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Dynamic Analysis of RC Multi-Storied Building for Various Irregular Conditions

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A B S T R A C T

The presence of vertical geometrical irregularity in building is a matter of concern when it is subjected to devastating earthquakes. Irregular configuration either in plan or in elevation is recognize as one of major causes of failure during earthquakes. The performance of a high rise building during strong earthquake motions depends on the distribution of stiffness, strength and mass along both the vertical and horizontal directions. If there is discontinuity in stiffness, strength and mass between adjoining storeys of a building then such a building is known as irregular building which triggers structural collapse of building when subjected to seismic loading. In the present study structures with regular and vertical irregularity buildings in different zones are considered and responses of the buildings are compared. Modelling of these all types of models is done with STAAD. Pro software for G + 17 storey. The goal of the study is to compare model results like Displacement, Base Shear & Drift values and find out which model performs better.

Key Words: Regular building, Vertical Geometric Irregular building ,Earthquake, STAAD Pro.

1. INTRODUCTION

A Earthquake causes the random ground motions in all directions, radiating from the epicenter. These ground motions cause structure to vibrate and induces inertia forces in them. For the structure to perform better during the earthquakes, it must be analyzed and designed as per the Indian seismic code IS 1893 (Part 1) 2016. In the past, several major earthquakes have exposed the shortcomings in buildings, which had caused them to damage or collapse. It has been found that regular shaped buildings perform better during earthquakes. Earthquakes causes ground to vibrate and structures supported on ground are subjected to this motion.

Thus the dynamic loading on the structure during an earthquake is not an external loading, but due to motion of support. The building can be designed to resist earthquake with certain amount of damage, but without causing the collapse and affecting the livelihood. The response spectrum represents an interaction between ground acceleration and the structural system, by envelope of several different ground motion records. Response spectrum analysis of the building model is performed using STAAD Pro.

1.1 Objectives Of Study

The objectives of this study are follows:

1) To perform a comparative study of the various seismic parameters of different types of reinforced concrete moment resisting frames with varying number of stories, configuration, and types of irregularity.

2) Analyzing the irregular buildings to earthquake by response spectrum analysis by using STAAD Pro software.

3) To propose the best suitable building configuration on the existing condition.

4) To compare the results such as displacement, Base Shear & Drift value of structural members.

1.2 SCOPE OF WORK :

There are some suggestions for future research work on pounding between adjacent structures

- Extension of this work needs to consider the different geometries, soils and seismic zones.
- Dynamic analysis of irregular structure with various structural systems.

2. Modeling and Analysis of Building

To observe the regular and irregular effect on buildings a Buildings is considered for this study. The buildings were modelled by using STAAD Pro software for all cases. The following cases are studied in this project.

2.1 Building Description

Number of stories	G+17
Story height	3.0m
Grade of concrete (for beams and slabs)	M30
Grade of steel	Fe500
Unit weight of concrete	25 kN/m^3
Unit weight of brick masonry	20 kN/m^3
Floor Finish+ unknown force	2 kN/m^2
Live load	3 kN/m^2
Beam size	0.45m x 0.45m
Column size	0.6m x 0.45m
Slab	150mm
Zone	IV&V
Response reduction factor	4&5
Importance factor	11
Soil type	I

Building Modeling

Footnotes should be avoided if possible. Necessary footnotes should be denoted in the text by consecutive superscript letters[1]. The footnotes should be typed single spaced, and in smaller type size (7pt), at the foot of the page in which they are mentioned, and separated from the main text by a one line space extending at the foot of the column. The Els-footnote style is available in the MS Word for the text of the footnote.

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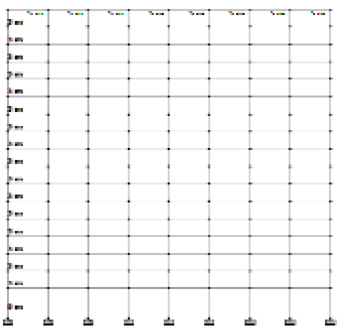

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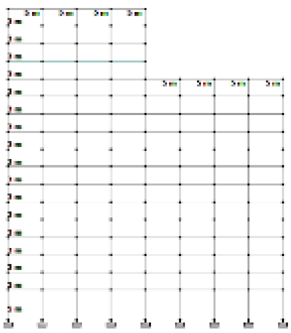

