ANALYSIS OF FLAT SLAB BY USING ETABS (G+4)

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ABSTRACT

Flat slabs are a type of construction that eliminates the usage of beams, which are commonly utilised in traditional ways of construction. The slab sits directly on the column, transferring the load from the slab to the columns and subsequently to the foundation. The term "Flat Slab" refers to a slab having walls. As a result, substantial bending moments and shear forces emergearound the columns. These forces cause concrete to crack and may cause the slab to fail, hencea bigger area at the top of the column, known as the column head/capital, is required. The purpose of this study is to show how flat plate/slab construction is used in India. Following the applications in buildings, a comparison of flat plate/slab structure designs based on Indian Standard 456:2000[1] is shown. Different countries have chosen different methods for designing flat slabs based on local constraints and material availability, and have provided guidance in their individual codes. The current study provides information on the parameters max strip moments, base shear, max storey displacement, and storey drift in accordance with IS 456:2000 code regulations. Flat slabs are commonly utilised in office buildings because oftheir low formwork costs, quick excavation, and simple installation.

Key words: Flat slab, Multi storied Building, Analysis of slab.RCC, bending moment.

1. INTRODUCTION

The loads are passed directly to thesupporting concrete columns because thereare no beams or girders. Both vertical and lateral weights are applied to them. Thedesign is governed by lateral loads caused by wind and earthquakes rather than vertical loads. Architects and clients alike choose flat slabs for their creative and financial benefits. This type of reinforced concrete building has more benefits than framed structures, but it also has some drawbacks, such as punching failure and greater deformation. A flat slab is areinforced concrete slab that is supported directly by concrete columns rather than using intermediary beams. C.A.P. Turner built flat slabs in the United States in 1906,mostly employing intuitive and intellectualideas, which marked the beginning of this form of construction. Between 1910 and 1920, several slabs throughout the United States were load-tested. Flat slab floor systems are particularly common in nationswhere cast-in-place construction is the prevalent method of construction because they offer several benefits in terms of architectural flexibility, space use, ease of formwork, and construction speed. Formwork costs are decreased, excavation is completed quickly, and installation issimple. Columns, slabs, and beams are commonly used in traditional frame construction. However, it may be conceivable to create without beams; in this scenario, the frame system would consist ofa slab and column with no beams .Becausetheir behaviour matches that of flat plates, these slabs are referred to as flat slabs. Theloads are transferred directly to the supporting concrete columns without the need of beams and girders. Both vertical and lateral weights are applied to them. Thedesign is governed by lateral loads caused by wind and earthquakes rather than vertical loads.

2. LITREATURE REVIEW

- **Dr. U. Gupta et al.** found about flat slab structures which are moreflexible than traditional RC frame structures, thus becoming more susceptible to seismic loading. Therefore, the seismic behaviour offlat slab buildings suggest thatsupplementary measures for designof these structures in seismic zones were required. To improve the performance of structure, provisionof shear walls was suggested by theauthor. The object of the author wasto storeyed buildings having flat slabswith drops to the two way RC slabswith beams and to study the effect of shear walls on the performance ofthese structures under seismicforces. This study provides us a decent source of

information on theparameters like lateral displacementand storey drift [1].

- **K. G. Patwari et al.** studied the effects of the flat slab structure having shear walls with differentlocations for different heights of thebuilding. The behaviour of Flat slabstructure and shear wall structurewas investigated with the help of three model by Time History analysis carried out by ETABsSoftware. The study concluded thatthe Natural time period of theconventional structure is more compared to the flat slab structure because of monolithi construction[2].

- **Manu K V et al**. observed the behaviour of various buildings models by keeping the plan symmetrical for all the models. Thebuilding modelled as conventional slabs, flat slab building with drop and without drop, flat slab with shear wall. This study concludedthat lateral displacement and storeydrift is minimum at plinth level, Base shear value is maximum atplinth level, also the Natural periodincreases as number of stories increases [3].
- **Devtale** studied the linear analysis of regular framed structure and flat slab structure building. The investigation concluded that the flatslab have low base shear capacity and large deflection. The study of flat slab with shear wall and regularframed structure also conducted. It concluded that the performance of the flat slab is improves with the useof shear wall. The study states that the performance of regular framed structure is better than that of flat slab structure the investigation also concluded that with the use of shearwall, the seismic performance of theflat slab structure is much more improves. [4].
- **Mohana H.S** studied about thebehavior of G+5 commercial building using ETABS for differentstudy focused on the performance ofthe both the structure under variousloading condition and also studies the behavior of both the structure for various parameters like base shear, lateral displacement, storey drift, axial force. This study concluded that base shear of flatslab is 6% more as compared to RCslab. This study also concluded thatdesign axial force on flat slab is5.5% more than that of RC structure. As the seismic level increases all the parameters like base shear, storey drift, lateral displacement and the axial force areincreases.[5].
- **SYED ASIM AMANI et al.** Thelateral behavior of a typical flat slabbuilding which is designed according to I.S. 456- 2000 is evaluated by means of dynamic analysis. The inadequacies of these buildings are discussed by means ofcomparing the behavior with that ofconventional beam column framing.Grid slab system is selected for thispurpose. To study the effect of droppanels on the behavior of flat slab during lateral loads, flat plate system is also analyzed. Zone factorand soil conditions -- the other two important parameters whichinfluence the behavior of the structure, are also covered. Software ETABS is used for this purpose. In this study relation between the number of stories, zoneand soil condition is developed [6].

