Comparative study on effect of Earthquake on Conventional and Flat slab building using ETABS software

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Abstract - *Flat slab buildings are commonly used for the construction because use of flat slab building provides many advantages over conventional RC Frame building in terms of economical, use of space, easier formwork, architectural flexibility and importantly shorter construction time. The structural efficiency of the Flat slab construction is most difficult by its poor performance under earthquake loading. It is necessary to analyses seismic behavior of buildings for various heights to see what are the changes are going to occur for the conventional RC frame building, flat slab building with and without drops. The analysis is done with E-Tabs software. The characteristics seismic behavior of conventional RC frame building, flat slab buildings suggest that additional measures for guiding the conception and design of these structures in seismic regions are needed and to improve the performance of building having conventional RC building, flat slabs under seismic loading. The object of the present study covers the behavior of multistory 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. Present study covers information on the parameters story drift, lateral displacement, seismic base shear.*

Key Words: Lateral Displacement, Storey Shear, Storey Drift, ETABS.

1. INTRODUCTION

Present days of living, all over the world the civil activities in construction going on as per demand which causes land shortage problems, Hence vertical structures is found to be an good solution. Numerous ways are there to help this plan to be successful and for speed work and budget dependent the best use is flat slab construction this technology will lowers the dead weight, and no beams will be considered, performance is good in floor area. "Flat Slab" where the technique is place the slab directly on the columns like walls. In the construction of flat slab the beams which are considered are utilized in the conventional methods are used to be new outcome the project. These constructional slabs are going to be directly resting while on the column where the load of the slab will be on the columns is going to be transferred directly and then goes to the foundation. This project aim is to compare the normal constructional technique used in Indian with that of the modern flat slab technique and its complete analysis and all aspects considered. The software used for this project is ETABS which helps in for the analysis of comparison of all the models considered. The main technique used is the equivalent static analysis considering the code which is IS 1893. The Models of the building is completely standardized as per the demand of analysis and the major aspects considered are as Lateral displacement, story drift and the story shear and final comparisons are made.

1.1 EQUIVALENTT STATIC CO-EFFICIENT METHOD

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.

1.2 RESPONSE SPECTRUM METHOD

The response spectrum method will be a big portion distinguished instrument methodology within the seismic research about systems. There are computational points along utilizing the response spectrum technique for seismic examination to prediction of displacements additionally part powers clinched along structural frameworks. Those approaches includes the figuring from claiming foremost the finest values of the displacements which is greater element and at each mode of vibration utilizing smooth birch outline spectra that are those normal about a few seismic tremor motions.

The codal provisions as per IS:1893 (Part 1)-2002 code for response spectrum analysis of multi-story building is also summarized.

2. METHODOLOGY

2.1 MATERIAL, FRAME AND SHELL PROPERTY CONSIDERATION

Material property

Grade of concrete: M25 and M30

Grade of steel: Fe 500

Young's modulus of concrete: 25000 and 30000Mpa

Young's modulus of steel: 200000MPa

Unit weight of steel: 76.9729 kN/m^3

Unit weight of concrete: 25 kN/m^3

Frame property

Beam: (400x600)mm

Column: (400x400) mm

Shell property

Slab: 200 mm

Wall: 230 mm

2.2 DESCRIPTION OF BUILDING WITH LOAD PARAMETERS

2.2.1 Conventional RC Building

Dead Load=5 KN/m^2

Masonry Load=19.2 KN/m

Height of wall=2.4m

Live load= According IS1893-2002 Code Line load for building is 2 KN/m^2 for terrace 1.5 KN/m^2

Floor Finish= According to code is 1.5KN/m^2

Masonry Load of Terrace(Parapet wall) =6 KN/m for Parapet wall top slab

No. Of Stories=G+8

2.2.2 Flat slab with Drop

Dead Load, Live load, Floor Finish are as same as that of conventional RC building system.

Drop size should not less than = $\frac{l_x}{3}, \frac{l_y}{3}$

$\frac{l_x}{3}$=5000/3=1666.66, $\frac{l_y}{3}$=5000/3=1666.66

Size of the drop considered as 2000×2000>1666.66

Drop=400mm

Slab=200mm

2.2.3 Flat slab without Drop

Load Parameters are same as Flat Slab with drop and load system as per conventional RC system.

