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# Seismic Effect on Design of Residential Multi-Storey Building (Stilt+17 Floors) In Zone-Iii and Zone-Iv using Etabs

**T.srinivas, M.Abinay raj**

***Abstract: :*** ***Structural Analysis is a branch which involves in the determination of behaviour of structures so as to predict the responses of different structural components due to impact of loads. ETABS (Extended 3 Dimensional Analysis of Building Systems) is a software which is incorporated with all the major analysis engines that are static, dynamic, linear and non-linear etc. The main purpose of this paper is to design Multi-storeyed building with a static method, since an effective design and construction of earthquake resistant structures are important all over the world. This project deals with seismic effect on "analysis, design and comparison of multi-storey residential building of stilt+17 floors in zone-iii and zone-iv using ETABS". It is an attempt to study the behaviour of a residential building using ETABS in different zones and areas with same soil bearing capacity. Analysis and design has been carried out as per IS1843-2002 (Part-1) and IS 456:2000. The more drifts and displacements have been noticed in zone 4 compared to zone 3.***
***Keywords: ETABS, static method, base shear, storey drifts, Diaphragm, storey stiffness***

## I. INTRODUCTION

ETABS is the present day leading design software in the market. Many design company's use this software for their project design purpose. So, this paper mainly deals with the comparative analysis of the results of zone-iii and zone-iv with same medium soil in both the zones. In this case, a 19.3 m x 22.6m, Stilt+17 storey structure is modelled using ETABS software. The height of each storey is taken as 3meter making the total height of the structure 57meter. Analysis of the structure is done and then the results generated by this software are compared in between zone-3 and zone-4 of the structure using IS 1893:2002.so why i have chosen this project is As our country is that the quickest growing country across the world that the need of shelter for highly inhabited cities like Mumbai and Delhi (the capital) which lies under zone-iii and zone-4 respectively.

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wherever the price of land is high and any horizontal growth isn't possible because of inaccessibility of area, so we the engineers taken a step forward and build buildings vertically After an earthquake happens it causes nice harm because of seismic motion when the peak of building is increased the wind load result conjointly acts on building. Structures are designed to resist these unforeseen forces and may have decent stiffness and strength to manage displacement at supports. Even the arrange configuration of building depends upon however the structure reacts on loading. For symmetrical building the deformation is lesser compared to a unsymmetrical arrange of columns and beam. So the first point we consider is the building should be symmetric Here a neighbourhood of structure is taken into account and also the centre line diagram is computed from AUTOCAD to ETABS. Then a model is been ready in ETABS The analysis of this structure is finished to match the bottom reactions once loading happens and deformation of various beams is observed. and compared the building in zone-iii and zone-iv with all the parameters like storey shear ,storey stiffness ,shear force and bending moments base shear and storey drifts are taken for seismic analysis according to Indian standards rules and regulations.

## II. MODELING

Generally building consists of beams, columns and slabs for multi storey building we consider
shear wall including with columns due to heavy load
Modelling in 3D view in ETABS and centre line drawing

