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Seismic Analysis of Commercial Building with Grid/Waffle slab using ETABS

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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 grid slab or waffle slabs was comes out. Grid /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: Grid Slab, Earthquake Load , Response Spectrum , Storey Drift, Storey Displacement , E-Tab 2018 , Base Shear, Time Period , Mode Shapes.

I. 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.

A. Grid Slab

Interconnected network frameworks are by and large ordinarily utilized or supporting structure floors connect decks and overhead water tanks pieces. A network is a planar primary framework made out of consistent individuals that either meet or cross one another .Grids are utilized to cover enormous section free regions and have been developed in number of regions in India and abroad. Is exposed to loads applied regularly to its plane, the design is alluded as Grid. It is made out of nonstop part that either meet or cross one another.

II. LITERATURE REVIEW

Amit A. Sathwane [1] has targeted on seismic analysis flat slab and grid slab by manual method and by stadd pro software also and finds that Grid slab is more safer in seismic.D Ramya [2] has analysed seismic behaviour of by staddpro and etab finds that quantity of steel given by E Tab is 9.25% less than Staddpro.Navjot Kumar Bhatiya [3] Studied that dynamic performance of flat slab, flat slab with & Without drop, and waffle slab for 3 earthquake zone as per indian standard code IS 1893-2002 . Anitha K [4] In this paper they studied that grid floor system is a customary technique where pillar are divided at a standard stretch in opposite ways solid projected with piece. Ulfat Sobaree [5] In this paper flat and grid slab on the basis of static and dynamic analysis in zone VI and r beams provided at square and rectangular intervals. K.N.Mate [6] In this the flat slab is analyzed .Flat slab framework is straightforward design of RCC which give long clear space, a decent tallness, basic formwork and no postpone time in development. It is shown that why the level section is more plausible and adaptable in contrast with other chunk . Bharat Nishan .

III. METHODOLOGY & BUILDING SPECIFICATION

In this Research Paper a regular commercial building 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.

A. 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. To begin with, the plan base shear is registered for the entire structure, and it is then conveyed along the tallness of the building. The horizontal powers at each floor levels hence got are circulated to individual sidelong burden opposing components.

B. 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 Spectrum Method is used for this study to analyse all the 3 Models with different slab arrangements and the various parameters such as story displacement, story drift, Storey Shear, Time Period are analysed and noted their response for comparison.

Table 1. Building Specifications.

S.No	Specifications	Grid Slab	Conventional 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

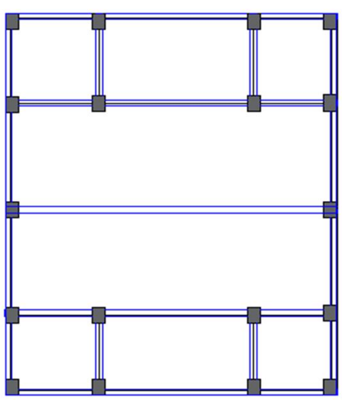

Fig 1. Plan View Of Grid Slab

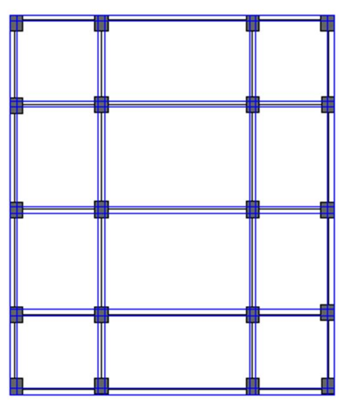

Fig 2. Plan View Of Conventional Slab

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IV. 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 Gird slab & Conventional slab arrangements such as Conventional ,Grid 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.

