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Structural Analysis of Conventional slab, flat slab and grid slab

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ABSTRACT

Urbanization is rapidly increasing nowadays therefore effect of earthquake also play an important role to analysis and design of structure. The principal purpose of this work is to analyses and design of G+10 commercial building for seismic zone IV & V with different slab arrangements, i.e., Conventional slab, Flat slab with drop panels, Grid/ Waffle slab. There are several parameters which affect the performance of structure from which storey drift; base shear and storey displacement play a crucial role in finding the behaviour of structure against the seismic loads. An evaluation of this seismic parameter has been analysis by ETAB 2016 software. The analysis and design are done by the IS 456:2000 and IS 1893:2016 by using the M30 grade of concrete and FE 500 grade of steel

Keywords: Conventional Slab, Flat slab, grid slab, storey displacements, storey drift, storey shear, base shear, storey stiffness

I. INTRODUCTION:

The earthquake may additionally harm the structural factors such as slab, beam, column. The sort of slab type i.e. Convectional slab, flat slab and grid slab also play a crucialrole in the seismic parameters of multi-storey building. Building with Conventional slab is the slab resting on regular beam and columns. In conventional slab, load transfers of the slab on columns, the columns to the beams and from beams to foundation. Flat slab is a concrete slab that is supported at once by columns without usage of beams. Flat slab with drop panel is stronger than the flat slab without drop panel. Flat slab is easy to construct and requires less scaffolding work. Grid/ Waffle/ Two-way ribbed slab is the reinforced concrete slab which consists of beams in two directions. Grid slab is widely used for industrial and commercial buildings. It is used for that place where column spacing is more and can be constructed rapidly as compared with conventional slab. Seismic load is the important factor for collapse of many high-rise structures. Seismic zone plays a significant role in the design of building structures for earthquake resistant. Base Shear, Storey displacement, Storey drift, and Lateral forces acting on a structure plays a vital role in checking the building's stability against seismic load. Design seismic load at each floor height is termed as storey shear. Summation of storey shear is base shear. Storey displacement is overall displacement of the storey. Storey drift is depicted as ratio of displacement of two successive floors to altitude of that floor. It is very important to determine the Storey drift for earthquake analysis of buildings.

II. Objectives

1. To analyse the comparative study between the conventional slab, flat slab and grid slab.
2. To perform the analysis and design of slab for seismic resistant structure.
3. Design the structure for the various seismic zones IV and analysis of convectional slab, flat slab and grid slab.
4. To find the effectiveness and strength of convectional slab, flat slab and grid slab for various seismic zone IV
5. To find out the seismic characteristics of structure like storey drift, storey shear, base shear.

III. Methodology

1. Prepare the software model on ETABs of G+10 RCC symmetrical building.
2. Analysis and design of building for convectional slab, flat slab and grid slab
3. Analysis and design of building for convectional slab, flat slab and grid slab for seismic zones IV using Etabs.
4. Compare the results analytically by using Etabs.

IV. Modelling

Specifications:

Dead Load: Self wight of beams, column. slabs, drops

Live load: 4KN/m^2(As per the IS 875 Part 1)

Floor Finish Load: **1**KN/m^2

Seismic Loads (IS 1893:2016)

Seismic Zones Z= 0.24

Response Reduction Factor R=5

Importance Factor I= 1

Silt Type=2

Table 1:Structural Dimensions

Parameter	**Conventional slab**	**Flat slab**	**Grid slab**
No ofstorey	G+10	G+10	G+10
PlanDimension	30m X 20m	30m X 20m	30m X 20m
BeamDimension	300mm X300mm	300mm X300mm	300mm X300mm
ColumnDimensions	500mm X500mm	500mm X500mm	500mm X500mm
SlabThickness	150mm	150mm	150mm
Drop PanelsThickness	Nil	100mm	100mm