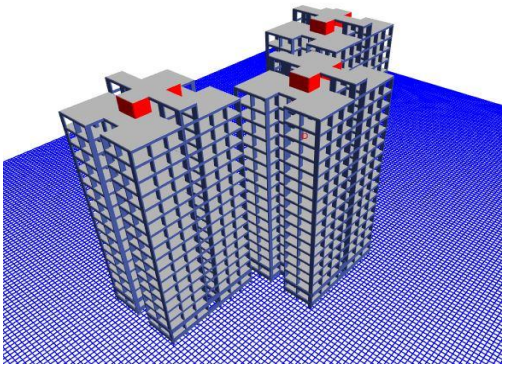

**Fig no: 1 3D model in EATABS**

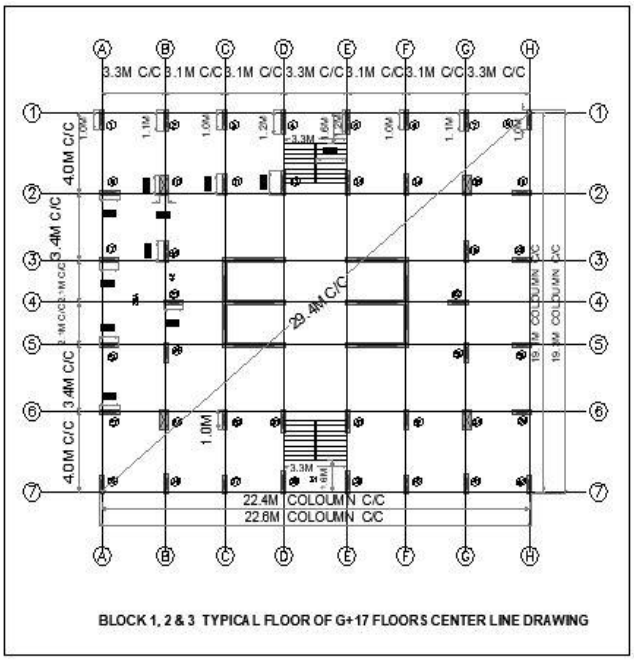


**Fig no: 2 Centre line diagram of the building**

Dimensions and centre line drawing is must for the execution of the building and analysis of the building in ETABS this values are taken form trial and error based theory. grades of concrete ,steel(rebar) and IS- codes are taken this are shown in table 1

**table 1 general dimensions of the building**

| Sl. no | Specifications | NOTATION | Values |
|---|---|---|---|
| 1. | Slab thickness | S1<br>S2 | 150mm<br>150mm |
| 2. | Beam dimensions | B1<br>B2 | 300x750mm<br>230x750mm |
| 3. | Column dimensions | C1<br>C2<br>C3 | 300x1000mm<br>300x1200mm<br>500x1000mm |
| 4. | Shear wall | W1 | 300mm |
| 5. | Block 1<br>Block 2<br>Block 3 | 22.6x19.3m<br>22.6x19.3m<br>22.6x19.3m | |
| 6. | Building height | 57m | |
| 7. | No of storey's | STILT+17 | |
| 8. | Steel | Fe500D | |
| 9. | Concrete | M35,M30,M25 | |
| 10. | Standards<br>Seismic loads<br>Load combinations | IS-CODE<br>IS: 1893:200 IS:8751987 PART 3 | |
| 11. | Software Used | ETABS-2016,AUTOCAD-2014 | |

Seismic loads - Seismic zone: III (Z=0.16), Soil type: II, Importance factor: 1, Response Reduction factor: 3, in MumbaiSeismic loads - Seismic zone: IV (Z=0.24), Soil type: II, Importance factor: 1, Response Reduction factor: 3, in Delhi

***Ultimate load combinations***

1. 1.5(dead load +impose load )
2. 1.2(dead load +impose load ± earthquake load )
3. 1.5(dead load ±earthquake load )
4. 0.9 load ±1.5 earthquake load )

***Services load combinations***

1. load + impose load
2. load ± earthquake load
3. load +0.8 impose load ±0.8 earthquake load

## III. RESULT AND DISCUSSION

We have different results for seismic in ETABS

### *3.1 Response plots*

1) Storey drifts
2) Storey stiffness
3) Base shear

#### *3.1.1 STOREY DRIFTS:-*

**"It is the displacement of storey with respected to the other storey"**

Where in storey drifts we consider for earthquake loads that is EQ-X direction and EQ-Y direction from both

