"Effect of soft storey and infill walls on seismic response in zone 4 and 5"

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Abstract— *It is common knowledge that structures that are constructed with RC frames and have an open first retail (also known as a soft story) perform poorly when significant earthquake shaking is applied to them. When the existence of masonry infill walls is factored into the behaviour of the structure when it is subjected to lateral stresses, the structure's lateral stiffness and lateral load carrying capacity significantly increase. This is because the presence of the infill walls allows the structure to better resist the lateral stresses. This is due to the fact that the presence of masonry infill walls has an effect on the functioning of the structure as a whole. In order to explain how vulnerable structures with soft floors are to earthquakes, this entire essay makes use of the illustration of a G+6 reinforced concrete structure. The modelling of the infill wall is accomplished with the help of ETab Software.*

Keywords: RC Frame, Earthquake Zone, ETab, Soft storey, Infill walls, RSA Analysis etc.

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INTRODUCTION

Reinforced concrete frames with Masonry infills are often used in the construction of high-rise structures in urban and semi-urban settings all over the world. This material combination is frequently used as the primary material combination for building construction. The term "infilled frame" is the term that is used when referring to a composite structure that is generated by the combination of a moment-resisting plane frame with infill walls. This type of structure is formed when the two elements are brought together. Masonry can be constructed using a variety of materials, including brick, concrete units, stones, and so on. Bricks are the material of choice for lining the interior of the RC frame, which functions as a partition wall but does not contribute to the building's structural integrity.

In high-rise structures, there is an urgent demand to offer a ground floor that is open to the public in order to satisfy both social and practical needs. These needs include the provision of space for vehicle parking, retail outlets, and reception areas, among other uses. Underground parking is currently considered a required amenity for the vast majority of multi-story structures in urban areas. In spite of the knowledge that multi-story buildings with parking levels, also referred to as "soft storeys," are liable to collapse as a result of the forces exerted on them by earthquakes, construction of these buildings proceeds uninterrupted. The majority of the time, these buildings are conceived of as framed structures, and the structural action of the masonry infill walls receives very little consideration from the designers.
When constructing a reinforced concrete building with a moment-resisting frame, it is recommended that stiffness balancing be carried out between the first and second levels of the structure. The building's first floor and second level will both have open floor plans.

Brick is typically utilized for the construction of the infill on the uppermost floors. An evaluation of a straightforward example structure calls for the use of a number of different models. The lateral displacement profile of the building, as well as the bending moment and shear force in the columns of the first storey, are all things that can be used to determine the effect that the building's stiffness has had on the first floor.

Objectives

1) Design and analysis RCC Frame Structure with Infill wall for zone 4 and zone 5
2) Modelling of the infill wall and to check the effect of soft storey on infill wall by using Etab Software
3) To analysis by using response spectrum analysis method to compare both the model using the technical parameters
4) The lateral displacement profile of the building, as well as the bending moment and shear force in the first-storey columns, show the stiffness effect on the first floor.
5)

Problem Statement:

The term infilled frame is used to denote a composite structure formed by the combination of a moment resisting plane frame and infill walls. The masonry can be of brick, concrete units, or stones .Usually the RC frame is filled with bricks as non-structural wall for partition of rooms so we need study on this structure for zone 4 and zone5 by using RSA method.

Methodology

- Study for literature review survey
- Study of structure RCC soft storey with infill wall structure and all parameters
- RCC soft storey structure including infill wall descriptions
- RSA analysis using ETAB software
- Analysis result
- Result and discussion
- Conclusion

DESIGN AND ANALYSIS

Input Parameters

Story	Stiffness Y 2	$\frac{K_i}{K_{i+1}}$ 0.7	check	$K_{av}=avg(K_{i+1..i+3})$	$\frac{K_i}{K_{av}}$ 0.8	check
TER	7830.447	-	-			
6TH	57836.673	7.39				
5TH	113516.734	1.96	Regular			
4TH	144972.904	1.28	Regular	59764.28		
3TH	177665.604	1.23	Regular	105475.44	1.68	Regular
2TH	183933.505	1.04	Regular	145385.08	1.27	Regular
1TH	139470	0.71	Regular	168857.34	0.77	soft Story
GF	178799.723	1.37	Regular	164023.04	1.09	Regular
BASE	901896.31	5.04	Regular	164397.74	5.49	Regular

