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Shear Wall Effect on G+9 and G+5 Storey Buildings in Hilly areas

CH. Lokesh, Chandan Kumar. Patnaikuni, Balaji, K. V. G. D, Santhosh Kumar.B, E. V. Raghava Rao

Abstract: The design of building in hilly areas is a typical criteria since the base of the foundation levels are varying due to availability of sloped terrain only. For better safety shear walls design can give the better safety against the Earthquake damages. This paper elucidate the variation of internal parameters for G+9 and G+5 storey buildings with shear walls on 30^{o} sloping ground. Earthquake analysis was made in E- tabs 17.0.1 software with soft and hard soil strata. The analysis for comparing internal parameters. G+9 storey building with core shear wall have higher story capacity while G+5 storey building have higher drift resistance.

Keywords : Shear walls,hilly areas , E-tabs soft ware ,. Internal parameters,

I. INTRODUCTION

Shear walls are one of the alternative means of resisting earthquake damage to multi-storeyed buildings. In present scenario, due to the economic growth and rapid urbanization there is a gradual development in hilly regions have transformed from the single storied buildings to multy storeyed structures. Eastern Ghats have mountain heights about 200 m from Mean sea Level. The buildings which are constructed in mountains are termed as "Hill Buildings".

It is observed that when compared to plain ground, the foundations base levels are determined according to terrain slopes. So the ground level storey columns are different heights. The short stiff columns have higher lateral forces in comparison with the long columns results failure of structure. Hence to avoid such failures the shear wall at the core of the structure is proposed.

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***** Correspondence Author

Ch. Lokesh*, Department of Civil Engineering, , GITAM, Deemed to be University, Visakhapatnam, India, ,lokeshchitturu27@gmail.com.

Dr Chandan Kumar Patnaikuni, Department of Civil Engineering, GITAM,, Deemed to be University, Visakhapatnam, India,. Email: pckumar20@gitam.edu

Prof. Balaji, K.V.G.D, Department of Civil Engineering, , GITAM,, Deemed to be University, Visakhapatnam, India,.: balajigitam@gmail.com

B.Santhosh kumar, Ph.D. Scholar, Department of Civil Engineering, , GITAM,, Deemed to be University, Visakhapatnam, India , santhoshamie@gmail.com

E. V. Raghava Rao, Department of Civil Engineering, K. K. University, Biharshariff, Bihar,

II. LITERATURE REVIEW

Mohammed Umar. Farooque Patel et al., [1]. This paper concludes that the buildings designed on sloping ground showed higher lateral displacement in comparison with the buildings on plain ground and this lateral displacement reduces when a shear wall is considered into account.

A S Swathi et al., [2] This study resulted that seismic Performance of the soft ground storey building is very less and is improved by addition of shear wall.

Prashant D et al., [3] the soft storey structures proved to be vulnerable during seismic activity, in comparison to other in-filled structures

Sujit Kumar et al., [4], it is notified, that the higher stiff ness for the short columns attract the more lateral forces which intern increases the horizontal shear force and bending moment.

S A Halkude et al., [5] This paper expressed that step back and set back building frames are recommended on sloping ground when compared with step back buildings.

N. Jitendra Babu et al., [6] .the examination of building on sloped ground have 24% more base shears in comparison with asymmetric building on plain Ground

Ravikumar, C.M et al., [7] the author initiated the awareness for seismic liability concept on practicing engineers

R. B. Khadiranaikar et al., [8] It is examined that the aspect ratios up to 1.00 are found better for seismic condition resistance, since time period and top storey displacement depend on increase of number of bays decreases in hill slope buildings.

Rayyan-Ul Hassan et al., [9] the advantages of infill wall and shear wall for behavior of structures for lateral load resistance by effectively reducing large joint displacements is examinined.

S. M. Nagargoje et al., [10] the observations made that the base shear in step back set back buildings are from 60% to 260% in comparison with setback building. They recommended the step back set back buildings may be favored on sloping ground.

Devesh P. Soni et al., [11] buildings with a vertical irregularities were designed with codal provisions on strength and serviceability limits have exhibited reasonable performances.

IS 1904-1984 (2002 Re affirmed code) Minimum slope requirement for foundations greater than or equal to 30 ^{o} to horizontal is stipulated.

