iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 Issue: III Month of publication: March 2018

DOI: http://doi.org/10.22214/ijraset.2018.3671

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue III, March 2018- Available at www.ijraset.com

Comparative Study of Seismic Performance in Flat Slab with and without Shear Wall of Multistoried Building in different Earthquake Zone

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Abstract: The effect of vertically irregularities within the seismic overall performance of systems will become definitely vital. Whilst such buildings are built in high seismic zones, the analysis and design turn into more complexes. The main objective of the analysis is to study the behaviour of flat slab system in vertical irregular multi-storied building against different forces acting on it during earthquake. Also, the objective of analysis is to study the structural behaviour of shear wall – flat slab interaction in different seismic zone. The analysis is carried out using STAAD Pro V8i software. Flat slab system with shear wall are modelled and analysed for the dynamic loading. The analysis is made between in the three types of 10 storey building with regular building and 200 % vertical irregular building. In all these building's shear wall is provided. Total 12 modelled are studied and their results were compared. Response spectrum analysis results provides a more realistic behaviour of structure response hence the analysis of flat slab system in regular, and 200% Irregular multi-storied buildings without shear wall and with shear wall in different seismic zone i.e. III, IV & V is carried out. Comparison in made between Center shear, Principal, Max Von Mis Stresses on flat slab, node displacement, peak storey shear, & the result are brought out.
Keywords: Flat slab, Vertical geometric irregularity, shear wall, Response Spectrum analysis, etc.

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. Irregular structures contribute a large portion of urban infrastructure. Vertical irregularities are one of the major reasons of failures of structures during earthquakes. For example, structures with soft storey were the most notable structures which collapsed. So, the effect of vertically irregularities in the seismic performance of structures becomes really important. Height-wise changes in stiffness and mass render the dynamic characteristics of these buildings different from the regular building. The irregularity in the building structures may be due to irregular distributions in their mass, strength and stiffness along the height of building. When such buildings are constructed in high seismic zones, the analysis and design become more complicated.

A reinforced concrete flat slab, also called as beamless slab, is a slab supported directly by columns without beams. A part of the slab bound on each of the four sides by center lines of columns is called a panel. The flat slab is often thickened near to supporting columns to provide adequate strength in shear and to reduce the quantity of negative reinforcement in the support regions. The thickened portion meets the floor slab or a drop panel, is enlarged so as to increase primarily the perimeter of the critical section, for shear and hence, increasing the capacity of the slab for resisting two-way shear and to reduce negative bending moment at the support.

II. OBJECTIVE OF THE WORK

A. The main objective of the analysis is to study the seismic performance of flat slab system in vertical irregular multi-storied building against dynamic forces acting on it during earthquake. The analysis is carried out using STAAD Pro V8i software.

B. The analysis is made between the flat slab multistoried regular building and 200 % vertical irregular building without shear wall and with shear wall in different earthquake zone i.e. Zone III, Zone IV and Zone V.

III. METHOD OF ANALYSIS

A reinforced concrete frame with 10 storey of dimension 30mx20m, has been taken for seismic analysis. 12 flat slab building models with varying of vertical geometric irregularities are considered for comparison

1) Model-1: Regular building without shear wall in Zone III, Zone IV and Zone V.
2) Model-2: Regular building with shear wall at center in Zone III, Zone IV and Zone V.

3) Model-3: 200% Irregular building without shear wall Zone III, Zone IV and Zone V.
4) Model-4: 200% Irregular building with shear wall at center in Zone III, Zone IV and Zone V.

