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AN ALYSIS OF STOREY RESPONSE OF COMMERCIAL STRUCTURES IN DIFFERENT SEISMIC ZONES BY USING ETABS

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Abstract:

In building structures wind is critical load and needs to be considered for safety and serviceability of structures. As we construct high rise buildings wind force acting on the surface of the structure increases. The structural results of analysis are used to verify the structure fitness for use. Computer software's are also being used for the calculations. Earthquakes are natural hazards under which disasters are mainly caused bydamage to or collapse of buildings and other man-made structures. Experience hasshown that for new constructions, establishing earthquake resistant regulations andtheir implementation is the critical safeguard against earthquake-induced damage. Asregards existing structures, it is necessary to evaluate and strengthen them based onevaluationcriteriabeforeanearthquake. To relate these two components here, I am using ETABS. ETABS is the present-day leading design software in the market. Many designscompany's use this software for their project design purpose. Analysis is done for multi-storied building structure using ETABS software. ETABS is intuitive and powerful graphical interface coupled with unmatched modelling, analytical, and design procedures, all integrated using a common database. The present study as consists of the following objectives, Analysis of the Structures, Zone wise analysis of SFD, BMD deflection for Beams, Zone wise analysis of SFD, BMD deflection for Columns, Zone wise analysis of Axial Force, Rebar percentage for each Zone, Analysis of Storey Shear in Each Zone, Analysis of Storey Drift in Each Zone and Analysis of Storey Displacement in Each Zone. As a result, from overall study and observation it is concluded that Story Shear, Story Drift & Story Displacement increases as seismic intensity increases from zone II to zone V.

KEY WORDS: Multi storey building, Design Analysis, Earth Quake, Seismic Zone and ETABS

1. INTRODUCTION:

India lies at the north western end of the Indo Australian Plate, which encompasses India, Australia, a major portion of the Indian Ocean and other smaller countries. This plate is colliding against the huge Eurasian Plate and going under theEurasian Plate; this process of one tectonic plate gettingunderanotheris calledsubduction. A sea, 3 Tethys, separated these plates before they collided. Part of thelithosphere, the Earth's Crust, is covered by oceans and the rest of the continents. The former can undergo subduction at great depths when it converges against another plate, but the latter is buoyant and so tends to remain close to the surface. Whencontinents converge, large amounts of shortening and thickening takes place, like atthe Himalayas and the Tibet. Three chief tectonic sub-regions of India are the mightyHimalayasalongthe.north,theplainsoftheGangesandotherrivers,andthepeninsula. The varying geology atdifferentlocations in the country implies thatthelikelihood of damaging earthquakes taking place at different locations is different.Thus, a seismic zone map is required to identify these regions. Based on the levels ofintensities sustained during damaging past earthquakes, the 1970 version of the zonemap subdivided India into five zones – I, II, III, IV and V. The maximum ModifiedMercalli (MM) intensity of seismic shaking expected in these zones was V or less, VI,VII, VIII, and IX and higher, respectively. Parts of the Himalayan boundary in thenorth and northeast, and the Kachchh area in the west were classified as zone V. Theseismic zone maps are revised from time to time as more understanding is gained onthe geology,the seismtectonicsandthe seismic activityinthe country. ETABS is the present-day leading design software in the market. Many designscompany's use this software for their project design purpose. Analysis is done

