

## International Journal of Innovative Research in Science, Engineering and Technology

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# Comparative Study of RC Shear Walls of Various Configurations in L Shape Building

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**ABSTRACT:** Considering shear wall effect to prepare a comparative study on an unsymmetrical L shape bare frame with a frame of same geometry and loading with shear walls having different positions on a structure to determine best position of a lateral force resisting shear walls to counteract maximum forces and displacement. Shear walls are the most commonly used lateral load resisting systems in high rise buildings. Shear walls have very high stiffness and lateral strength, which can be used to simultaneously resist very large lateral loads and also resist gravity loads, making them quite advantageous in many structural engineering applications. In this study we will mainly emphasize the structural behaviour of high rise building for the effect of different positions of shear walls in a L shape tall structure under the effect of seismic zone IV & medium type of soil condition. Modelling and analysis is done in analysis tool ETABS. Assuming material property is linear static. To compare the results modelled shear wall with different configurations models of various useful parameters such as Lateral displacement, Storey drift, Time period, Base shear, and obtained most effective position of RC shear wall on considered models.

**KEYWORDS:** Linear Static Analysis, Structural Analysis, L Shape Building, Shear Wall, Storey Drift, Base Shear, ETABS.

## I. INTRODUCTION

Now a day's population of our country is increasing very rapidly, therefore to settle this vast increment in population we need to construct tall structure which may face high displacement and drift due to lateral forces, to counteract such situations in our country. Quakes are happening much of the time now a day. The seismic investigation and outline of structures has customarily centred around diminishing the danger of death toll in the biggest expected tremor. To decrease the impacts caused by these earth tremors and wind loads diverse sidelong stacking frameworks are presented in the structures. Shear walls are one of the sidelong stacking frameworks usually built in elevated structures. Position of shear walls in unsymmetrical structures has due contemplations. It is exceptionally important to decide effective and perfect area of shear walls in unsymmetrical structures.

In this study we will perform analysis of a multi-story tall reinforced concrete frame under effect of seismic forces as per Indian Standards code 1893-2002 part-1 here we will present a comparative study on the effect of positioning of shear wall on a asymmetric L shape structure to determine its positive impact to enhance resistivity and comparing the variation in forces in bare frame, and different positioned shear wall to determine the load resisting capability of our modelled system.

## II. LITERATURE REVIEW

**M. I. Adiyanto (2008)** studied a 3storey hospital building using STAAD Pro. Seismic loads were applied to the building. The dead loads and live loads are taken from BS6399:1997 and seismic loads intensity is based on equivalent static force procedure in UBC1994. Result showed that the building can withstand any intensity of earthquake. It means that the buildings are suitable to be built in any area located near the epicenter of the earthquake.

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**Misam Abidi, Mangulkar Madhuri. N (2012)** studied an assessment to understand the behaviour of Reinforced Concrete framed structures by pushover analysis and the Comparative study was done for different models in parameters of base shear, displacement, performance point. The inelastic behaviour of the example structures are examined by carrying out displacement controlled pushover analysis

**Shahzad Jamil Sardar (2013)** To investigation of 25 stories working in zone V is given some examination which is broke down by changing different area of shear divider for deciding story float, story shear and dislodging is finished by utilizing standard bundle ETAB. Production of 3D building model for both straight static and direct unique strategy for investigation and impact of solid centre divider gave at the focal point of the building

**A Murali Krishna (2014)** studied on the optimum location of shear walls in unsymmetrical multi storey buildings. In this multi-storey building with different locations of shear walls with different shapes is considered for analysis. The high rise building is analysed lateral displacement, torsional strength and stability using ETABS software. The results of the analysis are comparing between the shear force, bending moment and torsion. The results are presented in tabular and graphical form. The results on the drift and displacement are checked with serviceability condition

**Raad Dheyab Khalaf (2016)** studied presence of irregularities like plan irregularities or vertical irregularities are considered as a major deficiency in the seismic behaviour of buildings. Dynamic Analysis is carried out using FEM software ETAB v 15 by response spectrum method. Shear walls are one of the very effective solutions to sustain the lateral forces and they provide required stiffness and strength, good for drift control and also simple to construct. In this study is made to investigate the plan irregularities by varying location of shear wall on different asymmetrical models. Analysis have been done to estimate the performance of multi-storey buildings and the effects of structural irregularities in stiffness, strength, mass and combination of these factors are to be going to be considered.

