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PERUSAL OF POST-TENSION AND REINFORCE CONCRETE FLAT SLAB UNDER INFLUENCE OF LATERAL LOADING

Prof. S. P. Tak [1], Kavita C. Jadhav[2]

[1]*Assistant Professor, Department of Applied Mechanics,Government College of Engineering, Amravati, India, 444604*
[2]*P.G. Student (M, Tech structures), Government College of Engineering, Amravati, India, 444604*

Abstract- Now a days post-tensioning method is increase widely due to its economical and functional advantages like its improved crack and deflection control and allow relatively large span to thickness ratios of the order of 35 to 45 which is less in case of RC up to 30. The main pursue of this paper is to research the behaviour of RCC flat slabs and Post-tensioned flat slab also to analyse the behaviour of PT and RC multi - storey building under influence of lateral loading. For comparison purpose PT flat slab is a better option as compared to RCC flat slab, for the economic purpose and time of construction. In this study paper, a study of structure of (G +6) mute- storey building in zone IV is considered, and analysis of RCC and PT flat slab is done to determine various variables like base shear, story drift, and displacement for the analysis by using ETABS 2016 software.

Keywords— RCC, Post-tensioned, Flat slab, Seismic analysis, Etabs2016 Include at least 5 keywords or phrases

I. INTRODUCTION

Due to the rapid expansion in the lack of land, construction of vertical structures is becoming a necessary part of our living. Construction of vertical structures brings provocations to prevent lateral load due to wind or earthquake load. For the construction of structures in earthquake sensitive areas, flat slabs are one of the common floor systems. Flat slab structures have various benefits over conventional slab structures. Flat slabs can be constructed by conventional reinforced concrete or by post- -tensioned flat slab could be a better option compared to RCC flat slab, in respect of the price of project and time of construction.

POST-TENSIONING: -In pre-stressed concrete structures to counteract the stresses appear during the service period, an initial load is applied to the structure prior to its benefits. Pre-stressing of concrete can be classified into Pre-stressing and Post-tensioning. Pre-tensioning is a method in which a tendons are tensioned before the casting of concrete and in Post-tensioning tension is applied to the tendons after hardening of the concrete. In a new era for a wide range of applications post-tensioning is a mature technology, providing economic, efficient, and elegant structural solutions. In Post-tensioned construction, the ducts in which the tendons are to be placed must be placed before the casting of concrete. Later than the casting of concrete, the tendons are placed in these ducts. The tendon is tensioned at one end and tie up at other end. A system of self-equilibrating forces are developed after the tensioning of tendons. The Post-tensioned slab is stronger and durable than the normal concrete slabs.

RCC FLAT SLABS: - A Flat slab is a slab in which it is directly hold up by columns and they doesn't have beams. So the loads are transferred directly to the supporting columns. In Flat slab structures, the absence of beams gives a plain ceiling and so an attractive appearance. The Flat slab is easy to construct and requires cheaper slab and beam structures. Flat slabs can be constructed by conventional reinforced concrete or by post-tensioning. Post-tensioned flat slab could be a better option compared to RCC flat slab, respect of the cost of project and time of constructionformwork In Flat slab structures, partition walls can be placed anywhere and these structures are less vulnerable in the case of fire than the conventional slab-beam structures. Because of the rapid increase in the shortage of land, construction of vertical structures is becoming a necessary part of our living. Flat slabs are common floor systems for the construction of structures in earthquake sensitive areas.

2.1 LITERATURE REVIEW

Literature review is carried out to investigate possibilities of design improvements in post tensioned slabs. Modern work for designing post tensioned slab for cost effectiveness is studied. Modelling of post tensioned slabs as well as for R.C.C slab are studied for, to find out possibilities for further development. Various feature of different types of post tensioned slabs, methods of analysis, and their modelling is explored to find out possibilities of further research.

Bahoria and Parbat (2013) did the relative work on post-tensioned slab and beams. They work on a multi-story building (G+4) and later then building was modelled by four cases, the PT flat slab, post-tensioned beams and the R.C.C. slab, only Reinforced concrete flat slab and the Reinforced concrete slab and beams. From the analysis, design and the evaluation of the office building for the four different cases it was found that from the economic point of view the post-tensioned flat slab is the most economical among all four cases and the thickness of post tensioned flat slab was

minimum. After that it was found that the pre-stressing steel required was greater and the reinforcing steel was less for the posttensioned flat slab than post-tensioned slab with reinforced concrete beams. The time for the construction of floor was less in case of PT flat slab than the other three cases. A relative study of Post-Tensioned and Reinforced concrete flat plate considering the seismic load using Equivalent frame method and using studs software shows that the deflection at centre of flat plate slab is controlled more effectively by parabolic and Trapezoidal tendon than triangular tendon. The moment calculated for Post-tensioned flat plate slab is less as compare to moment calculated for RCC flat plate. Due to posttensioning of flat plate slab there is no much effect on axial force but shear and moment on column increased.

