International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

Seismic Behaviour of Conventional Slab, Flat Slab with and Without Drop Panel for Different Building Patterns

Abhishek D S[1], Dr Kiran T[2]

[1]*P.G Student, Department of Civil Engineering U.V.C.E, Bangalore University, Bengaluru*
[2]*Associate Professor, Civil Engineering U.V.C.E, Bangalore University, Bengaluru*

Abstract - *Flat slab structures are widely seen in infrastructures as the use of flat- slab construction brings several benefits over Conventional slab due to its cost-effectiveness, design stability and duration of construction. The structural performance of flat slab building projects is quite demanding due to its low reliability against seismic load. The study involves comparison of flat slab and conventional slab for different building with Rectangular, L, T and U-shaped patterns of G+11 storey, each floor height of 3 m, as per IS 456-2000. Thickness of flat slab is 200 mm and conventional slab is 150 mm are considered in earth-quake zone 1 (0.1). The parameters like displacement, storey shear, base shear and deflection due to dead load are analyzed using finite element software ETABS.*

***Key Words*: Flat Slab, Conventional Slab, Storey displacement, Storey shear**

1. INTRODUCTION

For major projects, the structural optimization process is important because it affects the project cost directly. Even we increase the number of floors or structure height there are enormous horizontal and vertical forces that increase the building project costs in terms of materials. Consequently, optimization techniques are usually embraced to save the structure. New and various design methods have become a greater development of the optimization theory of computers and software resources.

1.1 Flat Slab

These are RC slabs placed completely over posts, excluding supports. A desired slab shall be provided between RC slab and column to shape a drop panel, also this is extremely customizable aspects that are commonly utilized throughout the building and other projects, offering minimal height, assembling processes. In greater earthquake regions this type of slab must be built to withstand the DL, but also LL must be managed to carry laterally resistant. DL, LL, and other loads from the slab are transmitted to a vertical member and the foundation.

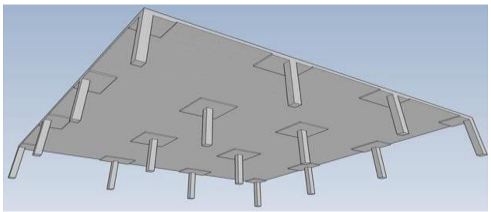

Fig. 1: Flat Slab

1.2 Conventional Slab

In this type, the slab is endorsed by main and secondary beams along with columns. For this form, the slab thickness is low while the beam depth is high as well as the force is shifted to horizontal and vertical members. More sheathing work is needed in this type of member and no need to cover the top of the column in the conventional type of slab. 100mm slab depth is required for the traditional slab, if the CAW material attracts regular large loads (Apartment buildings or trash vehicles), 130-150 mm is suggested. Standard slabs are rectangular and in any shape in a length of 400 cm.

Fig. 2: Conventional Slab

2. LITERATURE REVIEW

S.L Khan, A.R Mundhada (2015), this study tries to determine their comparable ground motion efficiency of Flat-Slab construction with Grid-Slab construction with 12, 15, and 18 floors structures at each 3.5 m floor height are dynamically evaluated for RS using ETABS software for zones (2-5) are analyzed for forces like Foundation shear, Story-drifts and displacement along with Time period. Relative to Flat-Slab construction the tremor efficiency of Grid-Slab structure was higher than that of FS Structure.

R Kiran, R Sridhar (2016), for this work the SAP software is used to analyze and compare with 3 models such as normal pattern, anomalous pattern and vertically irregularity pattern with 20 story, each height of 3 m for the dynamic and static EQ forces like foundation shear, story drift, displacement, and time-period in all the zones 2-5. The findings are that the normal patterns showed most movements and drifts for zones 2-5 from both analysis.

Akhil R, Aswathy S Kumar (2017), the report involves the modeling of G+10 story's in both systematic and unsystematic H form structure and the height of each story is 3.5 m in the 625 m2 area. Regular and Irregular with stepped, Inverted T, and U total of six structural buildings are modeled. For the duration of looking at seismic action, the efficiency of that kind of structural system depends on the amount of stiffness, stability, and mass in either direction. The 3 models in regular and abnormal structures with one kind of vertical abnormal structure are to analyze comparatively the rigidity of the structures it is the most important goal of this work. In this zone 5, as considered for seismic load for all the models, the displacements in irregularly form structure are greater than of regular structures are the outcomes are been obtained from the RSA. The structure is modeled and analyzed by using StaadPRO software, the structure behavior for factors such as Base shear, frequency, displacement nodes, and so on are analyzed. Efficiency standard structures are considered to be higher than of irregular structures.

