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Performance Assessment of RC-Structure Under Partial Flat-Conventional Slab Provisions

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ABSTRACT:

Flat slab structures are replacing conventional slab structures as they are more feasible to construct, take less time and shows good aesthetic appearance (V. P. Thakkar, 2012). But the major disadvantage of flat slab is its high flexibility due to which many problems like motion sickness, high story displacement etc. occurs so to overcome this the concept of Perimeter beams is adopted which reduces the flexibility of the flat slab structure to a much greater extend. Comparative study of conventional slab structure, flat slab structure & Structure with both flat and conventional slabs as it is necessary to analyze seismic behavior of structure. In this study, ETABS software is used for the analysis of different structures in Indian seismic zone IV with 10 stories. The models taken in this study have Rectangular shape configurations. IS 1893: 2016 is referred for the analysis purpose

IndexTerms–Base Shear, ETABS, Flat slab, High rise building,seismic zone.

I. Introduction

Slab is defined as the structural member of the building which is used to construct floors and ceilings. It is very important element in horizontal plane and its top and bottom surfaces are parallel. They are used in buildings, bridges, roads and many other types of structures. The slab is supported on beams which are monolithically casted with slab or directly on columns (R. G. Madiwalar et al., 2016). In civil engineering there are a number of slabs which are used at different places as per the design or as per the requirement.

In this research work, we have considered only two types of slabs –

a) Conventional Slab

b) Flat Slab

Reinforced Concrete slabs with huge spans extended over various bays and only hold up by columns, without beams known as flat slab. Flat slabs display economic, favourable as well as larger open space with more clear heights as compared to other systems of framing. Flat slab structure is effortless to construct and is efficient too it requires the minimum building height for a given number of stories. It is preferred in many parts of the world due to its relatively simple formwork and reinforcement layout and the potential for shorter story heights i.e. increasing the number of floors that can be built within a specific height. This gives a very well-regulated structure which minimizes material utilization and reduces the economic span range when compared to reinforced concrete conventional slab. In flat slab construction a plain ceiling is obtained and hence it offers charming appearance from architectural point of view (H. S. Mohana et al. 2015). The construction of flat slab is simple and cost-effective compare to other beam slabs and requires less formwork. And also required less time for construction compare to other beam slabs. The main disadvantage of flat slab is problem of two-way shear around the columns which is called the punching shear to overcome this limitation Drop Panels around the columns are provided which gives extra or additional resistance to shear. Provision of thickened portion of slab around column is called drop panel, drops haver shown an increase in shear strength of slab and to reduce negative reinforcement in the slab column connections thus reducing the effect of punching shear failure.

Familiar use of outline and development is to help the slabs by beams and support the beams by columns. This might be called as slab beam development. The beams diminish the open net clear roof height. Thus, in workplaces some of the beams are avoided and sections are specifically upheld on segments and can likewise be utilized at places where a lot of room is required like distribution centre, open corridors and so forth. These sorts of development are stylishly engaging too.

The flat slab system is generally the system of choice in low to moderate seismic zones where it is allowed as lateral force resisting system (LFRS), however in high seismic zones it is designed to resist only gravity loads. In this research, study is done on flat slabs with perimeter beams in high seismic zones

Figure 1: A Typical Flat slah

Along with the enlargement in stiffness of the structure perimeter beams also have several more advantages like-

- Flexibility in room layout, i.e., Partition walls can be positioned anywhere.
- Reinforcement placement is effortless.
- Framework installation gets easy.
- Foundation load will also reduce.
- Lesser time of construction.
- It provides higher headroom due to lack of interior beams.
- It provides more aesthetic appearance as compared to beam slab system.
- It gives repetitive construction sequence for formworks which accelerates the schedule and reduces the construction cost.
- Use of false ceiling is avoided.