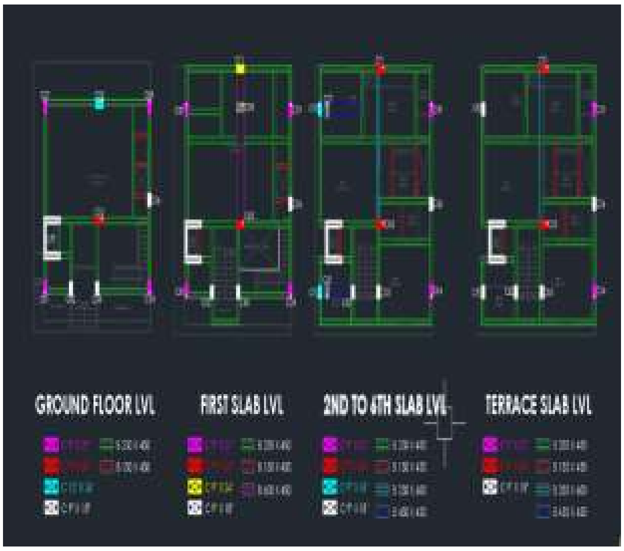


Figure1.1: CAD Plan Design

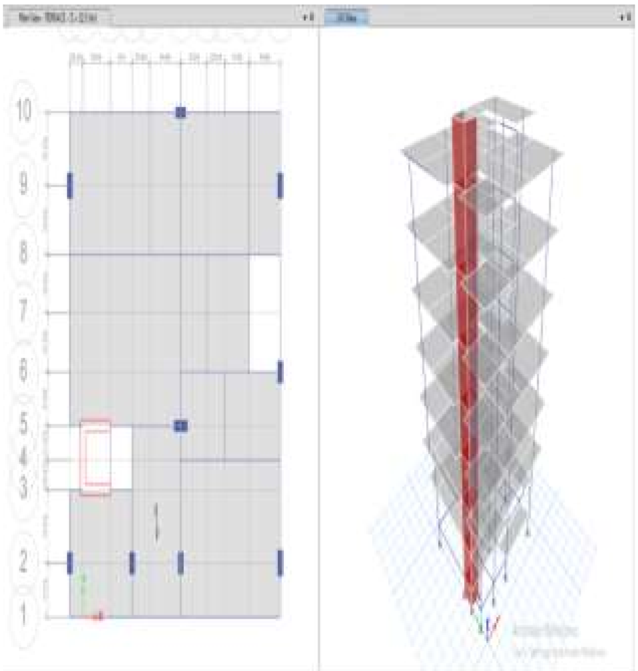
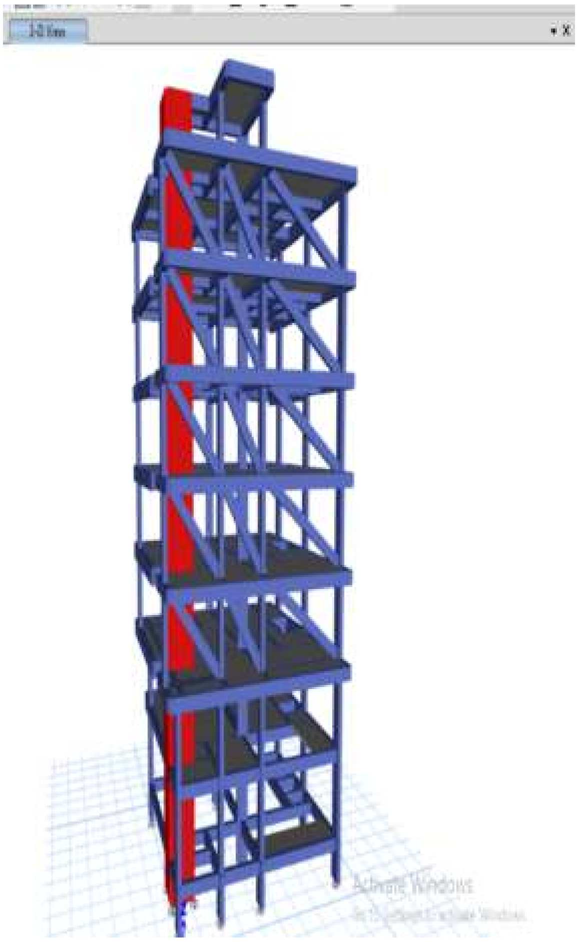


Figure1.2: Plan & 3D View



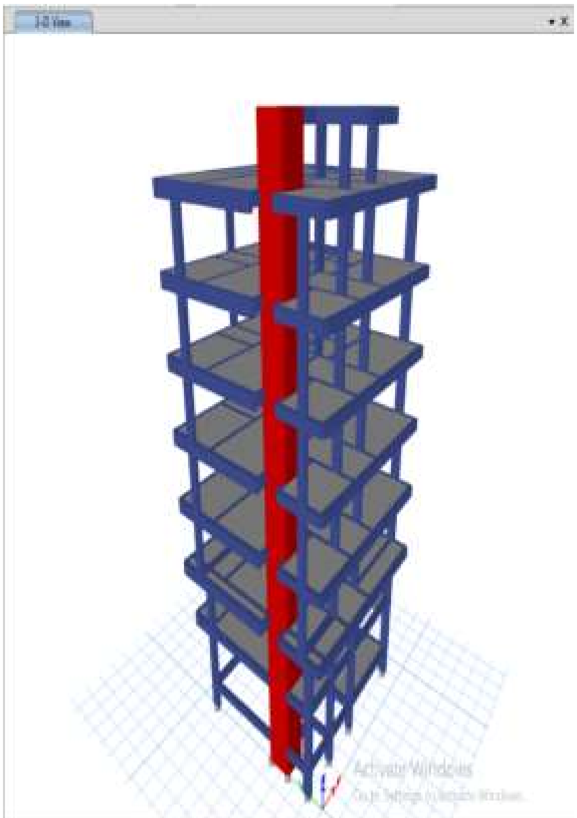


Figure1.3: Structure (Infill Wall Machinery)

