SEISMIC ANALYSIS OF R.C.C STRUCTURES UNDER DIFFERENT SOIL CONDITIONS

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Abstract- *In Seismic design of buildings reinforced concrete wall or Shear wall is structural component to resist lateral load acting on it. When a structure is subject to seismic waves, it interacts with the foundation and soil and thus changes the motion of the ground. This means that the movement of the whole ground-structure system is influenced by soil conditions. Understanding the shear wall behavior at different locations, different soil condition. Designer will be able to design the structures that will behave better during earthquake. In this paper an attempt has been to study the behavior of RCC shear wall at different location, different soil conditions.*

12 Story building with and without shear wall is analysed for ESA, RSA using ETABS V16 and the results from the study are presented in this paper

Key Words: Seismic, Shear Wall, ETABS V16.

1. INTRODUCTION

Shear wall is to resist lateral forces acting on tall buildings. When shear walls are designed and constructed properly, they will have the strength and stiffness to resist the horizontal forces. Properly designed and detailed buildings with shear walls have exhibited very good performance during the past earthquakes. Just like reinforced concrete (RC) beams and columns, RC shear walls also perform much better if designed to be ductile. Overall geometric proportions of the wall, types and amount of reinforcement, and connection with the other elements in the building help in improving the ductility of walls.

Asseismic waves reach a structure, they produce motions in the structure itself. These motions depend on the structure's vibrational characteristics of the building. For the structure to react to the motion, it needs to overcome its own inertia, which results in an interaction between the structure and the soil. The extent to which the structural response may alter the characteristics of earthquake motions observed at the foundation level depends on the relative mass and stiffness properties of the soil and the structure. The main objective of the present study is to know the seismic behavior of Shear wall placed at different locations on different soil condition. To determine the lateral displacement, Story drifts etc.

2. DESCRIPTION OF THE MODELS

A 12 Story building consisting of 5 bays having dimension of 6m in both X & Y direction is considered. The story height is kept 3.5m for all the floors. A plan layout is shown in Fig 1.

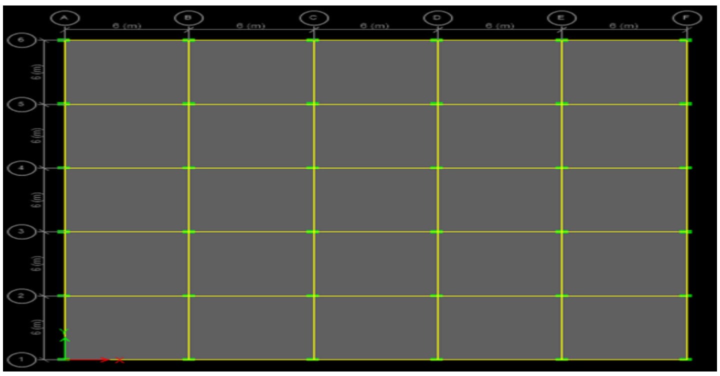

Fig -1: Plan Layout

Type I - Bare frame Model as shown in Fig 2.

Model 1- On Soft Soil .

Model 2- On Medium Soil.

Model 3- On Hard Soil.

Type II - Shear walls at central bays on all four sides as shown in Fig 3.

Model 4- On Soft Soil .

Model 5- On Medium Soil.

Model 6- On Hard Soil

Type III - Shear walls at corner bays on all four sides as shown in Fig 4

Model 7- On Soft Soil .

Model 8- On Medium Soil.

