

Optimum Shape for High Rise Mivan and Conventional Structure in Seismic Loading



Anuj Choubey, Savita Maru

Abstract: Generation is living in a time where in approx. 1.8 million people in India are homeless out of which 52% are based in town. Now a day's India is heavy populated city in India total 0.15% of the country's total population is homeless. However despite of the explosion in construction activities, the scenario on the housing sector remains far from acceptable. The construction of structure are more composite due to growing human enterprise and the construction industry need to respond to the exceptional challenges presented in front in terms of construction period, economically and durability resulting in affordable residence opportunities for current generation. There is a technology which is capable to overcome the problem the technology is mivan framework technology. Mivan technology is mainly used to construct the tall structures. In this technology we used concrete wall instead of masonry wall. The present paper focuses on the context the use of MIVAN technology for super high rise building and check the seismic response for different shapes i.e. Rectangle Shape, C shape, L shape and I shape of high rise building having irregularity were analyzed by Response spectrum Method using Etab software.

Keywords: Rise Building, Mivan technology, Irregularity, Storey Drift, Lateral Displacement, Seismic load, Etab.

I. INTRODUCTION

The building technique is rapidly converting for advancement. With-changing times, new techniques and the materials are being used. In current generation due to advancement, the construction industry has started focusing on new technology and modern ways of working. The construction industries have started new technologies and proceed towards. In order to increase the Strength and life of the project. A lot of research and development is carried out in the construction industry throughout the world construction period, necessity, economy, strength and utility of space have become the main factors of the construction industry. With all these advantages there is a technology used across globe named as Mivan technology.

The Mivan Company Ltd. from Malaysia started manufacturing formwork systems. There are a number of construction in India that are being constructed with the help of the Mivan technology, that has Required less time, less labor cost, less maintenance cost as well as suitable for the general Indian construction atmosphere.

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Mivan shuttering is a Rapid-paced construction technique which gives strength and stability to a building by use of aluminum formworks

Well here brief about the procedure:

- First the structure is erected by using steel reinforcement.
- This reinforcement is surrounded by prefabricated structures for the erection of slabs, walls.



Fig.1: Placing of prefabricated structures around The steel reinforcement

II. OBJECTIVES OF STUDY

The following are the objectives of present study:

- To study of conventional high rise Structure & Mivan High rise Structure.
- To Comparative seismic analysis of different regular and irregular tall Structure from conventional & Mivan Methods Results using ETAB.
- Between Conventional and Mivan Structure which Structure is useful in Seismic area.
- Determine Optimum shape which performs better in different aspects in various seismic areas.

III. METHODOLOGY

Using ETAB software, G+10 building models with plan dimension 35*40 m is been created. We have considered following shapes for both conventional & Mivan structure.

The following structures shape is to be considered:

- Rectangle
- C Shape
- I Shape
- L Shape

1. Rectangle Shape

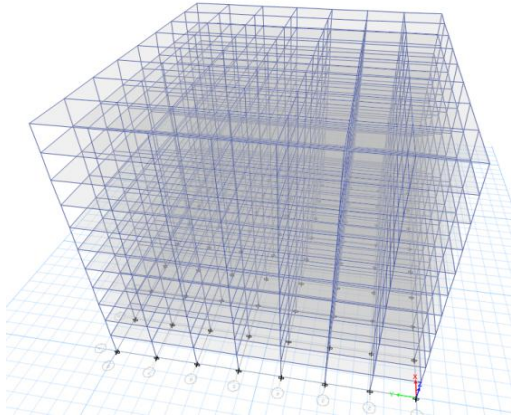


Fig 2.1 Rectangular Shaped Conventional Structure

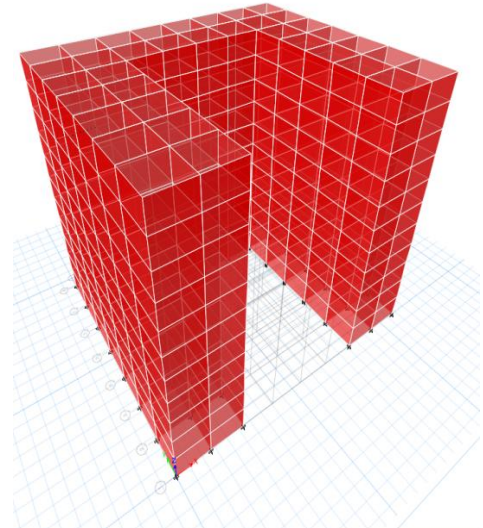


Fig 3.2 C-Shaped Mivan Structure

3. I Shape

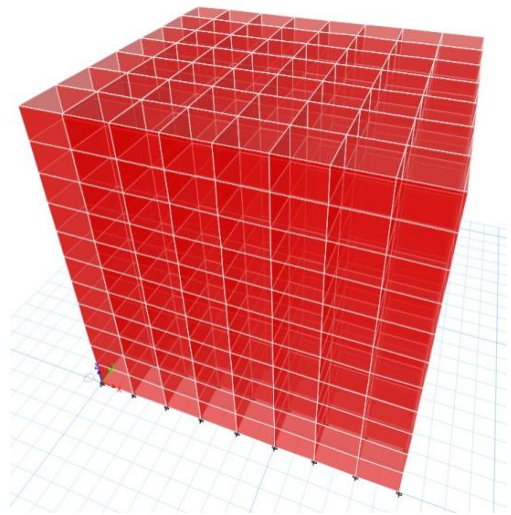


Fig 2.2 Rectangular Shaped Mivan Structure

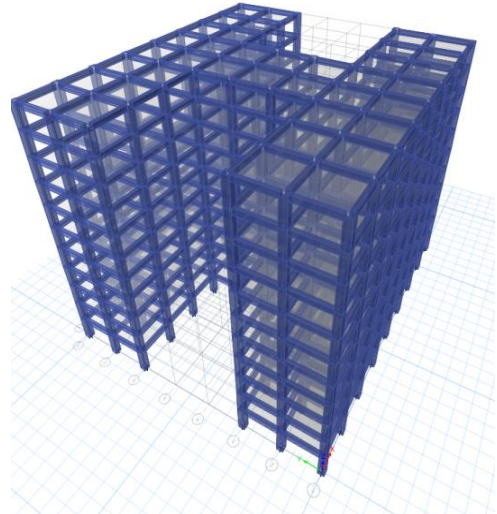


Fig 4.1 I-Shaped Conventional Structure

2. C Shape

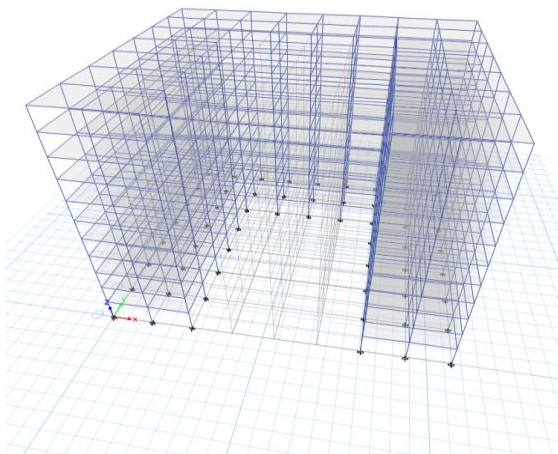


Fig 3.1 C-Shaped Conventional Structure

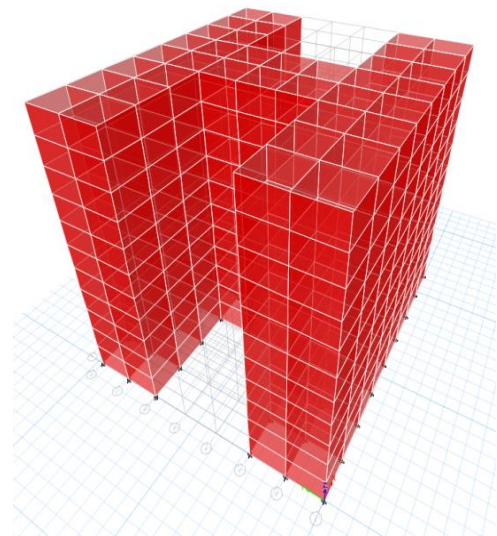


Fig 4.2 I-Shaped Mivan Structure

4. L Shape

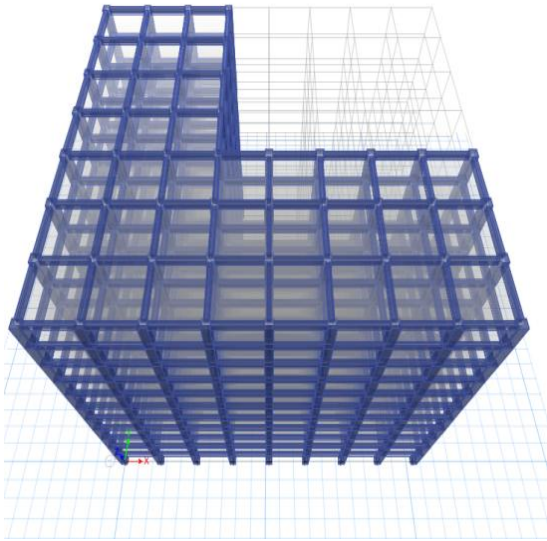


Fig 5.1 L-Shaped Conventional Structure

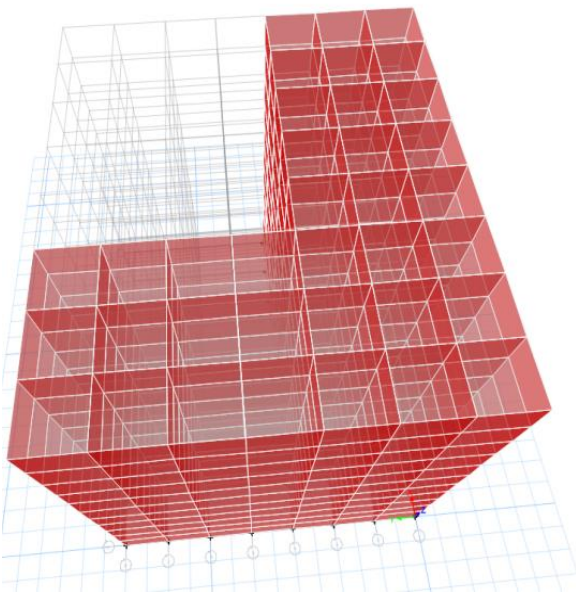


Fig 5.1 L-Shaped Mivan Structure

The base storey height of the model is 3.3 m and the rest storey's height is 3 m. Analysis has been performed for all the structures based on Seismic Zone using Response Spectrum method.

Beam size of the conventional building models is 400*600 mm and the column size is 750*750 mm in the entire building with the brick wall thickness 150 mm.

In Mivan structure, instead of the beam and column, concrete walls provided and wall thickness 200 mm has been used for the entire structure.

LOAD INFORMATIONS

Loads applied on the building are Self weight load and Seismic load. They are Estimate as follows:-

1) **Self weight:** The self weight of the building is estimated from IS 875 (I). The Density of concrete is taken as 25kN/m³. Etab has already self weight calculator. Floor finish is taken as 2 kN/m².

For Normal Structure:

Self weight of Wall is calculated as;

$$\begin{aligned} \text{Self weight of Wall} &= \text{Thickness of wall} \times \text{wall Height} \\ &\times \text{Density of the brick} = 0.150 \times 3 \times 22 \\ &= 9.9 \text{ kN/m} \end{aligned}$$

Where;

Thickness of wall is taken as 150 mm and height of wall as 3m. Total density is obtained as sum of the brick density and plastering density as 22kN/m³.