Desai and Shaikh (2016) presented Modelling and analysis of flat slab and PT flat slab was done using SAFE. Slab panel of 8m by 12m was modelled and Drops are provided along column strip. Results were compared with flat slab and PT flat slab with respect to deflection, punching, moment and stresses. Modelling was also done for different position of column and different orientation of column drops. The total amount of reinforcing steel, post-tensioning steel, concrete needed for the slab was premeditated for the same and cost per square meter were presented. It was observed that average percentage cost saving for PT flab slab was about 5-7 percent of flat slab. Deflection for PT flat slab was about 55% to 90% for diff column position and drop orientation. The punching shear capacity ratio and Stresses in case of PT flat slab were within the permissible values as per guidelines provided by IS: 1343-1980. Positive and negative moments in case of PT flat slab were less than flat slab. Overall study on Post-Tensioned flat slab proved that PT flat slab could be a better option compared to flat slab, in respect of cost of project, stability and durability.

Paul and Krishnan (2016) the PT columns can give greater re-entering capacity and uncracked portion after earthquake vibration effects. In present study, the earthquake behaviour of structure with and without PT columns was assessed by doing non-linear static analysis. Nonlinear static (pushover) analysis is a favoured instrument for seismic evolution of survive and current structures. In this push over (non-linear static) analysis, performance parameters of building were assessed. Perpendicular bonded tendons were similarly scattered across four sides of the columns. The building is located in Pattambi was choose for the study which is rest in earthquake zone III. In this analysis corner columns were pressured by providing extra vertical Post-tensioning pressure up to 50% of its axial load ability with maximal reinforcement steel up to 4% of the area. The results after analysis found that increases in Performance point, maximum base shear, response reduction factor, ductility factor and over strength factor given by increasing PT steel and PT force in tendons.

Reddy and Pradeep (2017) presents study an attempt is made to compare the cost effectiveness of Post- Tensioned flat slab systems with respect to reinforced concrete flat slab system. Both the systems are analysed using RAPT and ETABS respectively which is based on the design methodology. The model considered is having basement, ground and 4 floors. The cost analysis of the post tensioned and RCC flat slabs are calculated and compared. From the quantity estimations and costing it is observed that concrete needed and the cost of steel for R.C.C Flat Slab construction with edge beams is much more than in case of PT slab. Construction of a structure using PT Slab also leads to a lighter structure as the Dead Load gets reduced. And also the stiffness and strength of the structure using PT Slab will be more than the structure constructed using R.C.C Flat Slab.

B.S. et. Al (2018) Today Post-tensioning is a mature technology, contributing systematic, economic and sophisticated structural solutions for a wide range of applications. Post-tensioned flat slab could be a better option compared to RCC flat slab, in respect of the cost of project and time of construction. The aim of this project is to compare the behaviour of RCC flat slabs, Posttensioned flat slabs and conventional structure and also to analyse the behaviour of Posttensioned flat slab. Structure with and without shear walls under seismic effect. In multi-storey framed structures flat slabs have weak resistance to the lateral loads. So to provide stiffness to structures opposed to lateral forces shear walls are used. In this paper, a study of 15 storey building in zone IV is considered, and a comparative analysis of conventional structure with Posttensioned and RCC flat slab is done to calculated different parameters as base shear, storey drift, and displacement.

Also, the building is analysed with PT flat slab by changing various location of shear wall. ETABS 2016 software is used for the analysis.

2.2. OBJECTIVES OF THE WORK

To design multi storied business building considering (G+6) flat slab with drop panel system for gravity loadings by using ETAB 2016 software. To compare the performance of R.C.C and PT system and review the performance.

3. SYSTEM DEVELOPMENT

For the study, a (G+6) storey building with RC and PT flat slab systems are taken. The modelling and the analysis of RCC flat slab as well as PT flat slab structures have been done by using ETABS 2016 software package. Plan dimensions, storey levels, section properties, material properties and load patterns are defined and assigned. The model is analysed by considering seismic zone IV to determine various variables like base shear, storey displacement, storey drifts etc. by using ETAB software.

