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SEISMIC ANALYSIS OF STEP BACK BUILDING ON SLOPING GROUND WITH AND WITHOUT SHEAR WALL

S.Khaleelbasha[1], Dr.C.Sashidhar[2], B.Sreenivas[3]

[1]*PG Scholar, Department of Civil Engineering, Jawaharlal Nehru Technological University Anantapur, Anantapuramu, India.*

[2]*Professor, Department of Civil Engineering, Jawaharlal Nehru Technological University Anantapur, Anantapuramu, India.*

[3]*Structural Engineer, BUTLAS Consulting Engineers Pvt Ltd, Hyderabad, Telangana, India.*

Abstract: In this study a RCC building G+7storey with step back structure and the sloping ground in 15^0 is considered. A reinforced concrete structure including shear wall in the seismic analysis of structure is done by linear static analysis method. Shear walls are one of the most effective horizontal forces resisting components in multi storied structures. Structural walls give a productive efficient bracing system and offer incredible potential for lateral load resistance. In this project utilizing ETABS 2016 programming to storey displacements, storey drifts, along with tables and graphs to compare the inclining ground building with and without shear wall. Here investigated the storey displacements and storey drifts values are within permissible limits as per I.S. 1893-2016 code of practice earthquake analysis and also comparing the storey displacement and storey drifts values of sloping ground building in different zones.

Keywords: ETABS software, seismic analysis, shear wall, linear static analysis, sloping ground, storey displacement, storey drifts.

1. INTRODUCTION

Multi storied RCC structures are commonly large built on sloping ground; be that as it may, as a result of shortage of level grounds the development structures have been begun on slanting grounds. The economic growth and rapid urbanization in sloping region has stimulated the land progression. Along these lines, population density in the sloping area has increased enormously. In this way, there is interest for the improvement of multi-storey structures on slope ground and urban domains. In such condition it is difficult to excavate since it is over the top it is expensive. A significant component in structure setup is its regularity and symmetry in the plane and elevation. Structures on hill slopes are highly irregular and asymmetric in plan and elevation. One of the significant contributors of basic harm during solid seismic tremor is the discontinuities and inconsistencies in the load path. In slanting ground the height of the column is diverse at the base storey. It is deviated in plan and rise. The short columns are most effects and harm during the seismic tremor. Mass demolition of the low and raised structures earthquake prompts the need of examination especially in a creating country like India. Seismic tremors are most dangerous natural hazards. In northeast region of India, hilly area is increasingly inclined to seismic action. The seismic tremor impacts function is most harmful because of the fact that it's influences enormous region, and which happens abrupt and unusual. It causes more death toll and property and damages significant administrations, for example, transport water supply, communication, power, sewerage system etc. To take care of from the issue we have to discover the seismic presentation and horizontal stability of the structure. Shear divider are a most among effective horizontal force resisting components in multi storied structures. Exactly when shear wall are given at an appropriate location in a structure they can demonstrate to be productive.

2. LITERATURE REVIEW

Based on the research of **C. Sashidhar, B. Sreenivas** studied on seismic analysis of step back building comparing different zones i.e II and IV. And also comparing shear wall structure and without shear wall structure.

Jyotsna joseph, 2017 studied on a seismic analysis of setback building with shear wall on ground with different slope is done by linear static method. The behaviour of building components were analyzed and compared on basis of displacement, storey drifts in various zones utilizing with ETABS 2015.

E Venkata sravani, 2016 studied a multi storey building on sloping ground zone II. In this study, 3D model of 4 and 9 storied structures have been created for symmetric and asymmetric building models and analyzed using structural analysis tool "ETABS nonlinear". The seismic analysis of a (g+7)structure RCC expanding on differing sloping edges i.e 7.5^0 & 15^0 is examined and constructed and the equivalent on the level surface with storey displacements and drifts.

B.G. Birajdar, S.S. Nalawade, 2014 was conducted the seismic analysis performed on 24 RCC structures with three different configurations like step back structure, set back structure, step back – set back structure are introduced utilizing ETABS to find their results of storey displacements, storey drifts.

Varsha R. Harne, 2014 Comparative Study of Strength of RC Shear Wall at Different Location on Multi-storied Residential Building, main focus is to determine the solution for shear wall area in multi-story building. A RCC working of six storey set in Nagpur exposed to tremor stacking in zone-II is considered. A earthquake load is determined by seismic coefficient method utilizing IS 1893 (PART–I):2002.

Likhitharadhya YR(2016) conducted the study of RCC building on sloping ground and flat building in seismic analysis. Two types of configuration of building on sloping ground, one is step back and step back set back. In this study, G+10storey RCC building and ground slope varying from 10^0 to 30^0 have been considered. Using ETABS 2015 they get results of sloping ground building that is storey displacement and storey drifts.

P.P. Chandurkar(2013) was conducted in the seismic design of buildings, shear walls act as major earthquake resisting members. In this present study, main focus is to determine the solution of shear wall location in multi-storey building. And to determine the storey displacement and storey drifts in different zones.