3. OBJECTIVE

The main objectives of the study are as follows:

1. The main objective of the study is to compare the seismic behaviour of FSWD, FSWOD and CS in different building patterns.
2. The study consists of a G+11 floors structure with the IS specifications.
3. To study the Dynamic performances for different structure patterns of FSWD, FSWOD and CS.
4. The analyses are rendered using ETABS software.
5. To study the structure behavior for factors such as storey displacement, storey shear, base shear, and time period.

4. MODELS CONSIDERED.

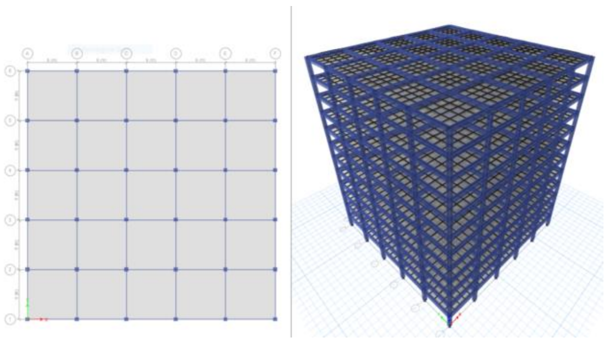

Fig. 3: Rectangular Shape building with Conventional Slab

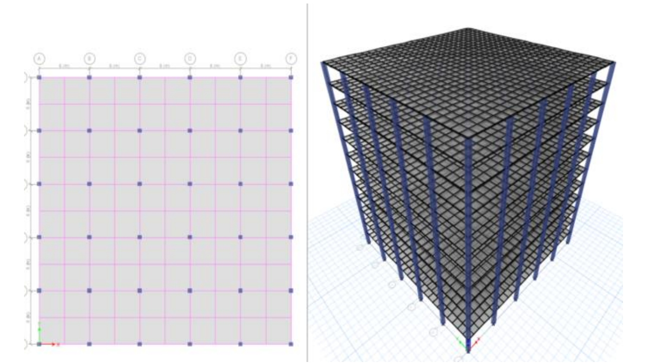

Fig. 4: Rectangular Shape building with Flat Slab without drop panel

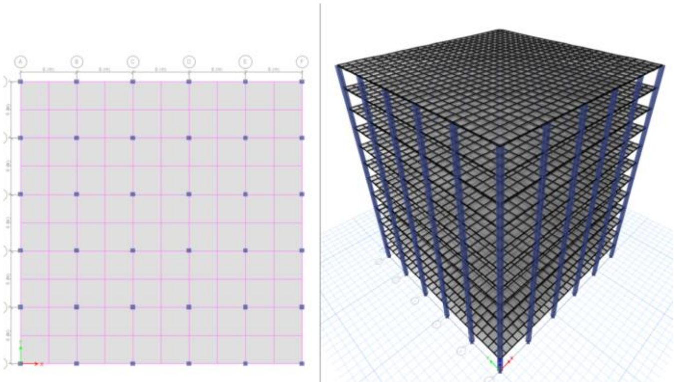

Fig. 5: Rectangular Shape building with Flat Slab without drop panel

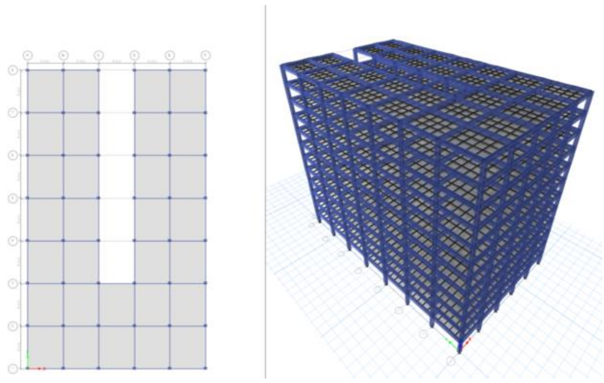

Fig. 6: U-Shape building with Conventional Slab

