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PERFORMANCE OF SHORT-LEG SHEAR WALL AND BARE FRAMES IN IRREGULAR RC STRUCTURES

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Abstract – *Pushover analysis in ETABS is considered to examine the structural performance. The performance of these structures depends on their location, construction expertise and building geometry. Especially in seismic-prone areas it's recommended to enhance structural ductility to prevent early failure. The performance variation can be seen when use of short-leg shear wall is incorporated in the design. Pushover curves, and graphical representation of the results are shown.*

1. INTRODUCTION

As the need for shelter arises more, the adequateness of land would remain dismal, in such cases demand for high-rise/mid-rise buildings increases rapidly, in order to take care of this problem.

The provision of short-leg shear wall in irregular buildings enhances the structural performance. Non-linear methods are to be used to understand their behavior because they give the exact picture both in elastic and plastic states. The analysis is done for Type-ii soil.

2. ETABS Modeling for asymmetrical plans

- No. of stories in all the models =10
- Story height --3.2m
- Beam and column: 300 mm x 600 mm & 500 mm square column
- Coupling beam: 200 mm x 750 mm
- Slab thickness: 150 mm
- Wall thickness: 230 mm
- Shear wall depth: 200 mm

2.1 SOIL AND MATERIAL PROPERTIES:

- Grade of Concrete: M40 – for Beams, Walls and Columns M25 – for Roof Slabs
- Grade of Reinforcing Steel: Fe–500-for Beams, Walls and Columns Fe–415- for Roof Slabs
- Soil type: Type-ii medium-stiff
- Zone-iv

2.2 Geometry and Loads

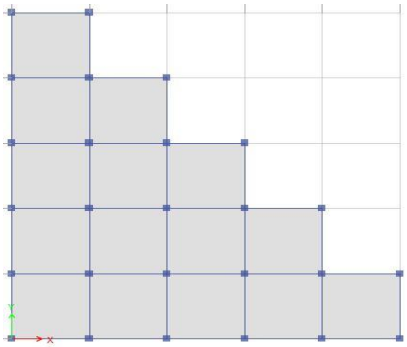
- Initial grid size: 25 m x 25 m
- Bay width in both directions: 5 m

Table -1: Loads

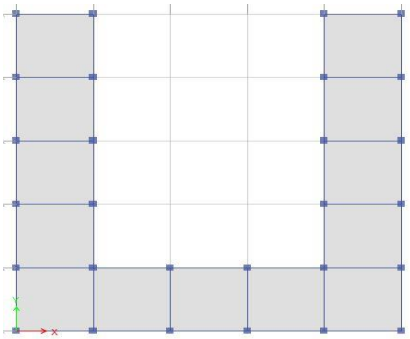
Floor finishes	1 kN/m^2
Imposed Load on all Floors	3.5 kN/m^2
Imposed Load on Roof Slab	1.5 kN/m^2
Partition Load on Beams	13 kN/m
Parapet Wall Load	7 kN/m
Seismic Zone and Zone factor	Z-iv, Z=0.24
Importance and Response Reduction Factor (I and R)	1 and 5

The models are shown below and pushover analysis is done subsequently for the models. The plan of buildings is taken as step-shaped for Model-9, U-shaped for Model-10Y, L-shaped for Model-11, T-shaped for Model-12Y. Then, for the same models short-leg shear walls are provided at the corners: Model-9S, Model-10YS, Model-11S, and Model-12YS.

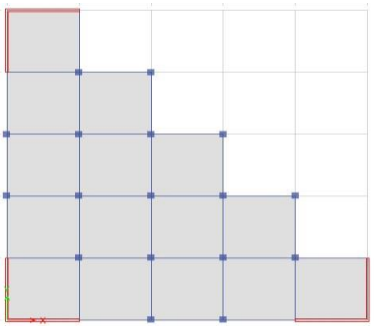
It's difficult to analyze the performance in linear methods hence non-linear methods are recommended for the design.



