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Comparative Analysis of Seismic Behaviour of Flat Slab and Conventional RC Framed Structure

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Abstract— ***Flat slab is called a beamless slab because it is supported directly by columns without use of beams. Flat slab structures have more advantages like the free design of space, economical aspects, less construction time, architectural – functional etc. Because of the beamless slab and shear wall, flat –slab structure is more flexible for lateral loads then conventional RC frame structure and that make the structure weak under seismic activities.In the case of a flat slab, large BM and SFdevelops around the column. Because of this, stress is developed essentially to cracks in concrete which possibly further responsible for the failure of slab. Therefore to avoid this, the flat slab is often provided with drop and column head or capitals.***
Keywords— ***Flat Slab structure, Drop, ETABS, Seismic performance, conventional building***

I. INTRODUCTION

Flat slab called a beamless slab is a slab carry directly by columns without beams. A part of slab restricted on four sides by the centre line of the column is known as the panel. The panel is divided into column strip and middle strip. The flat slab is thick near the supporting columns to give substantial strength in shear and to extract the amount of negative reinforcement in the support regions.

The thickened part is the projection beneath the slab is name as drop or drop panel. In some situation, the section of the column at the top as it forgathers the floor slab or drop panel is expanded to increase in the seminal state the perimeter of the critical section, for sheer and increasing the capacity of the slab for resisting two-way shear and to reduce –ve BM at the support. Similar extended or flared portion is called capital. The slabs which have a constant thickness and do not have drop panels or column capitals are called as flat plates. Flat slab systems are famous for use in office and residential buildings, hospitals, schools and hotels. They are rapid and easy to formwork and build. Deficiency of beams assents lower storey heights so as a result cost saving in vertical cladding, partition walls, mechanical systems, plumbing and a large number of other items of construction for medium and high rise buildings.

Flat slab is preferable by architects and clients because of its aesthetic and economic advantages. Though this form of reinforced concrete construction gives more advantages over frame structure, they also give some disadvantages because of brittle punching failure and large deformation. Many types of research said that flat slab may be designed to resist only gravity loads when it used in a high seismic zone and lateral loads may be carried by lateral resist in the system.

II. LITERATURE REVIEW

So many Research is carried out to know about the Seismic response of a flat slab structure from many years. Flat slab is suggested by architects and clients due to its aesthetic and economic advantages. Literature study for the seismic behavior of flat slab building is also covered.

K.S. Sable (2015) investigate the seismic behavior of building for different height to check which changes occur if the height of the conventional building and flat slab building changes. It was figure out that storey drifts in building with flat slab construction are expressively more as compared to conventional R.C.C buildings. So a result of this, more moments are developed. Therefore, such a column of buildings required to be designed by considering additional moment caused by the drift.

R. P Apostolka et al (2008), take out the analysis for six types of the structural system for a prototype of a residential building in Skopje. To define the seismic behavior and resistance of a flat slab structural system, they considered B+GF+4 residential building. The analyses had been carried out using FEM and SAP 2000 version 10.0.9 software. From the analysis, they decide that the purely flat slab RCC structural are more flexible for the horizontal loads than other conventional RCC frame structure. Structural element transformation will develop the low bearing capacity and deformability and will also increase the seismic resistance of flat slab structure.

Salman I Khan and R. Mundhada (2015), carried out the dynamic analysis of three different multistorey building i.e., 12, 15, 18 stories. They considered all the four Seismic Zones using the response spectrum method and the analyses were performed using Etabs version 9.7.3. From the analysis they finalized the selection for the slab in case of multistorey RCC building is most important for preventing the internal forces. From the search it was calculating the base shear for building with flat slab will be

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more as compared to building with grid slab at the terrace level. As well the lateral displacement will be less for grid slab as compared to flat slab structure. The storey drift and time period will also be more for flat slab than the grid slab.

