JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Seismic Analysis of Commercial Building with Flat & Waffle slab using ETABS.

ANURAG KUMAR PANDEY [a] , Ms. ANJALI RAI[b]
[a] M.Tech Student, Department Of Civil Engineering
[b] Assistant Professor, Department Of Structural Engineering
Institute of Engineering and Technology, Lucknow, Uttar Pradesh, India

Abstract :

In This I have studied the seismic response of various types of slab 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 seismic resistant designed building can provide safety for more people. slabs and roofs needed more columns if we design seismic resistant design but at some places like airport, shopping mall, commercial building more column can create some problem. To overcome this problem seismic design of Flat slab & waffle slabs was comes out. Flat /Waffle slab consists of Concrete beams spaced at uniform intervals in perpendicular directions which are monolithically casted with slab and they are more safe in earthquake situation as comparison of to normal conventional slab.

Keywords : 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 designing arrangements with the development of building like private houses. In a straightforward structure can be characterize as an encase space by dividers with rooftop, food, fabric and the essential necessities of people. In the early antiquated occasions people lived in caves, over trees or under trees, to shield themselves from wild creatures, downpour, sun, and so on as the occasions passed as people being begun living in cottages made of lumber branches. The sanctuaries of those old have been formed these days into delightful houses.

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.Methdology & Building Specification

In this Research Paper a regular commercial buildings with two different slab arrangements Waffle Slab & Normal conventional slab is considered and shown in Fig 2. For this study length of building taken is 15m and width of building is 18m is considered. the building height is considered as 45m. Support conditions are considered fixed.

1.Equivalent Static Analysis

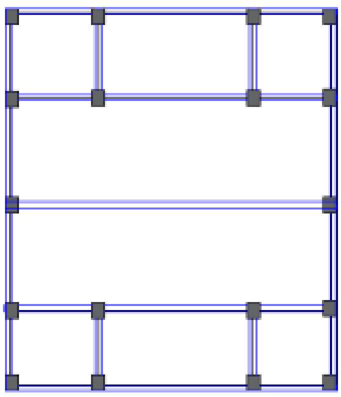
All plan against seismic burdens should think about the powerful idea of the heap. In any case, for straightforward standard constructions, investigation by identical direct static examination strategy is adequate. This is allowed in many codes of training for ordinary, low-to medium-ascent structures. This technique doesn't need dynamic examination; notwithstanding, it represent the elements of working in an estimated way. The static technique is the least complex one; it requires less computational endeavours and depends on formulae given in the code of training.

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 is gotten straightforwardly from the quake reactions. The most extreme reaction is plotted against the undamped normal period and for different damping values, and can be communicated as far as greatest relative speed or most extreme relative dislodging .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	15	15
4	Slab thickness	0.1m	0.125m
5	Waffle Slab Thickness	0.45m	-
6	Spacing Of Ribs	0.6m	-
7	Stem Thickness	0.125m	-
8	Size Of Beam	0.3m x 0.45m	0.3m x 0.45m
9	Size Of Column	0.6m x 0.75m	0.6m x 0.75m
10	Number Of Column On One Floor	20	18



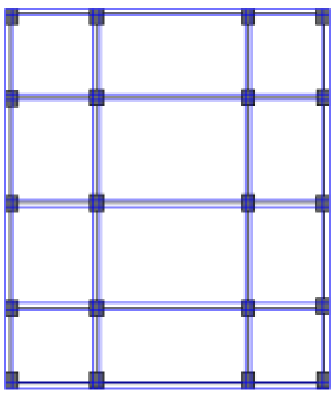
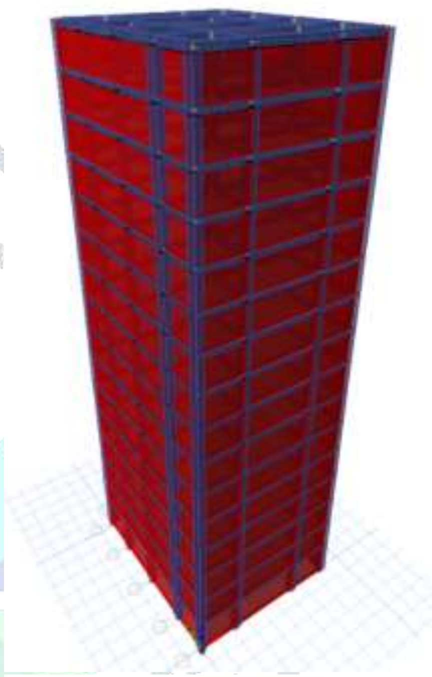


Fig 1. Plan View Of Grid Slab

Fig 2. Plan View Of Flat Slab

3.Modelling

Plan and 3-Dimensional View of the building is shown in below figure .The entire 2 type of building characteristics is shown in Table 1 & the following Fig 3,4, Shows the 3-Dimensional View of the building with Flat slab & Conventional slab arrangements such as Conventional ,Flat slab respectively. All the Structures are checked for Gravity Loads, Lateral Loads (Seismic Load) with various load combination as per IS codes and response spectrum is used for analysis.