Model 9- On Hard Soil

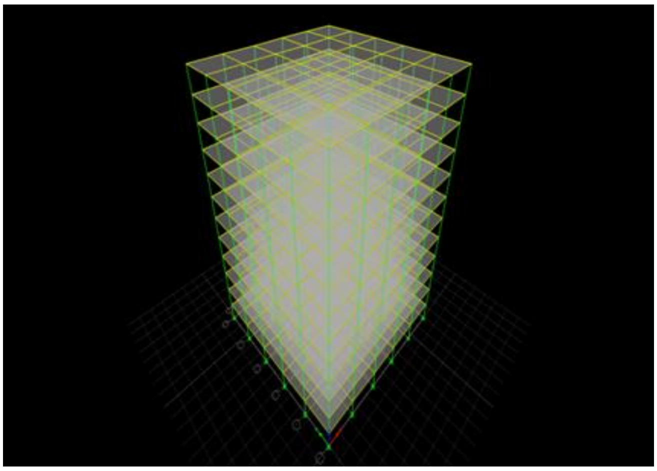

Fig -2: Bare frame Model

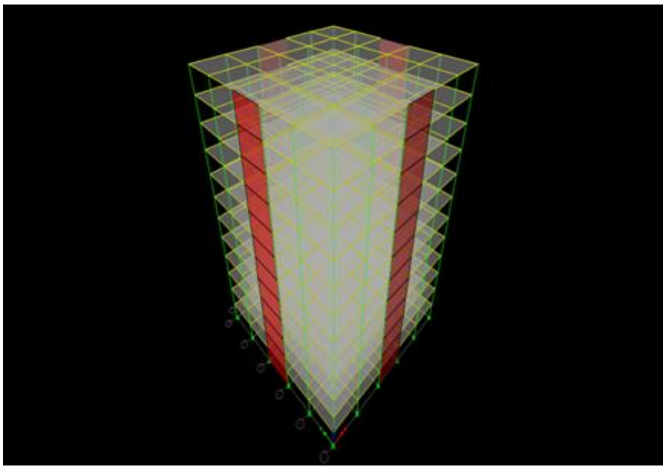

Fig -3: Shear walls at central bays on all four sides

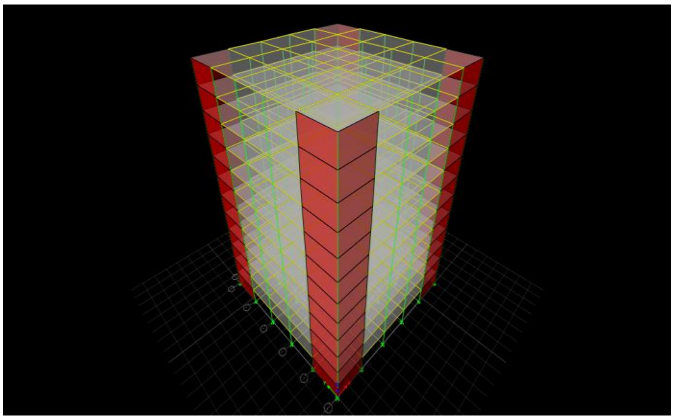

Fig -4: Shear walls at corner bays on all four sides

2.1 Design Data

Material Properties:

- Density of Reinforced Concrete = 25kN/m^3
- Density of brick masonry = 20kN/m^3
- Poisson's Ratio of concrete = 0.2
- Assumed Dead load intensities:
- Floor finishes = 1.5kN/m^2
- Beam dimensions =230x400mm
- Column dimension =300x600mm
- Live load intensities
- Imposed loads = 3.5KN/ m^2
- Roof live=1.5 KN/ m^2
- Thickness of wall =0.23m

2.2 Design Spectrum

- Zone –V.
- Zone factor, Z (Table2 of IS 1893-2002) – 0.36.
- Importance factor, I (Table 6 of IS 1893-2002) – 1.0
- Response reduction factor, R (Table 7 of IS 18932002) – 5.0
- Soil type (figure 2 of IS 1893-2002) –Type I (Hard soil), Type II (Medium soil) ,Type-III(Soft soil).
- Storey heights 3.0m.

2.3 Parametric Studies

- Storey displacements.
- Storey drifts.

3. RESULTS AND DISCUSSION

The lateral displacements and story drifts were obtained for the building frames without shear wall and with shear walls on different soil conditions. For both Equivalent static analysis and response spectrum analysis in X & Y direction. And are presented in tables 1 to 12 .

