Seismic Analysis of High Rise (RCC) Structures With Plan Irregularity

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Abstract- *ETABS stands for Extended Three dimensional Analysis of Building Systems. ETABS is commonly used to analyse Skyscrapers, parking garages, steel & concrete structures, low and high rise buildings, and portal frame structures. In this project analyses have been done to estimate the seismic performance of high rise buildings and the effects of structural irregularities in stiffness, strength, mass and combination of these factors are to be going to be considered. The work describes to the irregular plan geometric forms that are repeated more in the metro city areas such as Mumbai like L,H,T,I,U etc. These irregular plans were modelled in ETABS 9.6v considering 10 storied buildings, to determine the effect of the plan geometric form on the seismic behaviour of structures this paper aims to study and understand the critical behaviour of plan irregular structures subject to seismic excitation .Here 6 different shape models irregular in plan with same area and geometric data are considered and results are evaluated in the form of Lateral displacement, storey drift, base shear, storey displacement and storey overturning moment were the key parameters to ascertain performance of all the 6 models, modelled in Etab 9.6.2 software by Time history analysis Output from software consisting of Time history curves and results of all 6 models are presented, which creates the awareness of planning simple planned structures in order to minimize the effect of earthquake*

Keywords- Structure Design, ETABS, Time history analysis, Plan Irregularity.

I. INTRODUCTION

Now a days there a new generation of tall buildings which are slender and light. This is possible because of high strength materials, design procedures and computational methods. These buildings usually designed for commercial use as well as offices, by consuming very small space. With this architectural history also changing rapidly, this leads to the rapid growth of population in urban areas, which results in increasing demands in business activities leads to the change in shapes of the structure to do large quantity of things in small space. The high costs of the land in urban areas and to prevent agricultural production and disorganized expansion, the concept of tall buildings are implemented. Today all major cities consist of tall buildings. Irregularities in plan is related to in plan asymmetrical mass, stiffness and/or strength distributions, causing a substantial increase of the torsional effects when the structure is subjected to lateral forces, on the other hand irregularities in elevation involves variation of geometrical and/or structural properties along the height of the building, generally leading to an increase of the seismic demand in specific storey.

The component of the building, which resists the seismic forces, is known as lateral force resisting system (L.F.R.S). The L.F.R.S of the building may be of different types. The most common forms of these systems in a structure are special moment resisting frames, shear walls and frame-shear wall dual systems. The damage in a structure generally initiates at location of the structural weak planes present in the building systems. These weaknesses trigger further structural deterioration which leads to the structural collapse. These weaknesses often occur due to presence of the structural irregularities in stiffness, strength and mass in a building system. The structural irregularity can be broadly classified as plan and vertical irregularities.

To perform well in an earthquake, a building should possess four main attributes, namely simple and regular configuration, and adequate lateral strength, stiffness and ductility. Buildings having simple regular geometric and uniformly distributed mass and stiffness in plan as well as in elevation, suffer much less damage than buildings with irregular configurations.

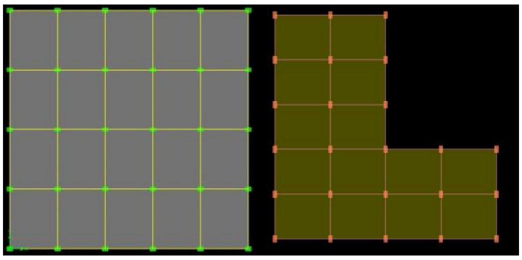
For the present work, (G+10) storey building with storey height 3 meter for all, with plan 20mx20m is taken.

II. SYSTEM DEVELOPMENT

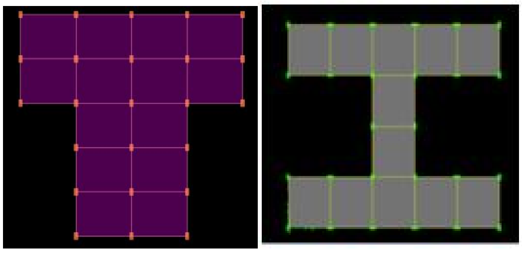
I have developed 6 models in ETABs software. The geometrical loading data, plan area, seismic data for each of the six models are kept sameto achive a behaviour pattern . These 6 models are shaped by considering Plan irregularities i.e. plan area for each structure is same only there is difference in geometry.

