Comparative Study of Flat Slab and Conventional Slab in Various Seismic Zones using E-Tabs

Sagar N. Kitey[1] G. D. Dhawale[2] Milind R. Nikhar[3]
[1]M. Tech Research Scholar [2]Professor [3]Assistant Professor
[1,2,3]Department of Civil Engineering
[1,2,3]Bapurao Deshmukh College of Engineering, Sevagram, Wardha, MH, India

Abstract— In present era, flat slab buildings are commonly used for the construction as it has many advantages over conventional RC frame building in terms of architectural flexibility, use of space, easier formwork and shorter construction time. In the present work a G+12 multistoried building having flat slab with column head and conventional slab has been analyzed using E-TABS software for the parameters like storey displacement, storey drift, storey shear, base shear and time period. The main objective of the present work is to compare the seismic behavior of multistory buildings having conventional RC frame, flat slab with column head and conventional slab in seismic zone II, III, IV, V and to study the effect of height of building on the performance of these types of buildings under seismic forces. Linear dynamic response spectrum analysis was performed on the structure to get the seismic behavior.

Keywords: Conventional RC frame building, flat slab with column head building, Response spectrum analysis, overturning moment, storey drift, base shear, displacement, time period

I. INTRODUCTION

This project presents the "Comparative Study of Flat Slab and Conventional Slab in various seismic zones using ETABS". This work includes the analysis of flat slab and Conventional Slab. The purpose of this study is to understand the characteristics, the method of analysis, and the design of flat slab and Conventional Slab in ETABS structural software; and to find out which slab system with certain parameters is superior to other. A slab is a flat two dimensional planar structural element having thickness small compared to its other two dimensions. It provides a working flat surface or a covering shelter in buildings. It primarily transfers the load by bending in one or two directions. Reinforced concrete slabs are used in floors, roofs and walls of buildings and as the decks of bridges. Concrete slab behave primarily as flexural members and the design is similar to that of beams.

SR. NO.	BASED ON	CLASSIFICATION OF SLAB
	Shape	Square, rectangular, circular and polygonal in shape.
	Type Of Support	Slab supported on walls, Slab supported on beams, Slab Supported on columns (Flat slabs).
	Support Or Boundary Condition	Simply supported Cantilever slab, Overhanging slab, Fixed or Continuous slab.
	Use	Roof slab, Floor slab, Foundation slab, Water tank slab.
	Sectional Configuration	Ribbed slab /Grid slab, Solid slab, Filler slab, folded plate.
	Spanning Directions	One way slab – Spanning in one direction Two way slab – spanning in two directions

Table 1: Classification of Slab

SR. NO.	FLAT SLAB	CONVENTIONAL SLAB
	Live load shall not exceed 3 times the design dead load.	Live load has no relation with design dead load
	The thickness of slab is large.	The thickness of slab is small while depth of beam is large.
	Greater clear ceiling heights.	Lesser clear ceiling heights.
	Load from slab is directly transferred to column.	Load from slab is transferred to beam and from beam to column.
	Less formwork hence not costly.	More formwork hence costly.
	Ratio of Longer span to shorter span should not be more than 2.2.	Ratio of Longer span to shorter span has no limitation.
	Reduction in storey height.	Increase in storey height as compared to flat slab.
	Dead load of structure is less.	Dead load of structure is more.
	In flat slab system, minimum thickness of flat slab is 125 mm.	In slab beam system, minimum thickness of slab is 100 mm.
	Reinforcements are commonly provided in two layers.	Reinforcements are commonly provided in one layer.
	Illumination is better as beams are absent.	Illumination is not as effective as in flat slab as beam are present.
	Easier to provide acoustical treatment underside of slab.	Difficult to provide acoustical treatment underside of slab.
	It is less resistant to earthquake as it is less flexible than slab beam system.	It is more resistant to earthquake as it is flexible than flat slab system.

