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Earthquake Analysis of Irregular Flat Slab High Rise structure in Diverse Earthquake Zone

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ABSTRACT

In recent time population expansion of India is extremely growing, day by days necessity of ground for shelter purpose is high. For fulfills this prerequisite of infrastructure but ground availability is now restricted and as future aspect multistoried system highly adopted in India and all over world. Vertical gametic multistoried building is one of the best options for residential purpose. But due to complex shape its very tough to execute the design in highly seismic zone. For this purpose, overcome this problem seismic analysis of such kind of structure very essential. In our study the proposed work is twenty by thirty m plan area in which size of panels is 5x5 m. the cantilever beam and column select by Span to depth ratio as per IS Code criteria for the given loads for a ten, twenty& thirty storied model. And linear dynamic analysis is done using Staad pro software. Total 27 model taken and obseved with regular and 200% and 300% vertical geometric irregularities and result obtained in terms of Node displacement, Peak Storey shear, Stresses on flat slab, storey Drift etc.

Key Words: Square root of sum Square method, Flat slab, Response spectrum analysis, Storey drift, Vertical Geometric Irregularity.

INTRODUCTION

Seismic forces are caused by inertia of the structure, which tries to resist ground motions. As the shifting ground carries the building foundations along with it, inertia keeps the rest of the structure in place for a short while longer. The movement between two parts of the building creates a force, equal to the ground acceleration times mass of the structure. In order to have a minimum force, mass of the building should be as low as possible since there can be no control on the ground acceleration. The point of application of this inertial force is the centre of gravity of the mass on each floor of the building. Once there is a force, there has to be an equal and opposite reaction to balance this force. The inertial force is resisted by the building and the resisting force acts at the centre of rigidity at each floor of the building. Earthquake Ground Motions are the most dangerous natural hazards where both economic and life losses occur. Most of the losses are due to building collapses or damages. Earthquake can cause damage not only on account of vibrations which results from them but also due to other chain effects like landslides, floods, fires etc. Therefore, it is very important to design the structures to resist, moderate to severe EQGMs depending on its site location and importance of the structure. If the existing building is not designed for earthquake then its retrofitting becomes important Real structures are almost always irregular, as perfect regularity is an idealization that very rarely occurs. Structural irregularities may vary dramatically in their nature and in principle, are very difficult to define. Regarding buildings, for practical purposes, major seismic codes distinguish between irregularity in plan and in elevation, but it must be realized that quite often structural irregularity is the result of a combination of both. In order to identify the torsionally irregular structures, IS:1893(Part-1)-2002 has given the clear definitions of irregular buildings in Clause 7.1. An expression for the design eccentricity, which is very much needed for the analysis of torsionally unbalanced structures is given in Clause 7.9 of the same. According to Clause 7.8.1, the method of analysis to be used for a structure depends on its irregularity, in addition to the total height of the structure and the seismic zone where it is situated. To understand the importance of codal provisions, which are especially meant for asymmetric buildings, an attempt is made in the present study considering various parameters, which are contributing to torsional irregularity.

OBJECTIVE OF THE WORK

Since various papers were studied and what the authors have been found is the way but not comparable. The only way to find the optimum result parameters is to obtain by comparing various building cases of multistoried buildings. So, for that, total 27 building cases are prepared with one optimum case of flat slab to find the result parameters. After then the load is to be taken as dead load, live load, earthquake load and as per IS 1893 2000, various load combinations are considered. Results hence obtained based upon the different cases analyzed, will be compared and suitable case where least value will obtain be the conclusion of the work.

The main purpose is to find the optimum building case to counteract earthquake forces and analysis is done using software STAAD Pro. So, for this, different loads applied, and parametric values obtained are considered and point of comparison of different building models is as follows:

1. Node displacement in regular and irregular buildings
2. Peak Storey shear in All Models
3. Max Von Mis stresses in Flat slab
4. Principal Stresses on Flat slab

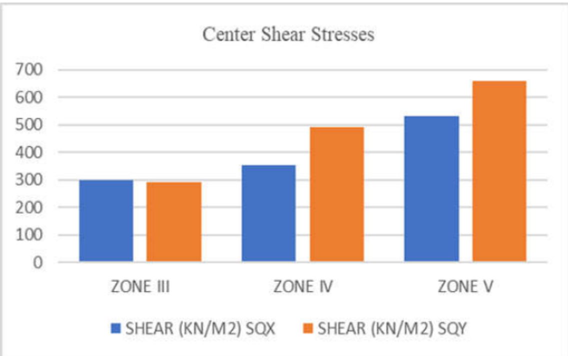
To obtain optimum building case among all building cases by observing and comparing their parameter values.

Model Description

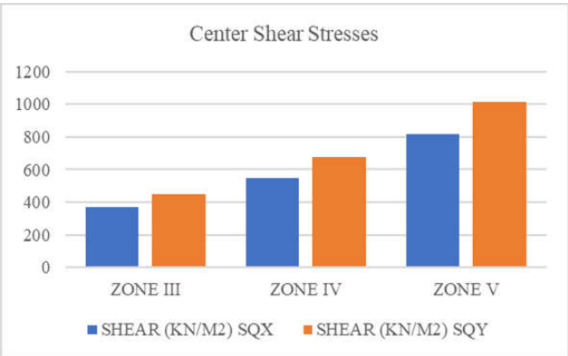
Sr.No	Particular	Dimension/Size/value
1.	Model	G+10, G+20, G+30
2.	Height of floor	3 meters
3	Plan size	20 X 30 M^2
4	Size of Column	500 X 500 mm^2
5	Cantilever beam Size	1000 X 2000 mm^2
6.	Slab Thickness	200mm
7.	Earthquake Zone	III, IV & V
8.	Soil Type	Medium Type-II

Result

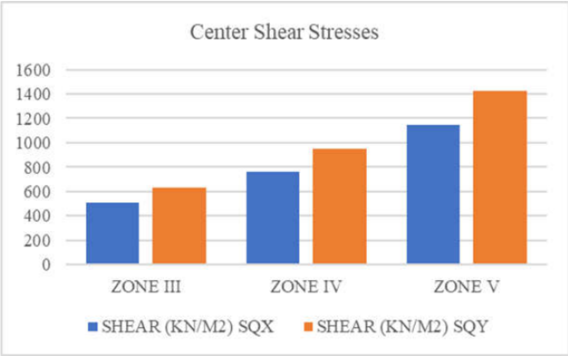
Center Shear Stresses on flat Slab in Regular Buildings