According IS 1893-2002 code Book I=1.5, G=9.81, R=5

Formulation for scale factor =$\frac{I \times G}{2R} = \frac{5 \times 9.81}{2 \times 5}$=1471.5 scale factor

Earthquake Calculations=$\frac{RSMAX}{EQX}$> 85%

3. SOFTWARES USED

Extended Three Dimensional Analysis of Building Structures ETABS was used for modeling and Analysis. Auto CADD was used for preparing plan of framed structure plan.

4. MODELING

Three models have been used.

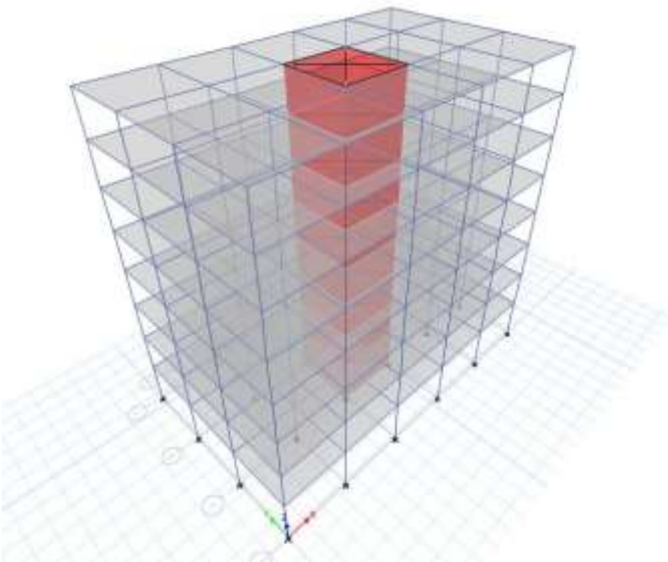

Fig -1: 3D wireframe of conventional RC structure

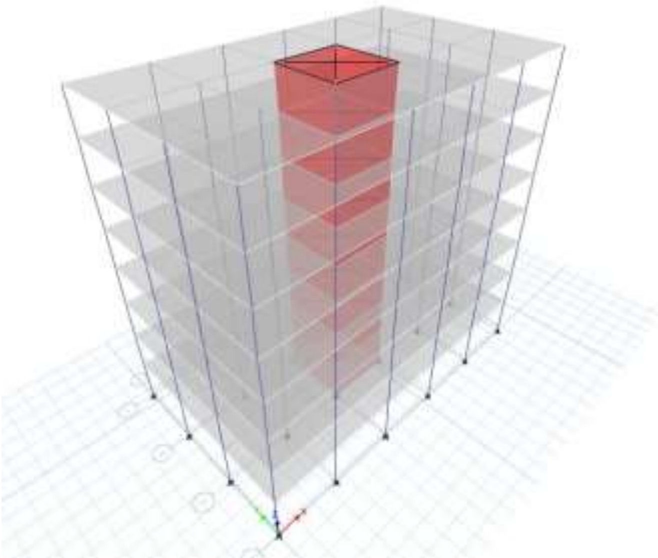

Fig -2: 3D wireframe of Flat Slab without drop structure

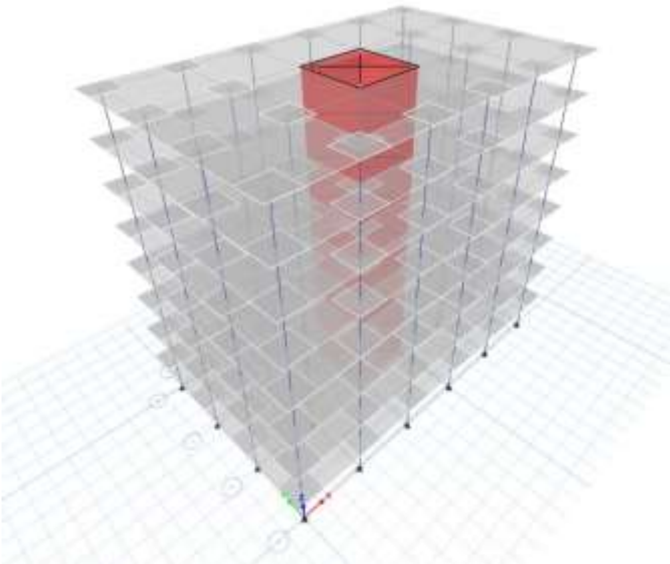

Fig -3: 3D wireframe of Flat Slab with drop structure

5. RESULTS

5.1 CONVENTIONAL RC STRUCTURE

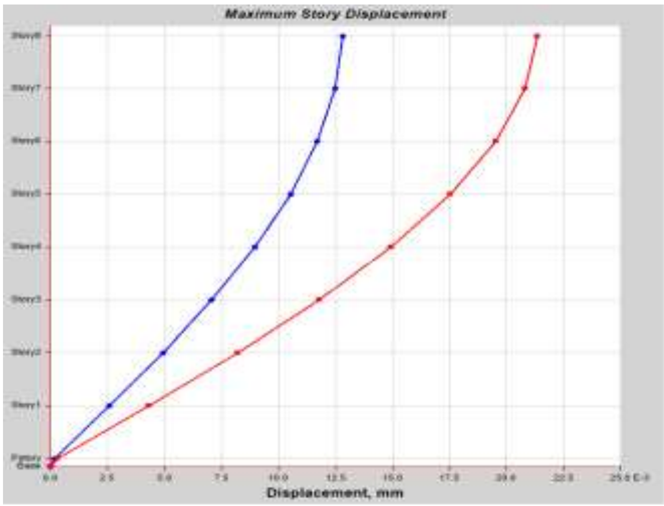

Fig -4: Maximum Story Displacement

Table -1: Tabulated Plot Coordinates Story Displacement Values

Story	Elevation	X-Dir	Y-Dir
	m	mm	mm
Story8	24.45	0.013	0.021
Story7	21.45	0.012	0.021
Story6	18.45	0.012	0.02
Story5	15.45	0.011	0.018
Story4	12.45	0.009	0.015
Story3	9.45	0.007	0.012
Story2	6.45	0.005	0.008
Story1	3.45	0.003	0.004
Pstory	0.45	1.706E-04	2.706E-04
Base	0	0	0