Table. 2.1 The specified shapes of models are as follows:

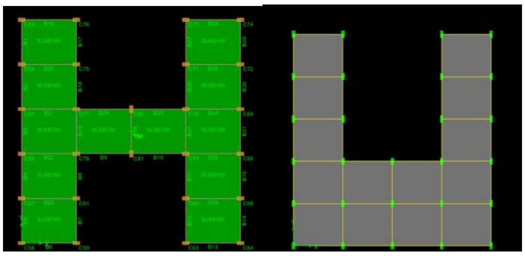
Square shape	L shape
T shape	I shape
H shape	U shape



(a) (b)



(c) (d)



(e) (f)

Fig.2.1Plan (a) Square (b) L shape (c) T shape (d) I shape (e) H shape (f) U shape of the Building.

Specifications for all above mentioned structural models are same and are given as follows:

Table 2.2 loading data

Live Load	3 KN/m^2
Roof Live Load	1 KN/m^2
Floor Finish	1 KN/m^2

Table. 2.3 Seismic data

Earthquake Zone	III
Damping Ratio	5%
Importance factor	1
Type of Soil	Medium Soil
Type of structure	All General RC frame
Response reduction Factor	5 [SMRF]
Time Period	Program Calculated

Table.2.4 Geometric data

Density of RCC considered	25 kN/m^3
Thickness of slab	160 mm
Depth of beam	380 mm
Width of beam	300 mm
Dimension of column	300mm x 450 mm
Density of infill	20 kN/m^3
Thickness of wall	230 mm
Height of each floor	3.4 m
Conc. Cube Comp. Strength, fy	20000 N/mm^2
Reinforcement yield strength, fy	415000 N/mm^2

