International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

Analysis and Design of Commercial Building with Flat Slab

Mohd Omer Ahmed & Mr. Abidi Madhu Sudhan
[1]M.Tech Student, [2]M.Tech , Asst Professor
Department Of Civil Engineering
Sphoorthy Engineering College

ABSTRACT: - "*Flat Slab" is better understood as the slab without beams resting directly on supports (like columns & or walls).By virtue of that large Bending Moment & Shear Forces are developed close to the columns. Flat slabs system of construction is one in which the beams used in t he conventional methods of constructions are done away with. The slab directly rests on the column and load from the slab is directly transferred to the columns and then to the foundation. To support heavy loads the thickness of slab near the support with the column is increased and these are called drops, or columns are generally provided with enlarged heads called column heads or capitals. Absence of beam gives a plain ceiling, thus giving better architectural appearance and also less vulnerability in case of fire than in usual cases where beams are used. Plain ceiling diffuses light better, easier to construct and requires cheaper form work. As per local conditions and availability of materials different countries have adopted different me thuds for design of flat slabs and given their guidelines in their respective codes. The Finite element analysis & Equivalent frame analysis is carried out by using software ETABS, The analysis & design is performed by Equivalent Frame Method with staggered column & without staggered column as prescribed in the different codes like IS 456-2000, ACI 318-08 are compared. In this process moments are distributed as column strip moments & middle strip moments. For carrying out this project an interior panel of a flat slab with dimensions 6.6 x 5.6 m and super imposed load 7.75 KN /m2 was designed using the codes given above.*

I. INTRODUCTION

1.1 General

A flat slab is a two-way reinforced concrete slab that usually does not have beams and girders, and the loads are transferred directly to the supporting concrete columns. They are subjected to both vertical and lateral loads. Lateral loads due to wind and earthquake governs the design rather than the vertical loads. The buildings designed for vertical load may not have the capacity to resist the lateral loads. The lateral loads are the premier ones because in contrast to vertical load that may be assumed to increase linearly with height; lateral loads are quite variable and increase rapidly with height. Under a 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 lateral loads are considerably higher in the top storey rather than the bottom storey due to which building tends to act as cantilever. These lateral forces tend to sway the frame. In many of the seismic prone areas there are several instances of failure of buildings which have not been designed for earthquake loads. All these reaction makes the study of the effect of lateral loads very important. In general normal frame construction utilizes columns, slabs & beams. However it may be possible to undertake construction without providing beams, in such a case the frame system would consist of slab and column without beams. These types of slabs are called flat slab, since their behavior resembles the bending of flat plates. Pure rigid frame system or frame action obtained by the interaction of slabs, beam and column is not adequate. The frame alone fails to provide the required lateral stiffness for buildings taller than 15 to 20 (50m to 60m) stories. It is because of the shear taking component of deflection. Produced by the bending of columns and slab causes the building to deflect excessively. 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. First approach has its own limits, whereas second one is more elegant which increases rigidity and stability of the structure and also confine the deformation requirement. In earthquake engineering, the structure is designed for critical force condition among the load combination. In the present study the response of

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

multi-storey commercial reinforced concrete. Frame and r c flat slab to the lateral and vertical loads have been done.

Scope of the study

This work includes the design and estimate for flat slabs of various spans, ranging from 6.0 m to 12.0 m, by reinforced concrete's. And prestressed concrete techniques. For smaller spans, associated with normal building works, prestressed concrete construction becomes too cumbersome, irrespective of the economics involved. Intensity of assumed loading is kept sufficient enough, so that the factored bending moment will be comparable to that developing in cases of commercial buildings. Post-tensioning is preferred as it is in vogue, in construction of large span slabs. All structural costs, floor framing is usually the largest component. Likewise, the majority of a structure's formwork cost is usually associated with the horizontal elements. Consequently, the first priority in designing for economy is selecting the structural system that offers lowest overall cost while meeting load requirements. Post tensioning is the key to cost-effective multifamily construction. In addition, post-tensioned structures can be designed to have minimal deflection and cracking, even under full load. Thinner floors provide lower building weight, which creates a corresponding reduction in other structural elements. There are also some associated labour and time savings

Objectives

- To study the performance of flat slab and conventional slab structure subjected to various loads and conditions.
- To the study the behavior of both structure for the parameters like storey shear, storey displacement drift ratio, axial forces.
- Comparisons of flat and conventional building for the above parameters
- The main objective of the analysis is to study the different forces acting on a building. The analysis is carried out in etabs software. Results of conventional reinforced concrete.c structure i.e. Slab, beam and column and flat slab reinforced concrete.c structure for different heights are discussed below
- Conventional reinforced concrete.c structure and flat slab reinforced concrete.c for different height are modeled and analyzed for the different combinations of dynamic loading. The comparison is made between the conventional reinforced concrete.c structure and flat slab reinforced concrete.c. Buildings are situated in seismic zone IV.

To study the vulnerability of purely frame and purely flat-slab models under different factors which are storey drift, lateral displacement, time period and base shear have been obtained for.

II. RESULTS AND ANALYSIS

General ETABS is a special-purpose computer program developed specifically for building structures. It provides the Structural Engineer with all the tools necessary to create, modify, analyze, design, and optimize building models. These features are fully integrated in a single, Windows-based, graphical user interface that is unmatched in terms of ease of- use, productivity, and capability. 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.