Prof. P. S. Lande [2015] compare notes about flat slab structure is permeable to the seismic excitation so that careful analysis of flat slab is important. In this paper, the seismic analysis on the flat slab is accomplished and compared to the conventional RC building. To lift up the performance of flat slab building shear wall and beam at the periphery is applied and the seismic response of the same is determined and compared with the flat slab building.

V.K.Tilva [2011] examine cost comparison between flat slab panel with drop and without a drop in four storey lateral load resisting building for analysing punching effect due to lateral loads. On the basis of permissible criteria according to IS: 456-2000, the economical thickness of flat slab with drop and without drop are picked and the cost comparison is done by using S.O.R.

III. METHODOLGY

Dynamic analysis is performed to get the design seismic force, and to distribute along the height of the building in different levels, and in different lateral loads resisting element.

Dynamic analysis is performed by the

Time history method

Response spectrum method

A. First Building Details

The entire document should be in Times New Roman or Times font. Type 3 fonts must not be used. Other font types may be used if needed for special purposes.

The Building is in Zone-III (moderate zone for Earthquake)

Analysis of Conventional Slab of Building using ETABS.

Building is designed as per IS 456:2000 & IS 1893:2002.

B. Second Building Details

Title must be

The Building in Zone-III (moderate zone for Earthquake)

Analysis of Flat Slab of Building using ETABS.

All building designed as per IS 456:2000 & IS 1893:2002.

Base Shear, Story shear, and Performance of the structure undergoing the seismic behavior at zone-III of different story levels were obtained.

Comparison of conventional Slab structure and Flat Slab Structure has been done in order to determine the difference between performances of both Structure.

C. Description Of Modelling

No more than

The detailed description of the model considered for the analysis is as follows:

The conventional slab structure and flat slab Structure are considered to have the same geometrical data

S.NO	VARIABLE	DATA
1	Number of stories	G+8
2	Height of each storey	3.2m
3	Total Height of structure	32m

1) *Preliminary data for the conventional slab:*

S.N	VARIABLE	DATA
1	Type of structure	Moment resisting frame
2	Live load	4 kN/m2
3	Floor finish load	1.0 kN/m2
4	Wall load (external)	12.88 kN/m2
5	Stair case load	12.588 kN/m2
6	Materials	Concrete (M25) and Reinforced with HYSD bars (fe415)

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7	Size of columns	400X400
8	Size of beams	230x300
9	Depth of slab	150mm thick
10	Specific weight of RCC	25 kN/m3
11	Zone	IV
12	Type of soil	Medium
13	Response reduction factor	5
14	Importance factor	1
15	Zone factor	0.24

2) Preliminary Data for Flat Slab:

S.NO	VARIABLE	DATA
1	Type of structure	Moment resisting frame
2	Live load	4kN/m2
3	Floor finish load	1.0 kN/m2
4	Materials	Concrete (M25) and Reinforced with HYSD bars(Fe415)
5	Size of columns	400X400
6	Depth of slab	150mm thick
7	Depth of drop	150mm thick
8	Specific weight of RCC	25 kN/m3
9	Zone	IV
10	Type of soil	Medium
11	Response reduction factor	5
12	Importance factor	1
13	Zone factor	0.24

D. Building Models

Modelled plans of the buildings such as (i) Flat slab (ii) conventional slab using ETABS software are shown in Fig (a), Fig (b).