TABLE I
DESCRIPTION OF MODEL

Description of building	
Structure type	Special Moment Resisting Frame[SMRF]
Plan dimension	30x20m
Storey height	3m
Height of building	33.5m
Grade of concrete	M25
Grade of steel	Fe415
Cantilever Beam sizes	500x2000mm
column sizes	500x500mm
slab thickness	200mm
Live load	1.5kN/m2
Floor finish	1.0kN/m2
Shear wall Thickness	200mm
Zone factor	II, III and V
Soil type	Medium soil type-2
Importance factor	1
Response reduction factor	5.0(SMRF)

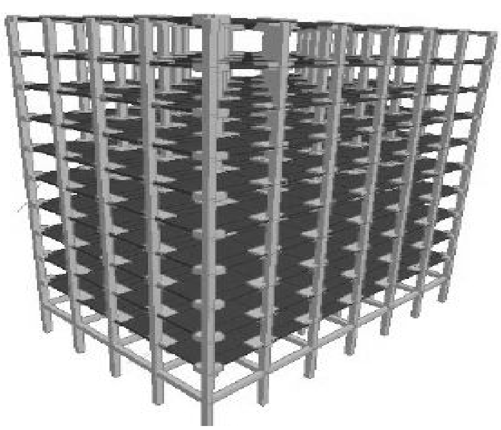

Fig 1: Elevation of regular building

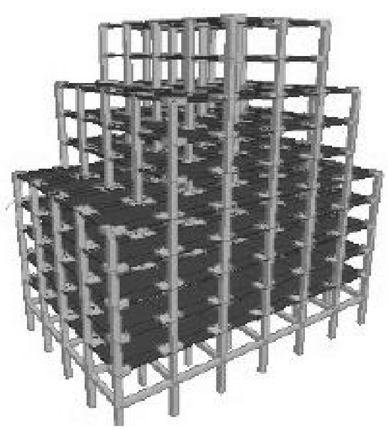

Fig 2: Elevation of 200% irregular building