Table -1: Lateral Displacements in longitudinal direction (ESA)

Type I Models			
Story	**Soft(M1)**	**Medium(M2)**	**Hard(M3)**
12	68.38	55.69	40.95
11	66.20	53.91	39.64
10	62.82	51.16	37.61
9	58.26	47.45	34.89
8	52.71	42.93	31.56
7	46.37	37.76	27.77
6	39.42	32.11	23.61
5	32.04	26.10	19.19
4	24.39	19.86	14.61
3	16.64	13.55	9.96
2	9.11	7.42	5.45
1	2.65	2.16	1.59
0	0.00	0.00	0.00

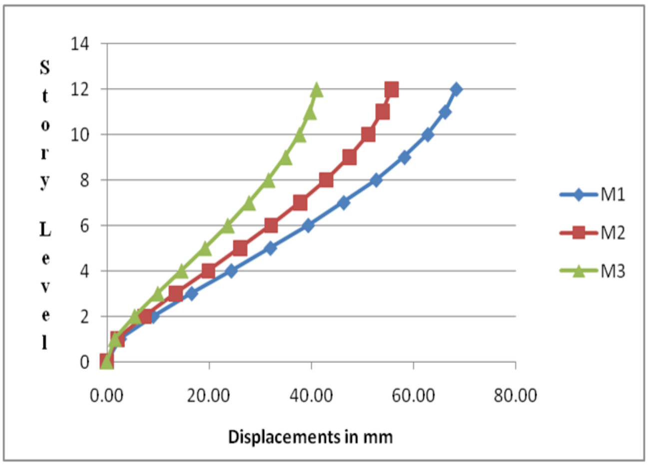

Fig -5: Lateral Displacements in longitudinal direction (ESA)

Table -2: Lateral Displacements in longitudinal direction (ESA)

Type II Models			
Story	**Soft(M4)**	**Medium(M5)**	**Hard(M6)**
12	51.72	42.12	30.97
11	46.84	38.14	28.05
10	41.73	33.98	24.99
9	36.46	29.69	21.83
8	31.06	25.30	18.60
7	25.64	20.88	15.35
6	20.30	16.53	12.15
5	15.19	12.37	9.10
4	10.49	8.54	6.28
3	6.38	5.20	3.82
2	3.09	2.52	1.85
1	0.84	0.69	0.51
0	0.00	0.00	0.00

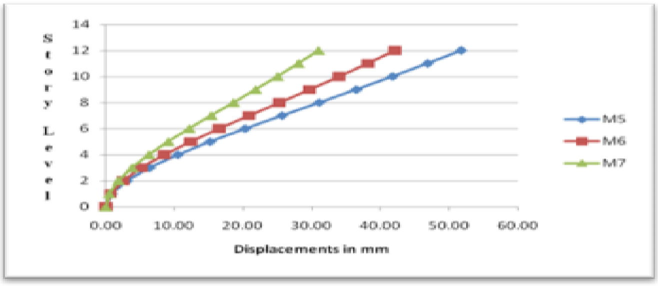

Fig -6: Lateral Displacements in longitudinal direction (ESA)

Table -3: Lateral Displacements in longitudinal direction (ESA)

Type III			
Story	**Soft(M7)**	**Medium(M8)**	**Hard(M9)**
12	37.77	30.76	22.62
11	33.84	27.56	20.26
10	29.82	24.28	17.85
9	25.75	20.97	15.42
8	21.68	17.66	12.98
7	17.69	14.41	10.59
6	13.86	11.29	8.30
5	10.28	8.37	6.15
4	7.04	5.74	4.22
3	4.27	3.48	2.56
2	2.08	1.69	1.24
1	0.59	0.48	0.35
0	0.00	0.00	0.00

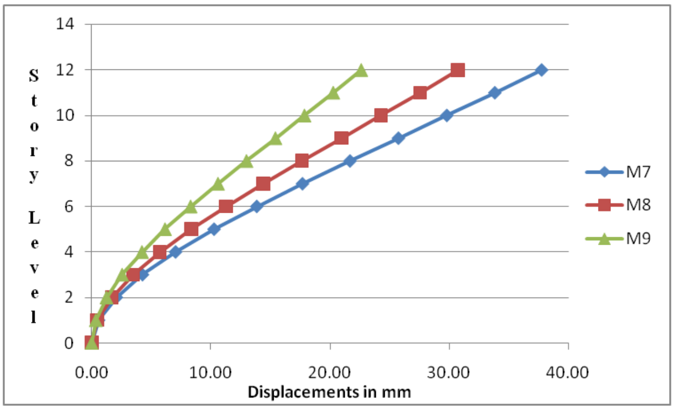

Fig -7: Lateral Displacements in longitudinal direction (ESA)