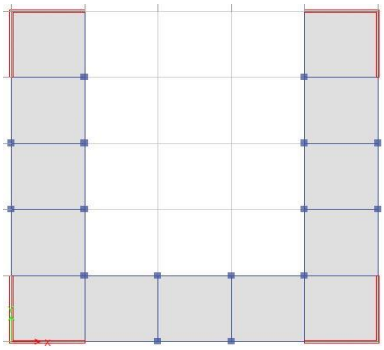
Model 9



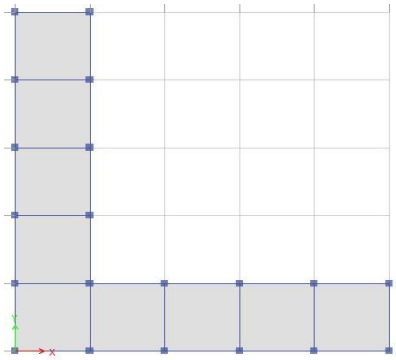
Model 10Y



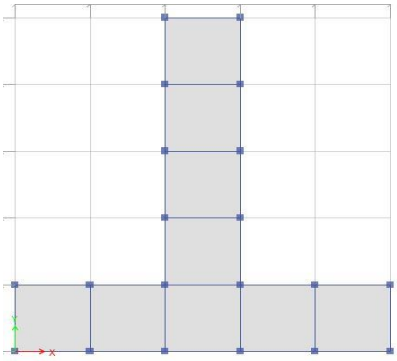
Model 9S



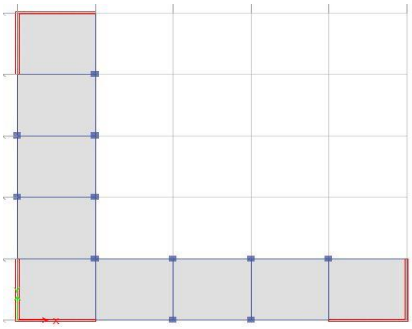
Model 10YS



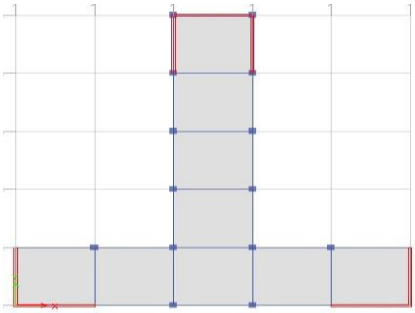
Model 11



Model 12Y



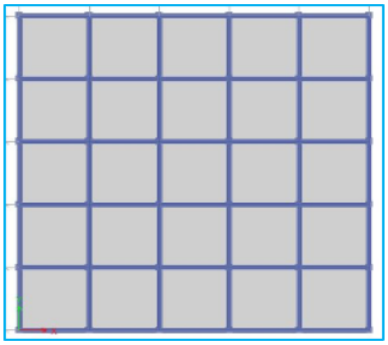
Model 11S

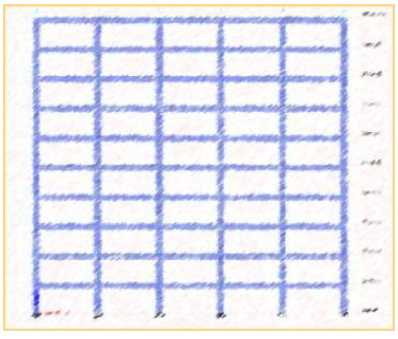


Model 12YS

3. Modeling for elevation (symmetrical and asymmetrical)

Here, the models for both symmetry and asymmetry are considered for the design for the same building details as mentioned earlier.





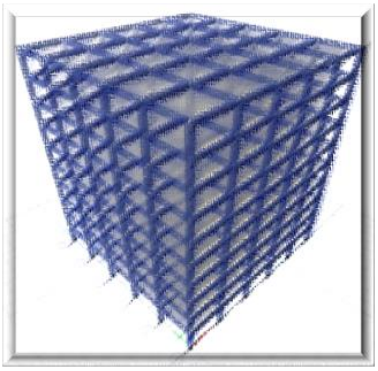
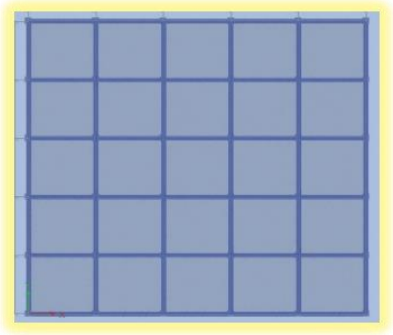
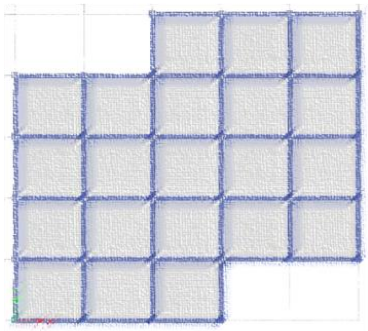