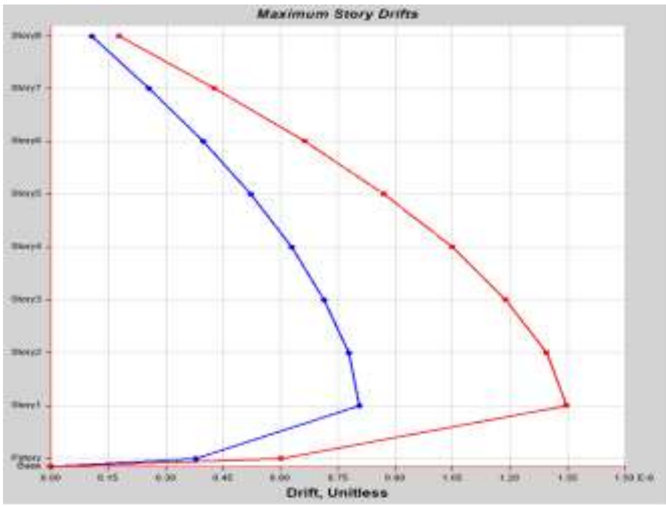

Fig -5: Maximum Story Drift

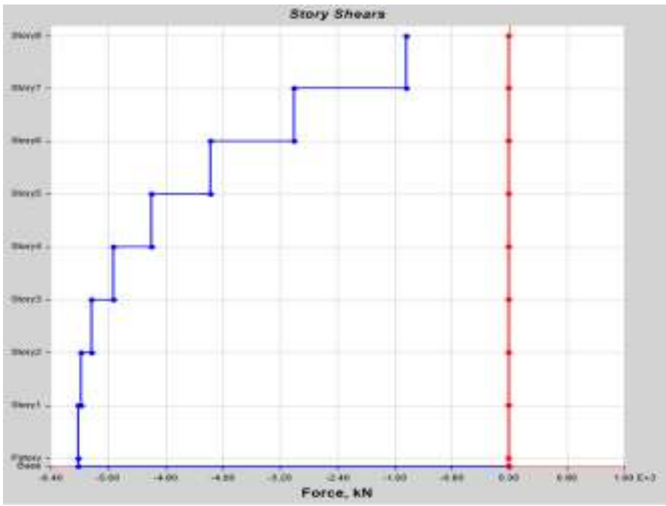

Fig -6: Maximum Story Shears

5.2 FLAT SLAB WITHOUT DROP STRUCTURE

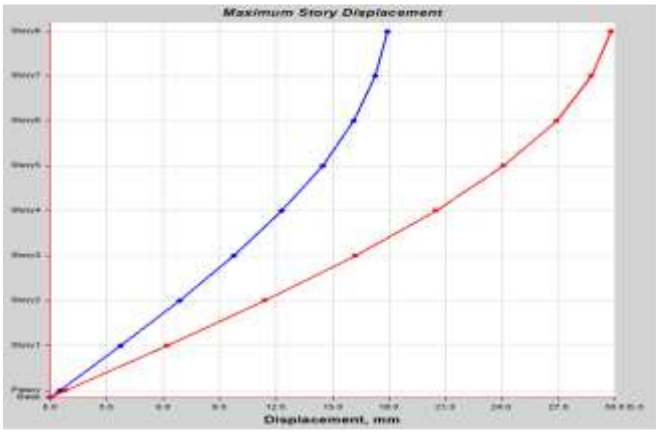

Fig -7: Maximum Story Displacement

Story	Elevation	X-Dir	Y-Dir
	m	mm	mm
Story8	24.45	0.018	0.03
Story7	21.45	0.017	0.029
Story6	18.45	0.016	0.027
Story5	15.45	0.014	0.024
Story4	12.45	0.012	0.021
Story3	9.45	0.01	0.016
Story2	6.45	0.007	0.011
Story1	3.45	0.004	0.006
Pstory	0.45	4.867E-04	0.001
Base	0	0	0

