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Research Paper on Seismic Performances of Flat Slab through Composite Columns

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ABSTRACT – As flat slab building structures are relatively more adaptable than customary concrete framed structure, so it turns out to be progressively powerless against seismic loading. In composite segment development, steel and concrete are incorporated as such that the upsides of the materials are enrolled in effective way. The fundamental goal of this examination is just to consider the seismic conduct of various sorts of flat slab building framework with composite segments. Likewise the similar investigation is finished with various kinds of flat slab working with customary column sections. Seismic parameters are followed by IS-1893-2016. And also there are many types of composite columns and from those fully encased steel columns (FESC) and concrete filled steel tube columns (CFST) are taken for the analysis. G+15 storied Model analyses preferred from previous studies by using Etabs, a software package for the analysis and design of civil engineering structures. Flat slab design parameters are followed by IS-456-2000.

Key Words: Flat slabs, composite column, structural analysis software Etabs, seismic response, seismic zones.

I. INTRODUCTION

In this study the focus is on the performance of flat slab RCC structure with all types likes flat slab without drop, flat slab with drop and flat slabs with perimeter beams which engage its actions to earthquake situation with composite column. As it is very much obvious from earlier literature so as to the flat slab arrangement is not stable in seismic force, so we are going to analytically investigate the outcome of flat slab normally with concrete encased composite columns and in different earthquake zones. The method considering for the analysis are Response spectrum analysis method, linear static analysis method as per the Indian Standard codal provisions and by using ETABS software.

A concrete-steel column is basically a compression column member. In a composite structure, columns are typically referred as load-carrying members. A steel column made-up from build-up and rolled steel shape and enclosed in structural concrete or made-up from steel pipe or tubing and filled with structural concrete where the structural steel portion account for minimum 4 percentage of the gross area of column. A composite column is basically a member which is under compression, comprising of either a concrete enclosed hot-rolled steel or a hollow section which is filled with concrete of hot-rolled steel. Generally, it is looked as a load-bearing structure in composite structure.

II. LITERATURE REVIEW

Sanjay P. N. (2014)[(1)] This study basically focus on the flat slab Reinforced Concrete Cement building structure behavior under the seismic loading conditions. The building structures which are made up of flat slabs are more flexible than traditional frame building structure and to progress the behaviors of structures which are taking flat slabs underneath the earthquake conditions of loading, establishment of flat slab through drops and deprived of drops are measured in the literature. The Ground (G +5) tall building structures with storeied height about 3.5 metre is made in E-tabs softwares. It is concluded that the drift values follows a parabolic curve laterally storeied heights with extreme value up to 4th floor. The important natural period values are high in flat slabs with drops structure as associated to neglecting panel drop.

Vishesh P. Thakkar (2017)[(2)] The similar examination completed for seismic conduct of level section and regular Reinforced Concrete surrounded structure. In these investigation, diverse story level structures having level section with drop, without drop and regular piece building has been broke down.The nine mock-ups are examined in Etabs programming, for example,(G)+(5),(G)+(8) and (G)+(11) with ordinary RCC, level piece with drop, level chunk without drop. After contemplated the outcomes, ends were made those are, regular structure has unrivaled execution in quake against level section with drop and without drop. Level section with drop and segment head is diminish enormous shear power and negative bowing second.

Rasna P, Safvana P. (2017)[3] studied the analysing flat slabs by traditional slabs by using software named ETABS. In this study, they compared the numbers of punch shear through design of flat slabs manually and software designing is done. Single storey rectangular plan building considered for analysis and various results such as displacing of shell, displacement of joint, bending moment, reactions at joints etc. are carried out. Conclusion of the study is displacements and shell stresses of conventional slabs are greater than flat slab. Thus, they determined the buildings which are consisting of flat slabs are good to construct.

