Seismic Analysis of Plan Irregular Buildings Using Staad-Pro

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Abstract- *The earthquake is a natural phenomenon which can generate most destructive forces on structure. Therefore, building should be safe for lives by proper design and detailing of structural members in order to have a resistance, so structure can withstand against seismic power. This paper consist study of behavior of multistoried building having plan irregularities by seismic coefficient method. Results of different irregular C, H, T and L shaped structures are compared to get more resistive result for residential building against seismic force. For same zone, the behavior is assessed by taking three different types of soils namely Hard, Medium and Soft for each shape C, H, T and L building. Post analysis of the structure, displacements, storey drift, and base shear results are also computed and compared for all the cases.*

Keywords- Plan irregularity, Seismic coefficient method, Seismic Analysis, Soil types, STAAD-Pro software.

I. INTRODUCTION

During an earthquake, failure of structure starts at points of weakness. This weakness arises due to discontinuity in mass, stiffness and geometry of structure. The structures having this discontinuity are termed as Irregular structures.The behavior of a building during an earthquake depends on several factors, stiffness, and adequate lateral strength, and ductility, simple and regular configurations.The buildings with regular geometry and uniformly distributed mass and stiffness in plan as well as in elevation suffer much less damage compared to irregular configurations. But nowadays the need and demand of the latest generation and growing Population has made the architects or engineers inevitable towards planning irregular Configurations.

II. OBJECTIVE AND SCOPE OF WORK

The goal of this research is to determine various seismic responses of RC framed regular and plan irregular structure. The comparison between various seismic parameters would suggest the suitable building configuration.

III. METHODOLODGY

Here we have taken G+6 storey plan regular structure for authentication purpose and we get the same answers for seismic weight in manual and in STAAD-Pro software. For our further work of regular and irregular shape we have taken G+7 storey with storey height of 3.5m provided. Also properties are defined. The seismic zone considered is zone-III. We have adopted 5 cases by assuming different plan and soil type. Different irregular buildings are C, L, H and T shape. The modelling of building is done for Indian seismic zone III, IS-1893:2016. For given structures applied loading includes seismic load, dead load, live load according to IS 875 part I & II and IS 1893/ 2016. Analysis is carried out by seismic coefficient method and STAAD-Pro software. Manual calculations of seismic coefficient method is carried out in Excel.

The analysis is carried out to determine maximum nodal displacement, storey drift and maximum base shear. After the calculations the results are shown in the form of graph in the conclusion.

IV. PLAN SPECIFICATIONS

- Plan dimension: 20m×15m
- No. of storey:7
- Beam dimension:0.4m×0.45m
- Column dimension:0.55m×0.55m
- Slab thickness:0.15m
- Bay width:5m in both direction
- Floor finish:1KN/m^2
- Live load:2KN/m^2
- Importance factor:1
- Response reduction factor:5
- Zone factor:0.16
- Concrete density:25KN/m^3
- Masonry density:20KN/m^3