Table -2: Tabulated Plot Coordinates Story Displacement Values

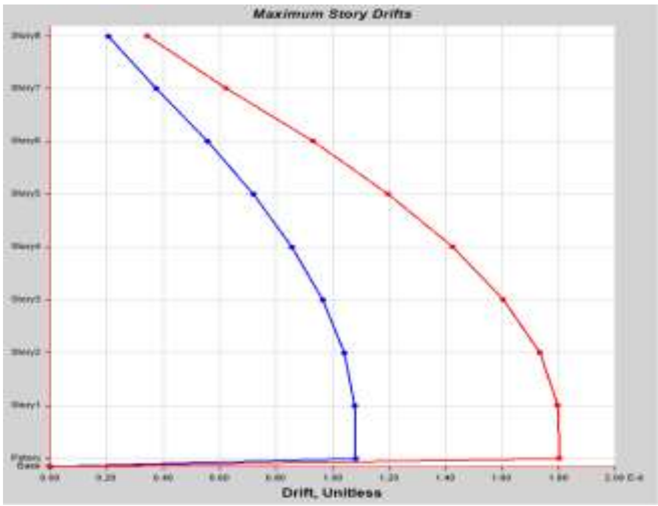

Fig -8: Maximum Story Drift

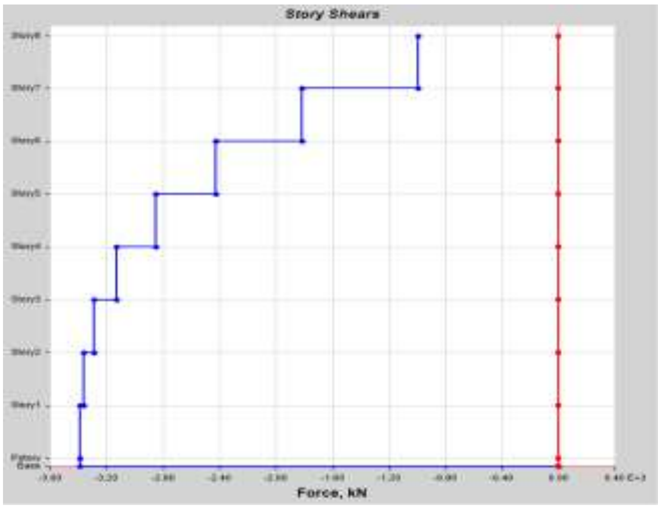

Fig -9: Maximum Story Shear

5.3 FLAT SLAB WITH DROP STRUCTURE

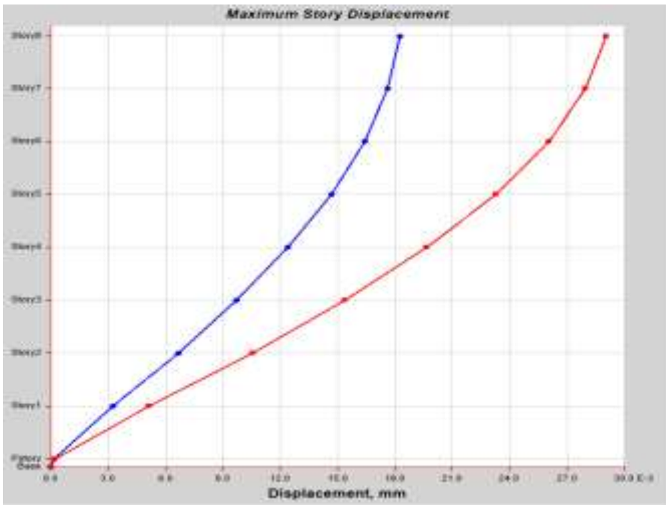

Fig -10: Maximum Story Displacement

Story	Elevation	X-Dir	Y-Dir
	M	mm	mm
Story8	24.45	0.018	0.029
Story7	21.45	0.018	0.028
Story6	18.45	0.016	0.026
Story5	15.45	0.015	0.023
Story4	12.45	0.012	0.02
Story3	9.45	0.01	0.015
Story2	6.45	0.007	0.011
Story1	3.45	0.003	0.005
Pstory	0.45	1.48E-04	1.956E-04
Base	0	0	0

