Seismic analysis of mass irregular structure of high rise building at different floor area with and without shear wall at different location

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Abstract: In the current scenario, population is rising day by day. High rise buildings are very much needed to meet the needs of the population. The high elevation buildings are designed to withstand the forces of the earthquake. It is said that a typical structure has uniform mass, stiffness, strength and structural form. The response to earthquake forces of a normal system is predictable. The behavior of an irregular structure to earthquake forces is unpredictable due to mass irregularity, irregularity of torsion, weak storey, discontinuity of the diaphragm, etc. Now for convenience of people mass differ in different floor location in building due to new parking systems, swimming pool, machinery (such as gym machinery) etc.. The shear wall provides the lateral strength required to withstand horizontal forces from the earthquake. Initially Building with various heights such as G+9 and G+14 is modelled which have mass irregularity in every 5th floor with different shear wall are applied and analyzed for Seismic Zone IV and V with the help of ETABS. Result of different models shows the response parameters and its difference are compared graphically to determine behavior of structure.

***Key Words* - Shear wall at outer side, Shear wall at core, mass irregularity, Response Spectrum, Time History, Etabs.**

I. INTRODUCTION

Earthquakes have been carefully studied by many scholars in previous years, and it took a lot of time to estimate the earthquakes. The structural engineer's goal is to know the reason for the collapse of the building and to find the appropriate solution for which a structure may be designed to withhold lateral forces etc. Most structural design engineers design structures primarily to assess safety, and stiffness also parameters structural performance under different seismic zones. Provisions and instructions for the special codes are used to design the buildings. Many researchers had done a lot of work to resist seismic structures without causing any damage to structures, and also loss of life.

The word earthquake is used to express any seismic occurrence whether natural or caused by humans that may produce seismic influence around any given area. Earthquakes are generally caused by the rupture within the earth of geological faults, but also by other events such as volcanic movement, landslides, mine blasts and atomic tests. Building performance during an earthquake is dependent on several factors, such as stiffness, mass, geometry and regular configuration. Structural failure begins at points of weakness. This weakness results from discontinuity in mass, stiffness, and structural geometry. A building is said to be a regular when the axis configurations of the building are almost symmetrical, and it is said to be the irregular when there is no symmetry and discontinuity in the geometry, mass or load resistant elements.

Mass Irregularity- Mass irregularity shall be considered to exist where the weight of any story is more than 200% of that of its adjacent story‘s. In Case of roofs irregularity need not be considered.

Shear Wall-A shear wall is a vertical structural element that resists lateral forces in the plane of the wall through shear and bending. In high-rise buildings, shear-walls are particularly important. Shear wall resist Lateral loads, seismic loads, vertical forces (gravity). Reduces the building's lateral sway. Provide large building strength and rigidity in the direction of its orientation. Vertical rigid diaphragm transfers the loads to Foundations.

II. OBJECTIVES

- To compare the structure with mass irregularity with different floor area.
- To analysis the structure with and without shear wall.
- To compare the structure with shear wall location.

III. LITERATURE REVIEW

[9]Ravindra N. Shelke, U. S. Ansari Dsouza investigated that the mass irregular building frames experience larger base shear than similar regular building frames. Stiffness irregular building experienced lesser base shear and has larger inter storey drifts. Base shear will increase when the zones changes from II to V and soil stratum III to I.

