

Comparative Study of Seismic Behavior of Flat Slab Building and Conventional Building

I.Oviya¹, N.Sumega², Dr.V.Selvan³

P.G. Student, Department of Structural Engineering, Kumaraguru College of Technology, Coimbatore, India¹

P.G. Student, Department of Structural Engineering, Kumaraguru College of Technology, Coimbatore, India²

Associate Professor, Department of Civil Engineering, Kumaraguru College of Technology, Coimbatore, India²

ABSTRACT: Tall commercial buildings are primarily a response to the demand by business activities to be as close to each other, and to the city centre as possible, thereby putting intense pressure on the available land space. Structures with a large degree of indeterminacy is superior to one with less indeterminacy, because of more members are monolithically connected to each other and if yielding takes place in any one of them, then a redistribution of forces takes place. Therefore it is necessary to analyze seismic behavior of building for different heights to see what changes are going to occur if the height of conventional building and flat slab building changes.

KEYWORDS: Conventional Building, Degree Of Indeterminacy, Flat Slab Building, Land Marks, Land Space, Monolithically Connected.

I. INTRODUCTION

This project is based on structural design of Rc building. The design shall generally be in accordance with Indian Standard IS 456:2000 codes. The document covers comparative study on seismic behavior of flat slab building and conventional building and analysis and design of IT park including calculation of seismic response spectrum ,time history analysis and thermal load calculation. The design calculations were done manually and cross checked with the help of software, This structure is modelled as 3D space frame in ETABS software.

II. REVIEW OF LITERATURE

M. AltugErberik, Amr S. Elnashai [2004] focused on the derivation of fragility curves using medium rise flat slab buildings with masonry infill walls. The study employed a set of earthquake records compatible with the design spectrum selected to represent the variability in ground motion. Inelastic response-history analysis was used to analyze the random sample of structures subjected to the suite of records scaled in terms of displacement spectral ordinates, whilst monitoring four performance limit states. The fragility curves developed from this study were compared with the fragility curves derived for moment-resisting RC frames. The study concluded that earthquake losses for flat-slab structures are in the same range as for moment-resisting frames. Differences, however, exist. The study also showed that the differences were justifiable in terms of structural response characteristics of the two structural forms. [4] S.W.Han [2009] told about the effective beam width model (EBWM) used for predicting lateral drifts and slab moments under lateral loads. They also studies on slab stiffness with respect to crack formation. This studies developed equations for calculating slab stiffness reduction factor by conducting nonlinear regression analysis using stiffness reduction factors estimated from collected test results. [5] A.B.Climent [2012] investigated about the effective width of reinforced concrete flat slab structures subjected to seismic loading on the basis of dynamic shaking table tests. The study is focused on the behavior of corner slab column connections with structural steel I- or channel-shaped sections (shear heads) as shear punching reinforcement. To this end, a 1/2 scale test model consisting of a flat slab supported on four box-type steel columns was subjected to several seismic simulations of increasing intensity. It is found from the test results that the effective width tends to increase with the intensity of the seismic simulation, and this increase is limited by the degradation of adherence between reinforcing steel and concrete induced by the strain reversals caused by the earthquake. Also, significant differences are found between the effective width obtained from the tests and the values predicted by formula proposed in the literature. These differences are attributed to the stiffening effect provided by the steel profiles that constitute the punching shear reinforcement. [6]



III. DESCRIPTION OF THE STRUCTURE

The plan dimension of the building is 103m×63m and height of 52m, Panel Size : 8m X 8m. This structure comes under zone 3 seismic region. Building Frame System For This Structure is RC Building With Special Moment Resisting Frame. The International System of Units (SI) is used to prepare the drawing and design documents

DESIGN DATA OF BUILDING	DETAILS
Plan dimension	103m×63m
No. of . Story	12
Typical storey height	47m
Bottom storey height	3
Building type	Office building
Location	Chennai
Thickness of drop	250mm
Thickness of slab	200mm - Flat slab 150mm- conventional Rc building
Size of drop	4m x 4m
Column size	900mm x900mm
Beam size	300mm x 600mm
Wall thickness	200 mm
Grade of concrete	M30
Grade of steel	Fe 415
Earthquake data	Zone-III

LOADS AND LOAD COMBINATIONS

All designs have been prepared in accordance with the specifications, Indian Standard Codes of practices or equivalent as listed below. Design of concrete Structures is done in accordance with IS 456:2000

- ✓ Live Load is considered in accordance with IS 875(Part-2)-2015
- ✓ Wind Loads are considered in accordance with IS 875(Part-3)-2015
- ✓ Seismic Loads are considered in accordance with IS 1893-2016
- ✓ Thermal load is taken from monthly mean temperature data