Graph 1Center Shear Stresses in G+10 Regular Building

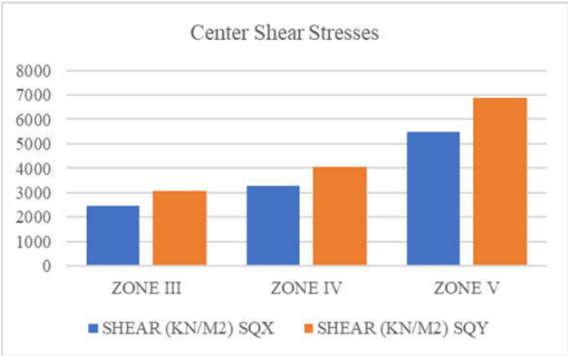


Graph 2 Center Shear Stresses in G+20 Regular Building

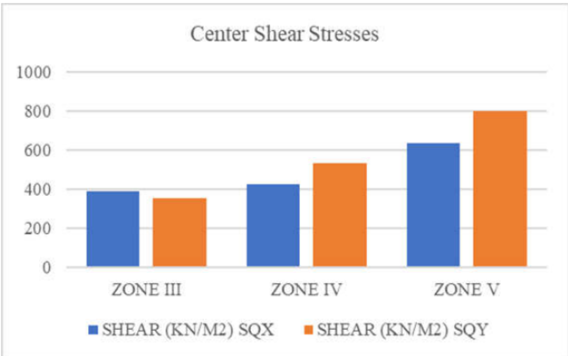


Graph 3 Center Shear Stresses in G+30 Regular Building

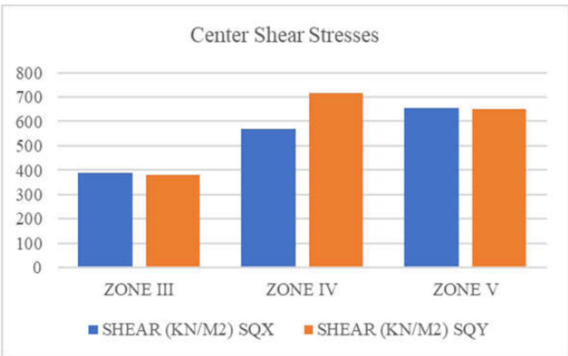
Center Shear Stresses on flat Slab in 200% irregular Buildings



Graph 4Center Shear Stresses in G+10 200% irregular Building

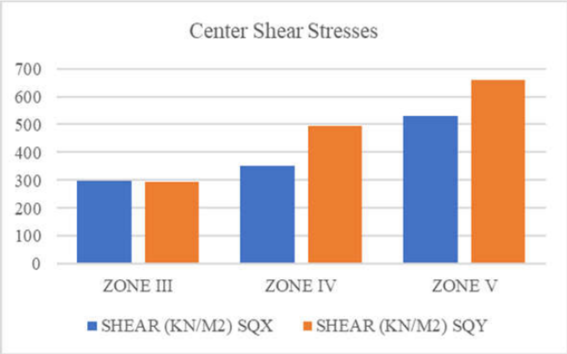


Graph 5 Center Shear Stresses in G+20 200% irregular Building

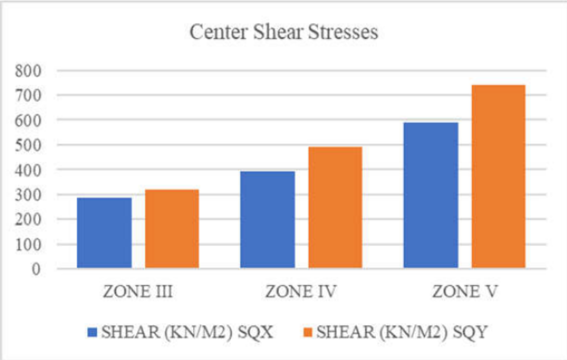


Graph 6 Center Shear Stresses in G+30 200% irregular Building

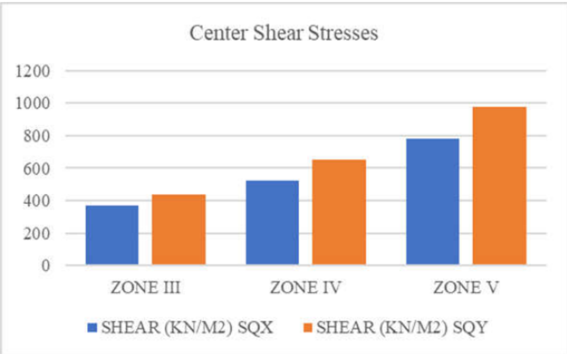
Center Shear Stresses on flat Slab in 300% irregular Buildings



