



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 10, October 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com



Study of Seismic Response of Multi-Storied Vertical Irregular Building in Different Type of Soils

Jai Ganesh B U¹, Ms. Ramya B V²

¹PG Student (Structural Engineering), Dept. of Civil Engineering, Bapuji Institute of Engineering Technology, Davangere, Karnataka, India

²Assistant Professor, Dept. of Civil Engineering, Bapuji Institute of Engineering Technology, Davangere, Karnataka, India

ABSTRACT: In this study of vertical structural irregularities, which are frequently unavoidable owing to structural and design constraints and have a significant influence on building costs. Regulations pertaining to Turkey, China, Iran, New Zealand, Mexico, and India are included in the definitions of structural irregularity in the vertical plane and earthquake codes of the various seismically active nations. In order to emphasise the importance of these in terms of architects comprehending the laws, the visual expression approaches of vertical structural irregularity definitions in the aforementioned regulations were also looked at. The study's target audience, which includes architects and architecture students, has undergone a comprehensive review that is enhanced with visualisations on vertical structural abnormalities. Common design choices that may result in structural irregularities and the countermeasures that may be used against all these irregularities are presented in order to avoid the seismic codes, which by their very nature contain a lot of methodologies and calculations, from being seen as documentation that should be memorised. Due to a greater knowledge of how visual forms affect human perception, each title is accompanied with a basic yet descriptive illustration. Although there is presently a lack of adequate study on the application of isolation technique to decrease seismic effect and problems associated to a weak story, vertical irregularities tends to have a negative impact on the seismic effect on buildings. In both situations of mass distribution and stiffness distribution, the study of isolated vertical irregular structures is the main topic of this work. The base isolation of irregular buildings offers improved seismic resistance by minimising base shear and enhancing damping characteristics, according to earlier publications mentioned and our case study research.

KEYWORDS: Response spectrum analysis, drift ratio, displacement, shear, seismic zone.

I. INTRODUCTION

General

Asymmetrical distributions of mass, stiffness, and strength, as well as geometric and diaphragm discontinuities, are the causes of plan irregularity. Stiffness, strength, ductility, simple and regular designs, and other characteristics all affect how a building responds to an earthquake. In comparison to irregular structures, structures with aims to standardize and uniform distribution load and stiffening in plan as well as in elevation sustain less damage. However, high rise structures with irregularities are desired because of the growing population and aesthetic appeal. If a structure is irregular, excessive stresses or pressures develop in the weak area and cause significant damage.

Vertical Geometric Irregularity- A structure is considered to be Vertical geometric irregular when the horizontal dimension of the lateral force resisting system in any storey is more than 150 percent of that in its adjacent storey.

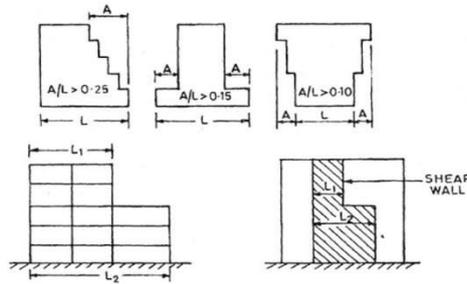


Fig 1: Vertical Geometric Irregularity when $L_2 > 1.5L_1$

Seismic Zones

Earthquake exposed areas of country has been found based on scientific observations of seismicity, historical earthquakes, and the region's tectonic structure. Based on information provided by the Bureau of Indian Standards, these four seismic zones-2, 3, 4, and 5 have been grouped for the nation. In this, zone-5 has the highest seismic activity, whereas zone-2 has the lowest. The seismic coefficient factor for different zones is provided as per IS code 1893-2016 for zone-2, 3, 4 & 5 are 0.10, 0.16, 0.24 & 0.36 respectively

II. OBJECTIVES OF THE STUDY

The present work focuses on the study of the following objectives:

- To study the seismic behavior of story vertically irregular structures when subjected to Earthquake force in earthquake zone III and different soil types.
- To analyse the asymmetric building models with dynamic analysis method in seismic zone III with varying soil types.
- To perform dynamic analysis on story building i.e. performing dynamic analysis by using Response spectrum method.
- To compare the performance of the structures that varies in soil strata and with different elements such as X Bracings and Fluid viscous dampers at corners of the building in different type of soils.

