EFFECT OF SHAPE ON SEISMIC RESPONSE OF A STRUCTURE

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Abstract - *The main objective of earthquake engineering is to analyse, design and build a structure in such a way that the damage to the structure and its structural component during an earthquake is minimized. A large number of papers have focused to study the effect of irregular structures. In this project, the variations in the behaviour of structure with different shape configuration subjected to seismic motion is studied. Building with irregular geometry responds differently against seismic action. Plan geometry is the parameter which decides its performance under different loading conditions. To workout the performance of the structure, equivalent static analysis has been adopted. ETABS 20 software is used for achieving this objective. Estimation of responses such as lateral displacement, storey drift and base shear has been carried out. Based on these parameters the response of each model has been compared. Results are expressed in the form of graphs. From the comparisons made with these parameters, it is observed that to minimize the effect of earthquake simple plan and configuration like regular shape must be adopted at the planning stage.*

Key Words: *ETABs, Equivalent static analysis, Rectangular shaped building, L shaped building, Lateral displacement, Storey drift, and Base shear*

1.INTRODUCTION

Seismic Analysis of structure is to find out the seismic forces of structure and also find the effect of structure of various shape of building. Earthquakes are unpredictable natural disaster and earthquake are not prevented. So that we are considered all types of seismic parameter and designed the structure to resisting earthquake (seismic) forces.

We have considered two types of building shape it means rectangle shape & L shape. Area of both rectangle and L plan is same that is 6900 SQ. M.

Generally we have designed structure by considering factors like load distribution, moment and forces, but we should design structure for earthquake resistant because earthquake are unpredictable and not prevented disaster. We have to calculate Seismic Forces of both shape of structure and after that we can predict that which shape of structure are performance well during earthquake.

In structural design, we are putting structural element that is beam & column in their proper place, we couldn't place in obstructed position. We have Design G+7 residential building in zone III so we have to consider safety parameter and safety factor during design of structure, structure should be safe is the aim while designing.

In modern and new technique of structural designing, it will be a challenge for structural designer to design irregular shape of building and is to become safe during earthquake. The main aim is to resist the earthquake forces and other seismic forces during earthquake.

2.METHODOLOGY

Equivalent static method

The response of the buildings is assumed in a linearly elastic manner as this method follow linear static procedure. It is one of the process to estimate the seismic load. As it does not consider all the parameter that are significance of the foundation condition thus high-rise structure are not considered for the design by static method. This method is only suitable for the design and analysis of small structure. This method considers only one mode for each direction. Tall structures are required more than two modes and mass weight of every story design earthquake resistant loads. Static method has a drawback as it uses only one mode of vibration of building. As per the IS 1893:2002 (part 1), analysis is carried out. The total base shear or design lateral force along X and Y direction is provided in terms of seismic weight of the structure and design horizontal seismic coefficient. There are several factors on which design horizontal coefficient depends namely, importance of the structure, fundamental natural time period, Response reduction factor, zone factor etc.

3.MODELLING OF BUILDING

In this study, the analysis of two different G+7 buildings of different plans is carried out with static analysis to find out the stability among the cases. The Analysis is carried out through ETABS 2020 software as it is more user-friendly and versatile program. The details of the seismic and other various parameters are mentioned in the tables below.

A. Seismic parameter

Table I: Seismic parameter

Soil Type	II
Importance Factor	1
Seismic Zone	III
Zone Factor	0.16
Response reduction factor	5

A. Load details

Table II: Load details

Property	Intensity of load (kN/m)
Live Load @ Floor	3
Live Load @ Roof	1
Main wall Load	9.12
Partition wall Load	4.8

B. Plan details

Table III: Plan details

Number of Stories	7
Support condition	Fixed
Storey height	3m
Concrete Grade	30MPa
Steel Grade	Fe500
Size of columns	300x600
Size of beam	250x600
Height of Parapet wall	1.2m
Parapet wall Thickness	100mm
Main Wall Thickness	200mm
Partition Wall Thickness	100mm
Slab thickness	150mm

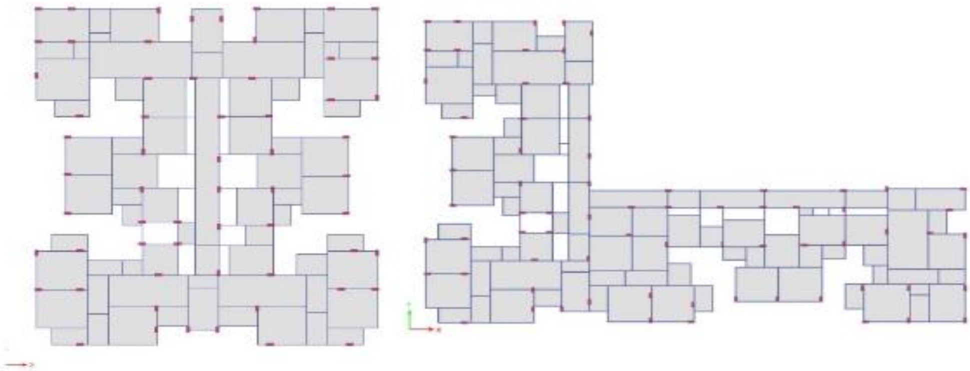

Fig. a)Rectangular Shape **b)L Shape**

4. RESULT AND DISSCUSSION

Storey displacement is the deflection of a single story relative to the base or ground level of the structure. Displacement increases as the storey height increases. In the figure below shows the storey displacements of the regular rectangular shaped building and L-shaped building.