Graph 7Center Shear Stresses in G+10 300% irregular Building

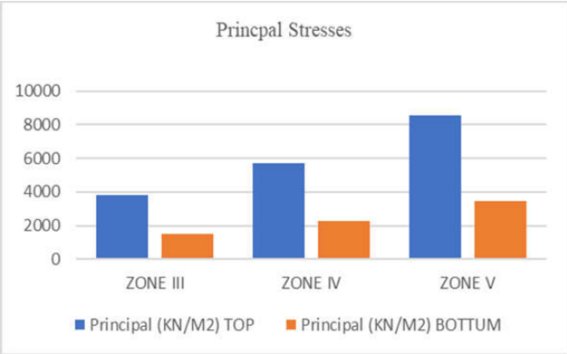


Graph 8 Center Shear Stresses in G+20 300% irregular Building

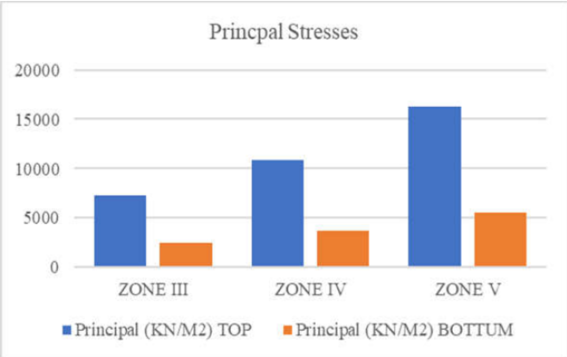


Graph 9 Center Shear Stresses in G+30 300% irregular Building

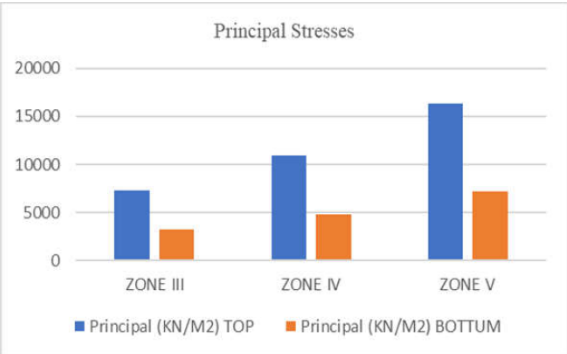
Principal Stresses on flat Slab in Regular Buildings



Graph 10 Principal Stresses for G+10 Regular Building

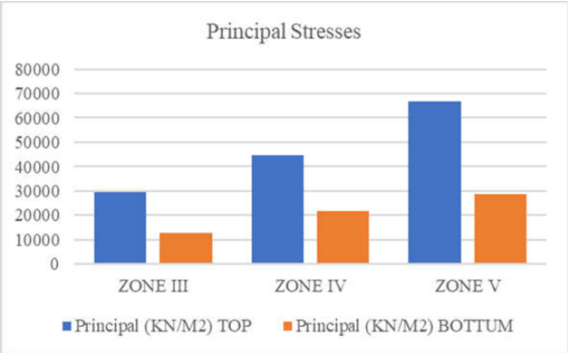


Graph 11 Principal Stresses for G+20 Regular Building

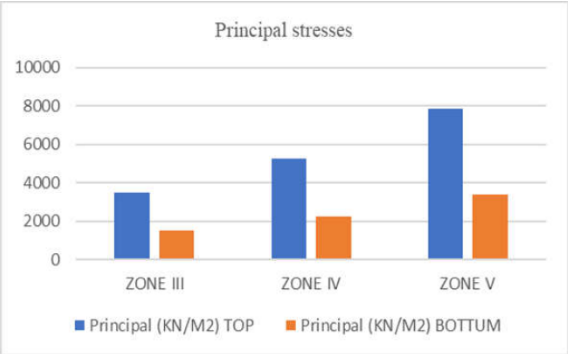


Graph 12 Principal Stresses for G+30 Regular Building

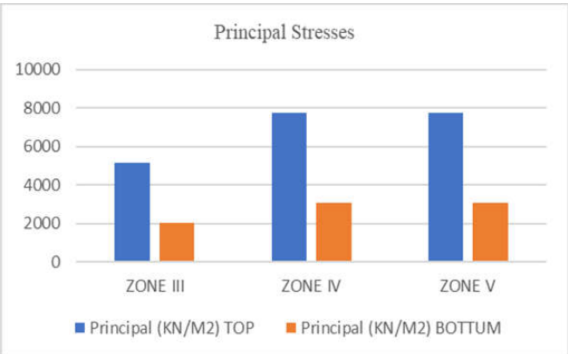
Principal Stresses on flat Slab in 200% irregular Buildings



Graph 13 Principal Stresses for G+10 200% irregular Building

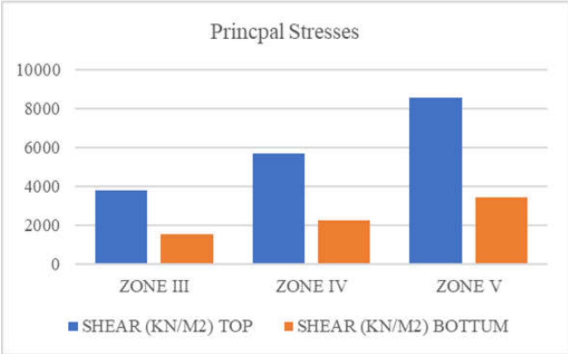


Graph 14 Principal Stresses for G+20 200% irregular Building

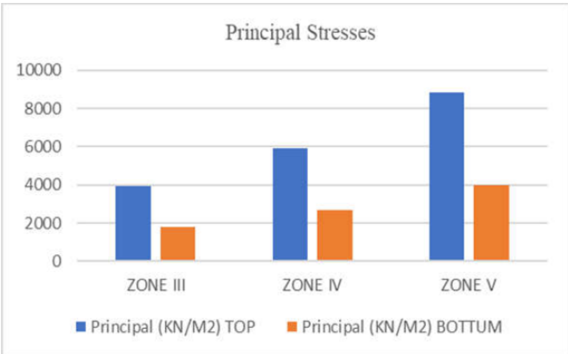


Graph 15 Principal Stresses for G+30 200% irregular Building

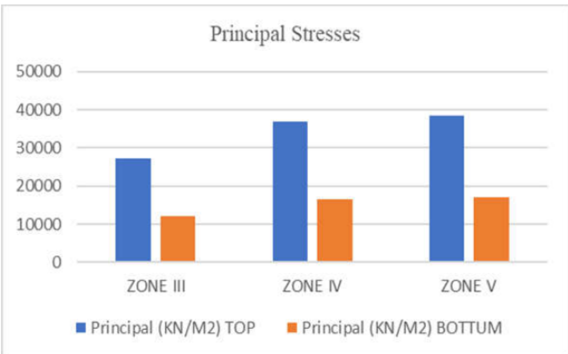
Principal Stresses on flat Slab in 300% irregular Buildings



