclosed structures are constructed aimed at loads of importance with formerly for seismic masses.
- The investigation was carried out using the analogous static approach and Response Spectrum Analysis to implement symmetrical bare frame building models in different zones.
- The study high points influence about the seismic region component in the various regions here taken into account in the assessment of the seismic performance of buildings.

- The study highlights with searches impact about seismic region feature scheduled construction structure about G+20 's seismic efficiency.
- Using the nonlinear version of ETABS 9.7 software, the entire process of modelling, investigation plus project of all the main features for all models is approved out.
- The research aims towards evaluate greatness about possible development snow seismic activity about RC structure replicas.
- Firstly, RC enclosed structures remain constructed pro loads of gravity also for seismic loads.

- Allure number of buildings has seen a substantial rise. The belongings about crosswise load, therefore attractive gradually important plus practically each expensive faces tricky about so long as satisfactory strength plus stability against the lateral load.
- Using ETABS software, the whole procedure about modelling, investigation, also plan about wholly the main features prow holly replicas is approved out.

Methodology

As examined in the past sections, a structure must be investigated and intended to oppose the parallel tremor powers. In this part, the investigation and plan methodology of the G+20 story building is examined with the assistance of ETABS Software by reaction range strategy. There are computational preferences in utilizing the reaction range strategy for seismic investigation for the forecast of structures. Allure technique comprises estimation is just every mode utilizing smooth plan spectra that is the normal of a few tremor movements.

To accomplish the destinations of the examination that is to demonstrating and break down of G+20 RC tall structure in various zones utilizing ETABS, which meets the fundamental prerequisites, for example, wellbeing, sturdiness, economy, stylish appearance, attainability, practicability and adequacy. It has been proposed to follow the accompanying technique.

Plan and 3D Model of the Building

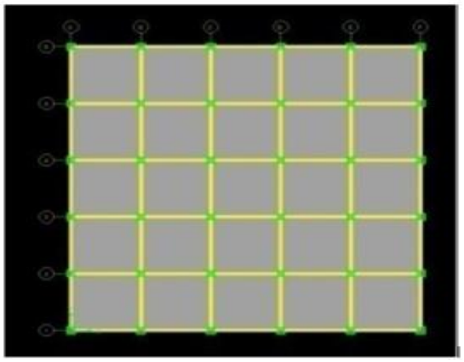


Figure 2: Bare Frame Model in 2D View

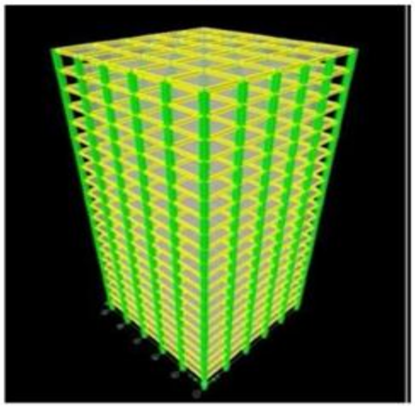


Figure 3: Bare Frame Model in 3D View

Modeling and Analysis Program

In this investigation a PC program has been created to examine the fortified solid structures under wind and tremor loads considering the new changes in the IS-1893 PART-1 2002.The program ascertains the base shear that oppose the plan parallel burdens. It computes likewise the focal point of mass and the focal point of inflexibility of the structure. Minutes, sidelong shear powers and the extra shear powers because of twist on every vertical component opposing parallel burden at the each floor are likewise determined. All the outcomes are represented graphically by the program to plainly indicating the outcomes

Table1: Building Configuration Data

In the investigation, construction idealconsumes20flooringsby a stable floor elevation of 3 m. Estimate with equal bay lengths, and for simplicity in each model, the numeral about bays plus bay thickness along 2parallelinstructionsbereservedstable. Here the results, different ZONE FACTOR standards be occupied with corresponding possessions be interpreted. Below are further details:

PARAMETERS	ZONE II	ZONE III	ZONE IV	ZONE V
Seismic zone factor	0.10	0.16	0.24	0.36
Basic wind speed	44 m/s	39 m/s	47 m/s	50 m/s
Response reduction factor	5	5	5	5
Importance factor	1	1	1	1
Soil thickness	Medium	Medium	Medium	Medium
Slab thickness	0.150 m	0.150 m	0.150 m	0.150 m
Beam size	0.45x0.25 m	0.45x0.25 m	0.45x0.25 m	0.45x0.25 m
Column size	0.75x0.75 m	0.75x0.75 m	0.75x0.75 m	0.75x0.75 m
Live load	2KN/m^2	2KN/m^2	2KN/m^2	2KN/m^2
Dead load	4.5 KN/m^2	4.5 KN/m^2	4.5 KN/m^2	4.5 KN/m^2
Floor finish	1.1KN/m^2	1.1KN/m^2	1.1KN/m^2	1.1KN/m^2
Material properties	M_{30}	M_{30}	M_{30}	M_{30}