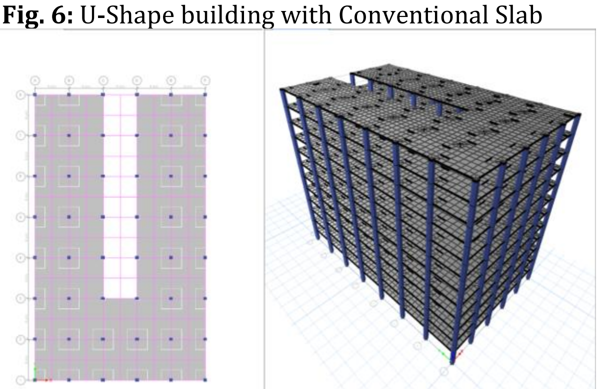

Fig. 7: U-Shape building with Flat Slab and drop panel

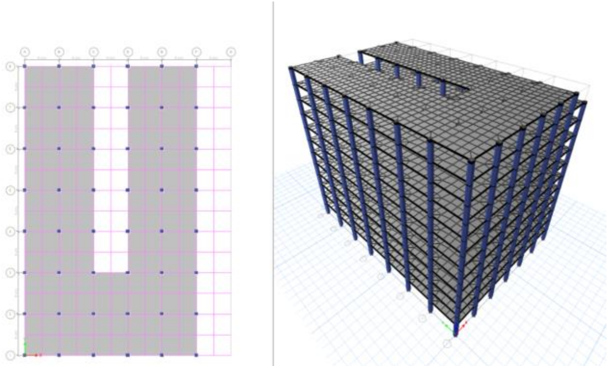

Fig. 8: U shape building with flat slab and without drop panel

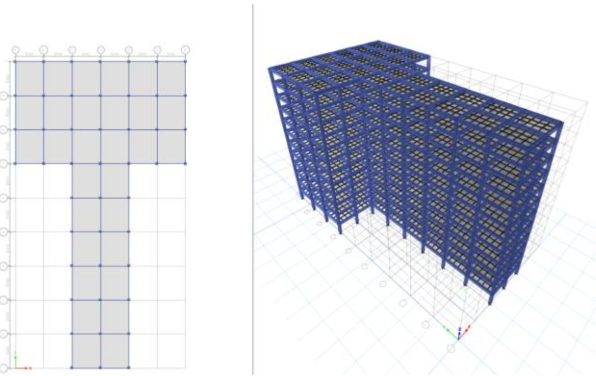

Fig. 9: T-Shape building with Conventional Slab

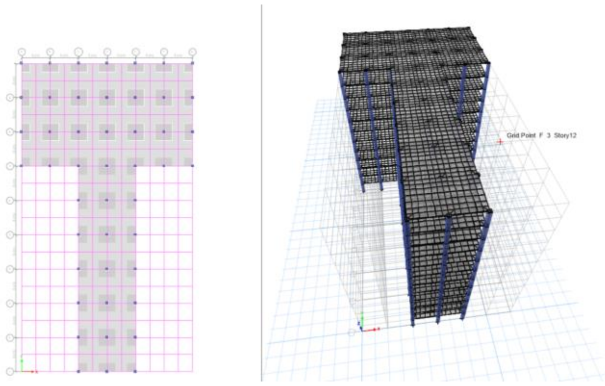

Fig. 10: T-Shape building with Flat Slab with drop

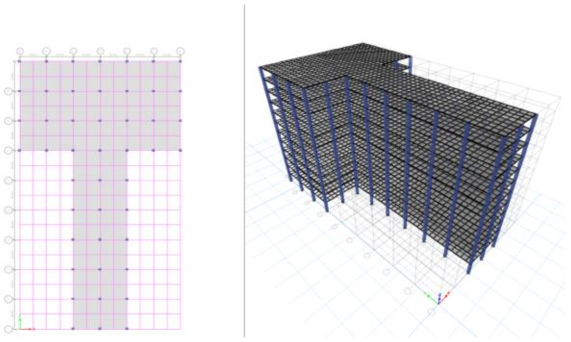

Fig. 11: T shape with flat slab and without drop panel

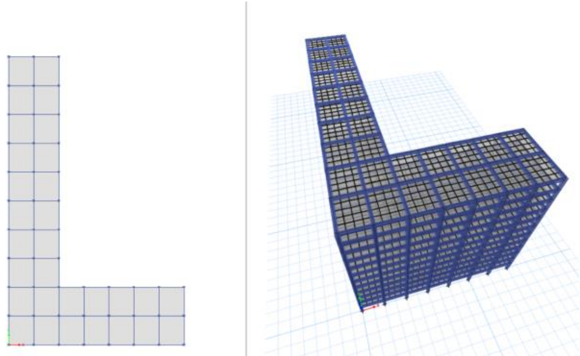

Fig. 12: L shape conventional

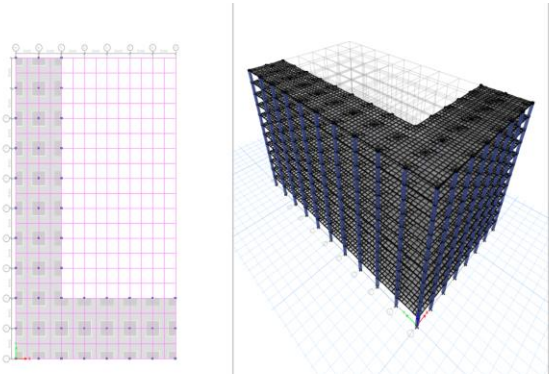

Fig. 13: L shape with flat slab and drop panel

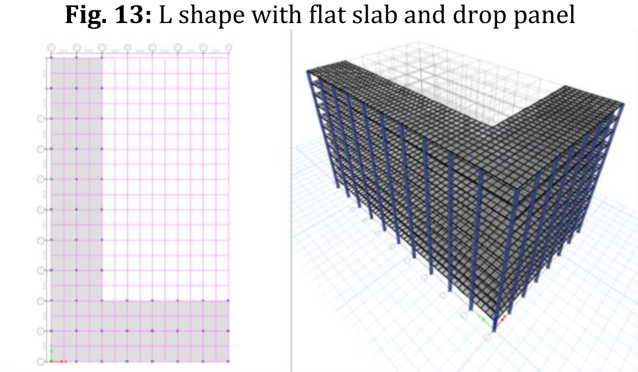

Fig. 14: L shape with flat slab and without drop panel

5. RESULT AND DISCUSSION

The following table gives the data for the three types of building patterns:

Table -1: Structural Data of the Building Patterns

Rectangular, L, U and T Shaped Building Patterns	
