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COMPARATIVE STUDY OF FLAT SLAB AND CONVENTIONAL SLAB IN VARIOUS SEISMIC ZONES USING E TABS

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ABSTRACT

In present era, flat slab buildings are commonly used for the construction as it has many advantages over conventional RC frame building. The flat slab allows architects to place partition wall wherever they are needed. It is widely use because it reduces weight, speed up buildings, and it is cost effective. Similarly, since its inception, the conventional slab has provided benefits such as increased stiffness, increased weight carrying ability, as well as being safe and cost effective. In present work a G+5 multistorey building having flat slab with drop, and conventional slab has been analyzed using E-TABS software for the parameters like storey displacement, storey drift, storey shear, base shear, axialforce and time period. The main objective of the present work is to analyze and study the performance and behaviour of both the structures in all seismic zone of India (II, III, IV, V) and to study the effect of height of building on the performance of these type of building under seismic zone.

Key words: Flat slab, Conventional slab, ETABS, Storey displacement, Storey drift, Storey shear, Base shear, Axial force, Time period.

I. INTRODUCTION

Flat slab is system of construction is one in which slab is directly rest on the column. The slab directly rests on the column and load from the slab is directly transferred to columns and then to the foundation. To support heavy, loads the thickness of slab near the support is increased and these are called drops. Flat slab systems need further attention. They process many advantages in terms of architectural flexibility, use of formwork and space shorter construction time.

Different types of flat slabs are follows:

- Flat slab with drop panel.
- Flat slab with column head.
- Flat slab with drop plane and column head.
- Flat slab without drop plane and column head.

The advantages of the flat slab are it reduce the overall height of the structure, required formwork, better quality control, better fire resistant then other floor system, fast construction. The disadvantages of flat slab are in the plate system construction of large span is not possible. Conventional slab supported by beams and columns. In these types, the thickness of the slab is small, while the depth of the beam is large and it is transferred to the load bearing beams and then to the columns. The advantages of the conventional slab are high break time due to relative deep beams, lateral loads resist due to beams. The disadvantages of conventional slab are the formwork is difficult. Beams disturb light and air circular in the building. Storey displacement: It is the displacement of a storey with respect to the base of a structure. Storey drift: It is the displacement of the storey with respect to the storey. Storey shear: Storey shear factor is the ratio of the storey shear force when storey collapse occurs to the storey shear force when total collapse occurs. Base shear: Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. Axial force: Axial force is the force that acts in the direction of the axis of a body. This force may be tensile or compressive. Time period: Time period refers to the time a building or structure taken to complete one oscillation which means the building moves as the waves passes and returns it its starting position in a single oscillation.

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II. OBJECTIVE

a. Searched the research paper for understanding purpose about our project.
b. We wrote the literature review of various research paper.
c. Comparing seismic behavior of multistorey building (G+5) having conventional slab and flat slab with drop panel.
d. To study the provision of IS 1893: 2002 and IS 875.
e. The properties such as storey shear, storey displacement, axial force, base shear, time period of fiat slab and conventional slab has been studied by the reference of internet.
f. Various parameters will be conducting on the structure made in ETABS in various seismic zone to check the sustainability.
g. By analyzing the properties and material required for constructing flat slab and conventional slab, the economic cost will be identified.

III. MODELING OF BUILDING

Size of Columns	380 X 450mm
Size of Beam	300 X 400mm
Thickness of Flat Slab	125mm
Thickness of Conventional Slab	100mm
Flat Drop Panel Size	2.5 X 2.5 m
Thickness of Drop Panel	120 mm
Plan Dimension	25 X 25m

Structural Element Details

Number of Stories	G+5
Height of each Storey	3.2 m

Model Description

Grade of Concrete	M20
Grade of Steel	Fe500

Material Properties

Zone	**Zone Factor**
II	0.10
III	0.16
IV	0.24
V	0.36

Different Types of Zones and Their Zone Factor

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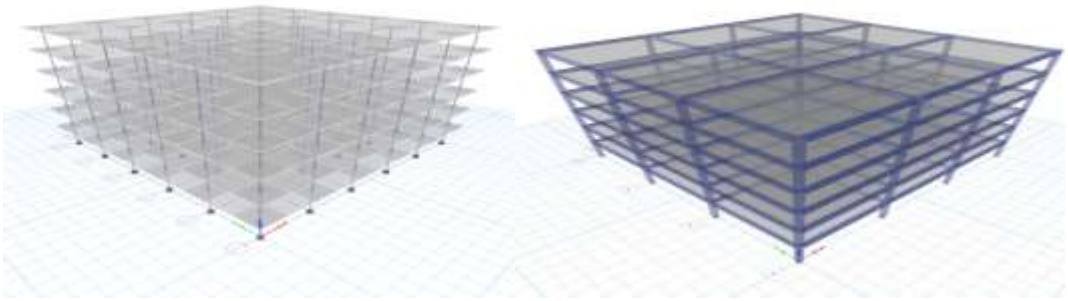

