Different PlanConfiguration for design of Multi-Storey Building

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ABSTRACT

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, lateraldisplacements, 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.

Keywords : Structural Analysis and Design, High Rise Building, Response Spectrum, Plan Irregularity, STAAD-Pro V8i.

I. INTRODUCTION

Earthquake has always been a threat to human civilization from the day of its existence, devastating calamity that it is very necessary for survival to ensure the strength of the structures against seismic forces. Therefore there is continuous research work going on around the globe, revolving around development of new and better techniques that can be incorporated in structures for better seismic performance. Obviously, buildings designed with special techniques to resist damages during seismic activity have much higher cost of construction than human lives, property and man-made structures. The very recent earthquake that we faced in our neighboring country Nepal has again shown nature's fury, causing such a massive destruction to the country and its people. It is such an unpredictable normal buildings, but for safety against failures under seismic forces it is a prerequisite.

Objective of this research is to study the effect of plan irregularity on the seismic behavior of the building. In this, modeling of G+24 storey RCC frame building is analyzed using Staad-Pro V8i software.

1) To study various effects of plan irregularity in the structure various parameters such as lateral displacement, inter-storey drift, base shear etc, are studied. These parameters are studied so that the

structure constructed can safely withstand the earthquake shocks and the associated unpredictable ground motion.

2) To evaluate the effect of plan irregularity on comparative cost of structure.

3) To study the effect of Mode shapes that is generated from dynamic analysis on design of structure.

Mohit Sharma and Dr. Savita Maru (2014), Analysis and design of buildings for static forcesis a regular event these days because of availability of specialized programs and affordable computers which can be used for the analysis. On the other hand, dynamic analysis requires enormous time along with additional input related to mass of the structure, and an understanding of structural dynamics for interpretation of analytical results. Reinforced cement concrete frame buildings are most regular type of constructions generally provided in urban India, which are subjected to several types of forces during their lifetime, such as static forces due to live and dead loads and dynamic forces due to the earthquake.

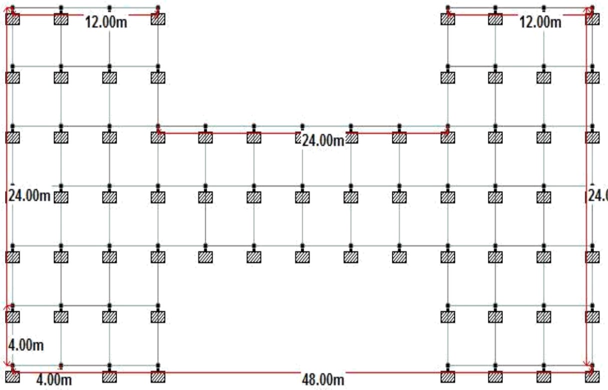
The performance of RCC Framed Structure is analyzed in zone II and III for both Static and Dynamic analysis and the results are tabulated. It has been seen that the values obtained for the Dynamic analysis are higher than that of obtained by Static Analysis for the same points and conditions.

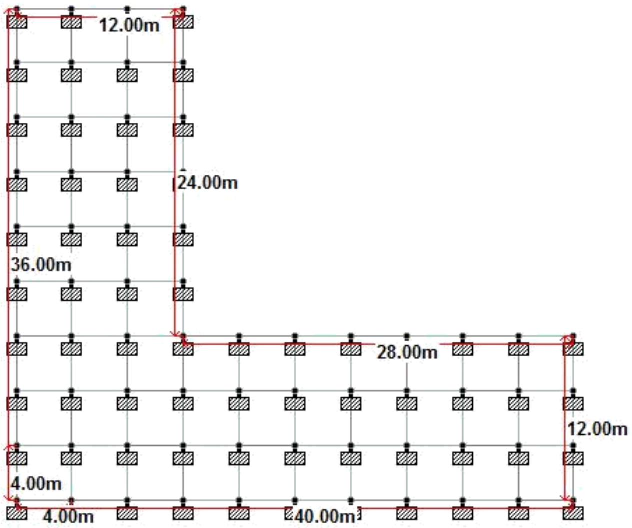
S.Mahesh and Dr.B.Panduranga Rao (2014) studied the effect of earthquake and wind load onG+11 multi story building using ETABS and STAAD PRO V8i .Assuming that material property is linear static and dynamic analysis are performed. These analysis are carried out by considering different seismic zones and for each zone the behavior is assessed by taking three different types of soils namely Hard , Medium and Soft .Different response like story drift, displacements base shear are plotted for different zones and different types of soils. From the above study it is inferred that the E-tabs gives more accurate results of the parameters used in analysis whereas the approximate results were obtained from STAAD-Pro during the analysis of the structure.