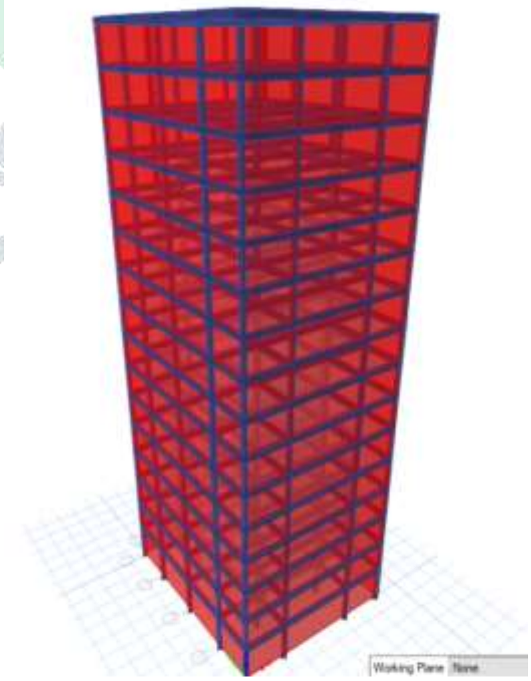


Fig 3. Flat Slab 3-D View

Fig 4. Flat Slab 3-D View

Table 2. Seismic Data

S.No	Specification	Value
1	Grade Of Steel	Fe-500
2	Grade Of Concrete	M-40
3	Seismic Zone	III
4	Zone Factor	0.16
5	Response Reduction Factor	5
6	Importance Factor	1.2
7	Type Of Soil	Medium

4.Analysis & Result Discussion

After analysing both the structure in E-Tabs, the constraints are drawn and shown in following figures.

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

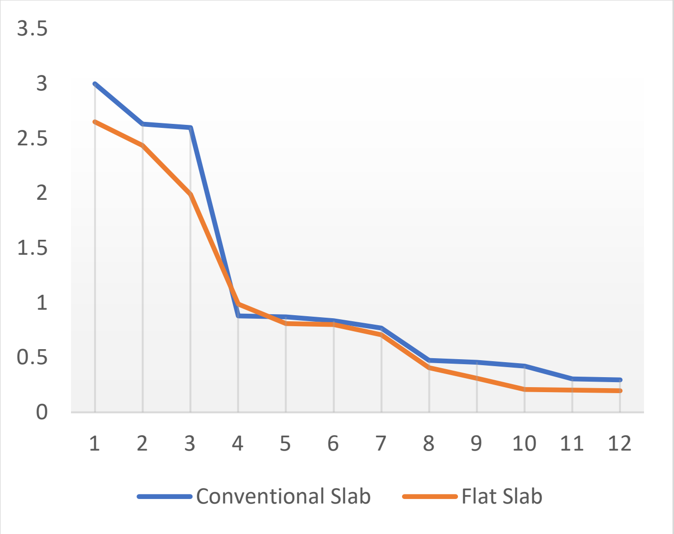


Fig 5. Comparison Of Time Period

Table 3. Comparison Of Time Period

Modal case	Conventional Slab	Flat Slab
1	2.998	2.650
2	2.630	2.435
3	2.598	1.987
4	0.879	0.987
5	0.869	0.808
6	0.834	0.801
7	0.767	0.708
8	0.474	0.407
9	0.456	0.309
10	0.421	0.208
11	0.303	0.201
12	0.296	0.195

2.Storey Displacement – It Is categorized as the dislocation of story with respect of bottom story.