### III. BUILDING DESCRIPTION

The present study includes comparative study of structural behaviour of different shapes of shear walls of various configurations in L shape RC building frame using ETABS 2016.v16.1 software. Detailed configuration and material specification of the building are shown in Table 3.1 and Table 3.2

In this study the plan configuration is same for all the models. Every model is of 15 storeys with 3m storey height. An irregular L shape building is considered in zone IV & medium type of soil condition.

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Table 3.1 Building Description

S.No.	Specifications	Details
1.	Plan Area	675 m <sup>2</sup>
2.	Grid Spacing	5m x 5m
3.	Storey Height	3 m
4.	Number of storey	15
5.	Beam Dimension	300mm x 450mm
6.	Column Dimension	600mm x 600mm
7.	Slab Thickness	150mm
8.	Thickness of shear wall	200mm
9.	Thickness of wall	230mm
10.	Bottom Support Condition	Fixed
11.	Seismic Zone	IV
12.	Zone Factor	0.24
13.	Soil Type	Medium
14.	Importance Factor	1.5
15.	Response Reduction Factor	5
16.	Eccentricity Ratio	0.05

Table 3.2 Material Specification

S. No.	Material Specification	Details
1.	Grade of Concrete, M-25	$f_{ck} = 25\text{N/mm}^2$
2.	Grade of Steel, Fe-415	$f_y = 415\text{N/mm}^2$
3.	Density of Concrete	$\gamma'_c = 25\text{KN/m}^3$
4.	Density of Brick wall considered	$\gamma'_{\text{brick}} = 20\text{KN/m}^3$
5.	Live Load	4KN/m <sup>2</sup>
6.	Wall Load	12KN/m <sup>2</sup>

## IV. MODELING AND ANALYSIS

Nine models have been considered for the comparative study. First model is bare frame, and remaining models are considered with various configurations of shear walls with same area and different positions in L shape building.

The layout of the plan and 3D view of building for all the models is same as shown in figure 4.1

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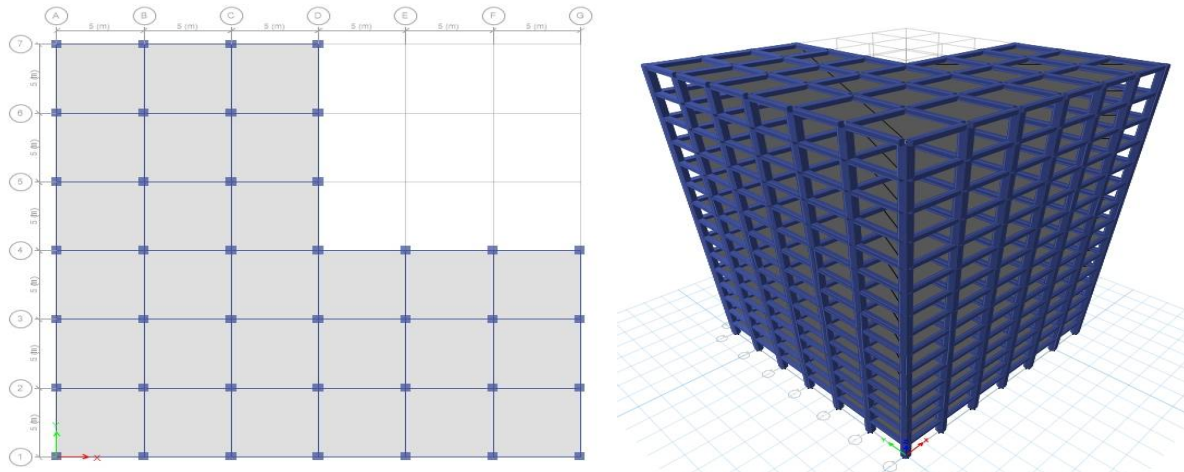


Fig 4.1 plan of model 1 & 3D view of L shape structure.