No. of STOREY's	G+11
Floor to Floor distance	3 m
Total structure height	36 m
Slab thickness for Conventional slab	150 mm
Slab thickness for Flat slab with drop	200 mm as per IS 456-2000
Column size	450x500 mm

Beam size	450 x 450 mm	
Grade of concrete	M 30	
Grade of steel	HYSD 500	
Seismic zone as per IS 1893:2002	Zone factor, Z	II (0.1)
	Importance factor, I	1
	Response reduction factor, R	SMRF (5)
	Site type	II

Table 1 shows Structural data of building, Fig. 15 and 16 represents displacements Fig. 17 and 18 shows storey shear respectively and area considered for all models is 900 m².

5.1 Storey Displacements

Displacement of Rectangular, T and U-shaped buildings in X Direction Using Response Spectrum Analysis

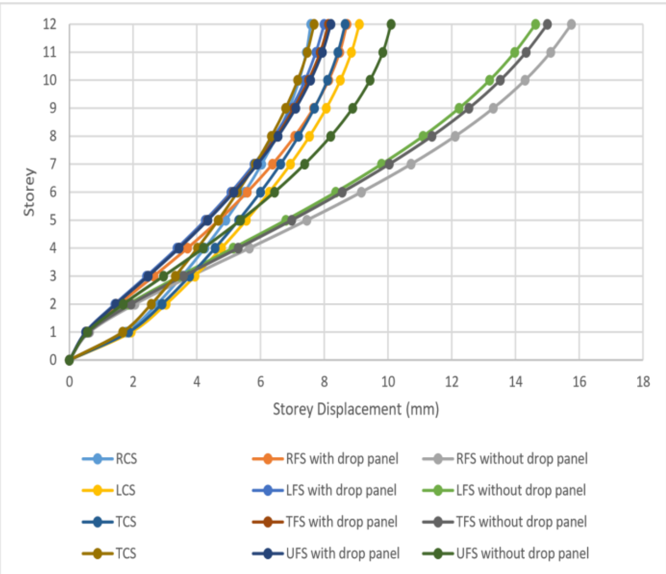

Fig. 16: Storey Displacements along X Direction for RSX

Displacement of Rectangular, T and U-shaped buildings in Y Direction Using Response Spectrum Analysis

