

Comparative Analysis of Regular and Irregular Configuration of Multistoried Building in Medium Soil and Various Seismic Zones (II&V)

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Abstract - Earthquakes are caused generally by rupture of geological faults inside the earth, but also by other events such as volcanic movement, landslides, mine blasts, and atomic tests. Irregularities are characterized by vertical discontinuities in the geometry, distribution of mass, rigidity and strength. Plan irregularity is the even inconsistency in the design of vertical parallel drive opposing components, in this way creating a differential between the focal point of mass and focus of Inflexibility, that ordinarily result in huge torsional requests on structure. A G+30 storey building is modeled in ETABS 2016 software and comparison is made between regular structure and plan irregular structures with varying seismic zones i.e., zone II and Zone V and in medium soil, these models are analyzed under response spectrum method. The comparison was made for base shear, storey drift, storey displacement, storey acceleration, storey forces and storey stiffness.

Key Words: Tall Building¹, ETABS², Response Spectrum³, Seismic Loads⁴, Wind Loads⁵

1. INTRODUCTION

The word earthquake is used to express any seismic occurrence whether natural or caused by humans that can produce seismic influence around any particular area. Earthquakes are caused generally by rupture of geological faults inside the earth, but also by other events such as volcanic movement, landslides, mine blasts, and atomic tests. Irregularities are characterized by vertical discontinuities in the geometry, distribution of mass, rigidity and strength. Setback buildings are a subset of vertically irregular buildings where there are discontinuities with respect to geometry. However, geometric irregularity also introduces discontinuity in the distribution of mass, stiffness and strength along the vertical direction. Majority of the studies on setback buildings have focused on the elastic response. The behavior of these types of building is something different. There is a need of more work to be done in this regard. So this research work is an attempt to reach on more accurate conclusion to reduce their effect on the structure. We observe that real structures are frequently irregular as perfect regularity is an idealization that rarely occurs in the practice. Regarding buildings, for practical purposes, major seismic codes across the globe differentiate between irregularity in plan and in elevation, but it must be realized that irregularity in the structure is the consequence of a combination of both types. It is seen that irregular structural

configurations either in plan or in elevation were often recognized as one of the major causes of collapse during precedent earthquakes.

1.1 Plan Irregularity

Plan Irregularity is the even inconsistency in the design of vertical parallel drive opposing components, in this way creating a differential between the focal point of mass and focus of Inflexibility, that ordinarily result in huge torsional requests on structure. In other word the state of being non uniform, or quickly fluctuating, rather than steady.

- Torsional Irregularity
- Re-entrant Corners
- Diaphragm Discontinuity
- Out of Plane Offsets
- Non Parallel Systems

1.2 Vertical Irregularities are mainly of five types

- Stiffness Irregularity
- Mass Irregularity
- Vertical Geometric Irregularity
- In-Plane Discontinuity in Vertical Elements Resisting Lateral Force
- Discontinuity in Capacity

2. OBJECTIVES

- The analysis of a multi-storeyed RC building having G+30 Storey is analysed with varying earthquake intensity.
- To Model regular and irregular buildings in Etabs Software.
- To analyse the regular and irregular building models with Response Spectrum method in seismic zones II and V and in medium soil.
- To compare the responses of regular and irregular configuration structures for base shear, storey drift, storey displacement and storey stiffness.
- To compare the performance of the structures that varies in plan dimensions and with different seismic zones in medium soil.

3. METHODOLOGY

- An extensive literature review is carried out to establish the above objectives for the project work.
- G+30 storey structure is chosen for the present investigation.
- ETABS software is chosen for modelling and analysis of the selected structure.
- To understand the behaviour of structure, two models are considered with regular and irregular configuration in different seismic zones and in medium soil.

3.1 Modelling

Table-1: Regular and Irregular configuration in seismic Zone II & V

Number of stories	G+30
C/C distance between columns in X-direction	5 m
C/C distance between columns in Y-direction	5 m
Foundation level to ground level	3 m
Floor to floor height	3 m
Live load on all floors	3 kN/m ²
Live Load on Roof	1.5 kN/m ²
Floor Finish	1.5 kN/m ²
Concrete	M25 and M30
Steel	Fe 415 and Fe 500
Size of column	850 x 850 mm
Size of beam	350 x 650 mm
Depth of slab	150 mm
Seismic zone II	0.10
Seismic zone V	0.36
Soil Type	Medium