For Mivan Structure:

Self weight of Mivan Wall;

$$\begin{aligned} \text{Self weight of Wall} &= \text{Thickness of wall} \times \text{Height of wall} \times \\ &\text{density of the concrete} \\ &= 0.200 \times 3 \times 24 \\ &= 14.4 \text{ kN/m} \end{aligned}$$

Where;

Thickness of wall is taken as 200 mm and height of wall as 3m. Density of concrete obtained is from IS-875 i.e. 24kN/m³.

2) **Seismic Load:** Assume that the structure is to be constructed in Zone-IV as per IS 1893 – 2016. So the zone factor is taken as per IS-1893 – 2016. Zone factor is 0.24. Importance factor is taken as 1 as per IS-1893–2016. Soil category is assume to be IInd.

3) Load Combination:

Design loads and its combination are considered in the analysis as per provisions in IS code IS 1893{Part I} : 2016, the following load combination is taken for the analysis of high rise building is represented below:

- 1.5 (DL_+LL_)
- 1.2 (DL_+LL_+EQ_X)
- 1.2 (DL_+LL_-EQ_X)
- 1.2 (DL_+LL_+EQ_Y)
- 1.2 (DL_+LL_-EQ_Y)
- 1.5 (DL_+EQ_X)
- 1.5 (DL_-EQ_X)
- 1.5 (DL_+EQ_Y)
- 1.5 (DL_-EQ_Y)
- 0.9 DL_+1.5EQ_X
- 0.9 DL_-1.5EQ_X
- 0.9 DL_+1.5EQ_Y
- 0.9 DL_-1.5EQ_Y

(DL₁ denotes addition of self weight and floor finish load and EQ_X/EQ_Y denotes seismic load in X—dirⁿ and Y—dirⁿ respectively).

PARAMETERS OF STRUCTURES

S. No.	Particulars	Model Data
1	No. Of Storey's	11 (G+10)
2	Beam Size	400 * 600 mm
3	Column Size	750 * 750 mm
4	Storey Height	Base storey 3.3 m & 3 m throughout the rest storey's
5	Material Property	M30
6	Slab Thickness	150 mm
7	Concrete Wall Thickness	200 mm

Table 1: Parameters of the Structures

S. No.	Particulars	Model Data
1	Zone Factor	IV Zone (Z=0.24)
2	Seismic Analysis	Response Spectrum Analysis
3	Soil Type	Type II Soil
4	Data Analysis	Max. Displacement Value, Storey Drift Value & Base Shear
5	Load Pattern	Live Load, Self weight, EQx&EQy
6	Software Selection	ETABS

Table 2: Some of the parameters used for the Analysis of building

IV. RESULTS

Results Estimated from the study of conventional high rise structure and mivan high rise structure with different shapes by using computer software ETABS (ver. 4.0) under earthquake loading. The Details of Different prepared software model which include total height, wall type and thickness, type of irregularity and shape of building considered for the analysis.

Shapes	Displacement (mm)	Maximum Storey Drift
Rectangle	42.519	0.001701
C Shape	45.574	0.001794
L Shape	44.62	0.001772
I Shape	43.88	0.001737

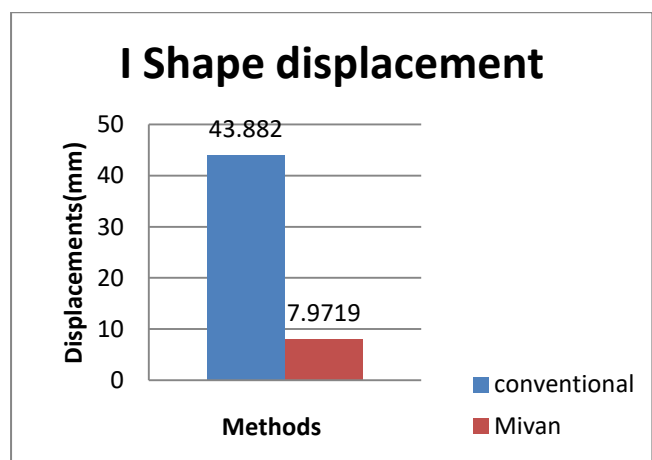
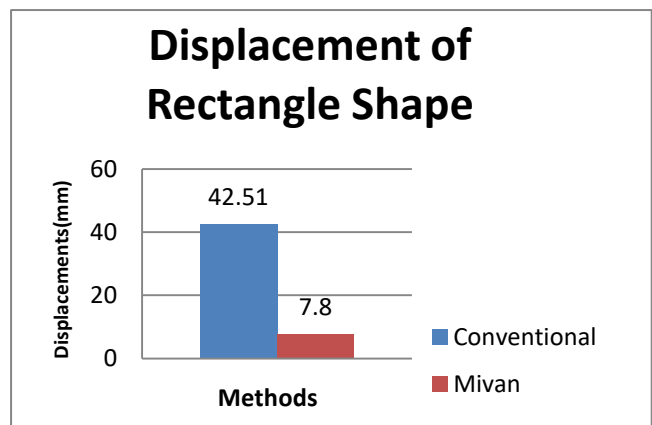
Table 3: Maximum Displacement & Storey drift for Conventional Building