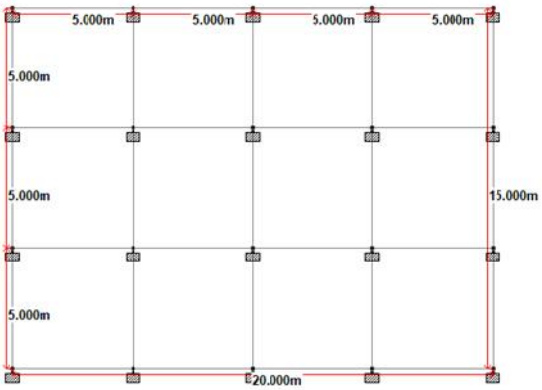


Fig-1 Plan of regular building

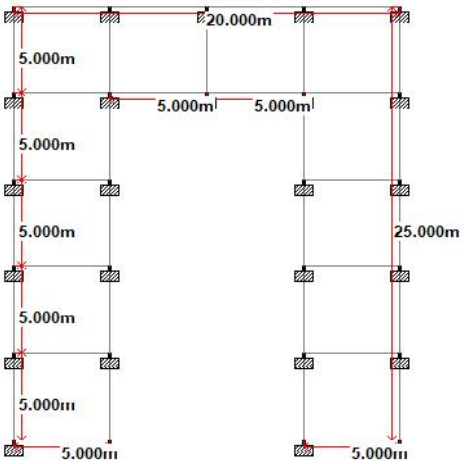


Fig-2 Irregular plan for C-shape building

V. MODELLING

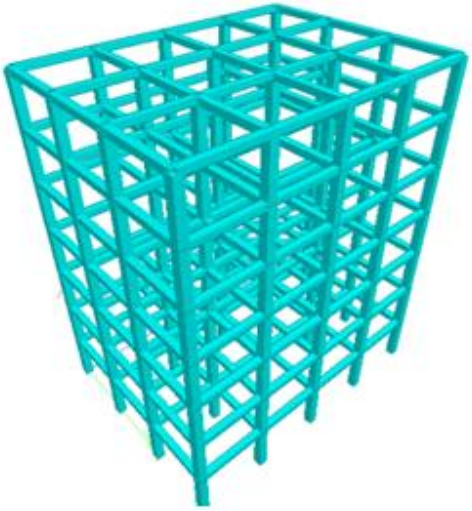


Fig-3 model-1 Regular shape

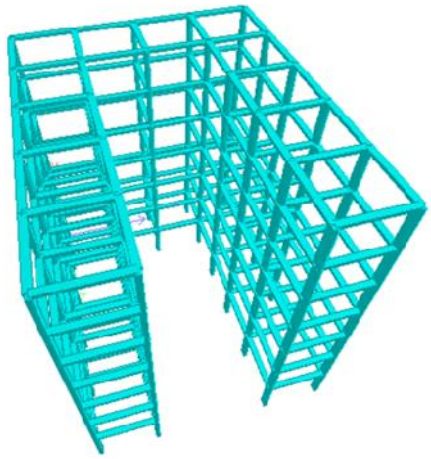


Fig-4 model-2 C-shape

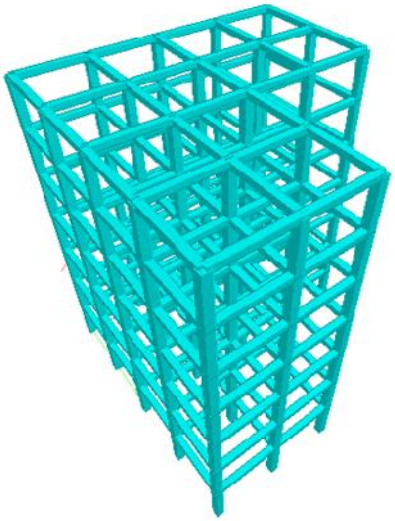


Fig-5 model-3 L-shape

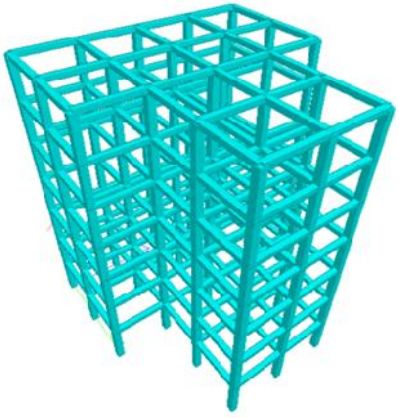


Fig-6 model-4 T-shape

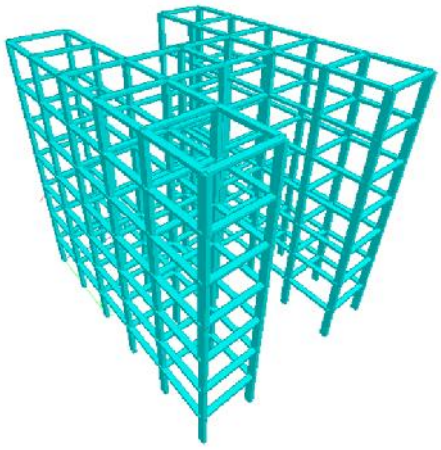
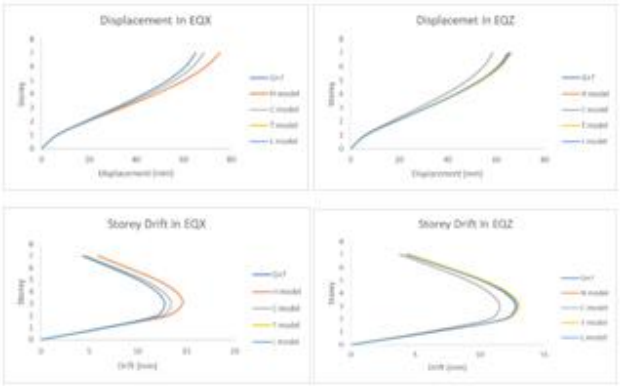