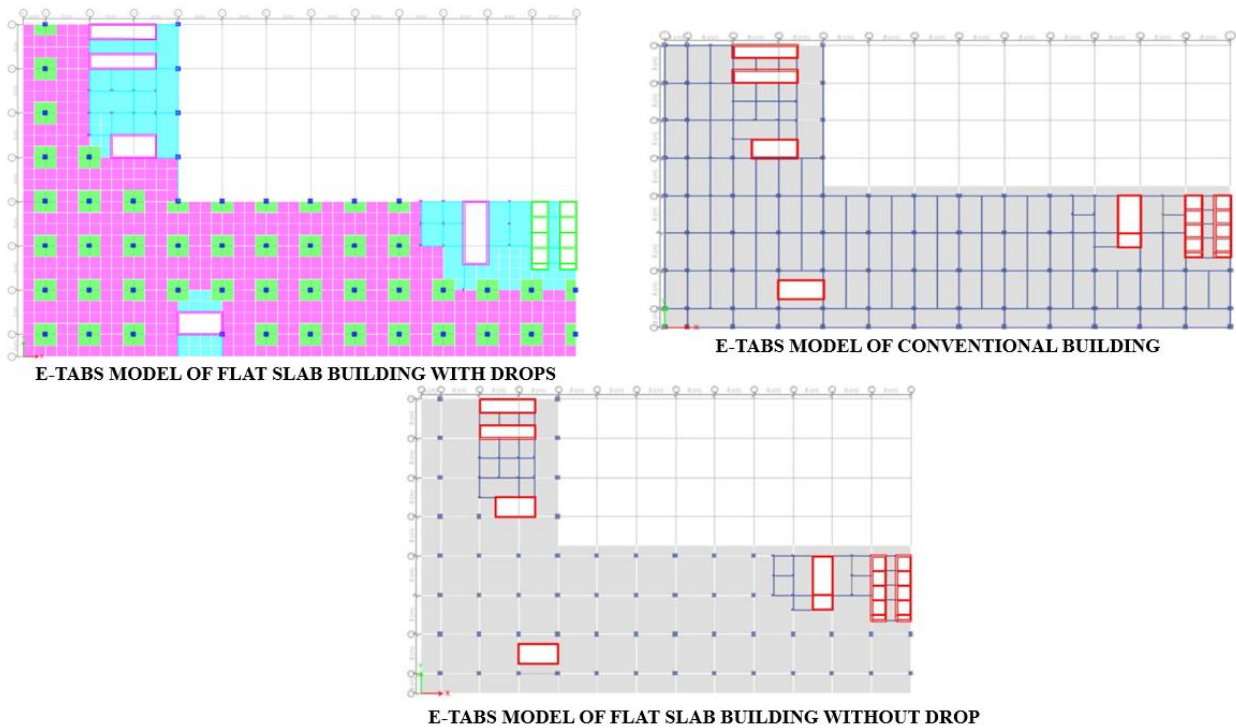


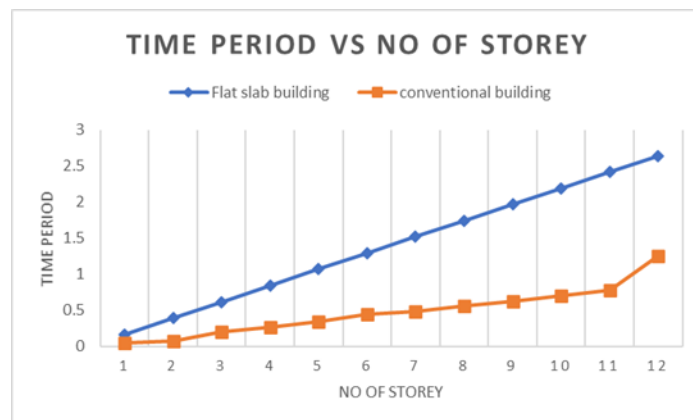
Fig 1 E-tabs Model

IV. EXPERIMENTAL RESULTS

. Dynamic analysis for conventional RC Frame building, flat slab with drop building and flat slab without drop building was done by using response spectrum analysis for earthquake zone III as per Indian standard code. The effect of height of building on these building is evaluated. There is significant change in seismic parameters like storey displacement, storey drift, storey shear, time period and base shear is noticed and discussed below

Natural Time Period

The time required for the undamped system to complete one cycle of free vibration is the natural period of vibration of the system in units of seconds.. Similar, variation of natural time period of different model V/s. no. of storey