Table 2: Flat Slab & Conventional Slab

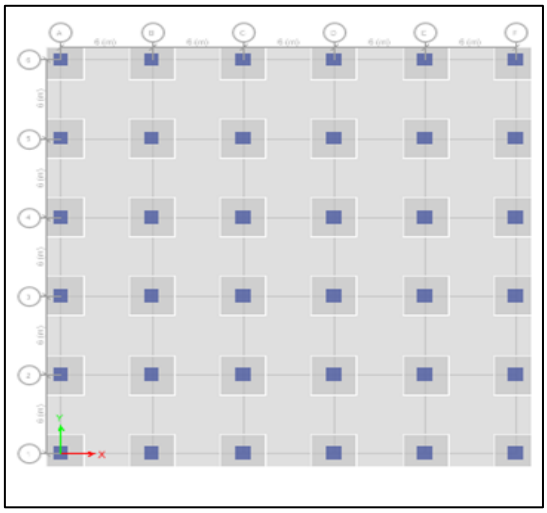

Fig. 1: Building plan for Flat slab building

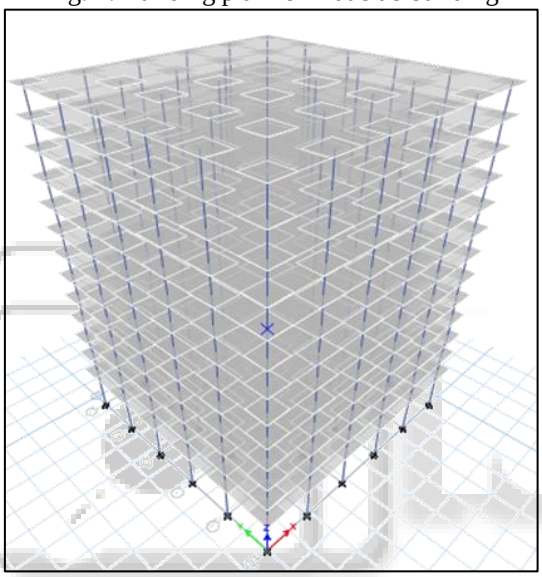

Fig. 2: 3D view of flat slab building

II. Objective

- To carry a relevant literature review by going through journal papers, conference proceedings, texts, reference books, standard handbooks etc.
- To analyze different form of slab arrangement for example conventional slab and flat slab for the given plan area and there comparative study.
- To make analysis of multistoried RCC building with flat slab and conventional slab (G+ 12 storey's) having regular geometry with response spectrum analysis taking into account earthquake zone II, III, IV, V as per the Indian standard code of practice IS 1893:2002 part-I, criteria for earthquake resistance structure.
- To evaluate the seismic behavior of different regular moment resisting flat slab and conventional slab structure.
- To evaluate base shear, overturning moment, storey displacement, storey shear etc.
- To model different structures aforementioned configuration and compare them using design aids like ETABS.

III. Literature Review

A. *[1] Vishesh P. Thakkar and Anuj k. Chandiwala*

The main objective of present work is to compare the seismic behavior of multi storey buildings having conventional RC frame, flat slab with drop and flat slab without drop in seismic zone III with type II medium soil and to study the effect of height of building on the performance of these types of buildings under seismic forces.

B. *[2] Thummala spoorthy and S. Ramesh Reddy*

In general the structures are analysis as RC slab and flat slab with a drop for G+ 15 storeys building in different zones using E-Tabs software. Therefore the characteristics of a seismic behavior of flat slab and conventional RC frame building measure storey shear, overturning moment and storey drift for flat and conventional slab is provided and its variation of these parameters in different zones is also detailed.

C. *[3] A. A. Sathwane and R. S. Deotale*

The study is focused on the most economical slab between flat slab with drop, flat slab without drop and grid slab. The proposed construction site is Nexus point opposite to vidhan bhavan and beside NMC office, Nagpur. Analysis of the flat slab and grid slab has been done both manually by IS 456:2000 and by using software also. Flat slab and grid slab has been analyzed by STAAD PRO. It was observed that the flat slab with drop is more economical than flat slab without drop and grid slabs.

D. *[4] A. B. Climent and D. Z. Sanchez (2012)*

Investigated about the effective width of reinforced concrete flat slab structures subjected to seismic loading on the basis of dynamic shaking table tests. The study is focused on the behavior of corner slab column connections with structural steel-I. To this end, a ½ scale test model consisting of flat slab supported on four box type steel columns was subjected to several seismic simulations of increasing intensity. It is found from test results that the effective width tends to increase with the intensity of the seismic simulation.

E. *[5] M. Altug Erberik and Amr S. Elnashai [2004]*

Focused on the derivation of fragility curves using medium rise flat slab buildings with masonry infill walls. The study employed a set of earthquake records compatible with the design spectrum selected to represent the variability in ground motion. The study concluded that earthquake losses for flat slab structures are in the same range as for moment resisting frames. The study also showed that the differences were justifiable in terms of structural response characteristics of the two structural forms.

