Comparative Seismic Analysis of Conventional Slab and Flat Slab with and without Shear Wall

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Abstract— The main objective is to obtain the most effective structure to resist the lateral loads and to identify the most vulnerable building among the model considered for seismic action. This report deals with the efficiency of concrete structures with shear wall and without shear wall with respect to the base shear, storey displacement, storey shear storey drift, stiffness and time period. Reference from the base model, flat slab models without shear wall are studied and compared with shear wall for all the models for seismic. The effects of shear wall on behavior of concrete structures are summarized using the obtained results. Based on the results and responses from earthquake loads applied, conclusions are made.

Key words: Storey Drift, Storey Displacement, Time Period and Storey Stiffness

I. INTRODUCTION

A. General

Flat slabs are element of construction is one in which slab is directly rest on the column. The slab at once rests at the column and load from the slab is immediately transferred to the columns after which to the foundation. To support heavy masses, the thickness of slab close to the support with the column is improved and these are called drops, or columns are usually provided with enlarged heads called column heads or capitals. These increasing thickness of flat slab inside the area assisting columns offer good enough strength in shear and to increase the amount perimeter of the important phase, for shear and therefore, increasing the potential of the slab for resisting -manner shear and to lessen negative bending moment on the help. Flat slab structure is preferred over traditional structure in creation because of their advantages in lowering storey top and creation duration as compared with traditional shape, main to discount of production expenses. Provision of the flat slab constructing wherein slab is immediately rested on columns, were adopted in lots of homes built lately due to the advantage of decreased ground to floor heights to fulfill the inexpensive and architectural needs.

B. Conventional Slab System

In case of conventional slabs, the0load from0slabs is first transferred0to beams and0then0to columns and hence the weight of structure increases and the formwork is also costly and complicated when compared to flat slab structures. In these kind of slabs, the thickness of slab is small whereas depth of beam is large and hence more formwork is needed as compared to that of flat slabs. In this type of slab the dead load is more than flat slab and also there is extra requirement of flat attractive appearance of ceilings.

C. Flat0slab System

A reinforced concrete flat slab, also called as beamless slab, is a slab supported directly by columns without beams. A part of the slab bounded on each of the four sides by center line of column is called panel. The thickened0portion i.e.0the projection0below the0slab is0called drop0or drop0panel. Flat slab is mainly used in commercial buildings where the aesthetic view is more important and for the ease of the construction of formwork.

D. Flat0slab With Shear Wall

This undesirable behavior is mainly due to the absence of deep beams and/or shear walls in the flat slab system which generally gives rise to excessive lateral deformations. Hence, it becomes more important to give further attention to the study of this structurally appealing system, yet controversial in terms of its seismic efficiency, reliability and vulnerability.

E. Advantages Of0flat Slab

- The flat slab construction will be faster compared to the construction of flat slab without flat slab.
- By using a flat slab we can minimizes the floor to floor height even in case false ceiling is not provided.
- The flat slab is flexible in many conditions such that if the owner needs any changes in the interior and needs use the accommodation to suite it can done easily
- The thickness of flat slab is different as it incur the minimized cost to the owner and it has advantage that we can increase the floor to ceiling height

F. Objectives

- To0obtain the0most effective0structure to resist0the lateral0loads.
- To0identify the most0vulnerable building0among the models0considered for0seismic action.
- Efficiency of concrete structures with and 0without shear wall0with respect to the base 0shear, storey displacement, drift0and storey shear, stiffness, time period.
- The effect of shear wall on behavior of concrete0structures0are summarized using0the 0obtained0results, by concluding variation of results in structures.

II. METHODOLOGY

Following methodology is adopted to analyze:

- RC concrete structure0is considered0for the0study0having 21 stories of height 63 m each floors is considered as 3 m height.
- The regular concrete moment resisting frame of square plan is0considered as0base0or reference0model.

- With0reference to0base0model, Flat slab model are studied and compared with shear wall for all the models for seismic.
- In0order to0get consistent0results, the0floor height is0kept constant0for0all structures.
- To understand the behavior under lateral loads applied loads as per ID 1893: 2002 are used respectively.
- Based0on the0results and0responses0from earthquake loads applied, conclusions are made.

