A Study on the Seismic and Wind Performance of RC Building Using E-TABS

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Abstract:-The principle objectives of this project are to analyze and design of educational building in different seismic zones by using the ETABS software. In this project, all four zones have been taken under considerations. This software is used to analyses and designs the buildings. The present work is to study the behavior of an educational building of G+3 storeys subjected to earth quake load by adopting response spectrum analysis. We analyses G+3 storey building for all possible load combinations (Dead load, live load, seismic loads).seismic loads were taken as per IS1893:2002. Our final work was the analysis of G+3 building under various load combinations. We considered an educational building as specified in the plan. The height from the ground floor to fourth floor is 3.0m. The structure was subjected to self-weight, dead load, live load, and seismic loads and wind pressure under the load case details of e-tabs. Seismic load calculations were done with the following IS1893:2002 (part 1).the materials were specifies and cross sections of the beam and column members were assigned the supports at the base of the structure were also specified as fixed.

Key words: Earthquakes, E-tabs, G+3, seismic load, dead load, live load. Load combinations.

I. INTRODUCTION

Calamities like earthquakes are the most dangerous by means of the damage and chaos caused to the structural components and they cannot be controlled. These natural calamities caused property damage and interruptions in development of the normal lifecycle. Since it's a global concern, most of the analysis should be carried out and provided with the results to prep the structure in order to attain time period. With the technological advancement, man tried combating with these natural calamities through various ways like developing early warning systems for disasters, adopting new prevention measures, proper relief and rescue measures. But unfortunately it is not true for all natural disasters. Hazard maps indicating seismic zones in seismic codes (IS 1893:2002) are revised from time to time which leads to additional base shear demand on existing buildings. The collapse of a structure can be minimized if the following points are taken in to consideration.

- The pattern of failure can be made ductile instead if brittle. If ductility is assured, dissipation of energy produced will show small deteriorations.
- Shear failure comes after the failure of flexure
- Columns should not fail before beams.
- The joints should be hard compared to members

II. OBJECTIVES OF THE STUDY

The following are main objectives of the study.

- To study the parameters like lateral displacement, storey drift and base shear by providing staircases in the model.
- To the bending moments, shear force, axial bending of the columns which are attached to the staircase slab.
- To understand the effects of seismic zones and number of storeys on the seismic performance of frame.
- To describe the importance of dynamic (Response Spectrum method) analysis in the seismic analysis of irregular structures, and to make the comparison between the structural responses obtained from dynamic analysis and equivalent static analysis.

III. STATEMENT OF THE PROJECT

- The main focus of the present work is to carry out dynamic analysis by response spectrum method (RSM) on an educational building for different seismic zone factors.
- For this purpose frames are initially designed using ETABS under static load and seismic load at different zones further.
- The model is analyzed by response spectrum method of analysis (RSM) have been adopted to study the seismic behavior of the residential

buildings during earthquake as per IS 1893(part1):2002 codal provisions.

- The present study is devoted to compare the result on storey drift, base shear, and internal forces, such as bending moment, shear force and axial force for all the earthquake zones.
- In order to capture exact behavior, all the analyses are performed on complete three dimensional models of the structures.

IV. METHODOLOGY

A structure must be analyzed and designed to resist the lateral earthquake forces. The analysis and design procedure of a G+3 educational building is done with the help of e tabs software by response spectrum method.

There are computational advantages in using response spectrum method of seismic analysis for the structural systems the method involves the calculation of only the maximum values of displacements and member forces in each mode using smooth design spectra that is the average of several earthquake motions.

In these different seismic zones are taken to get the building results, how it reacts to different zones.

V. METHODS OF SEISIMIC ANALYSIS

Indian Standard: 1893 (1962, 1966, 1970, 1975, 1984, 2002) code of practice on "Criteria for earthquake resistant design of structures" by the Bureau of Indian Standards (BIS), New Delhi [17]. Various approaches to seismic analysis have been developed to determine the lateral forces, ranging from purely linear elastic to non-linear inelastic analysis. Many of the analysis techniques are being used in design and incorporated in codes of practices of many countries. Different methods have been proposed by researchers across the world for the precise analysis. They are:

1. Linear methods

a) Linear static analysis (Equivalent static method)

b) Linear dynamic analysis (Response spectrum and time history analysis)

2. Non-linear methods

a) Nonlinear static analysis (Pushover analysis)

b) Nonlinear dynamic analysis (Nonlinear time history analysis)

The two approaches from force based Equivalent static method and Response spectrum method are different from each other. In the present work, an attempt is made to compare both the methods for the RC frame structure along with incorporating stairs in the model. However, in the present study the main focus is on the IS codal provision, the method of analysis described in IS 1893 (Part 1): 2002 are presented.

