



Seismic Analysis Of Building With Flat And Waffle Slab Using ETABS

¹Saurabh Kumar Gautam, ²Ushendra Kumar

¹M.tech Student, ²Assistant Professor

¹Lucknow Institute of Technology, Lucknow

²Dept. of Civil Engineering, Lucknow Institute of Technology, Lucknow, India

Abstract: In This I have studied the seismic response of various types of slabs in commercial buildings and their seismic behavior is studied. As we know every year uncountable number of earthquakes occur at different places, that means, small movements of tectonic plates occur all the time causing earthquakes. A building designed to withstand seismic activity can protect more people. If we construct seismic resistant slabs and roofs, we will require more columns, however in some situations, such as airports, retail malls, and commercial buildings, extra columns may cause problems.

To address this issue, seismic designs for flat slabs and waffle slabs were developed. Flat/Waffle slabs are made up of concrete beams separated at constant intervals in perpendicular directions and are monolithically cast with slab, making them safer in earthquakes than traditional slabs.

Index Terms - Flat Slab, Earthquake Load, Response Spectrum, Storey Drift, Storey Displacement, E-Tab 2018, Base Shear Time Period, Mode Shapes.

1.INTRODUCTION

Building development is the process of developing and constructing structures such as residential homes. A simple structure can be defined as an enclosed room surrounded by dividers with a roof, food, fabric, and the needs of life. People used to live in caves, over trees, or under trees to protect themselves from wild animals, rain, and the sun. As time passed, people began to live in cottages made of lumber branches. The medieval sanctuaries have been transformed into magnificent dwellings.

Flat slab: A flat slab is a two-way reinforced concrete slab that usually does not have beams and girders, and the loads are transferred directly to the supporting concrete columns Flat slabs are also known as beamless slabs are the type of slab in which the floor slab is supported directly on columns without the action of beams or girders. Thin flat slabs ranging from 5 to 9 m are the preferred solution for building in-situ concrete frame buildings. These slabs are typically used on parking decks, commercial buildings, hotels, or places where beam projections are not desire.

2.Methodology & Building Specification

In this research paper, a standard commercial structure with two distinct slab layouts (Waffle Slab and Normal conventional slab) is investigated and illustrated in Fig 2. For this study, the length and width of the building are 15m and 18m, respectively. The building's height is considered to be 45m. Support conditions are considered fixed.

2.1. Equivalent Static Analysis

Every design against earthquake loads should take the heap's powerful concept into consideration. In any case, the same direct static examination approach is sufficient for simple standard constructions. Many training rules permit this for common, low-to medium-ascent structures.

Although this method does not require dynamic analysis, it does reflect the components of working in an estimated manner. The static strategy is the simplest; it relies on formulas provided in the training code and takes less computational effort.

2.2. Response spectrum Method

Response spectrum method is the linear dynamic analysis method. In this method the pinnacle reactions of a design during a seismic tremor are gotten straightforwardly from the quake reactions. The most severe response can be expressed as the largest relative speed or the most extreme relative dislodging when it is plotted against the undamped normal period and for various damping values Response.

Table 1. Building Specifications.

S.No	Specifications	Flat Slab	Flat slab
1	Plan Dimensions	15m x 18m	15m x 18m
2	Floor to Floor Height	3m	3m
3	Number of Stories	14	14
4	Slab thickness	0.10m	0.125m
5	Waffle Slab Thickness	0.450m	-
6	Spacing Of Ribs	0.60m	-
7	Stem Thickness	0.125m	-
8	Size Of Beam	0.30m x 0.45m	0.30m x 0.45m
9	Size Of Column	0.60m x 0.75m	0.60m x 0.75m
10	Number Of Column on One Floor	22	20
5	Response Reduction Factor		5
6	Importance Factor		1.2
7	Type Of Soil		Medium

4. Analysis and Discussion of the Results

Following an analysis of the two structures in E-Tabs, the constraints are created and displayed in the figures that follow.

1.Time Period- Here we compare the time period for both the structure and got the results as shown in Fig 5.