III. ETAB MODELS

A. Model-1: Bare frame structure with conventional slab structure.

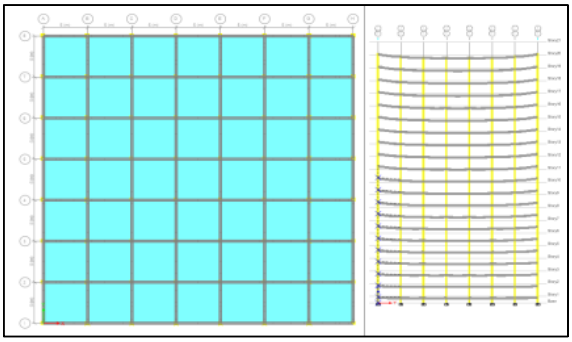

Fig. 3.15: Plan and elevation view of conventional slab structure

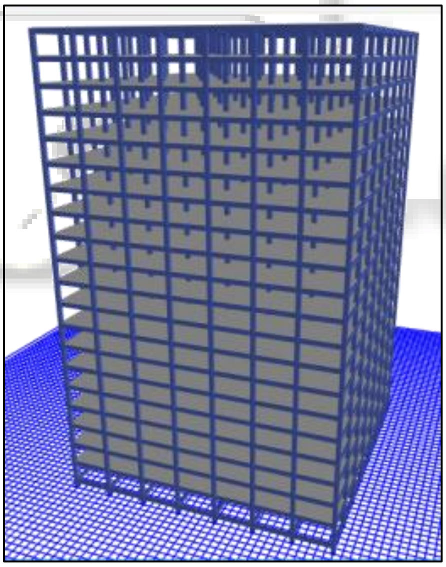

Fig. 3.16: Rendered view of conventional slab structure

B. Model-2 Flat slab structure without shear wall.

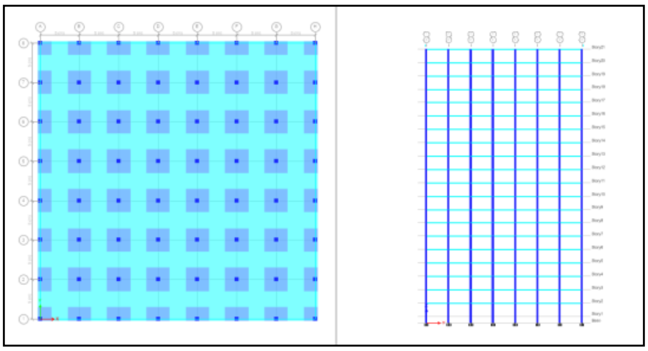

Fig. 3.17: Plan and elevation view of flat slab structure

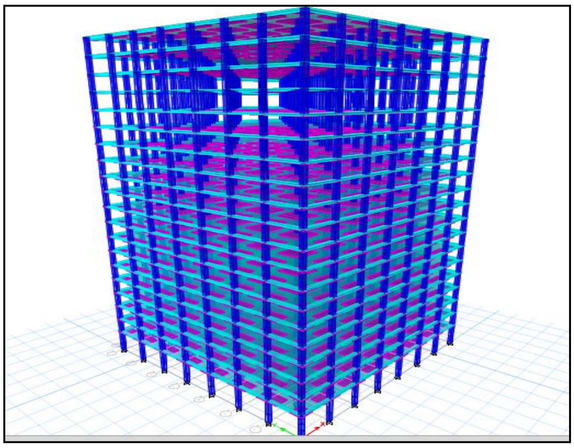

Fig. 3.18: Rendered view of flat slab structure

C. Model-3:0Flat slab structure with0shear0wall.

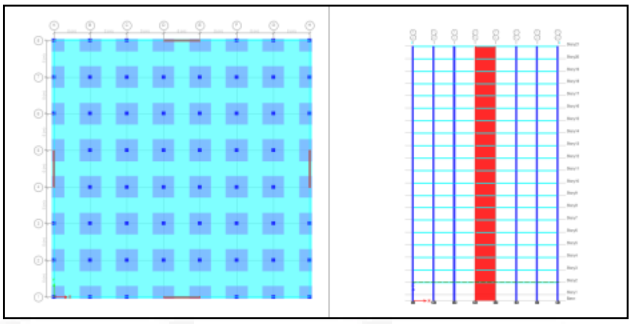

Fig. 3.19: Plan and elevation view of flat slab with shear wall structure

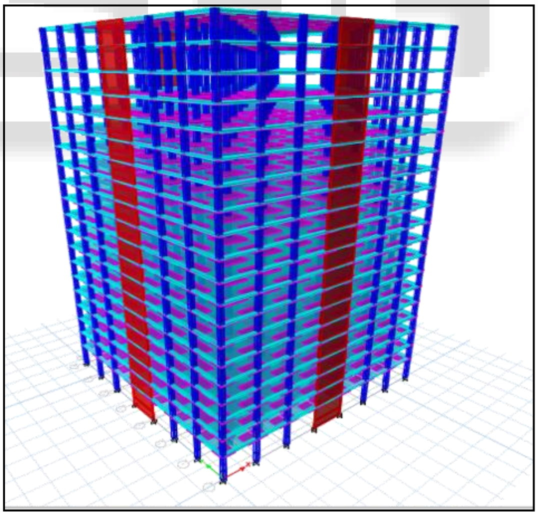

Fig. 3.20: Rendered view of flat slab with shear wall structure.

IV. RESULTS & DISCUSSIONS

In this chapter the behavior of each model is captured and the results are tabulated. The variation of systematic parameters0like0storey lateral displacement, storey drift, Storey stiffness, storey stiffness, natural time period and base shear has been studied for equivalent0static0method. The results of all the0models0are observed and the most suitable model is selected by comparing the results of each model.

