International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Analysis of Multistoried Building in Different Seismic Zones with Different Soil Conditions

Arun Babu M[1], Ajisha R[2]

[1]*PG Student, M-tech Structural Engineering, Sreepathy Institute Of Management And Technology, Vavanoor, India*
[2]*Assistant Professor, Department of Civil Engineering, Sreepathy Institute of Management and Technology, Vavanoor, India*

Abstract - *The foundation of a building is the substructure through which the loads of the whole structure are transmitted to the soil. There are various types of soil present in India. The types of soil play a major role while designing a structure. Here the analysis and design of building is done by varying the type of soil. The difference in analysis of structure is studied. After that the seismic analysis for various zones are carried out for the same soil conditions and also by changing the model of building, the same are done. And the difference is studied*

Key Words: Model Analysis, Static Earthquake Analysis, Time History Analysis, Base Shear, Story Displacement.

1. INTRODUCTION

In India most of the structures are low rise buildings. Now a days due to greater migration towards cities, results in increase in the population in most of the major cities. In order to fulfill the requirement of this increased population in limited land the height of building becomes medium to have high rise buildings. The improper design and construction of building may cause great destruction of structures all over the world. Hence we have to be concerned about the safety against the earthquake forces that are affecting the structures. The major factor is the asymmetry of the building the asymmetry contributes significantly for translational torsional coupling in the seismic responses which can lead to lateral deformation of the building. Buildings with asymmetric distribution of stiffness and strength in plan undergo coupled lateral and torsional motions during earthquake. In many of cases the centre of resistances dose not coincide with the centre of mass.

1.1 What Is An Earthquake ?

When two plates of the earth suddenly collide each other, there is sudden release of energy these energy is called as seismic waves that makes the ground shakes called earthquakes. Then the surface where the slip is called fault plane. The location below the earth surface where the earthquake starts is called hypocenter, and the location above the earth surface is called the epicenter. When the earth is disturbed by natural and artificial disturbances the vibrations are produced . these vibrations will transferred to all directions from the point of origin. The intensity of vibrations are high at the starting point then the vibrations will slowly decreases when going from the starting point. Seismographs is the instrument where the earthquakes are recorded and the recording is called seismogram When the earthquakes occurs the energy released is in the form of seismic waves. These seismic waves travel inside the earth and on the surface of the earth. The seismic waves are of two types body waves and surface waves. These body waves are again divided into two types primary Analysis of multistoried building in different seismic zones with different soil conditions 2 waves and secondary waves. P and S waves can cause higher damage to brick stone buildings especially the shorter ones. The surface wave can cause great damage to the tall buildings on soft soil conditions.

Classification Of Earthquakes

- Based on depth
- Based on focal depth
- Based on their cause
- Based on their magnitude
- Based on the epicentre distance

2. LITERATURE REVIEW

Saurabh G Lonkar and Prof. Riyaz Sameer Shah (Dec 2015) discussed about the comparative study of static and dynamic analysis of multi storey regular and irregular buildings. In this journal on the seismic behavior of the concrete reinforced building ,storey displacements, accuracy and exactness of time history analysis and response spectrum analysis, relative displacement of regular and irregular building by different method of seismic analysis and also to check the relative percentage damages to of regular and irregular building in different seismic zones. They did this project on four phases. In phase one they modelled the building and analysed and designed. In phase two displacement demand of model have been obtained using equivalent static, time history and response spectrum analysis. In phase three damage percentage of building has been obtained. And in phase four determinations of story displacement and displacement of center of mass is calculated. By this project they found that the displacement of each storey at centre of mass is lower as those compared to maximum displacement of joints. Static analysis is not sufficient for the high raise building its necessary to provide dynamic analysis. And as result of comparison it is observed that the displacement and corresponding damage obtained

from static analysis are higher than the dynamic analysis including response spectrum and time history analysis.

Ranjit V surve, Prof.D.S.Jagatap and Prof.Y.P.Pawar(April 2015) the paper aims at the performance based analysis of multistoried building with soft storey at different levels and by evaluate the Zone V selected reinforced concrete building to conduct static and push over analysis. Soft storey means that weak storey is defined as the storey in the building that has less stiffness or inadequate ductility to resist the earthquake induced in the building. By this paper the validation of earthquake analysis of G+16 building with the help of SAP2000 was studied. To find natural period of the multistoried building with soft storey at GL & 4th, 8th, 12th,16th Analysis of multistoried building in different seismic zones with different soil conditions 9 floors. And also to find the natural hinge formation pattern. they found that by shifting the soft storey to 4th floor soft storey to 16th floor soft story the values changes from 2.571 sec to 2.366 sec. the maximum base shear obtained is at the soft storey at the ground level. And the minimum base shear is obtained at ground and fourth floor. They found that the shifting of soft storey to higher levels the results in reduction of number of hinges. Also simultaneously displacement and base shear increases. Maximum yielding is observed at the base storey, due to the formation of maximum plastic hinges at the soft storey.