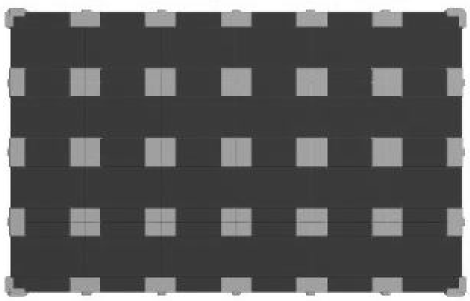

Fig 3: Plan of Regular, 200% Irregular Building

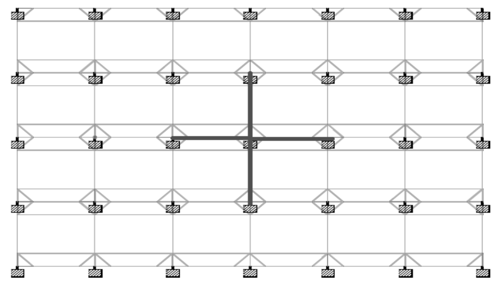

Fig 4: Plan of shear wall position in multistoried building

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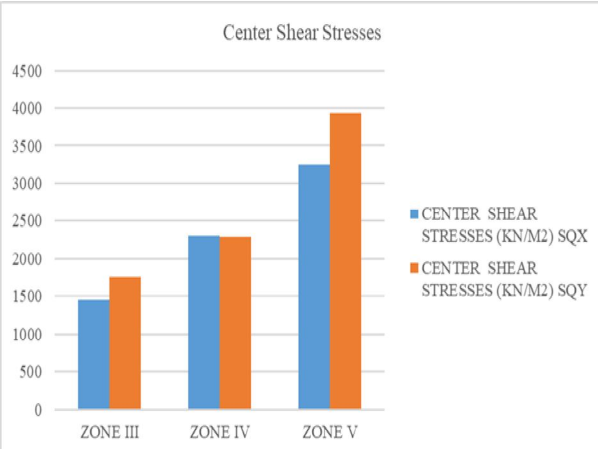
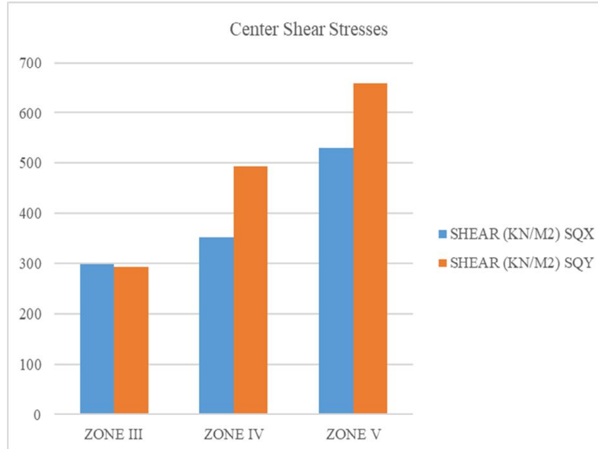
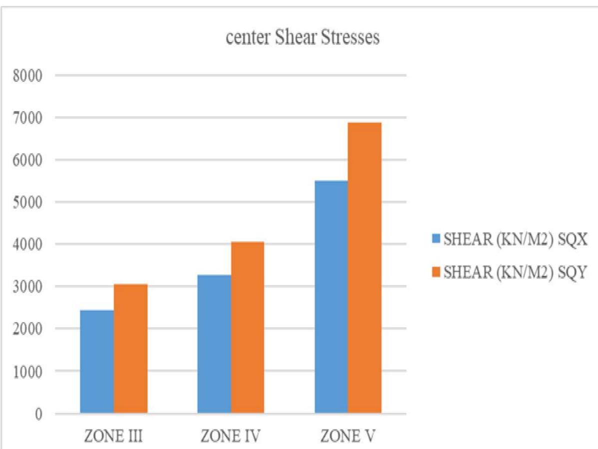
IV. RESULTS AND DISCUSSION



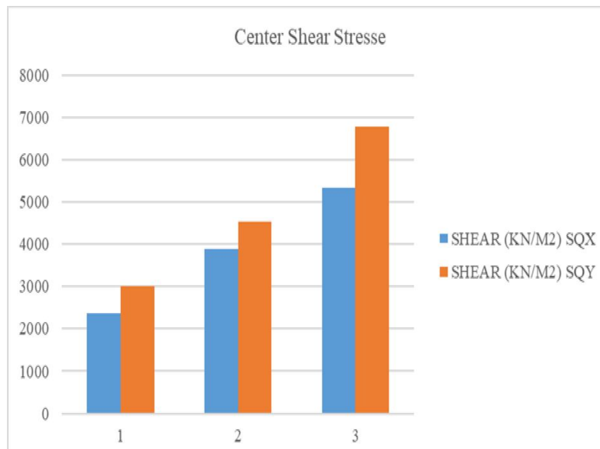
Graph 1 Zone Vs Maximum Center shear stresses on Slab In Regular Building Without shear wall



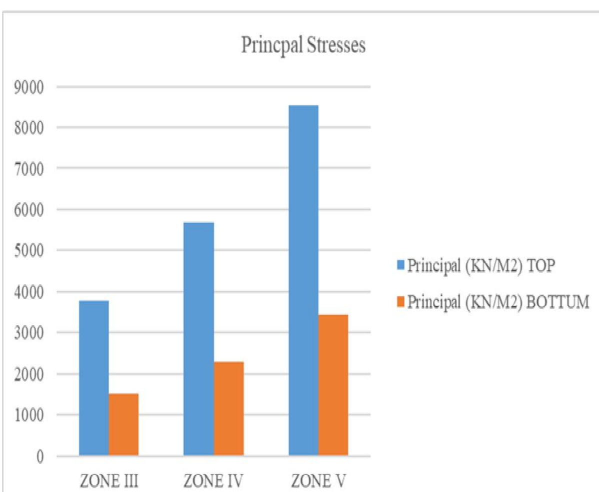
Graph 2 Zone Vs Maximum Center shear stresses on Slab In Regular Building With shear wall



