ABSTRACT:

Construction industry is being revolutionised with growing technology and innovation. Man started to reach sky not in any aeroplane but with the height of building. Tall structures have considerably reduced the problem of shelter but are considered highly susceptible to seismic loads and uneconomical. Both the problems are aroused due to high weight of the building. Of all the structural members in a building slabs are considered to be occupying high area and the load of the building is mostly contributed due to slab. In general for commercial areas normal slabs are not been considered, as the spans between the supports are more which leads to increasing in deflection and ultimately provision of huge depth and percentage of steel is increased beyond the codal provision .once such solution to reduce the slab depth and provide economical design is flat slabs technology.

INTRODUCTION:

The horizontal floor system resists the gravity load (dead load and live load) acting on it and transmits this to the vertical framing systems. In this process, the floor system is subjected primarily to flexure and transverse shear, whereas the vertical frame elements are generally subjected to axial compression, often coupled with flexure and shear. The floor also serves as a horizontal diaphragm connecting together and stiffening the various vertical frame elements. Under the action of lateral loads, the floor diaphragms behave rigidly (owing to its high in plane flexural stiffness) and effectively distribute the lateral load to the various vertical frame elements and shear walls. In cast in situ reinforced concrete construction the floor system usually consists of one of the following...
**Beam Supported Slab System**

**Two way ribbed (waffle) slab system**

**Flat Slab Systems**

RC slabs with long spans extended over several bays and only supported by columns, without beams known as flat slab. Flat slab system is very simple to construct and is efficient in that it requires the minimum building height for a given number of stories. Such structure contains large bending moment and vertical forces occur in a zone of supports. This gives a very efficient structure which minimizes material usages and decreases the economic span range when compared to reinforced concrete. Post-tensioning improves the structural behaviour of flat slab structure considerably. This is more acceptable concept to many designers. It is adopted in some office buildings.

**Drop Panels**: The 'drop panel' is formed by the local thickening of the slab in the neighbourhood of the supporting column. Drop panels or simply drops are provided mainly for the purpose of reducing shear stress around the column supports.

**Column Capital**: The column capital or column head provided at the top of a column is intended primarily to increase the capacity of the slab to resist punching shear. The flaring of the column at top is generally done such that the plan geometry at the column head is similar to that of the column.

**Drop panel and column capital**

**Types of FLAT SLAB:**

1. **FLAT PLATE**

2. **FLAT PLATE WITH COLUMN HEAD OR CAPITAL**
3. FLAT PLATE WITH DROP

4. FLAT PLATE WITH DROP AND COLUMN HEAD

ILLITERATURE REVIEW

R. P. Apostolska¹, G. S. Necevska-Cvetanovska², J. P.Cvetanovska³ and N. Mircic⁴:

Flat-slab building structures possesses major advantages over traditional slab-beam-column structures because of the free design of space, shorter construction time, architectural -functional and economical aspects. Because of the absence of deep beams and shear walls, flat-slab structural system is significantly more flexible for lateral loads then traditional RC frame system and that make the system more vulnerable under seismic events. The results from the analysis for few types of construction systems which is presented in the paper show that flat slab system with certain modifications (design of beam in the perimeter of the building and/or RC walls) can achieve rational factor of behaviour considering EC8 and can be consider as a system with acceptable seismic risk. Modifications with additional construction elements improve small bearing capacity of the system and increase strength and stiffness, improving seismic behaviour of flat-slab construction system. Selected result from the analysis is presented in the paper.

Mohd. Rizwan Bhina¹, Waseem Khan², and D.K.Paul³

Flat-Slab building is very popular from the aesthetic and architectural point of view. From functional aspect a flat-slab building is more efficient than a R.C. frame building. So, construction of Flat-Slab building is increasing also in high seismic zone. In this paper the response of Flat-Slab building and a normal symmetric R.C. frame building of same dimension have been studied for varying seismic intensities and serviceability. Static, Response Spectrum, have been performed to assess the performance of buildings. The costs of construction for these two buildings have also been compared. An extensive study of serviceability has also discussed in the paper. The paper also comments on the cost of the flat slab building and conventional building and there serviceability. Papers also conclude that which building is more serviceable during earthquake.

S.D.Bothara et.al

Studies about comparative effect of earthquake on flat slab & Grid floor system consisting of beam
spaced at regular intervals in perpendicular directions, monolithic with slab.

V.K. Rahman et al. work on design of R.C.C. as well as pre-stressed concrete flat slabs for various spans and then compare the results. Programming in MS EXCEL is done to design both types of flat slabs. The idea is to reach a definite conclusion regarding the superiority of the two techniques over one another. Results reveal that a R.C.C. flat slab is cheaper than pre-stressed concrete flat slab for smaller spans but vice versa is true for larger span.