III. RESEARCH SIGNIFICANCE

RESPONSE SPECTRUM ANALYSIS

The dynamic analysis of structures is carried out by two methods, Response Spectrum Method and Time History Analysis. The Response Spectrum method is to determine the response in every mode of vibration and their superimposing the responses in various modes to obtain the total response. IS 1893:2002 (part 1) stipulates the E.Q. Analysis of buildings by Response Spectrum Method.
ETABS is software for building systems. Design.

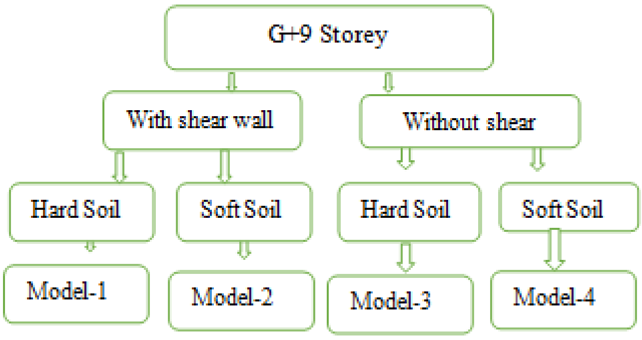
IV. METHODOLOGY

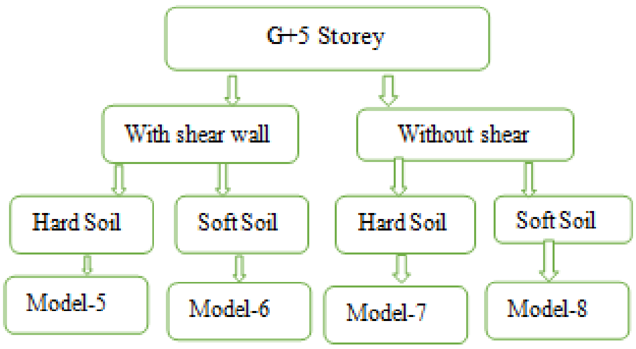
- The modelling of the buildings have been done using ETABS software, with the code provisions of IS 456-2000 and IS 1893-2002(part1),
- IS 1893-2002, code stipulated the load combinations as follows.

a) 1.5(DL±IL)
b) 1.2(DL±IL±EL)
c) 1.5(DL±EL)
d) 0.9DL±1.5EL

- Shear walls are designed as per IS 13920-1993 Clause 9.1.2 and their thickness is not less than 150mm.
- As per IS 1893-2016, the moment resisting frames are designed independently to resist up to ¼ of the design base shear.

For analysis and study purpose the models are developed for G+5 and G+9 storeys with and without shear walls at the core of the buildings for Zone II, III and IV along with soft and hard soil strata. All the structures are resting on sloped ground at a slope angle 30° with the horizontal. The total methodology is shown in the figure 1. The total Internal parameters are depicted in the figure 4 to figure 26. The model Description was shown in the table1.