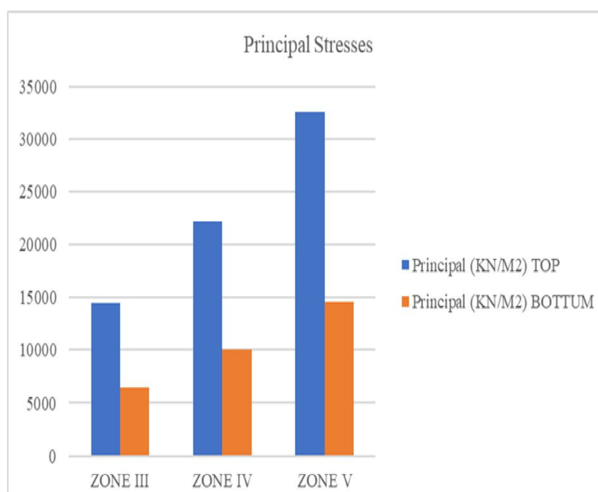
Graph 3 Zone Vs Maximum Center shear stresses on Slab In 200% irregular Building Without shear wall



Graph 4 Zone Vs Maximum Center shear stresses on Slab in 200% irregular Building With shear wall



Graph 5 Zone Vs Maximum Principal stresses on Slab In Regular Building Without shear wall



Graph 6 Zone Vs Maximum Principal stresses on Slab In Regular Building With shear wall

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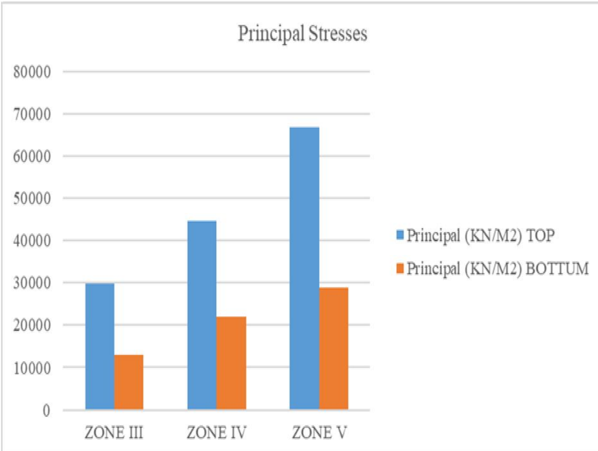
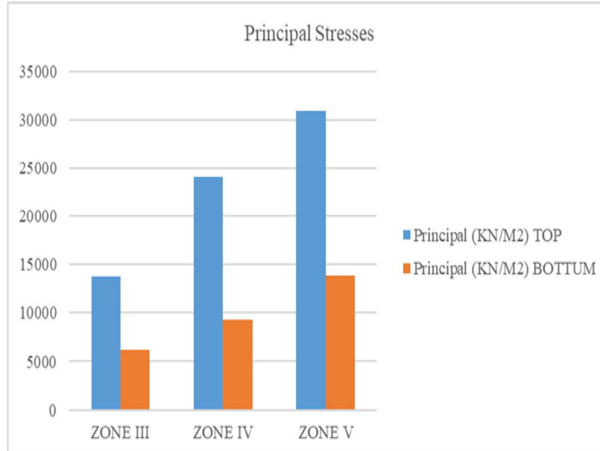
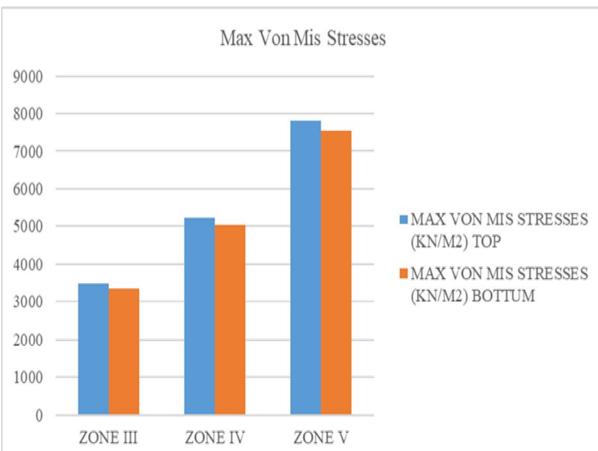