formulti-storiedbuildingstructureusingETABSsoftware.ETABSisintuitiveandpowerfulgraphicalinterfacecoupledwithunmatchedmodeling,analytical,anddesign procedures, all integrated using a common database ETABS is premier FEManalysis and design tool for any type of project including towers, culverts, plants,bridges,stadiums,andmarine structures. With an array of advancedanalysis andcapabilities including linear static, response spectra, time history, cable, and pushoverand nonlinear analyses. ETABS provides good compatibility with a scalable solutionthat will meet the demands of project every time. ETABS is a sophisticated, yet easytouse,specialpurposeanalysisanddesignprogramdevelopedspecificallyforbuilding system. ETABS version 9.0 features an intuitive and powerful graphicalinterface coupled with unmatched modelling, analytical, and design procedures, allintegrated using a common database. Although quick and easy for simple structures,ETABS can also handle the largest and most complex building models, including awide range of nonlinear behaviours,making it tool of choicefor structural engineersin the building industry. Dating back more than 30 years to the original developmentof ETABS,thepredecessorof ETABS,itwasclearlyrecognizedthatbuildingsconstitutedvery special class structures. Early releases of ETABSprovideinput,outputandnumericalsolutiontechniquesthattookintoconsiderationandcharacteristicsuniquetobuildingtypestructure,providingatoolthatofferedsignificant savings in time and increased accuracy, over general-purpose programs.ETABScanalsohandlethelargestandmostcomplexbuildingmodels,including wide range of non-linearbehaviours, making it tool of choice for structural engineers inthebuilding.4Ascomputersandcomputerinterfacesevolved,ETABSaddedcomputationally complex analytical options such as dynamic nonlinear behavior, andpowerful CAD like drawing tools in a graphical and object-based interface. Mostbuildingisofstraightforwardgeometrywithhorizontalandverticalcolumns.Although any building configuration is possible with ETABS, in most cases, simplegridsystem definedbyhorizontalfloorsandvertical columnlinescanestablishbuildinggeometrywithminimaleffort. **The present research study consists of the following objectives, Analysis of Storey Shear in Each Zone, Analysis of Storey Drift in Each Zone and Analysis of Storey Displacement in Each Zone**

2. MATERIALS AND METHODS:

Here we are using ETABS an analysis software.

ETABSparameters:

No. of stories of school building	4 (G+3)Heightofeachstory-3m
Size of beams	300mmX600mm
Sizeofcolumns	400mmX600mm
Thicknessofslab	150mm
Grade for beams	M30
Grade for columns	M30
Grade for slabs	M30
Gradeforlongitudinalbars	HYSD 550
Grade for distribution	HYSD 500
Dead load for slabs	1.5KN/m2
Live load for slabs	4KN/m2
Frame load	14.4KN/m2
Zone	II, III, IV & V
Zone factor II III IV V	 0.1 0.16 0.24 0.36
Soil condition	Type II Medium
Importance factor	1.5
Reduction factor	5

3. RESULTS AND ANALYSIS

StoreyDisplacement:

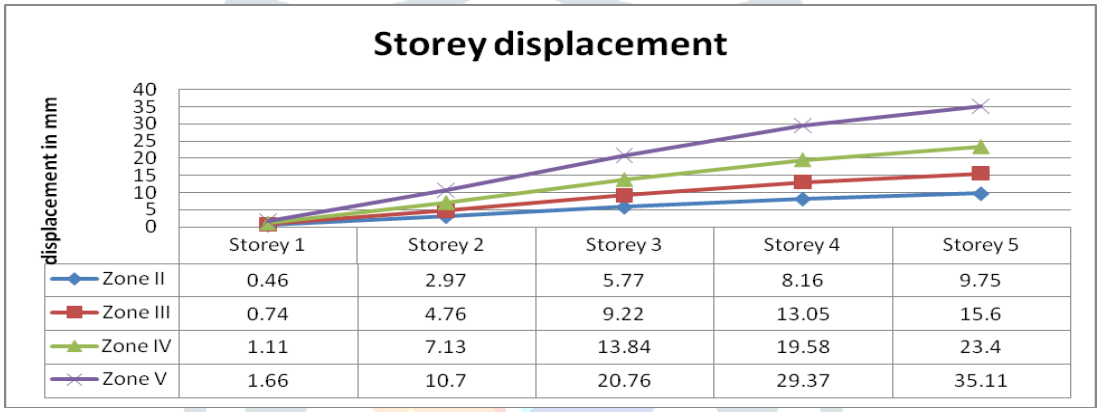
- The story displacement increases as seismic zone increases from zone II to zone V.
- Story displacement is very less at base while at story V it is very high.
- The storydisplacementatzone IIis 9.75andatzone Vis35.11.
- The story displacement increases with increase inseismic zones.

