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Study on Residential Building of Constant Area and Different Shape Using ETABS

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ABSTRACT

Earthquake is a form of disaster which occurs due to Natural or Man-made errors resulting in extreme damages to human civilization and any form of structure created by us. Recent example of such a disastrous earthquake was seen in our neighbouring country Nepal, resulting in massive destruction to the entire country destroying its economy and placing a setback of more than 10 years. It was such an unusual disaster, that it is extremely vital for survival to ensure the strength of the structures against seismic forces. In this way, there is persistent research work going on around the world, rotating around the advancement of new and better methods that can be consolidated in structures for better seismic execution. Structures designed considering exceptional methods to resist such forces and seismic forces have a considerably higher cost of development than ordinary structures, yet for prosperity against tension on the structure under seismic forces, it is fundamental. An Earthquake can be defined as vibration on the earth surface due to sudden release of energy from the Earth core resulting in formation of seismic waves. Brutal seismic forces are capable enough to destroy entire urban communities and cause tremendous loss to life and property. The seismicity alludes to the size, type and recurrence of earthquakes experienced over some stretch of time. In this study we are analysing four different cases of a tall structure G+20 considering various structure shapes considering seismic analysis as per I.S. 1893-I:2002 for zone III (betul). In this study we will determine the most suitable shape of structure in terms of forces, moment, displacement and cost of the structure.

Keywords : Area, Analysis, Staad, Earthquake, Forces, Moment, Cost, Displacement

I. INTRODUCTION

Earthquake is a form of disaster which occurs due to Natural or Man-made errors resulting in extreme damages to human civilization and any form of structure created by us. Recent example of such a disastrous earthquake was seen in our neighbouring country Nepal, resulting in massive destruction to the entire country destroying its economy and placing a setback of more than 10 years. It was such an unusual disaster, that it is extremely vital for survival to ensure the strength of the structures against seismic forces. In this way, there is persistent research work going on around the world, rotating around the advancement of new and better methods that can be consolidated in structures for better seismic execution. Structures designed considering exceptional methods to resist such forces and seismic forces have a considerably higher cost of development than ordinary structures, yet for prosperity against tension on the structure under seismic forces, it is fundamental.

In this study we are analysing four different cases of a tall structure G+20 considering various structure shapes considering P-delta analysis as per I.S. 1893-I:2002.

II. LITERATURE REVIEW

Shriram et. al. (2018) Here author illustrate that earthquake play an important role in designing structures. Lot of work has been done by many researchers who worked to study the effect of earthquake on different shape. Being inspired from the work contributed in the study on effects of earthquake on different shaped building in plan, Author presents effects of four shape configuration i.e., RECTANGULAR, SQUARE, TRIANGULAR, CIRCULAR with same area. Buildings with different shape geometry react differently against earthquake. The effect of different shape of structure have been carried out by using SAP2000 software. SAP 2000 software is a software for designing a mathematical model of and mechanically analyzing civil structure like everything ranging from cable-stayed bridges to concrete walls. There are several factors which affect the behavior of building from which base shear and lateral displacement play an important role in understanding the behavior of structure. Results are expressed in form of tables, bar charts. It has been observed from the result that Triangular shape is best for base shear as compared to rectangular, square, circular shape.

Deepesh et. al. (2017) Seismic analysis of a multi-story Reinforced concrete frame is analyzed under moderate earthquake loads as an application of seismic hazard and in accordance with the seismic provisions proposed in IS: 1893-2002 to analyze the performance of existing buildings if exposed to seismic loads. The frame was analyzed using the response spectrum method to calculate the seismic displacements and stresses.

The behavior of Multi-story building of regular and irregular plan configuration under earthquake is complex and it varies of wind loads are assumed to act simultaneously with earthquake loads. The study of this research mainly emphasize the structural behavior of multi-storey building for different plan configuration such as regular building along with L- shape and I- shape. In this modeling of G+ 24 storey RCC framed building is studied for earthquake load using STAAD-PRO V8i. Assuming that material property is linear static and dynamic analysis is performed. These analyses are carried out by considering different seismic zones (III and V) and for each zone the behavior is assessed by taking three different types of soils namely Hard, Medium and Soft. Post analysis of the structure, lateral displacements, story drift, base shear, maximum bending moment and design results are computed and then compared for all the analyzed cases. Designs of these structures in all cases are also done to obtain the most economic structure above all the cases.

Ramchandani et. al. (2016) Here Authors describes the analysis process for non-linear static and dynamic analysis of structures have been developed in recent years. In this paper, the response spectrum analysis is performed on two different shapes *i.e.* regular and irregular shape of structure by using STAAD PRO. And the comparison results are studied and compared accounting for the earthquake characteristics and the structure dynamic characteristics. As the results show that the earthquake response peak values and the main response frequencies are very close and comparable. It can be referred to by the engineering applications.

