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SEISMIC ANALYSIS OF REGULAR AND IRREGULAR BUILDINGS WITH VERTICAL IRREGULARITY USING STAAD.Pro

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Abstract-*This analysis aims to the seismic response of various vertical irregularity structures. The project is done by Response spectrum analysis (RSA) of vertically irregular RC building. This study includes the modelling of regular and H-shape plan irregular building having area of 25X25m and height of 3.5 m from each G+10 storey .The performance of this framed building during study earthquake motions depends on the distribution of stiffness, strength, and mass in both the horizontal and vertical planes of the building. The main aim of this work is comparative study of the stiffness of the structure by considering the three models in Regular Structure and three models in Plan irregular structure with different Vertical irregular structure. All models are analysedwith dynamic earthquake loading for the Zones V .Result found from the response spectrum analysis that in irregular shaped building displacements are more than that of regular shaped building. All building frames are modelled&analysed in software Staad.Pro V8i. Various seismic responses like base shear, frequency, node displacement, etc. are obtained. The overall performance of regular building is found better than irregular building.The seismic performance of multistory regular building is determined by Response Spectrum analysis in STAAD Pro. Software.*

Keywords*: *STAAD Pro, Response Spectrum Analysis

1.INTRODUCTION

Earthquake means the sudden vibration of earth which is caused by naturally or manually. We know that different type of vertical irregularities buildings are used in modern infrastructure. During an earthquake, the building tends to collapse. This is mainly due to discontinuity in geometry, mass and stiffness. This discontinuity is termed as Irregular structures. So vertical irregularities are one of the major reasons of failures of structures during earthquakes.In planning stage of vertical irregularity due to some architectural and functional reasons. The irregular building can't be avoided during the construction may due to space requirement in construction field so the tall structure has more demand.In the recent days the tall structure has more demand for the construction. The structural must withstand against lateral force acting on the structure due to the wind load another natural calamities so in this project the comparative studies is done for the zone V by providing the required size of the columns and beams by following Indian standards. If this analysis is not proper means the effect of earthquake may cause the structural collapse and life of people may spoil. So it may cause homeless to common people. So structure should be design in a proper way. The structure which performs against the earthquake means a structure must possess the simple, regular configuration and minimum lateral strength and also stiffness of the structure.. 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.. The behaviour 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.

The effects of non-structural infill walls are neglected by seismic codes during analysis. This neglects the effect of infill stiffness by assuming that this would give some conservative results, Fardis and Panagiotakos (1997). But this is not true in the case of columns present in the open ground storey. Many codes (e.g., IS 1893- 2002, EC -8, IBC) recommends a factor to take care for the magnification of bending moments and shear forces. This factor is known as multiplication factor.

2. OBJECTIVES

- To compare the behaviour of a regular building and plan irregular building in terms of response spectrum analysis.
- To compare the base shear and node displacement, time period, frequencies of

different types vertically irregular H shaped building.

- To identify the best building configuration from this analysis.

3. SCOPE

- Regular and H shaped RC buildings are considered.
- Only vertical geometric irregularity was studied.
- Response spectrum analysis
- Slabs are considered as solid structures
- Sesmic zone V is considered
- Medium type soil is considered

4. METHODOLOGY

Here the study is carried out for the behaviour of G+10 Storied Buildings, Floor height provided as 3.5m and also properties are defined for the building structure. The model of buildings is created in Staad pro software. The seismic zone considered is zone V and soil type is medium. Six models of buildings are prepared. Two types geometry are adopted this analysis regular and H shaped plan irregular building. Three different vertical irregular building such as stepped, inverted T,U shaped are modelled in both regular and irregular(H shape) building. The modelling of building is done for Indian Seismic Zone V, IS 1893-2002.For given structure, loading with applied loads includes live load, earthquake load and dead load are according to IS 875 part I, part II and IS1893-2002 respectively. Analysis is carried out by Response Spectrum Analysis using Staad pro software. The analysis is carried out to determine maximum node displacement and base shear. After analysis, results are obtained in the form of graphs which are in turn observed to form conclusions

Table -1: Dimensional Details of the Building

Plan dimension	25m×25m
Type of building:	Special moment resisting frame
Specific weight of infill	20 kN/m^3
Number of stories	G+10
Floor height	3.5 m
Grade of Concrete	M20
Grade of steel	Fe 415
Beam dimension	230mm×280mm
Column dimension	280mm ×280mm
Slab depth	150mm