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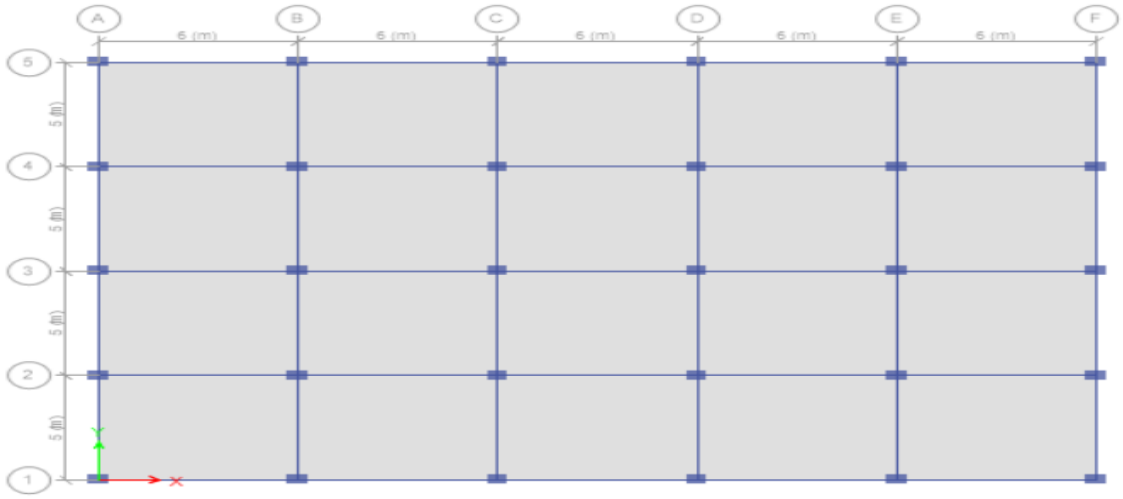