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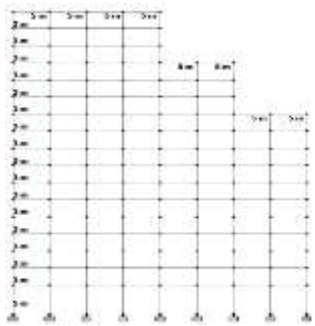

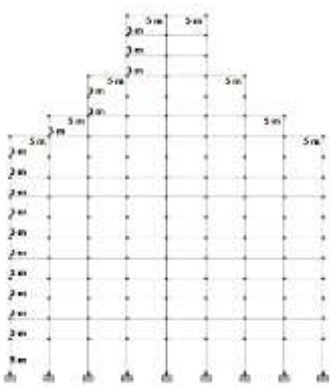

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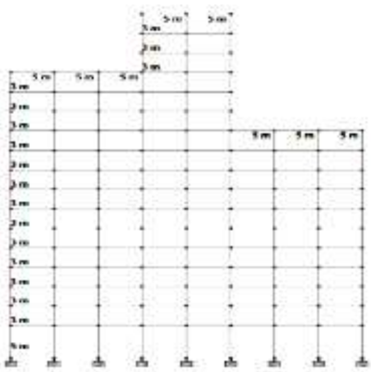

CASE 5

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3. Analysis Methods:-

Response Spectrum Analysis

Response spectrum analysis is a method to estimate the structural response to short, nondeterministic, transient dynamic events.

- The definition of a response spectrum Generation of a response spectrum from a given time history
- The use of a given response spectrum in a structural analysis
- In most cases, the engineer performing a response spectrum analysis is presented with a given design response spectrum, in which case the two first parts can be considered as background material.

Response Spectrum analysis was performed on various irregular buildings using STAAD Pro. The storey displacement was calculated for floors on which irregularity is considered and the behaviour is plotted. Maximum deformations due to irregularity are considered and compared with regular structures.

4. Results and Discussion

Equations and formulae should be typed in Mathtype, and numbered consecutively with Arabic numerals in parentheses on the right hand side of the page (if referred to explicitly in the text). They should also be separated from the surrounding text by one space.

$$\rho = \frac{\vec{E}}{J_C(T = \text{const.}) \cdot \left(P \cdot \left(\frac{\vec{E}}{E_C} \right)^m + (1 - P) \right)}$$

1. Base Shear Results

Case	Model ID	Base Shear (KN)			
		Zone-V		Zone-IV	
		In X - Direction	In Y - Direction	In X - Direction	In Y - Direction
1	REG	7094.0822	7094.0822	4729.4041	4729.4079
2	VIR1	7043	6734.4059	4694.9833	4489.6308
3	VIR2	7006.6118	6617.1432	4671.074	4411.4287
4	VIR3	7016.9677	7007.1806	4677.9784	4671.4537
5	VIR4	6995.6609	6854.4919	4663.7739	4569.6613

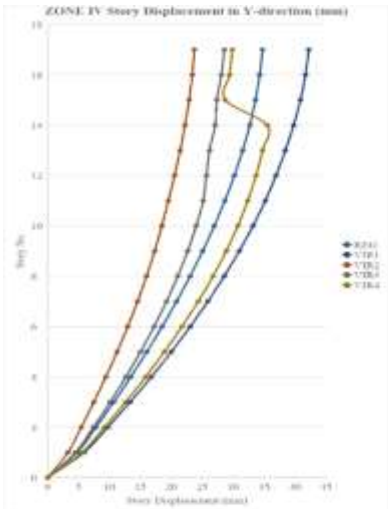
2.Story Displacement Results

Story No.	ZONE V Story Displacement in X-direction(mm)				
	REG	VIR1	VIR2	VIR3	VIR4
17	52.054	50.36	50.177	48.336	49.19
16	51.371	49.43	49.273	47.274	48.062
15	50.349	48.058	47.948	45.732	46.464
14	48.969	46.304	46.346	44.022	44.702
13	47.256	44.467	44.645	42.402	43.104
12	45.239	42.829	42.664	40.673	41.227
11	42.939	40.956	40.522	39.001	39.217
10	40.375	38.767	38.327	37.175	37.27
9	37.562	36.272	35.881	35.008	35.059
8	34.511	33.487	33.149	32.504	32.523
7	31.235	30.43	30.143	29.677	29.676
6	27.743	27.117	26.876	26.551	26.535
5	24.041	23.561	23.364	23.145	23.12