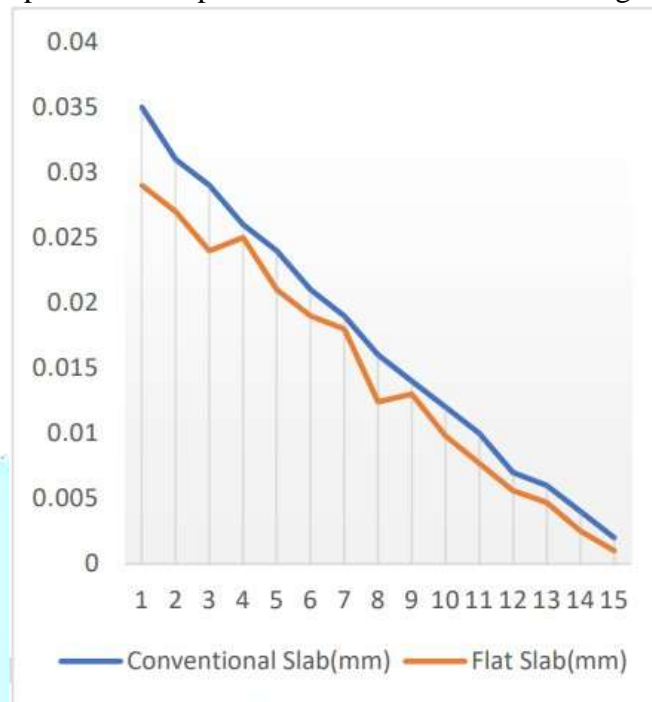


Fig 5. Comparison Of Time Period
Table 3. Comparison Of Time Period

Modal no.	Conventional Slab(mm)	Flat Slab(mm)
1	02.998	02.640
2	02.630	02.445
3	02.598	01.977
4	00.879	00.989
5	00.869	00.856
6	00.834	00.858
7	00.767	00.628
8	00.474	00.427
9	00.456	00.389
10	00.421	00.238
11	00.303	00.263
12	00.296	00.189

2.Storey Displacement – It falls under the category of tale dislocation with regard to the bottom story.

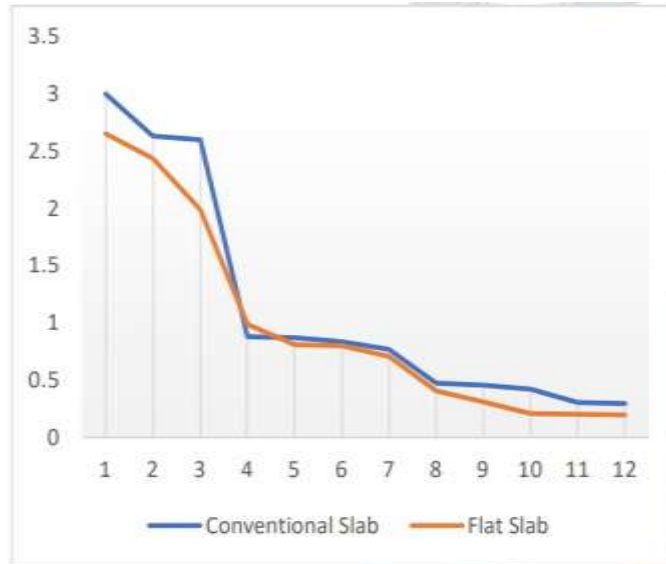


Fig 6 . Comparison Of Storey Displacement
Table 4 . Comparison of Storey Displacement

Modal no.	Conventional Slab (mm)	Flat Slab(mm)
1	0.034	0.030
2	0.030	0.026
3	0.028	0.022
4	0.027	0.020
5	0.025	0.018
6	0.022	0.019
7	0.020	0.016
8	0.018	0.0120
9	0.016	0.011
10	0.014	0.0010
11	0.011	0.0080
12	0.006	0.0060
13	0.005	0.0042
14	0.003	0.0028
15	0.001	0.002