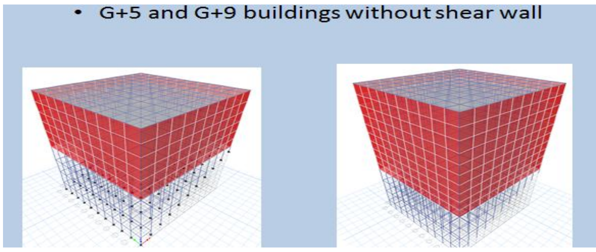


Fig. (1) Without Shearwall

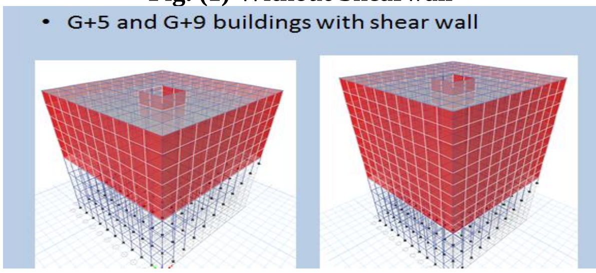


Fig. (2) With Shearwall

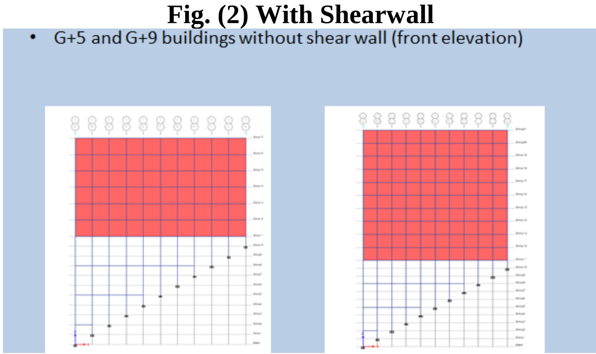


Fig. (3) Front Elevation

MODEL DESCRIPTION

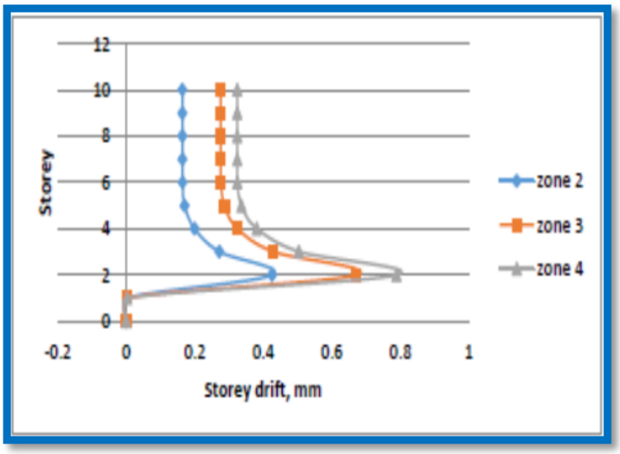
TABLE-1.STRUCTURE DESCRIPTION

No of Storeys		G+5
		G+9
Type of building		Residential
Plan dimension		30mx30m
Height of each floor		3m
Height of each tie beam		5.4m
Thickness of slab		150mm
Wall thickness	Walls	230mm
	Shear wall	300mm
Beams	Floor Beams	230mmX400mm
	Plinth Beams	230mmX300mm
	Tie Beams	230mmX450mm
Columns	Normal Building	250mmX250mm

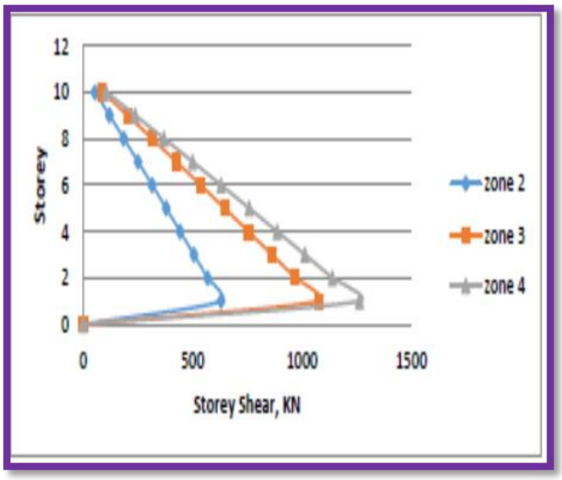
	End Columns below the base level	350mmX350mm
Self-weight of Slab(0.15x25)		3.75 kN/m^2
Floor finishing		1 kN/m^2
Unexpected load		1 kN/m^2
Concrete Grade		M30
Steel		Fe415
Ground slope/Gradient		30°

Table-2.Earthquake Parameters

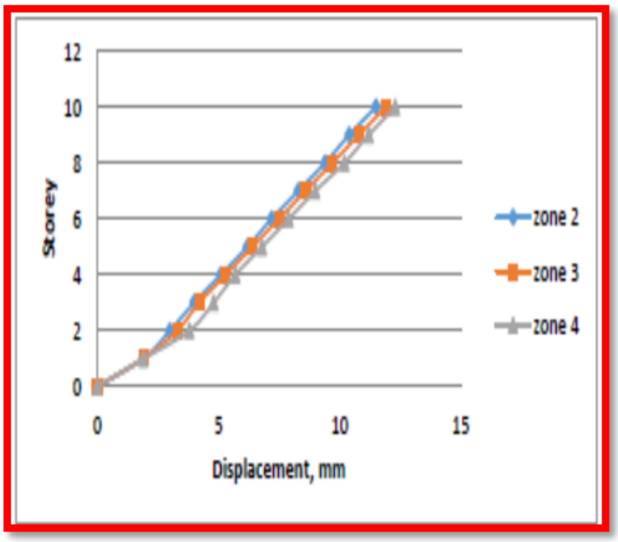
Parameters		Values
Type of Frame		OMRF
Seismic Zone Factor	Zone II	0.10
	Zone III	0.16
	Zone IV	0.24
Importance Factor		1
Response Reduction Factor		3
Percentage of Damping		5%
Soil Type		Hard soil
		Soft soil