The seismic analysis should be carried out for the building that has lack of resistance to earthquake forces. Seismic analysis will considerseismic effects hence the exact analysis sometimes become complex.

However for simple regular structures equivalent linear static analysis is sufficient one. This type of analysis will be carried out for regular and low rise buildings and this method will give good results for this typeof buildings. Dynamic analysis will be carried out for the building as specified time history method. Following methods are adopted to carry out the analysis procedure.

- Equivalent static analysis
- Linear dynamic analysis
- Response spectrum method
- Pushover analysis
- Nonlinear static analysis
- Nonlinear dynamic analysis

VI. LOADS ACTING ON THE BUILDING:

Loads on building in many ways such as large accumulation of gravity loads on the floors from Top to Bottom, increased significance of wind loading and greater importance of earthquakes thus multi storied structures need correct assessment of loads for safe and economical design. The following discussion describes the sum of most common kinds of R.C

- Dead loads
- Live loads
- Earthquake loads
- Wind loads.

VII. ANALYSIS AND RESULTS

ETABS software working is mainly dived into 4 parts they are modeling, defining, assigning and analysis.

Modeling: Modeling is the first process in which all the modeling work is done by preparing the whole plan into the grid pattern so that beams and columns can be placed eaisly.in this process the height of the structure is defined.

Defining: In this step all the material properties ,section properties, slab properties, wall properties, load patterns ,importance factor ,response reduction factor ,soil type diaphragm, response spectrum functions, load case and load combinations are defined. Material properties in this step

the materials as concrete and rebar are defined as M_{25}, Fe 415.the section properties include size of beam and columns are defined.

Load pattern are defined and for earthquake zones, zone factor, response reduction factor, importance factor, type of soil as well as diaphragm and response spectrum function values are defined for earthquake load cases.

Load case and combinations are defined by load patterns and extra cases are also defined for earthquake response spectrum functions and from load cases and load combinations are made.

Assigning: All assigning parts are done by assigning columns, beams, slab, diaphragm and loads.

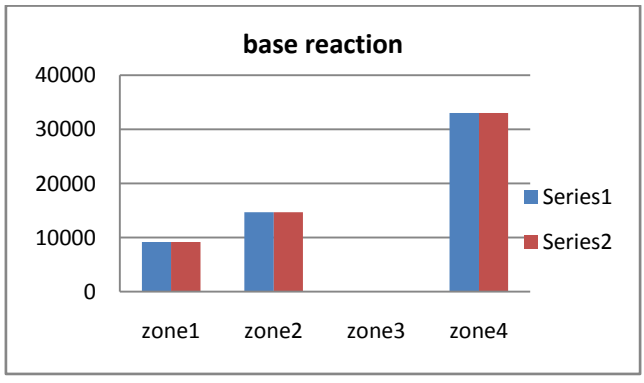
Analysis: After completion of all the process runs the analysis by clicking to analyze then run analysis. Similarly by changing the zone factor values the analysis is carried out for all zones

Results: The building modeled and analyzed using RSA method to study results on base reactions, storey drift.The results are tabulated below and graphs also plotted to see the variation.

Base reaction: Base shear is an estimate of the maximum expected lateral forces that will occur due to seismic ground motion at the base of a structure in the below table the values of the base reaction according to the response spectrum in different zones

Base reactions

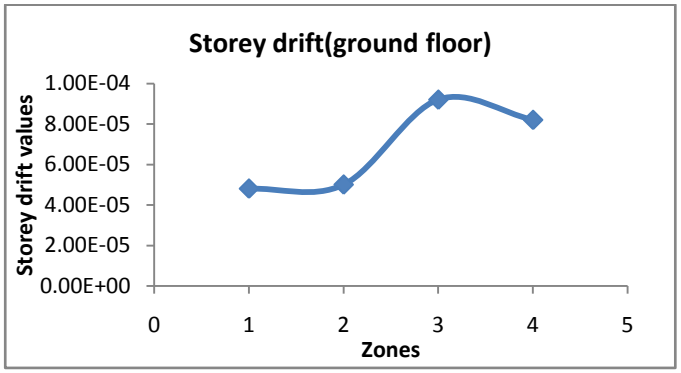
Sl no	zones	X direction	Y direction
1	Zone 2	9163.713	9163.7127
2	Zone 3	144661.94088	14661.9402
3	Zone 4	0.0003	0.0007
4	Zone 5	329889.368	32989.365