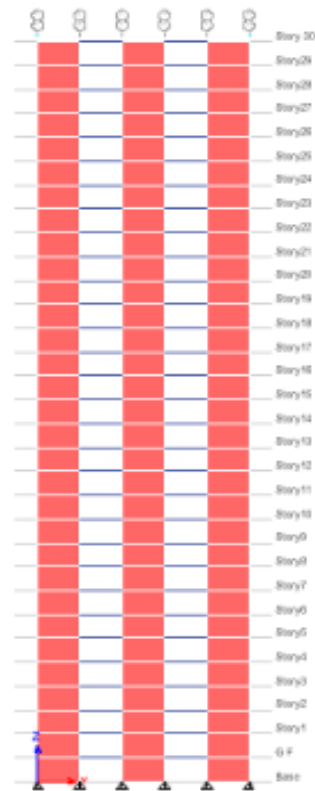


Fig-2: 2D Elevation of Model

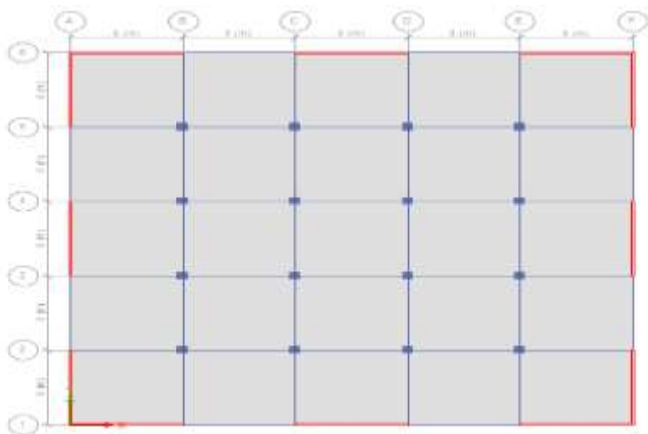


Fig-1: Structural Plan of Regular Model

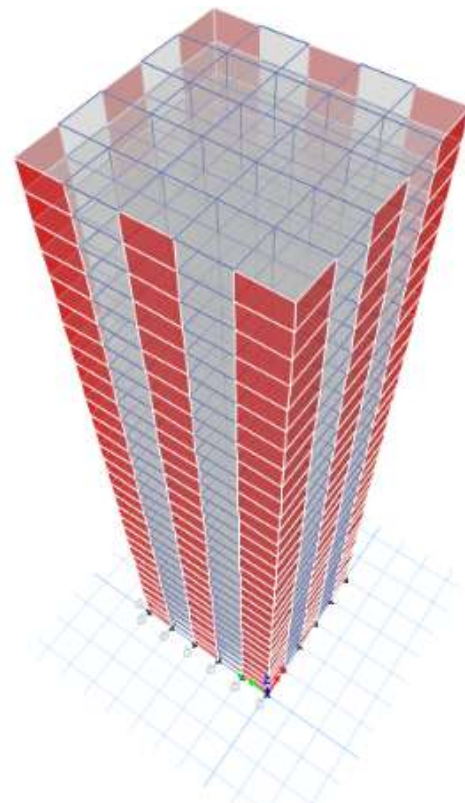


Fig-3: 3D Elevation of Model

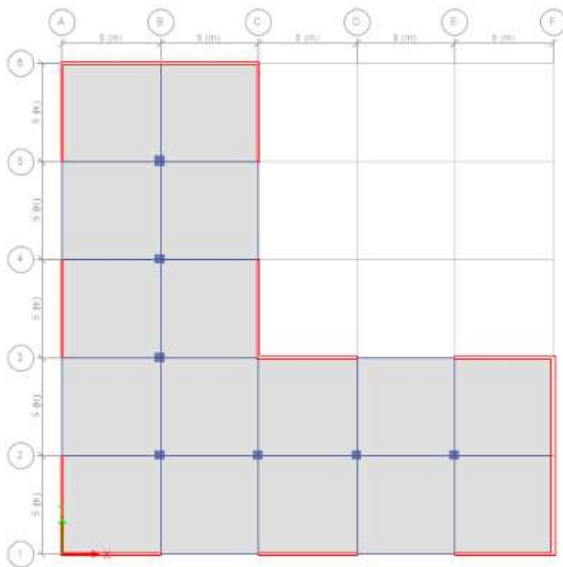


Fig-4: Structural Plan of Irregular Model

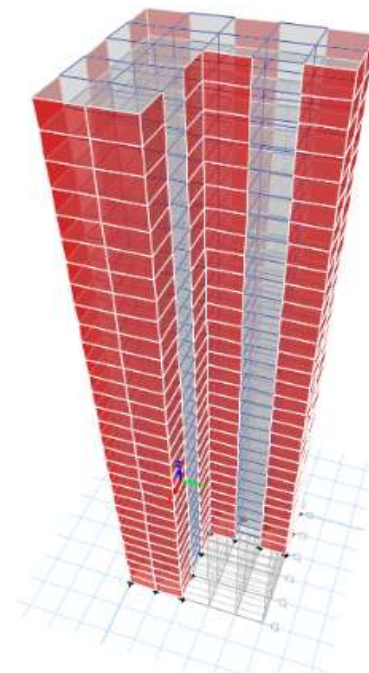


Fig-6: 3D Elevation of Irregular Model

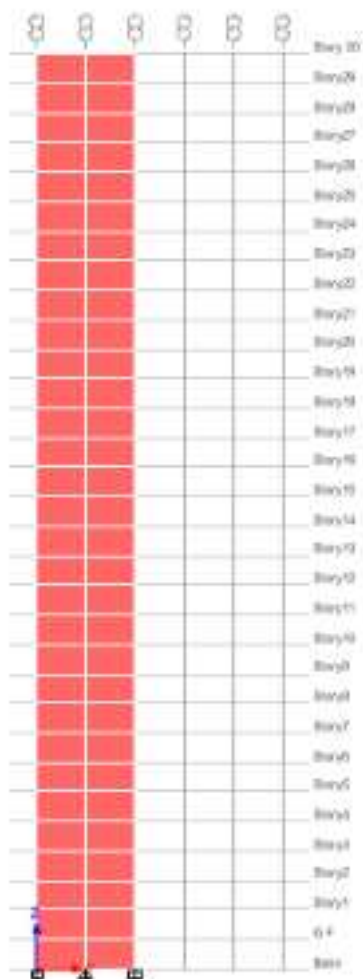


Fig-5: 2D Elevation of Irregular Model

4. Analysis Results

This chapter deals with results and discussion of RC building with Regular and Irregular configuration in Zone II and Zone V.

- Model 1- RC building with Irregular configuration in Zone II
- Model 2- RC building with regular configuration in Zone II
- Model 3- RC building with Irregular configuration in Zone V
- Model 4- RC building with regular configuration in Zone V

Discussions are made based on following parameters

- Storey Displacement
- Storey drift
- Storey acceleration
- Storey forces
- Storey Stiffness
- Base Shear