Table 3.1: MODELING AND ANALYSIS OF BUILDING

Plane dimensions	24x24 m
Total height of building	28 m
Height of each storey	4.0m
Height of parapet	1m
Size of beams	300 mm x 750 mm
Size of columns	500 mm x 500 mm
Thickness of flat slab	450 mm
Thickness of drop	450 mm
Size of drop	2000mmx2000mm
Thickness of external walls	230 mm
Seismic zone	IV
Soil condition	Hard
Response reduction factor	5
Importance factor	1.2
Floor finishes	1.5 kN/m2
Live load at all floors	4 kN/m2
Grade of Concrete	M25
Grade of Steel	Fe500
Density of concrete	25 kN/m3
Density of brick masonry	20 kN/m3

3.1 MODEL

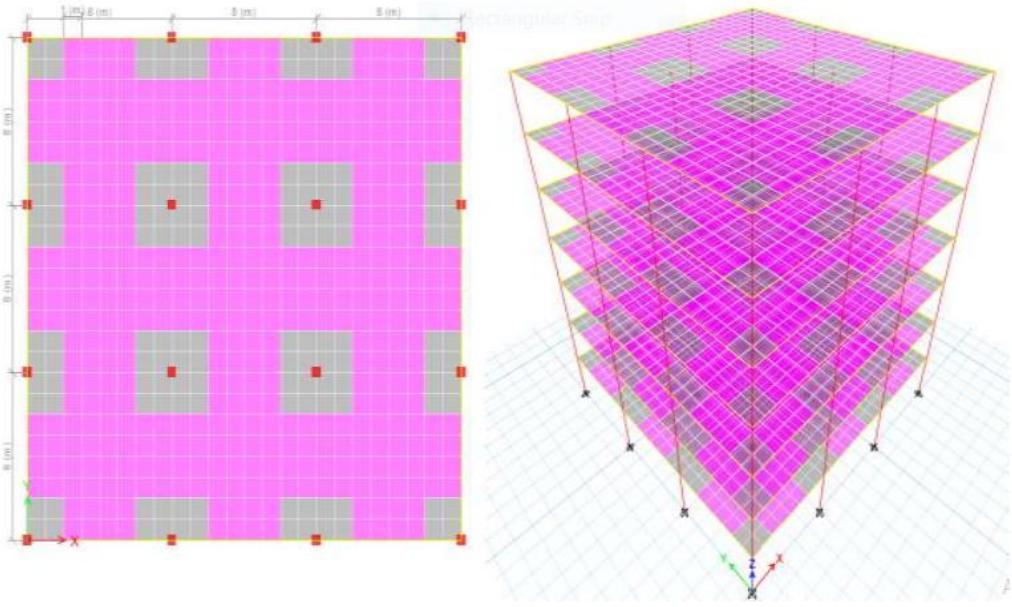

Figure 3.1 Snapshot of ETABs window of RC flat slab building

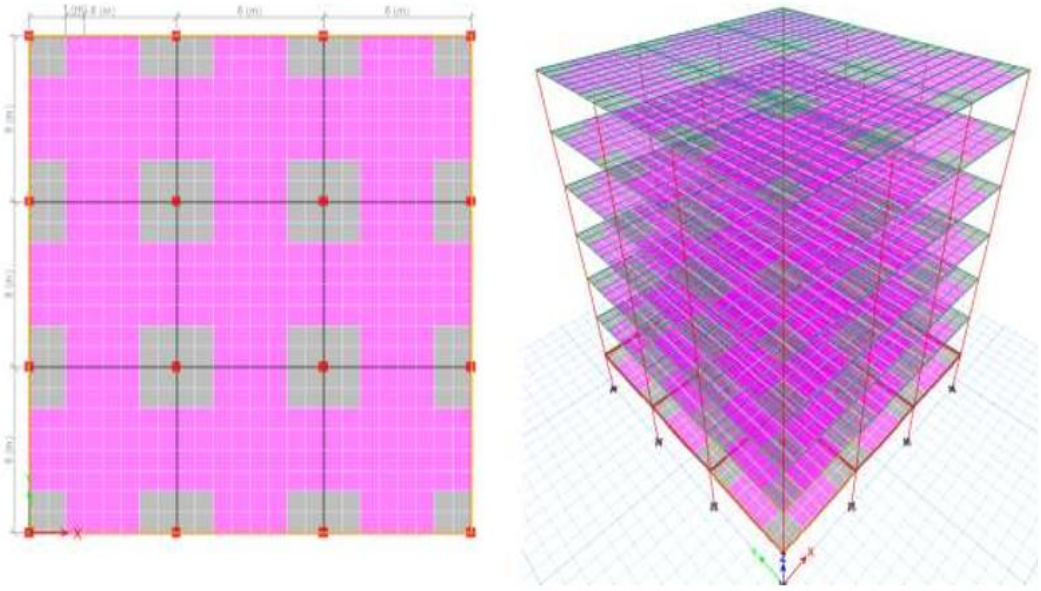

Figure 3.2 Snapshot of ETABs window of PT flat slab building

3.2 STOREY DISPLACEMENT: - Storey displacement is the whole displacement of storey with reference to ground and is due to the lateral forces in X and Y directions. The data of displacement of storey is collected for seismic loading from RCC Flat slab structure.

Table 3.2 Lateral displacement

NO.OF STORY	DISPLACMENT IN PT BUILDING	DISPLACEMENT IN RC BUILDING
Story 7	79.2	76
Story 6	64.8	61.8
Story 5	50.2	46.7
Story 4	36.1	32
Story 3	23	18.9
Story 2	11.6	7.5
Story 1	3.4	0.7