Fig1: Plan, elevation and isometric view of Model-1

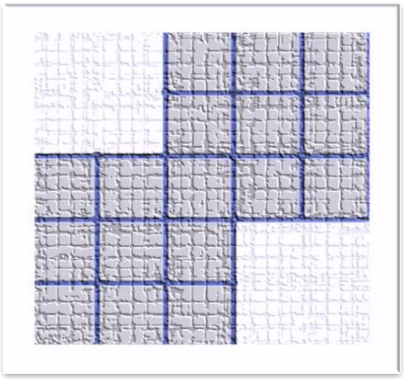
The same type of change in plan takes place for the following models.



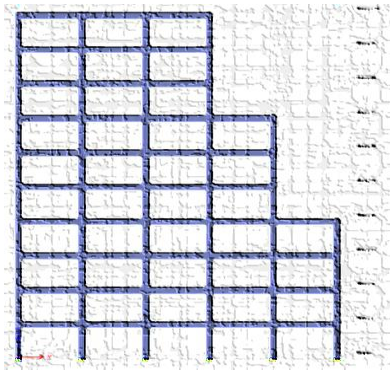
a. (1-4 stories)



b. (5-7 stories)



c. (8-10 stories)



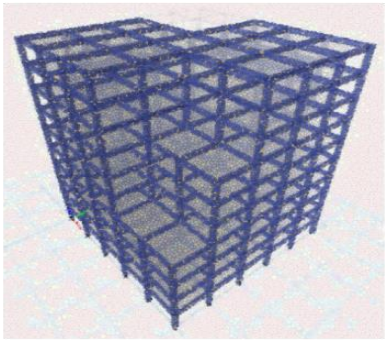
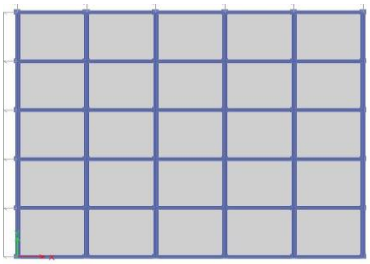
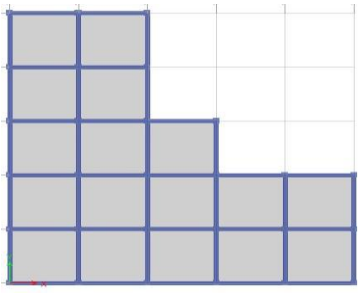
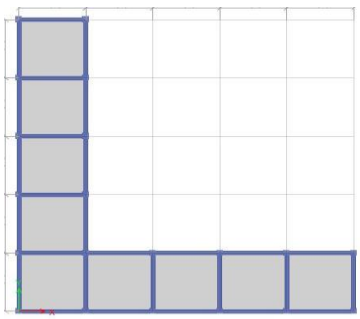


Fig 2: Plan for same above stories (a,b and c), elevation and isometric view of Model-13