Prof Swapnil B. Cholekar and Basavalingappa S.M (July 2015). In this paper the comparative analysis of multistoried RCC and Composite building due to mass irregularity was studied. The mass irregularity in the structure is due to the uneven distribution of mass, strength or stiffness or due to the structural form. they modeled a multistoried building of R.C.C and steel concrete composite 3D building considering mass irregularity at different stories, and various components of composite structures. And they also did go the comparative study of structural parameters like base shear, storey drift, and displacement of both RCC and steel concrete composite building. For the analysis they modeled the building in SAP2000. And the results obtained are joint displacement in building in X and Y directions, storey drift in X and Y directions, base shear in X and Y directions, shear force in X and Y directions for corner columns and the self weight of RCC and composite structure. By obtaining the results they come to the conclusion that the joint displacement values are less in composite structures compared to RCC structures.

Prof. SakthiA.Manchalwar, AkshayS.Puri and VishakhaAswale (April 2016). This paper deals with the comparative study of end moment of frame by manually and by using software SAP2000 of RC frame. For the analysis of structure they use three methods of analysis: they are Kanis method, moment distribution method, strain energy method. The objective of the paper is to study the analysis of building using Kanis method, SAP2000 and to study design of different elements involved in a building. In this project they found that Kani's method has the capability to analyze any frame section and it is much simpler than other methods like moment distribution and slope deflection method. For the analysis of building SAP software is beneficial because the values got during manual calculation and excel calculation are nearly same. And also they found Analysis of multistoried building in different seismic zones with different soil conditions 10 that the manual design of the building elements and software design are almost same for some elements in the building.

3. METHODOLOGY

On brief description of the adopted model (I section) and analytical validation. This paper focus on the effect of building in different seismic zones with different soil conditions. Different types of analytical method are there for the study of earthquake analysis. For the analysis of structure static earthquake analysis and time history analysis (Elcentro). Here 3 dimensional modeling and analysis of structure is going to do using the software by ETABS. The story displacement and base shear will help to compare the performance of all models and can identify which building has more performance against earthquake.

4. MODELING AND ANALYSIS OF STRUCTURE

For the analysis and design of the building the building is modeled as shown below. The building is designed with a grade of concrete M40. The rebar's used for design and analysis of the structure by Fe415. When going to the building details the structure has G + 10 story, each story of height 3m. the slab thickness used for the building is of 150mm and the plinth beam of height of 1.5m from the ground level. When going to the columns and beams the column of size 450mm X 450mmand the size of beam is 300mm X 500mm. the plan of the building is symmetrical. The main loads provided for the building are live load and floor load the live load provided for the design is 3 kN/m^2 and the floor load is 1 kN/m^2 .

Table -1: Building Details

Grade of concrete	M 40
Grade of steel	Fe 415
Floor to floor height	3 m
Plinth height above GL	1.5 m
Slab thickness	150mm
Column	450 x 450mm
Beam	300 x 500 mm
No of story	G + 10
Type of plan	Symmetrical

Floor load	1 kN/m^2
Live load	3 kN/m^2

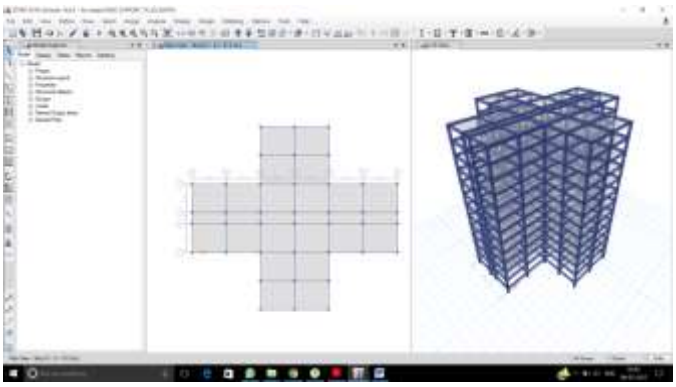

Fig-1: Plan and 3D model of structure

5. RESULT AND DISCUSSION

Table -2: time period by model analysis

Soil	Model analysis							
	Zone I		Zone II		Zone III		Zone IV	
	Time period (sec)							
	X dir	Y dir	X dir	Y dir	X dir	Y dir	X dir	Y dir
Fixed	2.0	1.8	2.03	1.89	2.03	1.89	2.03	1.89
Hard	2.0	1.9	2.05	1.93	2.05	1.93	2.05	1.93
Medium	2.0	2	2.09	2	2.09	2	2.09	2
soft	2.2	2.2	2.25	2.23	2.25	2.23	2.25	2.23