3. OBJECTIVE AND SCOPE

Objective:

1. Main point of the working project to check and analyze of the seismic reaction of the multi-storied structure on sloping ground with various zones utilizing ETABS.
2. To analysis of story displacements and story drifts.
3. To analyze the step back structure with & without shear wall.
4. Comparisons a inclining ground structure various zones.

Scope of study:

1. Three dimensional space frame analysis is carried out step back structure on inclining ground 7 stories structure along ground level under activity of seismic load.
2. In this project, static linear method only analyzing.

4. STRUCTURAL DATA

Loading standards:

Self weight	1 kn/m^2
live load	2 kn/m^2
Wall load	5 kn/m
Wind load	47 m/sec, Delhi 44 m/sec, Hyderabad

Geometric details:

Each floor height	3.0m
height of the plinth	0.5m above G.L
Materials	
Grade of concrete	M_{25}
Grade of steel	HYSD 500

Main features:

Utility of building	Step back building
Number of stories	8, (G+7)
Geometry of building	Irregular building on slope ground
Type of construction	Frame of RCC
Type of walls	Brick walls
Thickness of slab	125mm
Shear wall thickness	230mm

Section properties:

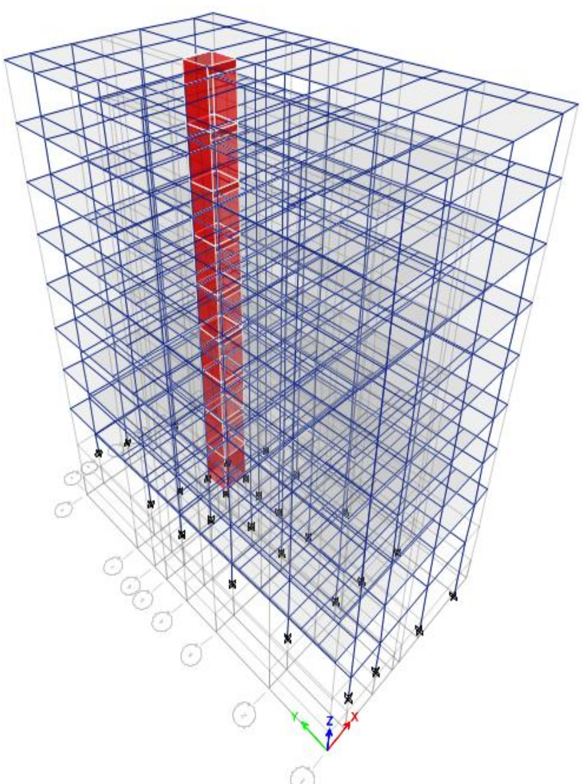
Beam sizes	300*425 mm
Floor beam	300*500mm
Plinth beam	300*450mm
Column sizes	300*600mm
Slab	125mm

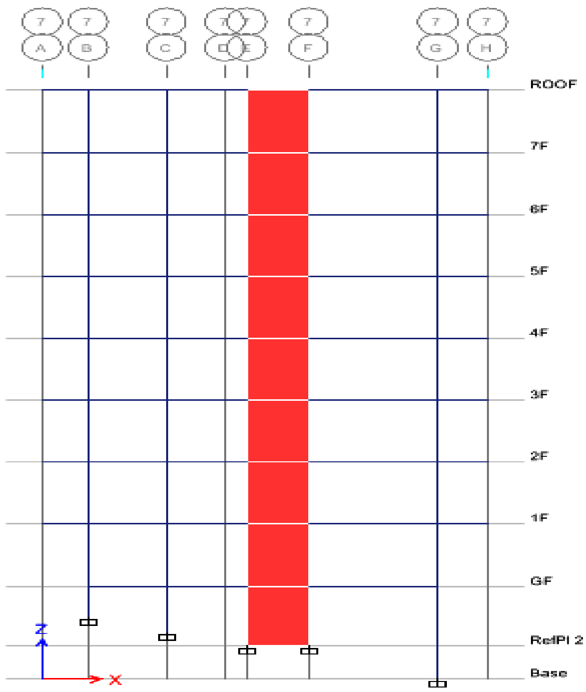
Seismic data:

	Zone factor	Response factor	Importance factor
Zone 2	0.1	5	1.0
Zone 4	0.24	5	1.0

5. ANALYSIS OF STEP BACK BUILDING

i. Shear wall structure include shear wall:



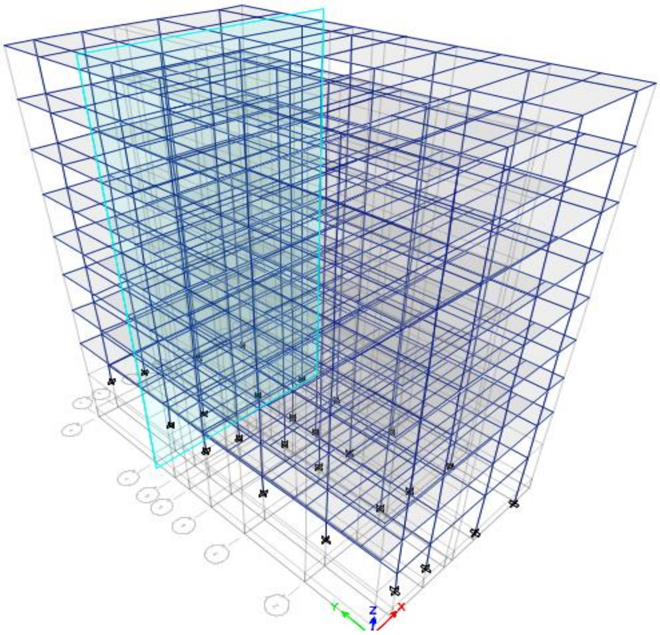


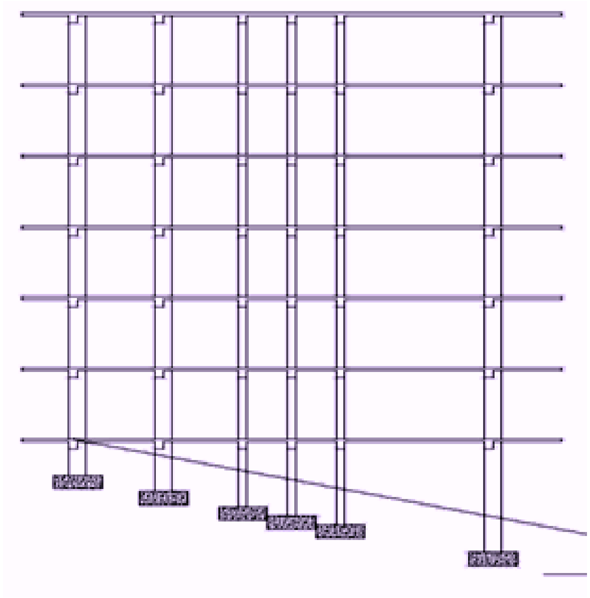
SHEAR WALL STRUCTURE IN 3D VIEW

ELEVATION VIEW OF STRUCTURE INCLUDE

SHEAR WALL

ii. General step back building:

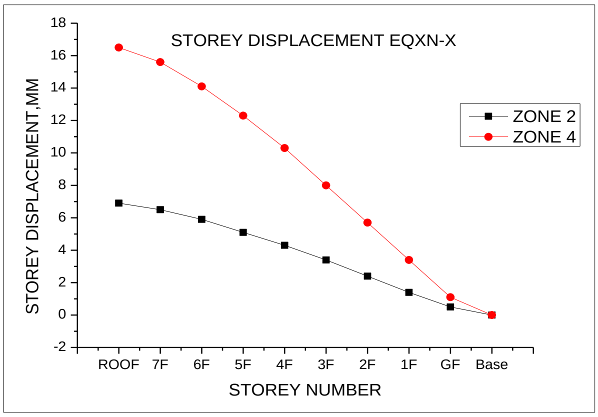


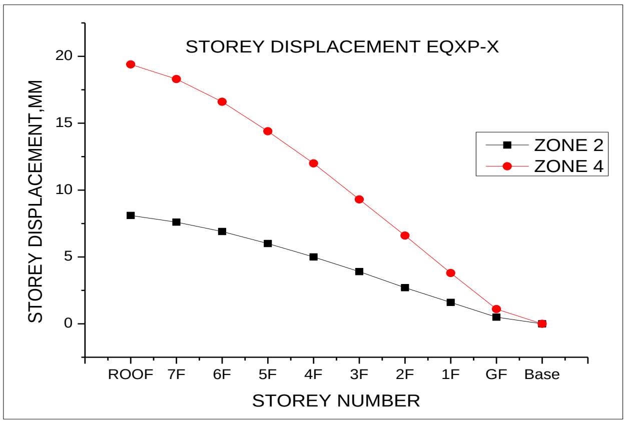


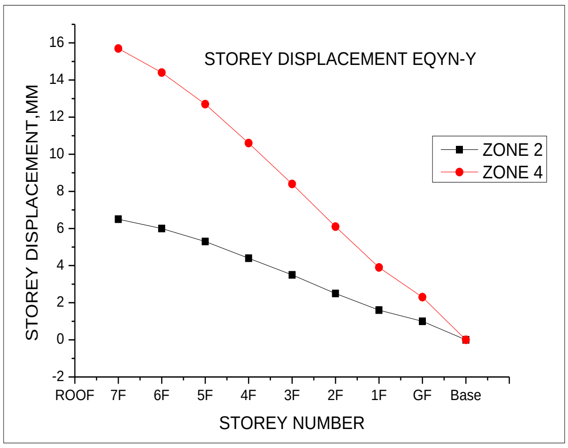
STEP BACK STRUCTURE IN 3D VIEW **STEP BACK BUILDING WITH 15^0 SLOPE**

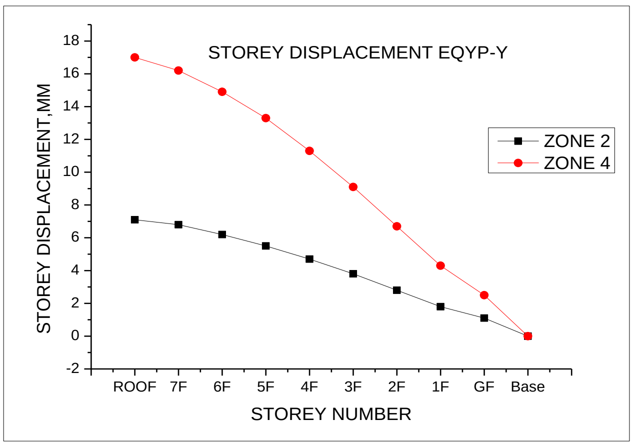
6. RESULTS

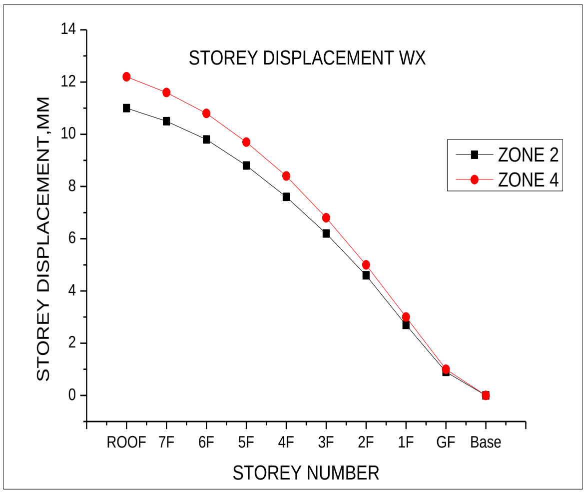
With shear wall building results of zone 2 and zone 4:

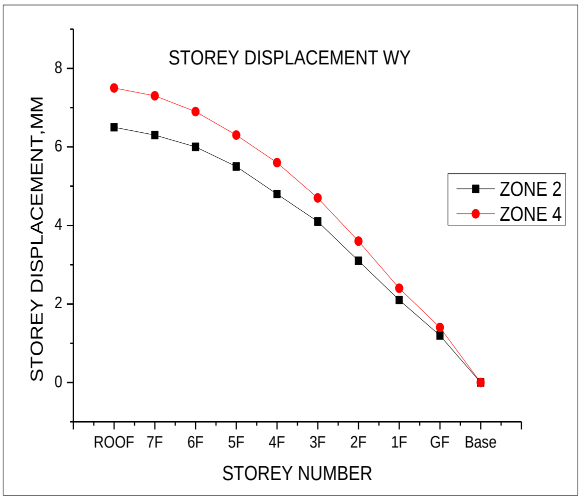


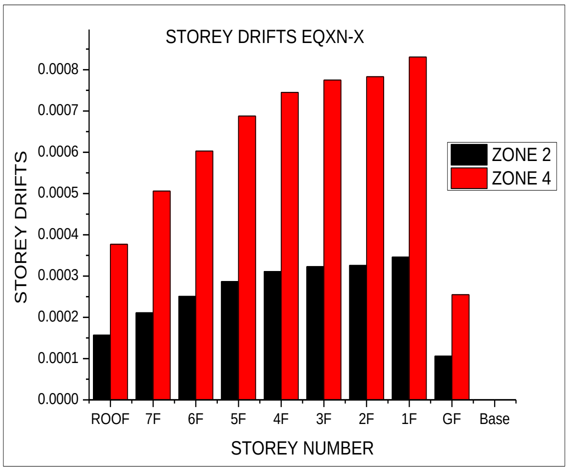


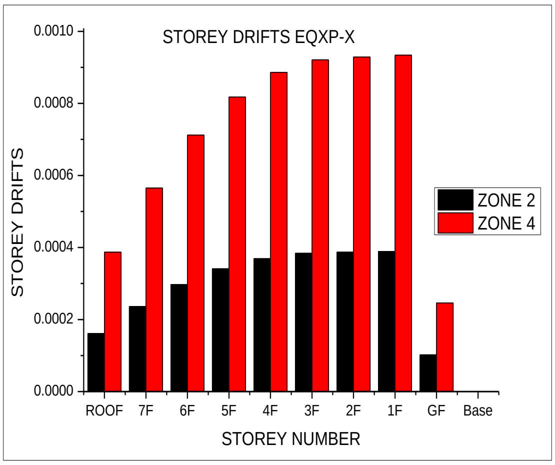


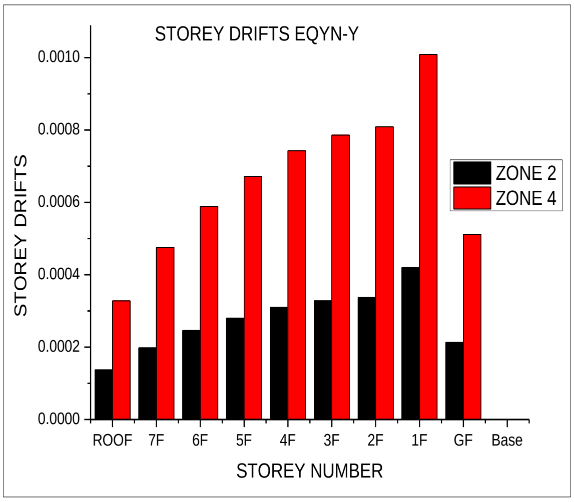


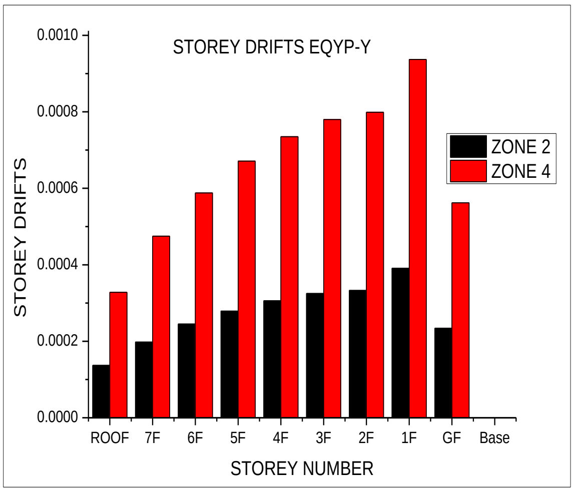

STOREY DISPLACEMENT WX
STOREY DISPLACEMENT,MM
STOREY NUMBER
ZONE 2
ZONE 4
ROOF 7F 6F 5F 4F 3F 2F 1F GF Base

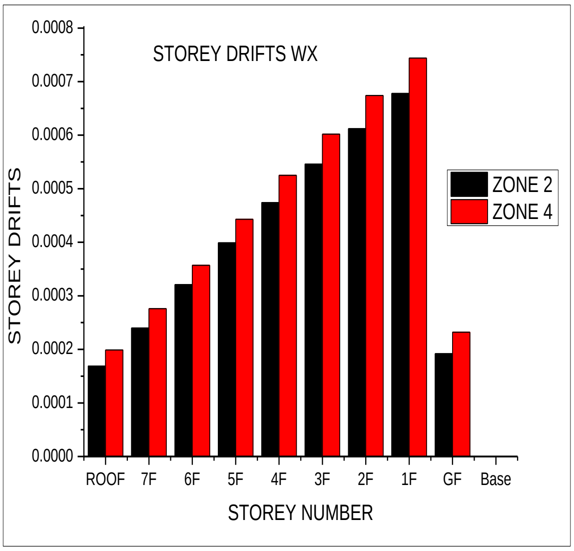

STOREY DISPLACEMENT WY
STOREY DISPLACEMENT,MM
STOREY NUMBER
ZONE 2
ZONE 4
ROOF 7F 6F 5F 4F 3F 2F 1F GF Base

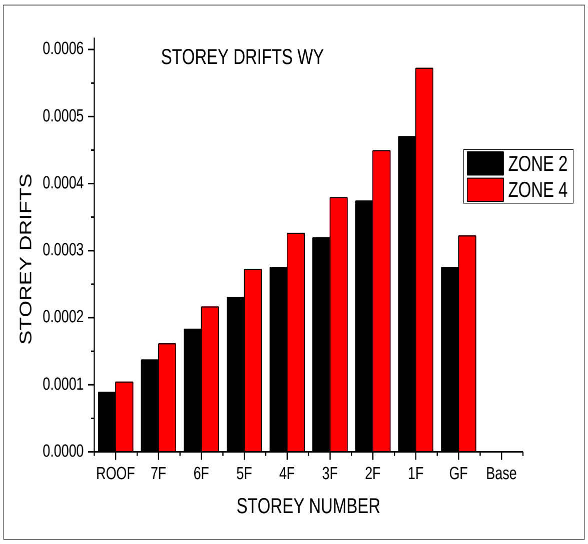

STOREY DRIFTS EQXN-X
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4
ROOF 7F 6F 5F 4F 3F 2F 1F GF Base


STOREY DRIFTS EQXP-X
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4
ROOF 7F 6F 5F 4F 3F 2F 1F GF Base

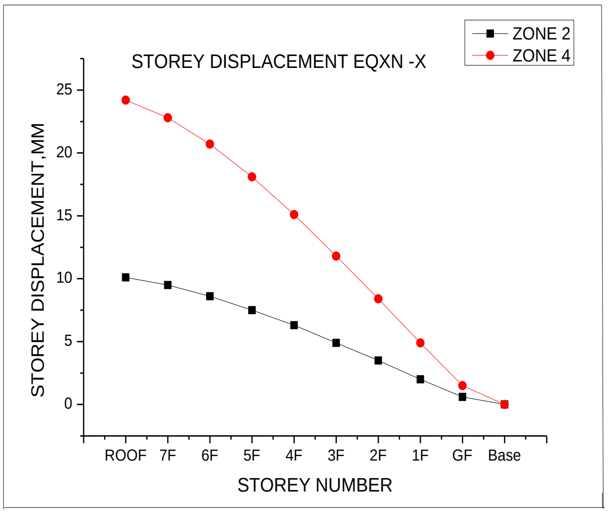

STOREY DRIFTS EQYN-Y
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4
ROOF 7F 6F 5F 4F 3F 2F 1F GF Base