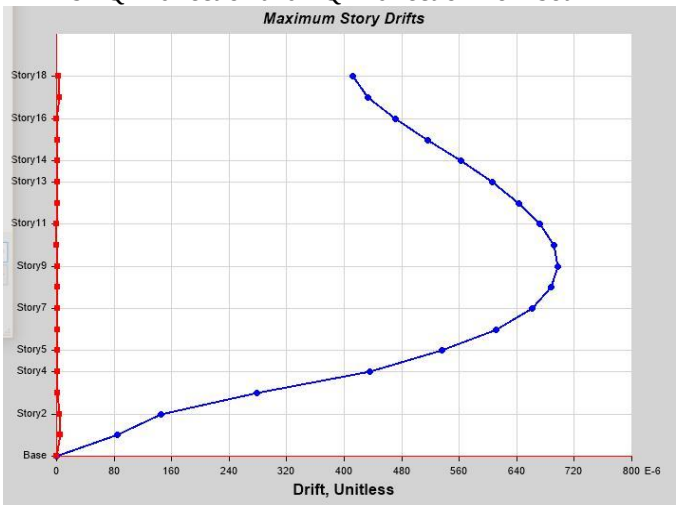


**Fig no 3- Storey Drifts - ZONE III**

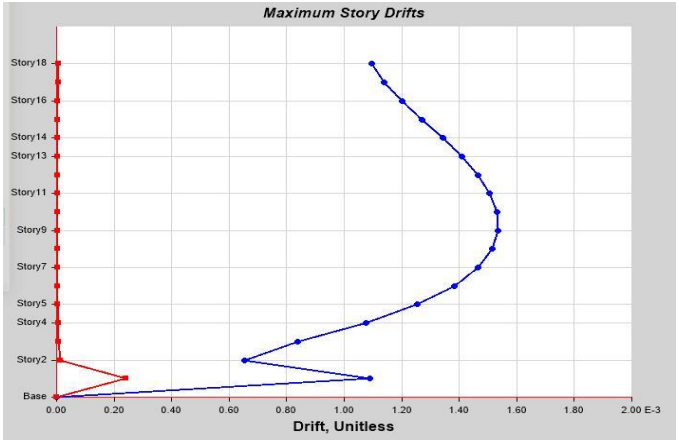


**Fig no 4- Storey Drifts - ZONE IV**

Storey drifts are high for zone 3 we can see in the images the 9th story have more displaced in both the cases where 0.000155 on 9th storey on zone -4 and 0.000697 on 9th storey that means we have more drift values in zone 3 .the drift limit according to the code IS:1893:2002 (PART 1) For seismic loads (0.01H) where H is height of the building and coming to our problem 0.01x57 that is 0.57 we did not cross the limit and our problem is safe .We have less in storey one more in top because of lateral loads and the design will change according to it and we can see the first floor is more displaced because of lateral forces at that storey one are high we can also see the values in tabular form given below

**Table 2 storey drifts along x direction**

| | | | ZONE-III | ZONE-IV |
|---|---|---|---|---|
| **Storey** | **Elevation M** | **Location** | **X-Dir mm** | **X-Dir mm** |
| **Base** | **0** | **Top** | **0** | **0** |
| **Storey1** | **3** | **Top** | **0.000120** | **0.00109** |
| **Storey2** | **6** | **Top** | **0.000145** | **0.000652** |
| **Storey3** | **9** | **Top** | **0.000278** | **0.000842** |
| **Storey4** | **12** | **Top** | **0.000436** | **0.001076** |
| **Storey9** | **15** | **Top** | **0.000697** | **0.001554** |

we can also see in tabular form at zone 3 we have more displacements at storey 1 and 2 because lateral forces and vibrations due to earthquake or seismic frequencies so the design will change according to the area

### *3.1.2. STOREY STIFFNES*

comparison between zone-iii and zone-iv at earthquake-x axis in graph form for storey stiffness