Table -3: Base shear by static earthquake analysis

Soil	Static Earthquake Analysis							
	Zone I		Zone II		Zone III		Zone IV	
	Base shear (kN)							
	X dir	Y dir	X dir	Y dir	X dir	Y dir	X dir	Y dir
Fixed	796	854	1274	1367	1911	2051	2866	3077
Hard	789	838	1262	1341	1893	2012	2840	3019
Medium	772	806	1235	1291	1853	1936	2779	2905
soft	717	722	1147	1156	1721	1734	2582	2601

Table -4: Story displacement by static earthquake analysis

Soil	Static Earthquake Analysis							
	Zone I		Zone II		Zone III		Zone IV	
	Story Displacement (mm)							
	X	Y	X	Y	X	Y	X	Y
	dir	dir	dir	dir	dir	dir	dir	dir
Fixed	12	11	19	18	29	28	44	42
Hard	12	11	20	19	30	28	45	43
Medium	12	12	20	20	31	29	46	44
soft	13	14	22	22	33	33	49	50

Table -5: Base Shear by Time History analysis (Elcentro)

Soil	Time History Analysis I(Elcentro)							
	Zone I		Zone II		Zone III		Zone IV	
	Base shear (kN)							
	X dir	Y dir	X dir	Y dir	X dir	Y dir	X dir	Y dir
Fixed	676	719	1083	1162	1624	1727	2437	2591
Hard	670	712	1073	1140	1609	1710	2414	2566
Medium	656	690	1050	1097	1575	1656	2362	2485
soft	609	613	975	982	1463	1473	2194	2210

Table -6: Story Displacement by Time History analysis (Elcentro)

Soil	Time History Analysis I(Elcentro)							
	Zone I		Zone II		Zone III		Zone IV	
	Story Displacement (mm)							
	X dir	Y dir	X dir	Y dir	X dir	Y dir	X dir	Y dir
Fixed	10	10	16	13	24	25	36	37
Hard	10	10	16	16	24	25	36	37
Medium	10	10	16	16	25	25	37	38
soft	11	11	17	18	26	27	38	40

6. CONCLUSIONS

From model analysis the time period obtained from all zones are same and its same for all soil conditions as in table 2. By static earthquake analysis the base shear obtained is maximum for fixed support conditions and for hard soil conditions then the base shear is decreasing to medium soil and then to soft soil. When comparing the zones in static earthquake analysis zone I have lowest base shear then its increases by zone II, zone III and zone IV as shown in table 3. But in case of story displacement Zone I have lowest displacement. Then Zone II have comparatively 7-8 % increase than zone I. when going to zone III and zone IV an average of 7-8% increase in story displacement .By Time History analysis (Elcentro) the base shear and story displacement obtained during analysis is comparatively lesser than Static earthquake analysis. Due to this the steel required is comparatively lesser than static earthquake analysis.

REFERENCES

[1] Saurabh G Lonkar and Prof. Riyaz Sameer Shah (Dec 2015). "Co,parative Study of Static and Dynamic Analysis of Multi Storey Regular and Irregular Building".InternationalJouranl of Research in Engineering Science and Technologies.(IJRESTs).Vol 1, No 8.

[2] Ranjit V surve, Prof.D.S.Jagatap and Prof.Y.P.Pawar(April 2015). "Performance Based Analysis Of Multistoried Building With Soft Story At Different Levels". International Journal of Engineering, Research and Technology.Vol 4, Issue 4

[3] Prof Swapnil B. Cholekar and Basavalingappa S.M (July 2015) "Comaritve analysis of multistoried RCC and Composite building due to mass irregularity" International Research Journal of Engineering and Technology (IRJET). Vol 2, Issue 4.

[4] A. cinitha, P.K.Umesha, Nagesh R Iyer and N lakshmanan (Dec 2015). "Performance Based Seismic Evaluation of RC Framed Building". The Institution of Engineers (India), 96(4), 285-294.

[5] Prof. SakthiA.Manchalwar, AkshayS.Puri and VishakhaAswale (April 2016) "comparative study of analysis and design of RC frame". International Journal of Science, Engineering and Technology Research (IJSETR).

[6] B K Raghuprasad, Vinay S, Amarnath K (May 2016). "Seismic Analysis of Building Symmetric and Asymmetric in Plan". SSRG International Journal of Civil Engineering (SSRG-IJCE)