Model 1: In this model, a bare frame is considered, as shown in fig 4.1 Model 2: In this model, closed box type L shape shear wall is considered which is symmetrical about plan of building, as shown in fig 4.2. Model 3: In this model, two closed box type shear wall is considered, as shown in fig 4.3. Model 4: In this model, three closed box type shear wall are considering, as shown in fig 4.4. Model 5: In this model, three closed box type shear wall is considered, as shown in fig 4.5. Model 6: In this model, shear wall is considered in all six corners of the building, as shown in fig 4.6. Model7: In this model shear wall is considered linearly symmetrical about minor axis of the building, as shown in fig 4.7. Model 8: In this model consider two I shape shear wall as shown if fig 4.8. Model 9: shown in fig 4.9.

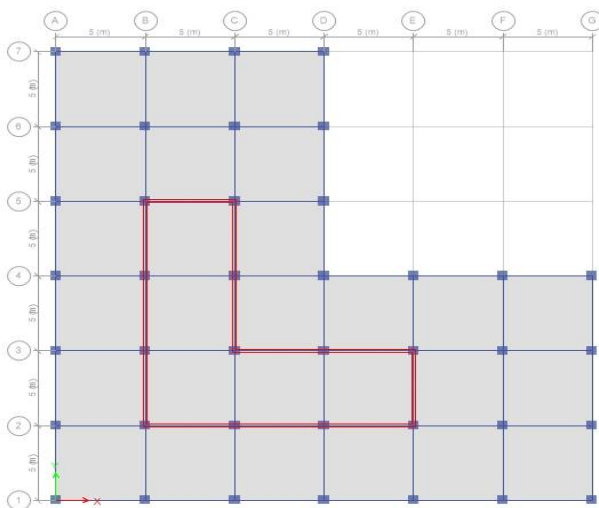


Fig 4.2 plan of model 2

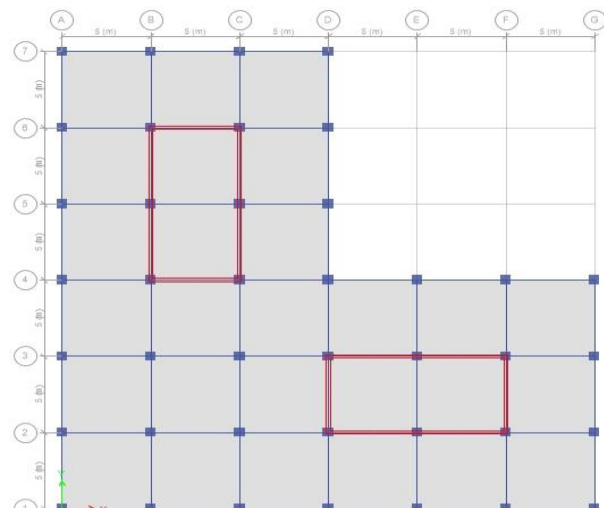


Fig 4.3 plan of model 3

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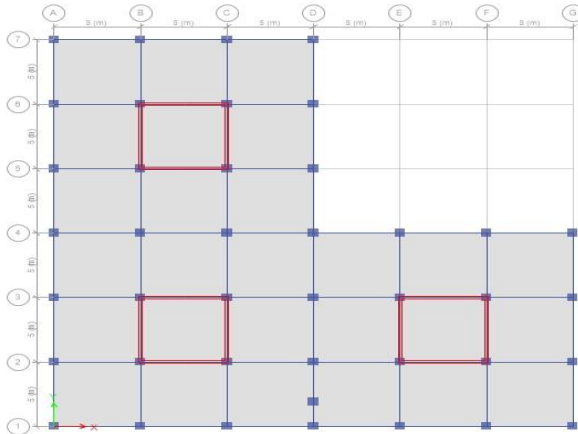