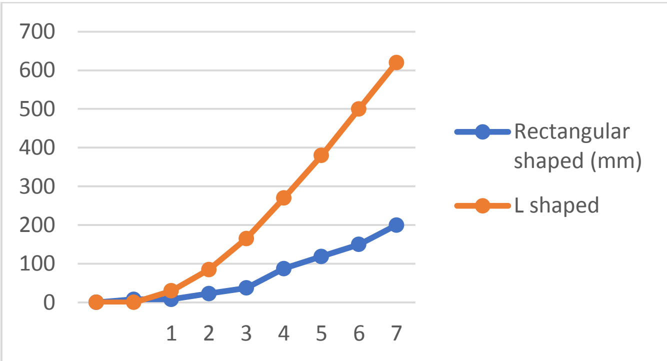

Fig. 1: Storey displacement

Storey drift is the lateral displacement of a floor relative to the floor below, and the storey drift ratio is the storey drift divided by storey height. In the figures below shows the storey drifts of the regular rectangular shaped building and L-shaped building both in X and Y directions.

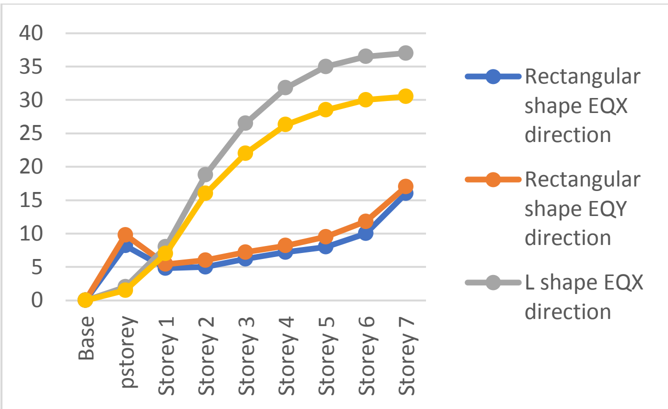

Fig. 2: Storey drift

Storey shear is the graph showing how much lateral load, be it wind or seismic, is acting per storey. The lower you go, the greater the shear becomes. Story drift on the other hand is the plot of resulting shear per floor.

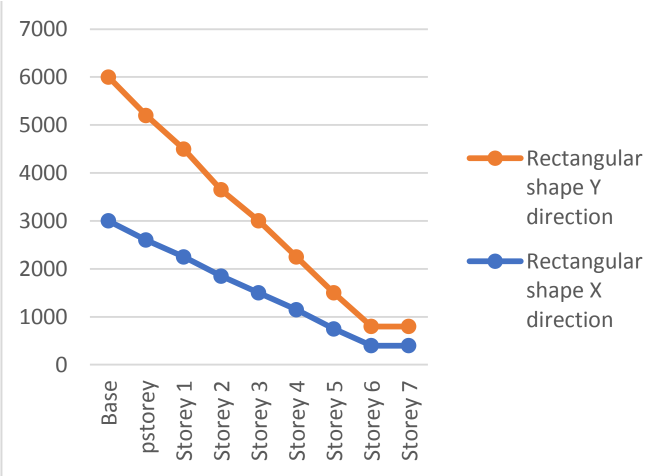

Fig. 3: Storey shear of Rectangular shape

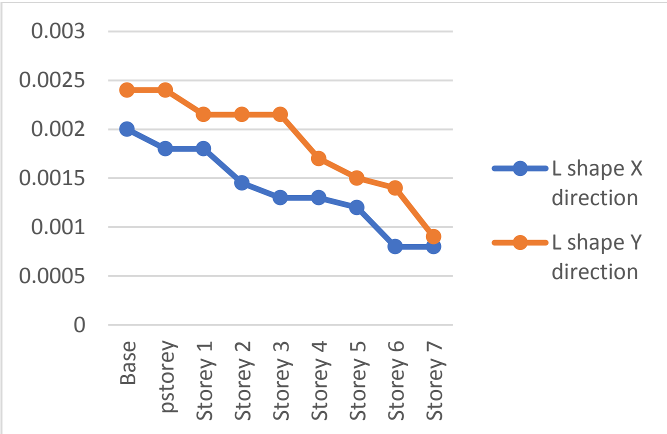

Fig. 4: Storey shear of L shape

5. CONCLUSIONS

•The lateral displacement of L-shaped building is more than rectangular buildings. In general we can say that regular shaped buildings shows lesser displacement than irregular buildings and hence they are safe against seismic loads. This may be due to slender geometry of L-shaped building as compared to rectangular.

•From linear static analysis it is observed that there is an increase of storey drift for L-shaped building as compared to rectangular model. The increase in the response demand may be due to the increase in the eccentricity due to plan configuration irregularity.

•There is an increase of base shear of rectangular model as compared to L-shaped model

•Considering all these above conclusions made on analysis of irregular structures, we may finally say that simple geometry attracts less force and perform well during the effect of earthquake.

•It is inevitable to omit complex geometries but these can be sorted into simpler one by providing seismic joint to reduce earthquake effect.

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