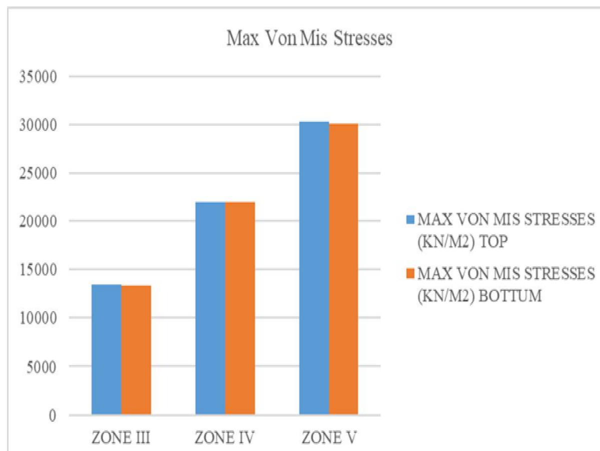
Graph 7 Zone Vs Maximum Principal stresses on Slab In 200% irregular Building Without shear wall



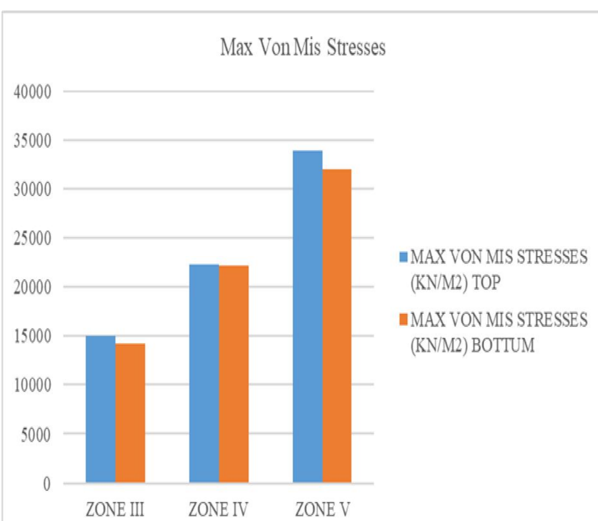
Graph 8 Zone Vs Maximum Principal stresses on Slab in 200% irregular Building With shear wall



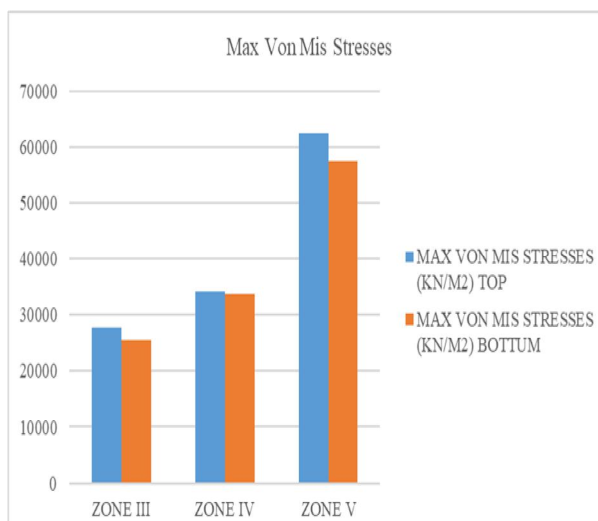
Graph 9 Zone Vs Maximum Von Mis stresses on Slab In Regular Building Without shear wall



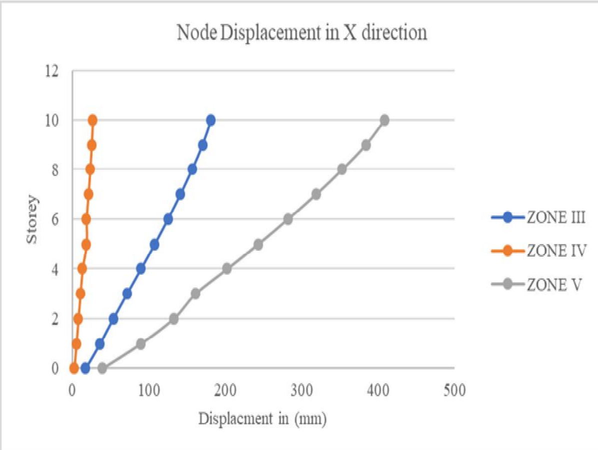
Graph 10 Zone Vs Maximum Von Mis stresses on Slab In Regular Building With shear wall