Fig 1: Plan of RCC building With Convectional Slab

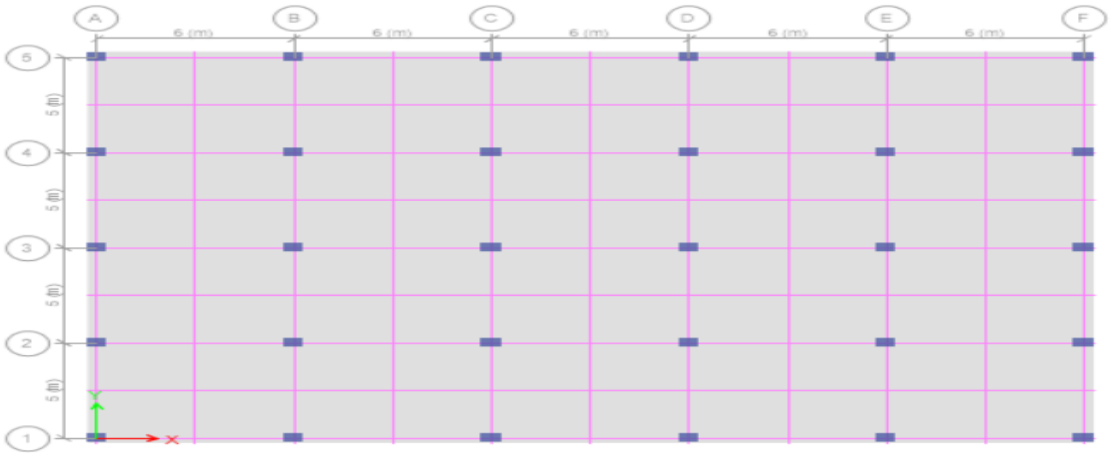

Fig. 2: - Plan of RCC building with flat slab

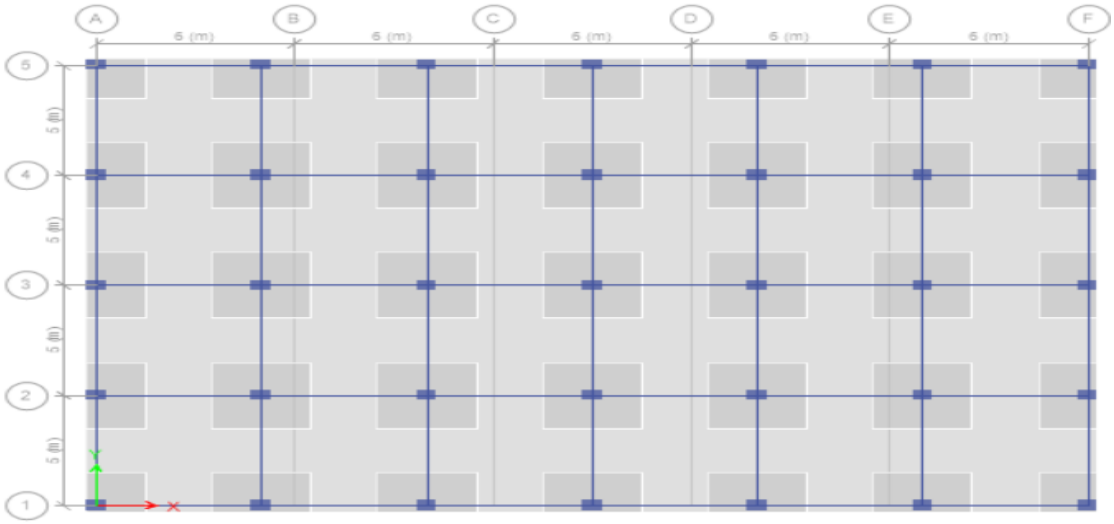

Fig. 3: - Plan of RCC building with Grid Slab

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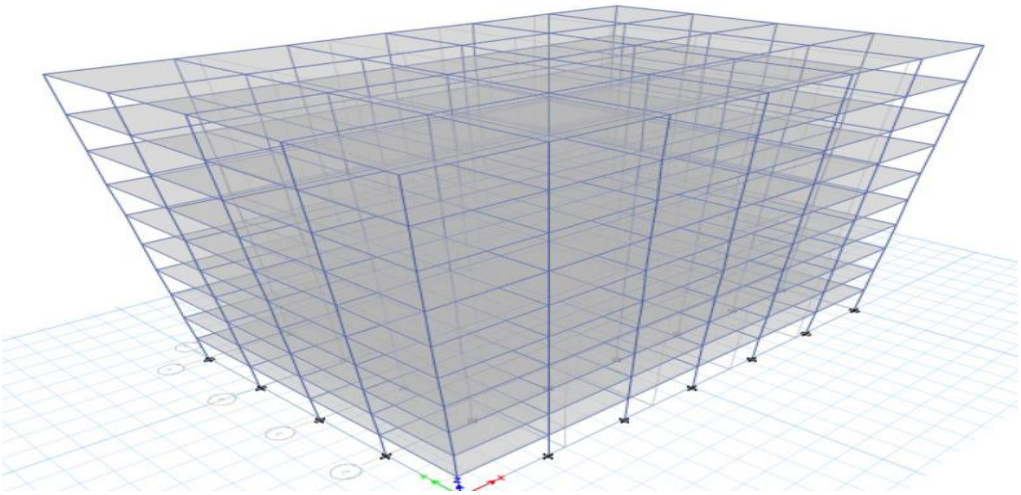