SCOPE

Outcome from this study will serve as a base or datum for all developing high rise buildings where irregular shape is providing.

This study is meant to develop a concept of structural designing with considering different shaped structures.

OBJECTIVES

The main objective of this study is to study suitable shape of a building for project area it will result suitable building using ETABS software:

1. To Study the effect of seismic forces over different shapes buildings.
2. To Study the effect of different shapes of residential buildings.
3. To Study and recommended suitable shape of buildings.
4. To study the cost analysis of all different shape with constant area building on proposed site area.

III. METHODOLOGY

Table 1: Geometrical details

Number of Stories	19
Support condition	Fixed
Story height	3m
Concrete Grade	35MPa
Steel Grade	Fe500
Size of columns	650×650
Size of beam	450×450
Height of Parapet wall	1.2m
Parapet Wall Thickness	150mm
Wall Thickness	300mm
Slab Thickness	150mm

Cases selected for comparative study are as follows:

Case I: Square Shape

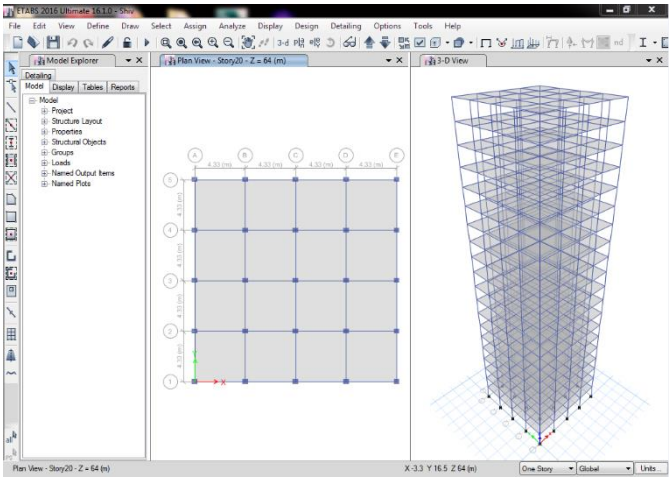

Fig 1: Square Shape

Case II: H Shape

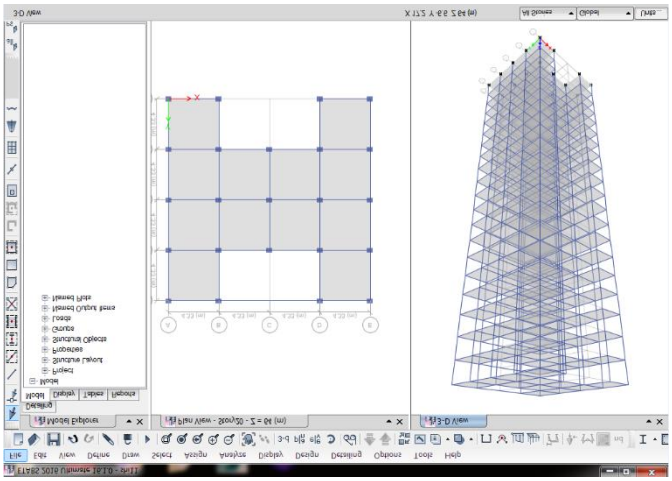

Fig 2: H Shape Structure

Case III: Plus Shape:

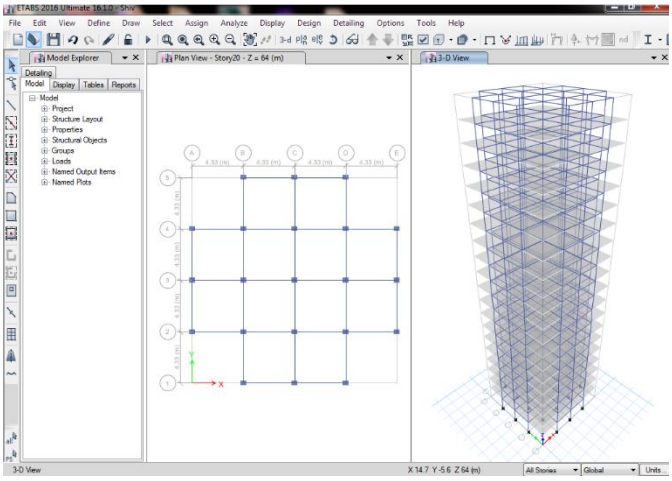

Fig 3: Plus Shape Structure

Case IV: T Shape Structure

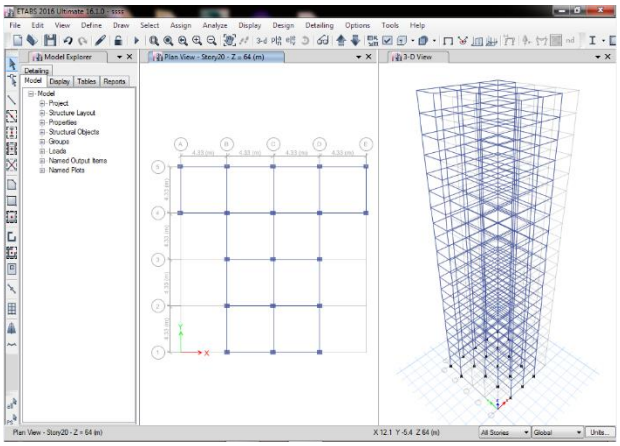

Fig 4 : T Shape Structure

General advances required for investigation and plan of the multi-story RCC building are given underneath :-

Step-1 Modelling of building frames

Step-2 Assigning section properties and material

Step-3 Assigning supports

Step-4 Application of Load

Step-5 Selection of parameters of seismic Definition of various soil conditions

Step-6 Application of response Spectrum

Step-7 Formation of load combination (8 load combination)