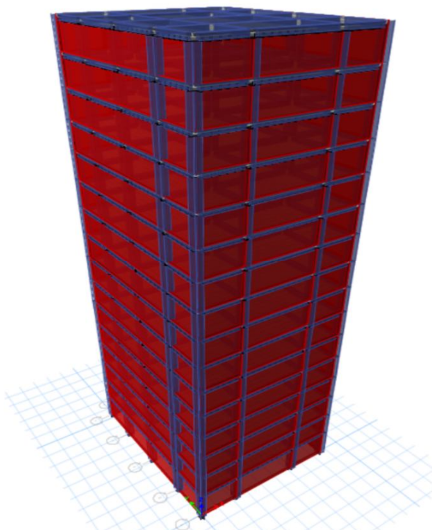

Fig3.Grid Slab 3-D View

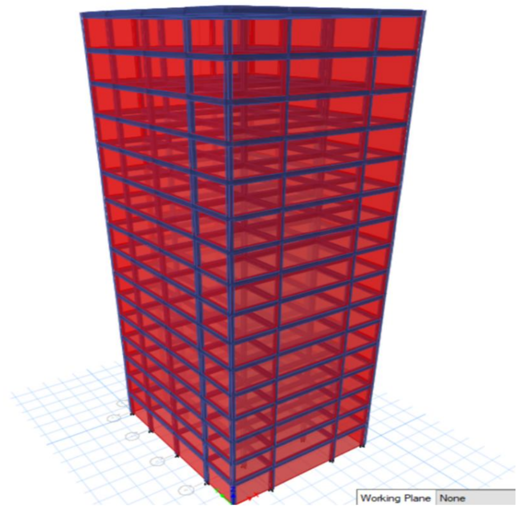

Fig 4. Conventional Slab 3-D View

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

V. ANALYSIS & RESULT DISCUSSION

After analysing both the structure in E-Tabs, the constraints are drawn and shown in following figures. From all the load combination the responses are recorded according to Response spectrum forces and compared, buildings are supposed to be permanently fixed joints. In Seismic Zone III all the models are analysed by response spectrum method for Maximum Storey Displacement, Base Shear ,Storey Drift ,Storey shear , Lateral Loads and Natural Time Period then results are compared for both the model.

A. Load Combinations

1) *Dead Load:* This Consists of Self Weight building characteristics (Beam ,Column , Slab & Brick work)
   a) Outer Wall Loads– 14.72Kn/m^2
   b) Internal Wall Load- 7.36 Kn/m^2
   c) Floor Finishes- 1 Kn/m^2

2) *Live Loads:* Live Loads as per IS 875 (Part 1) is 4Kn/m^2
3) Seismic Loads In X & Y Directions
4) Response spectrum Loads in X & Y Direction

a) *Time Period:* It can be defined as period for which a structure oscillate naturally at the time of seismic effect. Here we compare the time period for both the structure and got the results as shown in Fig 5.

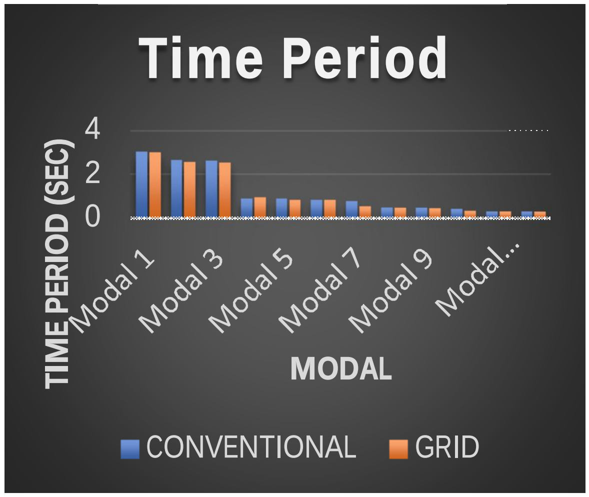

Fig 5. Comparison Of Time Period

Table 3. Comparison Of Time Period

Modal case	Conventional Slab	Grid Slab
1	2.998	2.992
2	2.630	2.531
3	2.598	2.517
4	0.879	0.925
5	0.869	0.822
6	0.834	0.807
7	0.767	0.516
8	0.474	0.456
9	0.456	0.449
10	0.421	0.338
11	0.303	0.298
12	0.296	0.294

b) *Storey Displacement:* It Is categorized as the dislocation of storey with respect of bottom storey. Displacement increases with increasing the number of storey and maximum at the top storey.