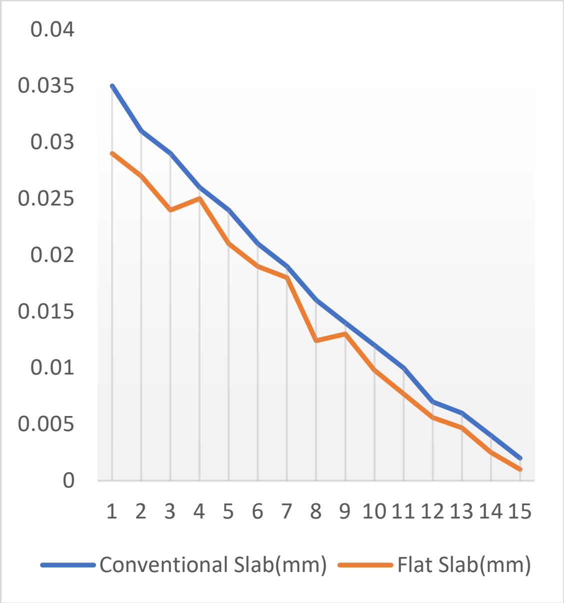


Fig 6 . Comparison Of Storey Displacement

Table 4 . Comparison of Storey Displacement

Modal	Conventional Slab(mm)	Flat Slab(mm)
1	0.035	0.029
2	0.031	0.027
3	0.029	0.024
4	0.026	0.025
5	0.024	0.021
6	0.021	0.019
7	0.019	0.018
8	0.016	0.0124
9	0.014	0.013
10	0.012	0.0098
11	0.01	0.0077
12	0.007	0.0056
13	0.006	0.0047
14	0.004	0.0025
15	0.002	0.001

3.Storey Drift - – It can be characterized as Displacement of one story with respect to other.

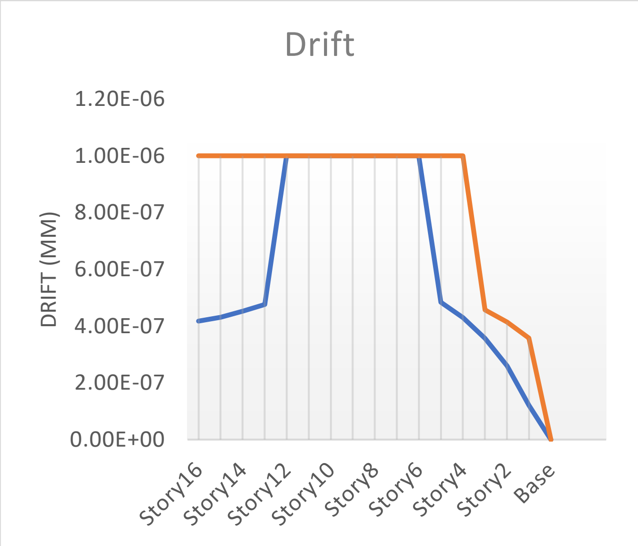


Fig.7 Comparison of Storey Drift

Table 5. Comparison Of Storey Drift

S.No	Conventional Slab	Flat Slab
1	0.000001	4.173E-07
2	0.000001	4.318E-07
3	0.000001	4.527E-07
4	0.000001	4.767E-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	4.843E-07
13	0.000001	4.304E-07
14	4.573E-07	3.565E-07
15	3.586E-07	2.596E-07

4. Base Shear – It is defined as the shear acting at the base of the structure it should be to be less to avoid the failure of building and in our analysis base shear for conventional slab is more than base shear for Flat slab.

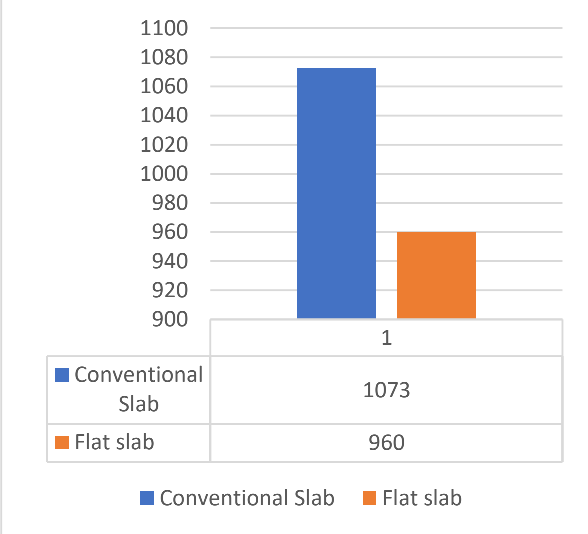


Fig 8.

Comparison of Base shear

6.Conclusion

- The Maximum Story displacement for normal conventional slab is <u>0.828%</u> higher than Flat slab.
- The Maximum Time period of normal conventional slab is <u>0.2%</u> higher than Flat slab.
- The Maximum story drift of conventional slab is *<u>0.5%</u>* higher than Flat/waffle slab.
- The base shear of Flat slab is *<u>26.92%</u>* higher than conventional slab. Instead of having high base shear building is safe in Flat slab.

So We can Conclude that on comparison of two structures with different Slab arrangements we got that Flat Slab are more safe on Seismic Responses in higher zone factor area, also Flat slab are recommended where we need to reduce the number of columns such as here we have reduced two number of columns per story and still we got the results as Building with Flat Slab is More Safe as comparison of Building With Conventional slab.

7.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.