IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁒ Impact Factor 8.066 ⁒ Peer-reviewed / Refereed journal ⁒ Vol. 10, Issue 5, May 2023

DOI: 10.17148/IARJSET.2023.10545

Comparative Study of Flat Slab with Conventional Slab Under Seismic Zone

Rizwan J Kudari[1], Khaja Asim Riyan[2]

PG Student, Structural Engineering Department, Dayananda Sagar College of Engineering, Bangalore, India[1]

PG Student, Structural Engineering Department, Dayananda Sagar College of Engineering, Bangalore, India[2]

Abstract: In the present scenario, Conventional slab buildings are commonly used for construction. The use of Flat slab building provides many advantages over Conventional slab building, like the use of space, easier formwork, architectural flexibility, and shorter construction time. The structural efficiency of the flat slab construction is obstructed by its poor performance under earthquake loading. In the present study, two Conventional RC slab and Flat slab buildings of G+8 storey building models are considered. Seismic zone III is considered for the analysis. The analysis is done using ETABS software. It is necessary to analyse the seismic behaviour of buildings with the same heights to see what changes are going to occur in conventional slab buildings and flat slab buildings. Therefore, the characteristics of the seismic behaviour of flat slab and conventional slab buildings suggest that additional measures for guiding the conception and design of these structures in seismic regions are needed and also to analyse the performance of buildings having conventional slab and flat slab under seismic loading. The object of the present work is to compare the behaviour of multi-storey commercial buildings having flat slabs and two-way slabs with beams under seismic loads. Present work provides a good source of information on the parameters: storey displacement, storey drift, storey shear, storey stiffness, and time period.

Keywords: Flat slabs, seismic zone.

I. INTRODUCTION

The common practice of design and construction is to support the slab by beam and beams by column. This may be called beam-column construction. The beam reduces the available net clear ceiling height. to make work faster and more economical also like introducing flat slab construction which reduces dead weight, and makes beams invisible, enhances floor area The aesthetically this type of construction is poor but the performance of those buildings is quite good. In recent practice, slabs are directly put on the column from aesthetic and architectural points of view. The load transmission path changes due to the deletion of beams. But the safety of those buildings is to be checked. Under uniform wind and earthquake loads the overturning moment at the base is very large and varies in proportion to the square of the height of the building. The frame alone fails to provide the required lateral stiffness for buildings taller than 15 to 20 (50m to 60m) stories. It is because the shear-taking component of deflection produced by the bending of columns and slab causes the building to deflect excessively. The lateral loads are considerably higher in the top storey rather than the bottom storey due to which building tends to act as a cantilever. These lateral forces tend to sway the frame To know the performance of the structure it should be subjected to all types of loadings, all seismic zones factors, and various soil categories then only we can extract the best choice or suitability parameter for the structures, Seismic codes are also silent on the design of flat slab. But from history it can be understood that the flat is very vulnerable in earthquake point of view. Keeping the failure in mind in this dissertation the performance of the flat slab building over a conventional building is about to estimate. Linear static and non-linear static, storey displacement, storey drift, base shear, storey shear, and pushover analysis has been performed to ensure the stability of flat slab building. the suitability of flat slabs for various seismic zones without compromising the performance of the conventional slab structures.

LITERATURE REVIEW

2.1 Vishesh P. Thakkar, Anuj K. Chandiwala and Unnati D. Bhagat, April [2017] - "Comparative study of seismic behaviour of flat slab and conventional RC framed structure". The survey of this paper tells that the storey drift decreases as the height of the building increase. The base shear is maximum at ground level and keeps on decreasing towards the top storey of the structure. As the height of the building increases the value of storey shear and base shear also increases. The flat slab is provided with a drop and column head to reduce large shear force and negative bending moment and the flat slab is also provided with a shear wall or bracing or damper as a lateral load resisting system to reduce seismic effect. Storey displacement is high at the top storey and least at the base of the structures. As the height of the building increases the value of displacement also increases.