Table -4: Lateral Displacements in Transverse direction (ESA)

Type-I			
Story	Soft(M1)	Medium(M2)	Hard(M3)
12	82.01	66.79	49.11
11	79.79	64.98	47.78
10	75.92	61.83	45.46
9	70.62	57.51	42.29
8	64.15	52.24	38.41
7	56.77	46.23	33.99
6	48.69	39.65	29.15
5	40.10	32.66	24.01
4	31.19	25.40	18.67
3	22.07	17.97	13.22
2	12.91	10.51	7.73
1	4.24	3.45	2.54
0	0.00	0.00	0.00

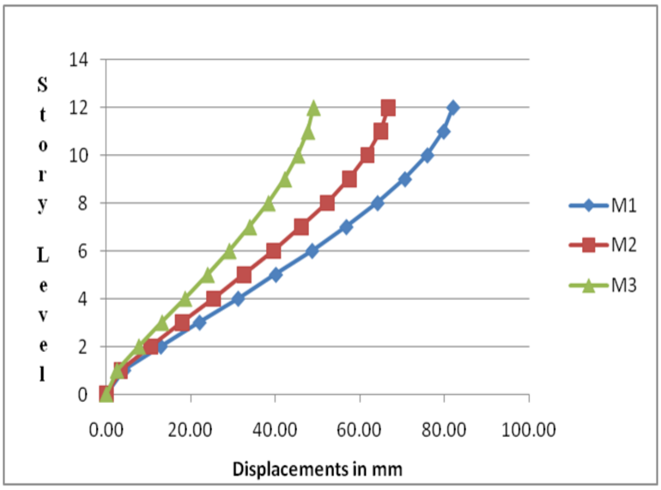

Fig -8: Lateral Displacements in Transverse direction (ESA)

Table -5: Lateral Displacements in Transverse direction (ESA)

Type-II			
Story	**Soft(M5)**	**Medium(M6)**	**Hard(M7)**
12	56.45	45.97	33.80
11	50.86	41.42	30.45
10	45.10	36.73	27.01
	39.21	31.93	23.48
8	33.24	27.07	19.91
7	27.30	22.23	16.35
6	21.50	17.51	12.88
5	16.01	13.04	9.59
4	10.99	8.95	6.58
3	6.65	5.41	3.98
2	3.20	2.60	1.91
1	0.87	0.71	0.52
0	0.00	0.00	0.00

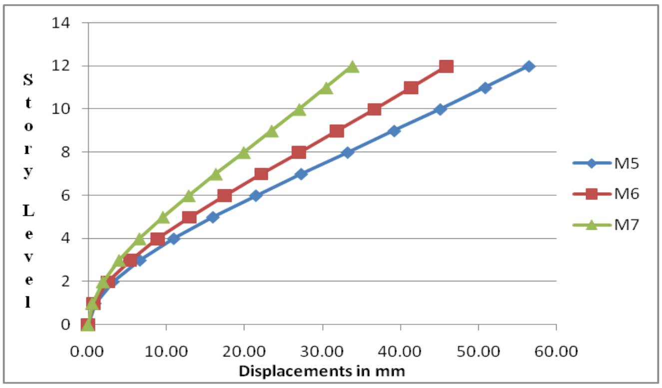

Fig -9: Lateral Displacements in Transverse direction (ESA)

Table -6: Lateral Displacements in Transverse direction (ESA)

Story	**Soft(M7)**	**Medium(M8)**	**Hard(M9)**
12	39.33	32.03	23.55
11	35.16	28.63	21.05
10	30.92	25.18	18.51
9	26.64	21.70	15.95
8	22.39	18.23	13.41
7	18.23	14.85	10.92
6	14.25	11.60	8.53
5	10.54	8.58	6.31
4	7.20	5.87	4.31
3	4.36	3.55	2.61
2	2.11	1.72	1.27
1	0.60	0.49	0.36
0	0.00	0.00	0.00