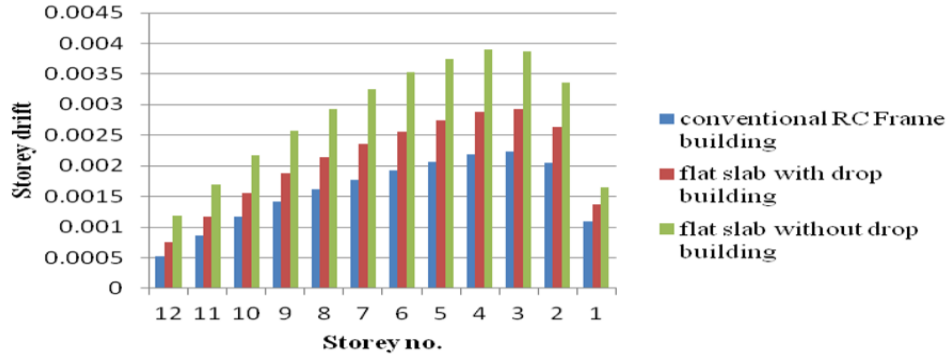


Comparison Of Time Period Vs Number Of Storey For Conventional Building And Flat Slab Building

STOREY DRIFT

Storey drift is defined as difference between lateral displacements of one floor relative to the other floor. Total storey drift is the absolute displacement of any point relative to the base. As per IS.1893-2002 cl.7.11.1 the storey drift in any

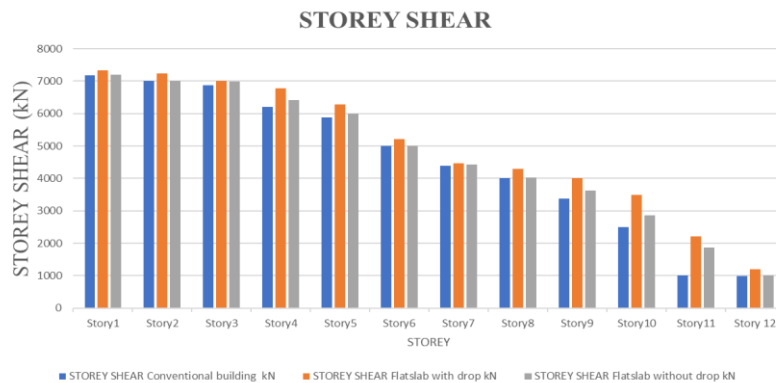
storey due to the minimum specified design lateral force with partial load factor 1.00 shall not be exceeding 0.004 times the storey height.



Comparison Of storey drift Vs Number Of Storey For Conventional Building And Flat Slab Building

STOREY SHEAR

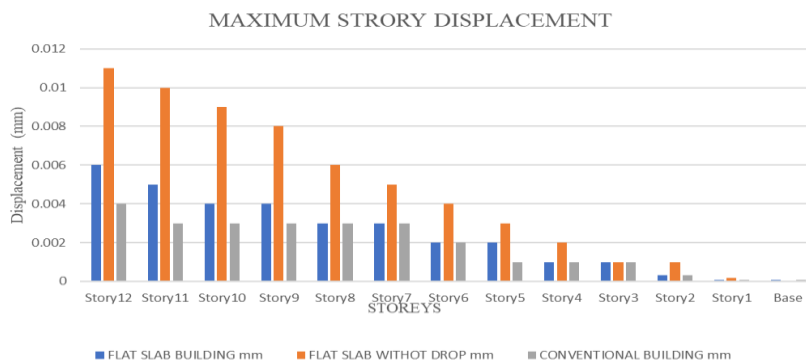
Seismic forces are lateral loads (external force) which intern will create total reactive forces at column base in direction opposite to that of lateral load i.e. (sum of lateral loads = base shear) this overall reactive force is base shear. But the load is not applied on base alone, as the lateral load is applied along the height of building and building in turn has different stiffness and masses along its height in different storey, so the reactive force in each storey due to lateral load varies and this reactive force is storey shear. Roughly storey shear can also be seen as distribution of base shear along its storey based on its stiffness and mass.



Comparison Of storey shear Vs Number Of Storey For Conventional Building And Flat Slab Building