A. Storey Displacement

It is total displacement of i^{th}storey with respect to ground and there is maximum permissible limit prescribed in IS codes for buildings.

The lateral displacements obtained for equivalent static method (EQS) for G+20 storey building model, along X direction are listed below

1) Storey displacement for conventional slab along X direction

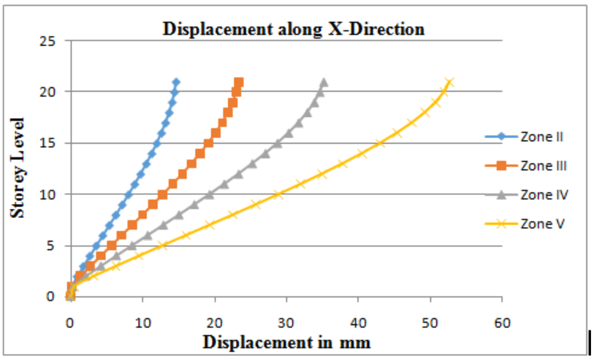

Fig. 4.1: Storey vs displacement

2) Storey Displacement for Flat Slab Along X Direction

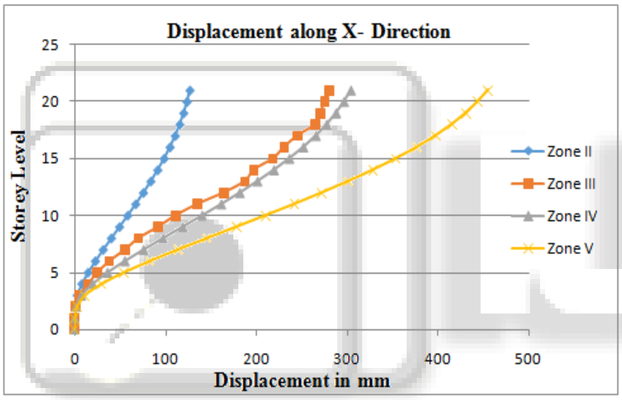

Fig. 4.3: Storey vs displacement for flat slab

3) Storey displacement for flat slab with shear wall along X direction

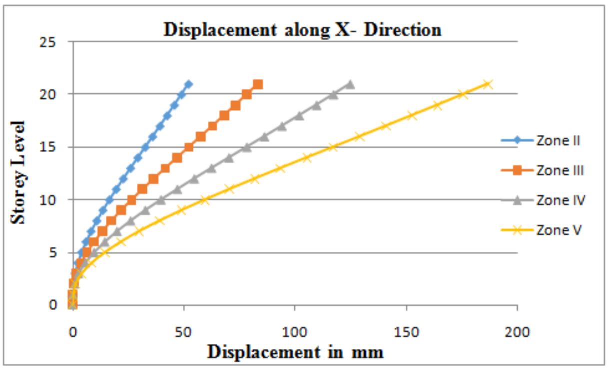

Fig. 4.5: Storey vs displacement for flat slab with shear wall

B. Storey Drift

It is defined as ratio of displacement of two consecutive floor to height of that floor. It is very important term used for research purpose in earthquake engineering.