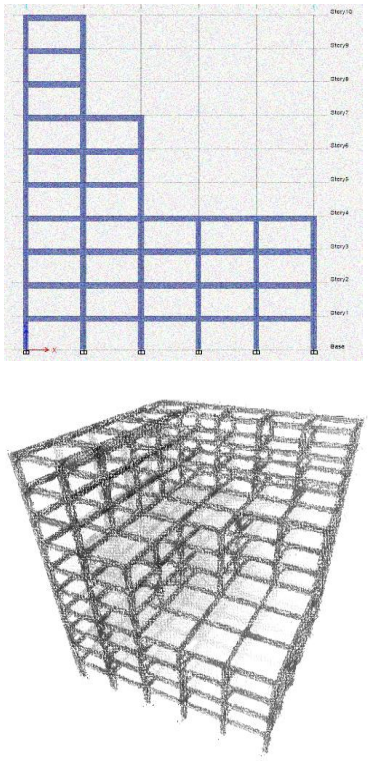


Fig 3: Plan for same above stories, elevation and isometric view of Model-14

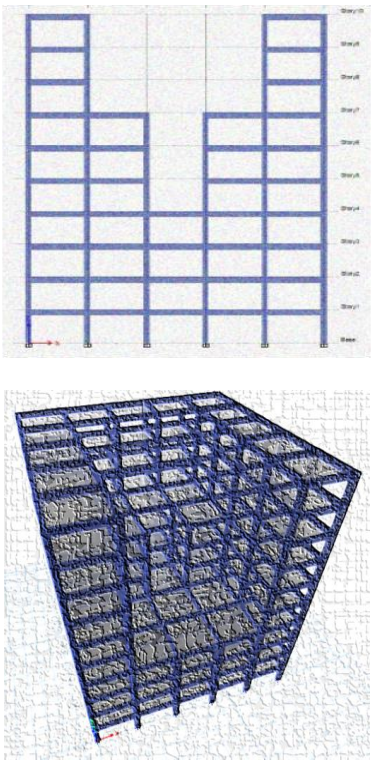
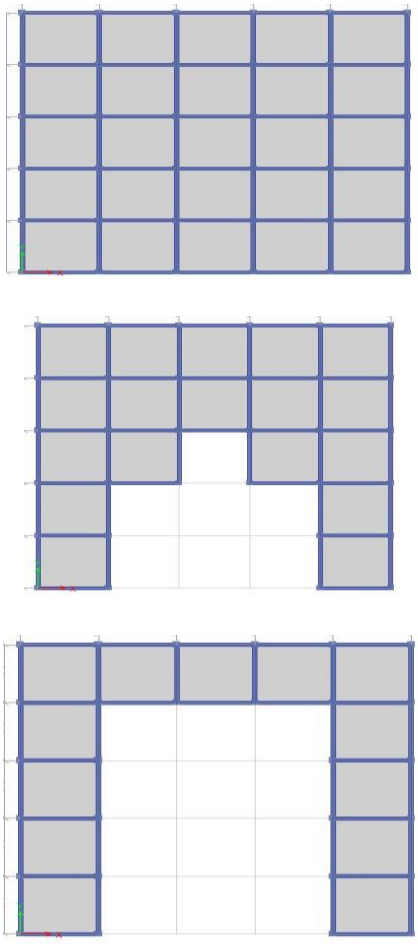
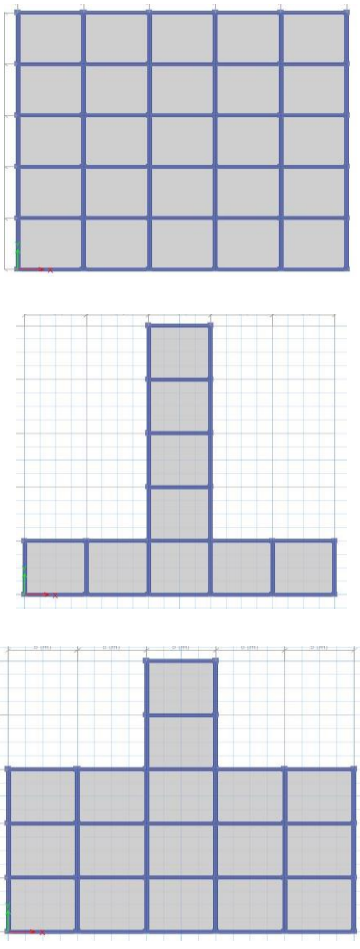


Fig 4: Plan for same above stories, elevation and isometric view of Model-15





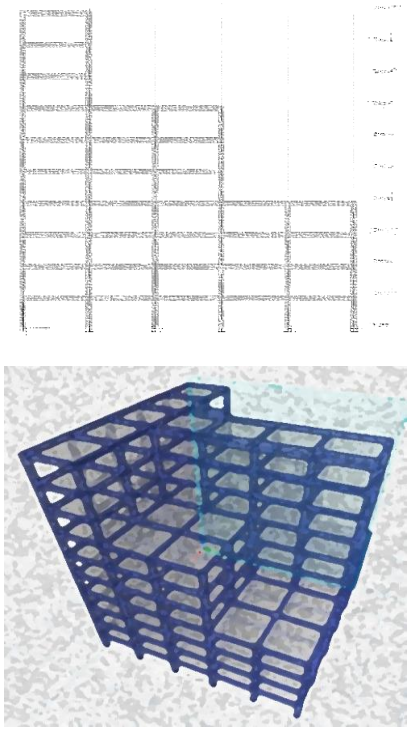
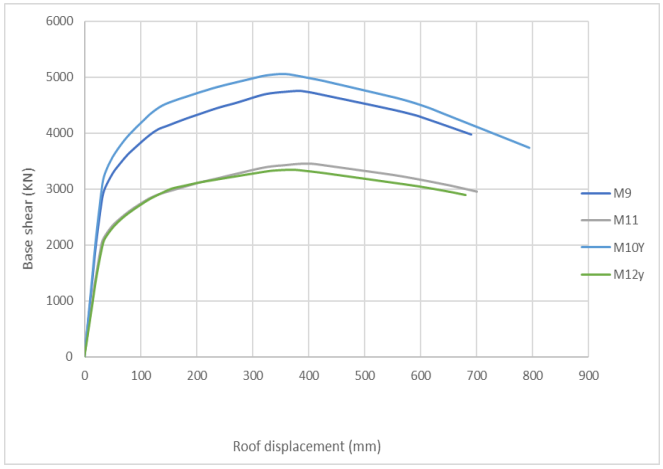