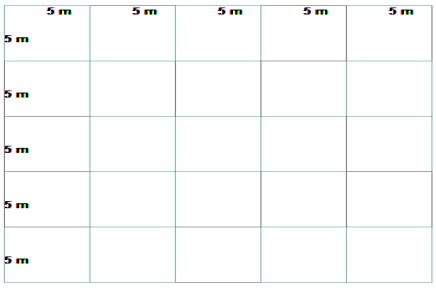

Fig. 1 -Plan of Regular square

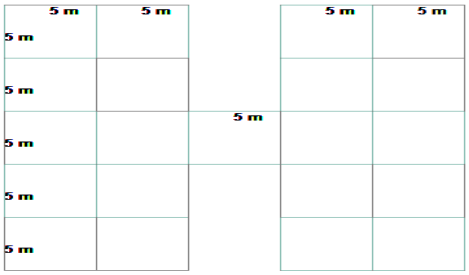

Fig. 2 -Plan of irregular H shaped Building

Table – 2: Details of Dead Load and Live Load

Load	Value
FL	1.5kN/m^2
LL	3kN/m^2

Table -3: Details of Seismic Load

Zone	V
Soil Type	Type II(medium)
Zone Factor, Z	0.36
Importance Factor, I	1
Response Reduction Factor,R	5

5. MODELLING

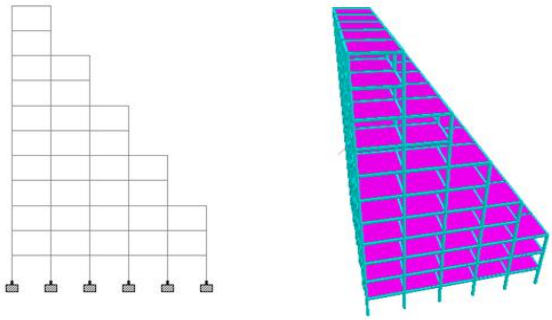

Fig 3- Model 1-Regular with stepped

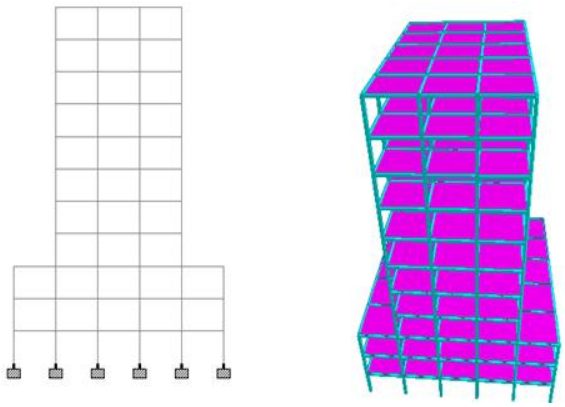

Fig 4-Model 2-Regular with inverted T

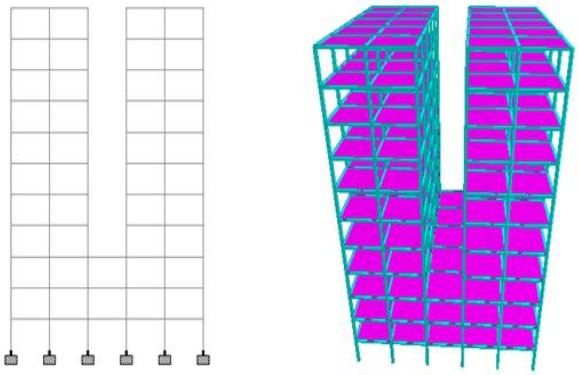

Fig 5-Model 3-Regular with U

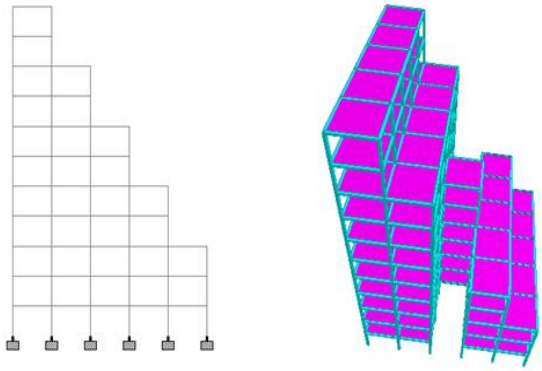

Fig 6-Model 4-Irregular with stepped

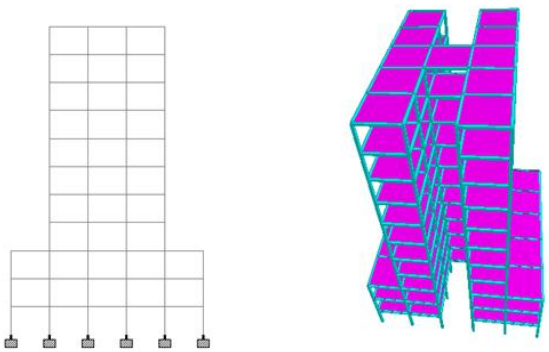

Fig 7- Model 5-Irregular with inverted T

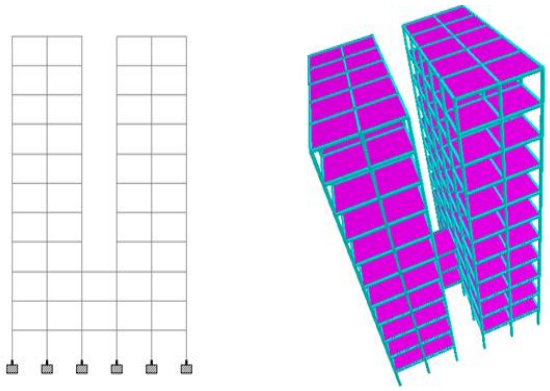

Fig 8-Model 6-Irregular with U

6.ANALYSIS RESULTS

The building with both geometry is analysed by Response spectrum analysis. The maximum node displacement data is taken for comparison from the analysis results. The maximum node displacement values for each model are tabulated below