Storey drift obtained for G+20 storey all building models along both X and Y directions are listed for both Equivalent static in the below tables.

1) Storey Drift for Conventional slab along X Direction

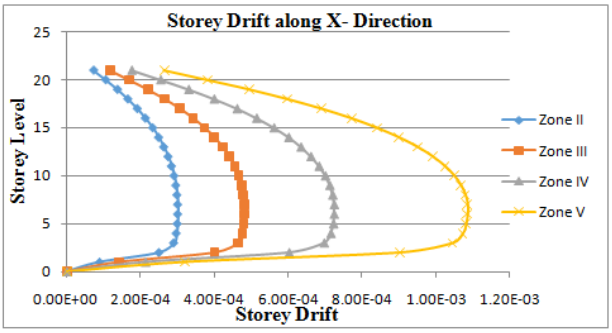

Fig. 4.7: Storey vs Drift

2) Storey Drift for Flat Slab along X Direction

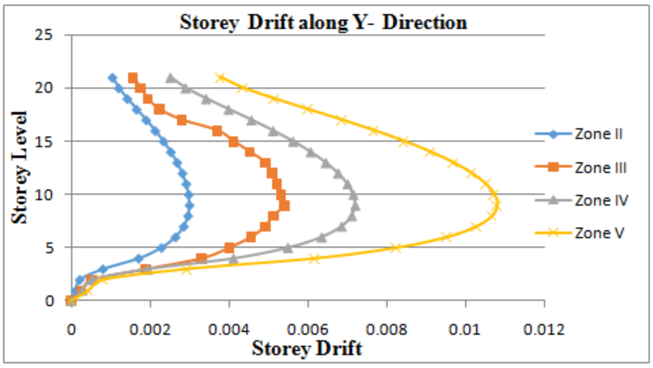

Fig. 4.9: Storey vs drift

3) Storey Drift for Flat Slat with Shear wall along X Direction

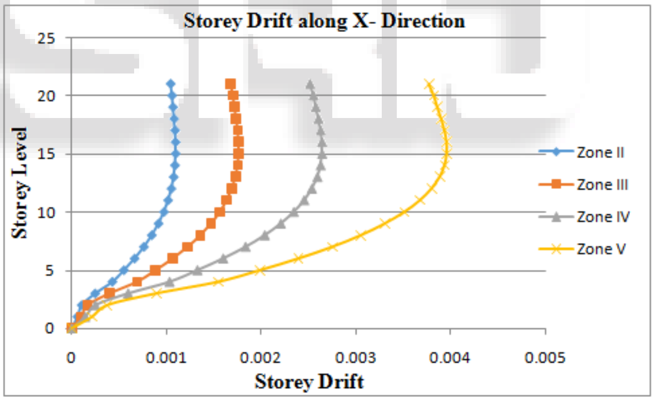

Fig. 4.11: Storey vs drift

C. Over Turning Moment

Overturning moments are those applied moments, shears, and uplift forces that seek to cause the footing to become unstable and turn over. Resisting moments are those moments that will resist overturn and seek to stabilize the footing.

1) Overturning Moment for Conventional Slab along X Direction

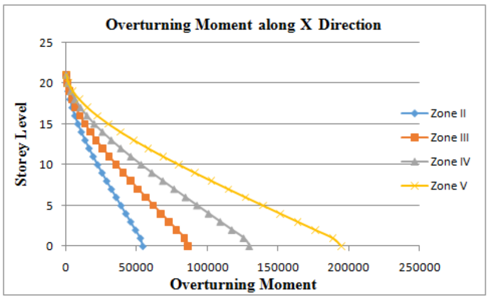

Fig. 4.13: Storey vs Over Turning Moment along EQX.