III. METHODOLOGY

In this part, the comparison between conventional building structure and structure using with different elements such as x bracings and Fluid viscous damper using analysis software called ETABS 2018(1.1). The structures are developed and analysis is done by Response spectrum method of investigation with different load combinations as per the IS (Indian Standard) codal provisions. From above structures the best performance for lateral deflections structure is then analysed for different soil type then results are compared.

Table -1:Description of Particulars

SL. NO.	PARTICULARS	SIZE/VALUE/ DIMENTIONS
1.	No. of floor/levels	G+20
2.	Type of structure	Commercial purpose
3.	Seismic zone	III
4.	Total height of building	60m
5.	Floor to floor height	3.0m
6.	Base to ground height	3.0m
7.	Plan dimensions	30x42m
7.	Grade of concrete	M45



9.	Grade of steel	Fe500
10.	Size of column	700mm X 700mm
11.	Shear wall thickness	300mm
12.	Conventional beam size	540mmX700mm
13.	Slab thickness	150mm
14.	Concrete Density	25KN/m ³
15.	Earthquake Load	As per IS:1893-2016
16.	Damping ratio	5%
17.	Response reduction factor	3
18.	Importance factor	1.5

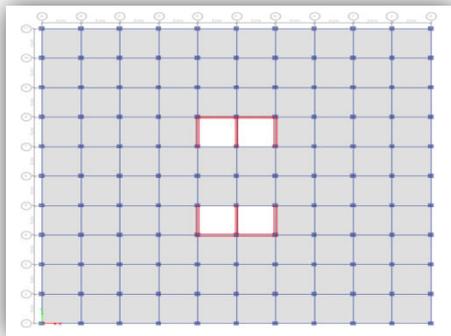


Fig-2: 2D Frame Layout

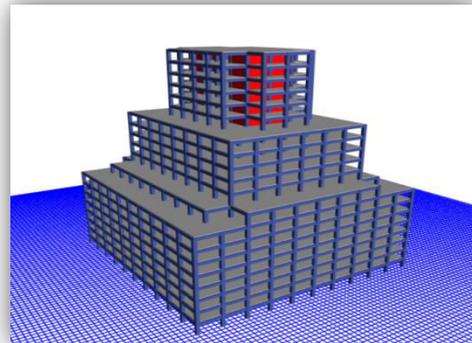


Fig-3: Rendered Layout

IV. RESULTS AND COMPARISION

Displacement:

The final comparison here is made for RCC , X Bracings and Fluid Viscous Damper provided at the corners . We can clear see that the Displacement reduces for RCC by providing the X Bracings at Corner as compare to Fluid viscous Damper at corner. Hence the X Bracings at four corner holds good.

Table-2: Showing Maximum Displacements Values for different type of Models

ELEMENT	MODEL	X DIR.IN MM	Y DIR.IN MM
RCC	FOR TYPE 1 SOIL	14.086	14.759
	FOR TYPE 2 SOIL	20.249	20.948
	FOR TYPE 3 SOIL	25.684	27.007
X BRACINGS	FOR TYPE 1 SOIL	13.832	14.198
	FOR TYPE 2 SOIL	20.696	21.027
	FOR TYPE 3 SOIL	25.189	25.948



FLUID VISCIOUS DAMPER	FOR TYPE 1 SOIL	14.386	13.357
	FOR TYPE 2 SOIL	20.653	19.125
	FOR TYPE 3 SOIL	24.959	23.278

From the below bar graph it's clear that for Fluid viscous dampers provided at corner is better but due to the column failure we can say the results holds good for X Bracings while providing at corner remains the good choice.

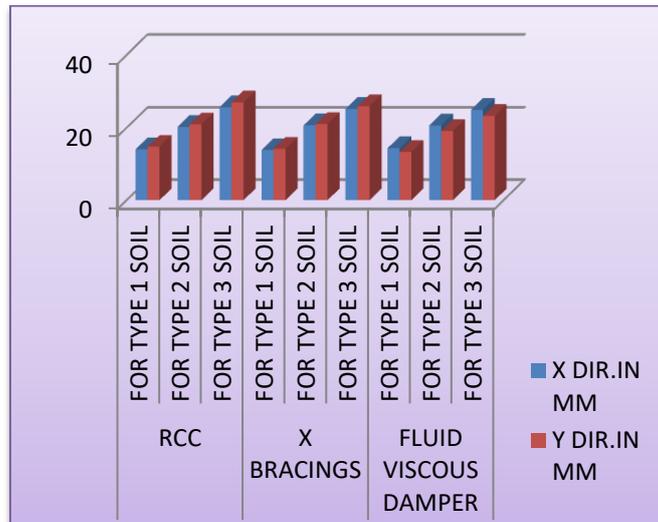


Fig 4: Graph Showing Maximum Displacements Values for different type of Models

Drift:

The final comparison here is made for RCC, X Bracings and Fluid viscous Dampers provided at the corners. We can clear see that the Drift decreases for RCC by providing X Bracings at four sides but. The results holds good for X Bracings while providing at corner remains the good choice.

