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SEISMIC ANALYSIS AND DESIGN OF HIGH RISE BUILDING BY USING ETABS IN DIFFERENT SEISMIC ZONES

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Abstract - From the recent earthquake studies, it is concluded that not only non-engineered but also the engineered structures are affected by earthquake. In these days constructions are fitting increasingly narrow and extra inclined to sway and consequently detrimental within the earthquake. Researchers and engineers have worked out within the past to make the constructions as earthquake resistant. So it is necessary to consider and analyze the effect of seismic load in design of a structure. The main objective of this project is to analyze and design a G+10 building in three dimensions for different seismic zones of India. In this work the structure is analyzed including load calculation using ETABS. Various parameters like Storey Drift, Storey Stiffness, Lateral Load and Storey Displacement of the building in different seismic zones are calculated and compared. Limit state method of design is adopted here and IS 1893:2002 is used for seismic analysis and detailing.

***Key Words*: Analysis, Design, Seismic zone, ETABS.**

1. INTRODUCTION

Our world is facing a threat of natural disasters from time to time. Earthquakes are one of the most unpredictable and devastating of all natural disasters. The records based on earthquakes occurrence show that the consequences are loss of human lives and destruction of properties which eventually affects the national economy. However the occurrence of earthquakes cannot be predicted and prevented but we can design the structures to resist such earthquake forces. The Design of buildings wherein there is no damage during the strong but rare earthquake is called earthquake-proof design. The engineers do not attempt to make earthquake proof buildings that will not get damaged even during the rare but strong earthquake. Such buildings will be too robust and also too expensive. The aim of the earthquake resistant design is to have structures that will behave elastically and survive without collapse under major earthquakes that might occur during the life of the structure. To avoid collapse during a major earthquake, structural members must be ductile enough to absorb and dissipate energy by post-elastic deformation.

1.1 ETABS

ETABS is a software created by computer and structural, Inc. (CSI), a structural and earthquake engineering Software Company. The tallest building in the world, Burj khalifa is also designed and analyzed in this software.

ETABS has been because of the following advantages:

- Easy to use interface.
- Confirmation with the Indian Standard Codes.
- Versatile nature of solving any type of problem.
- Accuracy of the solution.

ETABS features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, ETABS is the professional's choice for steel, concrete, timber, aluminum and cold-formed steel design of low and high-rise buildings, culverts, tunnels, bridges, pile foundations and much more.

1.2 Objectives

- To ensure safety of building from seismic wave in various zones.
- To compare various analysis results of building under different zones and determination of displacements subjected to earthquake loading from zone to zone.
- To calculate the types of loads and find out the bending moment and shear force selecting any one section for various seismic zones.
- To study the seismic analysis technique like, response spectrum analysis and its application by using the software.
- To make the building earthquake resistant against seismic effect.
- To analysis story drift, displacement, shear, story stiffness model period & frequency on different floor.

1.2 Scope of the study

- The study views to determine the extent of possible changes in the seismic behavior of RC building models.
- To produce good structural work for performing seismic analysis and design for a high rise building.
- There has been a considerable increase in the number of buildings. Thus the effects of lateral load like earthquake forces are attaining increasing importance and almost every designer is faced with the problem of providing adequate strength and stability against the lateral load.
- The study highlights the effect of seismic zone factor in different zones that is in zone II, Zone III, Zone IV and Zone V which is considered in the seismic performance evaluation of buildings.
- To expedite data preparation, output interpretation and execution throughput.

2. METHODOLOGY

In the present study, analysis of G+10 multi-story building in all seismic zones for wind and earthquake forces is carried out. A 3D model is prepared for G+10 multi-story building using ETABS. The steps involved in the study is as follows:

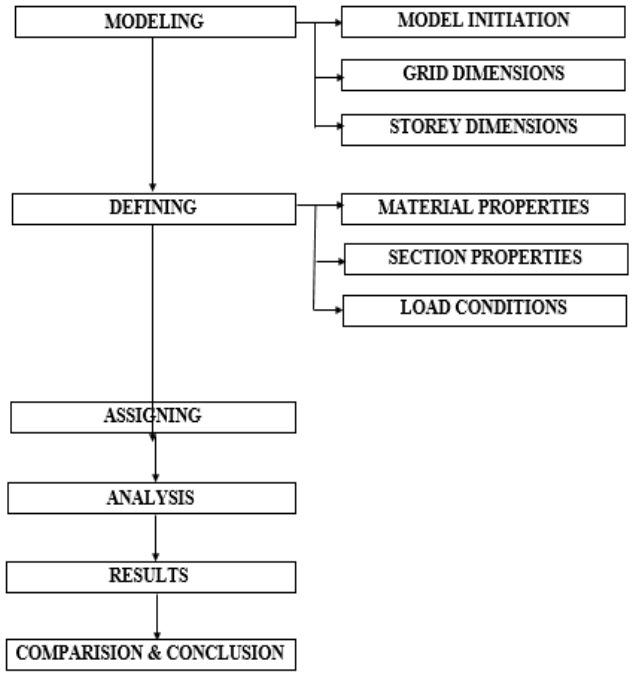

Fig -1: Steps involved

2.1 Layout and models

The layout of the building in AUTO CAD ad the plan, elevation and 3-D views of the G+10 building modelled in ETABS v.17 are given below.