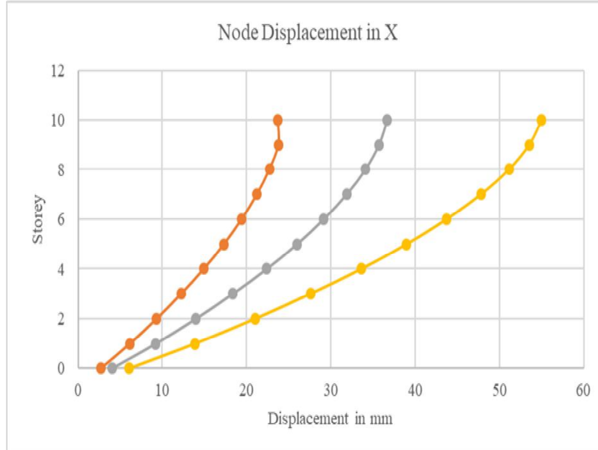
Graph 11 Zone Vs Maximum Von Mis stresses on Slab In 200% irregular Building Without shear wall



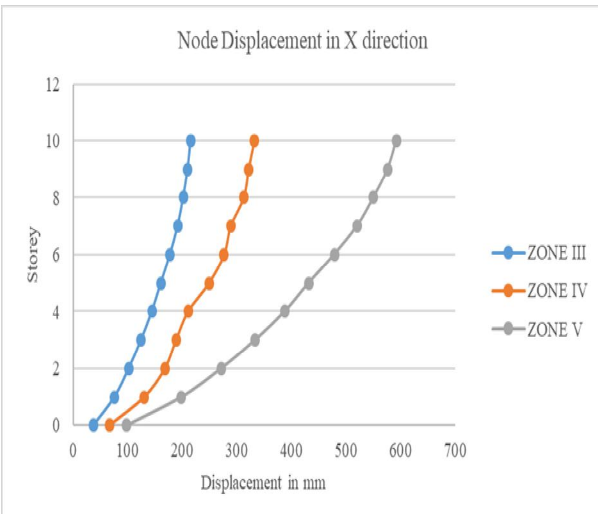
Graph 12 Zone Vs Maximum Von Mis stresses on Slab in 200% irregular Building With shear wall



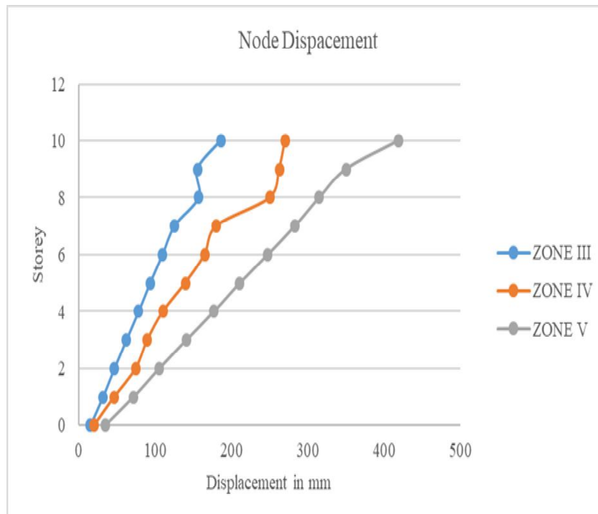
Graph 13 Zone Vs Maximum Node Displacement In Regular Building Without shear wall



