



Article Title: Seismic Analysis of a Structure Considering Effect of Soil Structure Interaction

Seismic Analysis of a Structure Considering Effect of Soil Structure Interaction

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ABSTRACT

Structural design is the main part of nowadays in life of civil and structural Engineer. As in today's scenario there are a lot of parameters which is used in designing parameter which affects the life and quality and the working life and ability of the structure. In today's life software's are used to design structure. The software's which are used in daily life nowadays are Stand pro and Etabs. So, in this project we are going to planning, designing and Analyze a Residential G+12 Building using Etabs. M25 grade of concrete and Fe 415 steel material use for the design of structure. IS Code 456-2000 & IS 800-2007 LSM are used for concrete and steel section design. We are looking for the seismic analysis due to earthquake load

Keywords: Analysis, designing, etabs, load calculation

1 Introduction

The response of a structure to earthquake shaking is affected by interactions between three linked systems: the structure, the foundation, and the soil underlying and surrounding the foundation. Soil-structure interaction analysis evaluates the collective response of these systems to a specified ground motion. In design offices the base of multi-story buildings are taken as fixed and analyzed for earthquake response using provisions of IS 1893-2016 with the aid of response spectrum given for soft, medium and hard soils in foundation. However, in reality, the type of soil present in and around the foundation structure also participates in the seismic response and the assumption of fixed base becomes conservative. Soil structure interaction usually carried out for soft, medium and hard soil.

In this paper, the foundation is considered part of the structure, and the term SSI has been adopted. For the study an apartment of G+10storey with an elevation of 40.15m and with the plan shape of 28.2mx16.1m have been used and finite element modelling of same structure has been done in ETABS 20 for four seismic zones II,III,IV and V and for two different soil condition as per IS 1893 part-2-2014.

For planning purpose AutoCAD is used nowadays and for calculation purpose excel is the most common software but it is a tough task to complete the calculation work in excel so we are going to design our G+10Residential building on Etabs.. In Fig. 1 the plan which is made on AutoCAD is given. On which our project is based and we are going to analyze and design this structure by Etabs.



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The building was analyzed and designed with and without SSI effect. The purpose of the present study is to understand the behaviour of a framed structure subjected to seismic loading and soil structure interaction and compare their output result to understand its behaviour. Twenty RC buildings having the same geometry plan and height have been designed and analyzed.

2 Modelling Parameters

For planning purpose AutoCAD & design our G+10 Residential building on Etabs. In Fig. 1, 2, 3 are the plan, structural plan and elevation of the structure which is made on AutoCAD is given. On which our project is based and we are going to analyze and design this structure by Etabs. Of G+12storey with an elevation of 40.15m and with the plan shape of 28.2mx16.1m

Stages in Structural Design

The Stages of structural design involves the following stages.

- Structural Planning
- Estimation of loads
- Analysis of structure
- Member design
- Drawing, detailing and preparation of structures
- Member design

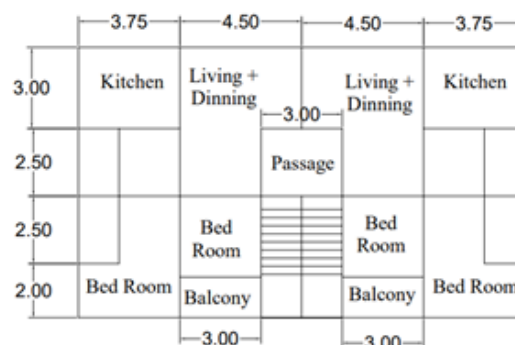


Figure 1: Plan of Structure



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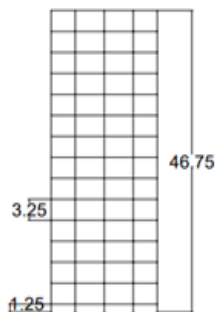


Figure 2: Structural Plan of Structure

- Drawing, detailing and preparation of structures.

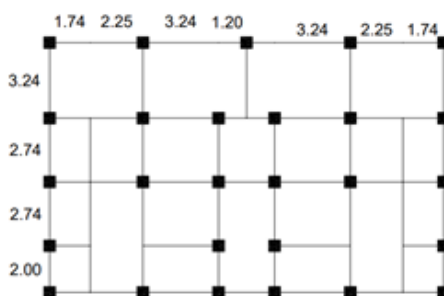


Figure 3: Elevation

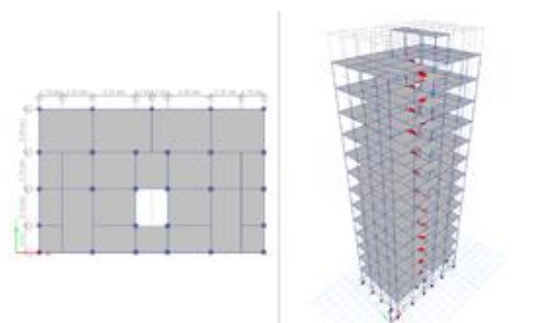


Figure 4: 2nd & 3rd view Etabs

3 Design and Analysis

The preliminary data required for the analysis of the structure is given in the table.

Table 1: Preliminary data for Analysis

1.Type of structure	Multi story rigid space frame(SMRF)
2. No. of storeys	G+10



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3.FloorSlab thickness	125 mm
4.Staircase waist slab	250 mm
5. Primary beam	240 mm X 325 mm
6. Secondary beam & Plinth beam	240 mm X 250mm
7. Column	350 mm X 350 mm 375 mm X 375 mm

Load calculation

As per Indian Standard code provisions Dead, Super Impose Dead, Live, and Wind & Seismic loads are taken.