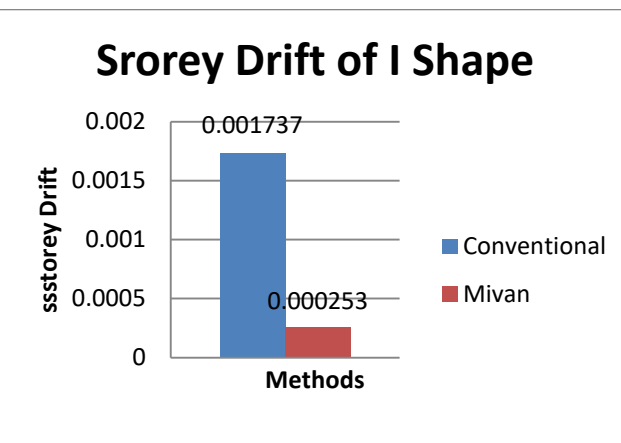
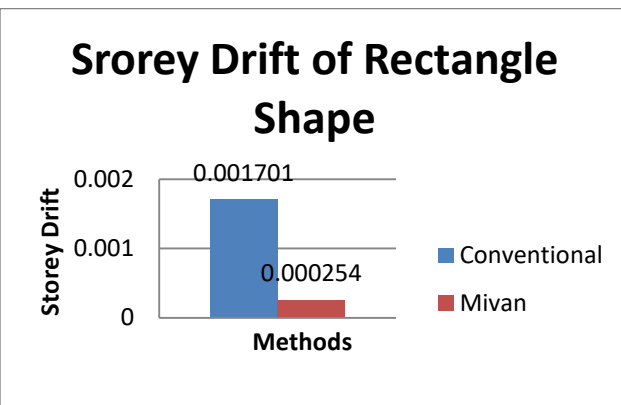
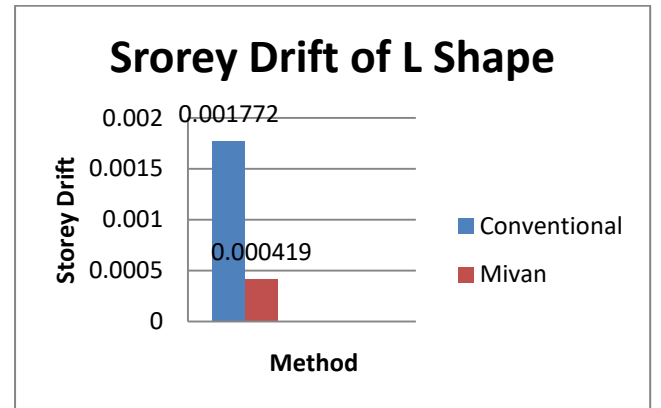
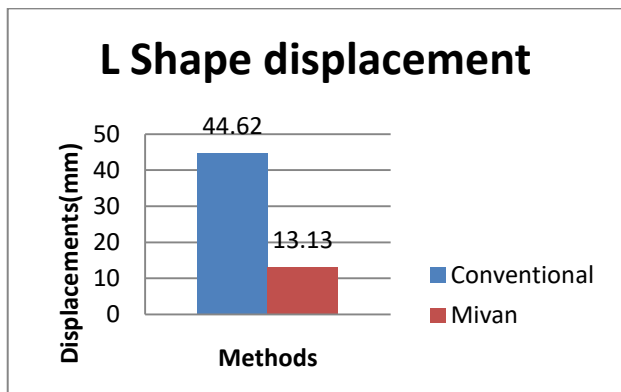
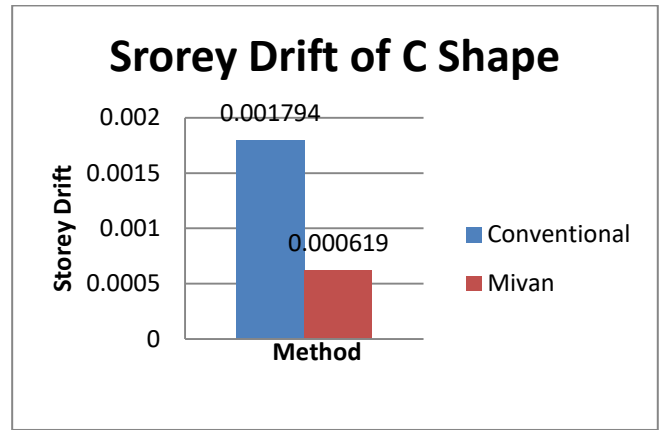
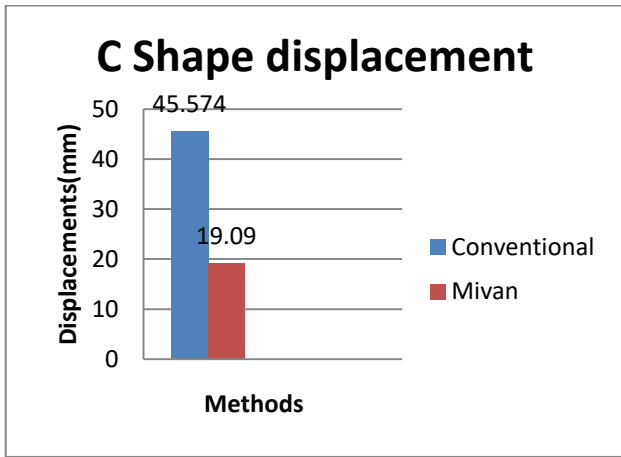
Shapes	Displacement (mm)	Max. Storey Drift
Rectangle	7.8	0.000254
C Shape	19.09	0.000619
L Shape	13.1	0.000419
I Shape	7.17	0.000253