III PROPORTIONING OF FLAT SLABS:

IS 456-2000 [Clause 31.2] gives the following guidelines for proportioning.

DROPS

The drops when provided shall be rectangular in plan, and have a length in each direction not less than one third of the panel in that direction. For exterior panels, the width of drops at right angles to the non-continuous edge and measured from the centre-line of the columns shall be equal to one half of the width of drop for interior panels.

COLUMN HEADS

Where column heads are provided, that portion of the column head which lies within the largest right circular cone or pyramid entirely within the outlines of the column and the column head, shall be considered for design purpose as shown in Figs. 3.2 and 3.4.

Thickness of flat slab

From the consideration of deflection control IS 456-2000 specifies minimum thickness in terms of span to effective depth ratio. For this purpose larger span is to be considered. If drop as specified in 3.2.1 is provided, then the maximum value of ratio of larger span to thickness shall be

\[
\begin{align*}
&= 40, \text{ if mild steel is used} \\
&= 32, \text{ if Fe 415 or Fe 500 steel is used}
\end{align*}
\]

If drops are not provided or size of drops do not satisfy the specification 3.2.1, then the ratio shall not exceed 0.9 times the value specified above i.e.,

\[
\begin{align*}
&= 40 \times 0.9 \\
&= 36, \text{ if mild steel is used.} \\
&= 32 \times 0.9 \\
&= 28.8, \text{ if HYSD bars are used}
\end{align*}
\]

It is also specified that in no case, the thickness of flat slab shall be less than 125 mm.

INTRODUCTION TO SOFTWARES

ETABS:

The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings. Incorporating 40 years of continuous research and development, this latest ETABS offers unmatched 3D object based modeling and visualization tools, blazingly fast linear and nonlinear analytical power, sophisticated and comprehensive design capabilities for a wide-range of materials, and insightful graphic displays, reports, and schematic drawings that allow users to quickly and easily decipher and understand analysis and design results.

SAFE:

SAFE is the ultimate tool for designing concrete floor and foundation systems. From framing layout all the way through to detail drawing
production, SAFE integrates every aspect of the engineering design process in one easy and intuitive environment. SAFE provides unmatched benefits to the engineer with its truly unique combination of power, comprehensive capabilities, and ease-of-use.

IV MODEL IN ETABS AND SAFE:

ETABS:

SAFE:

EXPORT TO SAFE

CELLER FLOOR PLAN IN SAFE

DESIGN OUT PUT:

PUNCHING SHEAR:

Punching shear: Max of $=0.9885$ which is less than 1 safe

BENDING MOMENT IN THE STRIPS

AREA OF STEEL ALONG THE STRIPS Y- AXIS
AREA OF STEEL ALONG THE STRIP X-AXIS

V DRAWINGS:

FOUNDATION DETAILS:

CELLAR PLAN:

COLUMN DETAILS:
FLOOR PLAN:

VI RESULTS:

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DESIGN OF FOUNDATION:

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IJPRES
**DISPLACEMENT:**

1. Flat-slab building structures possess major advantages over traditional slab-beam-column structures because of the free design of space, shorter construction time, architectural –functional and economical aspects.

2. Because of the absence of deep beams and shear walls, flat-slab structural system is significantly more flexible for lateral loads than traditional RC frame system and that make the system more vulnerable under seismic events.

3. The purely flat-slab RC structural system is considerably more flexible for horizontal loads than the traditional RC frame structures which contributes to its increase of vulnerability under seismic events.

4. The critical moment in design of these systems is the slab-column connection, i.e., the penetration force in the slab at the connection, which should retain its bearing capacity even at maximal displacements.

**BEAM DESIGN: DESIGNED FOR CRITICAL LOAD ONLY BEAM 40**

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**CONCLUSIONS**

1. Flat-slab building structures possess major advantages over traditional slab-beam-column structures because of the free design of space, shorter construction time, architectural –functional and economical aspects.

2. Because of the absence of deep beams and shear walls, flat-slab structural system is significantly more flexible for lateral loads than traditional RC frame system and that make the system more vulnerable under seismic events.

3. The purely flat-slab RC structural system is considerably more flexible for horizontal loads than the traditional RC frame structures which contributes to its increase of vulnerability under seismic events.

4. The critical moment in design of these systems is the slab-column connection, i.e., the penetration force in the slab at the connection, which should retain its bearing capacity even at maximal displacements.
5. The ductility of these structural systems is generally limited by the deformability capacity of the column-slab connection.

6. To increase the bearing capacity of the flat-slab structure under horizontal loads, particularly when speaking about seismically prone areas and limitation of deformations, modifications of the system by adding structural elements are necessary.

REFERENCE:


[7] The other code books referred for this project are, SP 16 (design aids for IS 456), IS 875 – Part I, II, III, V.