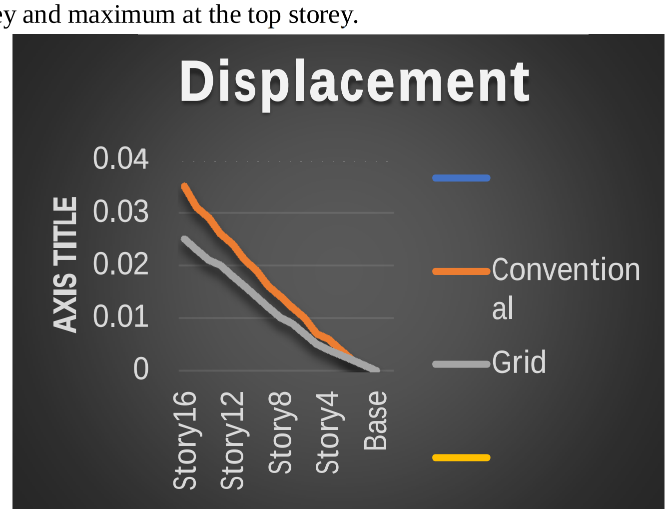

Fig 6 . Comparison Of Storey Displacement

Table 4 . Comparison of Storey Displacement

Modal	Conventional Slab(mm)	Grid Slab(mm)
1	0.035	0.025
2	0.031	0.023
3	0.029	0.021
4	0.026	0.02
5	0.024	0.018
6	0.021	0.016
7	0.019	0.014
8	0.016	0.012
9	0.014	0.01
10	0.012	0.009
11	0.01	0.007
12	0.007	0.005
13	0.006	0.004
14	0.004	0.003
15	0.002	0.002

c) *Storey Drift:* It can be characterized as Displacement of one story with respect to other.

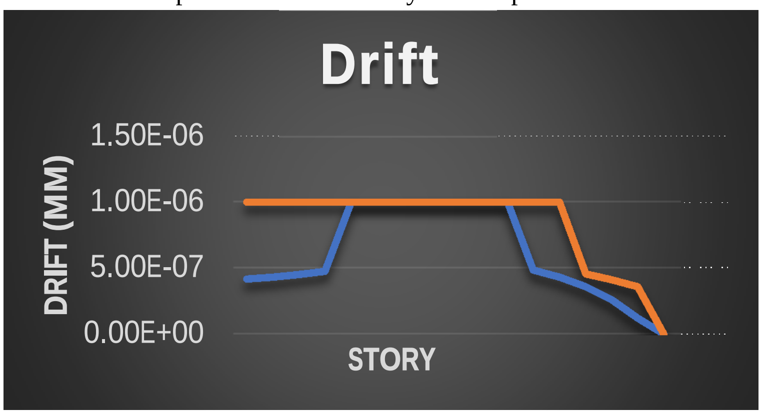

Fig.7 Comparison of Storey Drift

Table 5. Comparison Of Storey Drift

S.No	Conventional Slab	Grid 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

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d) *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 grid slab.