Table -3: Tabulated Plot Coordinates Story Displacement Values

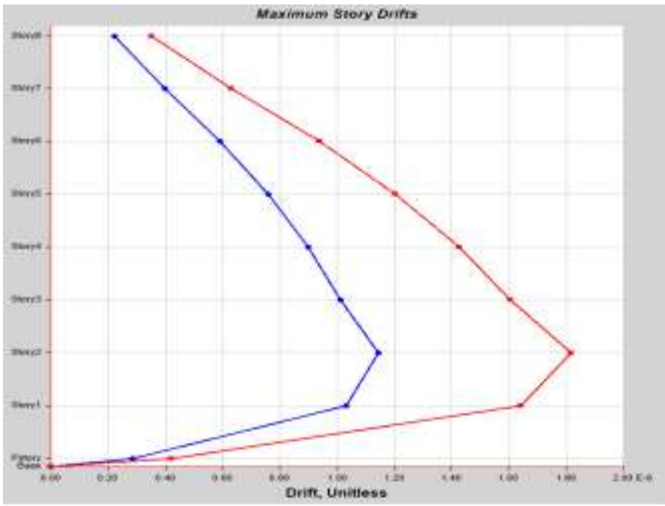

Fig -11: Maximum Story Drift

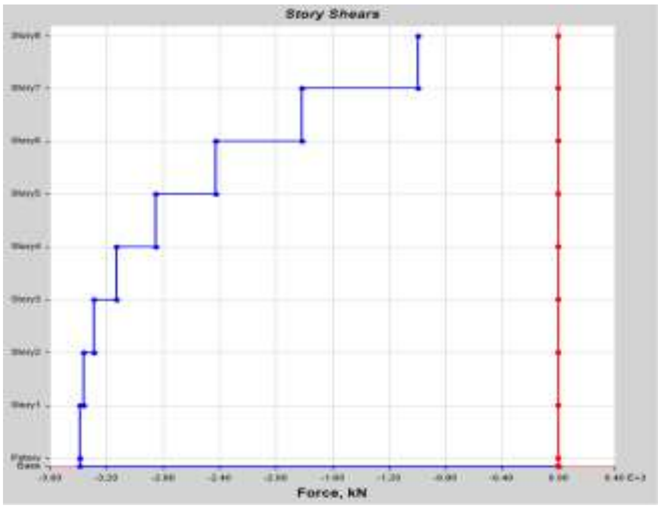

Fig -12: Maximum Story Shear

6. RESULTS AND COMPARISON

X Direction	Conventional RC structure	Flat slab without drop	Flat slab with drop
Displacement	0.072171	0.098487	0.09915
Drift	6.14E-06	7.58E-06	6.90E-06
Shear	144997.5	82113.36	89003.5