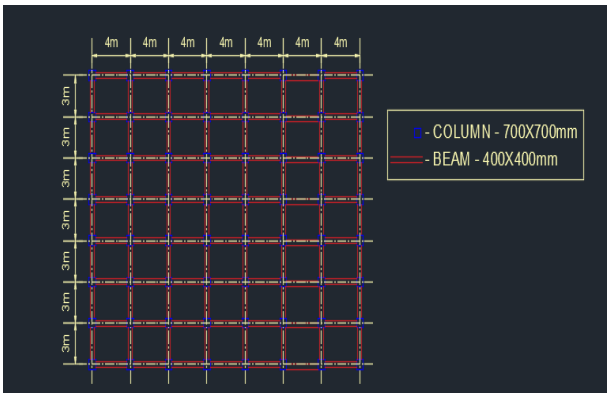

Fig -2: Column and Beam layout

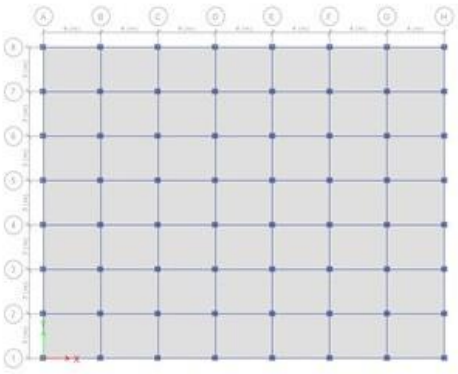

Fig -3: Plan in ETABS

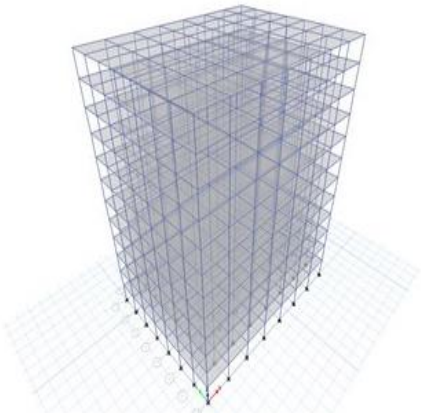

Fig -4: 3D view

Fig -5: 3D rendered view

2.2 Design data

Table -1: Design data

Building type	Residential building
No. of storey	G+10
Building shape	Rectangular
Storey height a. Ground floor b. Floor to floor	 3m 3m
Material details a. Concrete b. Steel	 M40 HYSD Reinforcement of Fe415
Seismic zones	II,III,IV and V
Type of construction	RCC Framed structure
Dimension of building	28m X 21m
Column size	700mm X 700mm
Beam size	400mm X 400mm

3. RESULTS AND DISCUSSIONS

The G+10 storey high rise building is analysed in ETABS and the following results are obtained

3.1 Storey Drift

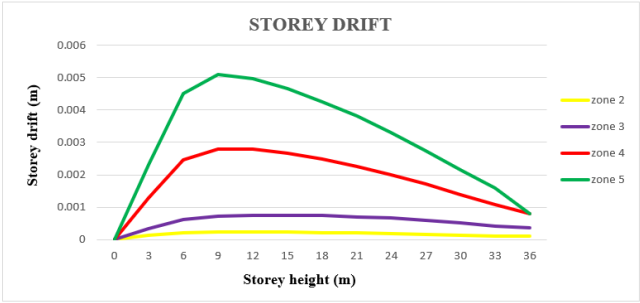

Chart -1: Storey Drift

Chart -1 gives the graphical representation of the storey drift values of the structure in each zone with respect to each storey.

From the graph, it shows that the plot of the values of each zone is similar to each other, the drift value is higher in zone 5 compared to the other three zones 2, 3 & 4 and zone 2 have the lowest value.

So, it is identified that the drift is increasing with higher zones.

3.2 Storey Stiffness

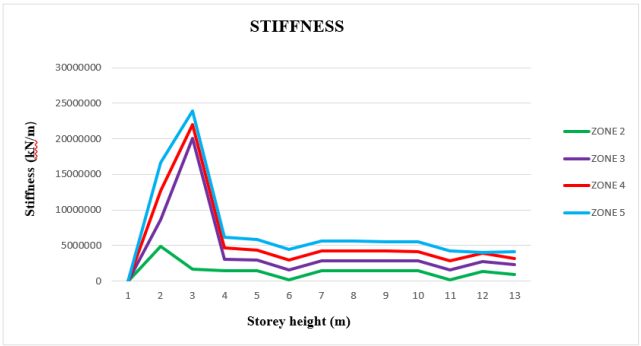

Chart -2: Storey Stiffness

Chart -2 gives the graphical representation of the storey stiffness values of the structure in each zone with respect to each storey.

From the graph, it shows that the plot of the values of each zone are homogeneous and the stiffness value is highest in zone 5 compared to the other three zones 2, 3 & 4 and zone 2 have the least value.

So, it is identified that the stiffness is increasing with higher zones.

3.3 Lateral Load

Chart -3: Lateral Load

Chart -3 gives the graphical representation of the lateral load values of the structure in each zone with respect to each storey.

From the graph, it shows that the plot of the values of each zone is similar to each other, the load value is higher in zone 5 compared to the other three zones 2, 3 & 4 and zone 2 have the lowest value.

So, it is identified that the load is increasing with higher zones.

3.4 Storey Displacement

Chart -4: Storey Displacement

Chart -4 gives the graphical representation of the storey displacement values of the structure in each zone with respect to each storey.

From the graph, it shows that the plot of the values of each zone are homogeneous and the displacement value is highest in zone 5 compared to the other three zones 2, 3 & 4 and zone 2 have the least value.

So, it is identified that the displacement is increasing with higher zones.

4. CONCLUSIONS

The conclusions of the study are as follows:

- In this project, a G+10 multi-storey building is taken for seismic analysis in different seismic zones.
- A 3D model of the building is modeled and imported to ETABS for the analysis process.
- Based on the inputs and the parameters considered the results from the different zones are obtained and compared such as storey drift, storey stiffness, lateral loads and storey displacement with respect to each storey.
- From the results, it is concluded that the zone 5 will be the one which undergoes the most severe damage and it should be designed with more safety considerations.

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