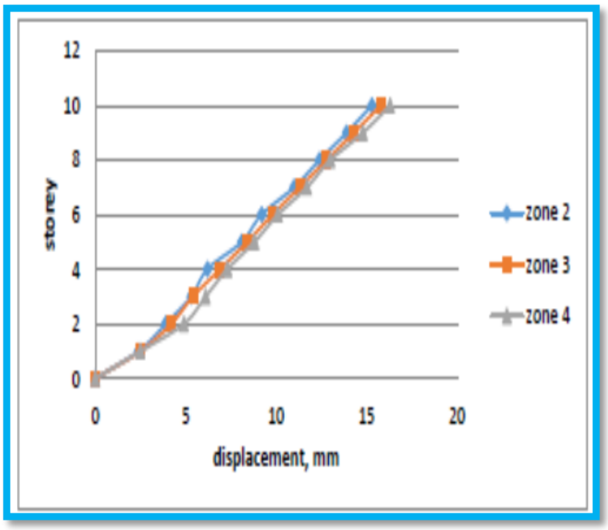
Fig(5): Storey drifts of G+9 with shear wall with hard soil medium



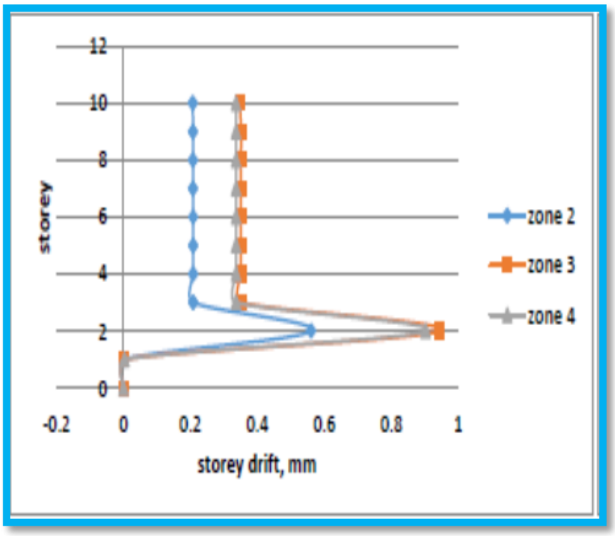
Fig(6): Max Storey shear of G+9 with Shear wall with hard soil medium



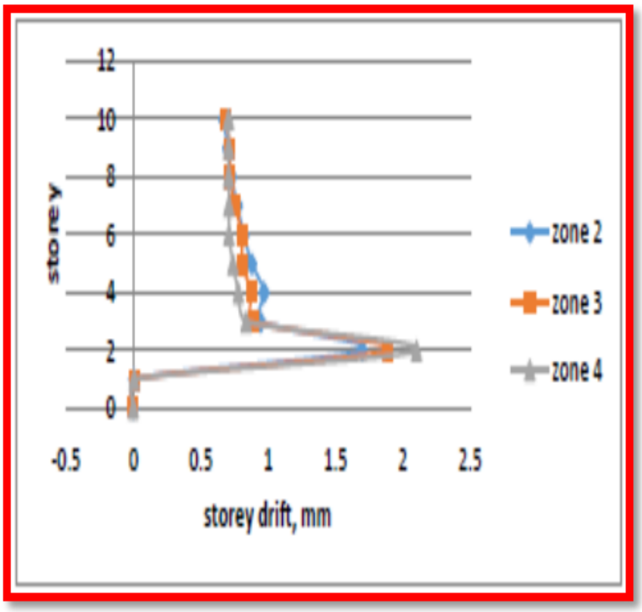
Fig(4): Max displacement of G+9 storey with shear wall Hard soil medium