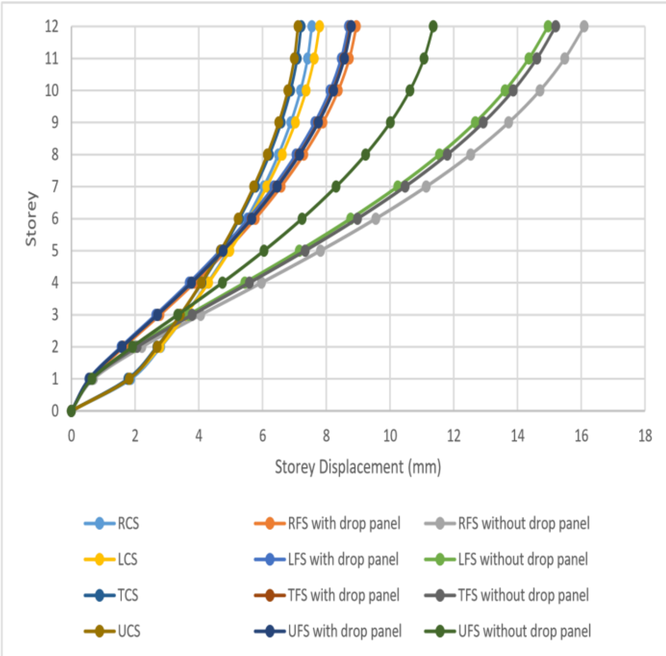

Fig.17: Storey Displacements along Y Direction for RSY

5.2 Storey Shear

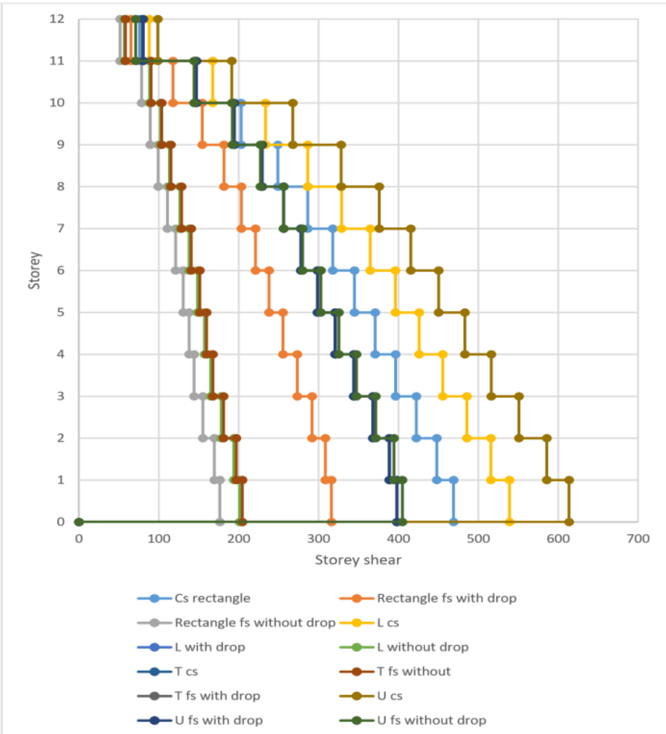

Fig.17: Storey shear along X Direction for RSX

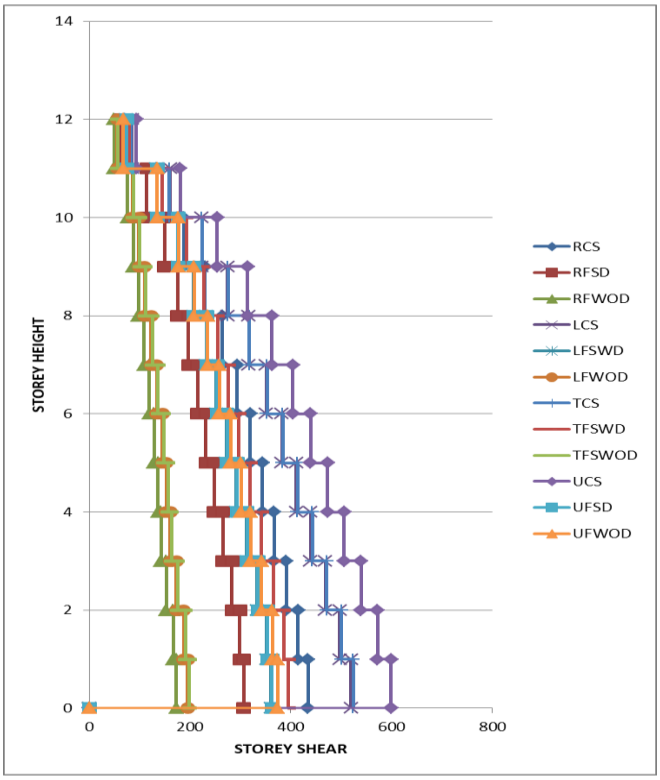

Fig.18: Storey shear along Y Direction for RSY

5.3 Base Shear

Base shear is an estimate of the maximum expected lateral force on the base of the structure due to seismic weight.

Table – 2: Base shear

	Rectangular		L		T		U	
	X- axis	Y-axis	X- axis	Y-axis	X- axis	Y-axis	X- axis	Y-axis
CS	551.7595	530.6462	634.2084	611.3632	647.1925	616.045	721.8662	704.96
FS with drop panel	371.9314	360.8583	468.5593	424.7713	468.2021	426.4055	468.3362	426.6845
FS without drop panel	207.623	203.4406	236.7297	229.3785	240.7084	233.3422	476.5138	439.6814

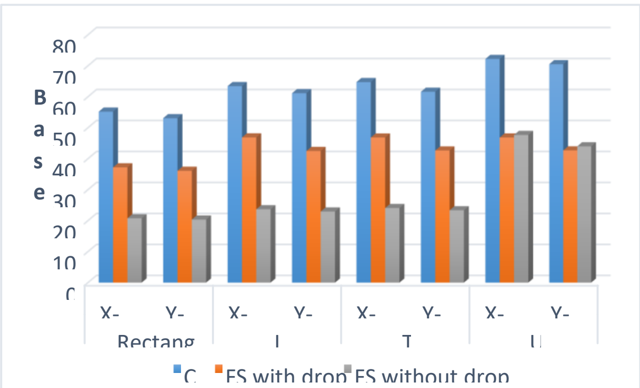

Fig. 19: Base shear

5.4 Modal Time Period

Time period is the time taken by a complete cycle of the wave to pass a point; Frequency is the number of complete cycle of waves passing a point in unit time.

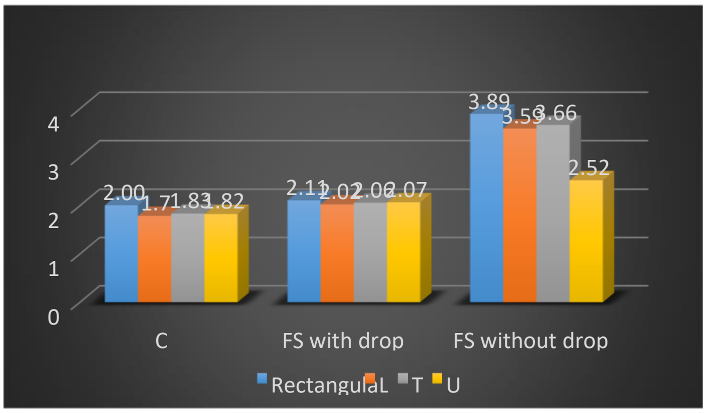

Fig.20: Time period

6. CONCLUSIONS

1. Displacement is more for rectangular flat slab without drop panel for different loading condition comparatively.
2. STOREY shear in the 1st floor is higher and has fewer values in a last floor. In all the models in X axis, floor shear from CS are greater than FS.
3. For rectangular, L and T shaped buildings base shear is in the decreasing order from CS, slab with drop panel and slab without panel. But for U shaped buildings base shear order changes from CS, slab without drop panel and slabs with drop panel.
4. Time period for mode 1 is more for structure without drop panel compared to conventional slab and slab with drop panel.
5. The CS is more owing to its dead weight of a structure compared to FSWOD and FSWD; it reveals fewer deflection since beams were eliminated.
6. Ultimately, the study of FS offers economic efficiency under EQ factors and responsive towards EQ affects relative to traditional slabs.

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BIOGRAPHIES

Abhishek D S
P.G Student
Department of Civil Engineering,
UVCE, Bangalore University,
Bengaluru.

Dr. KIRAN T
Associate Professor,
Department of Civil Engineering,
UVCE, Bangalore University,
Bengaluru.