COMBINATION NUMBER	LOAD COMBINATION
COMB1	1.5(D.L+L.L)
COMB2	1.5(D.L+EQX)
COMB3	1.5(D.L+EQY)
COMB4	1.5(D.L-EQX)
COMB5	1.5(D.L-EQY)
COMB7	1.2(D.L.+L.L+EQX)
COMB8	1.2(D.L.+L.L+EQY)
COMB9	1.2(D.L.+L.L-EQX)
COMB10	1.2(D.L.+L.L-EQY)
COMB11	1.0(D.L+L.L)
COMB12	1.0(D.L+EQX)
COMB13	1.0(D.L+EQY)
COMB14	1.0(D.L-EQX)
COMB15	1.0(D.L-EQY)
COMB16	1.0D.L.+0.8L.L+0.8E QX
COMB17	1.0D.L.+0.8L.L-0.8EQX
COMB18	1.0D.L.+0.8L.L+0.8E QY
COMB19	1.0D.L.+0.8L.L-0.8EQY

Table 2 Load combinations

Table 2: Load Combinations

The live load for the residential building was taken as 2KN / m2 analysis and design is being performed, according to IS 875 part-2, Dead load will be taken by the ETABS by default, it is time reducing issue. We took the wall loads as 5KN / m2 for this G+20 residential building because the economic sections were made. The load was taken as 1KN / m2 for floor termination.