Conventional Slab Flat Slab

IV. METHODOLOGY

ETABS Software, abbreviated for "Extended Three-dimensional Analysis of Building Systems" is a 3D integrated software that is used for structural analysis and design purposes in areas like civil engineering. It integrates every small aspect of engineering designing while also involving the production of schematic sketches. Modelling tools and templates, code-based load prescriptions, analysis methods and solution techniques, all coordinate with the grid-like geometry unique to this class of structure. Basic or advanced systems under static or dynamic conditions may be evaluated using ETABS. ETABS provides a wide range of tools that an engineer can use depending on the choice of structure that has to be designed. Immensely popular nowadays and highly productive, ETABS is really an easy-to-use software. It even supports the creation and modelling of complex designs and offers graphic displays, comprehensive designing techniques, linear and non-linear analytical power, visualization tools and reports.

Types of methods:

There are two types of following methods

1.Response spectrum analysis:

2. Equivalent static analysis:

3. Time history analysis

1. Response spectrum analysis: Response spectra are very useful tools of earthquake engineering for analyzing the performance of structures and equipment in earthquakes, since many behave principally as simple oscillators (also known as single degree of freedom systems). Thus, if you can find out the natural frequency of the structure, then the peak response of the building can be estimated by reading the value from the ground response spectrum for the appropriate frequency. In most building codes in seismic regions, this value forms the basis for calculating the forces that a structure must be designed to resist (seismic analysis).The result of a response spectrum analysis using the response spectrum from a ground motion is typically different from that which would be calculated directly from a linear dynamic analysis using that ground motion directly, since phase information is lost in the process of generating the response spectrum.In cases where structures are either too irregular, too tall or of significance to a community in disaster response, the response spectrum approach is no longer appropriate, and more complex analysis is often required, such as non-linear static analysis or dynamic analysis.

2. Equivalent static analysis: This approach defines a series of forces acting on a building to represent the effect of earthquake ground motion, typically defined by a seismic design response spectrum. It assumes that the building responds in its fundamental mode. For this to be true, the building must be low-rise and must not twist significantly when the ground moves. The response is read from a design response spectrum, given the natural frequency of the building (either calculated or defined by the building code). The applicability of this method is extended in many building codes by applying factors to account for higher buildings with some higher modes, and for low levels of twisting. To account for effects due to "yielding" of the structure, many codes apply modification factors that reduce the design forces (e.g., force reduction factors).Since the Static Equivalent method is accurate and easy for short building especially for single story building.

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V. LITERATURE REVIEW

Mr. Yogesh Gajanan Bedre, Prof. Sharif Shaikh [2022] Told about the behaviour of flat slab building under seismic loading. For that they compare the flat slab and conventional slab structure base on seismic behaviour. The building which are used in their report are (G+2), (G+7) and (G+11) analyzed for different zone (IV and V) using code response spectrum in STAAD Pro software. From observation it was concluded that,

1. For all the structure base shear increases as the height increases.
2. The time period is more for flat slab structure than conventional building.
3. In flat slab structure are reduced due to it's flexibility.

Nitin D. More, Mukund M. Pawar [2019] Compared the use of flat slab and conventional slab in seismic zone IV. Total 8 models have been prepared out of which four are conventional RC building and four are flat slab building and (G+7), (G+9), (G+11), (G+13), storey building model are considered. The analysis is done by using the ETABS software. A good source of information on the parameters like lateral displacement, storey drift, storey shear, column moment, axial force and time period is provided. The storey drift is checked for all conventional and flat slab building. As a result of this,

1. For same height the storey drift of flat slab is double of conventional slab building.
2. In out of 8 models in no model or buildings storey drift exceeds permissible limit given by IS 1893 part1.

A. S. Patil, Ashish Balasaheb Daphal, Shashank Sadanand Gavasane, Shubham Sambhajiro Ghorpade, Pankaj Dashrath Ekatpure, Akshay Ashok Nalawade [2018] Analyzed the behaviour of flat slab and conventional slab structure under seismic loading. 60% of land area of our country is damaging level of seismic hazard but safe building practices can certainly reduce the extent of damage and loss. So, the main objective of this work is to study the behaviour of flat slab structure under seismic loading in zone V and compare with conventional beam column structure. The analysis is carried out in STAAD Pro software. On this analysis it was concluded that,

1. In comparison with conventional RCC building to flat slab building the time period is more for flat slab building then conventional building.
2. Base shear of conventional RCC building is more than flat slab building.
3. Storey displacement in building with flat slab construction is significant more as compare to conventional RCC building.