III. MODELLING IN ETABS

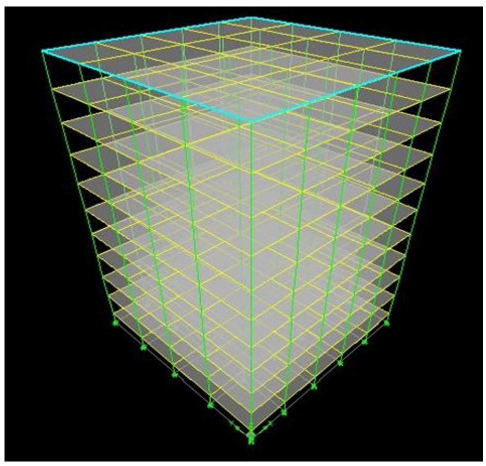


Fig. 3.1 3-D View of Squareshape building

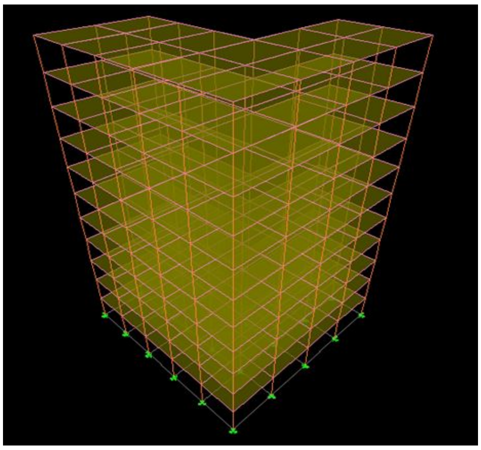


Fig. 3.2 3-D View of L shape building

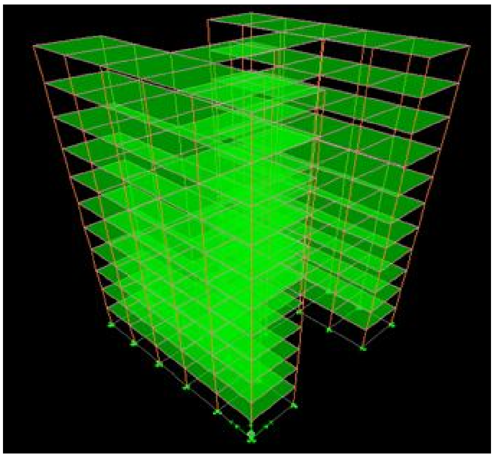


Fig. 3.3 3-D View of H shape building

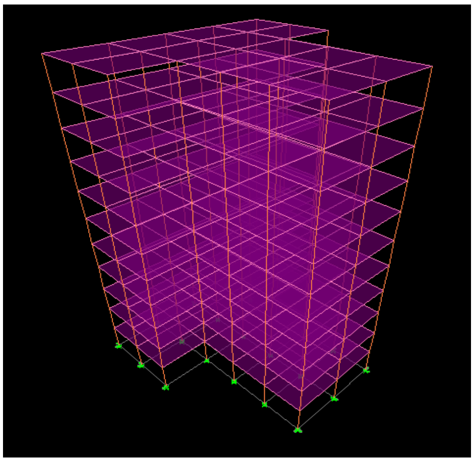


Fig. 3.4 3-D View of T shape building

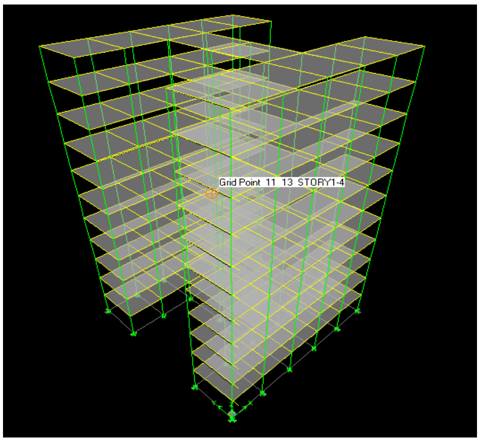


Fig. 3.5 3-D View of the I shape building

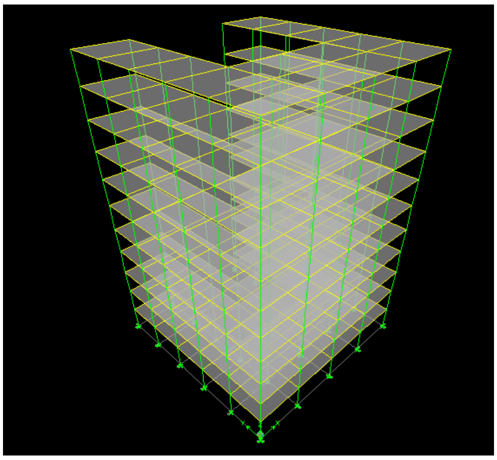
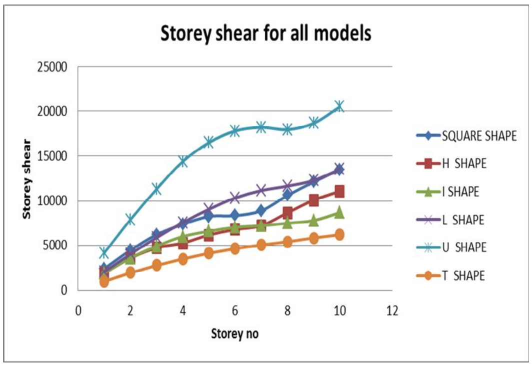


Fig. 3.6 3-D View of U shape building

IV. RESULTS AND DISCUSSION

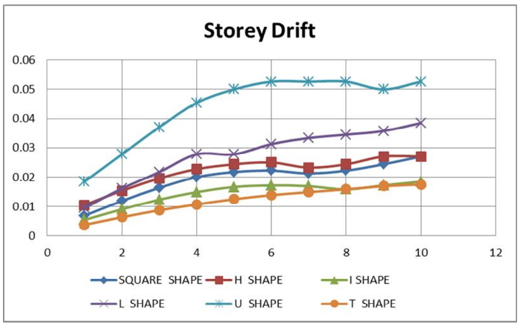
4.1. Comparison of Storey shear for all models



It is also observed that, increases, storey shear for U shape building is increased by 65.78%and it is decreased by 53.98% for T shape as compare to square shape model, from this it is observed that U shape building performance is good in this analysis.

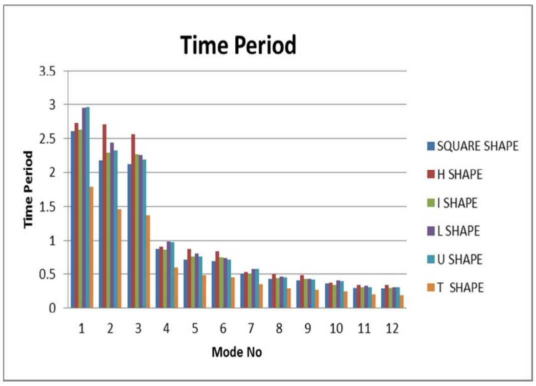
4.2. Comparison of Storey Drift for all models

Storey drift of all the 6 models are presented in graphical form.



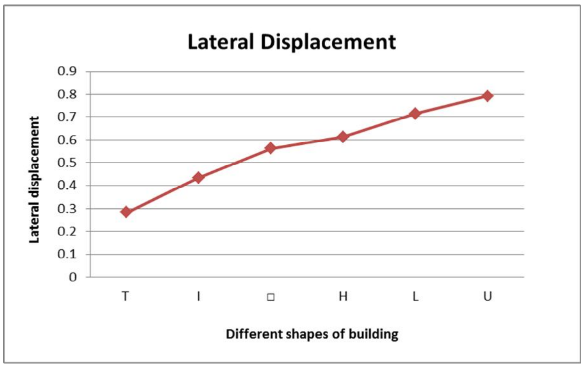
It is observed that storey drift for U shape model is more as compare to square shapemodel. And it is less in T shape model as compare to square shape model. From this it is observed that U shape is unsafe in this analysis and T shape is safe to use. It is also observed that, as storey height increases storey drift also is increases.