Graph 16 Principal Stresses for G+10 300% irregular Building

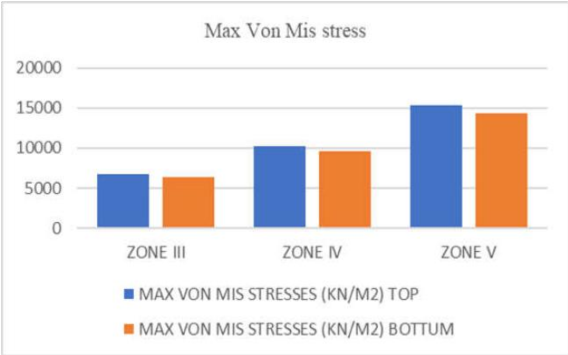


Graph 17 Principal Stresses for G+20 300% irregular Building

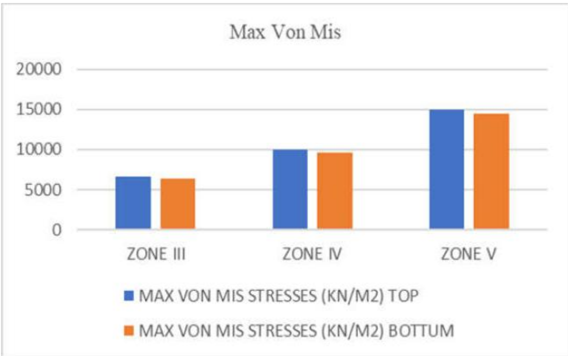


Graph 18 Principal Stresses for G+30 300% irregular Building

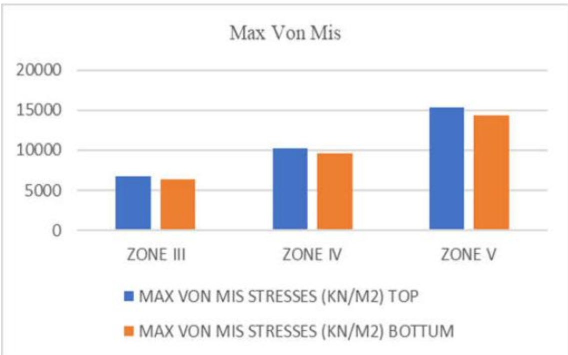
Max Von Mis Stresses on flat Slab in Regular Buildings



Graph 19 Max Von Mis Stresses for G+10 regular Building

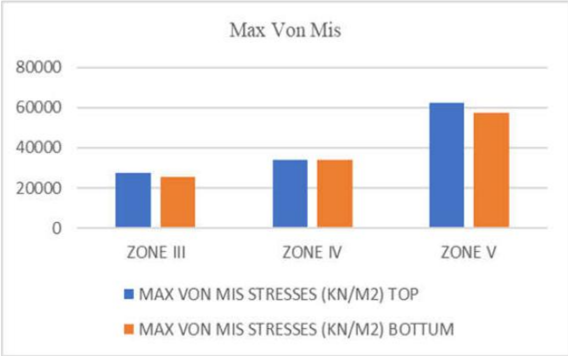


Graph 20 Max Von Mis Stresses for G+20 regular Building

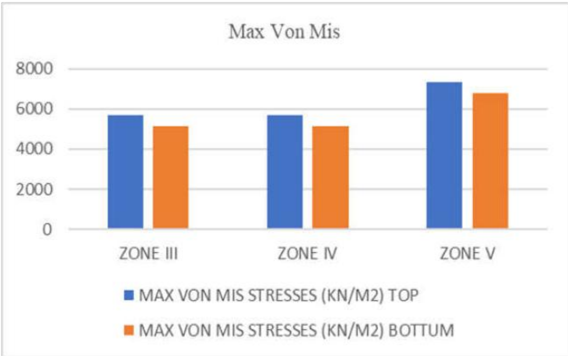


Graph 21Max Von Mis Stresses for G+30 regular Building

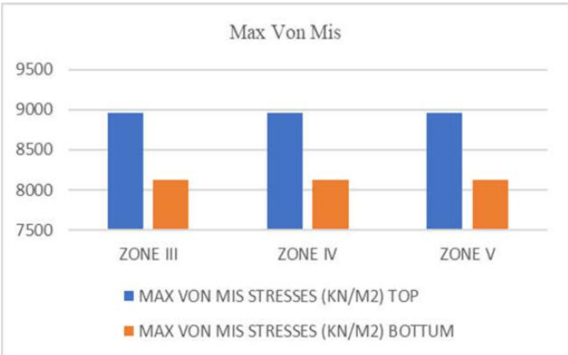
Max Von Mis Stresses on flat Slab in 200% irregular building



Graph 22 Max Von Mis Stresses for G+10 200% irregular Building

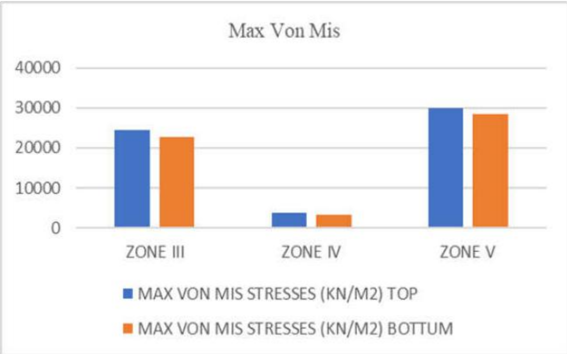


Graph 23 Max Von Mis Stresses for G+20 200% irregular Building

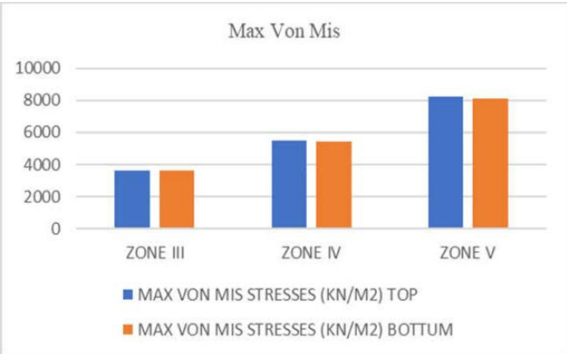


Graph 24 Max Von Mis Stresses for G+30 200% irregular Building

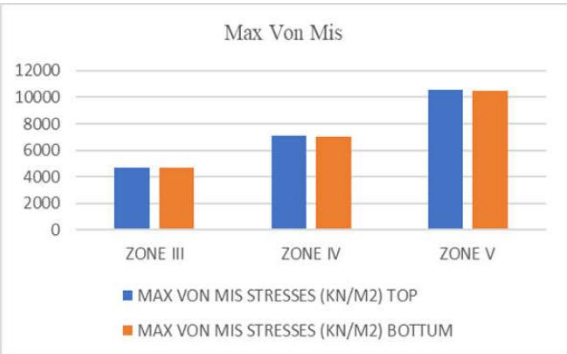
Max Von Mis Stresses on flat Slab in 300% irregular building