3. Proposed work

A flat slab is a reinforced concrete slab with or without drops, supported by columns with or without flared heads and oftenwithout beams. A flat slab can be solid or have recesses made on the soffit, resulting in a soffit with a series of ribs running in both directions. Filler bricks, either permanent or removable, can be used to create the recess. A flat slabis a reinforced concrete slab that is strengthened in two or more directions to transfer loads acting normal to its plane to supportingcolumns without the use of a beam or girder." The above definition is fairly broad, and it includes all of the many types of column- supported two-way slabs stated above. As previously stated, the code technique is based on the elastic analysis of equivalent framesunder gravity loads and closely follows the ACI code version of1997 The I.S code, unlike the unified code method, does not elaborate on the specific example ofa two-way slab with beams along column lines. B. Design Principles The analysis of flat slabs can be done in three ways.

1. Direct Design Method (DDM)
2. Equivalent Frame Method (EFM)
3. Finite Element Method (FEM)

3.1 About Etabs Software:

Computers and Structures Inc.'s "ETABS- Extended 3D Analysis of Building Systems" is a product. It's a type of engineering software that's employed in theconstruction industry. It offers sophisticated structure analysis and design software tailored to multi-story building systems. Modelling tools and templates, code-based load prescriptions, analysis methodologies, and solution strategies are all part of the integrated system. It canhandle the most sophisticated and huge building models and setups. The ETABS software includes CAD-like drawing tools with a grid representation and an

object- based interface.

1. It's a piece of construction software.It tests the load-bearing capacity of building structures and analyses and assesses seismic performance. Using this software, you can view and manipulate the analytical modelwith great accuracy. Plans andelevation views are auto-generated at every grid line.
2. You may inspect and manipulate theanalytical model with remarkableprecision with this software. At every grid line, plans and elevation views are generated automatically.
3. For the analysis of concrete shear walls and concrete moment frames,ETABS software is employed. It is well-known for static and dynamic analyses of multi-story frame and shear wall structures.
4. It is one of the most widely used civil design tools in the constructionsector, and it helps structural engineers work more efficiently. It also saves time and money by avoiding the use of general-purposesoftware.
5. ETABS' input, output, and numerical solution methodologiesare specifically developed to takeuse of the unique physical and numerical properties of building type structures. As a result, data preparation, output interpretation.

3.2Objectives:

- To study the performance of flat slab and conventional slab structure subjected to various loads and conditions.
- The behaviour of both structures was investigated for factors such asstorey shear, storey displacement drift ratio, and axial forces.

3.3Comparing the conventional and software values for validation:

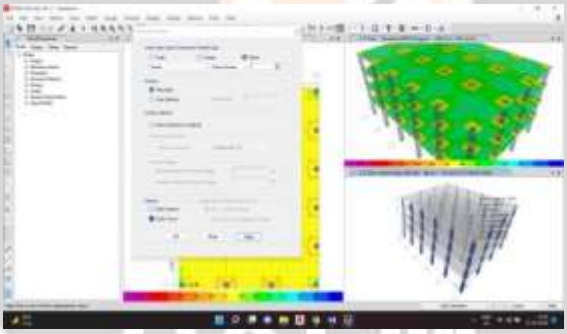

FIG-1: MAX^{m} & MIN^{m} STRESS DETAILS

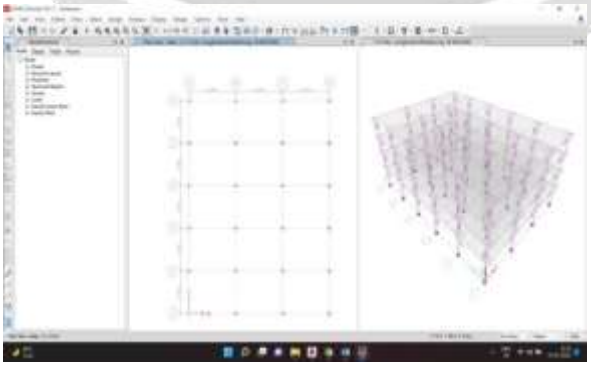

FIG-2: AFTER DESIGN THE SECTION IS SAFE

4.CONCLUSION

- For all models in flat slab construction, the results for Punching Shear and Strip Momentscriterion are satisfied in both circumstances (manual design and software analysis).
- For all models, the Design Base Shear for zone-3 & soil type-3 is substantially higher in flat slab without drop than in flat slab with drop.
- In square slab construction, the Design Base Shear is substantially higher than in rectangular slabconstruction.
- In both rectangular and squareslabs, the Natural Period value doesnot vary greatly.
- Storey Drift values follow aparabolic pattern along floor heightfor all models investigated, with thegreatest value laying the third storeyfor flat slab with drop building and the fourth storey for flat slab without drop building.

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6. REFRENCES

[1] Indian Standard Is 456:2000, Plain And Reinforced Concrete Code Of Practice.
[2] Indian Standard Is 1893 (Part 1): 2002, Criteria for Earthquake Resistant Design Of Structures.
[3] Agrawal. P. and Shrikhande. M (2007), "Earthquake Resistant Design of Structure", prentice Hall of India Private Limited, New Delhi, India.
[4] Bhavikatti S. S, "Advance R.C.C Design", New Age International (p) Limited, Publishers, New Delhi, India.
[5] Pradip S. Lande, Aniket B. Raut (Journal of Civil Engineering and Environment Technology Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 2, Number 10, April-June, 2015 pp. 7-10) 4 critical.
[6] Kim and Lee (Effective analysis of flat slab structure subjected to lateral loads, Engineering Structure, page no. 251-263.2005).
[7] M.A. Ismaeil (2014), pushover analysis of 4 storey building (IJSBAR-International journal of sciences: Basic and applied Research volume 16).
[8] Dhananjay D. Joshi, Dr. Pranesh B. Murnal, 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 (Sep.-Oct.2013), PP 41-44.
[9] Gupta U., Ratnaparkhe S., Gome, P.," Seismic behaviour of building having flat slabs with Drops", International Journal of Emerging Technology.