From the start of design conception through the production of schematic drawings, ETABS integrates every aspect of the engineering design process. Creation of models has never been easier - intuitive drawing commands allow for the rapid generation of floor and elevation framing. CAD drawings can be converted directly into ETABS models or used as templates onto which ETABS objects may be overlaid. Design of steel and concrete frames (with automated optimization), composite beams, composite columns, steel joists, and concrete and masonry shear walls is included, as is the capacity check for steel connections and base plates.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

Models may be realistically rendered, and all results can be shown directly on the structure. Comprehensive and customizable reports are available for all analysis and design output, and schematic construction drawings of framing plans, schedules, details, and crosssections may be generated for concrete and steel structures. ETABS provides an unequaled suite of tools for structural engineers designing buildings, whether they are working on one-story industrial structures or the tallest commercial high-rises. Immensely capable, yet easy-to-use has been the hallmark of ETABS since its introduction decades ago, and this latest release continues that tradition by providing engineers with the technologically-advanced, yet intuitive, software they require to be their most productive.

Finite element method

The finite element method is a numerical technique to find approximate solutions of partial differential equations. It was originated from the need of solving complex elasticity and structural analysis problems in civil, mechanical and aerospace engineering. In a structural simulation, finite element method helps in producing stiffness and strength visualizations. It also helps to minimize material weight and its cost of the structures. Finite element method allows for detailed visualization and indicates the distribution of stresses and strains inside the body of a structure. Many of fe software are powerful yet complex tool meant for professional engineers with the training and education necessary to properly interpret the results. This powerful design tool has significantly improved both the standard of engineering designs and the methodology of the design process in many industrial applications. The use of finite element method has significantly decreased the time to take products from concept to the production line. One must take the advantage of the advent of faster generation of personal computers for the analysis and design of engineering product with precision level of accuracy

Etabsnanalysis and design procedure Define Plan Grids and Story Data

- Define Material Properties
- Define Frame Sections
- Define Slab Sections
- Define Load Cases
- Draw Beam Objects (Frame Members)
- Draw Column Objects (Frame Members)
- Assign Slab Sections
- Assign Restrains
- Assign Slab Loads
- View Input Data in Tabular Form
- Run the Analysis
- View Analysis Results Graphically
- Design Concrete Frame Element

III. STRUCTURAL PLANNING

Structural planning is first stage in any structural design. It involves the determination of appropriate form of structure, material to be used, the structural system, the layout of its components and the method of analysis. As the success of any engineering project measured in terms of safety and economy, the emphasis today is being more on economy. Structural planning is the first step towards successful structural design.

Building Loads Categorized by Orientation:

Types of loads on a hypothetical building are as follows.

- Vertical Loads
- Dead (gravity)
- Live (gravity)
- Snow(gravity)
- Wind(uplift on roof)
- Seismic and wind (overturning)
- Seismic(vertical ground motion)

Assumptions

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

1. Using partial safety factor for loads in accordance with clause 36.4 of IS-456 2000 as ϒ t =1.5

2. Partial safety factor for material in accordance with clause 36.4.2 is IS-456- 2000 is taken as 1.5 for concrete and 1.15 for steel.

3. Using partial safety factors in accordance with clause 36.4 of IS-456- 2000 combination of load.

Table 1 : Density of Materials Used

MATERIAL	DENSITY
i) Plain concrete	24.0KN/m^3
ii) Reinforced	25.0KN/m^3
iii) Flooring material(c.m)	1.0KN/m2
iv) Brick masonry	19.0KN/m^3
LIVE LOADS: (In accordance with IS.875)	
i) Live load on slabs	2.0KN/m^2
ii) Live load on passage	4.0KN/m^2
iii)Live load on stairs	4.0KN/m^2

Using M25 and Fe 415 grade of concrete and steel for beams, slabs, footings, columns.

Table 2 : Design Constants

Therefore:	
fck	Characteristic strength for M25-25N/mm^2
f_y	Characteristic strength of steel-415N/mm^2

Data Collection

The building models are 15 storey's located in zone II. Tables 4.0 and Table 4.2present a summary of the building parameters.

Table 3: General data collection and condition assessment of building

Sl.No.	Description	Information	Remarks
1	Building height a) 11-storey	33 m	Including the foundation level
2	Number of basements below ground	0	----
3	Open ground storey	Yes	----
4	Special hazards	None	----
5	Type of building	Regular/Irregular Space frames	IS 1893:2002 Clause 7.1
6	Horizontal floor system	Beams and slabs	----
7	Software used	Etabs2013	----

IV. CONCLUSION

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 purely flat-slab RC structural system is considerably more flexible for horizontal loads than the traditional RC frame structures which contributes to the increase of its vulnerability to seismic effects. 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. The ductility of these structural systems is generally limited by the deformability capacity of the column-slab connection. 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.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

REFERENCES

I. Park et al. (2008) found that equivalent frame method is not appropriate in accurately predicting the response of two-way slab systems under lateral loads. Currently design .code, aci 318-05[2.1] permit the efm for the analysis of two-way slab system under gravity loads and lateral loads such as seismic loads.

II. Subramanian et al (2005) found that to increase the punching shear strength of flat slab, the shear reinforcement is found to provide economical solution. They not only enhance the shear capacity but also result in flexural failure of the slab and thus increasing the ductility of flat slab, which is very important in earthquake prone zone.

III. Fanella, David A. "Concrete Floor Systems: nd Edition. Portland Cement Association, 2000 Guide To Long-Span Concrete Floors, Cemen And Concrete Association Of Australia.

IV. Gowda N Bharath; Gowda S. B. Ravishankar; A.V Chandrashekar "Review And Design Of Flat Plate/Slabs Construction In India",2002.

V. Structural Design Guide To The Aci Building inhold

VI. Company. New York. 1985.

VII. Indian Standard Is 456:2000, Plain And Reinforced Concrete Code Of Practice.

VIII. Purushothaman P., Reinforced Concrete Structural Elements, Tata Mcgraw-Hill Publication Company Ltd. New Delhi. 1984