2) Overturning Moment for Flat Slab along X Direction

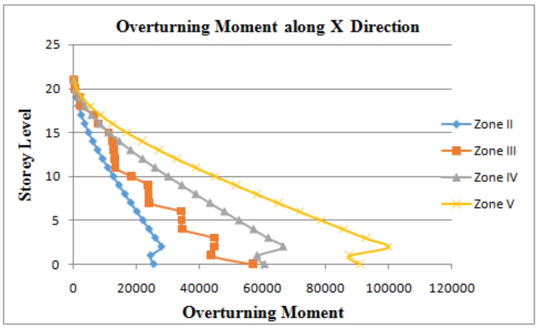

Fig. 4.15: Storey vs Overturning Moment structures along EQX

3) Overturning Moment for0Flat Slab0with Shear0wall along X Direction

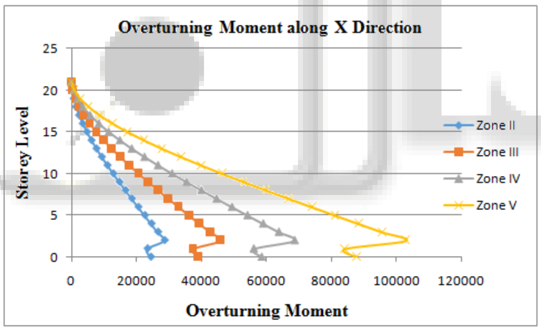

Fig. 4.17: Storey vs Overturning Moment structures along EQX

D. Natural Period

A time period is the time needed for one complete cycle of vibration to pass a given point.

1) Natural Time for Conventional Slab along X and Y Direction

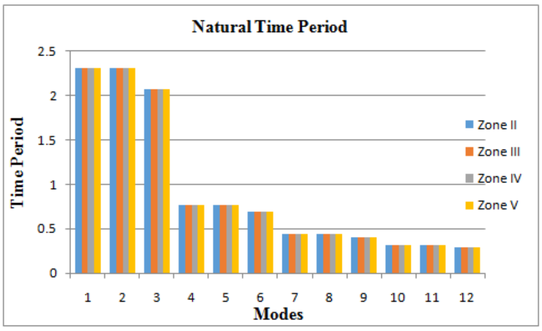

Fig. 4.19: Time vs mode for structures with seismic.

2) Natural Time for Flat Slab along X Direction

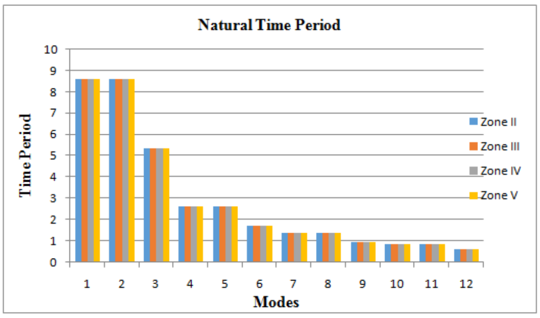

Fig. 4.20: Time Vs Mode for Structures With Seismic.

3) Natural Time for Flat0Slab with0Shear0wall along X and Y0Direction

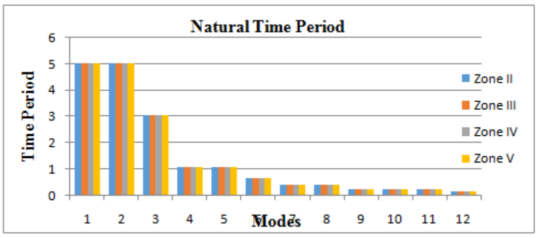

Fig. 4.21: Time Vs Mode for Structures with Seismic.

V. CONCLUSION

1) Displacement of industrial and commercial structure constructed using flat slab system is more than the conventional slab system. Here we can say that flat slab with shear wall gives better displacement resisting.
2) With the increase in height of structure displacement is also goes on increasing.
3) Storey shear0of Flat0slab building0is less0than conventional slab0building in Y-direction.
4) Storey shear 0is maximum0at base level and it decreases0as height0of0structure increases.
5) Base0shear of0flat slab0building is0less than0the base0shear in0conventional0slab building0in both X0and Y0directions
6) It is seen that storey drift is maximum for the conventional slab compared to flat slab and very less for the flat slab with shear wall.
7) Storey stiffness of conventional slab0building is stiffer than0Flat slab0building. As the storey no decreases stiffness goes on increasing.

VI. SCOPE OF FUTURE WORK

1) Study of effect of shapes on irregularities of slabs can used in construction of buildings is studied more by using different types of slabs also.
2) Study of effects of earthquake which are subjected to vibrations of motions can be done.
3) Other parameters which effect Seismic loads and wind load can be considered for future work.
4) Analytical results can be checked experimentally for further accuracy.

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