Milind V. Mohod (September 2015)studied the effects of plan and shape configuration onirregular shaped structures. Buildings with irregular geometry respond differently against seismic action. Plan geometry is the parameter which decides its performance against different loading conditions. The effect of irregularity (plan and shape) on structure has been carried out by using structural analysis software STAAD Pro. V8i. There are several factors which affect the behavior of building such as storey drift and lateral displacement used to understand the behavior of structure. It has been observed from the research that simple plan and configuration must be adopted at the planning stage to minimize the effect of earthquake.

II. Methodology And Loadings

An RCC Structure is mainly an assembly of Beams, Columns, Slabs and foundation inter-connected to each other as a single unit. Generally the transfer of load in these structures is from slab to beam, from beam to column and finally column to foundation which in turn transfers the entire load to the soil. In this study, we have adopted three cases by assuming different shapes for the structure modeled using STAAD-Pro V8i.





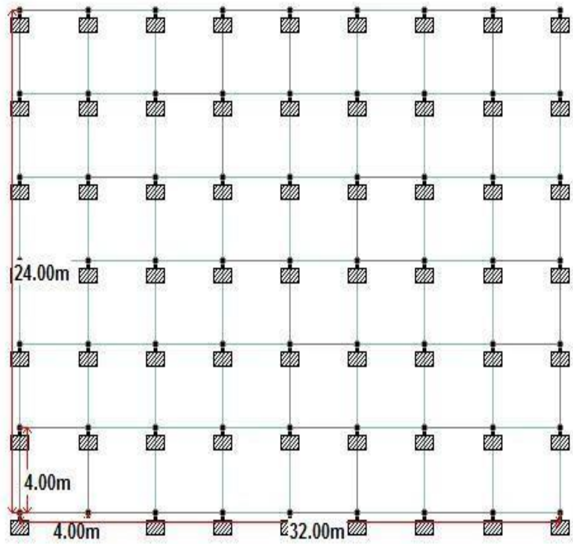


Fig:1 different geometric plans of building consider

For the analysis of the structure all the load conditions to the structure are applied. The values of design loads are calculated as per IS-875 Part I and II and IS-1893 part I. Dead loads shall be calculated on the basis of unit weights of materials given in IS 875 (Part I) which shall be established taking into consideration the materials specified for construction. The distribution of dead load is shown in figure 3.9. Imposed load is defined as the load that is applied to the structure that is not permanent and can be variable and shall be assumed in accordance with IS 87S (Part II).

Table:1 building sections and property considered

S. No.	Building- Description	
1.	Plan Area	768m^2
2.	X-Y Direction Grid Spacing	4m x 4m
3.	Storey Height	3.5m
4.	Number of storey	20
5.	Beam Dimension	350mm x 450mm

6.	Column Dimension	600mm x 600mm
7.	Slab Thickness	150mm
8.	Thickness of main wall	200mm
9.	Thickness of parapet wall	125mm
10.	Height of parapet wall	1000 mm
11.	Bottom Support Condition	Fixed

III. RESULTS

Maximum Bending Moment (KN-m)