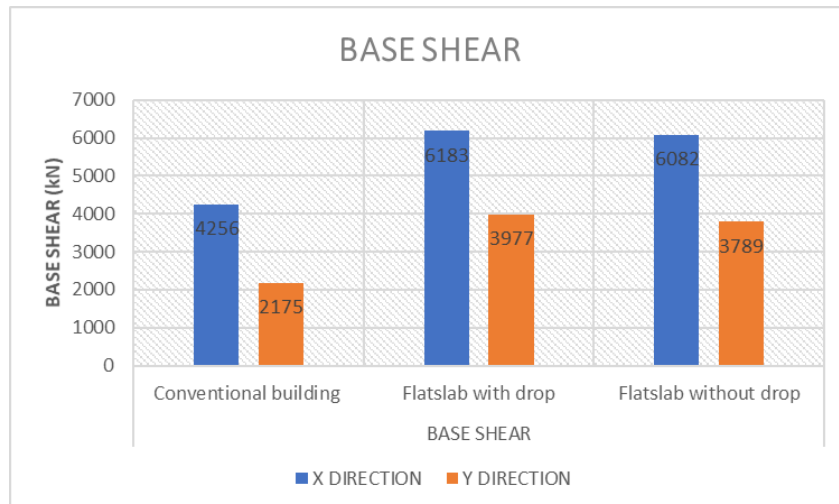
STOREY DISPLACEMENT

Storey displacement is important when structures are subjected to lateral loads like earthquake and wind loads. Displacement depends on height of structure and slenderness of the structure because structures are more vulnerable as height of building increases by becoming more flexible to lateral loads



Comparison Of maximum displacement Vs Number Of Storey For Conventional Building And Flat Slab Building

BASE SHEAR



Comparison Of Base Isolation For Conventional Building And Flat Slab Building

V. CONCLUSION

This is the summary of project work for conventional RC Frame building, flat slab with drop building, flat slab without drop building for different height of building in seismic zone III

The time period is maximum at mode 1, 2 and 3. After mode 3 time period reduces drastically. As height of the building increases the value of time period also increases. The time period of flat slab with drop building is about 52% higher compared to conventional RC Frame building ,because of monolithic construction.

Storey displacement is high at top storey and least at the base of the structures. As the height of the building increases the value of displacement also increases. The displacement value of flat slab without drop building is about 63% higher compared to conventional RC Frame building and 45.2% higher compared to flat slab with drop building.

Storey drift follows a parabolic path along storey height with maximum value lying somewhere near the storey three. After storey three, storey drift decreases as the height of building increases. The storey drift of flat slab without drop building is about 42.56 % higher compared to conventional RC Frame building and 25.12 % higher compared to flat slab with drop building.

The base shear is maximum at ground level and keeps on decreasing towards the top storey of the structure. As height of the building increases the value of storey shear and base shear also increases. The base shear of flat slab with drop building is about 31.16% higher compared to conventional RC Frame building and 1.63 % higher compared to flat slab without drop building.

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REFERENCES

[1] Navyashree K, Sahana T.S, “Use of flat slabs in multi-storey commercial building situated in high seismic zone”, International Journal of Research in Engineering and Technology (IJRET) Vol.3, Issue 8, pp. 439-451, August 2014.

[2] Dr. U. Gupta, S. Ratnaparkhe, P. Gome, “ Seismic behavior of buildings having flat slabs with drops”, International Journal of Emerging Technology and Advanced Engineering (IJETA) Vol. 2, Issue 10, October 2012.



- [3] S.Pahwa, V. Tiwari. M. Prajapati, “Comparative Study of Flat Slab with Old Traditional Two Way Slab” Internatinal Journal of Latest Trends in Engineering and Technology (IJLTET), Vol. 4, Issue 2, pp. 252-260, July 2014.
- [4] M. AltugErberik., Amr S. Elnashai, “Fragility analysis of flatslab structures”, ELSEVIER, 23 February2004.
- [5] Sang Whan Han, Young Mi Park, SeongHoon Kee, “Stiffness reduction factor for flat slab structures Under lateral loads - A literature review on experimental study”, Journal of structural Engineering © ASCE / JUNE 2009 / 743.
- [6] A.B. Climent, D.Z. Sánchez, J.F. Gil-Villaverde, “Experimental study on the effective Width of flat slab structures under dynamic seismic loading ”, ELSEVIER, April 2012.
- [7] Saraswati Setia, Shakti Kalyani “Seismic Behavior of Connections Subjected to Punching Shear in Flat Slab Systems” Journal of Engineering and Technology (JET) Vol.5, Issue 1, pp. 45-51, June 2015.
- [8] V.K. Tilva, A.B.Vyas, P. Thaker, “Cost comparison between flat slabs with drop and Without drop in four storey lateral load resisting building”, National Conference on Recent Trends in Engineering & Technology, 13-14 May 2011, B.V.M. Engineering College, V.V.Nagar, Gujarat,India.
- [9] Prof. P. S. Lande, Aniket B. Raut, “ Comparative Study of Flat Slab Building with Traditional Two Way Slab Building under the Seismic Excitation ” International Journal of Pure and Applied Research in Engineering and Technology (IJPRET), Vol.3, Issue 8, pp. 51-58, April 2015.
- [10] Widiyanto, Ying Tian, Jaime Argudo, OguzhanBayrak, James O. Jirsa, “Rehabilitation of earthquake-Damaged reinforced concrete flat plat slab column connections for two way shear”, Proceedings of the 8th U.S.National Conference on Earthquake Engineering, April 18-22, 2006, San Francisco, California, USA