Graph 25 Max Von Mis Stresses for G+10 300% irregular Building

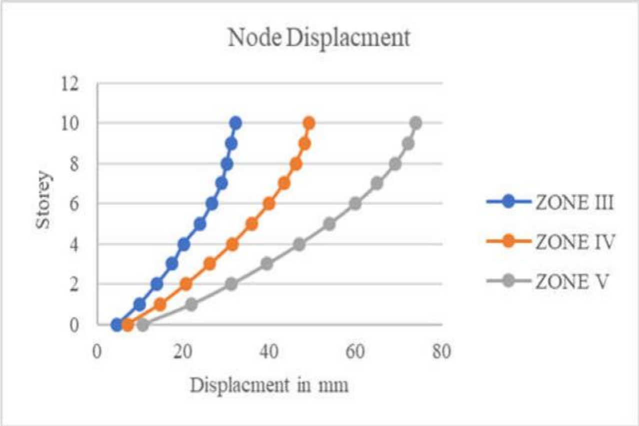


Graph 26Max Von Mis Stresses for G+20 300% irregular Building

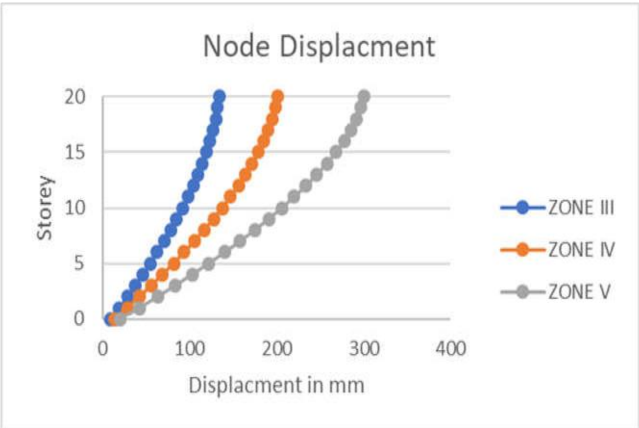


Graph 27Max Von Mis Stresses for G+30 300% irregular Building

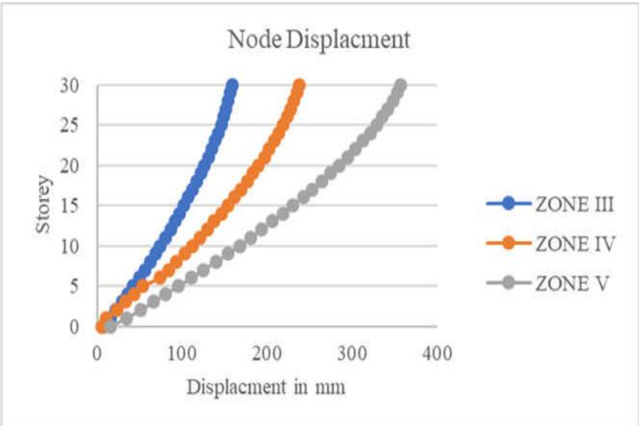
Node Displacement for Regular buildings



Graph 28 Node Displacement in G+10 regular Building

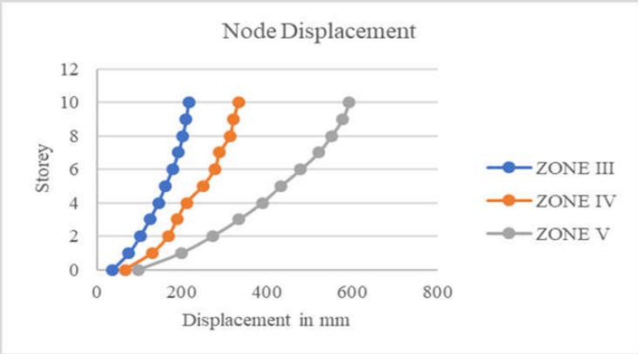


Graph 29 Node Displacement in G+20 regular Building

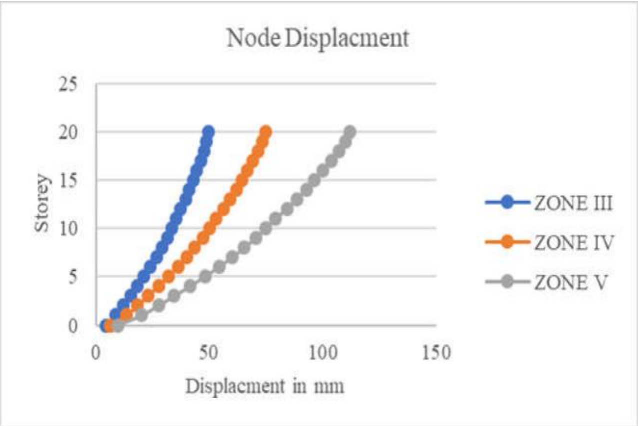


Graph 30 Node Displacement in G+30 regular Building

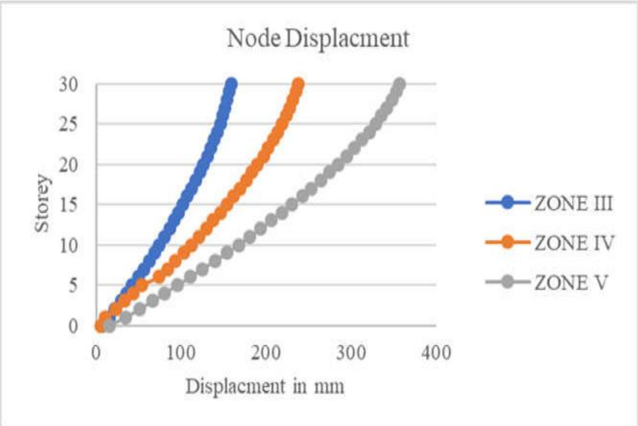
Node Displacement for 200% irregulars' buildings