Table - 2: Maximum node displacement

Model	Regular with stepped	Regular with inverted T	Regular with U	Irregular(H shape) with stepped	Irregular with inverted T	Irregular with U
Node displacement(mm)	90.073	92.586	95.008	69.271	84.981	91.849

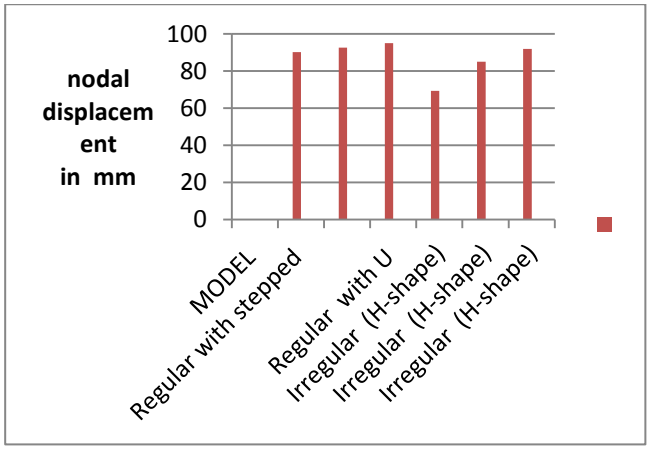

Fig.9-Comparison of maximum node displacement for each model

Table - 3: Maximum time period and frequency

Model	Regular with stepped	Regular with inverted T	Regular with U	Irregular(H shape) with stepped	Irregular with inverted T	Irregular with U
Frequency	0.417	0.388	0.366	0.417	0.407	0.359
Time period	2.399	2.580	2.732	2.398	2.459	2.784

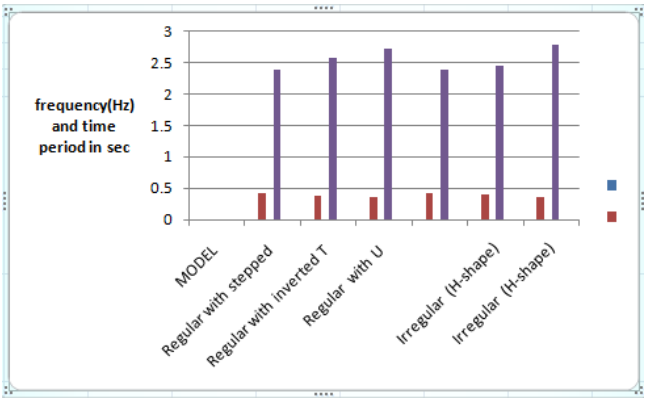

Fig.10-Comparison of maximum time period and frequency for each model

Table -3: Maximum Base shear

Model	Regular with stepped	Regular with inverted T	Regular with U	Irregular(H shape) with stepped	Irregular with inverted T	Irregular with U
Base shear(kN)	309.89	373.42	398.24	338.76	324.16	382.90

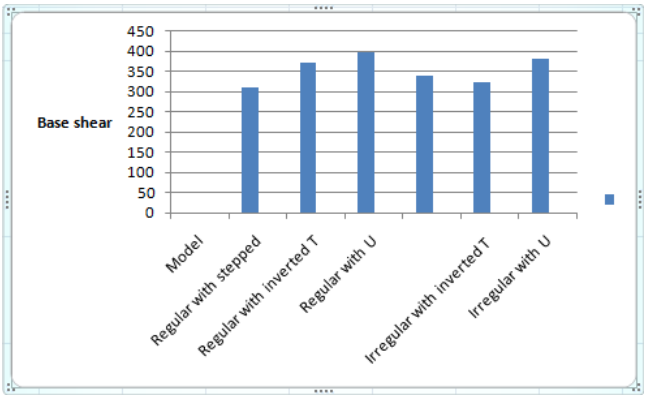

Fig.11-Comparison of Base shear for each model

7.CONCLUSIONS

- Response spectrum method allows a clear understanding of the contributions of different modes of vibration. It is also useful for approximate evaluation of seismic reliability of structures.
- Comparing the maximum base shear for both regular building and irregular building the maximum shear is obtained for regular building.
- Time period is maximum for H-shaped plan configuration.
- Average Frequency was maximum for Irregular Buildings.
- Maximum displacement for regular shapes and minimum for irregular shapes.
- Regular with U shaped vertical irregular building have maximum displacement compared to other shapes..

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