Modelling in Etabs

Table 2: Maximum Storey displacement, Maximum storey drift and over tuning movement of a structure with fixed base condition

SL.No.	Story	Max. Storey Displacement (mm)		Max. Storey Drift		Overturning Moments (kN-m)	
		Z = 0.1	Z = 0.16	Z = 0.1	Z = 0.16	Z = 0.1	Z = 0.16
1	Story10	3.3	4.2	0.000379	0.000379	6204.136	6204.136
2	Story9	1.9	2.8	0.000258	0.000258	23374.12	23374.12
3	Story8	1.2	2.1	0.000046	0.000046	50221.57	50221.57
4	Story7	0.9	1.7	0.000056	0.000056	78040.74	78040.74
5	Story6	0.6	1.3	0.000042	0.000042	105859.9	105859.9
6	Story5	0.3	0.9	0.000095	0.000095	141521.5	141521.5
7	Story4	0.3	0.8	0.000082	0.000082	178154.9	178154.9
8	Story3	0.2	0.6	0.000071	0.000071	214788.2	214788.2
9	Story2	0.2	0.4	0.000055	0.000055	251421.6	251421.6
10	Story1	0.1	0.2	0.000056	0.000056	288055	288055
11	Base	0.1	0.1	0	0	292913.5	292913.5

Table 3: Maximum Storey displacement, Maximum storey drift and over tuning movement of a structure with flexible base condition

SL.No.	Story	Max. Storey Displacement (mm)		Max. Storey Drift		Overturning Moments (kN-m)	
		Z = 0.1	Z = 0.16	Z = 0.1	Z = 0.16	Z = 0.1	Z = 0.16
1	Story10	2.4	3.9	0.000379	0.000379	6204.136	6204.136
2	Story9	1.8	2.9	0.000153	0.000153	23374.12	19999.12
3	Story8	1.5	2.4	0.000014	0.000014	50221.57	41446.57
4	Story7	1.4	2.2	0.000012	0.000012	78040.74	63865.74
5	Story6	1.2	1.9	0.000031	0.000031	105859.9	86284.9
6	Story5	0.9	1.5	0.000063	0.000063	141521.5	114746.5
7	Story4	0.8	1.2	0.000044	0.000044	178154.9	144179.9
8	Story3	0.5	0.9	0.000032	0.000032	214788.2	173613.2
9	Story2	0.3	0.5	0.000022	0.000022	251421.6	203046.6
10	Story1	0.1	0.2	0.000008	0.000008	288055	232480
11	Base	0	0	0	0	292913.5	237338.5

4 Results and Discussion

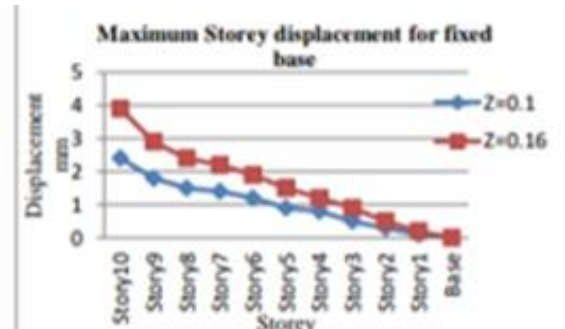
The structure was analysed in the versatile software Etabs 20. Joint coordinate command allows specifying and generating the coordinates of the joints of structure, initiating the specifications



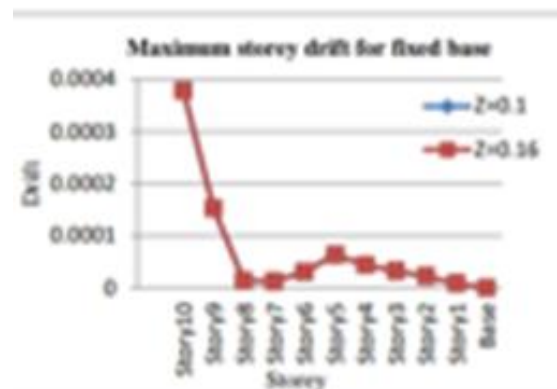
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of the structure. Member properties have to be specified for each member. From the analysis, maximum design loads, moments and shear on each member was obtained. From these values, we design the structure.

Maximum Storey Displacement



Maximum Storey Drift

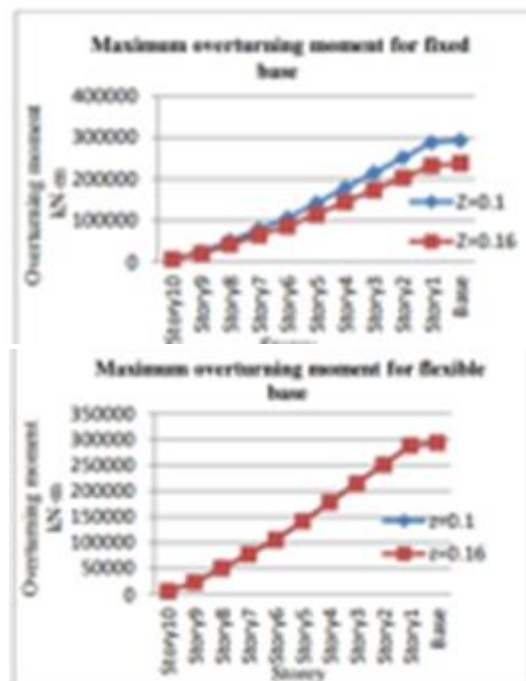




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Maximum Overturning Moment



5 Conclusions

Analysis and design of a RC building having G+12 Storey with different seismic Zone as zone II, III, IV, and V and with different soil types (hard, soft and medium) is done.

From the above outcomes, it is possible to conclude that, the maximum storey displacement and maximum story drift have significantly changed with their higher values when SSI effect is considered.

There is no drastic change in the overturning moments with flexible base condition compared with fixed base condition.

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