Graph 31 Node Displacement in G+10 200% irregular Building

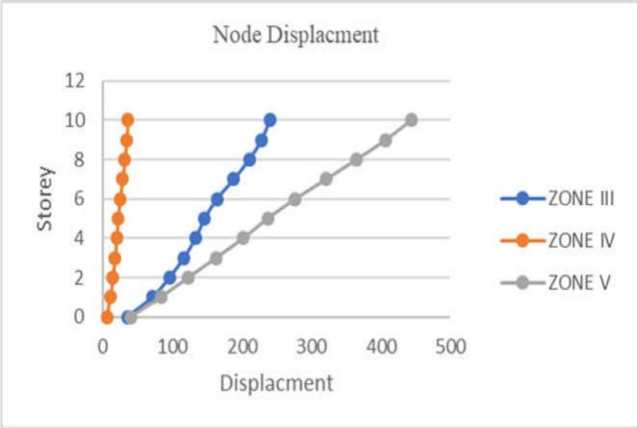


Graph 32 Node Displacement in G+20 200% irregular Building

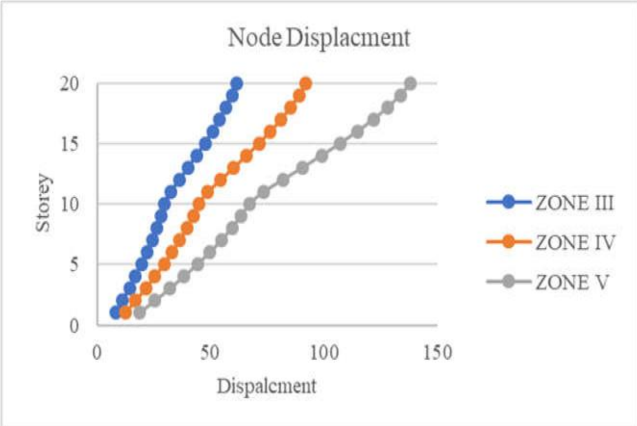


Graph 33 Node Displacement in G+30 200% irregular Building

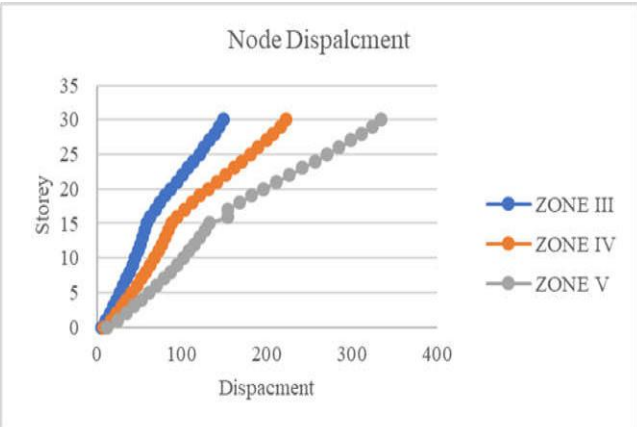
Node Displacement for 300% irregulars' buildings