3.3 STOREY DRIFT: -. Storey drift is the dissimilarity of displacement in middle of two successive stories divided by the height of that storey. The data of drift of story in X-direction is collected for seismic loading from RCC Flat slab structure.

Table 3.3 Story drifts

NO.OF STOREY	STORY DRIFTS IN PT BUILDING	STORY DRIFTS IN RC BUILDING
Story 7	0.00401	0.00363
Story 6	0.00403	0.00332
Story 5	0.00392	0.00298
Story 4	0.00365	0.00248
Story 3	0.00314	0.00189
Story 2	0.00229	0.00116
Story 1	0.00093	0.00029

3.4 BASE SHEAR: - Base shear is a determination of the largest expected lateral pressure that will take place due to seismic ground motion at the base of a structure. Calculation of base shear (v) depend on soil conditions. Base shear obtained from analysis is given in table 3.4

Table 3.4 Base shear

Sr. No.	Base shear of RC building	Base shear of PT building
1.	6990	6990

4. PERFORMANCE ANALYSIS

Comparison of RC flat slab building and PT flat slab building modelled in ETABs2016 has done in terms of base shear, time period, storey displacement, storey drifts. Base shear is taken from response spectrum analysis and the time period is taken from modal analysis.

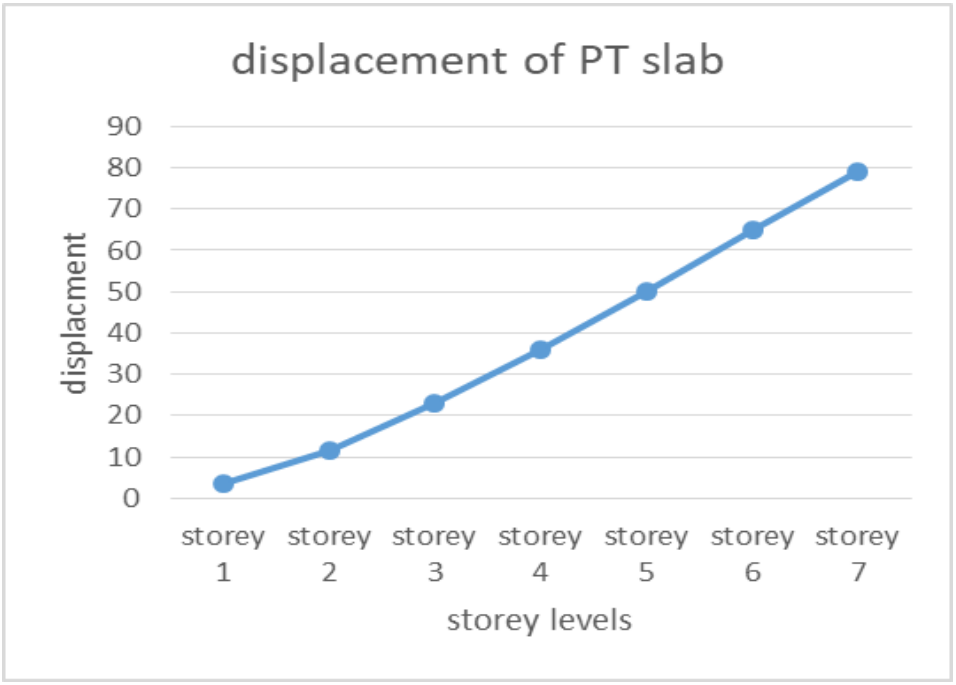

Fig. 4.1 (a) Graphical representation of Storey displacement curve obtain from research analysis for PT flat slab building