Mr. B. R. Navale, Dr. M. R. Wakchaure, [2018] Compared the behaviour of multistorey building having conventional RC frame, flat slab without drop and also studied the effect of height of building under seismic forces. A G+9 commercial multistorey building analysed for the parameters like base shear, storey drift, axial force and displacement. This work has been analyzed using ETABS software in seismic zone III. It was observed that,

1. Flat slab construction has many advantages over conventional slab. It can be very good option for the modern construction.
2. Flat slab is more economical as compare to the conventional slab.

Abhijit K. Sawwalakhe, Prabodh D. Pachpor [2021] Studied about the most cost-effective slab among the standard slab, flat slab with drop and grid slab. A G+5 commercial multistorey structure with flat slab, conventional slab and grid slab was investigated for characteristic such as storey displacement, shear force, bending moment and storey drift. In this study the performance and behaviour of all structures in India's seismic zone III have been investigated with the application of dead load, live load and seismic load. It was concluded that,

1. The weight of the flat slab structure is relatively more.
2. Flat slab having more bending moment and shear force when compare with grid slab and two-way slab.

Whereas, the conventional slab is more suitable for residential and small span structure, while grid slab is more suitable for bigger span structure. But the overall result values make flat slab more economical compared to the conventional and grid slab.

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Rathod Chiranjeevi, Sabbineni Ramyakala, mandala Venugopal, Nandanar Anusha [2016] Studied the seismic demand for different regular RC flat slab with drop and conventional slab structure by using push over analysis producer as per ATC 40. It is necessary to analyze seismic behaviour of building for different height to see what change are going to occur if the height of conventional RC frame building and the flat slab building changes. In this work they considered six, eight, and ten storey building model and. For analysis seismic zone III is considered. The analysis is done by using ETABS software. It was concluded that,

1. Base shear of flat slab is found to be greater than conventional slab.
2. Displacement for flat slab is found to be less than conventional slab.
3. Storey drift for slab construction is less compare to the conventional building.
4. The time period increases as height of building increases.

Vishesh P. Thakkar, Anuj K. Chandiwala, Unnati D. Bhagat [2017] Compared the seismic behaviour of multistorey buildings (G+5, G+8, G+11) having conventional RC frame, flat slab with drop and without drop in seismic zone III with type II medium soil using ETABS software for parameters like displacement, drift, shear and time period. It was concluded that,

1. The storey displacement of flat slab without drop building is higher as compared to conventional RC frame building and flat slab with drop building.
2. The base shear of flat slab with drop is higher as compared to the conventional RC frame building and flat slab without drop building.
3. The displacement value of flat slab without drop is higher as compared to the conventional RC frame building and flat slab with drop building.
4. The time period of flat slab without drop building is higher compared to the conventional RC frame building and flat slab with drop building.

By comparing all parameter, it was observed that, conventional building has superior performance in earthquake against flat slab with drop and flat slab without drop.

Deepak Kumar Vishwakarma, Dr. J. N. Vyas [2021] Studied seismic behaviour of flat slab, Grid slab and conventional slab with C-Type and L-Type shear wall by finding the parameters such as storey displacement, bending moment, storey drift, shear force, torsion etc. The G+14 building is used and the comparison is done using STAAD ProV8i software. The analysis is done in seismic zone II. It was concluded that,

1. By using conventional slab system in building deformation is increased as compare to flat slab system. Thus, flat slab is preferred.
2. The building with conventional slab system with C-Type shear wall is very vulnerable to seismic force than all the other buildings.

Anghan Jaimis, Mitan Kathrotiya, Neel Vagadia, Sandip Mulani [2016] Propose research on comparative study of flat slab and conventional slab using software of Aid. This research said that, the configuration of building is very much important for good performance of the building. The important aspect affecting seismic configuration of a building are overall geometry, structural systemand load part. Those parameters are behaving different way in flat slab and conventional slab. Research on the design of structure not only started in India but in other developed countries also. As a result, it was observed that,

1. The time period is more for conventional building then flat slab building because of monolithic construction.
2. The base shear of conventional RC frame building is more than flat slab building.
3. The storey drift of flat slab construction is significantly more as compare to the conventional RCC building.
4. Axial force on column is approximately same in both building.
5. Shear force and bending moment is comparatively more in conventional slab building.

Raunaq Sing Suri, Dr. A. K. Jain [2018] Analyzed the flat slab and conventional slab and conventional slab structure under seismic condition. The ETABS software is used for the analysis of the structure in Indian seismic zone III, IV, V having 10, 12, and 15 storeys. The model takes into this study have rectangular and L shape configuration. From the analysis for rectangular and L shape configuration it was observed was that,

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1. The maximum reaction is reduced in flat slab with perimeter beam as compare to the conventional slab structure.
2. The maximum storey displacement is increased in flat slab with perimeter beam as compare to the conventional slab structure.
3. The maximum overturning moment is reduced in flat slab with perimeter beam as compare to the conventional slab structure.
4. The maximum storey drift is increased in flat slab with perimeter beam as compare to the conventional slab structure.

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