StoreyDrift:

- The story drift increases as seismic zone increases from zone II to zone V.
- Story drift is very less at base while at story V it is very high.
- MaximumstorydriftisinzoneVwhencompared to zoneII,III,IV
- The storydriftatzone IIis 0.000352andatzone Vis0.001914

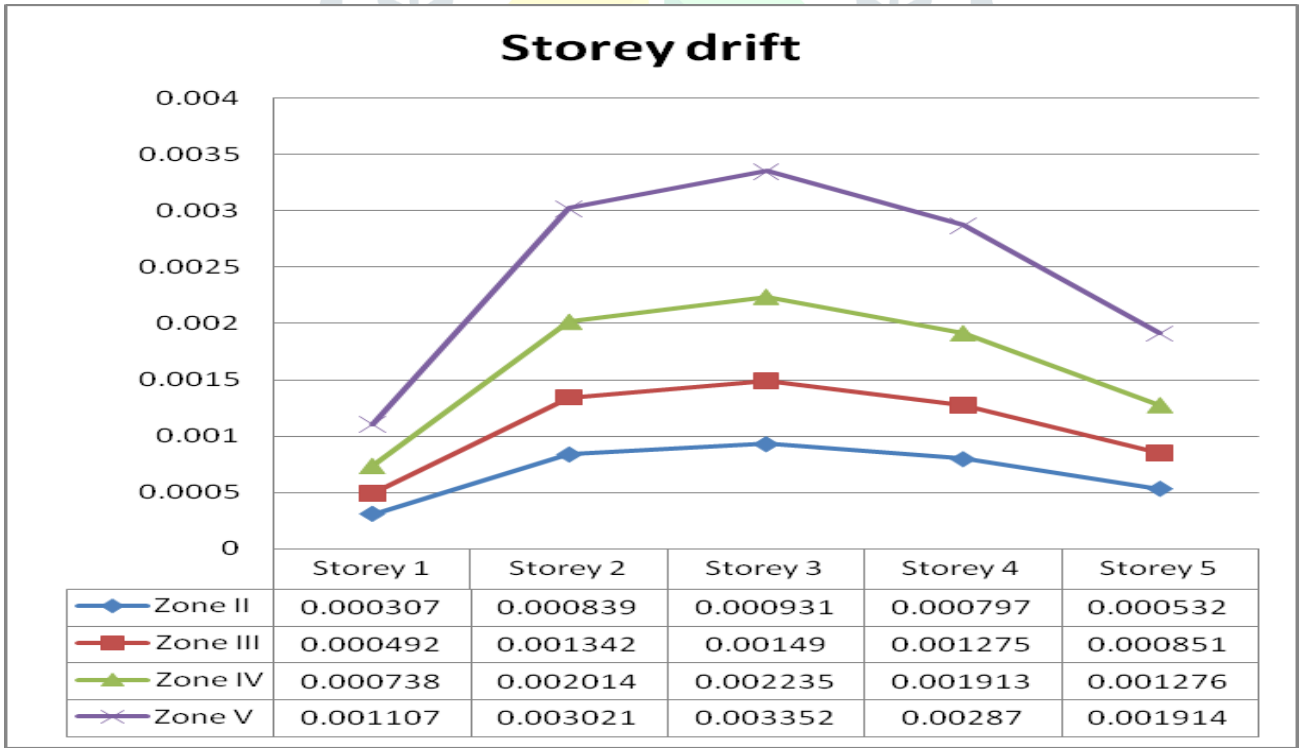
StoreyShear:

- ThestoryshеardecreasesasseismiczoneincreasesfromzoneIItozoneV.
- MaximumstoryshearisinzoneIIwhencompared to zoneIII,IV, V
- The storyshearatzone IIis -888.54andatzone Vis-3198.7