2

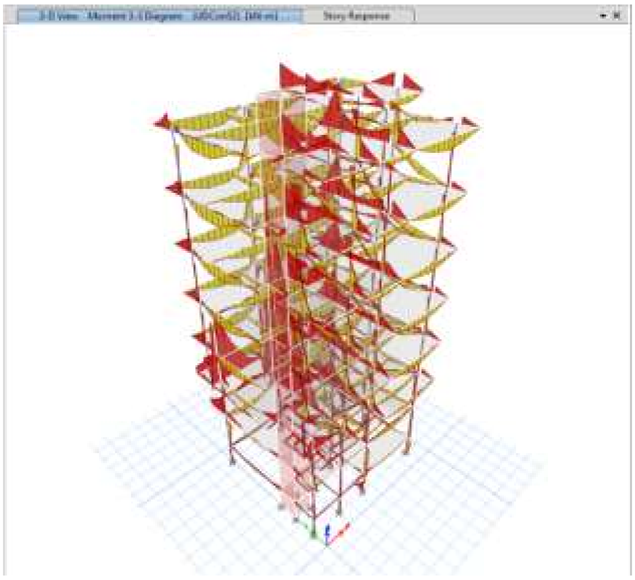


Figure1.4: 3D Render View

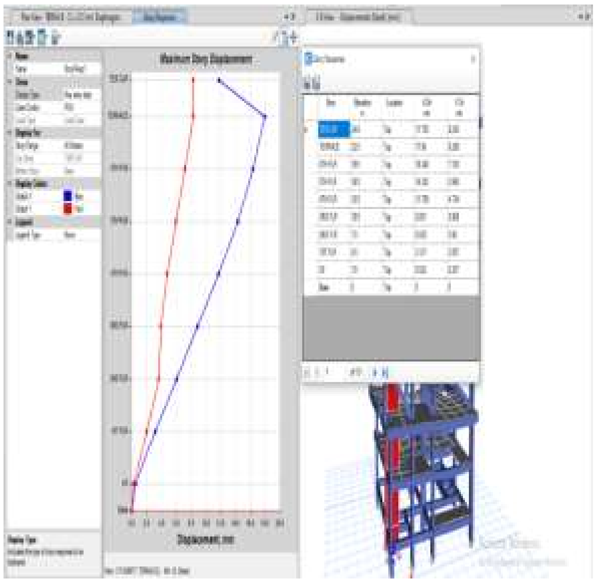


Figure1.7: SF1 ZONE4

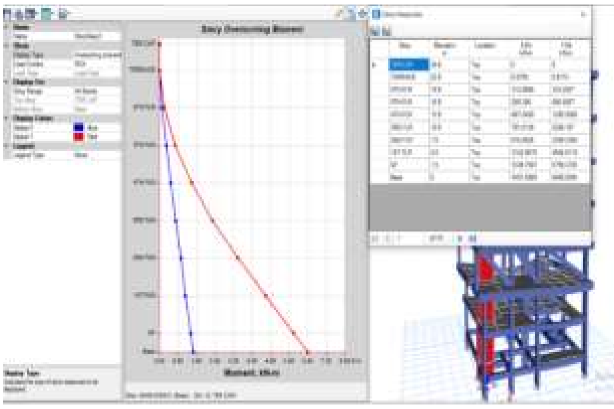


Figure1.5: Bending Moment of Zone 4
Figure1.6: Overturning Moment of Zone 4

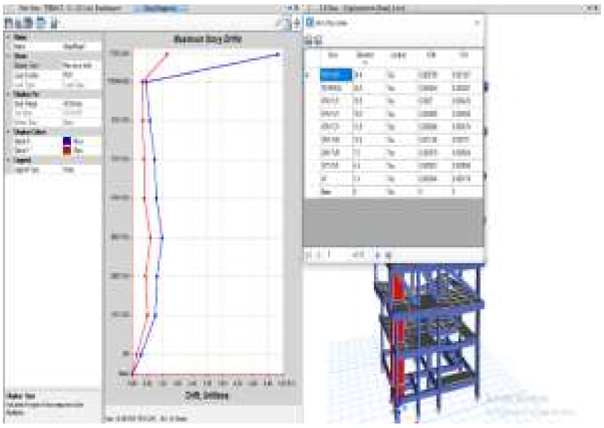
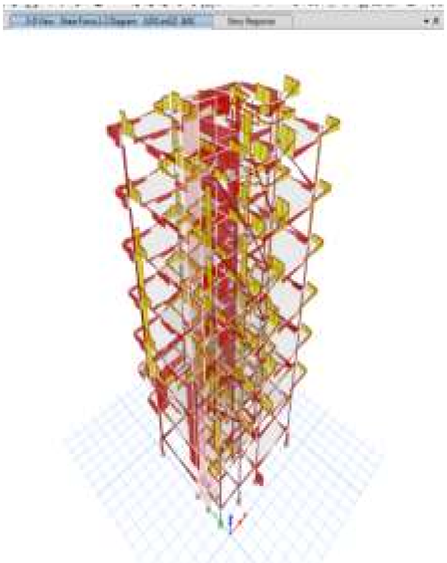