Solid State Technology
Volume: 63 Issue: 2s
Publication Year: 2020

Analysis and Design

Step by step analysis procedure of Building by using E-Tabs

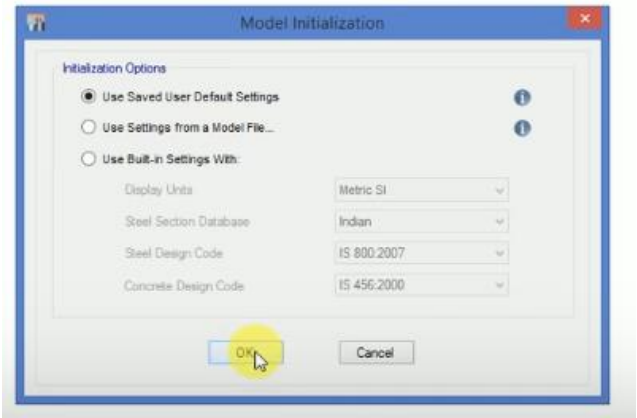


Figure 4: Model Using Settings

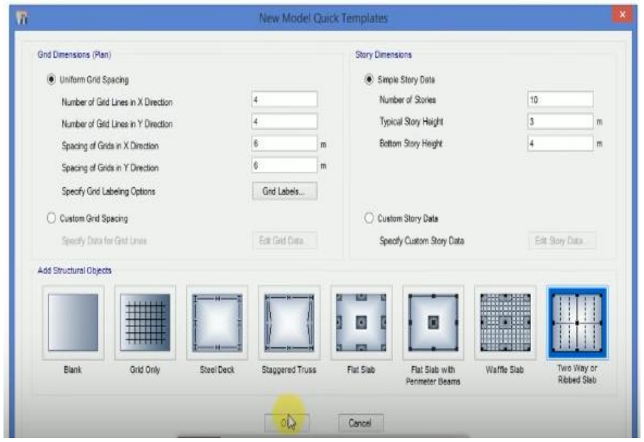


Figure 5: Select the Grid dimensions

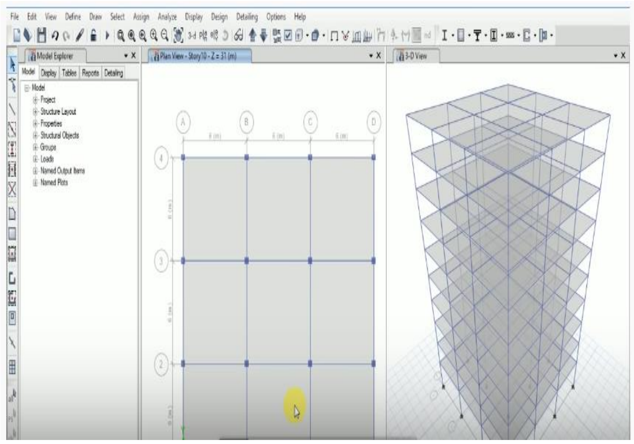


Figure 6: 2D & 3D Building

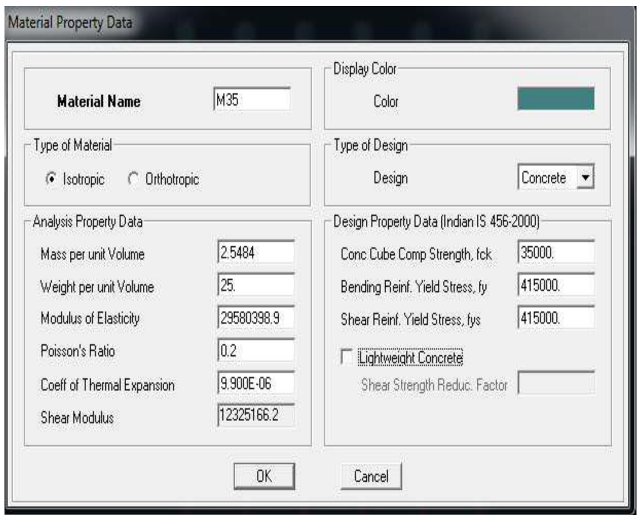
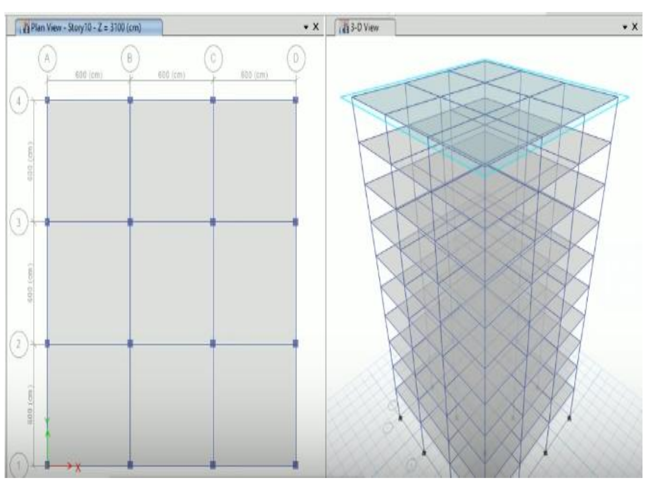


