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A Review: Analysis and Design of Building and Cost Optimization with Different Floor System

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Abstract - Earthquakes play an important part in the analysis and designing of structures. The analysis is a technique for determining the ways of a structure under various load combination. Design is the way of achieving convenient description for a structure. It takes a long time to manually plan and analyze a structure. The analysis and construction of structure can be done easily with the use of software. This project aims to analyze and design a building with different floor systems and cost comparison of floor systems. viz., Flat slab with drop panels, Flat slab, Conventional slab, Grid slab, and ribbed slab. The effects of seismic forces on buildings with different slab structures were investigated by using ETABS tools. ETABS stands for Extended Three-Dimensional Analysis of Building System. IS 456-2000 is used for design and analysis. Fe-500 steel and M40 grade of concrete were used. Load combinations are taken as per IS 1893-part 1 (2016). Live loads are taken according to IS 875 (part 1). Earthquake zone 2 has been adopted for analysis. Axis force, shear force, bending moment, storey drift, base shear, Storey shear, and storey displacement all affect the structure's output when it comes to seismic loads. After the design of these mentioned five cases, a comparative study concerning the economy is carried out. The results are presented using tables and bar charts

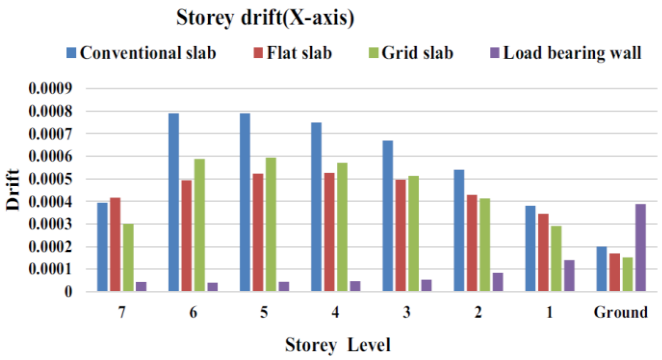
Key Words: storey displacement, drop panel, grid slab, ribbed slab, axis force, base shear, bending moment. storey drift

1. INTRODUCTION

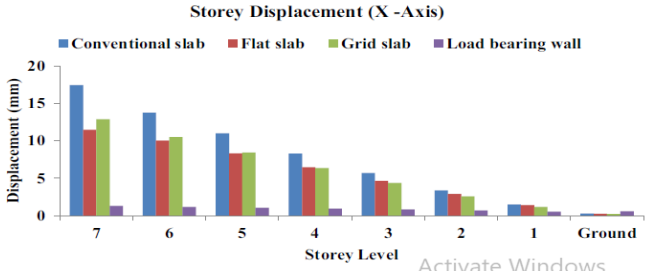
In this present developing industrial period, we can see the vast construction activities taking place all over the world-wide. The human being needs a better lifestyle the essential requirement of a human is shelter [1]. Due to the rise in population development of high-rise buildings and structures is a necessity [2]. Hence land space will be insufficient. So, the construction of high-rise structures is the solution to overcome this problem there are several modification techniques used to make work faster and economical [3]. In the past few years, many high-rise building structures have been constructed and many more are being planned in the world [4]. Construction of high-rise buildings requires a long period but now day skilled manpower and modern techniques are used to construct tall buildings and structures [5]. So a load of a high-rise building is an important factor that should be keeping in mind while constructing the building and structures. The load on various elements of structures such as walls, beams, columns and slabs is reduced which decreases the load on the structure. Like other components floor (slab) is a very important structural element [6].

2. LITERATURE REVIEW

Nishant, et al. (2020) [11] determined the behavior of different types of slab arrangements such as conventional slab, flat slab, grid slab, and load-bearing wall and compared the result in terms of story displacement, story drift, and base shear. The result shows that story displacement and story drift are maximized for conventional slab and minimum for the load-bearing wall type. A load-bearing wall is safer against wind and earthquake loads. But, considering cost as an important factor Grid slab is economical and safer when compared with other building slab arrangements. The graph below shows the story drift, story displacement, and base shear of different types of slab arrangement with a load combination of 1.2(DL+LL+EQ) and 1.5(DL+LL+WL) [1].



Graph -2.1: Storey drift v/s storey height for 1.2(DL + LL + WNX) in X-direction [1]



Graph -2.2: Storey displacement v/s storey height for 1.2(DL + LL + WNX) in X-direction [11]

Graph -2.3: Base Shear for 1.2(DL + LL + EQX) and 1.5(DL + LL + WNX) load combinations [11]

D. D. Roche, et al. (2020) [4] Studied Conventional, flat, and grid slab, they found that laterals displacement of both grid slab and conventional slabs are minimizing at the bottom level and increases consistently floor by floor. It was proposed that story drift is a least at the bottom story and reach a peak at middle stories then constant decreases to the top story in both seismic co-efficient method and response spectrum method.