2.2 Dr. Sudhir S, Bhadauria, Danish Khan and Mohit Jain, [2016]- “Flat slab system is compared with wide beam system and analyzed under gravity and seismic load”. In this paper flat slab system is compared with the wide beam system in which 4 storey building model is considered and is analysed under gravity and seismic load, we conclude that deformation in the building is less in the case of the flat slab system compare to the wide beam system. When we perform linear static analysis under gravity load this is due to when we used flat slab the weight of stricture is reduced. From the seismic analysis, it is observed that lateral deformation of comparatively larger magnitude has been observed in the case of a flat slab. This is due to a decrease in lateral stiffness.

2.3 Samruddhi Dhawal, Prof. Apoorva Kitey, [2019] - “Analysis of seismic behaviour of flat slab structure” In the case of a flat slab, large BM and SF develop around the column. Because of this, stress is developed essentially into cracks in concrete which is possibly further responsible for the failure of the slab. Therefore, to avoid this, the flat slab is often provided with a drop and column head or capitals. Shear is maximum at ground level and keeps on decreasing towards the top storey of the structure. The height of the building increases the value of storey shear and the base shear also increases. Storey displacement is high at the top storey and least at the bottom storey. As the height of the building increases the value of displacement also increases. Time-saving economical."

2.4 Prof. B A Rashmi and Prof. H S Basavraj, May [2015], - “Flat slab building model strengthens by perimeter beams and shear walls”. This paper presents the research on the flat slab building model strengthened by perimeter beams and shear walls shows better seismic performance. The Greek codes’ provisions, concerning the compulsory use of shear walls lead to the conclusion that the implementation of such systems is restrained. If Flat-slab structural systems with perimetric beams are supported only by columns then in such case big cross sections for the columns are needed. Use of flat slabs with drop results in an increase in drift values in shorter plans and a decrease in larger plans, marginally in a range of 0.5mm to 3mm.

2.5 Dhananjay D Joshi and Dr. Pranesh Sangave, Oct [2015], - “Performance of flat slab structure using pushover analysis”. This report states that the pushover analysis is a relatively simple way to explore the non-linear behavior of buildings. The base shear of conventional RCC buildings is more than that of flat slab buildings. The performance point of a flat slab is more than the conventional structure due to its flexibility. The behavior of properly detailed conventional buildings is adequate as the intersection of the demand and capacity curves. The results obtained in terms of demand, and capacity gave an insight into the real behavior of the structure.

2.6 Tejaswini M L, Sandhyarani, [2018]- “Seismic behaviour and pushover analysis of irregular flat slab building with different lateral resisting systems.” To compare buildings with different lateral resisting systems with respect to their time period, base shear, storey drift, and displacement. To evaluate the most effective type of lateral resisting system. The pushover analysis shows the base force is found to be almost the same for all models in the X axis since there is no lateral load-resisting systems support. However, base shear values in the Y axis vary. There is a noticeable increase in the base shear value. This shows the stiffness of the shear wall structure attracts base shear value.

2.7 Mohana H.S1, Kavan M.R2, [2015] - “To know the performance of the structure it should be subjected to all type loadings, all seismic zone factors, and various soil categories then only we can extract the best choice or suitability parameter for the structures. Lateral displacement increases as the storey level increases. Lateral displacement will be minimum at the plinth level and maximum at the terrace level, Study the performance of flat slab and conventional slab structures subjected to various loads and conditions. the study of the behaviour of both structures for the parameters like storey shear, storey displacement Drift ratio, and axial forces. Comparisons of flat and conventional buildings for the above parameters.

2.8 Sourabh Ram Ingole, Ansari Fatima Uz Zehra, [2022] - “Comparative analysis and design of flat and grid slab system with conventional slab system by etabs”. In flat slab system, it is found from the study that maximum displacement, maximum force, and maximum bending moment in x, y, and z direction is minimum, Flat slab having more bending moment and shear force when compared with grid slab and two-way slab. The values of Maximum Displacement are least in Conventional slab in X- Direction as compared to Flat Slab.

2.9 Navyashree K, Sahana T.S, - “Use of flat slabs in multi-storey commercial building situated in high seismic zone”. Conventional R.C.C. building and flat slab building for different floor height in the seismic region. The moment is maximum at the plinth, first, and second levels. After the second level moments decreases and increase at the top storey. The column behaviour changes as the height of the building increases, Column moments in flat plate vary from 10 to 20

DOI: 10.17148/IARJSET.2023.10545

(%) as compared to that of conventional R.C.C frames depending upon the storey. The natural time period increases as the height increases. The earthquake forces are more predominant than other loads.