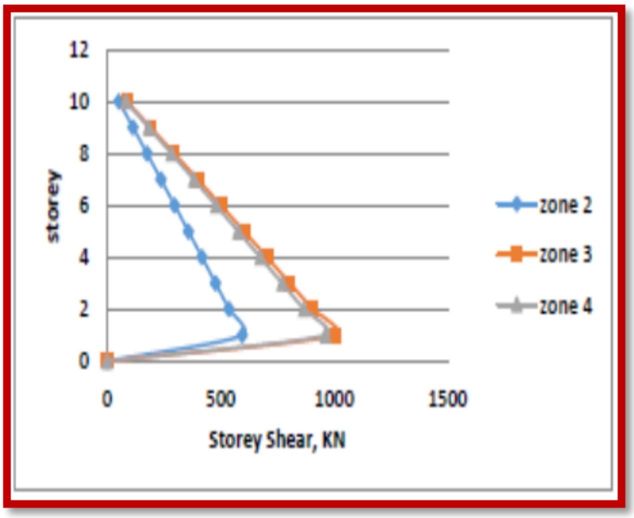
Fig(6): Max displacement of G+9 without Shear wall with hard soil medium



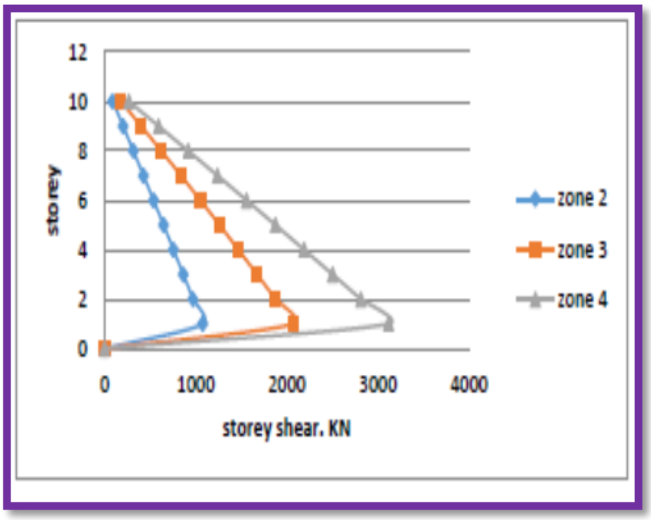
Fig(7): Max Storey drifts of G+9 without Shear wall at zone with hard soil medium



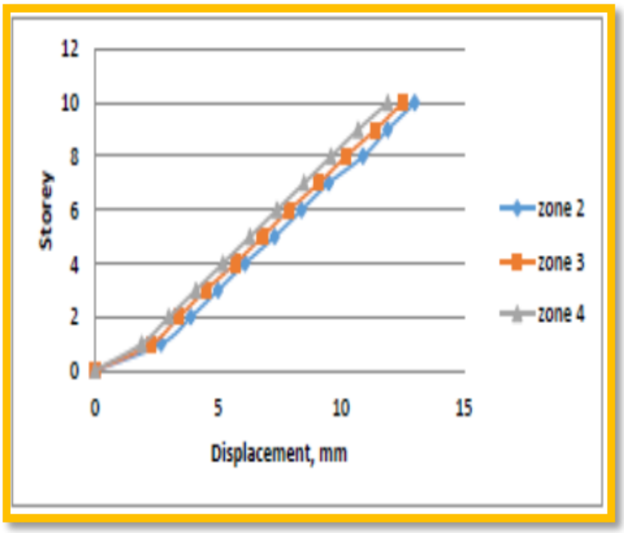
Fig(10): Max Storey drift of G+9 with Shear wall



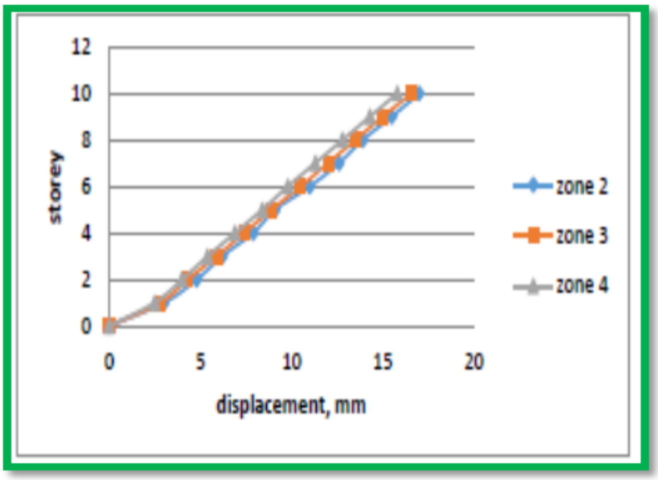
Fig(8): Max Storey shear of G+9 without Shear wall with hard soil medium