S O A Olawale, et al. (2020) [12] It was observed through the research that there is considerable reduction in construction cost because it is usually employed in large floor area without any structural framing beams. The use of the in-built genetic algorithm function of MATLAB software was employed to minimize the design at various steel ratios.

Amit A. Sathawane, et al. (2020) [13] In this paper they determine the most economical slab between flat slab with drop, flat slab without drop and grid slab, it is design by M35 grade concrete and Fe415 steel. Analysis of flat slab and grid slab has been done manually by IS 456:2000 by using software also.it was observed that flat slab with drop is economical than flat slab without drop and grid slab.

Markanday Giri (2019) [14] It has been examine from various findings that the stresses generated in the flat slab analysis, its intensity should lessen in order to provide stability to the structure. For this, four cases have been taken viz., simple flat slab providing shear wall at lift area and at maximum stress location, flat slab with drop providing shear wall at lift area, flat slab with drop providing shear wall at the lift area and at maximum stress location on G+11 multistoried residential building located at seismic Zone 4. Using response spectrum method with the help of analysis and design tool STAAD Pro V8i, to evaluate analysis parameters such as nodal d displacement, shear forces in column, Compressive and tensile stresses, storey drift, von mistress along with principle stress values.

T. Spoorthy, et al. (2018) [7] Studies on the seismic variation of conventional RC slab and flat slab and their comparison, found that as story displacement, story shear, and overturning moment, and story drift, values of flat slab higher than that of the conventional slab. It was also found that the flat slab with drop and column head provides a large shear force reduction and negative bending moment and thereby loss due to seismic condition reducing.

Anitha. K and rinu isah (2017) [15] have focused on the influence of various parameters on the economical spacing of transverse beams in grid floor. In this study parameters, consider are span to depth ratio, the spacing of the transverse beams, the thickness of the web, and thickness of the flange. They calculated the bending moment, shear force, and mid-span deflection developed in grid floors beam and comparing their results.

Dr. Ayad Abdulhameed Sulaibia (2017) [16] in this paper finite element method (FEM) by using ANSYS (v.15) software to analyses the specimens of experimental work to verify the validity of FEM by comparison with experimental results. In addition, some parametric studies on these works are done to cover the effect of some important variables on the ultimate load capacity and deflection which were not covered in the experimental work. The results of ANSYS software for chosen examples show good agreement with the experimental results. Load-deflection curves for ANSYS models are higher than the experimental curves. It was found that the percentage of increase in stiffness increases with increasing of slab thickness, but this increase is governed by the spacing between ribs.

Renuka Gurusiddappa Madiwalar (2016) [1] in this study, structure having conventional slab and flat slab has been analyze under earthquake loading using equivalent statics method. Comparative analysis of conventional slab, flat slab without drop, flat with drop, flat slab with column head and flat with both drop and column head. And they considered 15 (G+14) storey building. They studied same building for different seismic zone which are located in zone (II,III,IV,V) and taking soil type to Also they are studied parameters like lateral displacement storey drifts, storey shear, design base shear and axial forces.

P.M. Raju (2015) [17] It was also observed that the cost of the grid floor would be minimized if minimize the thickness of the slab, minimum width of ribs and maximum spacing of ribs is adopted.

Boskey Bahoria (2010) [18] The design of the post-tension flat slab can be done by using load balancing and equivalent frame method. The equivalent frame method is widely used. The posttensioning method one can design the most economic and the safe design.it was observed that economic point of view the post-tensioned flat slab is the most economical among all four floor systems and the reinforced concrete slab with reinforced concrete beam is the costlier one for this span.

3. Objectives

The following objectives were identified based on these parameters:

- The objective of this project is to do comparative study of the regular and plane irregular building under earthquake forces
- To study the effect of irregular distribution of mass in plan on the seismic response of structures.
- To study the influence of asymmetric distribution of stiffness on the structural responses.
- To study the performance level of the structure.
- To study the effect of irregular distribution of mass, asymmetric distribution of stiffness and irregular plan configurations and compare it with the seismic response of a regular structure.

4. Modeling

ETABS software is used to model and analyze all five cases of buildings. According to Indian criteria, models are analyzed for gravity loads and lateral loads (Seismic) with various load combinations. Both the gravitational and lateral loads are measured according to the Indian specifications. The amounts of reinforced steel and concrete needed for the floor structure have been measured for the five cases.