Fig-7model-5 H-shape

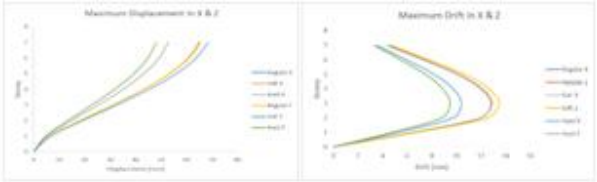
VI. ANALYSIS AND RESULTS

The graph shows the comparison of Regular and Irregular models for Nodal displacement and Storey drift.

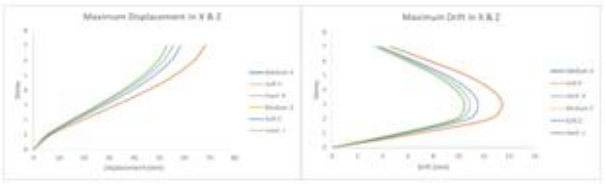


The graph shows the comparison of different soil type for regular and irregular models.

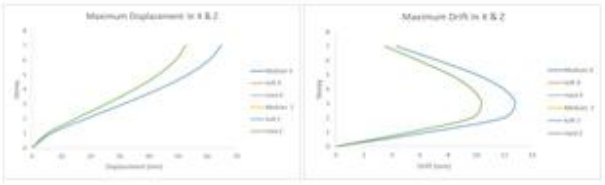
1. For regular model



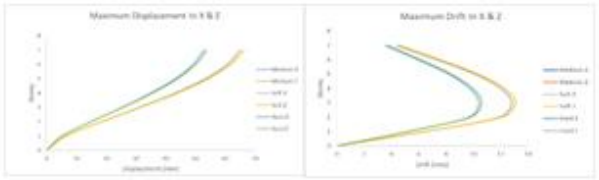
2. For C shape model



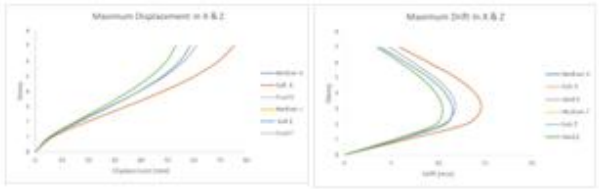
3. For L shape model



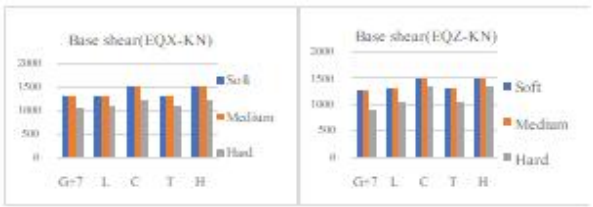
4. For T shape model



5. For H shape model



The graph shows the comparison between Regular and Irregular models for base shear.



VII. CONCLUSION

- Maximum displacement is 49.07% more in H-shape with compare to regular shape for EQX direction.And for EQZ direction, 43.52% more displacement in compare to regular shape.
- The base shear of C & H shape has maximum shear with compare to regular model.

- From the available graph we have seen that the value of storey drift will be increasing upto 3rd storey. After that the above storeys the value is decreasing .So we conclude that for H shape irregular model the maximum storey drift will be occurred in X direction. For T-shape irregular model maximum storey drift will occurred in Z direction with compare to regular shape.
- From the graph and analysis of different soil type maximum displacement in X direction, H-shape 46.04% more in medium and soft with compare to hard soil. In Z direction, T-shape 35.74% more of medium and soft with compare to hard soil.
- From the graph and analysis of different soil type maximum drift in X direction is in H-shape 0.29% more in medium and soft with compare to hard soil. In Z direction, C-shape 0.13% more of medium soil with compare to hard soil.
- The base shear for L & T shape is same and similarly same for C & H shape model.This is because the orientation of building and percentage of irregularity. It is also easily seen that from all the structure the base shear goes increasing as the percentage of irregularity increases.

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