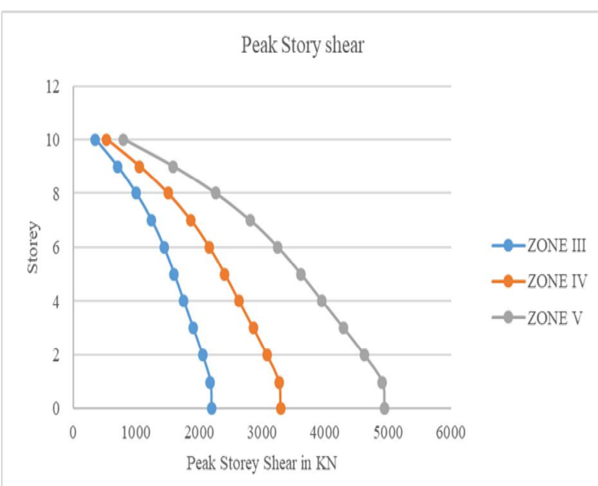
Graph 14 Zone Vs Maximum Node Displacement In Regular Building With shear wall



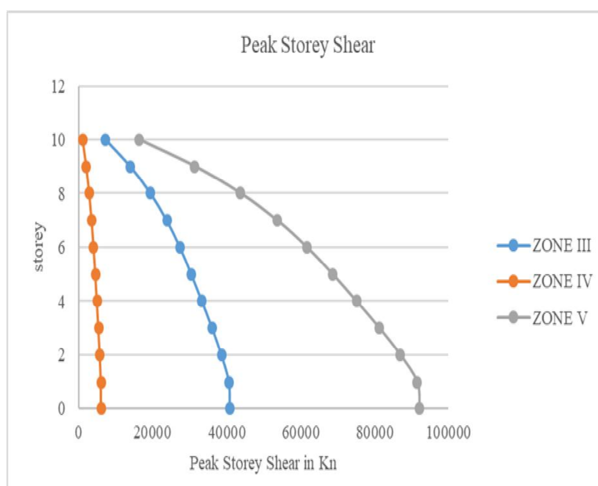
Graph 15 Zone Vs Maximum Node Displacement In 200% irregular Building Without shear wall



Graph 16 Zone Vs Maximum Node Displacement in 200% irregular Building With shear wall

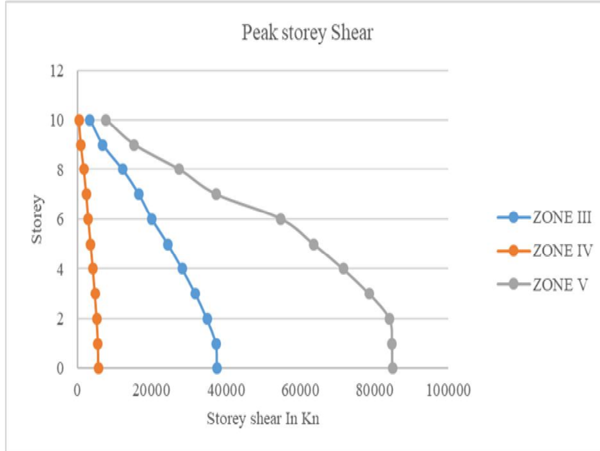


Graph 17 Zone Vs Peak Storey Shear in regular building Without shear wall



Graph 18 Zone Vs Peak Storey Shear in Regular Building with shear wall

Graph 15 Zone Vs Peak Storey Shear in 200% irregular Building Without shear wall



Graph 16 Zone Vs Peak Storey Shear in 200% irregular Building With shear wall

V. CONCLUSION

A. Center shear stresses X direction i.e. SQX in Flat slab increases about 18% and 77% in zone IV & Zone V respectively when compare it Zone III similarly the stresses in Y direction SQY increases about 68% and 124% in Zone IV and V, when shear wall provided at the center stresses decreases in all respective zones in regular and 200% irregular flat slab building.

B. The Von Mis & Principal top and bottom stresses in flat slab more decreases when shear wall provided at centre in Regular building but more increases in 200% irregular building in different zones.

C. Peak Storey shear increases when shear wall provides at the center in 200% irregular multi-storey building in different zones.

D. Node displacement in X direction will be more restricted when shear wall provides at center in all type of model i.e. regular & 200% irregular building in all respective zones.