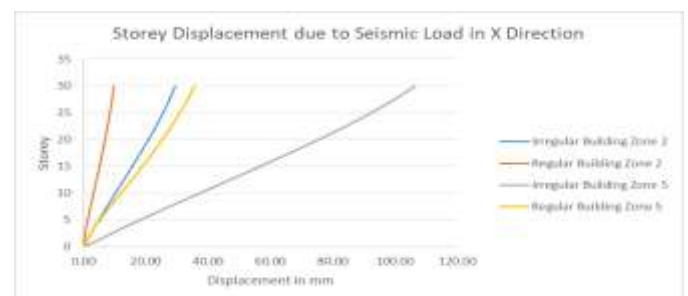


Chart-1: Storey Displacement due to Seismic Load in X Direction

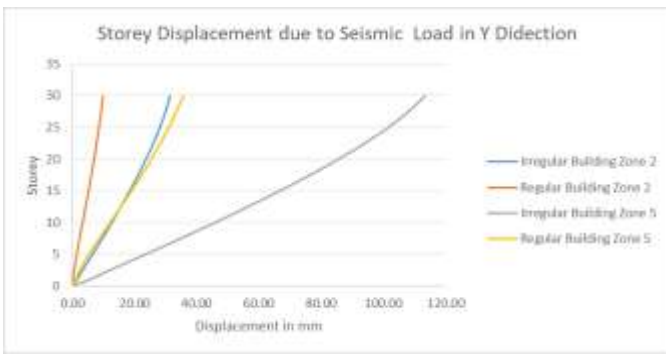


Chart-2: Storey Displacement due to Seismic Load in Y Direction

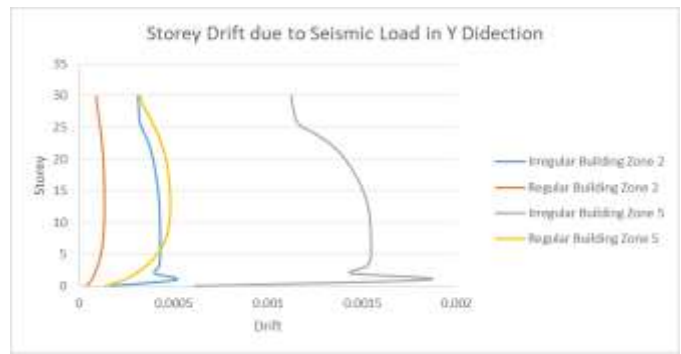


Chart-6: Storey Drift due to Seismic Load in Y Direction

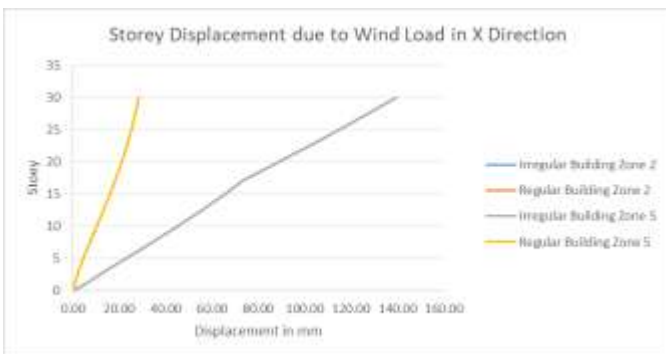


Chart-3: Storey Displacement due to Wind Load in X Direction

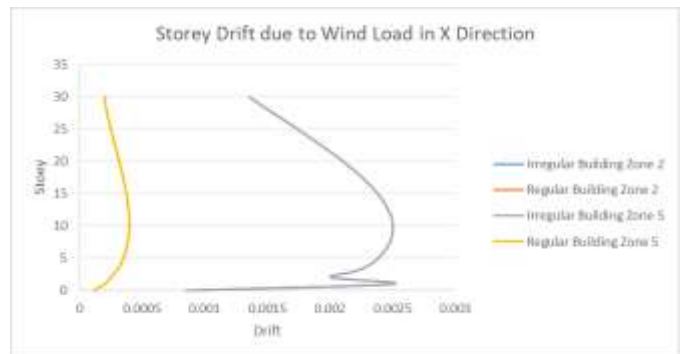


Chart-7: Storey Drift due to Wind Load in X Direction

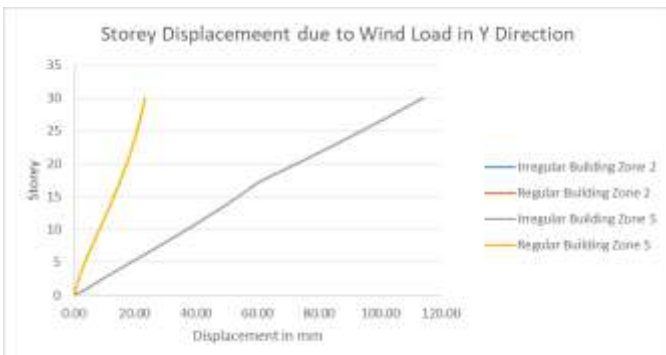


Chart-4: Storey Displacement due to Wind Load in Y Direction

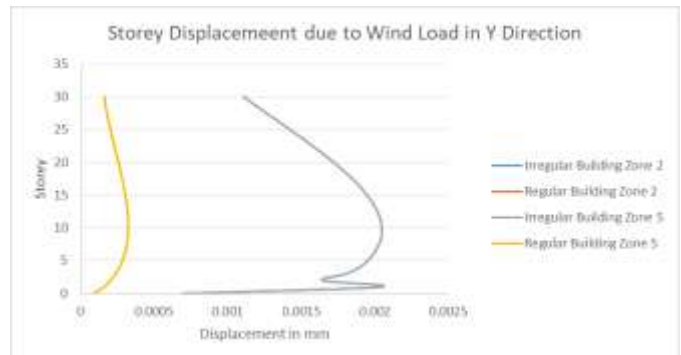


Chart-8: Storey Drift due to Wind Load in Y Direction

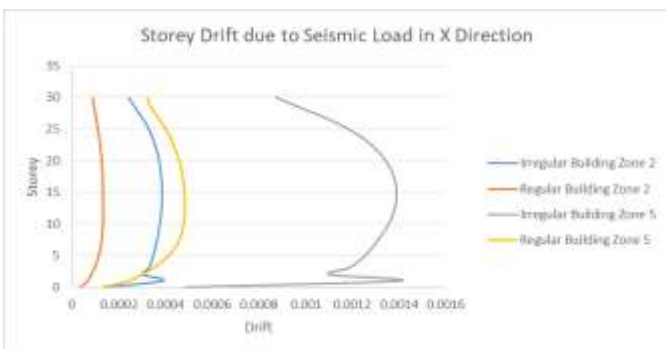


Chart-5: Storey Drift due to Seismic Load in X Direction

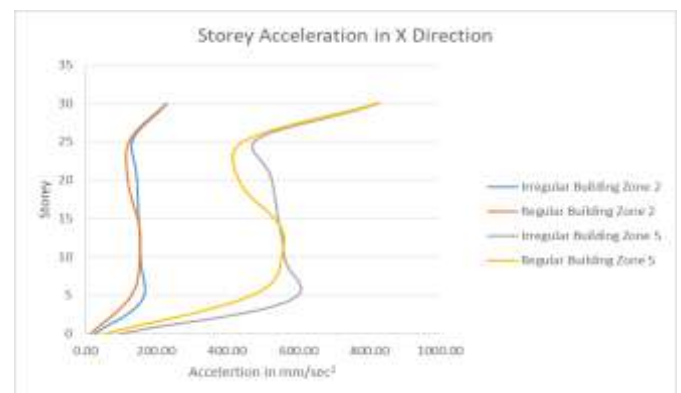


Chart-9: Storey Acceleration in X Direction

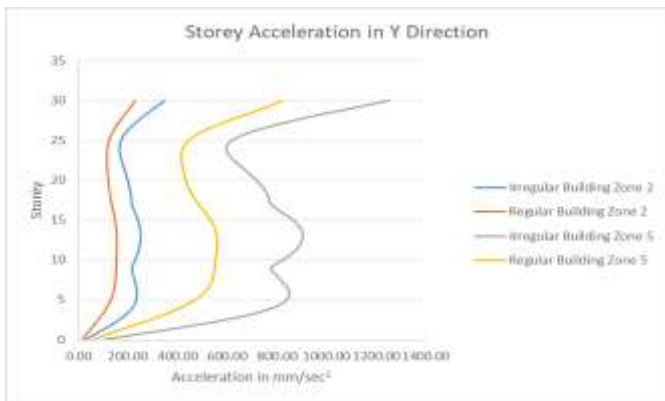


Chart-10: Storey Acceleration in Y Direction

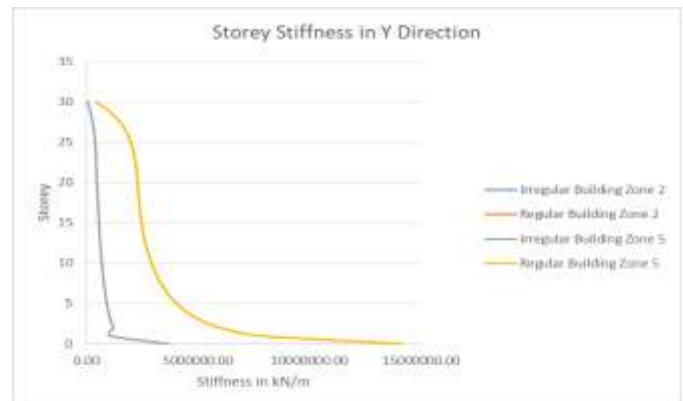


Chart-14: Storey Stiffness in Y Direction

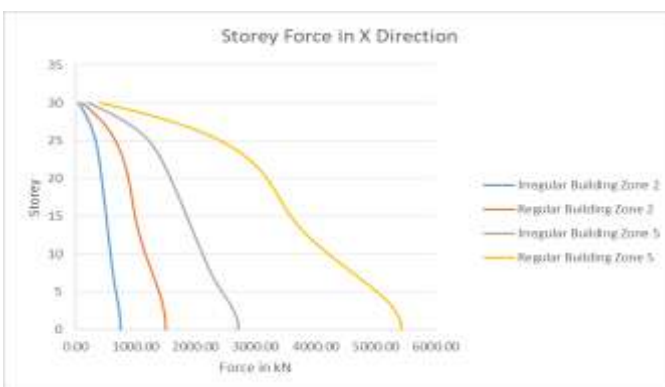


Chart-11: Storey Force in X Direction

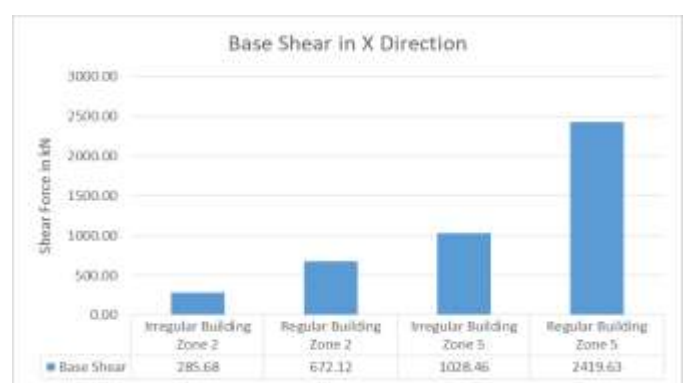


Chart-15: Base Shear in X Direction

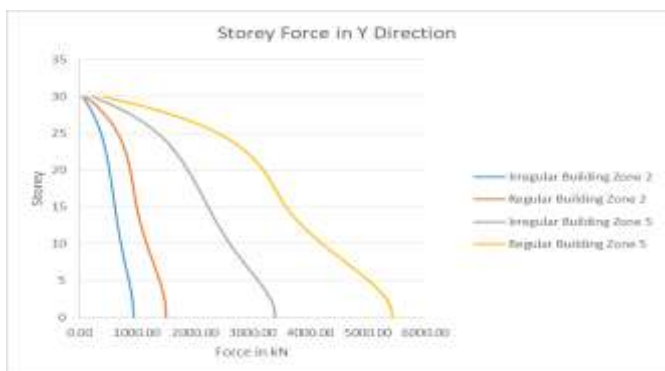


Chart-12: Storey Force in Y Direction



Chart-16: Base Shear in Y Direction