II. OBJECTIVES OF THE STUDY

The main objectives of the present thesis are as follows;

1) To study the Maximum Reactions, Maximum Story Displacement and Maximum Overturning Moments and Maximum Story Drift of high-rise structure having flat slab in all the stories.
2) To compare the above results with the conventional slab structure.
3) To study the effect of partially modeled flat slab structure at various stories (floors).
4) To suggest the suitability of flat slab structure in seismic zone IV.

III. METHODOLOGY

The In order to study the effect seismic force on Assessment zone IV of India is considered.

Table 1: Cases Considered for the Study

Software used	Configuration of Building	Model Dimensions	Storey	Remarks
ETABS	All (10) floors withConventi onal Slab	18 m X 24 m	10	Seismic forces of Zone IV as per IS: 1893:2002.
ETABS	All (10) floors withFlat Slab	18 m X 24 m	10	Seismic forces of Zone IV as per IS: 1893:2002.
ETABS	5 floors with Flat Slab & 5floors with Conventional Slab	18 m X 24 m	10	Seismic forces of Zone IV as per IS:1893:2 002.
ETABS	5 floors with Conventional Slab & 5floors with Flat slab	18 m X 24 m	10	Seismic forces of Zone IV as per IS:1893:2 002.

Table 2: Description of the Structure

Specifications	Data
Typical Storey Height	3 m
Base Storey Height	3.0 m
No. of Bays along X-Direction	3
No. of Bays along Y-Direction	4
Bay Length along X-Direction	6 m
Bay Length along Y-Direction	6 m
Concrete Grade	M-25
Density of R.C.C.	25 KN/m^3
Density of Masonry	20 KN/m^3
Columns	500 mm x 500 mm
Beams	300 mm x 450 mm
Slab Thickness	150 mm
Bottom Support Conditions	Fixed
Live Load- Roof **Rest of the structure**	1. KN/m^2 2.5 KN/m^2
Soil Conditions	Type 2 Soil (medium)
Damping Ratio	5%, asper IS-1893: 2002 (Part-1)
Poisson Ratio	0.2
Response Reduction Factor	5
Importance Factor	1
Zone Factor	As per IS1893- 2002 (Part 1) for Seismic Zone (IV) = 0.24