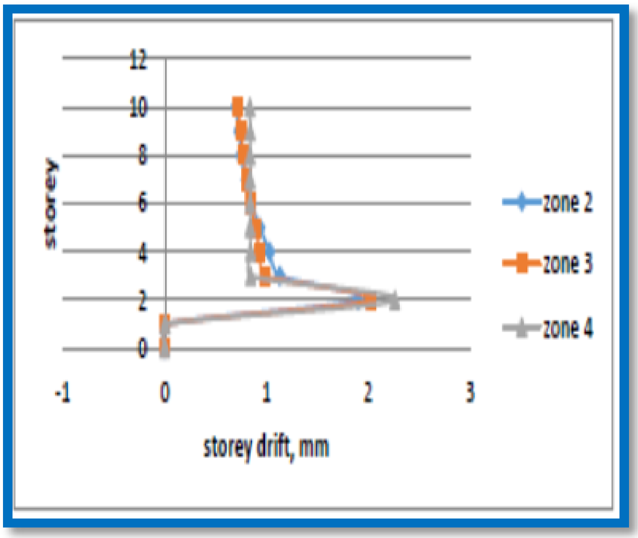
Fig(l1): Max Storey shear of G+9 with Shear wall



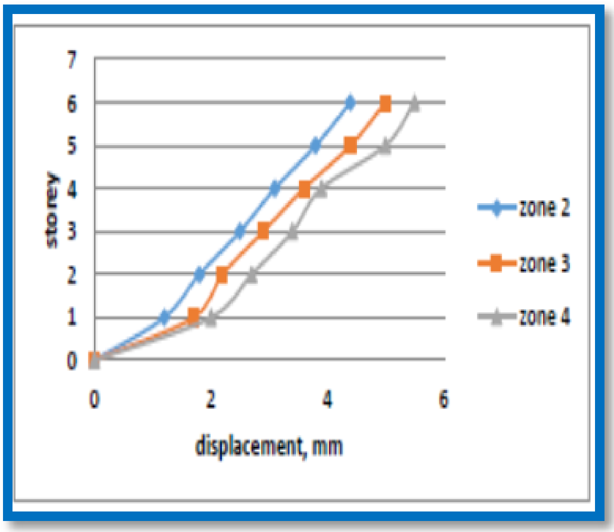
Fig(9): Max displacement of G+9 with Shear wall



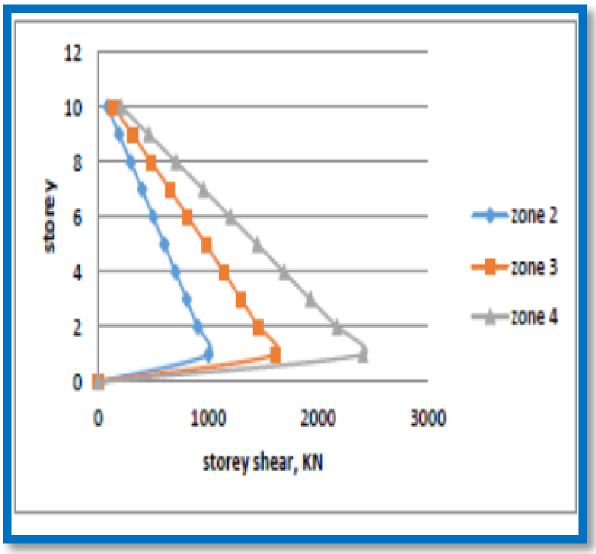
Fig(12): Storey shear of G+9 Without Shear wall