Graph 34 Node Displacement in G+10 300% irregular Building

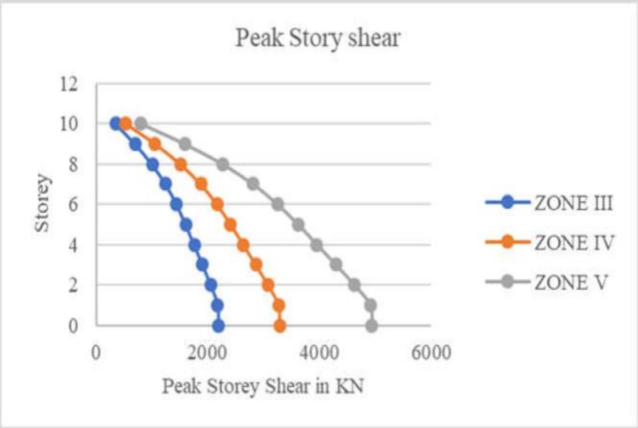


Graph 35 Node Displacement in G+20 300% irregular Building

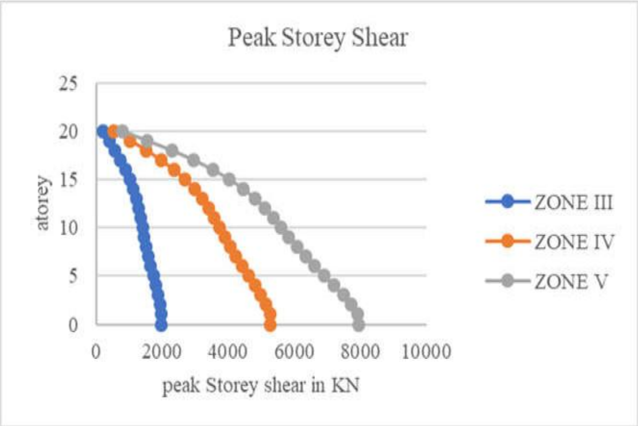


Graph 36 Node Displacement in G+30 300% irregular Building

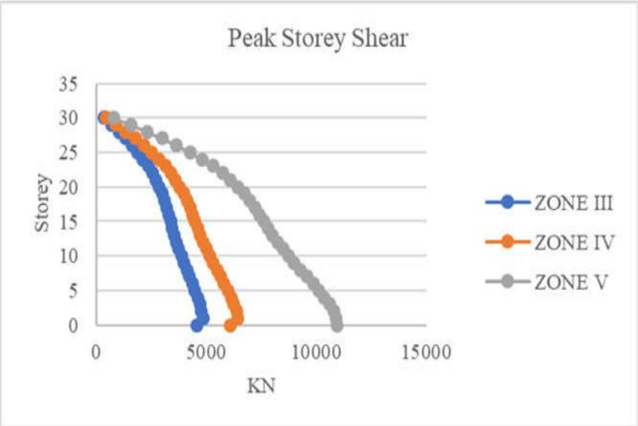
eak Storey Shear for Regular Buildings



Graph 37 Peak Storey shear in G+10 regular Building

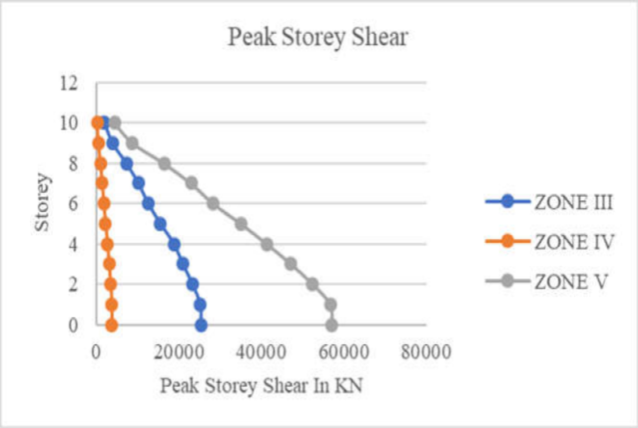


Graph 38 Peak Storey shear in G+20 regular Building

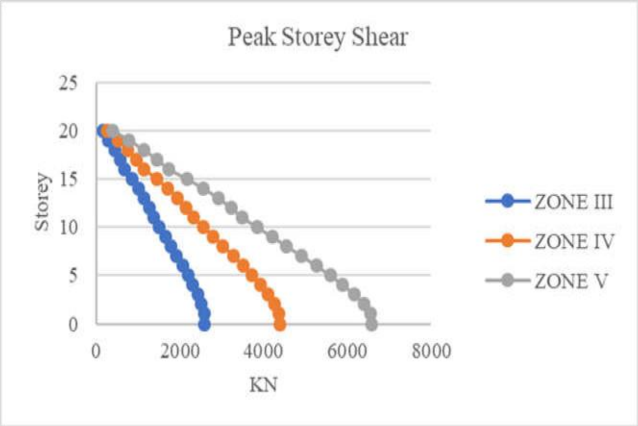


Graph 39 Peak Storey shear in G+30 regular Building

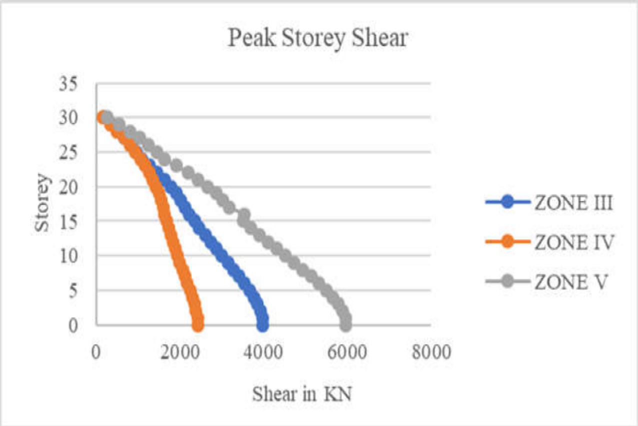
Peak Storey Shear for 200% irregular Buildings



Graph 40 Peak Storey shear in G+10 200% irregular Building

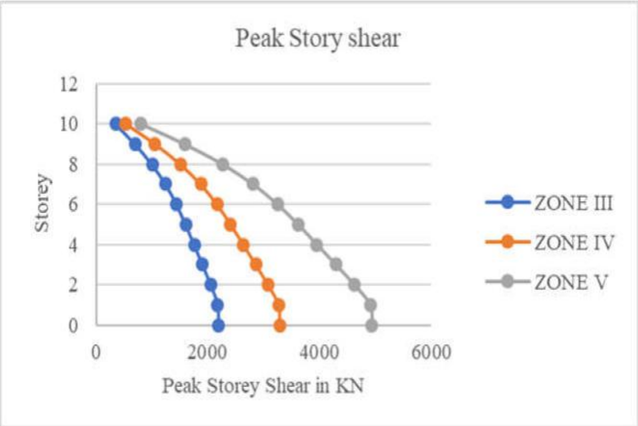


*G*raph 41 Peak Storey shear in G+20 200% irregular Building

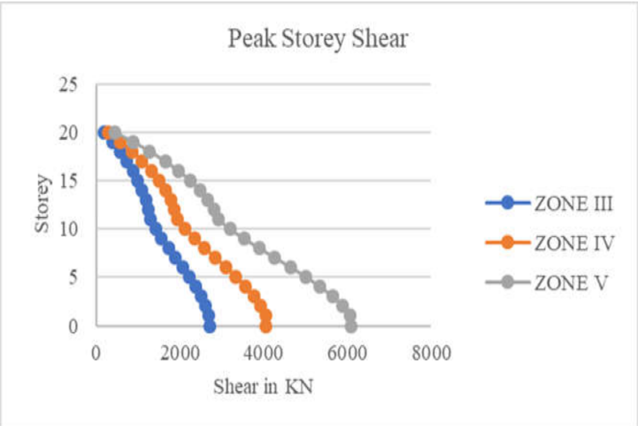


Graph 42 Peak Storey shear in G+30 200% irregular Building

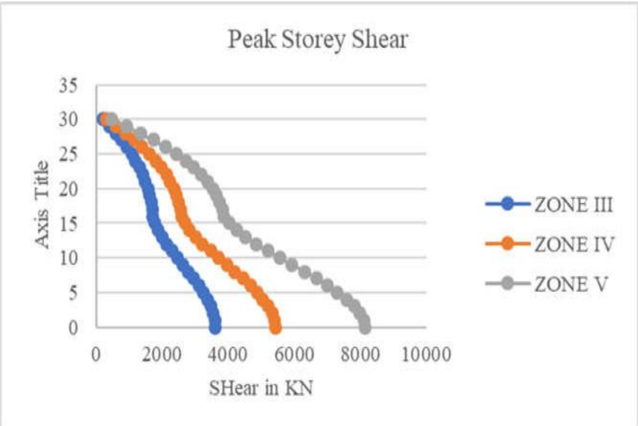
Peak Storey Shear for 300% irregular Buildings



Graph 43 Peak Storey shear in G+10 300% irregular Building



Graph 44 Peak Storey shear in G+20 300% irregular Building



Graph 45 Peak Storey shear in G+30 300% irregular Building

Conclusion-

Analysis of G+10, G+20% G+30 Regular building, 200% Irregular and 300% Irregular multistoried buildings with flat slab system different Seismic zone and carried out and the following conclusions are drawn from the study:

1 In G+10 Storied building the natural period of building increases as compared with G+20 & the G+30 Storied building because Natural periods of buildings increase with an increase in mass.