Figure1.8: Storey Displacement of Zone 4



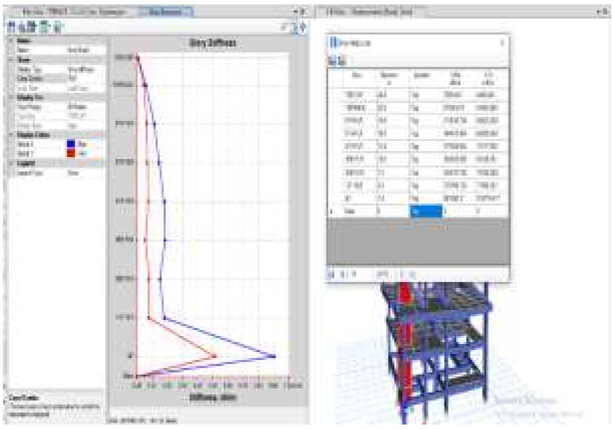


Figure1.9: Storey Drift of Zone 4
Figure1.10: Storey Stiffness of Zone-4

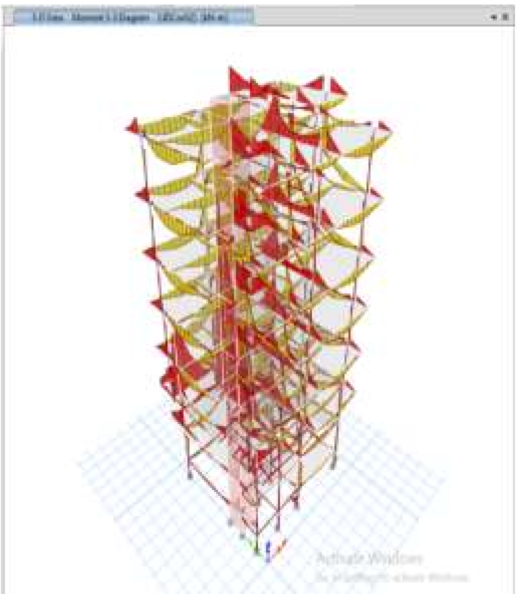


Figure4.14: SF1 For Zone-5

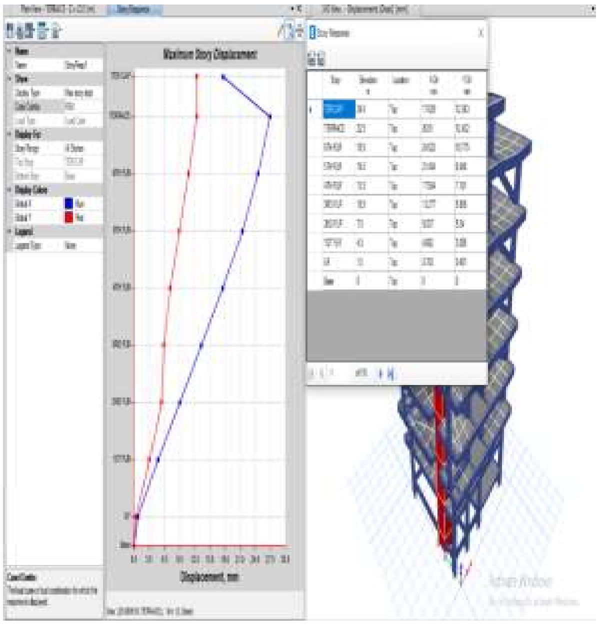


Figure4.12: Overturning Moment of Zone-5

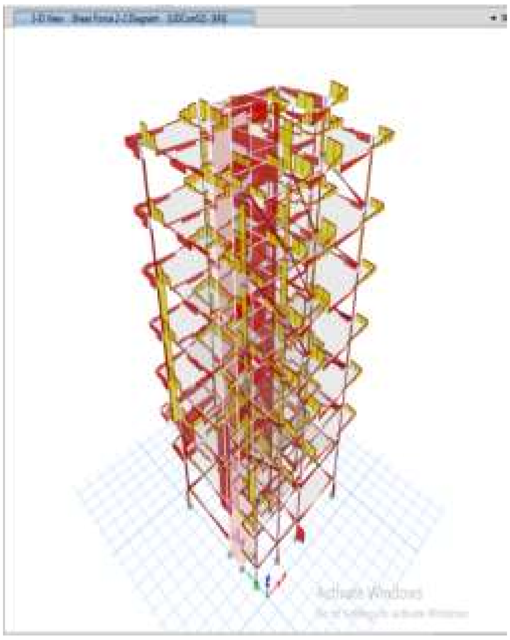


Figure4.11: Bending Moment of Zone-4

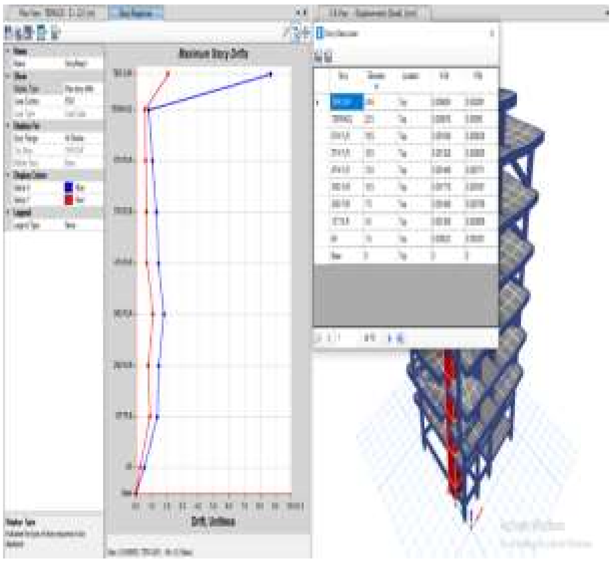
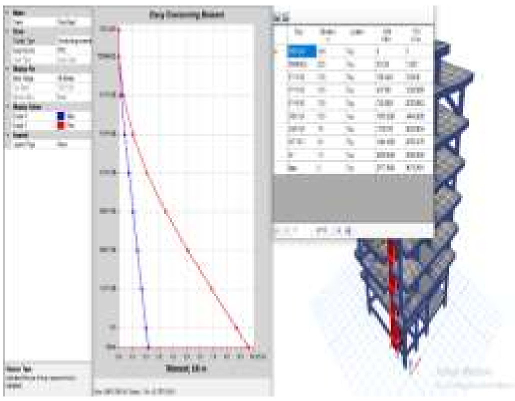