Figure 7: Defining the Material property



Solid State Technology
Volume: 63 Issue: 2s
Publication Year: 2020

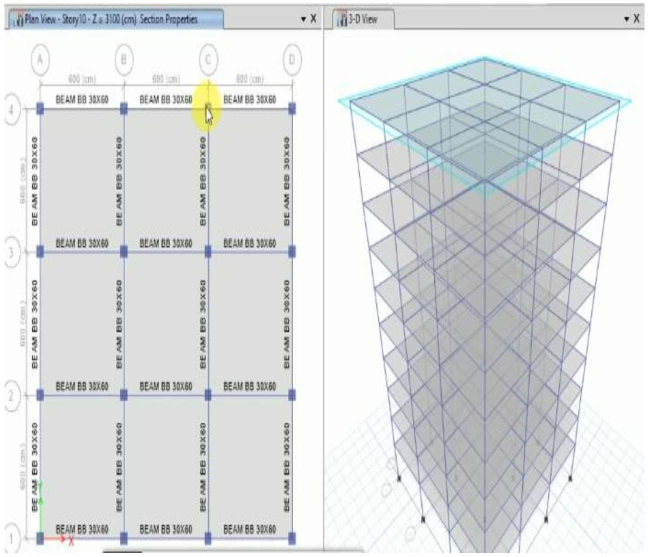


Figure 8: Plan shows the view of the Beam

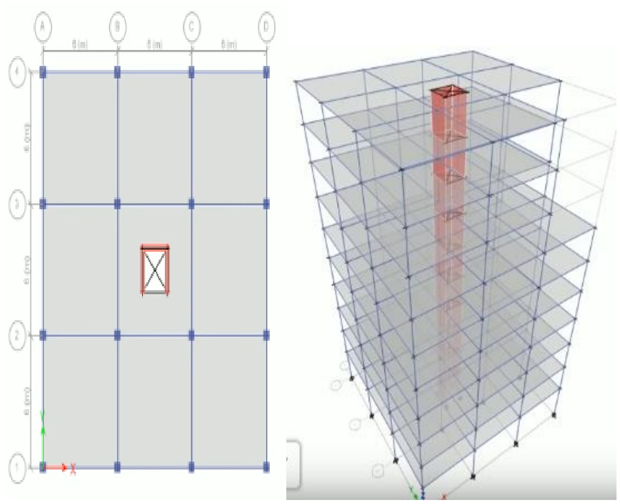


Figure 9: 2D & 3D Elevation

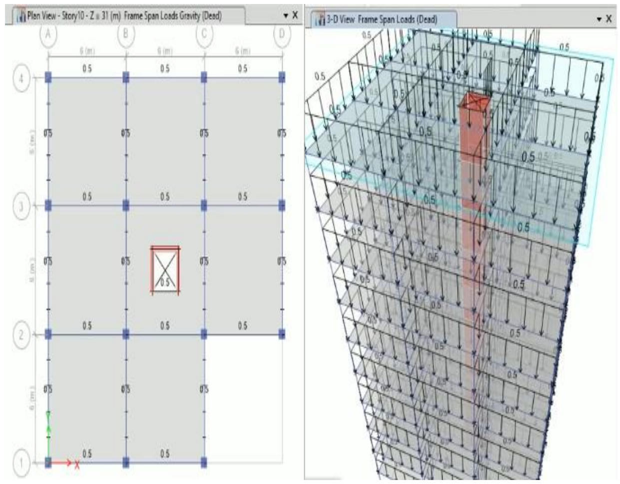


Figure 10: 6. Loads are applied on a building

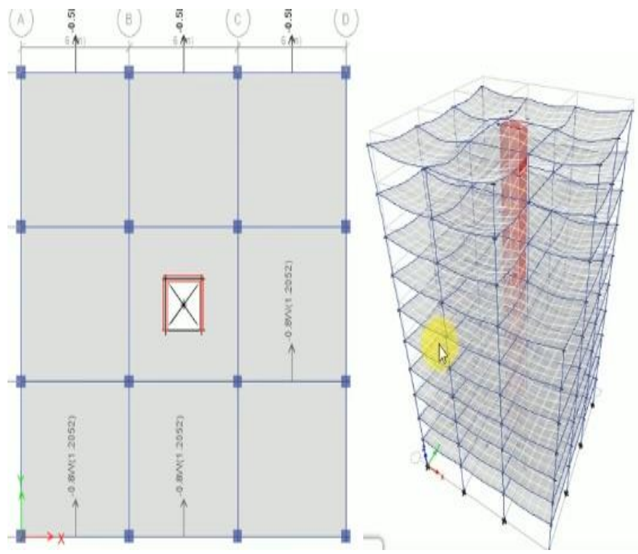


Figure 10: 6. Wind Load applied on a building

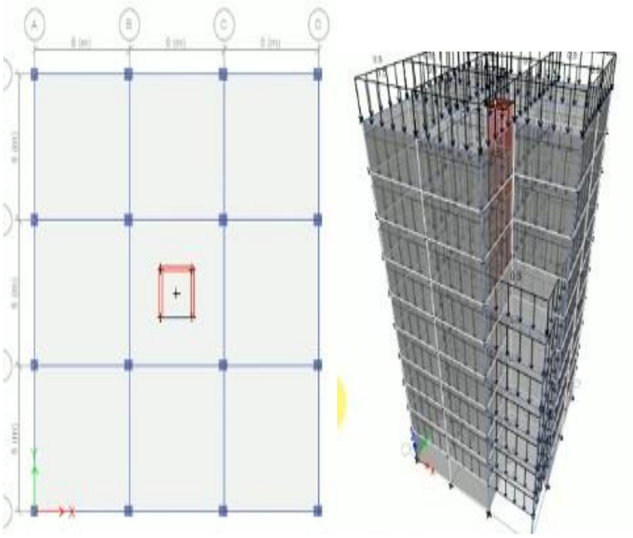


Figure 9: Base Reactions

Results and Discussions

Most constructions also experience seismic investigation under the base that the lateral force be similar toward the definite loading. It presumes that in its fundamental mode, the building reacts. The building must be low rise and must not twist dramatically as the ground shifts in order for this to be true.