Fig(13): Storey drift of G+9 Without shear wall



Fig(21): Displacement of G+5 with shear wall



Fig(14): Max Storey shear of G+9 without shear wall

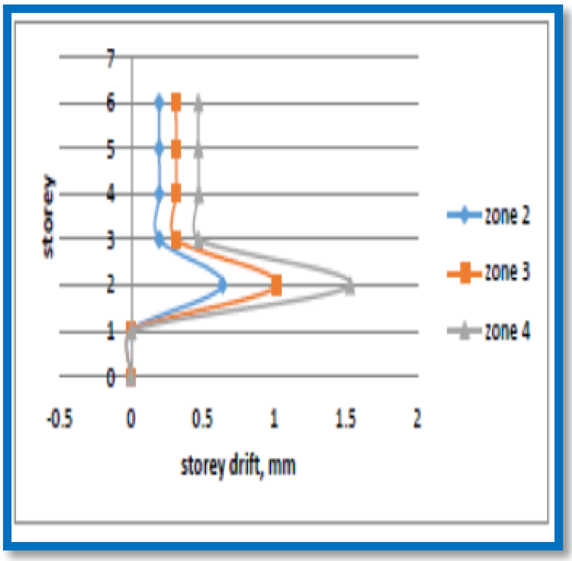


Fig (22): Storey drift of G+5 With shear wall

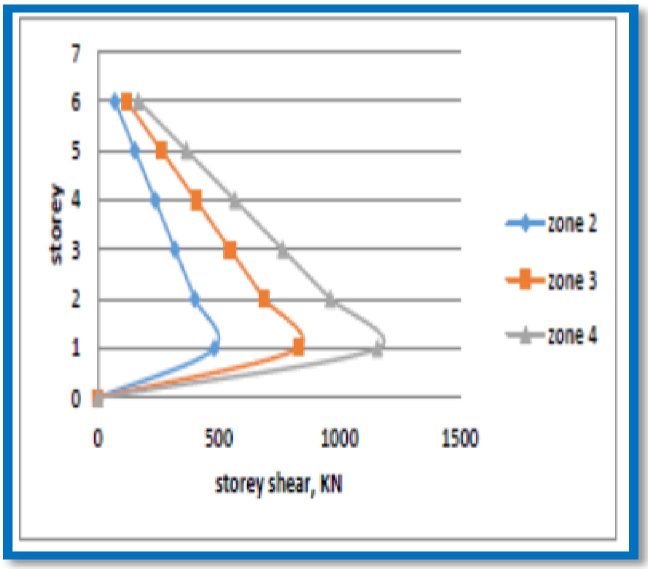
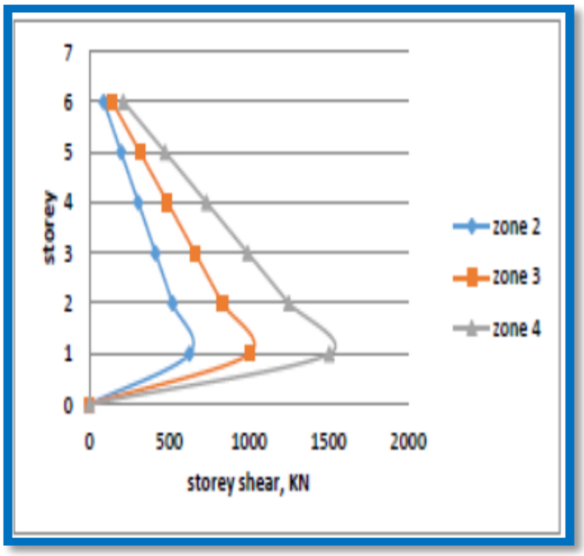