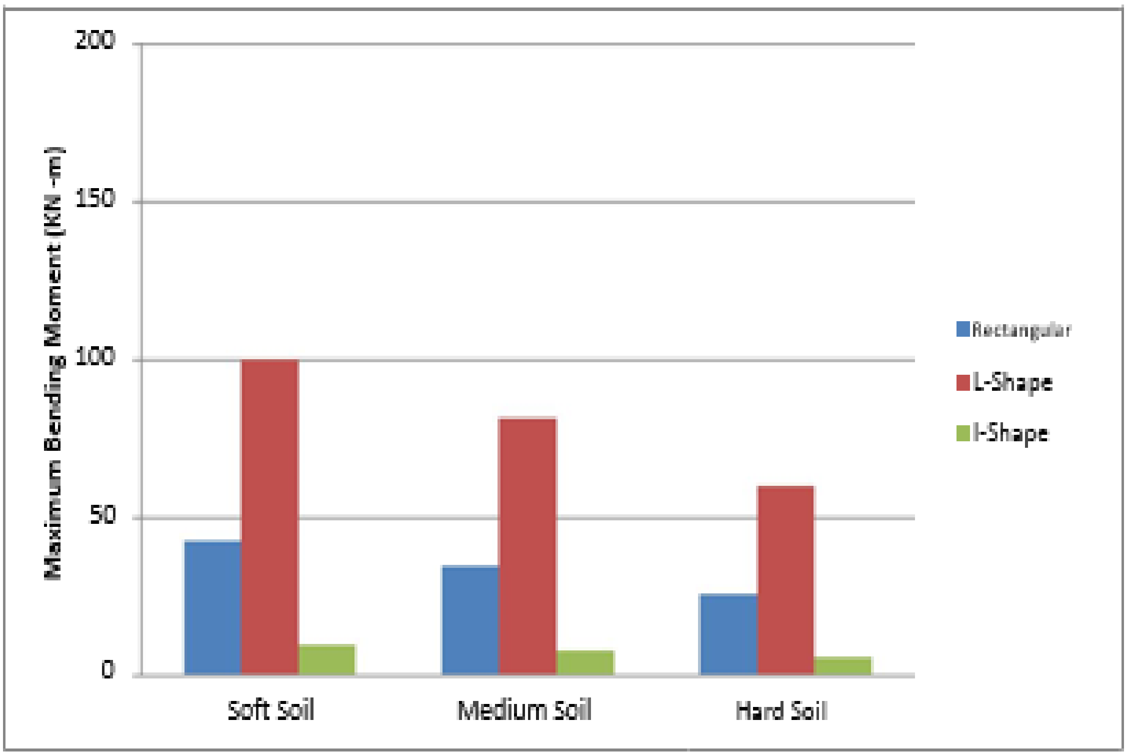


Fig:2 Maximum bending moment.

Quantity of concrete (cum.)

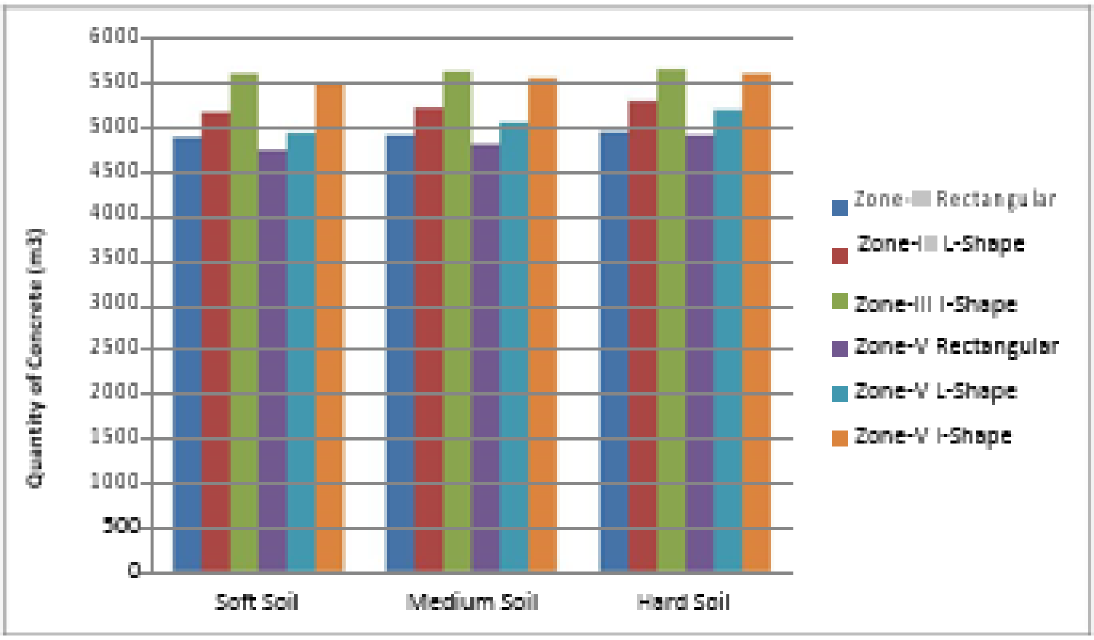


Fig:3 quantity of concrete (cum)