Preparing the model of building frame

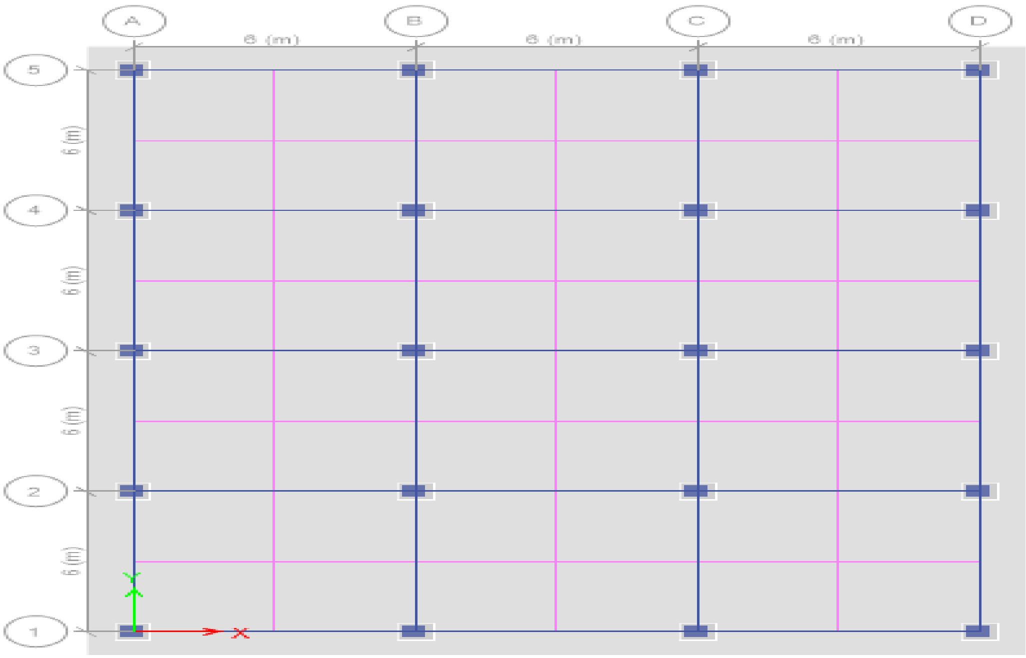

Figure.3Plan for Structure

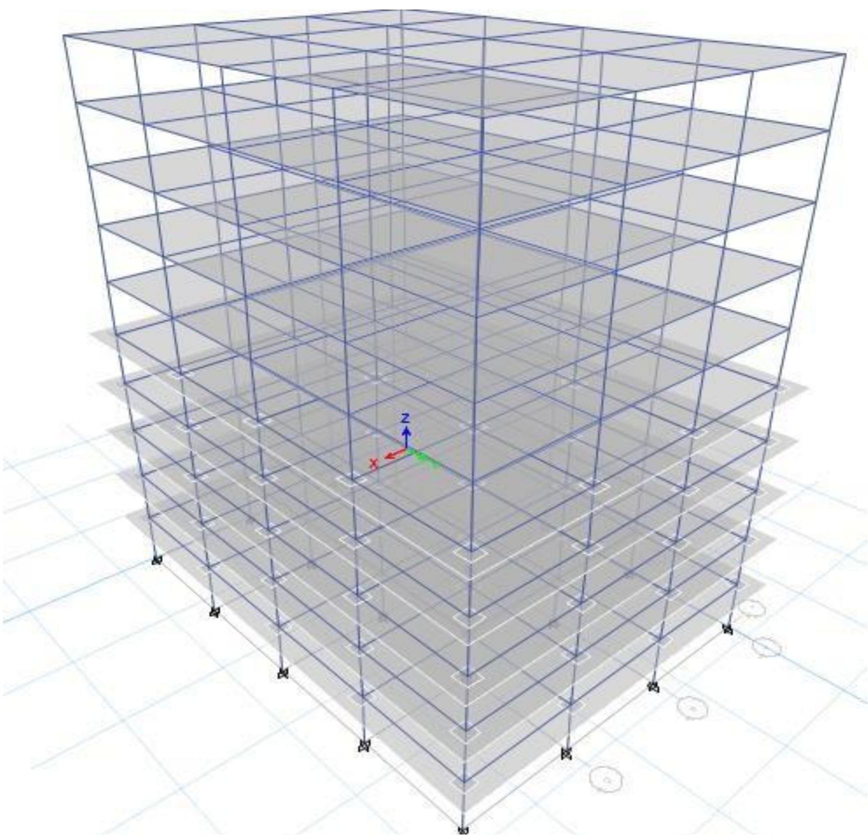

Figure.43-DviewforStructure

IV RESULTS

RC Structure with having Rectangular configuration is studied with the Conventional Slab Structure, Flat Slab Structure & structure having flat and conventional slabs both for Seismic Zone IV of India with respect to 10 stories. The results of the seismic analysis are shown below