5. Methodology

In order to study, the comparison of conventional slab, flat slab and grid slab, ribbed slab structural system. Analysis & design the structural system to check the behavior of the structure after acting the load. In the structure dead and live load are applied, the structure showing various behaviors. The structure is analyzed & design in the software. The selection and design of building frames as per the design code procedure. The design frame modeled for analysis using ETABS software.

Axial forces, shear force, bending moment shear have been calculated for three different columns.

In this study (G+15) construction plan is used. Length, width and height of the building are 77 meters, 36 meters and 56 meters respectively. Size of the column is 1000 X100 mm. For below five cases different floor systems have been used.

Case1- Flat Slab
Case2- Flat Slab with Drop
Case3- Conventional Slab
Case4- Grid Slab
Case5- Ribbed Slab

6. CONCLUSIONS

1. Story displacement and story drift are maximized for conventional slab and minimum for the load-bearing wall type.
2. A load-bearing wall is safer against wind and earthquake loads. But, considering cost as an important factor Grid slab is economical and safer when compared with other building slab arrangements.
3. Storey drift is a least at the bottom story and reach a peak at middle stories then constant decreases to the top story in both seismic co-efficient method and response spectrum method.
4. The most economical slab between flat slab with drop, flat slab without drop and grid slab, it is design by M35 grade concrete and Fe415 steel.
5. Studies on the seismic variation of conventional RC slab and flat slab and their comparison, found that as story displacement, story shear, and overturning moment, and story drift, values of flat slab higher than that of the conventional slab.
6. The percentage of increase in stiffness increases with increasing of slab thickness, but this increase is governed by the spacing between ribs.
7. Economic point of view the post-tensioned flat slab is the most economical among all four floor systems and the reinforced concrete slab with reinforced concrete beam is the costlier one for this span.

REFERENCES

1. R. G. Madiwalar and V. Vijapur, “Comparative Study of Different Type of Flat Slab and Conventional Slab for an RC Structure Under Earthquake Loading,” Bonfring Int. J. Man Mach. Interface, vol. 4, no. Special Issue, pp. 50–55, 2016, doi: 10.9756/bijmmi.8156
2. D. D. Roche, K. Ramesh, and R. Shanmugasundaram, “Comparative Study Of Behaviour Of Rc Slab And Grid Slab Using Etabs In Seismic Zones In India.,journal of seybold report, vol. 15, 2020,”
3. D. D. Roche, K. Ramesh, and R. Shanmugasundaram, “Comparative Study Of Behaviour Of Rc Slab And Grid Slab Using Etabs In Seismic Zones In India.,journal of seybold report, vol. 15, 2020,”
4. T. Spoorthy and S. Ramesh Reddy, “Comparison between the seismic variation of conventional RC slab and flat slab with a drop for G+15 storey building in different zones using etabs software,” Int. J. Adv. Res., vol. 4, no. 3, 2018, [Online]. Available: www.IJARIIT.com.
5. M. Hukre and V. R. Harne, “Analysis & Design of Beamless Slab,” Helix, vol. 10, no. 1, pp. 179–183, 2020, doi: 10.29042/2020-10-1-179-183.
6. C. L. Nishanth, Y. Sai Swaroop, D. C. K. Jagarapu, and P. Kumar Jogi, “Analysis and design of commercial building with different slab arrangements using ETABS,” Mater. Today Proc., no. July, pp. 0–5, 2020, doi: 10.1016/j.matpr.2020.05.823.
7. S. O. A. Olawale, M. A. Tijani, M. A. Kareem, A. M. Ogungbire, and O. Alabi, “Cost optimisation of the design of reinforced concrete flat slab to BS8110,” IOP Conf. Ser. Mater. Sci. Eng., vol. 640, no. 1, 2019, doi: 10.1088/1757-899X/640/1/012052.
8. A. A. Sulaibi, “Analysis and Parametric Study of Reinforced Concrete Two-Way Ribbed Slabs by using ANSYS,” Am. Sci. Res. J. Eng. Technol. Sci., vol. 30, no. 1, pp. 16–36, 2017.
9. P. M. Raju, “Analytical Study on Economic Effect of Grid Floor Geometric Parameters,” no. January, 2015.
10. IS 456:2000 Indian standard code of practice for plain and reinforced concrete
11. IS 1893:2016 (Part 1) Criteria For Earthquake Resistance Design Of The Structure
12. IS 875:1987(Part 2) Codes Of Practice For Design Loads (Other Than Earthquake) For Building And Structures, Imposed Load.