The seismic force at the base of the structure is referred to as base shear. Storey shear is the lateral forces induced by the earthquake on multiple floors. The value is the highest on the bottom floor and the minimum on the top floor. It is known as the lateral force acting horizontally during the earthquake on each storey, also extreme structure, which is called the Base shear, should every time is extreme.
Max Tale Shear along the X & Y axis for ESA
For the seismic load combination (1.2DL+1.2LL+1.2EQX) the floor shear is obtained in the building along the X direction and for the seismic load combination (1.2DL+1.2LL+1.2EQY) along the Y direction.

Story	Drift X	Drift Y
Story 20	0.000197	0.000486
Story 19	0.000257	0.000317
Story 18	0.000126	0.000498
Story 17	0.000133	0.000452
Story 16	0.000289	0.00046
Story 15	0.000222	0.000439
Story 14	0.000185	0.000605
Story 13	0.000181	0.000461
Story 12	0.000502	0.000569
Story 11	0.000808	0.000491
Story 10	0.000377	0.000743
Story 9	0.000377	0.000743
Story 8	0.000272	0.000442
Story 7	0.000853	0.000633
Story 6	0.000361	0.000421
Story 5	0.000508	0.000834
Story 4	0.000424	0.000375
Story 3	0.000467	0.000559
Story 2	0.00095	0.000551
Story 1	0.000376	0.000922

Table 3 Story Shear

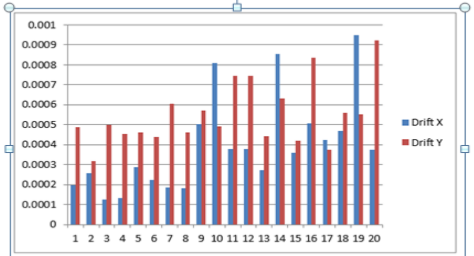


Figure 5 Story shear for G+20 building

Graph 1: Storey Shear for G+20 Building

From the above story shear diagram unmistakably, the story shear of structure increments as we go to higher seismic stories. The story shear of the structure for each floor in Drift X is 0.000376, 0.00095, 0.000467, 0.000424, 0.000508, 0.000361, 0.000853, 0.000272, 0.000377, 0.000808, 0.000502, 0.000181, 0.000185, 0.000222, 0.000289, 0.000133, 0.000126, 0.000257, and 0.000197.

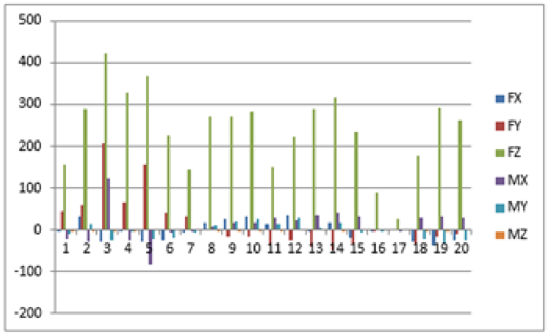
The story shear of the structure for each floor in Drift Y is 0.000922, 0.000551, 0.000559, 0.000375, 0.000834, 0.000421, 0.000633, 0.000442, 0.000743, 0.000743, 0.000491, 0.000569, 0.000461, 0.000605, 0.000439, 0.00046, 0.000452, 0.000498, 0.000317, and 0.000486.

Support Reactions:

Help reactions involve Shear Force and bending moments in two ways. Shear force help reactions are articulated here FX, FY also FZ. With the bending moment's support responsesbe represented in MX, MY also MZ.

Story	Point	Load	FX	FY	FZ	MX	MY	MZ
BASE	1	EQX	-0.14	44.32	157.12	-21.512	-9.085	-0.78
BASE	2	EQY	33.13	57.75	288.68	-28.064	14.595	-1.809
BASE	3	WIND X	-27.14	208.72	422.2	124.049	-26.237	-0.417
BASE	4	WIND Y	-0.02	66.15	327.6	-24.55	-5.265	-0.044
BASE	5	SPEC 1	-26.97	156.21	368.92	-84.221	-23.07	0.088
BASE	1	EQX	-23.98	41.55	225.44	-6.221	-19.71	1.238
BASE	2	EQY	-6.19	31.14	142.41	-0.103	-6.992	0.534
BASE	3	WIND X	15.7	1.74	271.15	6.588	9.801	-0.469
BASE	4	WIND Y	25.55	-15.16	272.15	16.202	20.72	-0.572
BASE	5	SPEC 1	32.3	-17.5	283.2	15.63	27.154	-0.232
BASE	1	EQX	13.18	-36.85	150.33	27.762	14.579	-0.651
BASE	2	EQY	35.03	-26.49	221.05	21.836	30.506	0.393
BASE	3	WIND X	-2.1	-40.48	287.99	34.22	5.05	0.764
BASE	4	WIND Y	17	-49.98	315.69	42.194	18.303	-0.705
BASE	5	SPEC 1	-19.22	-35.23	235.91	32.755	-6.941	0.554
BASE	1	EQX	-2.56	-0.75	89.39	0.668	-1.092	0.182
BASE	2	EQY	0.22	0.16	25.81	-0.456	1.109	0.156
BASE	3	WIND X	-27.37	-34.23	175.68	29.591	-21.019	-0.148
BASE	4	WIND Y	-38.49	-15.22	290.99	31.312	-30.853	-0.455
BASE	5	SPEC 1	-26.42	-10.62	263.33	28.586	-26.547	0.085