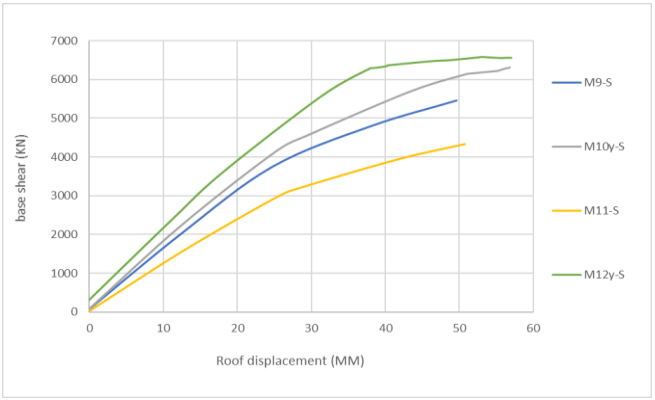
Fig 5: Plan for same above stories, elevation and isometric view of Model-16

Results and Conclusions

The pushover analysis was carried out for the above models, following shows the variation of performance when short-leg shear wall is used in the design.

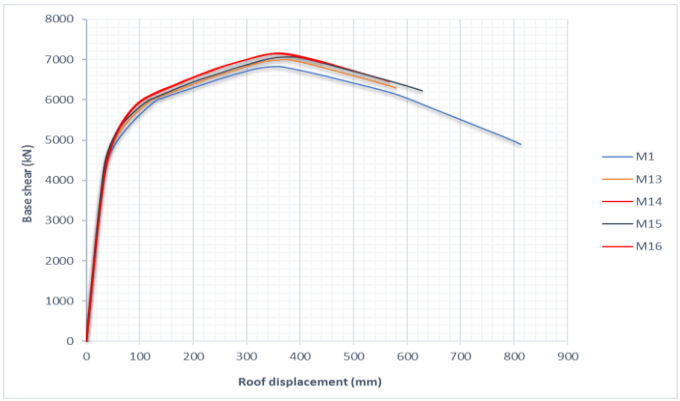


Pushover curves without SLSW



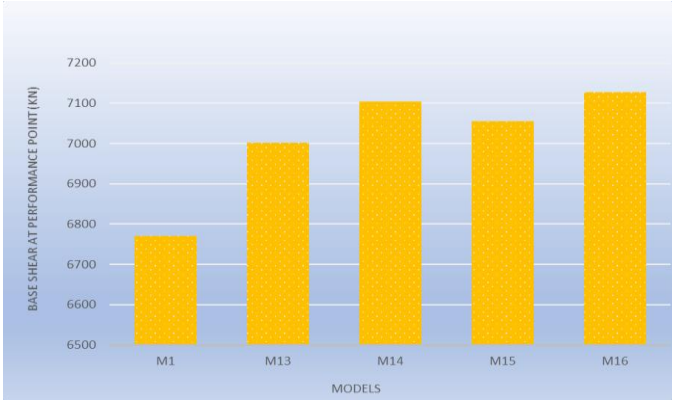
Pushover curve for models with SLSW

The roof displacement corresponding to maximum base shear is highest for model 10y-S. The pushover curves of models 10Y and 12y-S show highest strength before reaching collapse.



Pushover curves for bare frames

The roof displacement corresponding to maximum base shear is highest for model 16 and least for model 16 among elevation asymmetric models. The roof displacement corresponding to maximum base shear of all elevation asymmetric models is greater than the symmetric model.



Base shear vs roof displacement for bare frame models

The base shears obtained at performance point is maximum for model 16 and minimum for model 1 among the RC frame models with elevation asymmetry. Also, the base shears at performance point of all the elevation asymmetric models are greater than the symmetric model.

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