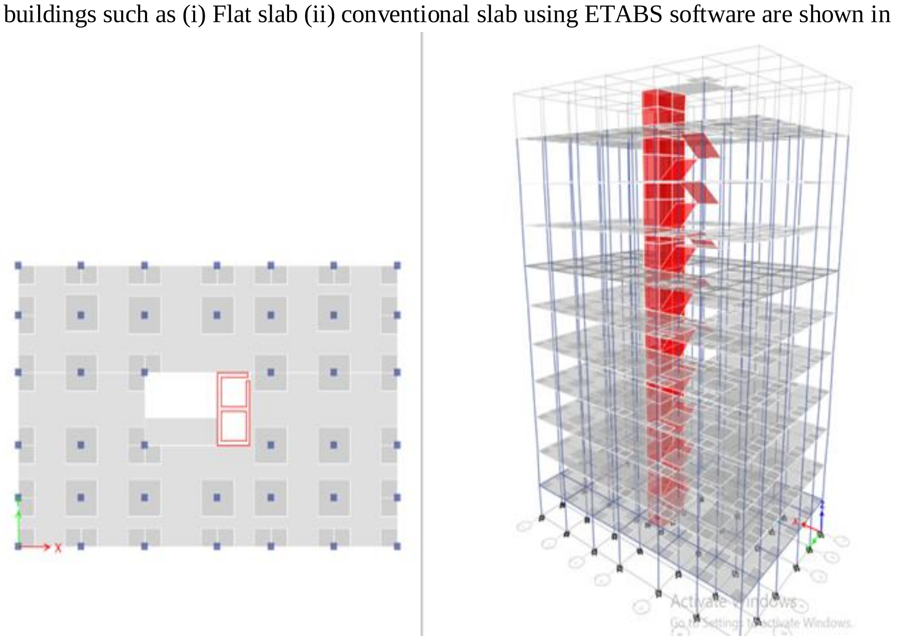

Fig (a) Flat slab

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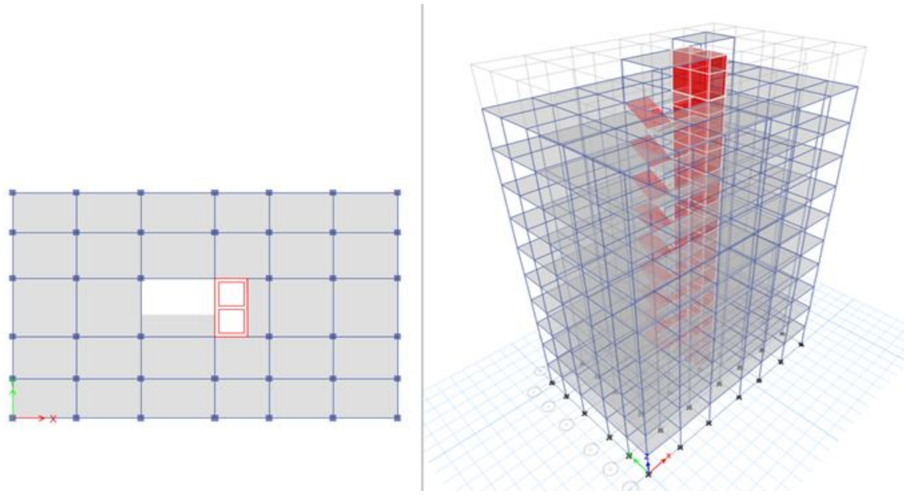
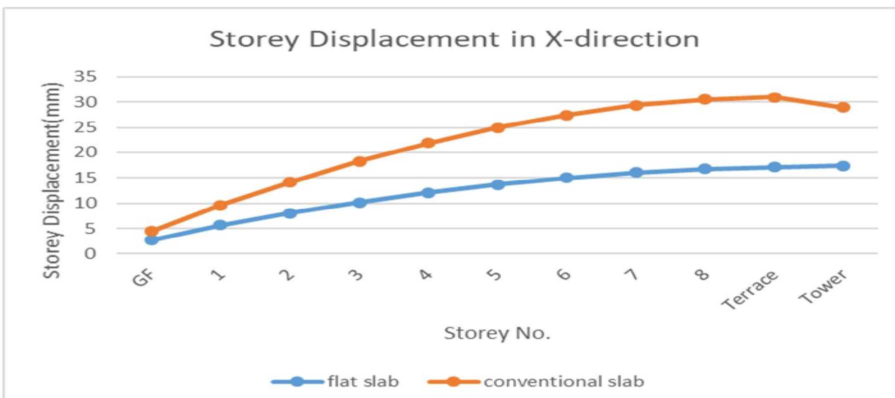


Fig (b) conventional slab

IV. RESULTS AND DISCUSSION

A. Storey Displacement

Displacement depends on height of structure and slenderness of the structure because structures are more vulnerable as height of building increases by becoming more flexible to lateral loads. Storey displacement is high at top storey and least at the base of the structures.