4.3Modal time period for all models



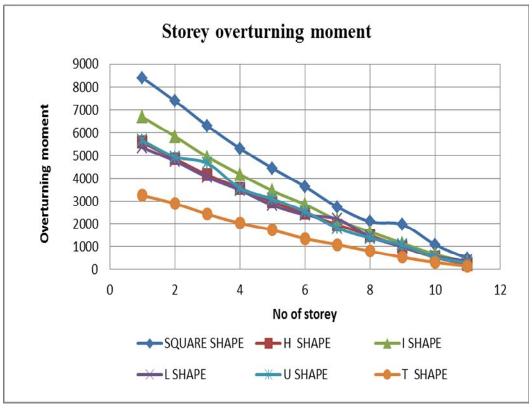
From this graph it is observed that as mode no increases time period decreases It is also observed that time period of T shape model is less as compared to all other models. &for U shape model and L shape model is nearly equal at mode no 1 and it is maximum for U shape model and at mode no 12, time period is maximum for H shape model as compares to all other models.

4.4 Comparison of Lateral for all models



It is observed that U shaped model has lateral displacement that is 0.792 and T shape model has minimum displacement that is 0.2834. lateral displacement for I and T shape model is less as compare to square shape and maximum displacement for H, L & U shape model is more as compare to square shape. And it is maximum for U shape model

4.5. Comparison of Storey overturning moment for all models



Storey overturning moment decreases with increase in storey height for all cases. Storey overturning moment for T shape model is less at 10th storey as compare to all other shaped models, and for square(regular) shape storey overturning moment value is maximum at base i.e. 8398 kN-m and minimum at the 10th storey i.e. 479 kN-m. From this graph, it is observed that storey overturning moment for T shape model is less (for all stories) as compare to all other models

V. CONCLUSION

- It can be concluded that, the increment in storey shear is U shape building is observed as 52.04% and percentage reduction in T shape building is observed as 53.98%.
- It is observed that, the reduction in peak storey drift in T shape is (marginal) 45.45% and increment in storey drift

in U shape is (substantial) 62.52% as compared with square shape building. From this it is observed that, storey drift increases with storey height.

- The percentage reduction in Lateral displacement in T shape building is 49.39% and increment in lateral displacement in U shape building is 41.13% in comparison with square shape.
- It is observed that time period decreases with increase in mode no irrespective of shape of building & type of building
- It is observed that, increment in storey overturning moment is marginal (33.47%) for H shape but it is substantial (61.17%) for T shape as compare to square shape building.
- It is observed that base shear and storey drift increases as the no of storey increases. About time period it is observed that as mode no increases time period decreases.

REFERENCES

[1] International Journal of Scientific Engineering and Technology Research Volume.05, IssueNo.36, October-2016, Pages: 7787-7594 Arlekar, Jain &Murty (1997)

[2] Review of different Structural irregularities in buildings studied by S.Varadharajan, V.K. Sehgal, and B.Saini Civil Engineering Department, National Institute of Technology Kurukshetra, Haryana - 136 119, INDIA (2011)

[3] Analysis of Reinforced Concrete Building with Different Plan Shapes Resting on Sloping Ground was studied by, Prashanth.P, Anshuman.S, Pandey.R.K, Arpan Herbert (2012), may conclude that E-TABS gave lesser area of required steel as compared to STAAD-PRO.

[4] Ahmed J and Raza S. A [2014] for the study on seismic analysis of buildings with plan irregularity selected models with rectangular shape, Y shape and diaphragm discontinuity

[5] Effects of Building Configuration on Seismic Performance of RC Buildings by Pushover Analysis was studied by Yasser Alashker, SohaibNazar, Mohamed Ismaiel (2015)

[6] PankajAgrawal and Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI Learning Private Limited, May 2010, pp. 234-238.

[7] IS-875 (Part 2): 1987 Indian Standard Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Part 2 Imposed Loads. (Second Revision)

[8] IS-1893 (Part 1): 2002 Indian Standard Criteria for Earthquake Resistant Design of Structures, Part 1 General Provisions and Buildings, (Fifth Revision)

[9] IS-456-2000 Indian Standard code of practice for plain and reinforced concrete. Bureau of Indian standards, New Delhi-2000.