2.10 Nitin D More, Mukund M Pawar, Dipak M Kolekar, [2019] - "Comparative Study of use of Flat Slabs and Conventional Slabs for the Buildings Situated in Seismic Zone IV". To analyse seismic behaviour of building for different heights to see what changes are going to occur if the height of conventional RC Frame building and flat slab building changes. The frame alone is not capable to provide the required lateral stiffness for buildings taller than 15 to 20 (50m to 60m) stories. It is because the shear taking component of deflection produced by the bending of columns and slab causes the building to deflect more. There are two ways to satisfy these requirements, first is to increase the size of members beyond and above the strength requirements and second is to change the form of structure into more rigid and stable to confine deformation.

II. CONCLUSION

Storey Displacement depends on the height and slenderness of the structure and increases with the height of the building. Storey displacement of both structures lies within the range of permissible limits. In Conventional Slab, initially, storey drift increases then decreases but Flat Slab follows the parabolic path along the storey height. Storey drift of both structures lies within the value of the permissible limit. In Conventional Slab and Flat Slab, storey shear is high at the first storey and decreases gradually, as it depends on the loads carried at the base of each storey, hence ground storey is designed for high seismic loads. Storey stiffness is maximum at the first storey and keeps on decreasing towards the top storey of the structure. Higher the storey stiffness, the lesser the flexibility. The time period depends on the mass of the building and indicates the flexibility of the building, the number of modes increases its value decreases. Flat slab is more economical than Conventional slab, as Flat Slab is about 3.45% lesser compared to Conventional Slab.

REFERENCES

[1]. Nithin D More and Mukund M Pawar [2019] "Comparative Study of use of Flat Slabs and Conventional Slabs for the Buildings Situated in Seismic Zone III", ISSN: 2321-3361, Vol. 9, Issue 11, 2019
[2]. Vishesh P. Thakkar, Anuj K. Chandiwala and Unnati D Bhagat [2017] "Comparative study of seismic behavior of flat slab and conventional RC framed structure", International Journal of Engineering Research and Technology (IJERT), ISSN: 2278-0181, Vol.6, Issue04, April-2017.
[3]. Mohit Jain1, Dr.Sudhir S. Bhadauria 2, Danish Khan2 [2016] "Seismic analysis of flat slab and wide beam system",American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN : 2320-0936 Volume-5, Issue-10, pp-291-295.
[4]. Samruddhi Dhawale1, Prof. Apoorva Kitey2, [2019] "comparative analysis of seismic behavior of flat slab and conventional rc framed structure", (IRJET) e-ISSN: 2395-0056, Volume: 06 Issue: 05.
[5]. Dhananjay D. Joshi1, Dr. Pranesh B. Murnal2, [2013] "Performance of Flat Slab Structure Using Pushover Analysis", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 8, Issue 3
[6]. Tejaswini M L1, Sandhyarani2, [2018] "seismic behaviour and pushover analysis of irregular flat slab building with different lateral resisting systems", (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 06
[7]. Mohana H.S1, Kavan M.R2, [2015] "Comparative Study of Flat Slab and Conventional Slab Structure Using ETABS for Different Earthquake Zones of India", (IRJET) e-ISSN: 2395-0056 Volume: 02 Issue: 03
[8]. Sourabh Ram Ingole1, Ansari Fatima Uz Zehra2 [2022] "comparative analysis and design of flat and grid slab system with conventional slab system by etabs. International Research Journal of Modernization in Engineering Technology and Science, e-ISSN: 2582-5208 Volume:04/Issue:06
[9]. Navyashree K1, Sahana T.S2. "Use of flat slabs in multi-storey commercial building situated in high seismic zone", IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308.
[10]. Meera Pradeep1, Sabeena M V2,[2016] "Seismic Behaviour of Flat Slab Building Strengthened with Perimeter Beams, Shear Walls and Beam Slab in Alternate Storeys". International Journal of Innovative Research in Science, Engineering and Technology. ISSN(Online): 2319-8753, Vol. 5, Issue 8