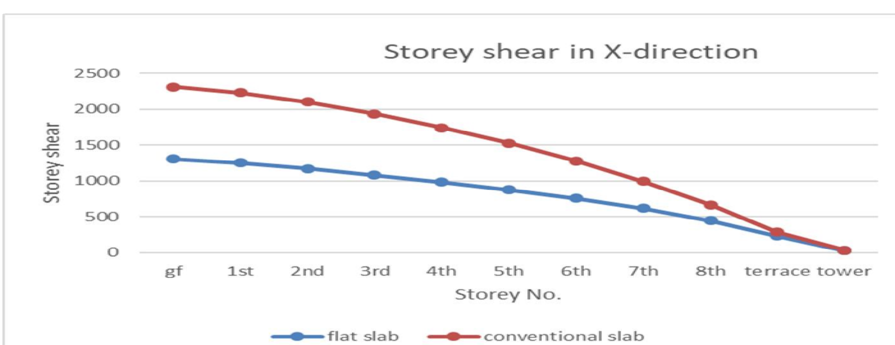


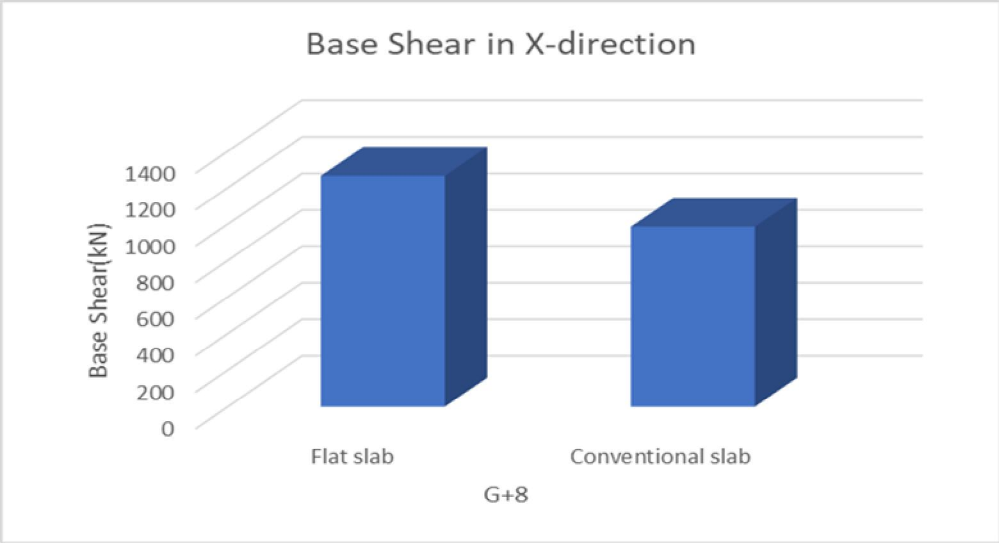
B. Storey Shear and Base Shear

The storey shear is maximum at ground level and keeps on decreasing towards the top storey of the structure.

From the above charts it was observed that storey shear and base shear of flat slab with drop building is more than conventional RC Framed building.

As height of the building increases the value of storey shear and base shear also increases.





C. Storey Acceleration

The storey acceleration are more at the top storey and least at the bottom storey for both flat slab with drop and conventional slab. Storey acceleration depends mainly on the amount of drift taking place in the building.

V. CONCLUSIONS

A. Storey displacement is high at top storey and least at bottom storey As the height of building increases the value of displacement also increases.

B. The base shear is maximum at ground level and keep on decreasing towards top storey of structure.Height of building increases the value of storey shear and base shear also increases.

C. The storey acceleration is more at top storey and least at bottom storey.for both flat slab with drop and conventional slab.

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