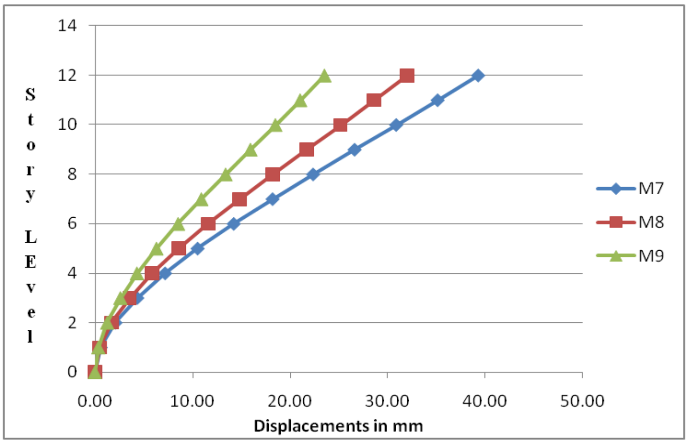

fig -10: Lateral Displacements in Transverse direction (ESA)

Table -7: Lateral Displacements in Longitudinal direction (RSA)

Type I Models			
Story	**Soft(M1)**	**Medium(M2)**	**Hard(M3)**
12	473.19	385.45	283.49
11	460.62	375.16	275.86
10	441.07	359.20	264.12
9	414.44	337.54	248.24
8	381.36	310.65	228.52
7	342.40	278.92	205.16
6	297.98	242.71	178.46
5	248.42	202.38	148.80
4	194.06	158.21	116.45
3	135.66	110.75	81.70
2	75.75	61.94	45.81
1	22.33	18.29	13.55
0	0.00	0.00	0.00

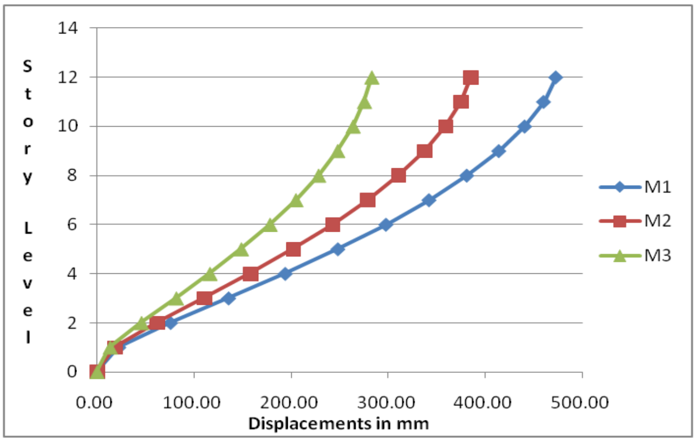

Fig -11: Lateral Displacements in Longitudinal direction (RSA)

Table -8: Lateral Displacements in Longitudinal direction (RSA)

Type II			
Story	Soft(M4)	Medium(M5)	Hard(M6)
12	326.30	265.97	196.01
11	296.09	241.23	177.55
10	264.59	215.48	158.47
9	232.14	189.06	139.04
8	198.93	162.10	119.38
7	165.40	134.94	99.68
6	132.15	108.03	80.20
5	99.99	81.97	61.27
4	69.93	57.54	43.38
3	43.20	35.71	27.21
2	21.32	17.73	13.70
1	6.01	5.05	3.98
0	0.00	0.00	0.00