Arpitha Gowda S. L.(2017)[4] This gives the near investigation of Reinforced Concrete segment and composite segment with level section framework utilizing direct static examination and constructional successive investigation. G+17 with 2 storm cellars multi-storeyed structure considered for investigation in Etabs examination programming. They reasoned that the constructional consecutive examination gives exact outcomes when contrasted with ordinary investigation. Solidness is more in composite structure when contrasted with Reinforced Concrete cement (RCC) structure. Shear base in composited building is relatively not exactly RCC structures. Development consecutive investigation will give progressively solid outcomes and suggested in normal practice.

Dr. Ramkrishna Hegde (2018)[5] worked on the proportional learning on earthquake examination of traditional slab, flat slab and grid slab system for Reinforced Concrete bordered structure. Ground +15 multi-storey structure is taken for designing and analysing for the comparing of traditional, flatslab and gridslab systems. Models are broke down in Etabs 2015 with IS-456-2000 boundaries. The proportionate static strategy is utilized to examination and plans the structures as depicted by May be 1893-2002. After perception of results, end were pointed those are, seismic conduct of lattice piece structure is similarly superior to level slab and ordinary section, story float of matrix and level piece is 10 % not exactly customary slab. And also base shear of flat slab is lower than traditional slab and slab with grid.

III. METHODOLOGY

To study the behaviour of various models in case of seismic parameters, previous studies are preferred [15], the building plan, material and sectional properties and results are preferred to study of analysis results. The construction is modelled in three Dimension as viable construction via Etabs program. In the current effort, G+15 storeyed steel-clad concreted surround structures located in Zones III as per IS Codes is well-thought-out aimed at the learning. Total amount of straight outlines and perpendicular outlines are described then the flooring altitude is assumed. The structure elevation is stated forty five metre. The structures are considered as spaced surrounds. The intended planetary borders are considered for seismic load, live load, dead load and wind loads. The buildings are associated for Shear base, displacements of storeys, storey drift, storey shear and time period. The investigation were accepted with the subsequent model cases

Case 1: Conventional slab with composite columns.

Case 2: Flat Slab without drop, Flat slab with drop with composite columns (FESC).

Case 3: Flat Slab without drop, Flat slab with drop with composite columns (CFST).

Table 1. Structure details

Plan Dimension	42 m x 25 m
Number of arms in X-axis	7
Number of arms in Y-axis	5
Arm length in X-axis	6 m
Arm length in Y-axis	5 m
Height of the Floor	3 m

Table 2. Gravity Loads

Dead Load	Default value taken by Software
Live load	2 KN/m^2
Floor Finish	1.5 KN/m^2
Wall Load	12.19 KN/m [0.23x(3.0-0.5)x21.20]

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Table 3. Section Properties

Structural Element	Flat Slab model	Conventional Slab model
Beam Size	-	350 mm x 500 mm
Column Size Conventional- Composite-	750 mm x 750 mm 550 mm x 550 mm	750 mm x 750 mm 550 mm x 550 mm
Slab Thickness	200 mm	150 mm
Drop slab (2mx2m)Thickness	300 mm	-
Shear wall	230 mm Thickness	230 mm Thickness

IV. RESULTS AND DISCUSSIONS

4.1 BASE SHEAR

Table 5. Base Shear of all models with respect to Earthquake forces in X and Y directions

Model No.	Base Shear (kN)	
	EQx	EQy
Model 1	12712.89	9799.52
Model 2	12072.71	9306.05
Model 3	13265.69	10225.64
Model 4	12567.32	9687.31
Model 5	12726.02	9809.64
Model 6	12013.97	9260.77
Model 7	12546.07	9670.93
Model 8	11992.72	9244.39

From the above table it was concluded that base shear flat slab with drop is more than without drops and also from traditional RC enclosed structure,as height of storeyincreses the values of base shear also increases