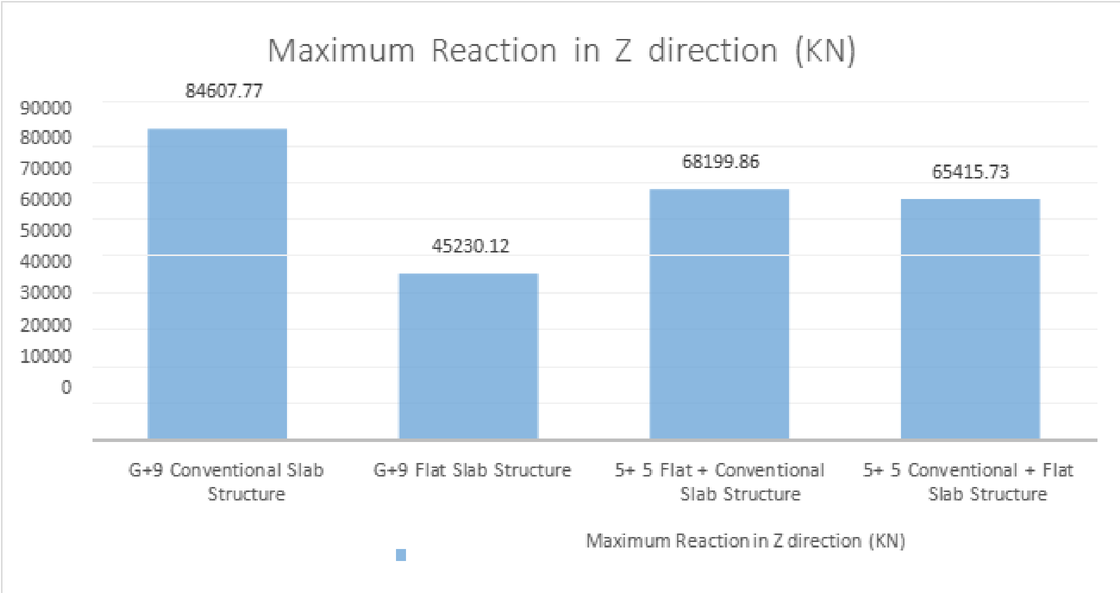

Figure 5 Maximum Reaction in Z direction

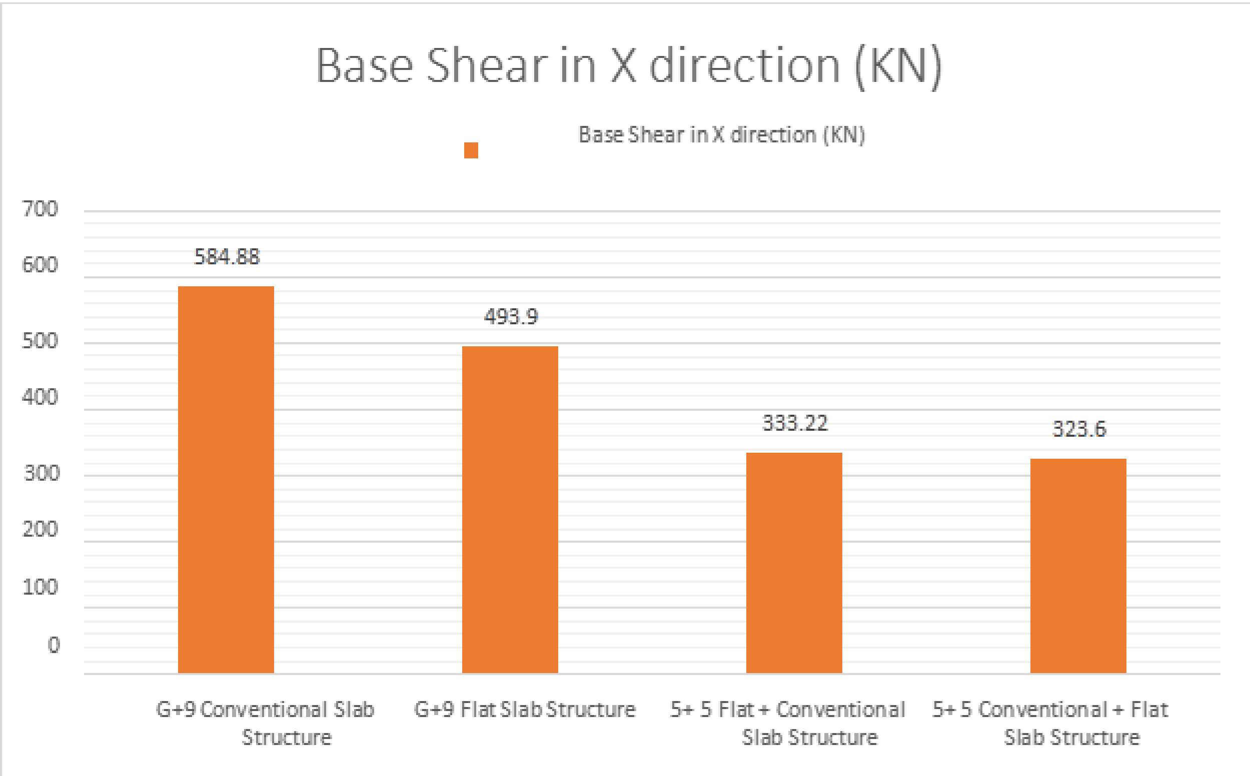

Figure 6 Maximum Base Shear in X direction

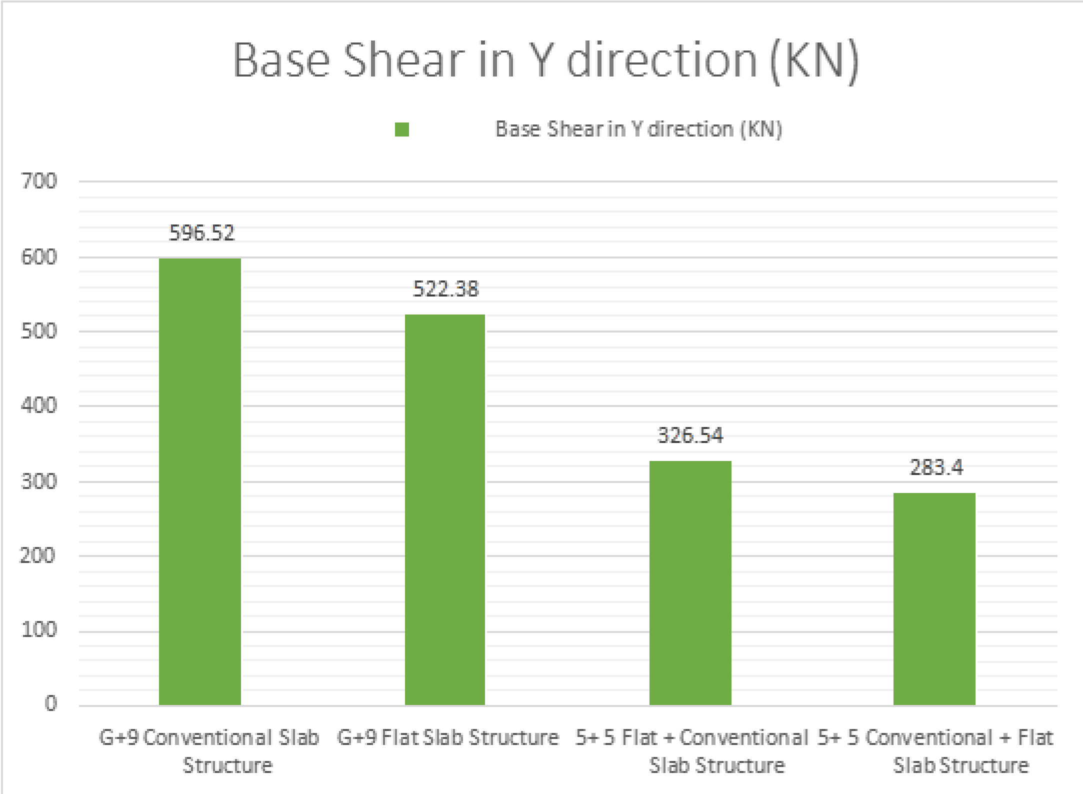

Figure 7 Maximum Base Shear in Y direction

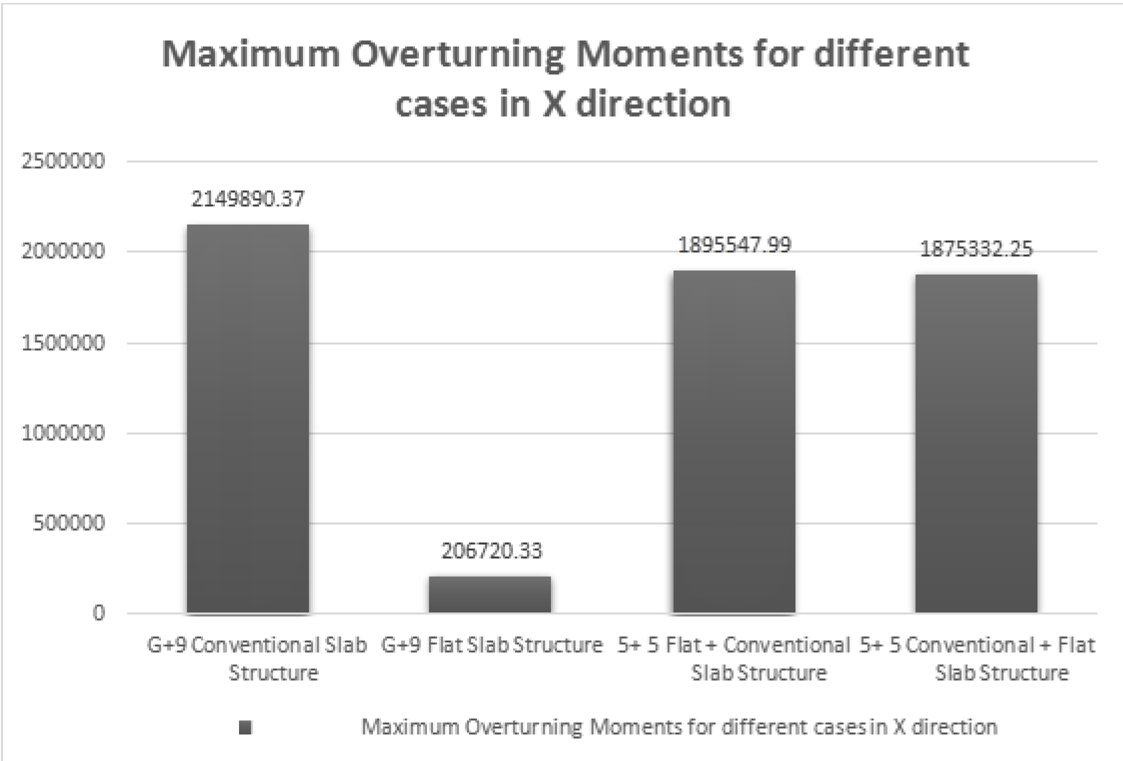

Figure 8 Maximum Overturning Moments

V Conclusions

The best combination for smallest value of storey drift is G+F (5+5).The base shear for building Model in X direction is reduced by 75.22% after the implementation of F+C (5+5) mixed structure system and in Y direction the same is reduced by 82.80% as compared to Conventional Slab Structure.For building Model the base shear in X direction is reduced by 18.54 % after the implementation of Flat Slab System and in Y direction the same is reduced by 14.16%.The Maximum Reaction for building Model in Z direction is reduced by 29.33% after the implementation of C+F (5+5) mixed structure system and the same is reduced by 87.60% after the implementation of Flat Slab system in Conventional Slab Structure.The effect of C+F (5+5) Slab System is considerable in the overturning Moment as 13.41% of a multistoried building but it is 10 times smaller for the Same Structure Flat slab system.summation of moments in those structures which have large number of beam elements (C 10) are higher than the summation of moments in those structures which have less number of beam elements (F 10) or either does not have any beam elements

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