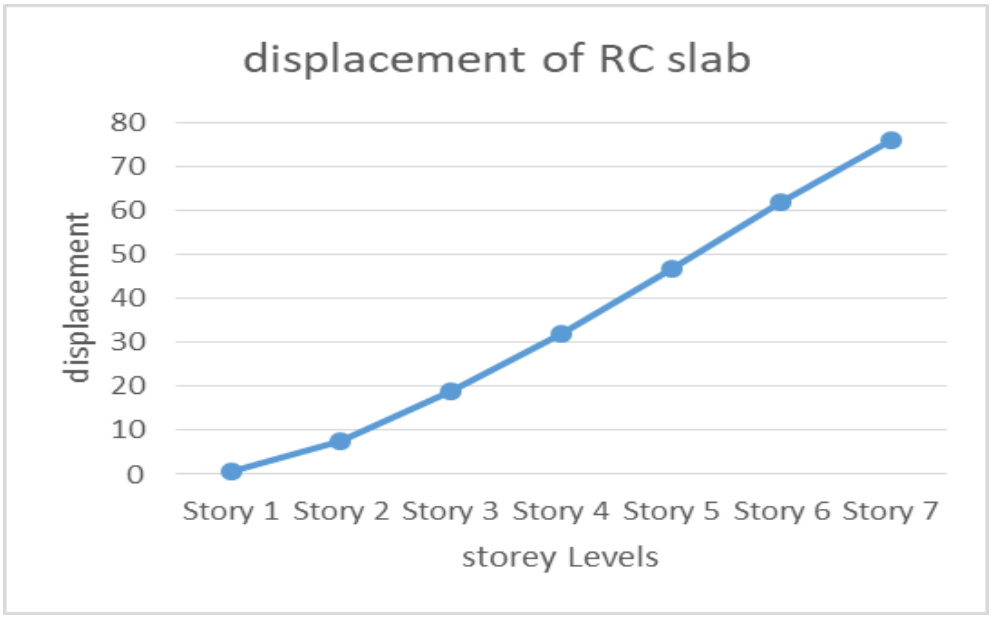

Fig. 4.1 (b) Graphical representation of Storey displacement curve obtain from research analysis for RC slab building

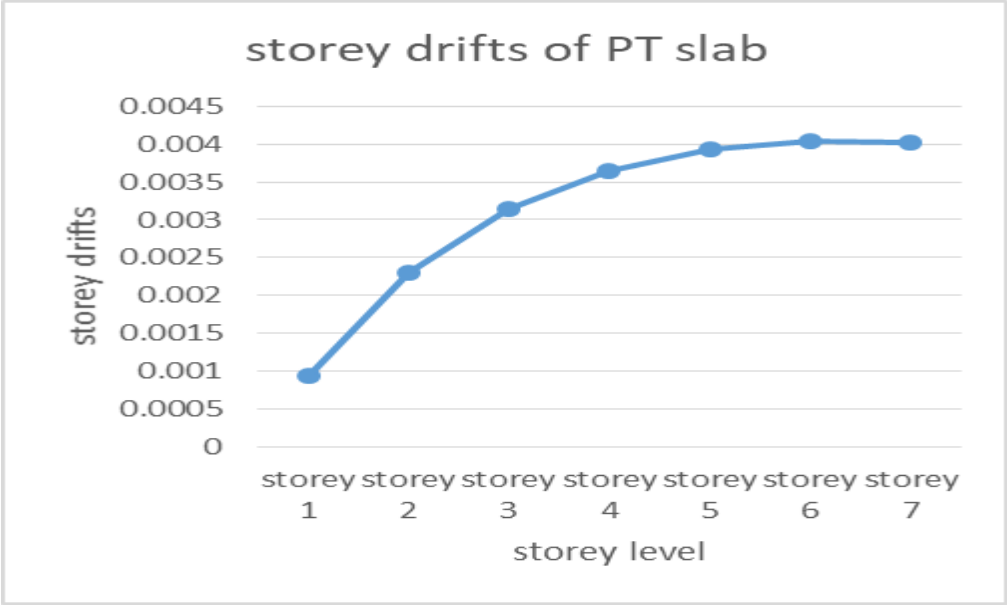

Fig. 4.2 (a) Graphical representation of Storey drift curve obtain from analysis for PT flat slab building