Figure4.13: Storey Displacement of Zone-5



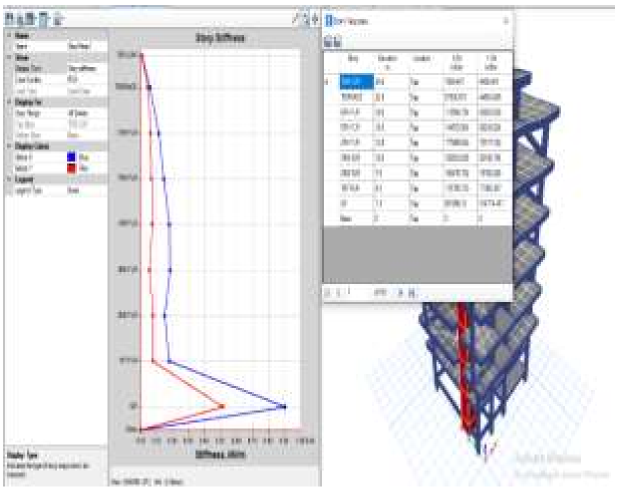


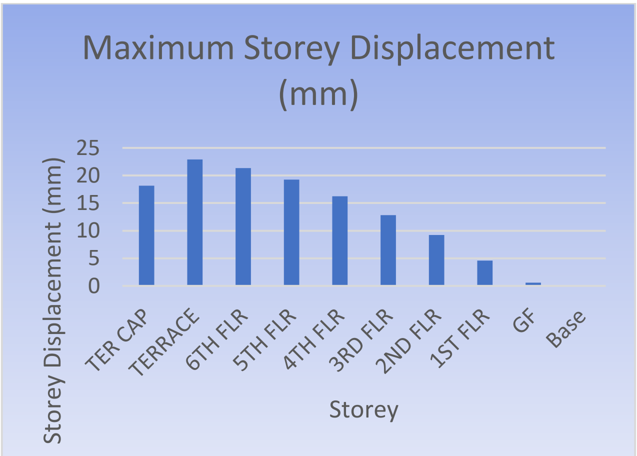
Figure4.15: STOREY DRIFT ZONE5

4

Parametric Study of Maximum Storey Displacement of Earthquake Zone-4

Table1.1: Maximum Storey Displacement Earthquake Zone-4

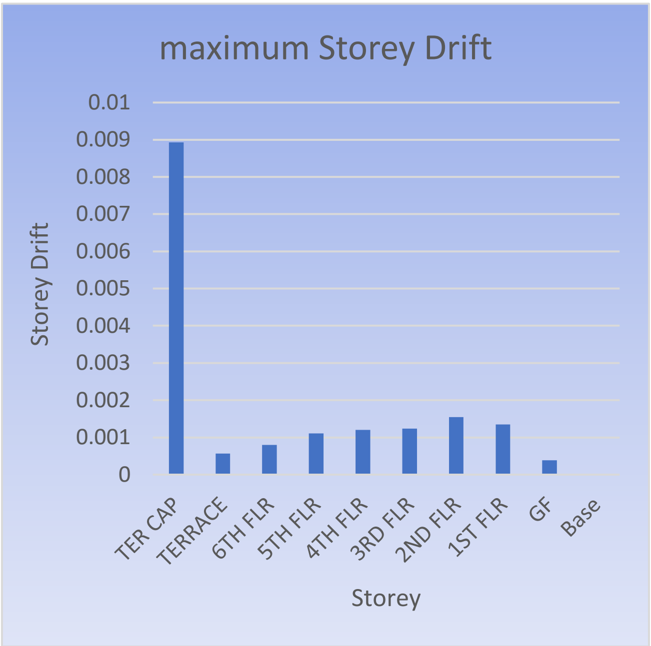
Maximum Storey Displacement	
Storey	Max Displacement (mm)
TER CAP	18.18
TERRACE	22.889
6TH FLR	21.37
5TH FLR	19.239
4TH FLR	16.246
3RD FLR	12.835
2ND FLR	9.228
1ST FLR	4.605
GF	0.577
Base	0



Graph1.1: Maximum Storey Displacement of Earthquake Zone-4

1.2 Maximum Storey Drift of Zone-4
Table1.2: Maximum Storey Drift of Zone-4

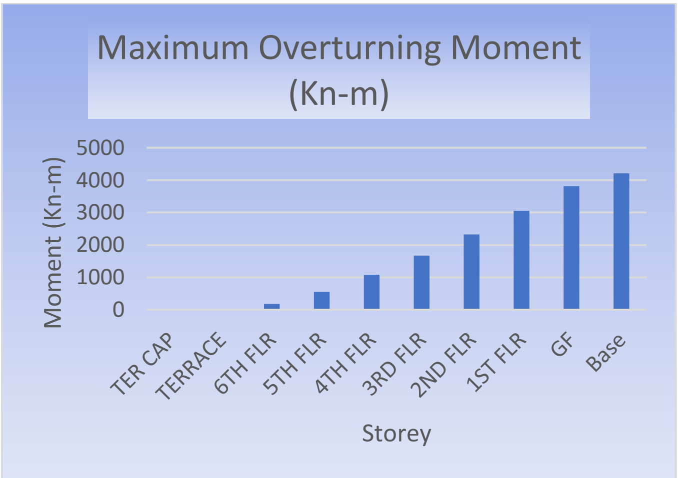
Maximum Storey Drift	
Storey	Storey Drift
TER CAP	0.008931
TERRACE	0.000566
6TH FLR	0.000802
5TH FLR	0.00111
4TH FLR	0.001203
3RD FLR	0.001233
2ND FLR	0.001543
1ST FLR	0.001347
GF	0.000385
Base	0



Graph1.2: Maximum Storey Drift of Zone-4

1.3 Maximum Overturning Moment of Zone-4
Table1.3: Maximum Overturning Moment of Zone-4

Maximum Overturning Moment (KN-M)	
Storey	Moment (Kn-m)
TER CAP	0
TERRACE	8.289
6TH FLR	181.5793
5TH FLR	562.1857
4TH FLR	1077.9818
3RD FLR	1670.0578
2ND FLR	2328.2035
1ST FLR	3052.5949
GF	3816.628
Base	4206.7364

