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Comparison of Flat Slabs with and without Drop in Different Seismic Zones Using ETABS

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***Abstract*: We all know that Flat Slab is a type of slab in which Beams are not present in the structure. The Load is transferred directly to columns from the slabs. An extended part of slab called as Drop is provided to resist the Shear. Flat slab is an economical slab when compared to conventional slabs. A lot of material is saved. In this work, the area of focus is to bring a cross section of structural elements which can satisfy the stability criteria as per IS standards. The main focus in this work is finding the structural elements which are economical for G+10 structure under different seismic zones. The building models are analyzed with the aid of the CSI ETABS 2018 program.**

***Keywords*: Drop, ETABS, Flat slabs, G+10 structure, Storey displacement.**

1. Introduction

In general, flat slab is a Beamless slab. In multistory, shopping malls the aesthetic view is improved by using flat slab in place of conventional slab. The usage of flat slab is for residential buildings is also in practice provided span not more than 6m. Both conventional and flat slab structures are subjected to vertical as well as lateral loads. As the height of the building increases, the effect of lateral load increases. The effect of lateral loads higher than the effect of vertical load distribution. These lateral-load (wind or seismic) tends to sway the structure. As such structure behaves as a cantilever. In seismic zones many structures will collapse if the construction is done by taking proper measures. All these criteria made to study the behavior of structure under different seismic zones. As we know in different seismic zones, the intensity and magnitude varies. It is necessary to study some seismic parameters like storey displacement, base shear etc.

A. Flat Slab

Generally, the system consists of columns, beams and slab. But there is a way of construction without beams, this frame system consists of slab and columns only. This type of slab is called Flat Slab. The flat slab is reinforced by rebars, thus forming RC slab with or without a drop, generally retained by columns and slab. Components of Flat Slab are Drop and Column head.

B. Drop

The thickened part of slab above columns is called Drop. It provides resistance to punching shear which is predominant at the junction of column and slab. It provides resistance to punching shear which is predominant at the junction of column and slab.

C. Column Head

These are also called as capitals, used to increase the shear strength of slabs and to reduce the bending moment in the slab by reducing the effective span.

Flat slab buildings are significantly more flexible than the conventional RC frame buildings during earthquakes. The Flat slab thus satisfies Architectural demand by some highlighting features such as better illumination, simple formwork and maximum vision with the optimum use of available space, hence leading to an admired concept in the field of Structural Engineering.

In this project the analysis of flat slab with drop and flat slab without are to be executed.

Fig. 1. Flat slab with drop panels

Fig. 2. Flat slab without drop panels

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2. Literature Review

U. Gupta et.al study focuses on flexibility of Flat slabs when compared to traditional RC wall structures, and design of these Flat slab building in seismic regions. The study presents usage of shear walls as resistant to flexibility under seismic conditions for Flat slabs as well as traditional RC wall structures.

M. A. Eebrik study focuses on compatibility between various seismic zones for flat slab RC frame structure using inelastic response history method and design ground movement method. The fragility curves obtained for the flat slab in different seismic zones are compared to that with moment resisting curves. The results a similarity between Flat slab fragility curves obtained in observation and in literature.

Rajini A. T, Dr. Manjunath N Hegde (2016) in their paper

analyzed about comparative study of the behavior of flat slab and conventional slab structures of 20 stories in diverse cases. Conventional RC slab and flat slab structure, flat slab structure with column drop, conventional structure and flat slab structure with shear wall at diverse locations were analyzed by taking into consideration two typical zones of zone III and zone V, through dynamic response spectrum analysis by using ETABS software. Comparing the results of all models in condition of time period and frequency, lateral displacements, story shear and story drifts by plotting graphs. Flat slab structure with arrangement of column drop and shear wall is performed extremely fine under seismic loads to decrease the displacements and drifts with enhancement in stiffness of building. This paper summarized a review of the study, for conventional R.C.