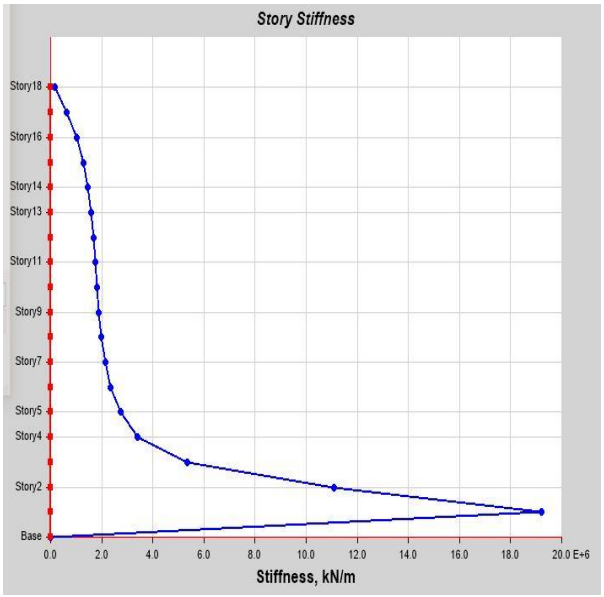


**Fig -5 Storey stiffness x axis- zone iii**

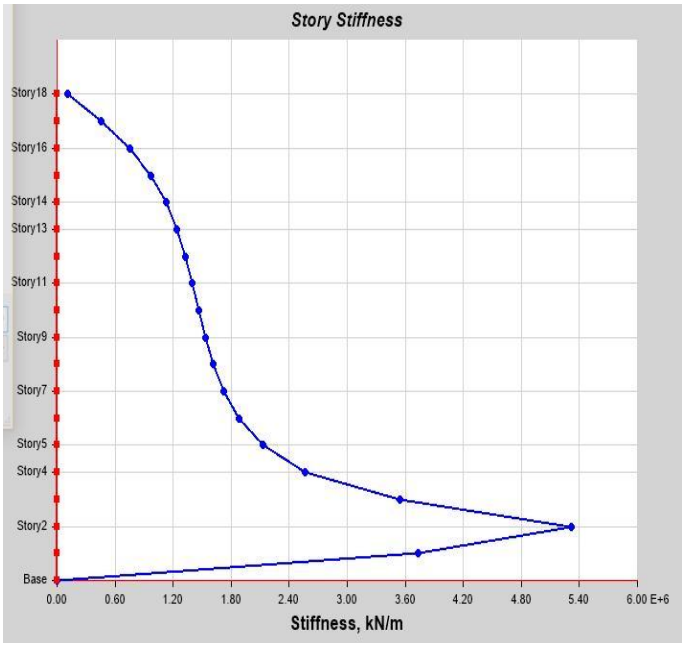


**Fig -6 Storey stiffness- x axis- zone- iv**

Comparison between zone- iii and zone-iv at earthquake-x axis in tabular form for storey stiffness

**Table :3 storey stiffness x axis zone III**

| | | | ZONE-III | ZONE-IV | % drop |
|---|---|---|---|---|---|
| **Storey** | **Elevation M** | **Location** | **X-Dir mm** | **X-Dir mm** | |
| **Base** | **0** | **Top** | **0** | **0** | **0** |
| **Storey 1** | **3** | **Top** | **19200213.566** | **3729467.288** | **80.575** |
| **Storey 2** | **6** | **Top** | **11080862.271** | **5321393.635** | **51.976** |
| **Storey 3** | **9** | **Top** | **5344721.736** | **3542509.962** | **33.719** |
| **Storey 17** | **51** | **Top** | **633860.504** | **459894.151** | **27.445** |
| **Storey 18** | **54** | **Top** | **158231.849** | **113452.918** | **28.299** |

From the above table we can see the difference between zone III and zone IV .zone III has more Stiffness than zone IV that is 19200213.566 in zone-3 and zone-4 as 3729467.288 it as decreed to 80% in zone III the more stiffness as we have more problem at storey one and as the storey's are increasing stiffness value is decreasing we have less storey in 17th storey because of head room so we can conclude that storey one at the bottom as more stiffness and we have to change the design and have tough reinforcement in storey 1 compare to each storey

### *3.1.3 BASE SHEAR*

Comparison between base shear plotting in ETABS for zone iii and zone iv in x direction