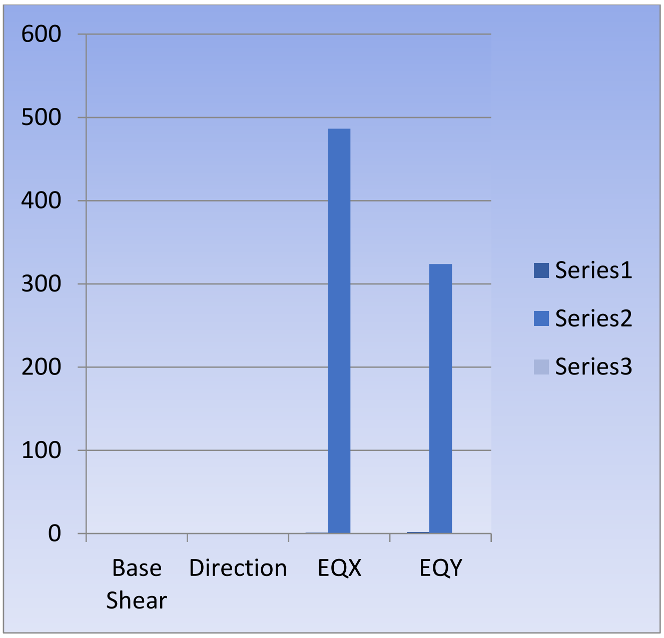


Graph1.3: Maximum Overturning Moment of Zone-4

1.4 Base Shear for Zone-4

Table1.4: Base Shear for Zone-4

Base Shear		
Direction	**Time period**	**Base Shear (KN)**
EQX	**1.15**	**486.2758**
EQY	**1.727**	**323.6754**

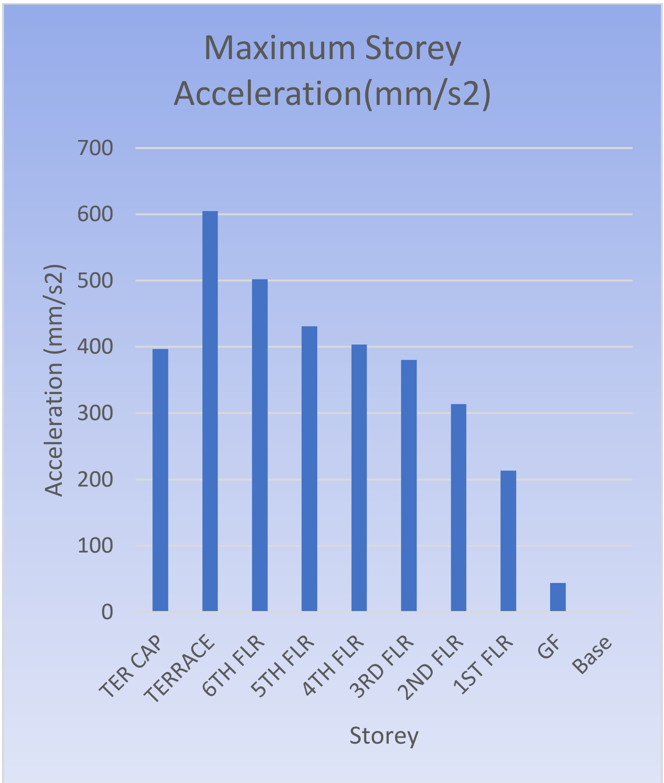


Graph5.4: Base Shear for Zone-4

1.5 Maximum Storey Acceleration for Zone-4

Table1.5: Maximum Storey Acceleration for Zone-4

Storey Acceleration (Mm/S2)	
Storey	**Zone4**
TER CAP	**396.57**
TERRACE	**604.96**
6TH FLR	**501.93**
5TH FLR	**431.25**
4TH FLR	**403.34**
3RD FLR	**380.2**
2ND FLR	**313.87**
1ST FLR	**213.55**
GF	**43.7**
Base	**0**



Graph5.5: Maximum Storey Acceleration for Zone-4

1.2 Parametric Study of Maximum Storey Displacement of Earthquake Zone-5

Table1.6: Maximum Storey Displacement of Earthquake Zone-5

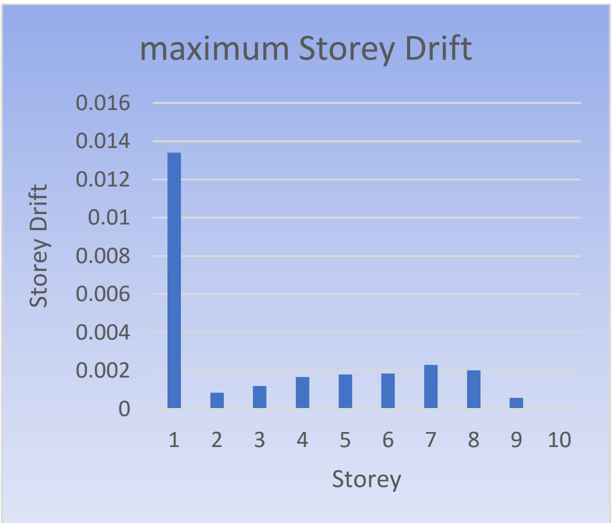
Storey Displacement	
Storey	**Max Displacement (mm)**
TER CAP	**27.27**
TERRACE	**34.333**
6TH FLR	**32.055**
5TH FLR	**28.859**
4TH FLR	**24.369**
3RD FLR	**19.253**
2ND FLR	**13.842**
1ST FLR	**6.907**
GF	**0.865**
Base	**0**

Graph1.6: Maximum Storey Displacement of Earthquake Zone-5

1.7 Maximum Storey Drift of Zone-5

Table5.7: Maximum Storey Drift of Zone-5

Maximum Storey Drift	
Storey	**Storey Drift**
TER CAP	0.013396
TERRACE	0.000849
6TH FLR	0.001204
5TH FLR	0.001665
4TH FLR	0.001805
3RD FLR	0.00185
2ND FLR	0.002314
1ST FLR	0.00202
GF	0.000577
Base	0