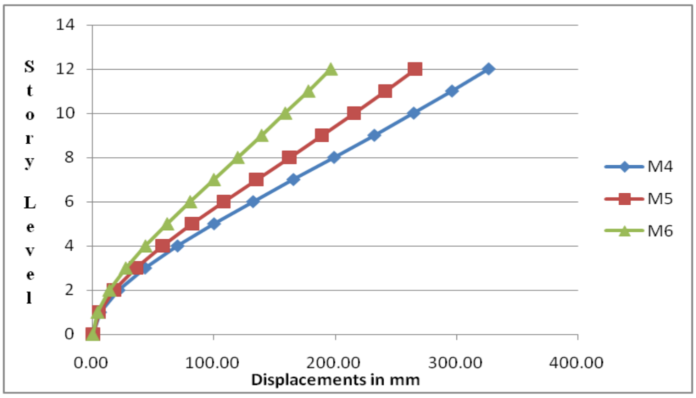

Fig -12: Lateral Displacements in Longitudinal direction (RSA)

Table -9: Lateral Displacements in Longitudinal direction (RSA)

Type III			
Story	Soft(M7)	Medium(M8)	Hard(M9)
12	235.80	192.09	141.36
11	211.61	172.36	126.78
10	186.86	152.18	111.90
9	161.84	131.80	96.92
8	136.82	111.45	82.00
7	112.18	91.43	67.36
6	88.38	72.11	53.26
5	65.99	53.92	39.97
4	45.62	37.35	27.83
3	27.96	22.96	17.22
2	13.81	11.39	8.63
1	4.00	3.33	2.57
0	0.00	0.00	0.00

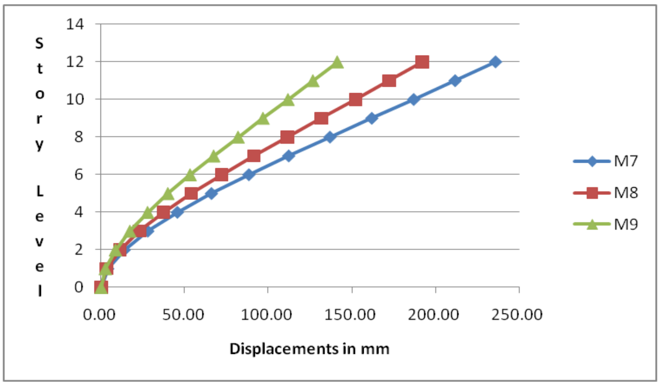

Fig -13: Lateral Displacements in Longitudinal direction (RSA)

Table -10: Lateral Displacements in Traverse direction (RSA)

Type-I			
Story	**Soft(M1)**	**Medium(M2)**	**Hard(M3)**
12	572.7525	466.56	343.09
11	560.3351	456.36	335.56
10	538.5612	438.60	322.52
9	508.1552	413.90	304.38
8	470.0532	382.94	281.58
7	424.953	346.20	254.57
6	373.3755	304.12	223.66
5	315.7558	257.18	189.15
4	252.3884	205.70	151.25
3	183.5414	149.85	110.24
2	109.986	90.06	66.40
1	36.69719	30.13	22.28
0	0	0.00	0.00

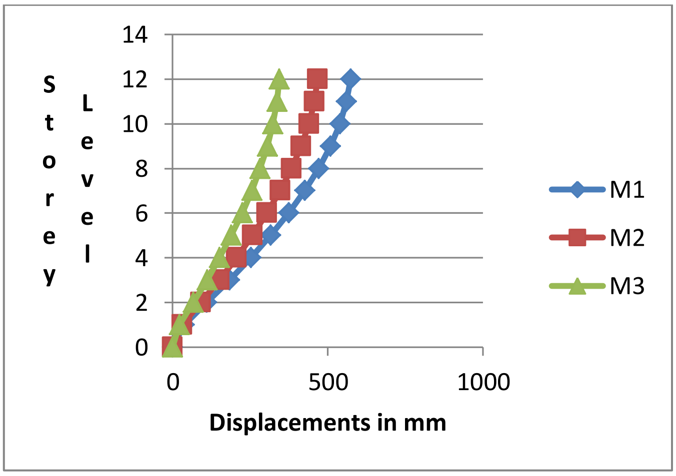

Fig -14: Lateral Displacements in Traverse direction (RSA)

Table -11: Lateral Displacements in Traverse direction (RSA)