S. D. Bothara et.al studies discuss the comparative study of the earthquake on flat slab & Grid floor system. Grid slab consisting of beam spaced at regular intervals in perpendicular directions, monolithic with slab, whereas Flat slab does not consist of beams. A comparative study gives how flat slab is more feasible than Grid slab.

3. Methodology

A. Model Specification

Table 1
Built configuration

Parameter	Assumed Data
Number of Storeys	G+10
Plan	24m x 24m
Column cross section	400mm x 400mm
Slab thickness	200mm
Drop thickness	250mm
Fy	415 N/mm^2
Fck	30 N/mm^2

Table 2
Seismic zone levels

Seismic Zone	Z
II	0.10
III	0.16
IV	0.24
V	0.36

Table 3
Type of soil

Level	Property
I	Hard or Rocky
II	Medium
III	Soft

Table 4
Wind terrain

Category	Height in meters
I	< 3
II	3 - 10
III	> 10
IV	> 40

Storey displacement is tabulated for both X-Direction and Y-Direction.

Storey Displacement for buildings with flat slab with drop and for buildings with flat slab without drop are determined and analysed.

Table 5
Storey displacement in X direction for Flat Slab with Drop

Storey level (m)	Seismic Zone 2 (mm)	Seismic Zone 3 (mm)	Seismic Zone 4 (mm)
0	0	0	0
1	4.197	4.197	4.853
2	10.724	10.724	12.985
3	17.078	17.078	21.658
4	22.785	22.785	30.252
5	27.732	27.732	38.502
6	31.864	31.864	46.176
7	35.15	35.339	53.009
8	37.566	39.133	58.7
9	39.111	41.954	62.931
10	39.885	43.67	65.505

Table 6
Storey displacement in Y direction for Flat Slab with Drop

Storey level	Seismic Zone 2	Seismic Zone 3	Seismic Zone 4
0	0	0	0
1	4.197	4.197	4.853
2	10.724	10.724	12.985
3	17.078	17.077	21.658
4	22.785	22.785	30.251
5	27.732	27.732	38.501
6	31.864	31.864	46.175
7	35.149	35.338	53.008
8	37.566	39.132	58.698
9	39.11	41.953	62.929
10	39.885	43.669	65.503

Table 7
Storey displacement in X direction for Flat Slab without Drop

Storey level	Seismic Zone 2	Seismic Zone 3	Seismic Zone 4
0	0	0	0
1	5.288	5.288	5.288
2	14.316	14.316	14.316
3	23.467	23.467	24.452
4	31.806	31.806	34.658
5	39.061	39.061	44.475
6	45.122	45.122	53.592
7	49.935	49.935	61.689
8	53.472	53.472	68.414
9	55.751	55.751	73.427
10	56.956	56.956	76.584

Table 8
Storey displacement in Y direction for Flat Slab without Drop

Storey level	Seismic Zone 2	Seismic Zone 3	Seismic Zone 4
0	0	0	0
1	5.29	5.29	5.29
2	14.321	14.321	14.321
3	23.476	23.476	24.425
4	31.818	31.818	34.619
5	39.075	39.075	44.425
6	45.138	45.138	53.532
7	49.952	49.952	61.619
8	53.488	53.488	68.336
9	55.765	55.765	73.343
10	56.969	56.969	76.497

4. Results and Discussion

Storey displacement is graphically represented for both X-Direction and Y-Direction.

Fig. 3. Graphical representation of Storey displacement in X direction for Flat Slab with Drop