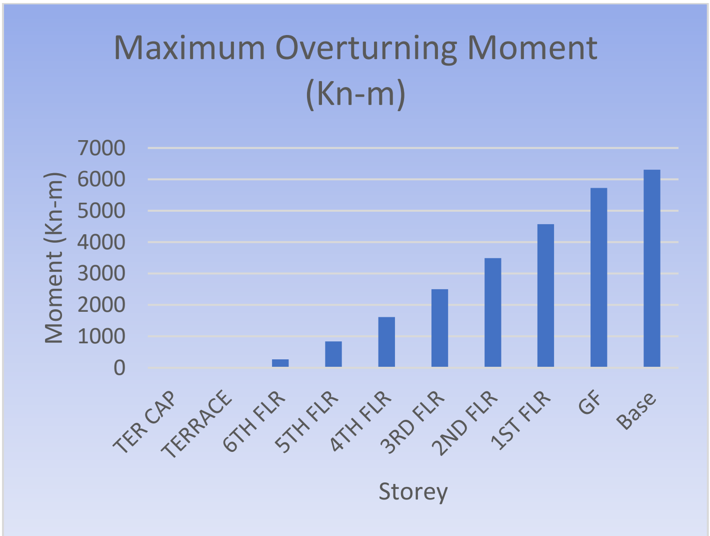


Graph1.7: Maximum Storey Drift of Zone-5

1.8 Maximum Overturning Moment for Zone-5

Table1.8: Maximum Overturning Moment for Zone-5

Maximum Overturning Moment (KN-M)	
Storey	**Moment (Kn-m)**
TER CAP	0
TERRACE	12.4335
6TH FLR	272.3689
5TH FLR	843.2785
4TH FLR	1616.9727
3RD FLR	2505.0867
2ND FLR	3492.3053
1ST FLR	4578.8924
GF	5724.9421
Base	6310.1045

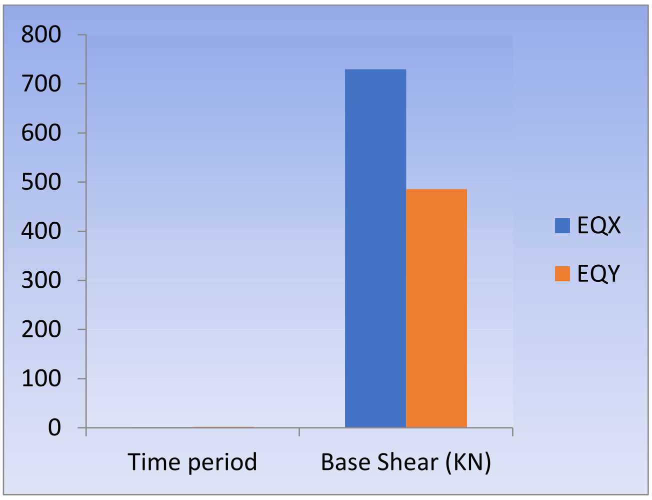


Graph5.8: Maximum Overturning Moment for Zone-5

1.9 Maximum Base Shear forZone-5

Table1.9: Maximum Base Shear forZone-5

Base Shear		
Direction	**Time period**	**Base Shear (KN)**
EQX	1.15	729.4137
EQY	1.727	485.5131

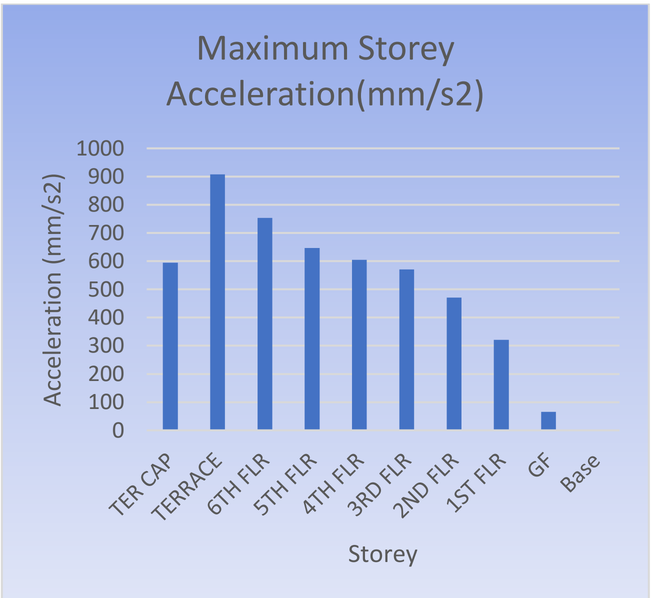


Graph1.9: Maximum Base Shear forZone-5

1.10 Maximum Storey Acceleration for Zone-5

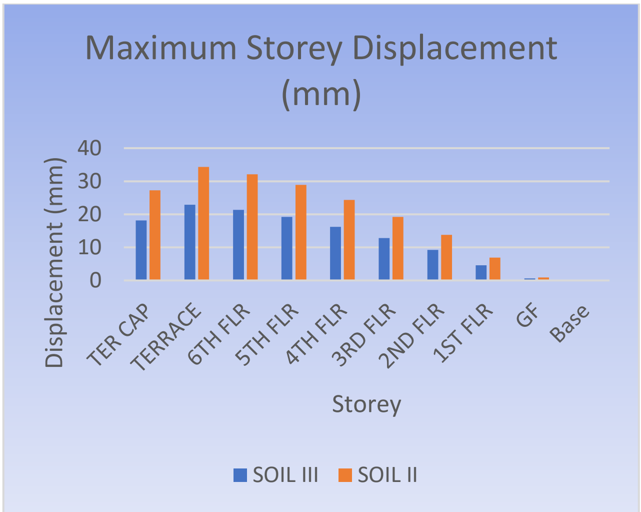
Table1.10: Maximum Storey Acceleration for Zone-5