Type-II			
Story	**Soft(M4)**	**Medium(M5)**	**Hard(M6)**
12	352.84	287.6087	211.9697
11	318.39	259.3894	190.9216
10	283.02	230.4936	169.5039
9	246.97	201.1401	147.9274
8	210.50	171.5441	126.3539
7	174.09	142.0631	104.9948
6	138.37	113.1663	84.09852
5	104.16	85.45623	63.99308
4	72.47	59.70495	45.14808
3	44.55	36.89433	28.23754
2	21.89	18.25682	14.19261
1	6.21	5.247266	4.183602
0	0.00	0	0

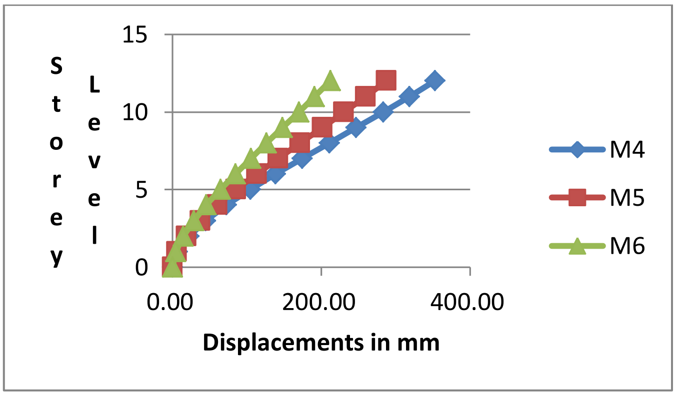

Fig -15: Lateral Displacements in Traverse direction (RSA)

Table -12: Lateral Displacements in Traverse direction (RSA)

Type-III			
Story	**Soft(M7)**	**Medium(M8)**	**Hard(M9)**
12	245.21	199.76	147.0027
11	219.55	178.82	131.5346
10	193.46	157.55	115.8519
9	167.18	136.15	100.1158
8	141.00	114.85	84.50937
7	115.32	93.99	69.25973
6	90.64	73.95	54.625
5	67.51	55.16	40.89657
4	46.54	38.11	28.4079
3	28.45	23.37	17.5474
2	14.02	11.57	8.778062
1	4.08	3.40	2.632678
0	0.00	0.00	0

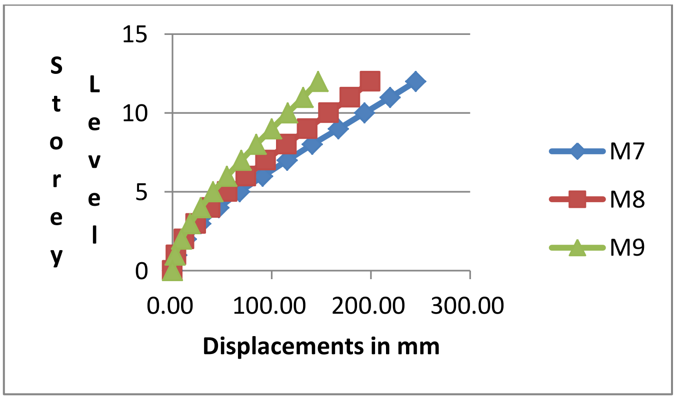

Fig -16: Lateral Displacements in Traverse direction (RSA)

It Can be seen that the lateral displacements is reduced by 18.5% & 26.46% from soft soil to medium soil and medium soil to hard soil respectively for bare frame models in longitudinal and transverse direction for both ESA and RSA, it can also be seen that the lateral displacements is reduced by 24.3% and 26.96% from Brae frame models to central bay shear wall and central bay shear wall to corner shear wall frames respectively for ESA.

For RSA it can be seen that lateral displacements is reduced by 30.85% and 27.87% from bare frame models to central bay shear wall and central bay shear wall to corner bay shear walls frames respectively

3. CONCLUSIONS

1. The presence of shear wall influences the overall behavior of structures when subjected to lateral forces. Joint displacements and story drifts are considerably reduced.

2. Results indicate the corner shear wall have large effect on the behavior of structures under earthquake excitation compared to central bay shear walls.

3. The study gave an idea to study the maximum stiffness with shear walls under different soil conditions.

4. Displacements and story drifts are found to be within the limit in linear static method and non-linear dynamic method

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