Table -4: Results and Comparison values

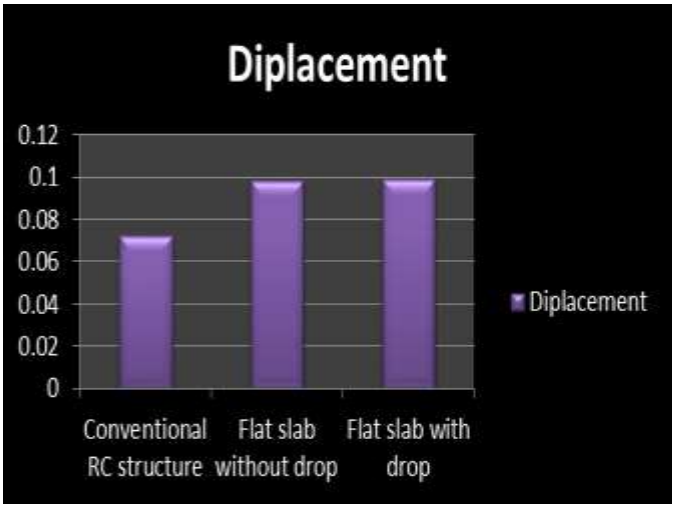

Fig -13: Displacement values

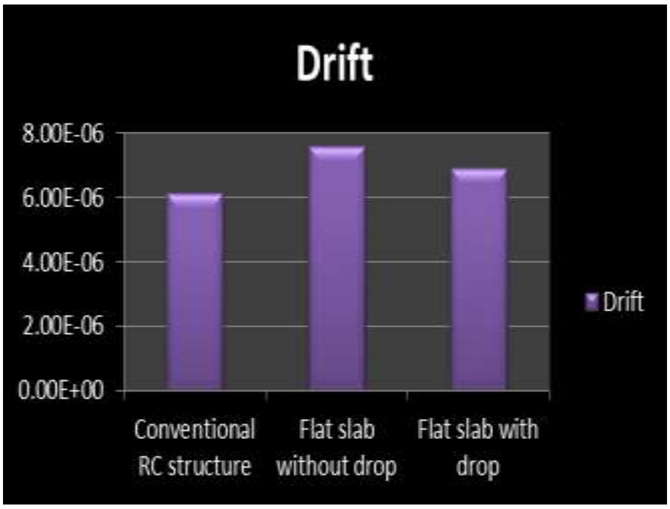

Fig -14: Story Drift values

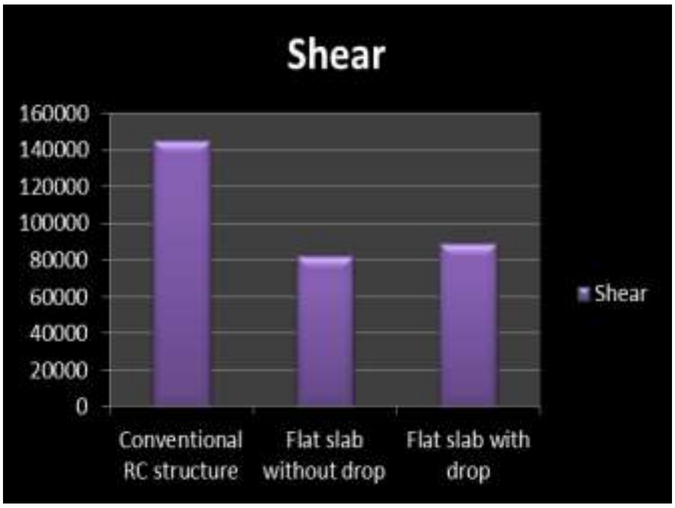

Fig -15: Story Shear values

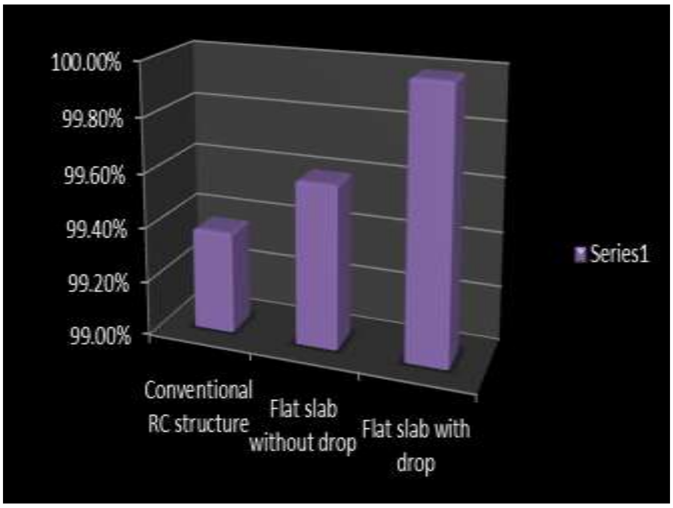

Fig -16: Response Spectrum comparison for structures

Conventional RC structure	Flat slab without drop	Flat slab with drop
99.375%	99.60%	99.99%

Table -5: Response Spectrum Analysis

6. CONCLUSIONS

The following conclusions can be drawn from the analysis.

- The conventional RC frame structure gives more resistance to earthquake.
- The displacement in the Flat slab with and without drop structure is more as compared with Conventional RC Frame structure.
- The Story Drift in the Flat slab with and without drop structure is more as compared with Conventional RC Frame structure.
- The Base Shear in the Flat slab with and without drop structure is less as compared with Conventional RC Frame structure.
- Hence from all the observation made, it is clear that the conventional RC structure will be suitable as compared with flat slab with drop and flat slab without drop structure.

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REFERENCES

(1) Mrs.Sumitpahwa, "Study of the comparison of the flat slab in one or two way".