Storey acceleration (mm/s2)	
Storey	zone4
TER CAP	594.85
TERRACE	907.44
6TH FLR	752.89
5TH FLR	646.87
4TH FLR	605.02
3RD FLR	570.29
2ND FLR	470.81
1ST FLR	320.33
GF	65.55
Base	0



Graph1.10: Maximum Storey Acceleration for Zone-5

1.11 Comparative Parametric and Graphical Study of Maximum Storey Displacement Zone-4 & Zone-5



Graph1.11: Comparative Study of Maximum Storey Displacement for Zone-4 & 5

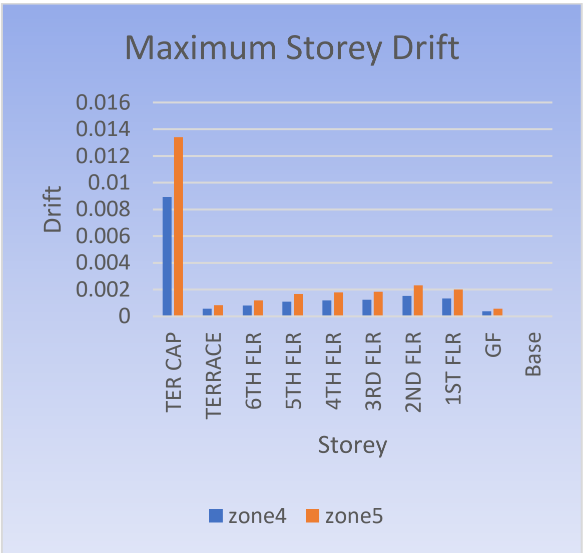
Table1.11: Comparative Study Maximum Storey Displacement for Zone 4& 5

Maximum Storey Displacement (Mm)		
Storey	Zone4	Zone5
TER CAP	18.18	27.27
TERRACE	22.889	34.333
6TH FLR	21.37	32.055
5TH FLR	19.239	28.859
4TH FLR	16.246	24.369
3RD FLR	12.835	19.253
2ND FLR	9.228	13.842
1ST FLR	4.605	6.907
GF	0.577	0.865
Base	0	0

1.12 Comparative Study Maximum Storey Drift for Zone4& 5

Table1.12: Comparative Study Maximum Storey Drift for Zone4& 5

Maximum Storey Drift		
Storey	Zone4	Zone5
Ter Cap	0.008931	0.013396
Terrace	0.000566	0.000849
6th Flr	0.000802	0.001204
5th Flr	0.00111	0.001665
4th Flr	0.001203	0.001805
3rd Flr	0.001233	0.00185
2nd Flr	0.001543	0.002314
1st Flr	0.001347	0.00202
Gf	0.000385	0.000577
Base	0	0

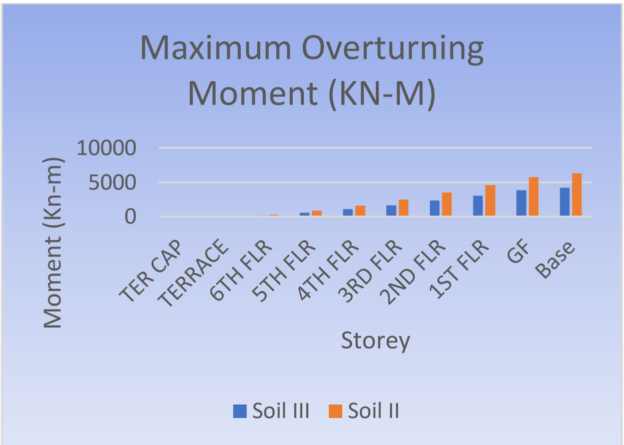


Graph5.12: Comparative Study Maximum Storey Drift for Zone4& 5

1.13 Comparative Study Maximum Overturning Moment for Zone4& 5

Table1.13: Comparative Study Maximum Overturning Moment for Zone4& 5

Maximum Overturning Moment (Kn-M)		
Storey	**Zone4**	**Zone5**
Ter Cap	**0**	**0**
Terrace	**8.289**	**12.4335**
6th Flr	**181.5793**	**272.3689**
5th Flr	**562.1857**	**843.2785**
4th Flr	**1077.982**	**1616.9727**
3rd Flr	**1670.058**	**2505.0867**
2nd Flr	**2328.204**	**3492.3053**
1st Flr	**3052.595**	**4578.8924**
Gf	**3816.628**	**5724.9421**
Base	**4206.736**	**6310.1045**



Graph1.13: Comparative Study maximum Overturning Moment for Zone-4 & 5

CONCLUSION

- Maximum Storey Displacement: Maximum storey Displacement in Structure varies from 1.5 times greater from zone V (34.33mm) to zone IV (22.889mm).
- Maximum Overturning Moment: Maximum Overturning Moment in Structure varies from 1.5 times greater from zone V (6310 KN/M) to zone IV (4206 KN/M).
- Maximum Storey Drift: Maximum Storey Drift in Structure varies from 1.5 times from zone V (0.000849) to zone IV (0.000566.)
- Maximum Base Shear: Maximum Base Shear in Structure varies from 1.5 times greater from zone V (729.4 KN) to zone IV (486.3 KN).
- Maximum Storey Acceleration: Maximum Storey Acceleration in Structure varies from 1.5 times greater from zone V (907 mm/s2) to zone IV (604 mm/s2).
- The columns steel percentage from zone IV to zone V varies from 1.02% and 1.5 % respectively.

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