Table-3: Showing Drift Values for different Models in both X and Y Directions

ELEMENT	MODEL	X DIR	Y DIR
RCC	FOR TYPE 1 SOIL	0.000232	0.000236
	FOR TYPE 2 SOIL	0.00032	0.00031
	FOR TYPE 3 SOIL	0.000399	0.000387
X BRACINGS	FOR TYPE 1 SOIL	0.000226	0.000208
	FOR TYPE 2 SOIL	0.000324	0.000285
	FOR TYPE 3 SOIL	0.000389	0.000341
FLUID VISCIOUS DAMPER	FOR TYPE 1 SOIL	0.000253	0.000176
	FOR TYPE 2 SOIL	0.000349	0.000238
	FOR TYPE 3 SOIL	0.000415	0.000281



From the below bar graph it's clear that as we are not considering any torsional Irregularities the Values decreases from RCC to Fluid Viscous Damper and there after reduces to X Bracing. In below graph we can see drift for the Structure with Fluid Viscous Damper showing less values in Y direction but in X direction values are very high. But in the structure with X Bracings both values in Y as well as in X direction are less comparatively to the structure wiouth Fluid Viscous Damper. Struture with X Bracings holds good for this project.

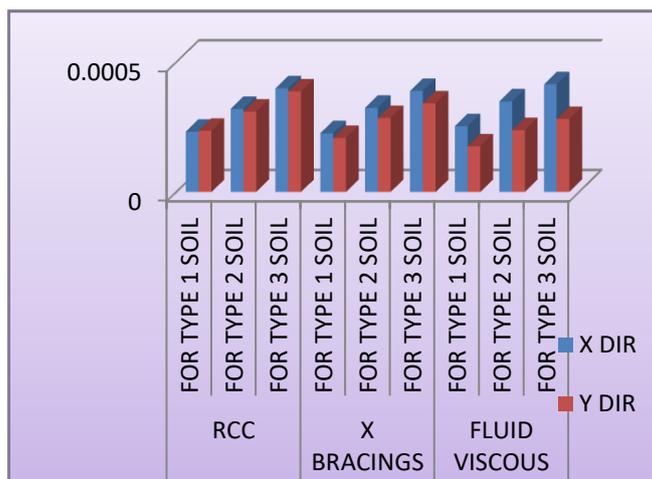


Fig 5:Graph Showing Drift Values for different Models in both X and Y Directions

Shear:

Consider the below table its shows that the structure with Fluid viscous Dampers having less base shear values in all type soil as compare to the structure with X Bracings. Due to this the structure with Fluid Viscous Dampers holds good for all type of soils.

Table-4: Showing Storey Shear Values for Model 9 in both X and Y Directions

ELEMENT	MODEL	X DIR. IN KN	Y DIR. IN KN
RCC	FOR TYPE 1 SOIL	13935.0912	12650.1141
	FOR TYPE 2 SOIL	18921.6519	16952.9952
	FOR TYPE 3 SOIL	23501.1494	21335.0076
X BRACINGS	FOR TYPE 1 SOIL	14116.5832	12958.2304
	FOR TYPE 2 SOIL	20001.5866	18226.7789
	FOR TYPE 3 SOIL	23871.7532	22032.7692
FLUID VISCIOUS DAMPER	FOR TYPE 1 SOIL	10049.5484	9754.8171
	FOR TYPE 2 SOIL	13584.7469	13297.001
	FOR TYPE 3 SOIL	16094.0996	15927.1145

The structure with Fluid viscous Dampers having less base shear values in all type soil as compare to the structure with X Bracings. Due to this the structure with Fluid Viscous Dampers holds good for all type of soils.