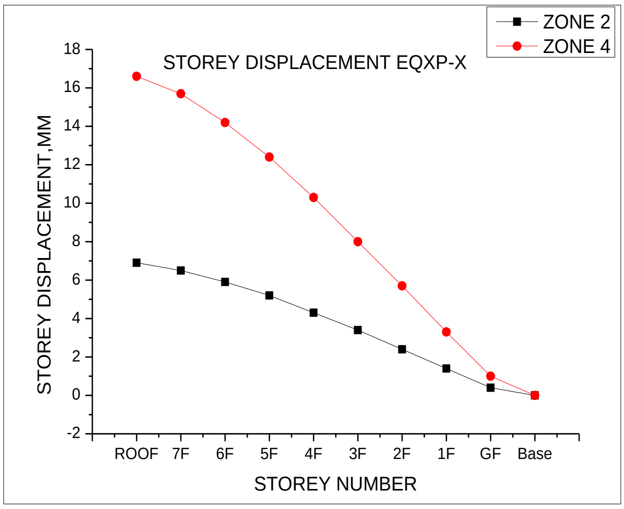

STOREY DRIFTS EQYP-Y
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4
ROOF 7F 6F 5F 4F 3F 2F 1F GF Base

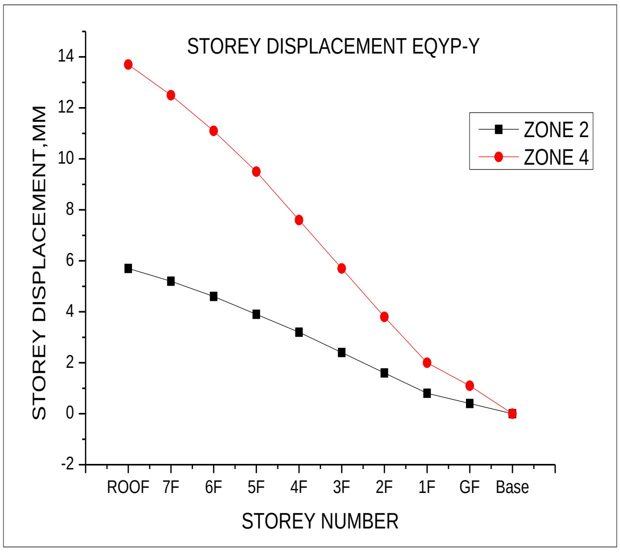


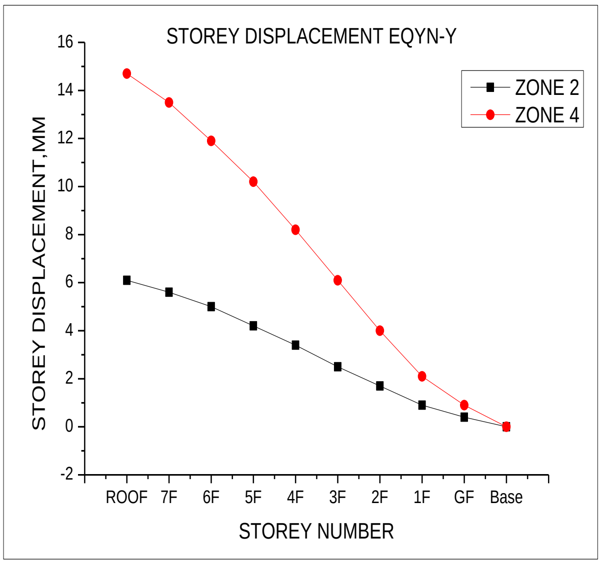


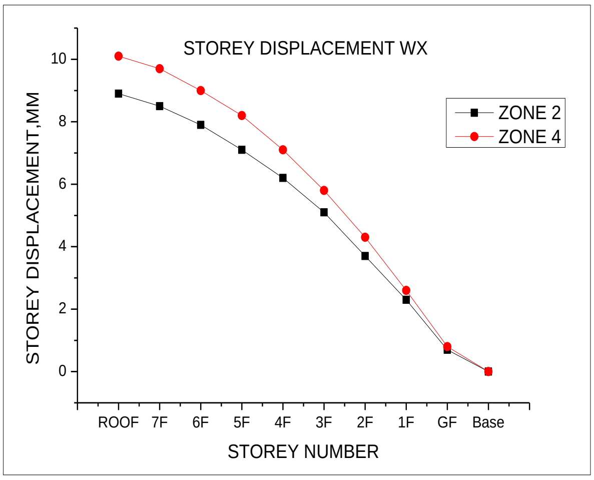
Without shear wall building results of zone 2 and 4:

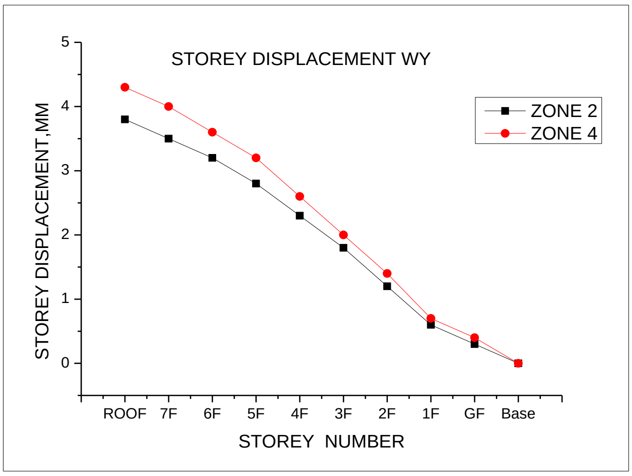


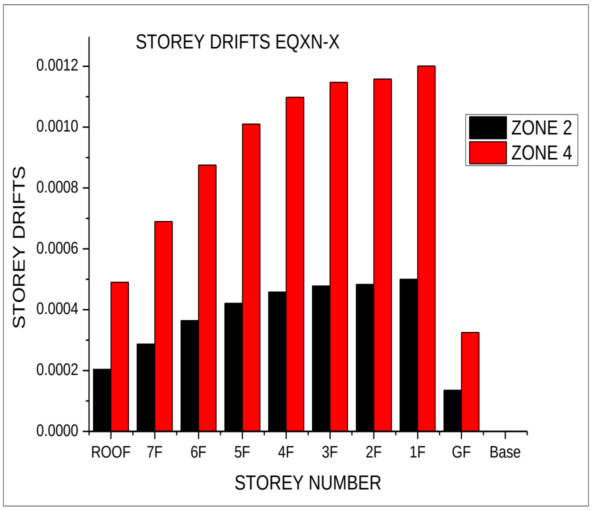


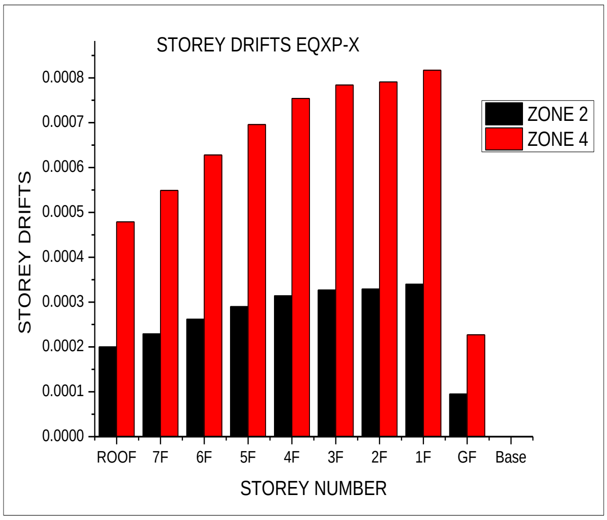


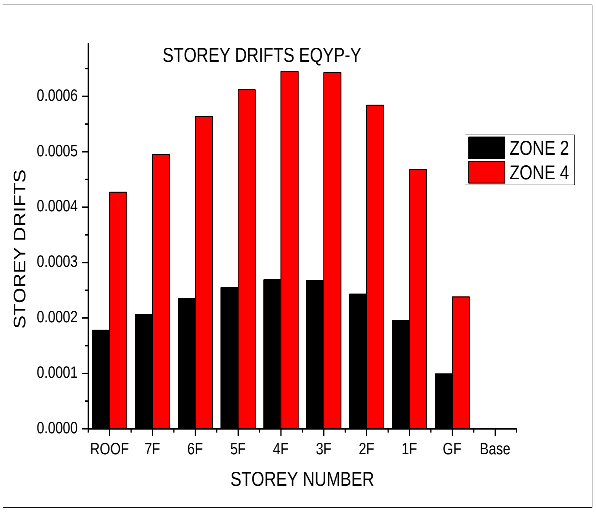


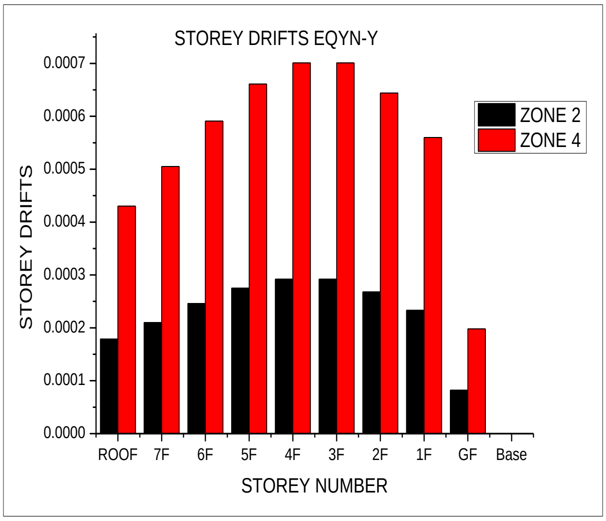

STOREY DISPLACEMENT WX
STOREY DISPLACEMENT,MM
STOREY NUMBER
ZONE 2
ZONE 4

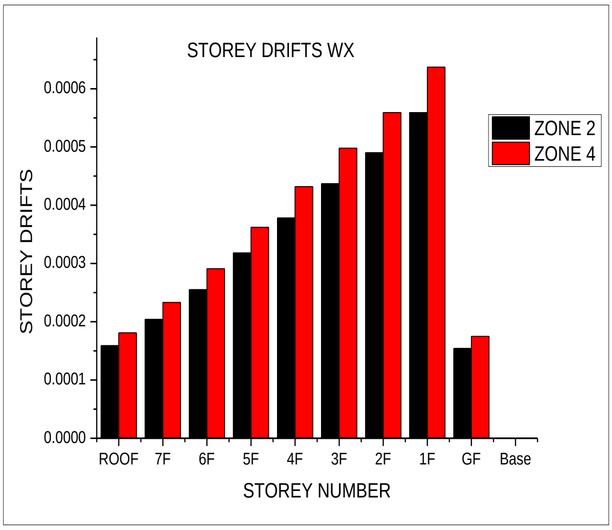

STOREY DISPLACEMENT WY
STOREY DISPLACEMENT,MM
STOREY NUMBER
ZONE 2
ZONE 4

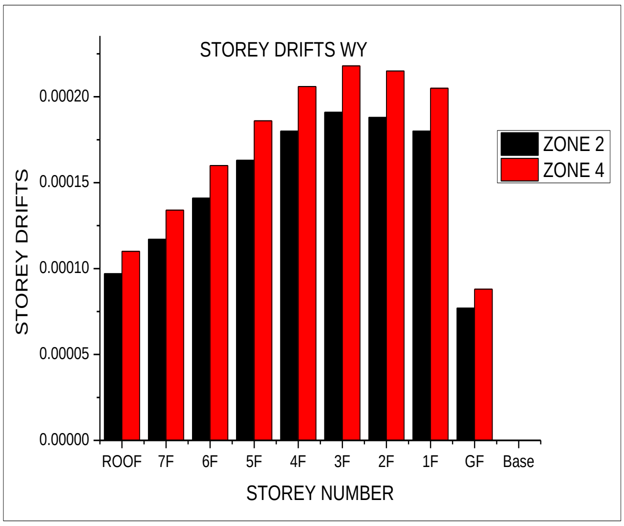

STOREY DRIFTS EQXN-X
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4


STOREY DRIFTS EQXP-X
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4


STOREY DRIFTS EQYP-Y
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4


STOREY DRIFTS EQYN-Y
STOREY DRIFTS
STOREY NUMBER
ZONE 2
ZONE 4





7. DISCUSSION OF RESULTS

- According to IS 456:2000, maximum lateral displacemnt is (H/500) m, where H is the height of the building. Here H is 28.5m maximum limit for displacement is (28.5*1000)/500 = 57mm.
  - In this analysis, we get the results of maximum value of displacement of step back building on sloping ground in zone II is 8.1mm<57mm **Hence safe**.
  - In this analysis, we get the results maximum value of displacement of step back building on sloping ground in zone IV is 19.4mm<57mm **Hence safe.**

- According to IS 1893(part1):2002, clause 7.11.1 the story drift in any story will not exceed 0.004 times the story height (h).
  - Story height h = 3m & Permissible story drift = 0.004h = 0.004*3 = 0.012
  - In this analysis, we get the results of maximum storey drift value of taken structure in zone II is 0.000161<0.012 **Hence safe.**
  - In this analysis, we get the results of maximum storey drift value of taken structure in zone IV is 0.000387<0.012 **Hence safe.**

8. CONCLUSIONS

- Displacement is more at top story of building compared with ground floor storey of building in with and without shear wall building in the both zones II and IV.
- The storey displacement and storey drifts values are within permissible limit.
- Storey displacement is less in with shear wall building and more in without shear wall building in the both zones II and IV.
- Storey drifts are also less in with shear wall building and more in without shear wall building in the both zones II and IV.
- Shear wall generally providing at certain places in building to decreases the displacement because of earthquake.
- Now the taken model is analyze that shear wall structure is better results than the without shear wall structure.
- Shear wall structure is suitable in seismic tremor inclined regions.
- EQXN and EQXP maximum lateral displacement and storey drifts are more in zone IV compared with zone II.
- EQYP and EQYN maximum lateral displacement and storey drifts are more in zone IV compared with zone II.
- WX and WY are also displacement and drifts are more in zone IV compared with zone II.

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