4	20.134	19.772	19.618	19.475	19.448
3	16.023	15.759	15.644	15.555	15.528
2	11.699	11.52	11.441	11.389	11.366
1	7.089	6.985	6.939	6.912	6.898
0	0	0	0	0	0

TABLE 5.3 STORY DISPLACEMENT RESULTS (1V)

Story No.	ZONE IV Story Displacement in X-direction(mm)				
	REG	VIR1	VIR2	VIR3	VIR4
17	34.702	33.571	33.452	32.224	32.793
16	34.247	32.951	32.849	31.516	32.041
15	33.566	32.036	31.966	30.488	30.976
14	32.646	30.867	30.897	29.348	29.802
13	31.504	29.642	29.763	28.268	28.736
12	30.159	28.55	28.443	27.116	27.484
11	28.626	27.302	27.015	26.001	26.145
10	26.917	25.843	25.552	24.783	24.847
9	25.041	24.179	23.921	23.339	23.373
8	23.008	22.323	22.1	21.669	21.682
7	20.824	20.285	20.095	19.785	19.784
6	18.495	18.077	17.918	17.701	17.69
5	16.028	15.706	15.576	15.43	15.414
4	13.423	13.181	13.079	12.984	12.965
3	10.682	10.505	10.429	10.37	10.352
2	7.8	7.679	7.627	7.593	7.578
1	4.726	4.656	4.626	4.608	4.598
0	0	0	0	0	0



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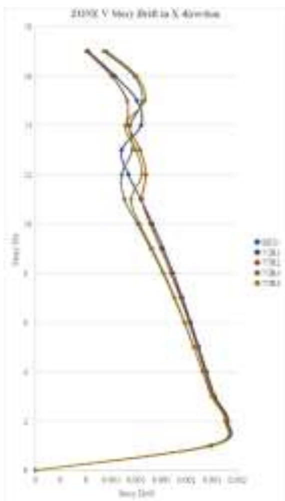

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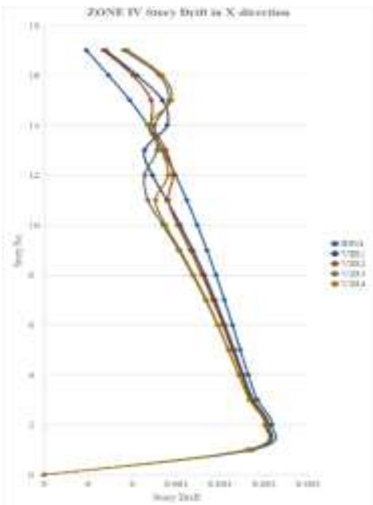

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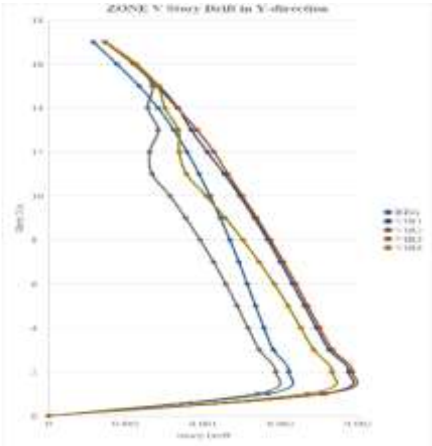

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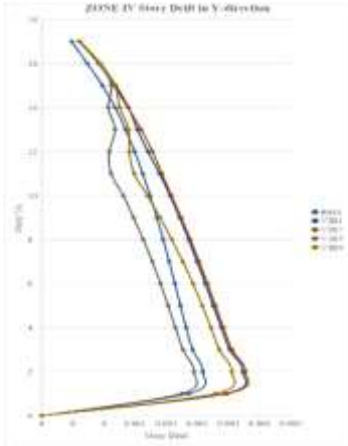

CASE 5

5. Conclusion

1. Comparison of vertical geometric irregular buildings with regular buildings shows that, buildings with irregular configuration attract less base shear as compared to regular ones.

2. The buildings with various irregularities are behaving differently in both the zones. In ZoneV regular structure is showing more displacement than irregular, where as in ZoneIV irregular structure is showing more displacement than regular.

Acknowledgements

Acknowledgements and Reference heading should be left justified, bold, with the first letter capitalized but have no numbers. Text below continues as normal.

References

[1] Devesh P. Soni and Bharat B. Mistry, "Qualitative review of seismic response of vertically irregular building frames", *ISET Journal of Earthquake Technology,* Vol.43, NO. 4, 121-132, 2006.

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