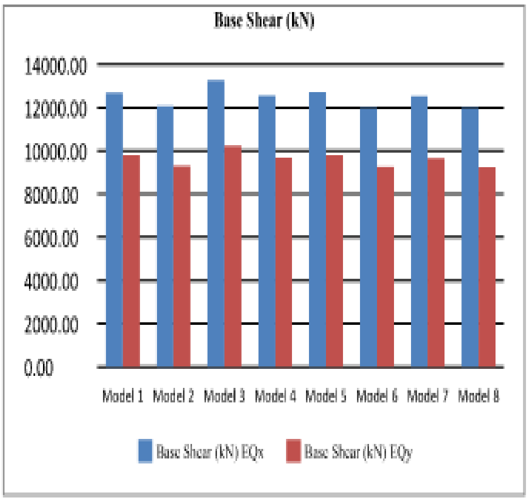

Chart 1: Graphical Representation of Base shear with respect to Earthquake forces

4.2 STOREY DISPLACEMENT

Table 6. Storey Displacements of all models in X and Y directions respectively

Storey	Maximum storey Displacement in X- Direction							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Storey16	151.9	167.6	242.4	247.8	292.6	294.1	236.4	284.6
Storey15	142.9	156.8	225.2	229.9	270.4	272	219.5	263.3
Storey14	133.1	145.5	207.3	211.4	247.7	248.9	201.9	241
Storey13	122.9	133.7	189	192.4	224.5	225.5	183.9	218.3
Storey1	112.2	121.5	170.2	173.1	201.1	202	165.6	195.5

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2								
Storey11	101	109	151.2	153.6	177.6	178.3	147	172.6
Storey10	89.5	96.2	132	134	154.1	154.8	128.2	149.7
Storey9	77.9	83.4	113	114.6	131	131.6	109.7	127.3
Storey8	66.2	70.7	94.3	95.6	108.6	109.2	91.5	105.4
Storey7	54.6	58.1	76.3	77.3	87.3	87.7	73.9	84.6
Storey6	43.4	46.2	59.3	60.1	67.3	67.7	57.4	65.2
Storey5	32.8	34.9	43.7	44.2	49.1	49.4	42.1	47.5
Storey4	23.1	24.6	29.8	30.1	33.1	33.4	28.6	31.9
Storey3	14.6	15.7	18.2	18.3	19.9	20	17.3	19
Storey2	7.6	8.4	9.1	9	9.8	9.7	8.5	9.2
Storey1	2.5	3.1	3.2	2.9	3.4	3	2.6	2.7
Base	0	0	0	0	0	0	0	0

Storey displacement is more at highest storey and minimum at the base of the structures. The displacement estimation of flatslab without drop building is about 26.19 % higher when contrasted with flatslab considering drop building and furthermore can be higher when contrasted with traditional RC Frame building.