Fig 4.4 plan of model 4

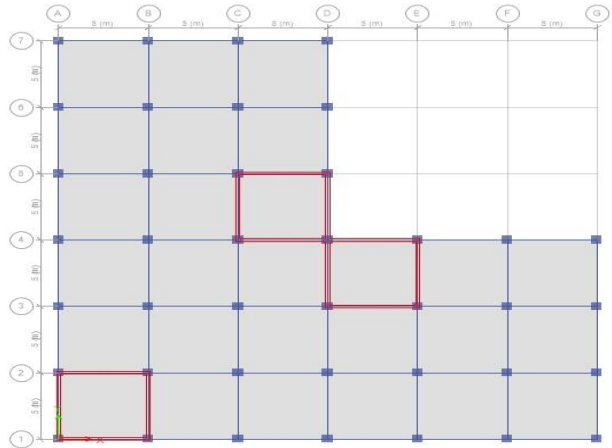


Fig 4.5 plan of model 5

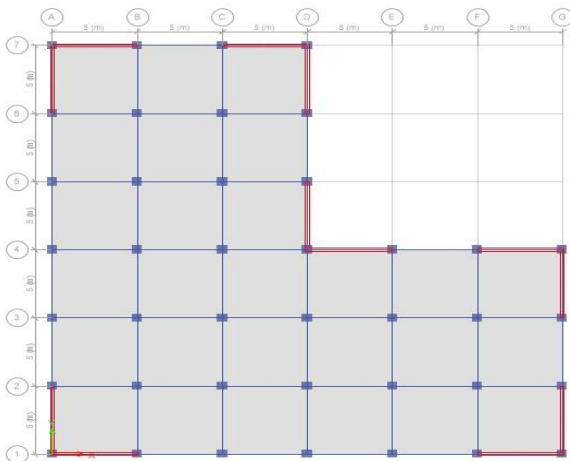


Fig 4.6 plan of model 6

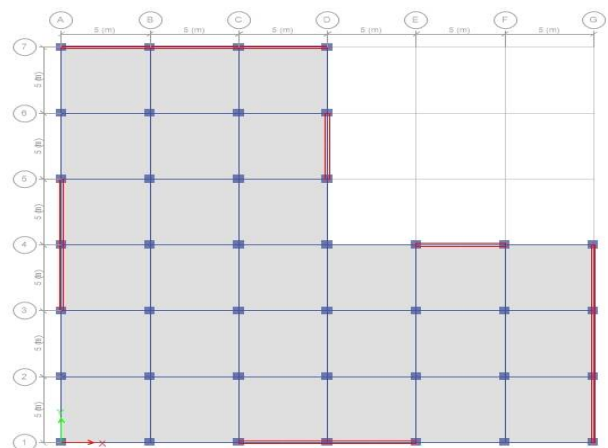


Fig 4.7 plan of model 7

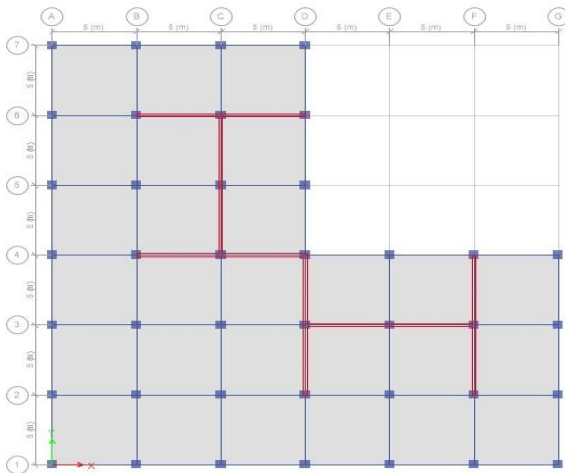


Fig 4.8 plan of model 8

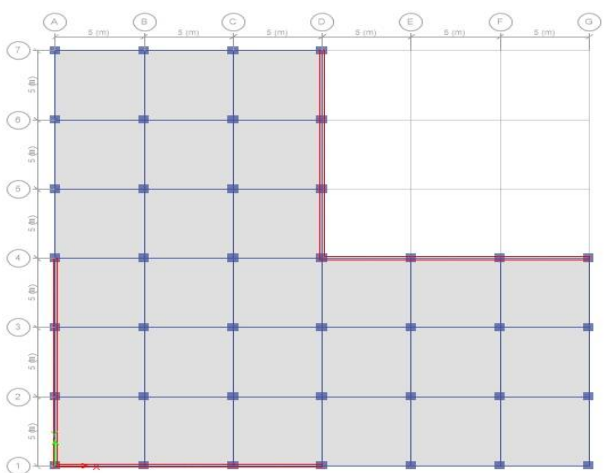


Fig 4.9 plan of model 9

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## V. RESULTS AND INFERENCES

In this study linear static analysis method is used to analyses the structures with unsymmetrical geometry to configure its stability and resisting factor. In this analysis results are computed for a combination of loading as per I.S. 875 part-5. Thus we are considering (1.2 {dead load + live load +lateral force})load combination.