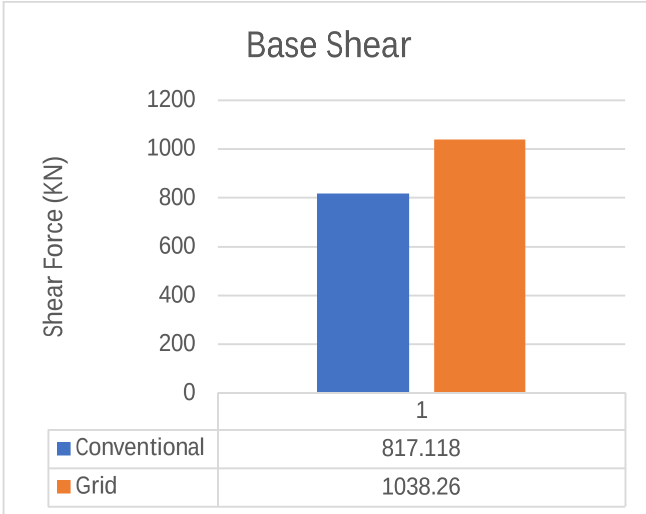


Fig 8. Comparison of Base shear

e) *Lateral Force Comparison:* It is Defined as lateral Seismic Load Acting on the Structure.

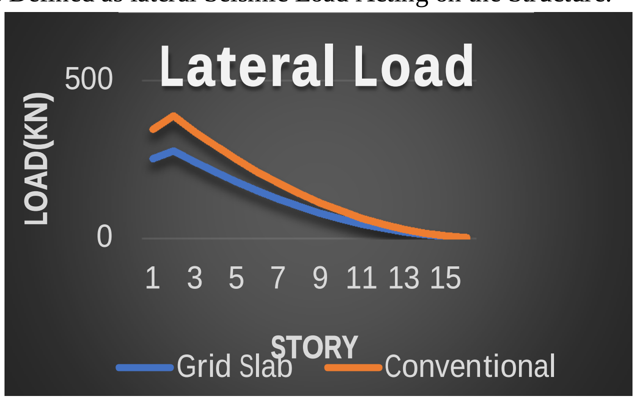


Fig 9. Comparison Of Lateral Loads

VI. CONCLUSION

A. The Maximum Story displacement for normal conventional slab is 40% higher than grid slab.
B. The Maximum Time period of normal conventional slab is 0.2% higher than grid slab.
C. The Maximum story drift of conventional slab is *0.5%* higher than grid/waffle slab.
D. The Maximum Lateral Loads in conventional is *36.9%* higher than Grid/waffle slab.
E. The base shear of grid slab is *26.92%* higher than conventional slab. Instead of having high base shear building is safe in Grid slab.
F. The stiffness of normal conventional slab is higher than grid/waffle slab but too much stiff building is not safe for seismic response hence we can conclude that for overall seismic response of building with Grid slab is better than conventional slab.

So We can Conclude that on comparison of two structures with different Slab arrangements we got that Grid Slab are more safe on Seismic Responses in higher zone factor area, also Grid 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 Grid Slab is More Safe as comparison of Building With Conventional slab.

REFERENCES

[1] Chintha Santosh, Venkatesh Wadki, S. Madan Mohan, S. Sreenatha Reddy (2016), " Analysis and design of multi-storey Building with Grid slab Using ETABS", Iternational journal of Innovative Research in science, Engineering and Technology, vol. 5, issue 9.