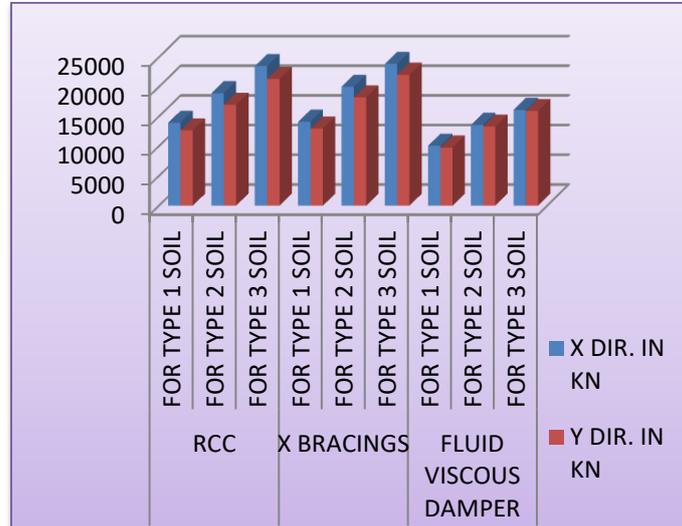


Fig 6: Graph Showing Storey Shear Values for Model 9 in both X and Y Directions

V. CONCLUSION

1. As comparing the results of displacements for all the models, we can see displacements are less for type soil 1 in all the models. This is because type soil 1 consists of rock, hard soil and well graded gravel having value of N above 30, where N is the standard penetration value.
2. As compare to conventional RCC structure, X Bracings structure is having 9.035% less displacement in X direction at top storey in type 1 soil. And 5.61% less displacement in Y direction.
3. As compare to conventional RCC structure, structure with FVD element is having 2.12 % more displacement in X direction and 9.49% less displacement in Y direction at the top storey in type 1 soil.
4. As comparing the results of maximum drift at top storey, we can see maximum drift is less in type 1 soil as compared to type 2 and type 3 soil in all the models. Since the type 1 soil consists of hard soil which holds superstructures firmly.
5. As compare to conventional RCC structure, X bracing structure is having 2.5% less drift in X direction and 11.86% less drift in Y direction in type 1 soil at top storey.
6. As compare to conventional structure, FVD structure is having 9.051% more drift in X direction and 25.42% less in Y direction in type 1 soil at the top storey.
7. As comparing the results of storey shear, we can see storey shear values are less for type 1 soil.
8. As comparing the results of X bracing structure and Fluid viscous damper Structure, we can see storey shear is less in FVD structure in all type of soils. This is due to dampers dissipates large amount of input energy and reduces the energy dissipation demand on the structural members.

VI. FUTURE SCOPE OF STUDY

1. By varying the number of stories to be taken into consideration during analysis and the number of bays.
2. To get more accurate earthquake assessment non liner dynamic analysis method should be adopted.
3. By varying the thickness of the shear wall in the structure and by providing shear walls in different location other than core and corner of the structure.
4. In the structure with shear wall positioned at various location by wind analysis.

REFERENCES

[1].Alokkumar A. Mondal, Miss. Deepa Telang, Mrs. Gitadevi. B. Bhaskar (2017), "Comparing the Effect of Earthquake on High-Rise Building with Shear Wall and Flange Concrete Column", International Journal for Research in Applied Science & Engineering Technology, Vol. 05, Issue 07, pp. 697-711.

[2] B. R. Jayalekshmi and H. K. Chinmayi (2014), "Effect of Soil Flexibility on Seismic Force Evaluation of RC



Framed Buildings with Shear Wall: A Comparative Study of IS 1893 and EUROCODE8”, Journal of Structures, Hindawi Publishing Corporation, Vol. 2014, pp. 850-860.

[3] Donthireddy Raja Shekar Reddy and Joshi Sreenivasa Prasad (2019), “ *The Seismic Analysis of Multi Storied Building with Shear Walls of Different Shapes in all Zones*”, International Research Journal of Engineering and Technology, Vol. 08, Issue 07, pp. 719-725.

[4] Jonty Choudhary, Dr. G. P. Khare, (2018), “ *Comparative Study and Analysis of Unbraced RCC Framed Structure with Steel Braced RCC Framed Structure using Response Spectrum Method*”, International Journal of Scientific and Engineering Research, Vol. 07, Issue 8, pp.120-132.

[5] Ketan Bajaj, Jitesh T Chavda, Bhavik M Vyas (2013), “ *Optimum seismic behaviour of buildings on different types of Soil*” Indian Geotechnical, Research gate, Vol. 69, pp. 22-24.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.118



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details