- [1] Lateral displacement
- [2] Story drift
- [3] Time period
- [4] Base shear
- [5] Torsion
- [6] Resisting moment

### 5.1. Maximum Lateral Displacement

Maximum lateral displacement in X-direction for all models in seismic Zone-IV is shown in fig 5.1

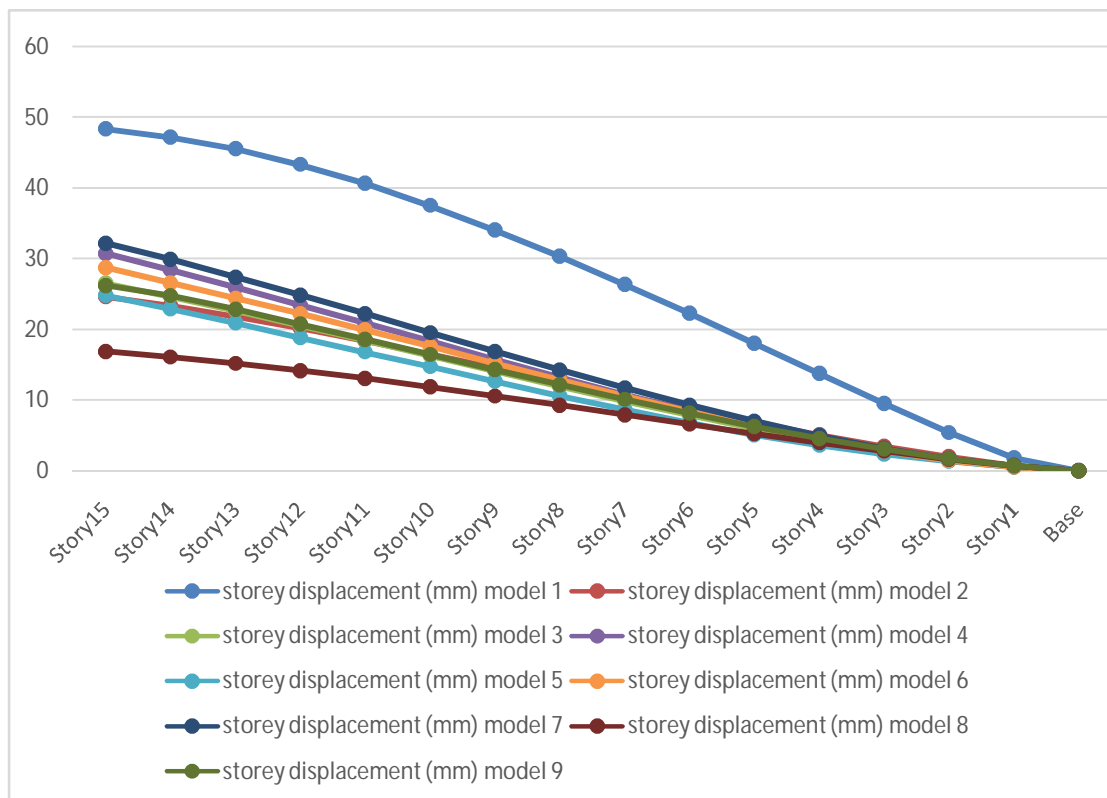


Figure: 5.1

It is clearly observed from the above figure that minimum story displacement in X-direction is in model 8, due to I-shape of shear wall followed by model 2 and maximum displacement occurs in model 1 due to without shear wall.

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## 5.2. Storey Drift

StoreyDrift in X-direction for all models in seismic zone-IV is shown in fig 5.2.