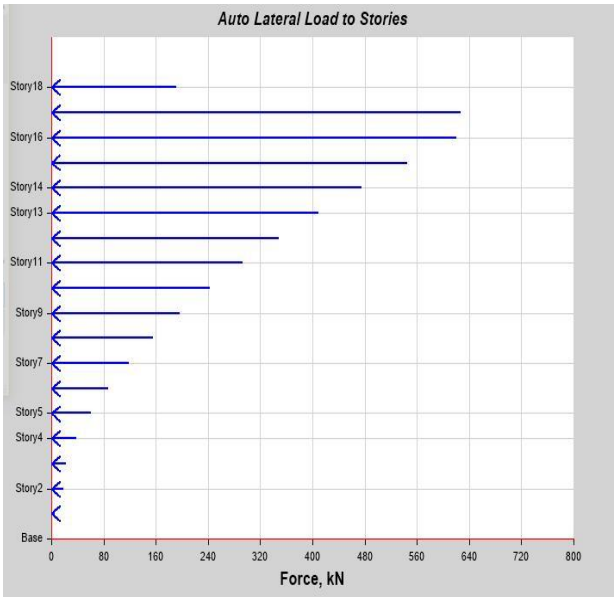


**Fig -7 Shows ZONE III of base shear**

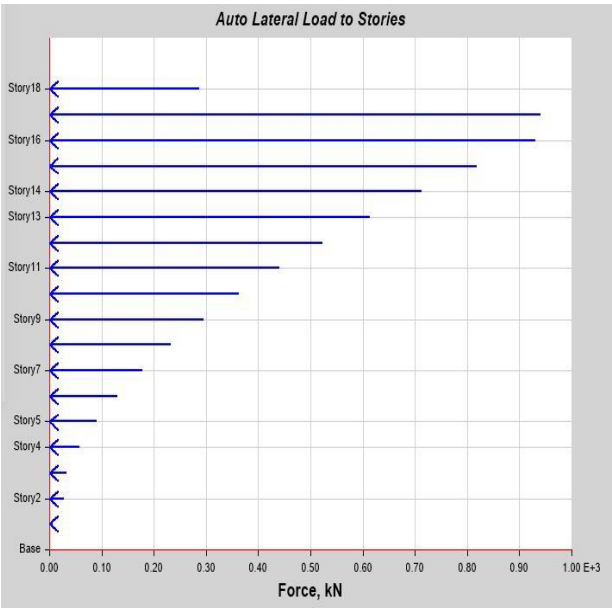


**Fig -8 Shows ZONE III of base shear**

**Table :4 Base Shear- X- axis in zone III and zone IV**

| | | | ZONE - III | ZONE-IV | % Gain |
|---|---|---|---|---|---|
| **Storey** | **Elevation m** | **Location** | **X-Dir mm** | **X-Dir mm** | |
| **Base** | **0** | **Top** | **0** | **0** | **0** |
| **Storey 1** | **3** | **Top** | **4.74** | **7.12** | **50** |
| **Storey 16** | **48** | **Top** | **620.6** | **930.99** | **50** |
| **Storey 17** | **51** | **Top** | **626.9** | **940.36** | **50** |
| **Storey 18** | **54** | **Top** | **191.2** | **286.94** | **50** |

We can see the base shear results for this building in x direction zone 4 has more shears we gain 50% because of more earthquake at zone 4 the values are less at storey one and we can see at the storey 18 has less because of head room of lift and head room of staircase so we get less shear in that place the values are given above in Tabular form because of less space I have shown only the critical sections and we can see the graph for more details. We can see the difference by calculating the base shear in manual by the code IS:1897:2002 (part1) By substituting in the formulas by calculating loads we got base shear in zone 4vb=13348.0312 In zone 3 and vb=20026.0843 we have a difference of 6678.0531. According to the results we have to Change The rebar sections and placement of three blocks because of less gap between the buildings can also change the displacement Comparison of the building of base shear of the building is done in ETABS it shown in graph and tabular representation

## IV. CONCLUSION

1) It is observed that the support reactions have got maximum values in zone-4 than zone-3 due to forces and moments.
2) It is noticed that the drift in zone-4 has higher values when it is compared to the drift values in zone-3.
3) The storey drift is increased from top storey to bottom storey in both zone - 3 and zone - 4. At storey1, the drift is maximum as compared to other stories.
4) Zone-4 has more intensity of seismic wave's effect as compare to zone 3, because of less space between the blocks.
5) It is found that base shear values are more in zone-4 than zone -3 due to more earthquake forces. It is having 50% more displacement in 17$^{th}$ floor compare to storey one.

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