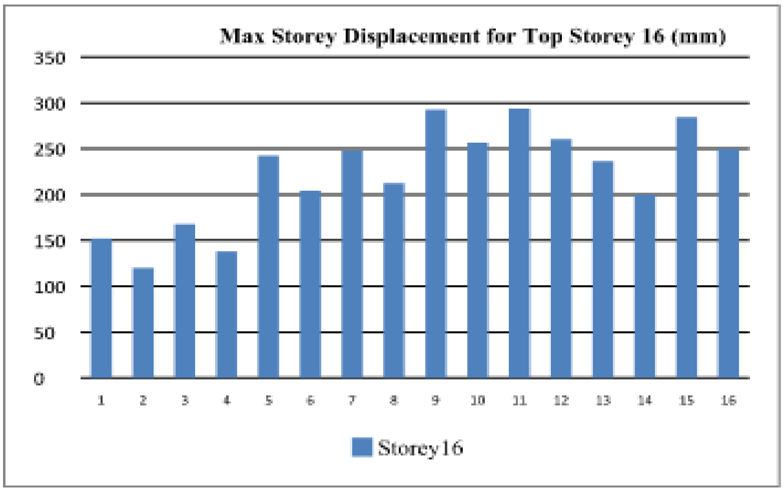

Chart 2: Graphical Representation of Storey displacement at Storey 16

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4.3 STOREY DRIFT

Table 7. Maximum Storey drift of all models in X directions

Storey	Maximum storey Drift in X- Direction							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Storey16	0.002011	0.002396	0.003817	0.003979	0.004929	0.004985	0.003754	0.004816
Storey15	0.002162	0.002521	0.003971	0.004118	0.005061	0.005131	0.003901	0.004954
Storey14	0.002274	0.002621	0.004076	0.004212	0.005145	0.005196	0.003997	0.005031
Storey13	0.002378	0.0027	0.004165	0.004284	0.005205	0.005233	0.004077	0.005071
Storey12	0.002477	0.002783	0.004233	0.00434	0.005233	0.005261	0.004139	0.005101
Storey11	0.002555	0.002841	0.00426	0.004357	0.005211	0.00524	0.004162	0.005081
Storey10	0.002593	0.002848	0.004232	0.004312	0.005126	0.00514	0.004128	0.00499
Storey9	0.002604	0.002837	0.004151	0.004222	0.004978	0.004995	0.004047	0.00485
Storey8	0.002572	0.002782	0.004002	0.004066	0.004751	0.004772	0.0039	0.00463
Storey7	0.002483	0.00266	0.003774	0.003827	0.004438	0.004451	0.003675	0.00432
Storey6	0.002351	0.002503	0.003473	0.003522	0.004042	0.004064	0.003382	0.003941
Storey5	0.002157	0.002283	0.003078	0.003128	0.003543	0.003571	0.003	0.003455
Storey4	0.00189	0.001985	0.002589	0.002636	0.002945	0.002974	0.002525	0.00287
Storey3	0.001559	0.001628	0.002004	0.002055	0.002247	0.002282	0.00196	0.002191
Storey2	0.001143	0.00118	0.00132	0.001374	0.001445	0.001502	0.0013	0.001431
Storey1	0.000547	0.00068	0.000713	0.000634	0.000748	0.000659	0.00058	0.000607
Base	0	0	0	0	0	0	0	0

Storey drift trails a parabolic pathway laterally storey stature through extreme worth lying wherever nearby the middle storey. After the above charts it was experiential that storey drift of flatslab neglecting drop building is high than flatslab with drop and traditional RC Framed building. As tallness of the structure surges the value of storey drift also rises. The storey drift of flatslab neglecting drop structure is 42.56 % more as linked to traditional RC Frame structure and 25.12 % more as associated to flatslab through drop structure.

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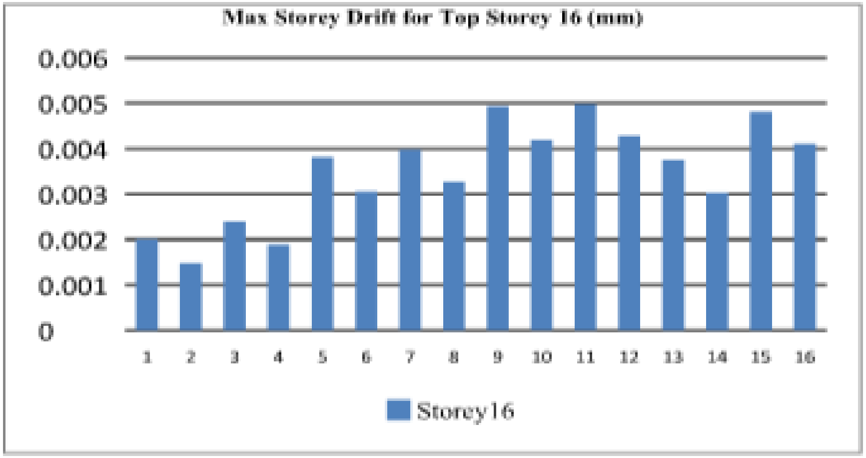