Fig (20): Storey shear of G+5 Without shear wall



Fig(23): Storey shear of G+5 With shear wall

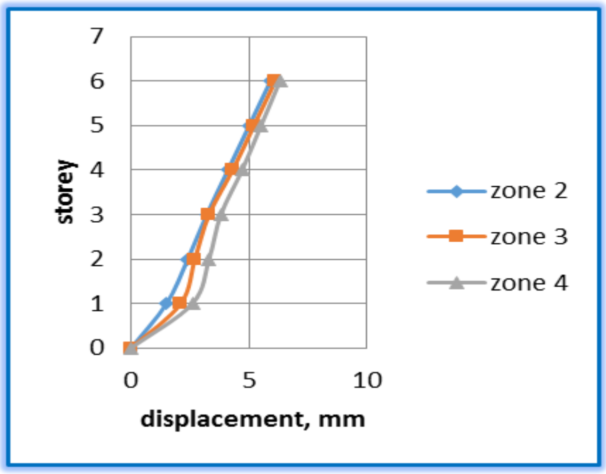


Fig (24): Displacement of G+5 without shear wall in soft soilmedium

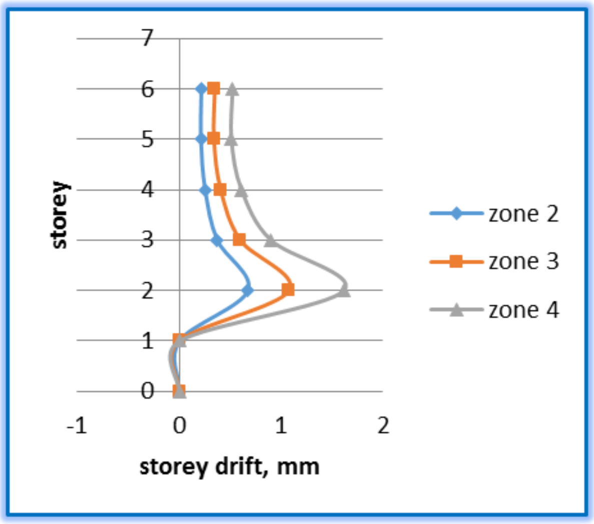


Fig (25): storey drift of G+5 without shear wall in soft soil medium.

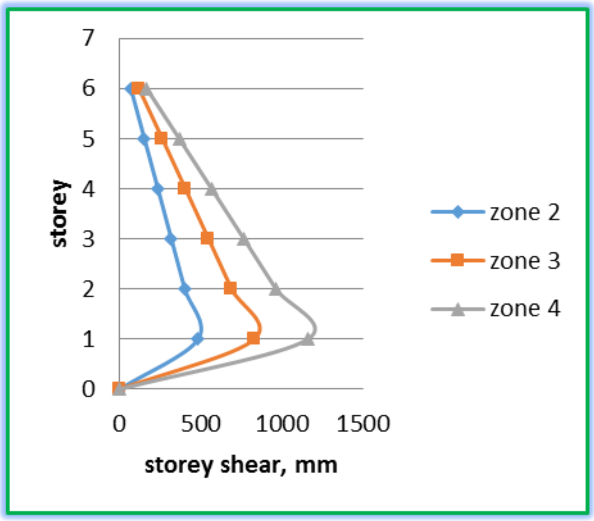


Fig (26): storey shear of G+5 without shear wall in soft soil medium.

V. DISCUSSIONS

Max displacement of G+9 with shear wall for zone 2 to zone 4 with hard soil medium are 11.5mm,11.9mm,12.3 mm
Max displacement of G+9 with out shear wall at zone 2 to zone 4 with hard soil medium are 15.3mm,15.6mm,16.3mm
Max displacement of G+5 with shear wall at zone 2 to zone 4 with soft soil medium are 4.4mm,5mm,5.5mm
Max displacement of G+5 without shear wall at zone 2 to zone 4 with soft soil medium are 5.9mm,6.1mm,6.3mm
Storey shear of G+9 with shear wall at zone 2 to zone 4 with hard soil medium are 89.6kN,179.4kN, 265.5kN
Storey shear of G+9 without shear wall at zone 2 to zone 4 with soft soil medium are 52.2kN,87.3kN,83.6kN
Storey shear of G+5 with shear out wall at zone 2 to zone 4 with hard soil medium are 88.4kN,141.4kN,212.2kN
Storey shear of G+5 with out shear wall at zone 2 to zone 4 with soft soil medium are 69.5kN,119.4kN,166.8kN

VI. CONCLUSION

The following conclusions are drawn from the discussions in the previous para

With Shear wall effects the storey shear for G+9 is about 3 times more in Zone 4 and 2 times more for zone 3 and up to 1.7 times more for zone 2
With Shear wall effects the storey shear for G+5 is about 1.22 times more in Zone 4 and 1.18 times more for zone 3 and up to 1.27 times more for zone 2.
With Shear wall effects the top displacement for G+9 is about 1.302 times less in Zone 4 and 1.286 times less for zone 3 and up to 1.325 times more for zone 2
With Shear wall effects the top displacement for G+5 is 1.14 times less in Zone 4 and 1.22 times less for zone 3 and up to 1.25 times less for zone 2.
Hence the shear wall effect is more in G+9 storey for storey shear capacity while G+5 storey have higher drift capacity

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