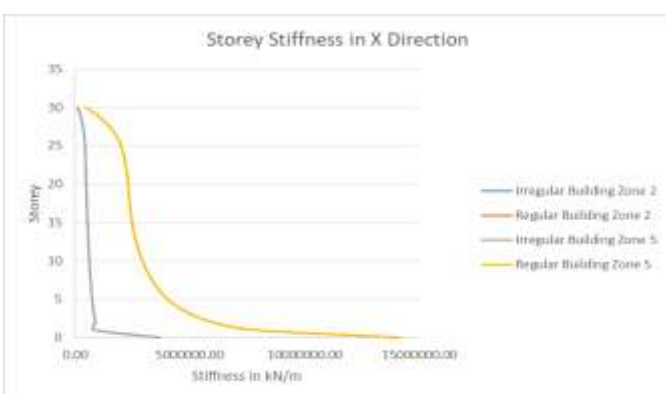


Chart-13: Storey Stiffness in X Direction

5. CONCLUSIONS

In the above thesis four models are considered in two are regular and two are irregular and are compared for seismic zones like Zone II (0.1) and Zone V (0.36) respectively. The effects on models have been shown in the form of graph in successive part of results and discussions, by comparing various parameters such as displacements, storey drifts, storey acceleration, storey force, storey Stiffness, and base shear. Hence from the obtained results the following conclusions are made,

1. Considering the effect of lateral displacement on structure. It has been observed that, building with L-shape have displaced more in comparison to regular simple shaped building.

2. The storey drifts being the important parameter to understand the drift demand of the structure. L-shaped models showed larger drift than regular simple shaped models.
3. The storey force in both the zones i.e., for II and V showed that regular building model has a lower force than that for the building with irregular configuration.
4. The storey stiffness in both the zones i.e., for II and V showed that regular building model has high stiffness than that for the building with irregular configuration.
5. The graphs of base shear for zone II and V, has a higher shear values for the regular simple building than that for irregular configured building.
6. The result shows the storey displacement, storey drift and storey acceleration is increased by 66%, 85% and 17% respectively in irregular structure than regular structure.
7. From the obtained results it is observed that storey forces, storey stiffness and base shear is increased by 48%, 77% & 37% respectively in regular structure than irregular structure.
8. As the storey force decreased and an increase in storey stiffness and base shear for the regular simple shaped building, which give a clear indication that regular configured building perform better then that the irregular structure.
9. Shear wall increases the stiffness and strength of the structure and affect the seismic behavior of the structure.
10. The presence of shear wall increase the lateral stability in irregular building and thus help in safe guarding the structure to some extent.
11. It is observed that, there are no torsional effects in the frame because of symmetry that is the centre of mass that coincides with the centre of rigidity, hence symmetric structure perform better in resisting earthquake force.
12. From the above results so obtained from all the graphs is clear that building with regular configuration give a better resistance against earthquake forces and offer a stable structure.

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