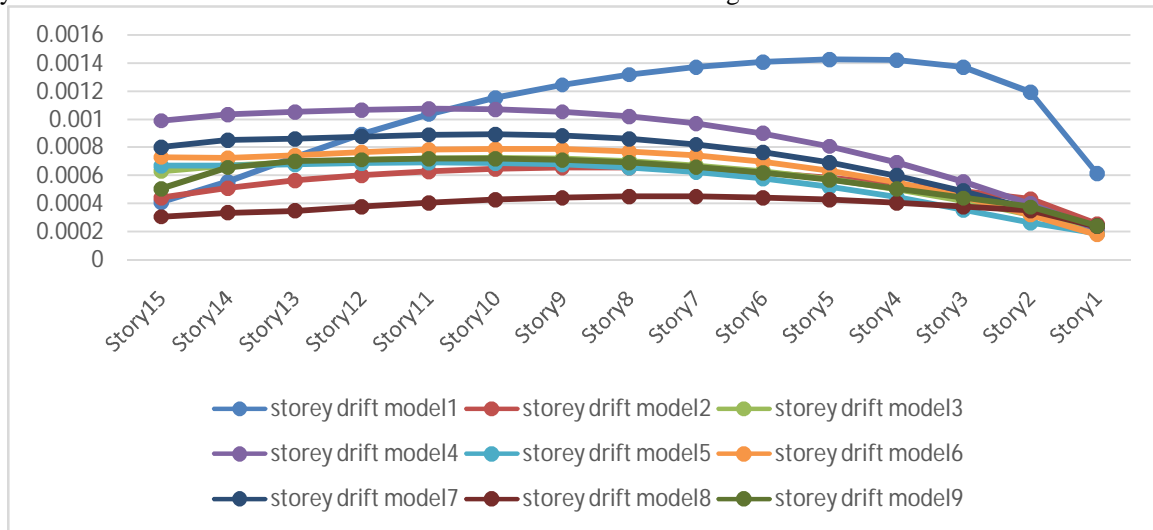


Figure: 5.2

It is studied from the above graph that minimum Storey Drift in X-Direction in Zone-IV in model 2 followed by model 8 and maximum Storey Drift occurs at model 1 considering medium type of soil condition.

## 5.3. Time period

Time period in X-direction for all models in seismic zone-IV is shown in fig 5.3.

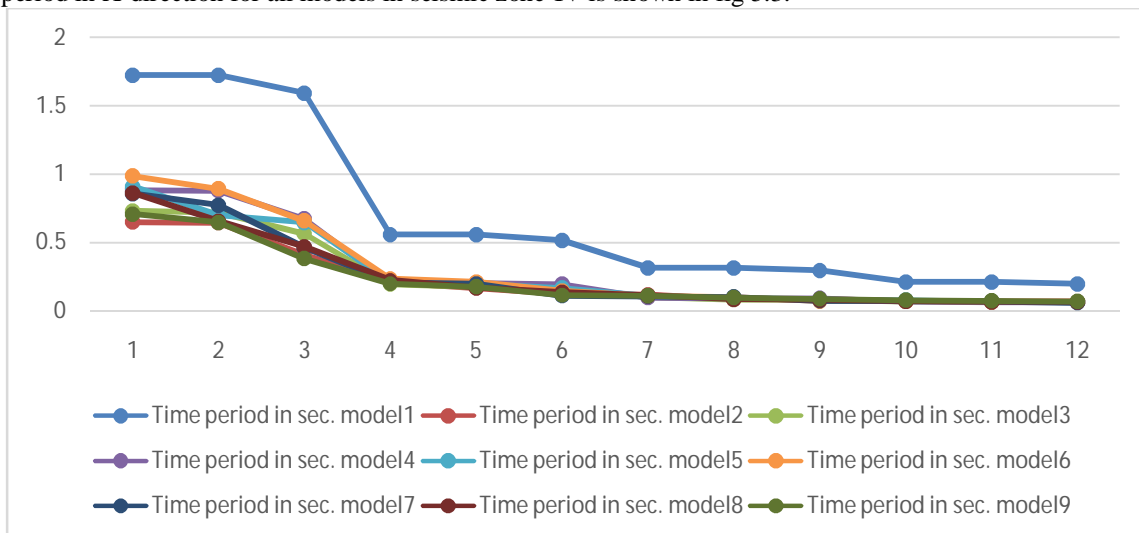


Figure: 5.3

It is viewed from the above figure that minimum time period is in model 2, due to closed L-shape shear wall and maximum time period occurs in model 1, due to absence of shear wall considering medium type of soil condition.