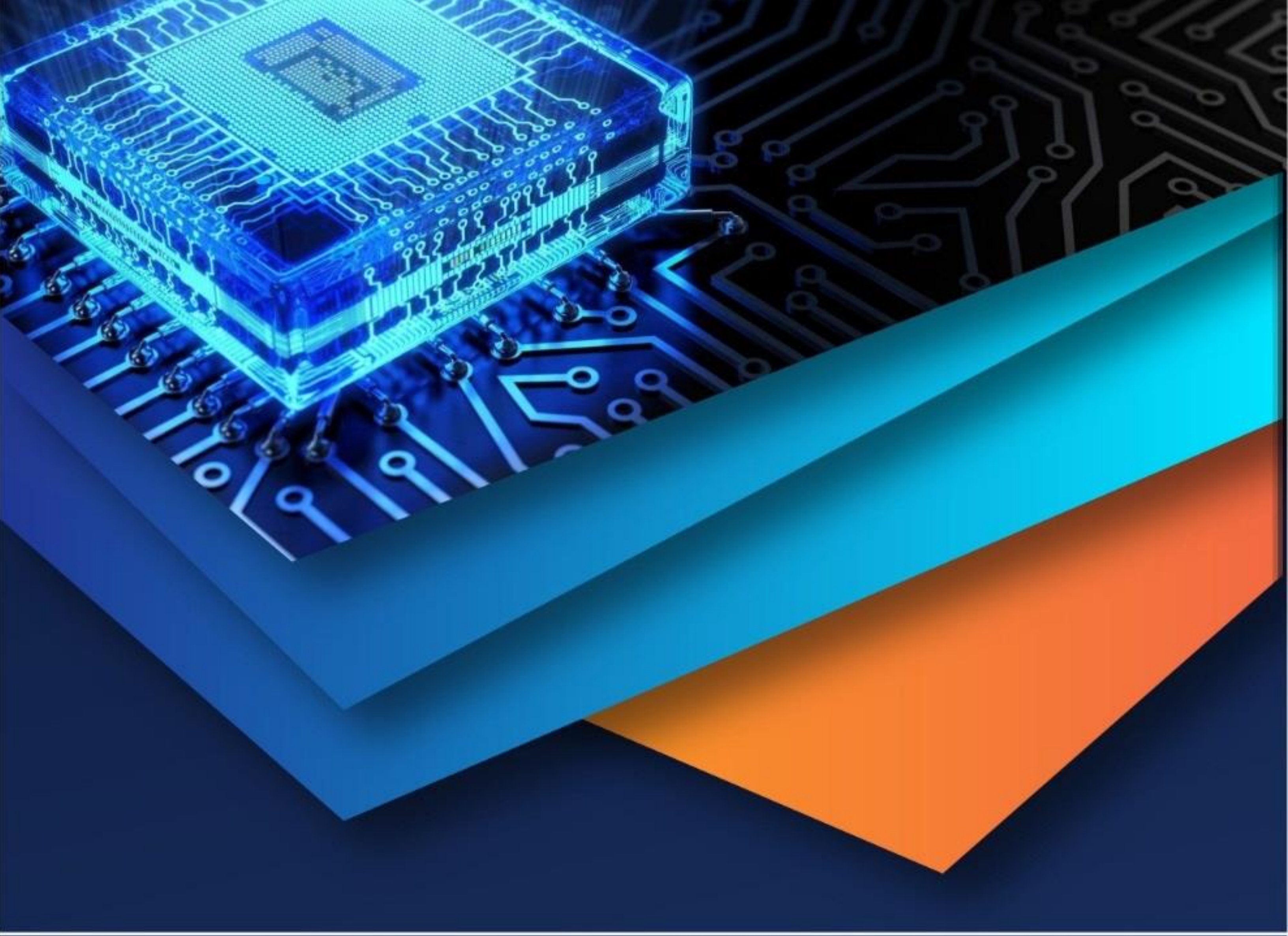
[2] Santosh D Bothara, Dr. Valsson Varghese (2012), " Dynamic Analysis of Special Moment Resisting frame Building with flat and grid slab", international journal of engineering research and application, vol. 2, issue 4.

[3] Miss. S. N. Utane, Prof. H. B. Dahake (2016)," Effect of Shape Irregularity on Flat slab Industrial Building under Lateral Loading", International Journal of Modern Trends in Engineering and Research (IJMTER), Volume 03, Issue 03.

[4] Navjot Kaur Bhatia, Tuhsar Golait (2016)," Studying the Response of Flat Slabs & Grid Slabs Systems in Conventional RCC Buildings", International Journal of Trend in Research and Development (IJTRD), Volume 3(3).

[5] Ch.Rajkumar, Dr.D.Venkateswarlu (2017)," Analysis and Design of Multi-storey Building with Grid Slab Using ETABS", International Journal of Professional Engineering Studies, Volume VIII, Issue 5.

[6] Sohan Lal (2018), "Comparison between Flat and Conventional Slab of High Rise Buildings with Varying Geometry under Seismic Loading Condition", Journal of Structural Technology, Volume 3, Issue 1. etc.



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