3. Storey Drift - One way to describe it would be the displacement of one story relative to another.



Fig.7 Comparison of Storey Drift

Table 5. Comparison Of Storey Drift

S.No.	Conventional Slab (mm)	Flat Slab (mm)
1	0.000001	4.183E-07
2	0.000001	4.328E-07
3	0.000001	4.537E-07
4	0.000001	4.768E-07
5	0.000001	0.000001
6	0.000001	0.000001
7	0.000001	0.000001
8	0.000001	0.000001
9	0.000001	0.000001
10	0.000001	0.000001
11	0.000001	0.000001
12	0.000001	4.743E-07
13	0.000001	4.454E-07
14	4.582E-07	3.665E-07
15	3.678E-07	2.996E-07

4. Base Shear – According to our calculations, the base shear for a conventional slab is more than the base shear for a flat slab. Base shear is defined as the shear acting at the base of the structure; it should be less to prevent building failure.

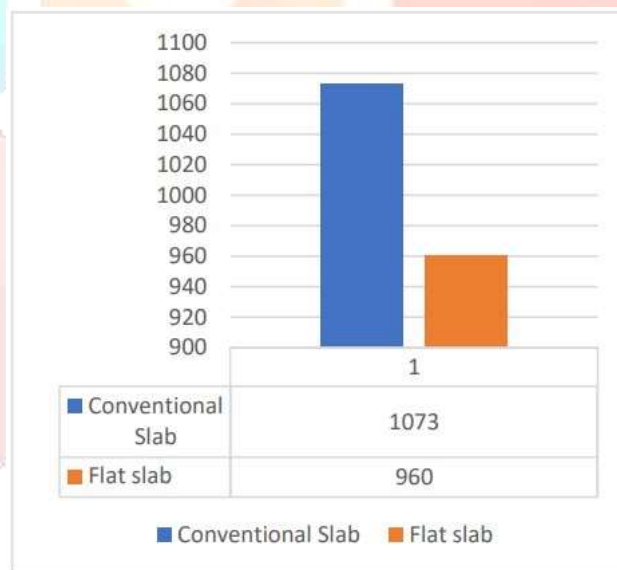


Fig 8. Comparison of Base shear

6. CONCLUSIONS

- Compared to a flat slab, the maximum story displacement for a typical conventional slab is 0.828% higher.
- Normal conventional slabs have a maximum time duration that is 0.2% longer than flat slabs.
- Compared to flat or waffle slabs, the maximum story drift for a standard slab is 0.5% higher.
- Compared to a typical slab, the base shear of a flat slab is 26.92% higher. Shear building is safe in flat slab as opposed to steep base.

We can therefore draw the conclusion that, when two structures with different slab arrangements are compared, the building with a flat slab is safer in terms of seismic responses in higher zone factor areas.

Additionally, flat slabs are advised in situations where fewer columns are needed, as in this case, where there are fewer than two columns per story.

REFERENCES

- [1]“Dynamic Analysis Of Special Moment Resisting Frame Building With Flat Slab And Grid Slab”, International Journal of Engineering Research and Application, Vol. 2, Issue 4, pp.275-280.
- [2] Muniraju K.S, Subramanya K.G (2015),” Comparative Study of Seismic Analysis between Conventional RC Frame and Flat Slab with Drop”, International Journal for Scientific Research & Development, Vol. 3, Issue 09.
- [3] R.S.More, V. S. Sawant, Y. R. Suryawanshi (2015),” Analytical Study of Different Types of Flat Slab Subjected to Dynamic Loading”, International Journal of Science and Research (IJSR) , Volume 4 Issue 7.
- [4] Archana Shaga, Satyanarayana Polisetty (2016),” Seismic Performance of Flat Slab with drop and Conventional Slab Structure”, International Journal of Latest Engineering Research and Applications (IJLERA), Volume 01, Issue 09, PP 79-94.
- [5] Chintha Santhosh, Venkatesh Wadki, S.Madan Mohan, S.Sreenatha Reddy (2016), “Analysis and Design of Multistorey Building with Grid Slab Using E-Tabs”, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 9.