### 5.4. Base Shear

Base Shear for all models in seismic zone-IV is shown in fig 5.4

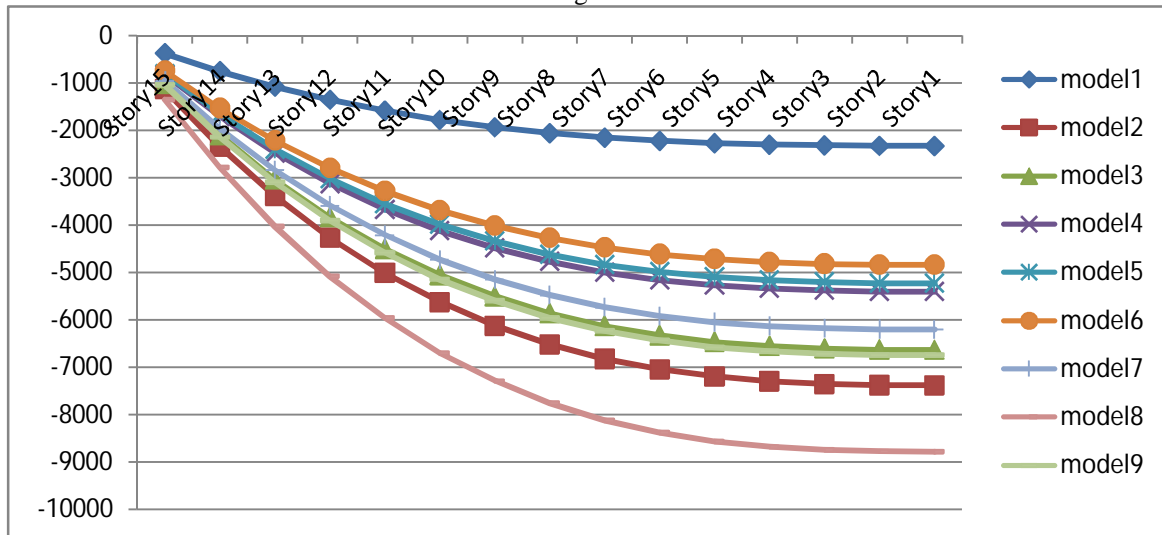


Figure: 5.4

It is clearly viewed from the above figure that minimum base shear in Zone-IV in model 1 followed by model 6 and maximum base shear in model 8 considering medium type of soil condition.

### 5.5. Maximum Torsion

Maximum Torsion in X-direction for all models in seismic zone-IV is shown in fig 5.5.

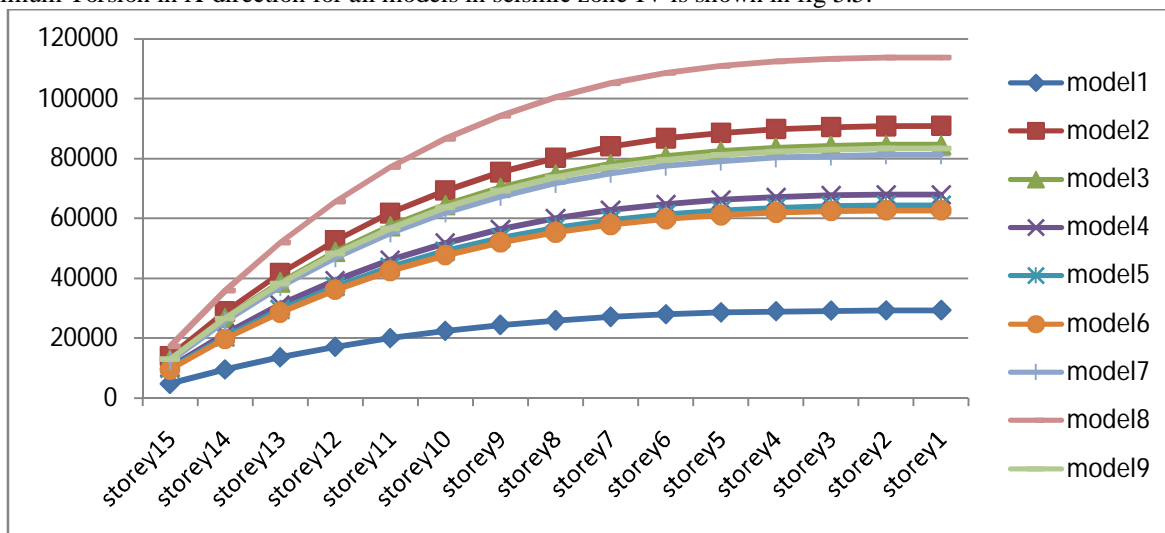


Figure: 5.5

It is viewed from the above figure that minimum torsion in model 1 and maximum torsion in model 8 considering medium type of soil condition.