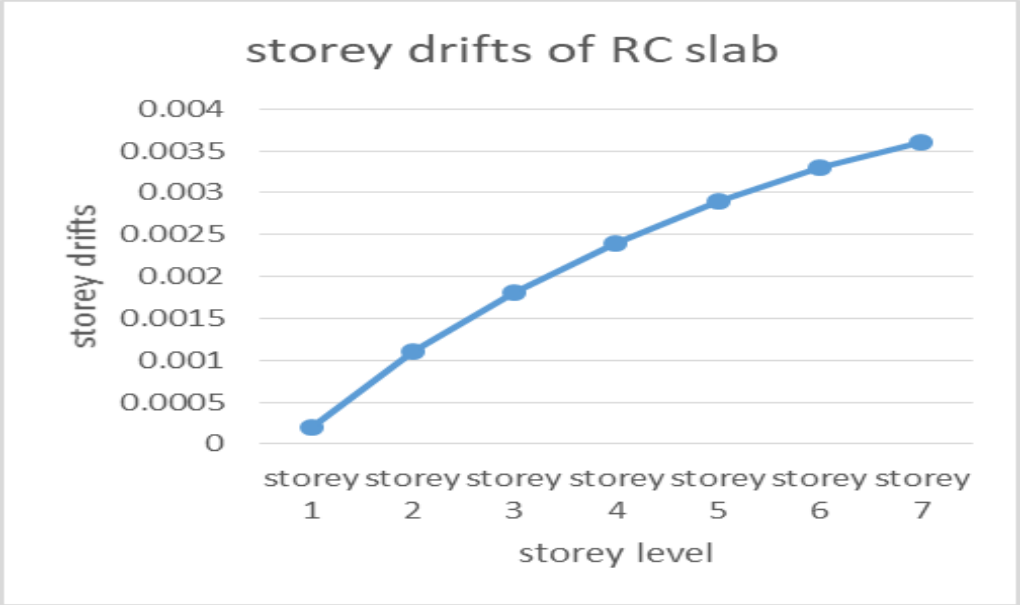

Fig. 4.2 (b) Graphical representation of Storey drift curve obtain from analysis for RC flat slab building

4.1 Comparison of RC and PT flat slab building

Table 4.1 Comparison of RC and PT flat slab building based on linear dynamic Analysis

Parameter for comparison	RC flat slab building	PT flat slab building	% decrease in PT wrt RC
Base shear (kN)	6990	6990	0%
Time period (sec)	1.78	1.80	1.11%

We know section sizes can get reduced in PT as compared to RC but for the comparison purpose section sizes in PT and RC are kept same hence base shear of both the buildings is same. Time period slightly get reduced in PT building. But decrease in time period is also negligible as it is less than 10%.

5. CONCLUSIONS

Based on study conducted on analysis, conclusions are as follows

1. From above analysis of RC flat slab and PT flat slab structure there is a 1.2 percentage of error is found in story displacement and 5.4 percentage of error is found in story drift.

2. In seven storied building, base shear of RC building and PT building remains same as the section sizes of any members have not changed for comparison purpose. Time period of PT structure slightly less than RC structure but the difference is not more than 10%.

3. It shows that PT flat slab building is inelastic than RC building. But the achievement of both the buildings is quite similar, hence we can say that PT flat slab can be used in severe seismic area.

6. REFERENCES

1. Z. Tuna, S. Gavridou , and J.W. Wallace, 2010 E-Defence Four-Story Reinforced Concrete and Post-Tensioned Buildings – Preliminary Comparative Study of Experimental and Analytical Results. 2012.
2. Boskey Vishal Bahoria and Dhananjay K. Parbat (2013). "Analysis and Design of RCC and Post-tensioned Flat Slabs Considering Seismic Effect".
3. V. G. Mutalik Desai, Mohammad J. Shaikh (2016). "Comparative Analysis of Flat Slab and Post-Tensioned Flat Slab Using SAFE".
4. Paul and Krishnan Y. (2016). "Lateral load analysis of Post tensioned and RCC building using Pushover analysis." IRJET, 3(9), 711-717.
5. Reddy and Pradeep (2017). "Comparative Study of Post Tensioned and RCC Flat Slab in Multi-Storey Commercial Building." IRJET, 4(6), 238-242.
6. Darsana. P.M Bhavya. B.S (2018) Analysis of Post-Tensioned and RC flat slabs in multistorey framed structures by using E-tabs Software.