Table 4: Maximum Displacement & Storey drift for Mivan Building

Above results conclude following points:

- From the above Tables in case of conventional structure and Mivan structure, rectangle And in irregular structure I shape has less displacement as compare to other shapes.
- Displace values of Concrete wall structure are less than that of Masonry Structure.
- Maximum Displace rate of different shapes in conventional building lies in the range of 40-45mm. But in Mivan structure it is reduced to 7-20mm.
- While comparing the maximum storey drift values of different structures, for rectangle shape building has the minimum storey drift in both cases.
- Storey drift values of Mivan wall buildings are much lesser than conventional buildings for all shapes.
- Maximum values of storey drift for all the shapes in conventional building lie in between 0.00170-0.0018. But in Mivan it is reduced to 0.000254-.000628.
- In the above tables shows that Mivan structure is valuable in both parameters i.e. Displacement and storey drift





V. CONCLUSION

From the analysis of Different high rise structure by conventional and Mivan method successive conclusions are obtained:

- All the results i.e. displaced value also maximum Drift of Mivan wall buildings are less than conventional building.
- For the Displacement and storey drift Perspective in irregular structure I shape is better than other irregular shapes.
- From the outcomes it is conclude that Concrete wall structure are very efficient in resist the earthquake forces as compare to Conventional building.
- Performed seismic analyses by Response spectrum for different regular and irregular tall conventional & Mivan structures and conclude that Mivan grow the overall rigidity of the building.

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