4.4 TIME PERIOD

Table 8. Time periods of all models for modal cases of all modes

Modes	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1	1.868	2.077	2.556	2.413	2.656	2.648	2.346	2.596
2	1.867	1.985	2.37	2.391	2.624	2.506	2.33	2.45
3	1.827	1.907	2.251	2.276	2.447	2.46	2.225	2.42
4	0.615	0.7	0.827	0.795	0.856	0.842	0.766	0.813
5	0.513	0.538	0.593	0.595	0.612	0.616	0.582	0.606
6	0.485	0.499	0.544	0.542	0.554	0.555	0.533	0.548
7	0.355	0.414	0.465	0.469	0.48	0.506	0.444	0.479
8	0.243	0.291	0.307	0.327	0.315	0.36	0.303	0.332
9	0.242	0.251	0.268	0.266	0.268	0.278	0.262	0.273
10	0.225	0.23	0.244	0.246	0.243	0.277	0.238	0.246
11	0.177	0.221	0.218	0.241	0.222	0.247	0.223	0.244
12	0.149	0.177	0.163	0.195	0.165	0.222	0.172	0.19

There are 12 number of mode in building every mode has diverse estimation of timespan. Timespan relies upon mass of building and it demonstrates adaptability of building. The quantity of mode builds, the estimation of timespan diminishes. From the above outlines it was seen that timespan of level chunk without drop building is more than level section with drop and traditional RC Framed structure. As tallness of the structure expands the estimation of timespan likewise increments. The timeframe of level chunk without drop building is about 25.17 % higher when contrasted with regular RC Frame building and 14.04 % higher when contrasted with level section with drop building.

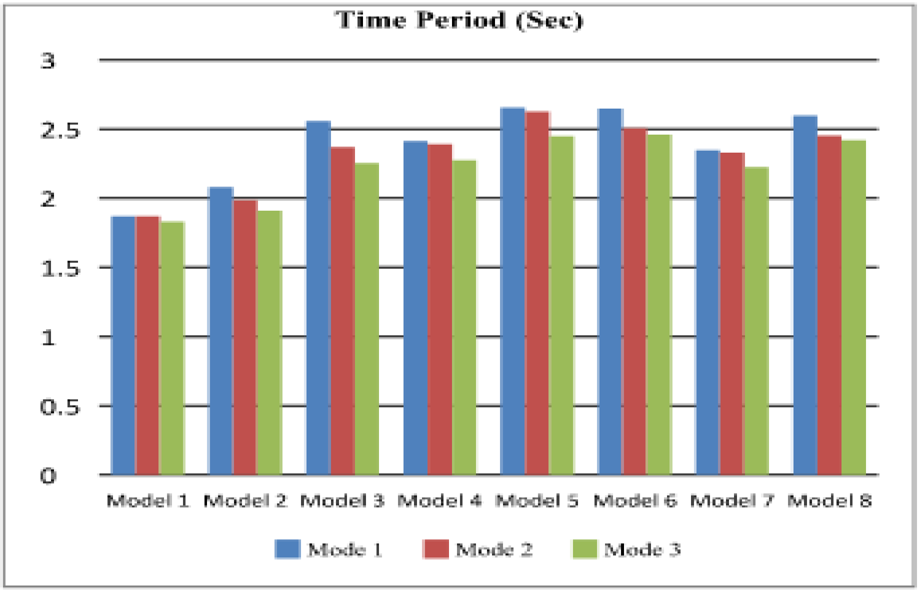

Chart 4: Graphical Representation of Time period for first three modes

V. CONCLUSION

The chief explanations and assumptions tired are potted beneath:

- Shear base of flatslab without drop through CFST column frame is minimum than flatslab by drops buildings by composite besides conventional column frames due to deduction of mass of drop slab. But base shear of flatslab through panel drops through CFST pillar frame is also lesser as compared to conventional columns frame, and this frame has less values in storey displacement, drift etc.
- The time period ,displacement of storeys and drift storey of flat slab by drop with CFST column frame is minimum that of flatslab short of drops buildings with composite and traditional column frames.
- By means of discuss above points we can conclude that the overall performance of the steel tube filled through concrete composite post is better as associated with conventional and fully enclosed steel composite post.

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