E. It's concluded that the Structure with shear wall at center is effective for the effect of Dynamic load on the performance of building.

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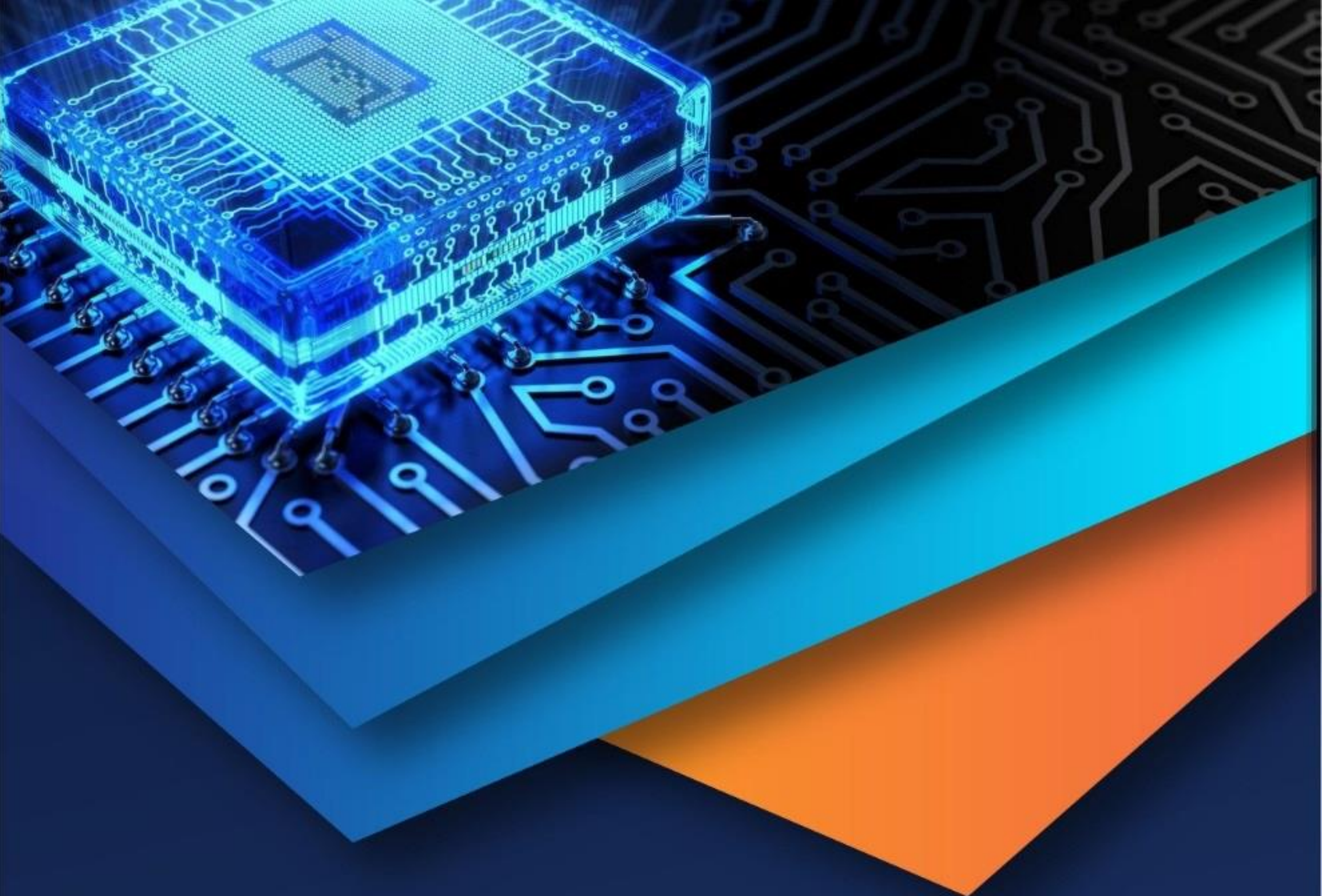

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