Table 4 Support Reactions



Graph 2: Graph for Support Reactions

The chart be clear that the values about shear force be here FX, FY also FZ. Values of the bending moment here MX, MY also MZ.

Conclusions:

The Following ends are produced using the current investigation

- E-TABS programming gives satisfactory quality, solidness, workableness alongside economy
- E-TABS depends on limit state technique
- Dislodging is more as the story is expanding, hence 21st story is having high relocation
- Shear power, twisting second, story float, and torsional power will be appeared
- As the story stature builds the bowing second and shear power for pillars and sections will increment
- Substitution of light weight block rather than customary block will decrease the dead burden in this way impacts the shear powers and bowing second to diminish
- The elements of bear or section ought to be expanded as to oppose against seismic burdens
- E-TABS chiefly lessens the time and work alongside more precision
- The base shear of structure increments as we go to higher seismic zones. For a comparative structure the base shear estimation of ZONE II and ZONE V. This implies base shear increments by over 350% if seismic ZONE changes from II to V.
- From results it is seen that the Story Shear is diminished as tallness of the structure expanded and decreased at highest level in all the structure models exposed to seismic burdens considered. The story shear is greatest at the base.
- The twist is basically impact on base of the structure. This implies the story float is increments by over 25% when contrast with ZONE II to ZONE V.
- It is reasoned that as the breeze pressure expands, the twist influence on the structure is additionally increments. What's more, the twist is mostly impact on base of the structure. This implies the twist is increments by over half when contrast with low wind strain to high wind pressure.
- By utilizing shear dividers, dampers, elastic cushions, spring we can decrease harm of seismic impact of a R C building laying on high seismic zone.
- The Story Shear is diminished as stature of the structure expanded and decreased at highest level in all the structure models exposed to seismic burdens considered. The story shear is most extreme at the base.

References:

1. Sunayana Varma B and Venugopal K. Karthik eyan International Journal of Civil Engineering and Technology (IJCIET), ISSN 2321 –919X (Online), Volume 2, Issue 8, August (2014).

2. Narla mohani and Mounika vardhan. A, department of Civil Engineering, vishwa bharathi college of engineering, Adj Brundavancolony, Nizampetroad. Opp JNTUH., Kukatpally, Hyderabad-500085, vol.7, no.9, pp. 98-99, MAR 2017

3. IITK-GDMA, (2005), IITK-GSDMA Guidelines for Proposed Draft Code and Commentary on Indian Seismic Code IS: 1893 (Part 1), IITKGSDMA-EQ05, vol.4, no.6, pp. 245-298, August 2005.

4. Mariopaz of structure Dynamics: Theory and Computations, (Second Edition), CBS Publishers & Distributors-New Delhi, vol.3, no.7, pp. 265- 348, 2004.

5. Mahdihosseini and Ahmed najim Abdullah alaskari, Prof. N. V. Ramana Rao, International Journal of Civil Engineering and Technology (IJCIET), ISSN 0976 –6316(Online), Volume 5, Issue 8, August (2014).

6. IS: 1893 (Part 1), (2007), Indian Standard Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.

7. IS: 456, (2000), Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.

8. IS: 875 (Part 1): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 1: Dead Loads (Second Revision) (1987).

9. IS: 875 (Part 2): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 2: Imposed Loads (Second Revision) (1987).
10. IS: 875 (Part 3): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 3: Wind Loads (Second Revision) (1987).

11. IS: 13920, (1993), Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, Bureau of Indian Standards, New Delhi.

12. Dr. VinodHosur's text book titled "Earthquake Resistant Design of Building Structures" in the year 2013