2 Similarly, in the flat slab Principal and Von Mis top and bottom stresses and more increases with seismic zone provided as the building height increase stresses will be more increase in 200% irregular & 300% irregular multi storied building when compares its Regular building.

3 Total base shear increases when in regular buildings when compared with 200% & 300% irregular multi-storey building.

4 Flat slab G+30 Multistoried building have larger fundamental natural period than G+10 & G+20

5 Flat slab center shear stresses SQX and SQY more increase with seismic zone provided as the building height increase stresses will be more increase in 200% irregular & 300% irregular multi storied building when compares its Regular building.

6 Node displacement in the X direction will be more restricted in regular building when it compared with 200% & 300% irregular structure, but it will be more increases with the height of the Building.

7 Natural periods of buildings reduce in flat slab G+30 & G20 Storied building as compared with flat slab G+10 because the natural period of the building reduce with an increase in stiffness.

REFERENCES

[1] Prabesh Sharma., D.R Rajendra. S, Vanisree C.N. (2016). "Scrutinizing the Structural Response of Regular and Irregular Structure (With and Without Shear Wall) Subjected to Seismic and Wind Loading." International Journal on Recent and Innovation Trends in Computing and Communication, 4(3), 353 – 359.

[2] Maikesh Chouhan., Ravi Kumar Makode (2016). "Dynamic Analysis of Multi-Storeyed Frame- Shear Wall Building Considering SSI." Int. Journal of Engineering Research and Application, 6(8) part-I, 31-35.

[3] Navjot Kaur Bhatia., Tushar Golait,(2016). "Studying the Response of Flat Slabs & Grid Slabs Systems in Conventional RCC Buildings." International Journal of Trend in Research and Development,3(3), 334-337.

[4] Mohd Atif., Prof. Laxmikant Vairagade., Vikrant Nair., (2015). "COMPARATIVE STUDY ON SEISMIC ANALYSIS OF MULTISTOREY BUILDING STIFFENED WITH BRACING AND SHEAR WALL." International Research Journal of Engineering and Technology (IRJET), 2(5), 1158- 1170.

[5] Akil Ahmed (2015). "Dynamic Analysis of Multi-storey RCC Building Frames." International Conference on Inter Disciplinary Research in Engineering and Technology, 89-94.

[6] Mr.K.LovaRaju., Dr.K.V.G.D.Balaji., (2015). "Effective location of shear wall on performance of building frame subjected to earthquake load." International Advanced Research Journal in Science,
Engineering and Technology. 2(1), 33-36

[7] N. Janardhana Reddy., D. Gose Peera., T. Anil Kumar Reddy (2015) "Seismic Analysis of Multi- Storied Building with Shear Walls Using ETABS-2013" International Journal of Science and Research (IJSR) ,4(11), 1030-1040.

[8] Ali Koçak, Başak Zengin, Fethi Kadioğlu (2014) "PERFORMANCE ASSESSMENT OF IRREGULAR RC BUILDINGS WITH SHEAR WALLS AFTER EARTHQUAKE" http://dx.doi.org/10.1016/j.engfailanal.2015.05.016

[9] Anuja Walvekar, H.S.Jadhav (2015) "PARAMETRIC STUDY OF FLAT SLAB BUILDING WITH AND WITHOUT SHEAR WALL TO SEISMIC PERFORMANCE" International Journal of Research in Engineering and Technology. 4(4),601-607.

[10] K. G. Patwari, L. G. Kalurkar (2016) "Comparative study of RC Flat Slab & Shear wall with Conventional Framed Structure in High Rise Building" International Journal of Engineering Research., 5(3), 612-616

[11] RAVINDRA B N, MALLIKARJUN S. BHANDIWAD (2015) "DYNAMIC ANALYSIS OF SOFT STOREY BUILDING WITH FLAT SLAB" International Research Journal of Engineering and Technology (IRJET), 2(4), 1644-1648.

[12] Vishal A. Itware., Dr. Uttam B. Kalwane (2015) “Effects of Openings in Shear Wall on Seismic Response of Structure” Int. Journal of Engineering Research and Applications 5(7) 41-45.

[13] 1Ravikanth Chittiprolu, 2Ramancharla Pradeep Kumar “Significance of Shear Wall in High-rise Irregular Buildings” International Journal of Education and applied research 4(2) 35-37.

[14] Navyashree K, Sahana T.S (2014). “USE OF FLAT SLABS IN MULTI-STOREY COMMERCIAL BUILDING SITUATED IN HIGH SEISMIC ZONE” International Journal of Research in Engineering and Technology. 3(8) 439-451.

[16] Sumit Pawah., Vivek Tiwari., Madhavi Prajapati. (2014) “Analytical approach to study effect of shear wall on flat slab & two-way slab” International Journal of Emerging Technology and Advanced Engineering.,4(7) 244-252.

[17] Amit A. Sathawane., R.S. Deotale., (2014) “Analysis and Design of Flat Slab And Grid Slab And Their Cost Comparison.” International Journal of Engineering Research and Applications, 1(3) 837- 848.

[18] Sejal Bhagat (2014). “OPTIMIZATION OF A MULTISTOREY-BUILDING BY OPTIMUM POSITIONING OF SHEAR WALL” International Journal of Research in Engineering and Technology, 3(1), 56-74

[19] Satpute S G., and D B Kulkarni (2013). “COMPARATIVE STUDY OF REINFORCED CONCRETE SHEAR WALL ANALYSIS IN MULTISTOREYED BUILDING WITH OPENINGS BY NONLINEAR METHODS.” Int. J. Struct. & Civil Engg. Res. 2013 2(3) 183-189.

[20] Sharmin Reza Chowdhury., M.A. Rahman, M.J.Islam., A.K.Das (2012) “Effects of Openings in Shear Wall on Seismic Response of Structures International Journal of Computer Applications, (0975 – 8887), 59(1), 10-13.