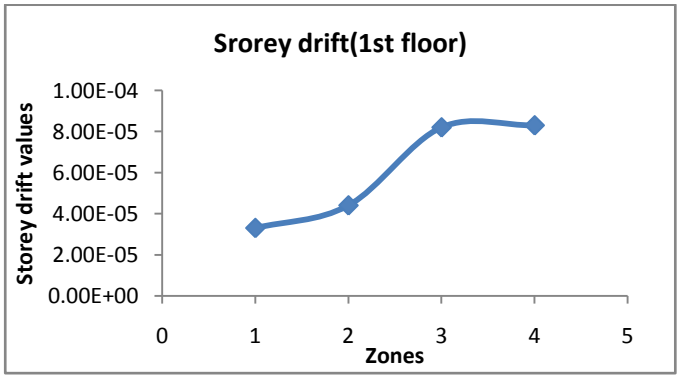


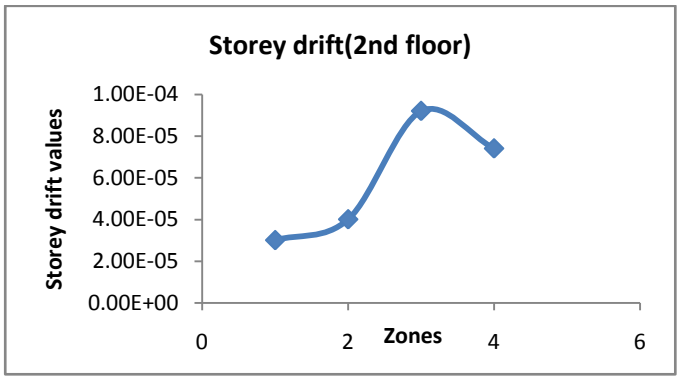
Storey drift:it is the difference of displacements between two consecutive storeys divided by height of that storey. storey displacement is the absolute of the displacement of the storey under the action of the lateral force

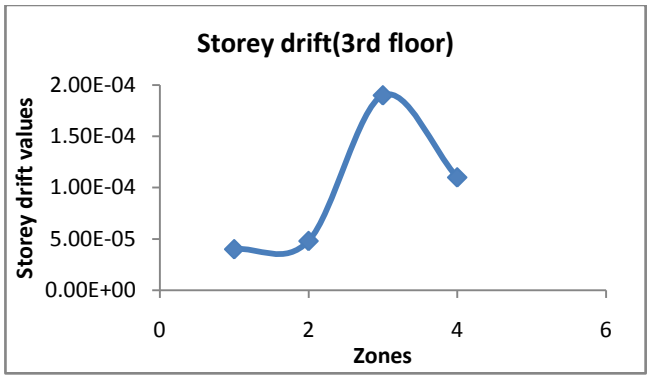
Storey drift values

Sl no	zones			
	Zone 2	Zone 3	Zone 4	Zone 5
1	4.8E-05	5E-05	9.2E-05	8.2E-05
2	3.3E-05	4.4E-05	8.2E-05	8.3E-05
3	3E-05	4.E-05	9.2E-05	7.4E-05
4	4E-05	4.8E-05	0.00019	0.00011









VIII. CODE BOOKS USED

1. The dead load and live load were calculated as per IS 875 (Part1 and 2):1987.
2. Type of earthquake loading is strictly as per IS 1893(part-1): 2002.
3. Plan Irregularity due to diaphragm discontinuity is analyzed for 4 storey, buildings.
4. Effect of different seismic zones is analyzed on the seismic performance of the RC frame structures.

IX. CONCLUSION

- As from the table it can easily see that base shear is almost same to zone to zone, there is very little changes.
- As from table the values are changing as in zone 2 the value is 9163.713 and in zone 4 is 0.0003 that decreased the values.
- In table the base shear values in the global y direction are facing the same as in x direction because in y direction the values are high in zone 5 as compare to zone 2.
- so as the zone is changed the zone factors are changed and because of this, the structure act's differently in different zones.as zone 2 is low earthquake prone zone so in this the base reactions are low and as zone 5 is high earthquake prone zone so in this base reactions are high.
- The study drift mainly occurred at the middle of the building, in this building the middle storey is the second storey and it has maximum storey drift.
- In table the storey drift values for load combinations and zones are there from this table it is seen that the middle storey 2 has the maximum storey drift values, all storey drift values are in m.
- The storey drift values increases with the increase of seismic zone factor, so as the zone is increased from zone 2 to zone 5 the values for zone 2 ,second storey value is 3.4E-05 and for zone 5 the value is 8.2E-05.so the storey drift values increased as the zone is increased.
- In the above of table it shows the increase in the storey drifts from zone to zone.
- For all the load combinations the storey drift is increasing as the zone is increasing and in the middle storey (2^{nd}), the storey drift is maximum.
- Using this software ETABS, reduces the time for analysis and design work and gives high accuracy and due to this software, we can get the values of the structure easily and can get the values for any zone.

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