(2) Ms. Navyashree K and SahanaInternational, "Analysis of flat slab using the conventional method at different seismic zones".

(3) Dr. Uttamashagupta, "Seismic behavior of buildings having flat slabs with drops". International Journal of Emerging Technology and Advanced Engineering website: www.ijetae.com (ISSN 2250-2459, volume 2, issue 10, October 2012).

(4) IS: 875 – 1987 - code of practice for design loads (other than earthquake) for buildings and structures, part 1: Dead loads, part 2: Imposed loads, part 5: Special loads and load combinations, bureau of Indian standards, New Delhi.

(5) IS: 1893 (part–1)–2002 - code of practice for criteria for earthquake resistant design of structures, part 1: general provisions and buildings, bureau of Indian standards, New Delhi.

(6) IS:456-2000-code of practice for plain and reinforced concrete, fourth revision.

(8) Pradip S. Landel, Aniket B. Raut Associate Professor Government College of Engineering, Amravati Maharashtra, India, "Seismic Behaviour of Flat Slab Systems".

(9) DhananjayD.Structural Engineering Department, Govt. College of Engineering Aurangabad, "Performance of Flat Slab Structure Using Pushover Analysis".

(10) A. E. Hassaballa , M. A.Department of Civil Engineering, Jazan University, Jazan, KSA, "Pushover Analysis of Existing 4 Storey RC Flat Slab Building".