COMPARATIVE STUDY OF FLAT SLAB AND CONVENTIONAL SLAB STRUCTURE BASED ON SEISMIC BEHAVIOR: A REVIEW

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ABSTRACT

Recent earthquakes in which many concrete structures have been severely damaged or collapsed, have indicated the need for evaluating the seismic adequacy of buildings. About 60% of the land area of our country is susceptible to damaging levels of seismic hazard. We can't avoid future earthquakes, but safe building construction practices can certainly reduce the extent of damage and loss. As being one of the special reinforced concrete structural forms, flat-slab systems need further attention. They possess many advantages in terms of architectural flexibility, use of space, easier formwork and shorter construction time. However the structural efficiency of the flat-slab construction is hindered by its poor performance under earthquake loading. This undesirable behavior has originated from the insufficient lateral resistance due to the absence of deep beams or shear walls in the flat-slab system. This gives rise to excessive deformations that cause damage in non-structural members even when subjected to earthquakes of moderate intensity.

Keywords: flat Slab, STAAD Pro, ***R.C.C. structure, Sesmic***

I. INTRODUCTION

As being one of the special reinforced concrete structural forms, flat-slab systems need further attention. They possess many advantages in terms of architectural flexibility, use of space, easier formwork and shorter construction time. However the structural efficiency of the flat-slab construction is hindered by its poor performance under earthquake loading. This undesirable behavior has originated from the insufficient lateral resistance due to the absence of deep beams or shear walls in the flat-slab system. This gives rise to excessive deformations that cause damage in non-structural members even when subjected to earthquakes of moderate intensity.

Flat plate slabs are economical since they have no beams and hence can reduce the floor height by 10-15%. Further the formwork is simpler and structure is elegant. Hence flat plate slab construction has been in practice in the west for a long time. However, the technology has seen large-scale use only in the last decade and is one of the rapidly developing technologies in the Indian building industry today. Material advances in concrete quality available for construction, improvement in quality of construction; easier design and numerical techniques has contributed to the rapid growth of the technology in India.

It is widely known that the slab-column connection is a critical component in the slab-column frame system as shown in Fig 1 This is the region of slab immediately adjacent to the column that has to transmit large torsion, shear and bending moments between slab and column and is therefore susceptible to punching shear failure.

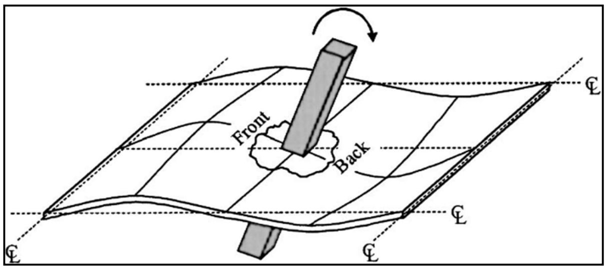


Fig 1 Behavior of Slab-Column Connection in Flat Slab Structure

Despite the rapid growth of flat plate/slab construction, literature and tools available for designers to design and engineer flat plate/slabs in India, has been limited in terms of both Indian standards and Indian research papers. Indian engineers often have to resort to other standards to design flat plate/slab

II. PROBLEM STATEMENT

For the study, two types of hypothetical RCC buildings are considered without infill. Mass of infill and slab is considered on beam element as uniformly applied load and floor load respectively. Stiffness of infill and slab is not considered.

The buildings which are used in this report are (G+2), (G+7) and (G+11).The total dimension of building is 20m x 20m.The above building are analyzed for firstly with beam-column structure, and then these buildings are analyzed as flat slab buildings. Following are the designation of the six models used in this study.

- **Model 1** - A 2 storey conventional R.C.C. structure (CS 2)
- **Model 2** - A 2 storey flat slab R.C.C. structure (FS 2)
- **Model 3** - A 5 storey conventional R.C.C. structure (CS 7)
- **Model 4** - A 5 storey flat slab R.C.C. structure (FS 7)
- **Model 5** - A 11 storey conventional R.C.C. structure (CS 11)
- **Model 6** - A 11 storey flat slab R.C.C. structure (FS 11)

III. RESULTS AND DISCUSSION

A. Results and Discussion Of Free Vibration Analysis

Table 1 Natural Time Period

MODE NO.	MODAL TIME PERIOD (SEC)					
	CS2	**FS2**	**CS7**	**FS7**	**CS11**	**FS11**
1	1.07	0.99	2.9	4.04	3.14	5.28
2	0.78	0.84	1.96	3.52	2.29	5.02
3	0.73	0.77	1.86	3.13	2.2	4.58
4	0.37	0.28	0.97	1.31	1.04	1.71
5	0.26	0.2	0.64	1.09	0.73	1.57
6	0.24	0.17	0.606	0.97	0.71	1.43