Step-8 Design of RCC structure

IV. Analysis Results

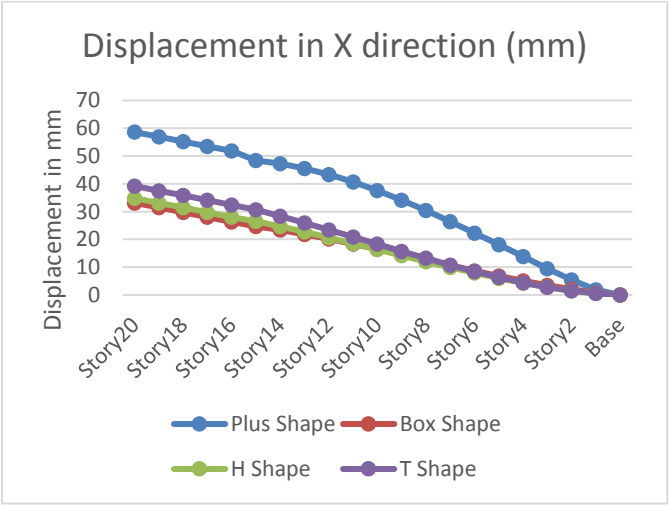

Fig 5: Displacement

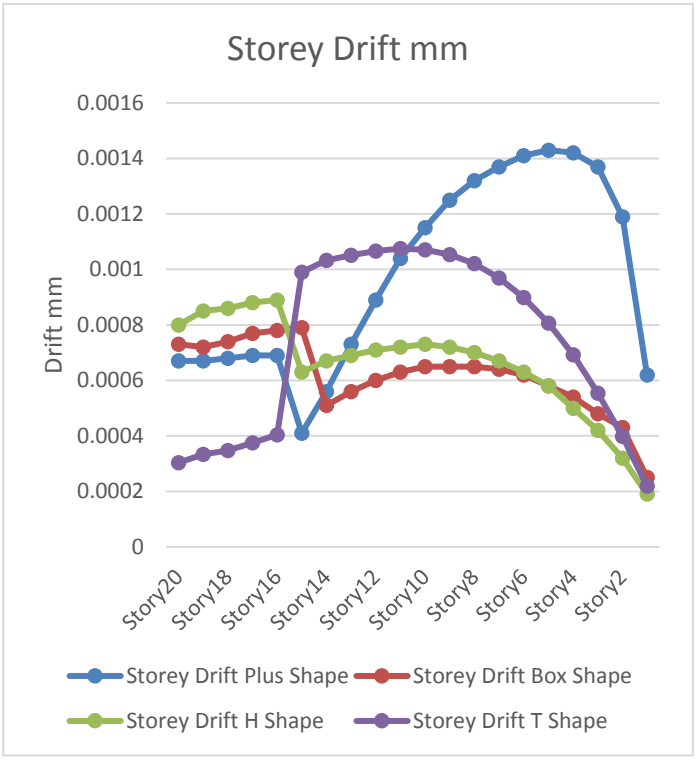

Fig 6: Drift

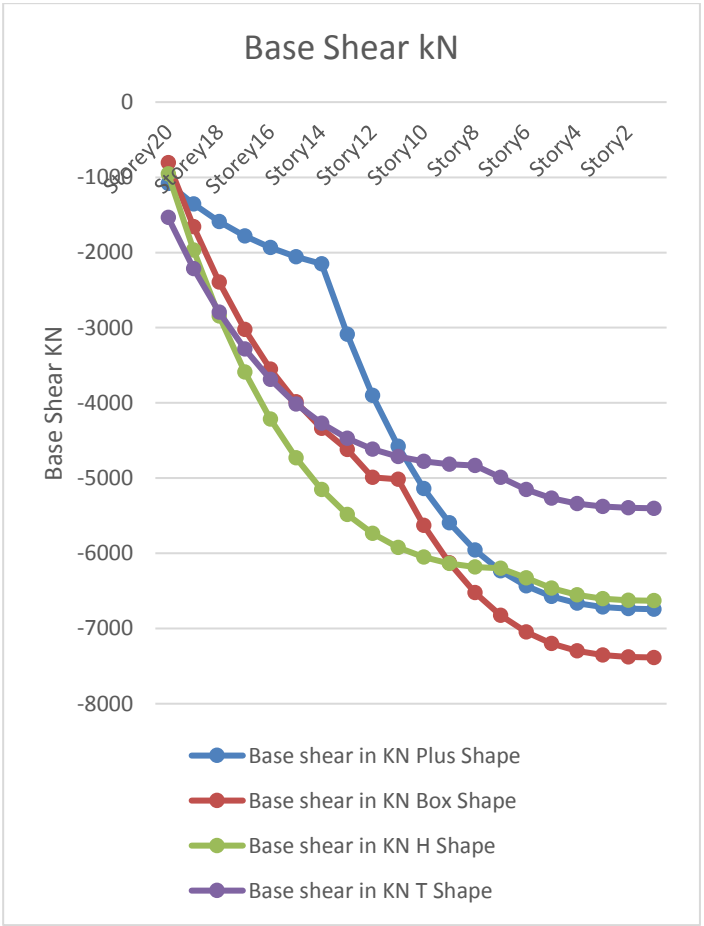

Fig 7: Base Shear

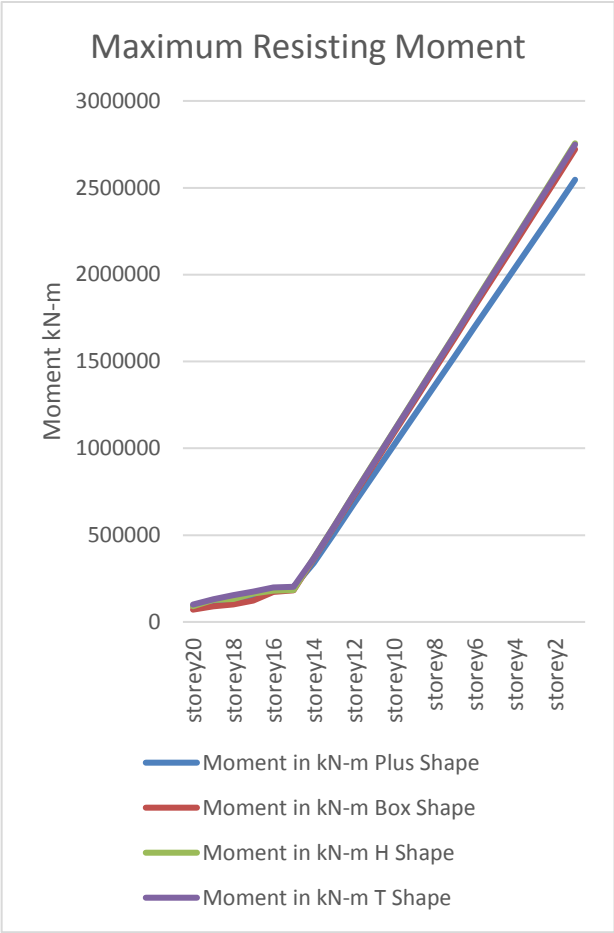

Fig 8: Moment

V. CONCLUSION

1) Lateral displacement is maximum in model in T shape at every floor and model with box shape shows least values. Considering the effect of lateral displacement on different shapes of the building of the structure. it has been observed that, Plus-shape ,H-shape and T-shape building have displaced more in both direction (X and Y) in comparison to box shaped building.

2) Story drift has significantly influenced with the shape of structure. In comparison to other cases, model in box shape shows least story drift value in comparison to other models.

3) The shape of shear wall and its position have significant difference in the time period. From the ETABS 2016.v16.1 analysis model 2 shows minimum time period in comparison to other models due to the presence of box shape which is symmetrical about building.

4) 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 theses can be sorted into simpler one by providing seismic joint to reduce earthquake effect.

5) The value of torsion is maximum for T shape in whereas Box shaped presented the least torsion moment.

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