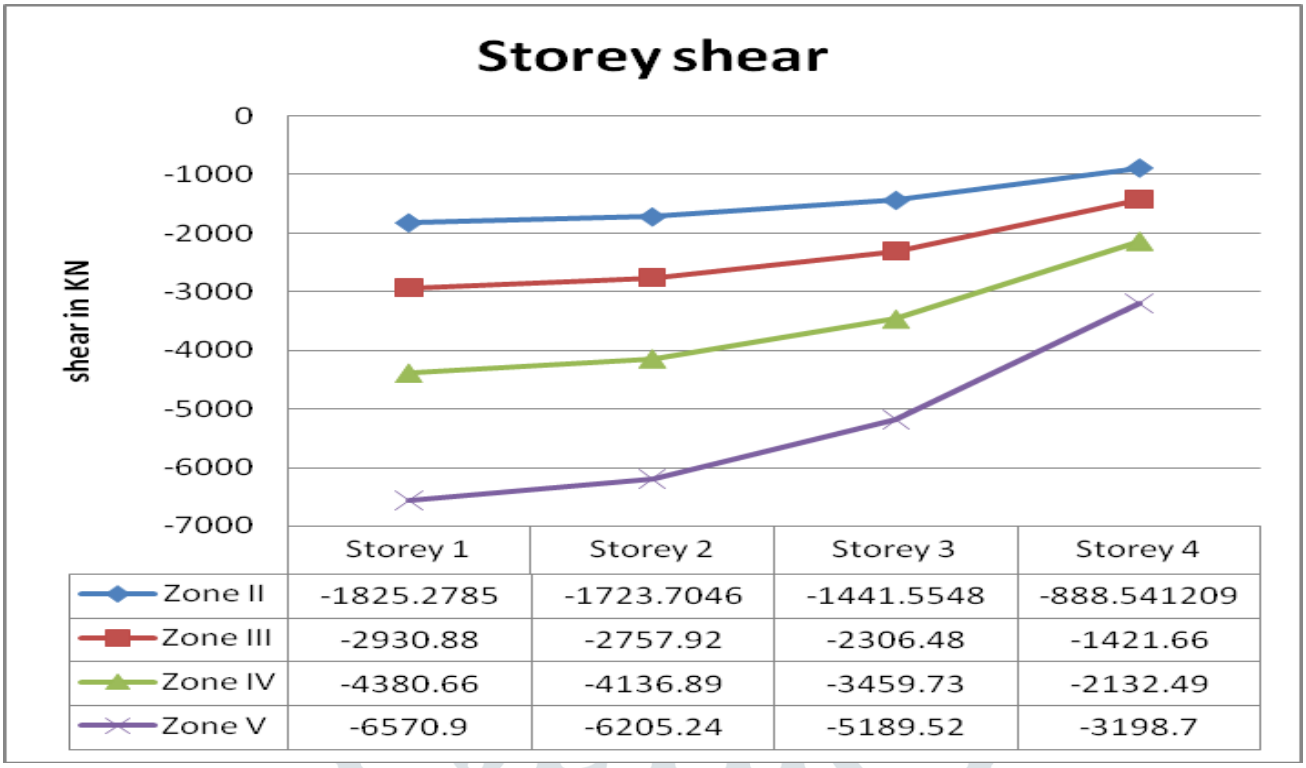
	Storey 1	Storey 2	Storey 3	Storey 4	Storey 5
Zone II	0.46	2.97	5.77	8.16	9.75
Zone III	0.74	4.76	9.22	13.05	15.6
Zone IV	1.11	7.13	13.84	19.58	23.4
Zone V	1.66	10.7	20.76	29.37	35.11

Fig 1. StoreyDisplacement



	Storey 1	Storey 2	Storey 3	Storey 4	Storey 5
Zone II	0.000307	0.000839	0.000931	0.000797	0.000532
Zone III	0.000492	0.001342	0.00149	0.001275	0.000851
Zone IV	0.000738	0.002014	0.002235	0.001913	0.001276
Zone V	0.001107	0.003021	0.003352	0.00287	0.001914

Fig 2. StoreyDrift



	Storey 1	Storey 2	Storey 3	Storey 4
Zone II	-1825.2785	-1723.7046	-1441.5548	-888.541209
Zone III	-2930.88	-2757.92	-2306.48	-1421.66
Zone IV	-4380.66	-4136.89	-3459.73	-2132.49
Zone V	-6570.9	-6205.24	-5189.52	-3198.7

Fig 3.Storey Shear

4. CONCLUSIONS

The following conclusions were drawn from the above study,

- **The storey displacement varies from zone II to zone V**
- **The storey drift also varies from zone II to zone V**
- **The storey shear varies from zone V to zone II**

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