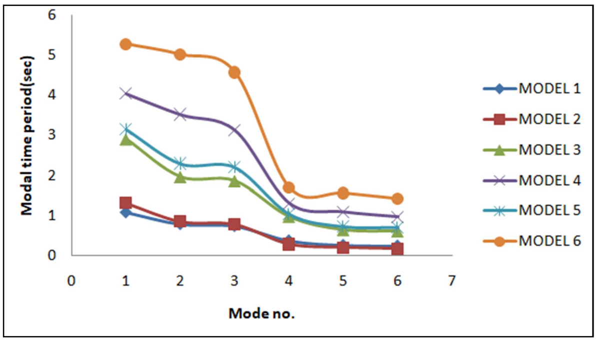


Table 2 Modal Mass Participation in %

Type of Structure	First Mode	Forth Mode
CS2	72.31	7.92
FS2	65.41	17.15
CS7	77.38	8.96
FS 7	64.55	22.01
CS11	77.99	9.44
FS11	35.95	50.83

The mode shapes of different structures, considered in different direction from these table it is found that there is significant change in same modes represent change in behaviors of flat slab structure.

B. Result And Discussion Of Response Spectrum Analysis

Two types of buildings are analyzed i.e. conventional beam-column building and building with flat slab for two different zones (IV&V) using code response spectrum. The maximum base shears for different structures by SRSS method

Table 3 Base Shear for Different Models

Base Shear (kN)					
Height	**storey**	**Zone-IV**		**Zone-V**	
		CS	**FS**	**CS**	**FS**
9	2	1166	1101	1750	1615
26.5	7	1390	940	2085	1574
40.5	11	2145	1012	3218	1755

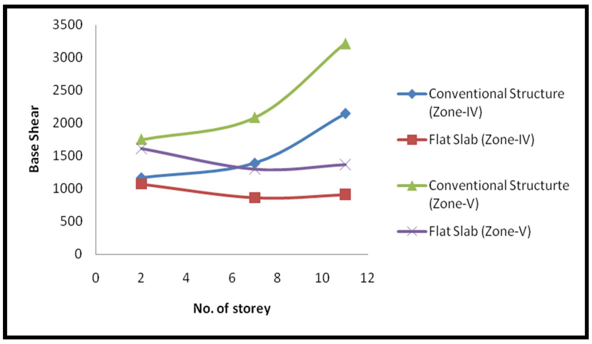
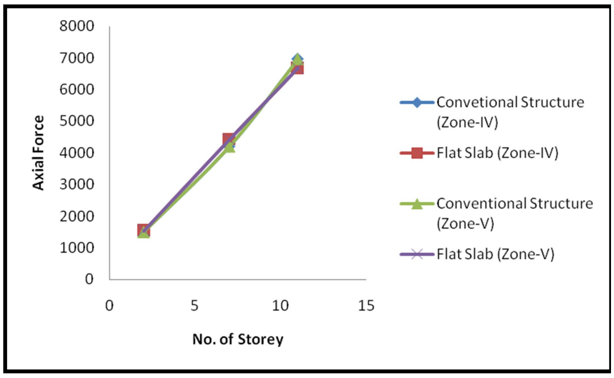


Table 4 Maximum Axial Forces for Different Models

Axial Force (kN)					
Height	storey	Zone-IV		Zone-V	
		CS	FS	CS	FS
9	2	1492.54	1538.48	1492.54	1538.48
26.5	7	4202.37	4429.5	4202.37	4429.5
40.5	11	6969.93	6689.26	6969.93	6689.26



IV. RESULTS AND DISCUSSION

In this work a comparative study of conventional beam-column building and a flat slab building subjected to seismic forces is carried out. The main objective of study is to understand the behavior of flat slab buildings under seismic loading. Based on this analytical study following conclusion can be drawn:

[1] Although the acceleration in flat slab structures are reduced due to its flexibility, the storey drift increases significantly and are many times exceed the permissible limits specified by the code. This may make the flat slab structure unserviceable during earthquakes.

[2] The natural time period increases as the height of building (No. of stories) increases, irrespective of type of building viz. conventional structure, flat slab structure.

[3] In comparison with the conventional RCC building to flat slab building, the time period is more for flat slab building than conventional building.

[4] For all the structure, base shear increases as the height increases

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