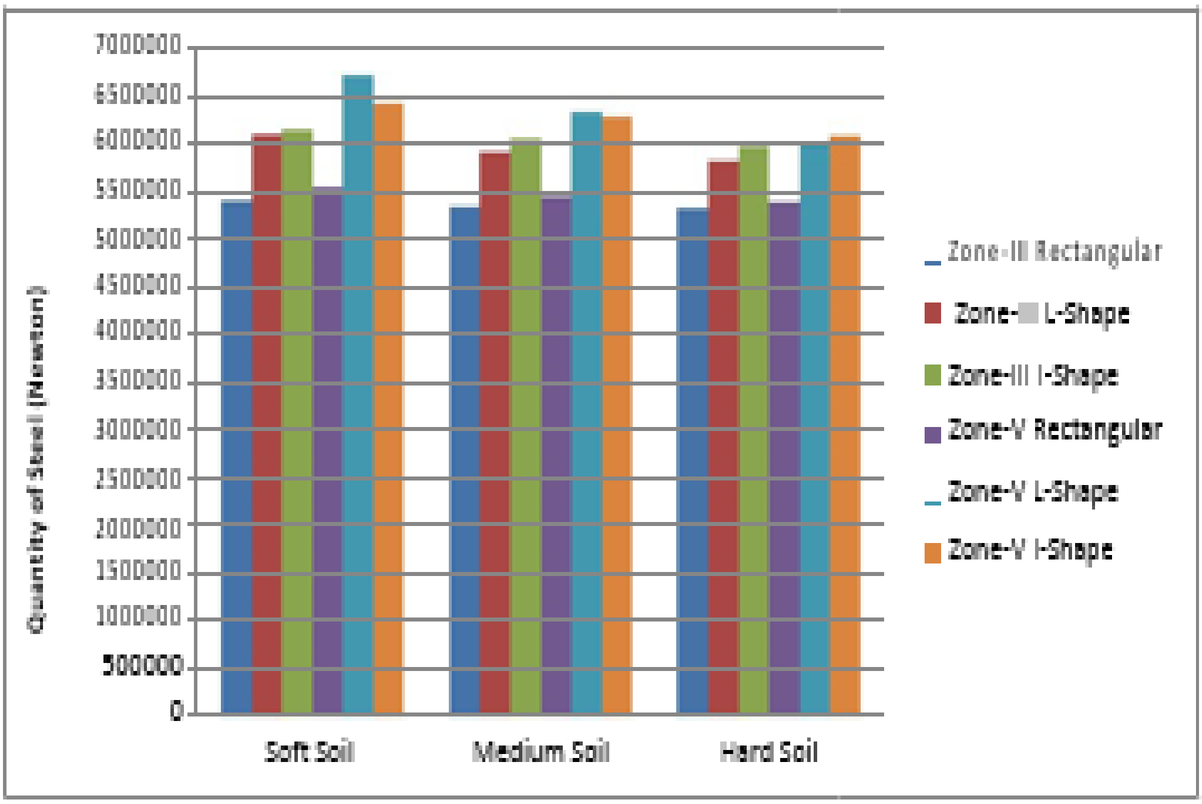


Fig:4 quantity of steel (newton)

INTERSTOREY DRIFT:

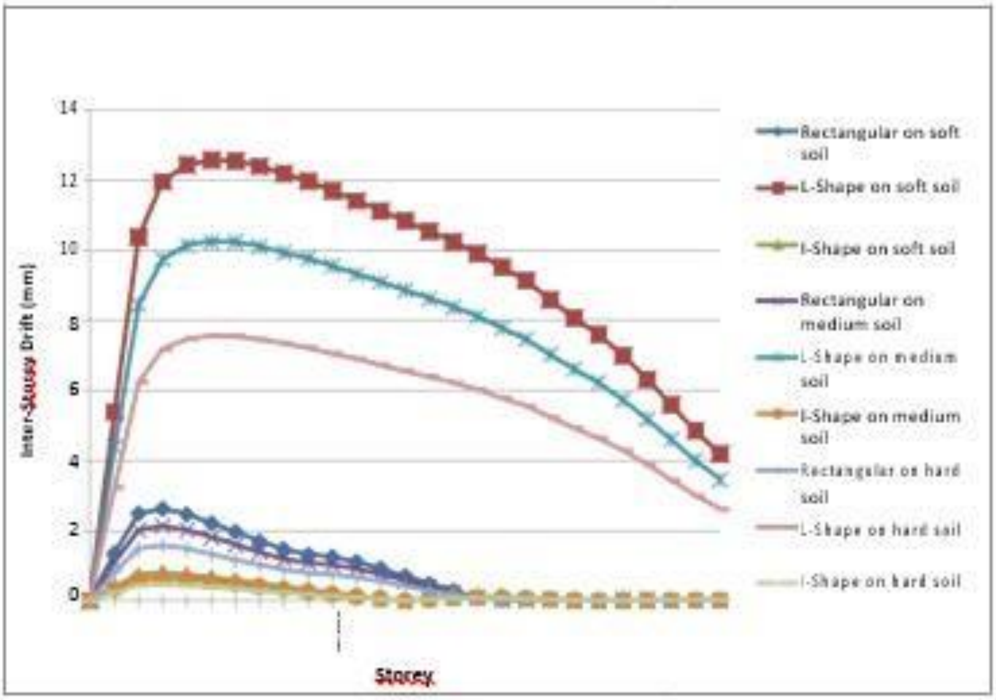


Fig:5 inter-storey drift

Storey displacement:

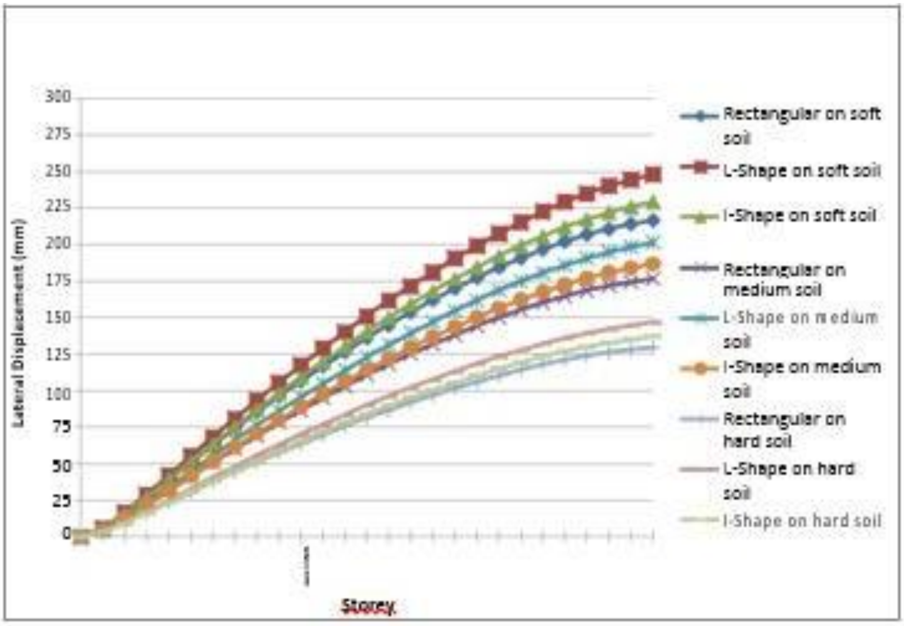


Fig:5 storey displacement

IV. CONCLUSION

1. The value of both maximum bending moment and maximum displacement is maximum in L-shape which shows torsion irregularity in the plan geometry whereas, the Rectangular and I-Shape shows similar results.
2. While considering the effect of lateral displacement on different shapes of the building of the structure it has been observed that, asymmetrical shape such as L-shape shows higher value which means building is

displaced more in both directions as compare to regular shape.

3. It is clearly visible that the inter-storey drift increases with storey height up to 4th storey reaches the maximum value and then started decreasing. The inter-storey drift value is maximum for L-shape whereas the rectangular shape gives the best results in X-direction while in Z-direction rectangular and I-shape type of buildings gives almost similar results.
4. Design results shows than the overall cost of irregular structure is much higher due to torsion and high shear force the amount of steel and concrete required is more as compared to regular structure which shows less requirement of concrete and steel.

V. FUTUTRE SCOPE

1. We can also study the effect of different other complex geometries such as T- Shape, E-Shape, Y-Shape, Channel Shape etc, on RCC frame using Response spectrum method.
2. The effect of combined irregularity both in plan as well as in elevation can be studied.
3. The effect of change in height can also be studied by increasing the height of the building by introducing different lateral load resisting elements.

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