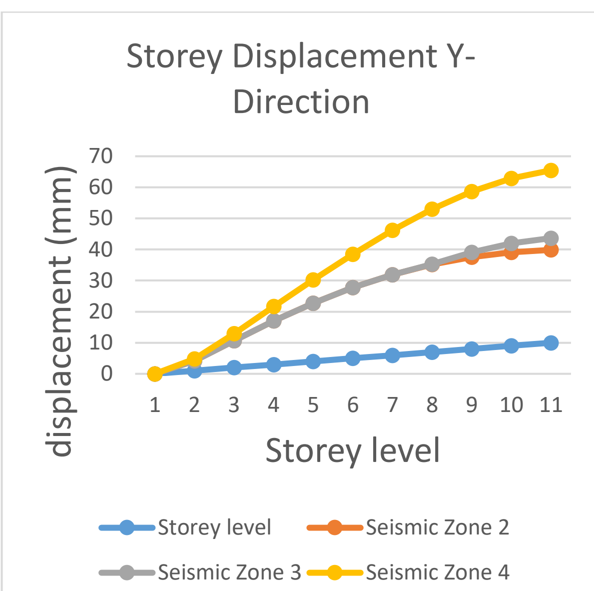

Fig. 4. Graphical representation of Storey displacement in Y direction for Flat Slab with Drop

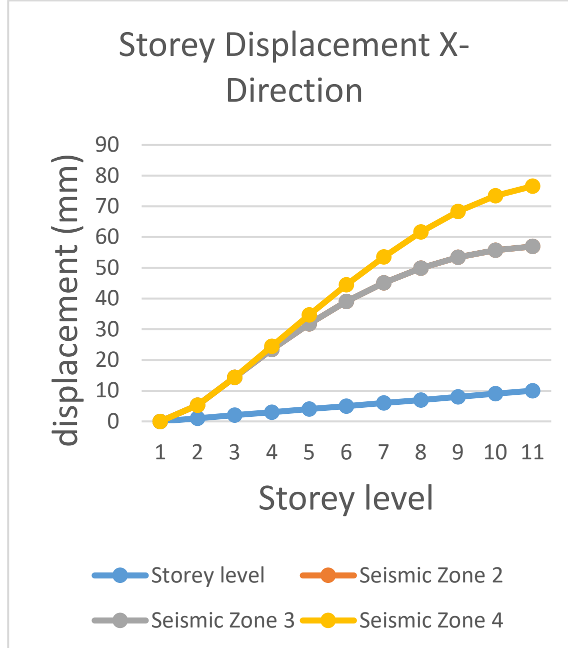

Fig. 5. Graphical representation of Storey displacement in X direction for Flat Slab without Drop

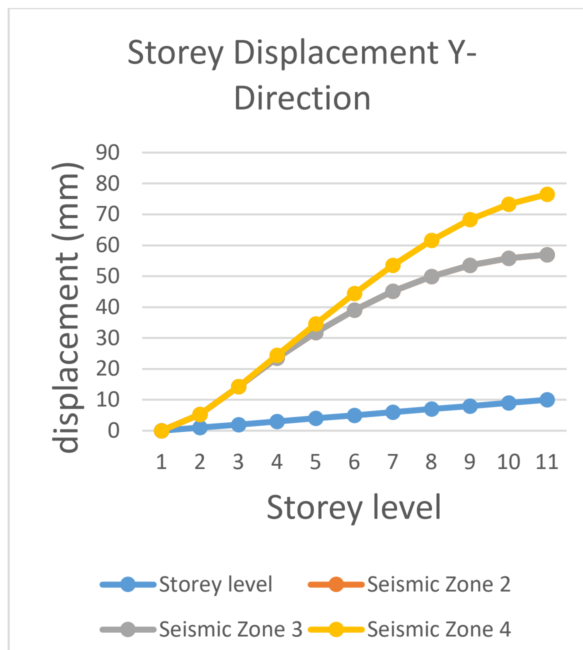

Fig. 6. Graphical representation of Storey displacement in Y direction for Flat Slab without Drop

In seismic zone 2, 3, all the storey displacements are within the limits as per standards.

In seismic zone 4, all the storey displacements are within the limits except 7,8,9,10 in structure without Drop and 9,10 storeys in structure with Drop. They are exceeding the limit 60mm.

5. Conclusion

- We can observe that as the seismic zone is changing the storey displacements are increasing, this is due to the increase in the intensity if the zone.

- To control this effect, we need to increase the cross section of the columns; so that the displacements come under control as well as lateral sway.

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