F. *[6] K. N. Mate [2015]*

Analyzed the flat slab system is simple structure of RCC which provide long clear space, a good height, simple formwork and no delay time in construction. It is shown the why the flat slab is more feasible and flexible in comparison to other slab. This study includes complete analysis and design of flat slab as per Indian code of practices IS456:2000.

G. [7] Naveen Kumar B. M and Priyanka S. [2015]

The present study covers the behavior of multistoried buildings having conventional RC frame building, flat slabs and to study the effect of height of the building on the performance of these types of buildings under seismic forces.

IV. RESEARCH METHODOLOGY

The proposed work is planned to be carried out in the following manner.

- To carry a relevant literature review paper by going through journal papers, conference proceedings, text/reference books, standard handbooks, BIS publications etc.
- Both the slab system will be analyzed by E-TABS software.
- The outcome of the design will be tabulated.
- The result so obtained will be discussed and conclusion will be drawn.

V. THEORY AND FORMULATION

Research is currently ongoing. Analysis will be done by using E-TABS model for different slab arrangements. The structure selected for this project is a simple Residential building. Different loads such as Dead Load, Live Load, and Earthquake Load will be applied on E-TABS model at appropriate location as per codes used for Loading. IS Code for Dead Load: - IS 875 Parts 1, IS Code for Live Load: - IS 875 Parts 2. For the present study following values for seismic analysis are assumed. The values are assumed on the basis of reference a step given in IS 1893-2002 and IS 456:2000. All the results obtain from E-TABS structural software and these results are compared in tabular form.

REFERENCES

[1] Vishesh P. Thakkar, Anuj K. Chandiwala, Unnati D. Bhagat "Comparative study of seismic behavior of flat slab and conventional RC framed frame structure" International Journal of Engineering Research & Technology. Volume: 06 Issue: 04, April 2017.
[2] Thummala Spoorthy, 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 E-Tabs software" International Journal of Advance Research, Ideas And Innovations In Technology. Volume: 04Issue:03
[3] A. A Sathwane, R. S. Deotale, "Analysis and design of flat slab and grid slab and their cost comparison" International Journal of Engineering Research and Applications, Volume- 01, Issue- 03, pp.837-848.
[4] A. B Climent, D. Z. Sanchez, J. F. Gill-Villaverde, "Experimental study on the effective width of flat slab structures under dynamic seismic loading" ELSEVIER, April 2012.
[5] M. Altug Erberik, Amr S. Elnashai, "Fragility analysis of flat slab structures" ELSEVIER, 23 February 2004.
[6] K. N. Mate, "Study of flat slab" International Journal of Science and Research, Volume-04, Issue-06, June 2015, pp.1106-1110.
[7] Naveen Kumar B M, Priyanka S, Manu K V1,"Comparative study of flat slabs and conventional RC slabs in high seismic zone" International Research Journal of Engineering and Technology" Volume: 02, Issue: 06, Sept-2015.
[8] K. Venkatrao, N. Nageshwarao "Seismic behavior of reinforced concrete framed structure with flat and conventional floor slab system" International Journal and magazine of Engineering Technology, Management and Research, Vol.03, Issue-04, pp.536-545, April 2016.
[9] Kiran S. Patil, N. G. Gore, P. J. Salunke, "Optimum design of reinforced concrete flat slab with drop panel" International Journal of Engineering Research and applications, Vol.02, Issue:04, pp.37-39, sept-2013.
[10] K. S. Sable, V. A. Ghodechor, S. B. Kandekar, "Comparative study of seismic behavior of multistory flat slab and conventional reinforced concrete framed structures" International Journal Of Computer Technology and Electronics Engineering, Vol.02, Issue:03, pp.17-26, June-2012.
[11] K. Tilva, A. B. Vyas, P. Thaker, "Cost comparison between flat slabs with drop and without drop in four storey lateral load resisting building" National conference on recent trends in engineering & technology, 13-14 May-2011.
[12] Ms. Navyashree K, Sahana T. S."Use of flat slabs in multy storey commercial building situated in high seismic zone" International journal of research in engineering and technology. Vol.03, Issue: 08, Aug-2014.
[13] IS 1893 (Part – 1):2002 – "Criteria for Earthquake Resistant Design of Structures" – Bureau of Indian Standards, New Delhi, India
[14] IS-875 (Part 1):1987 – "Dead Loads on Buildings and Structures" – Bureau of Indian Standards, New Delhi, India.