Fig 4 : Elevation of RCC building with convectional slab

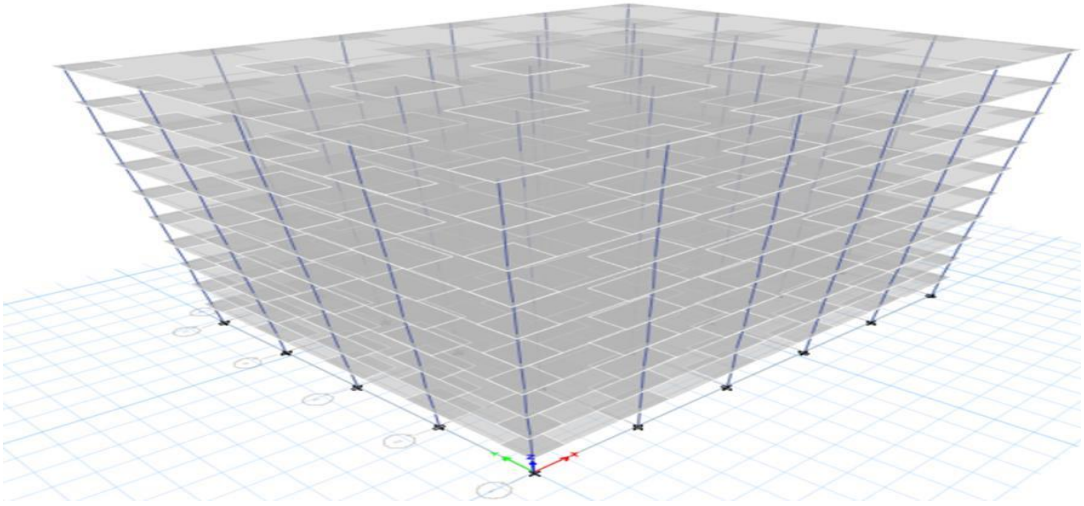

Fig 5 Elevation of RCC building with Flat slab

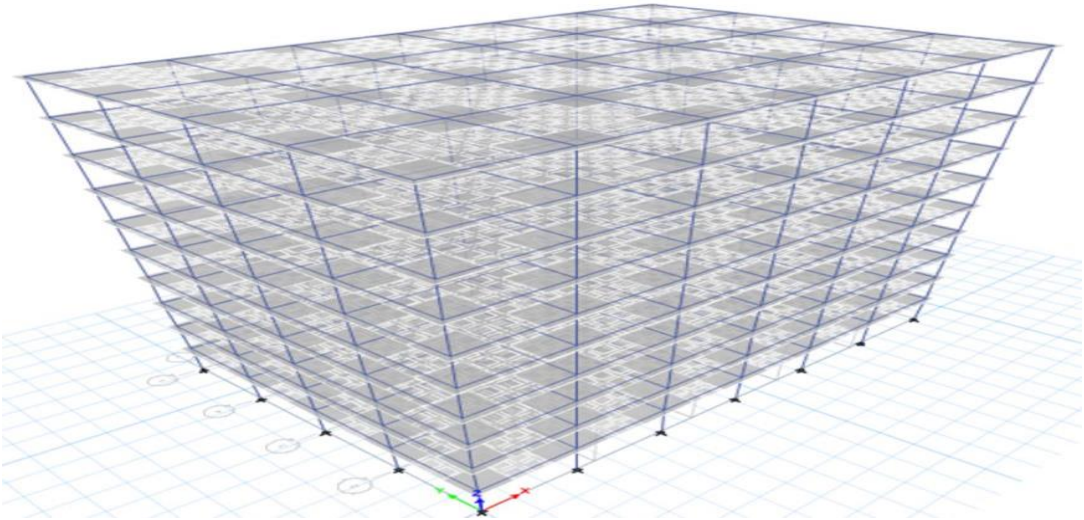

Fig 6: **Elevation of RCC building with Grid slab**

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V. Results

- Maximum storey displacement of various models –

Table 2. Values of max storey displacement for Zone IV

STOREY	Convectional Slab	Flat Slab	Grid Slab
10	9.178	13.763	19.85
9	8.688	13.028	19.209
8	8.042	12.06	18.183
7	7.214	10.819	16.809
6	6.211	9.314	15.157
5	5.059	7.587	13.298
4	3.806	5.708	11.29
3	2.526	3.788	9.173
2	1.331	1.997	6.928
1	0.398	0.597	4.302

- Storey shear of various models

Table 3. Values of storey shear for Zone –IV

STOREY	Convectional Slab	Flat Slab	Grid Slab
10	-477.006	-164.658	-112.118
9	-890.573	-312.114	-118.623
8	-1217.34	-428.622	-164.06
7	-1467.52	-517.824	-198.847
6	-1651.33	-583.36	-224.405
5	-1778.97	-628.871	-242.154
4	-1860.67	-657.998	-253.513
3	-1906.62	-1413.95	-259.903
2	-1927.04	-1583.87	-262.742
1	-1932.15	-1753.78	-263.452

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- Storey drift of various models

Table 4. Values of storey drift for Zone –IV

STOREY	Convectional Slab	Flat Slab	Grid Slab
10	0.000738	0.000541	0.000407
9	0.000983	0.000882	0.000446
8	0.00183	0.001179	0.000493
7	0.002078	0.001411	0.000537
6	0.002178	0.001584	0.000568
5	0.0023	0.001706	0.000569
4	0.00215	0.001789	0.000532
3	0.00195	0.001976	0.000449
2	0.0024	0.0022	0.000312
1	0.001901	0.00422	0.000114

- Storey stiffnessof various models

Table 5 Values of storey stiffness for Zone –IV

STOREY	Convectional Slab	Flat Slab	Grid Slab
10	458513.762	251997.488	29900.6
9	525495.175	388988.521	51005.705
8	538761.437	441127.42	61200.481
7	543332.968	460117.487	64976.781
6	545336.084	469944.261	66987.909
5	546303.935	483107.763	69441.854
4	545591.668	483107.763	75322.152
3	534768.007	353107.763	89534.129
2	461679.743	283107.763	14999.083
1	237114.706	183107.763	14529.42

VI.CONCLUSION:

Conclusions that can be drawn from study are as follows-

1. storey displacement for grid slab is 90% less than the conventional slab. Storey displacement for grid slab is

70% less than the flat slab. Grid slab storey displacement is 30% minimum than the flat slab and 90% minimum than conventional slab.

2. The storey shear for the conventional slab is 6.6% is more than the value of grid slab for seismic zone IV and V. storey shear for flat slab is 0.67% more than the grid slab. The storey shear for conventional slab is 5.94% more than the flat slab.

3. Base shear is 1.3% minimum for the building design with the grid slab than the building design flat slab. The value of base shear for building design with the conventional slab 22.89% more than the building design with the flat slab.

4. Storey drift is maximum for the conventional slab and it is maximum for the storey 5. Flat slab has maximum displacement than grid slab. Grid slab have minimum displacement than the flat slab and conventional slab. storey drifts for conventional slab and is 53.93% and 29.87% more than the grid slab

5. stiffness is minimum for the grid slab than flat slab and conventional slab. Building design with the conventional slab has 49.55% more than grid slab. Flat slab has 23.06% more than grid slab. It is concluded that building design with grid slab is economical and safer when compared with other building slab arrangements. This increases the flexibility of the structure and increase the safety of the structure against earthquake.

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