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## 5.6. Maximum Resisting Moment

Maximum Resisting Moment in X-direction for all models in seismic zone-IV is shown in fig 5.6.

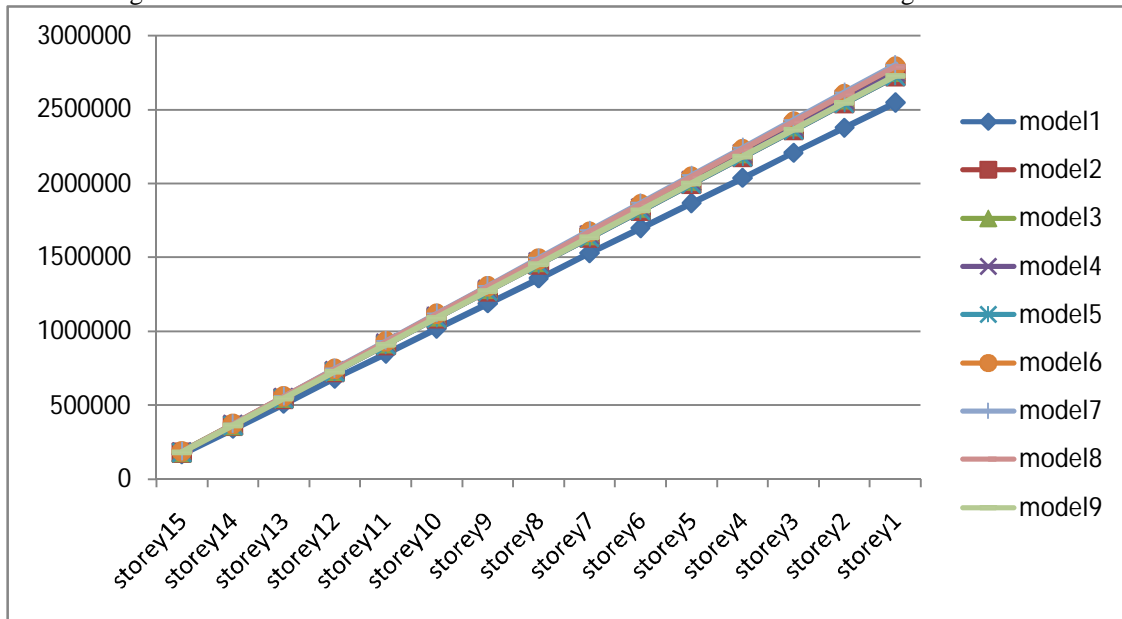


Figure: 5.6

It is viewed from the above figure that minimum resisting moment in X-direction is in model 1 followed model 2 and maximum resisting moment in model 8 considering medium type of soil condition.

## VI. CONCLUSION

- 1) Lateral displacement is maximum in model 1 at every floor due to the absence of shear wall, by the introduction of I shape shear wall in model 8 shows least value.
- 2) Story drift has significantly influenced by the introduction of shear walls and the positions of shear wall. In comparison to other cases, model 8 shows least story drift value because of the presence of I shaped shear wall.
- 3) The shape of shear wall and its position have significant difference in the time period. From the analysis model 2 shows minimum time period in comparison to other models due to the presence of closed L shape shear wall which is symmetrical about L shape building.
- 4) It was found that seismic base shear values are much varied by the addition of shear walls since the seismic weight increases and model 8 have maximum base shear value as compared to the other models due to the presence of I shape shear wall.
- 5) The value of torsion is maximum for model 8, due to the presence of I shape shear wall and the value of torsion is minimum for model 1, due to the absence of shear wall.
- 6) The value of resisting moment is maximum for model 7, due to presence of shear wall and the value of moment resisting is minimum on model 1.

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