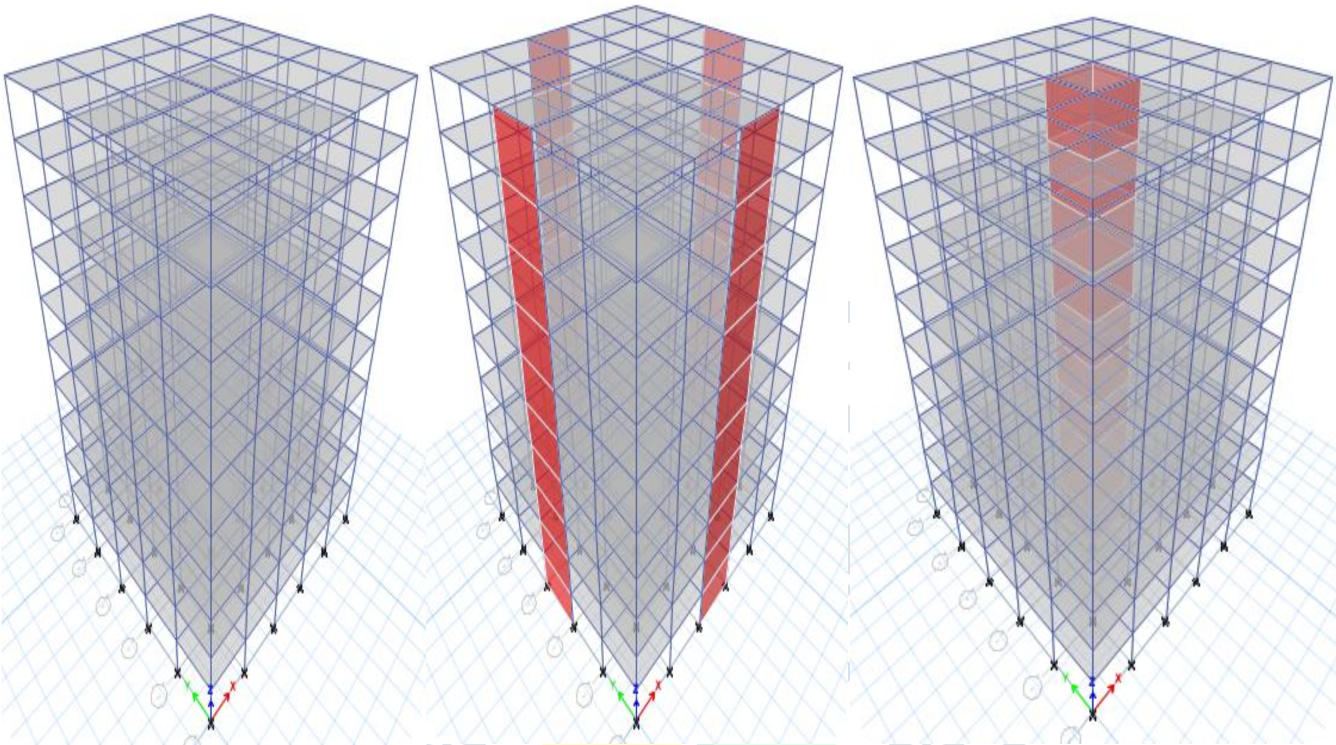
[6]Niveditha M P, Sunil R investigated that the lateral displacement is less in regular and irregular building without shear wall as compared to regular and irregular shear wall building. Stiffness will be higher in regular and irregular building with shear wall when compared with the regular and irregular building without shear wall. Storey drift is more in regular and irregular buildings without shear wall as compared with the regular and irregular buildings without shear wall.

[4]N Anvesh, Dr. Shaik Yajdani, K. Pavan kumar observed that there is an increase of 67% in the moments of mass irregular buildings than buildings without mass irregularity. Beams in mass irregular area are expected to have more shear force and bending moment.

[8]Ravi Kiran, Sridhar R investigated that the values for plan irregular building is 58.143% less and vertical irregular building 35.713% is less when compared to regular building for maximum displacement at zone 3. The fundamental time period for regular structure was found to be least and maximum for vertical irregular structure.

IV. METHODOLOGY

For response of structure with additional mass three types of structural system is considered (i.e. Bare frame Model, Shear wall at outer side and Core shear wall) for 10, and 15 storey structure. Additional mass percentage is consider on plan area as 0, 4, 12, 36, 60 and 100 percentage of plan area. Additional mass is considered at every 5th storey. For Response structure analysis seismic zone IV and V is considered with medium soil and for time history analysis Bhuj Time history is taken.



WITHOUT SHEAR WALL(WOS) SHEAR WALL AT OUTER SIDE(SS) SHEAR WALL AT CORE(SC)

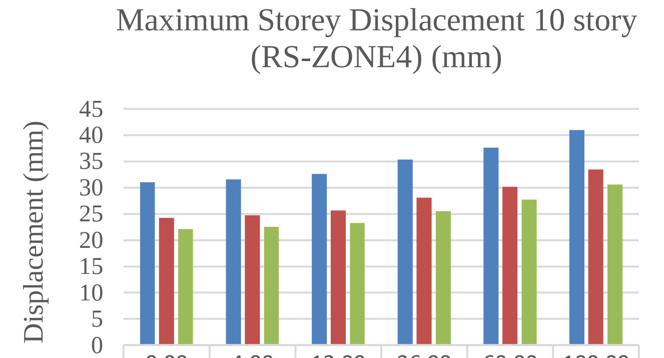
Plan and Structure Details:-

Plan dimension	20mX20m	**Grade of steel**	Fe415
Number of bays in x & y direction	Fe415	**Grade of concrete**	M30
Number of bays in x & y direction	5 nos	**Height of the floor**	3m
Bay length in x & y direction	4m	**Shear wall thickness**	230mm
Size of Beam	300 x 450 mm	**Slab thickness**	200mm
Size of column	550 x 550 mm		

Load Details:-

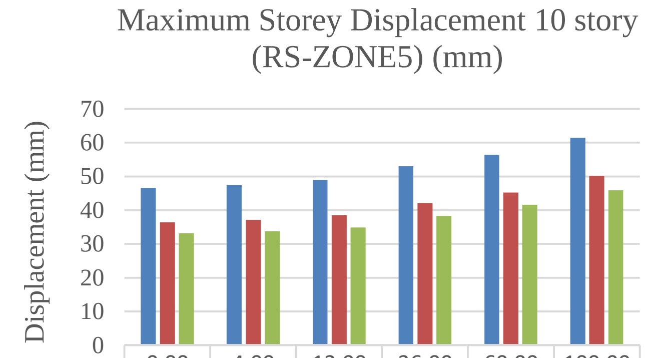
Live load	4 KN/m^2	**Wall load**	13.8 KN/m
Additional Live Load	20 KN/m^2 @ every 5th floor	**Floor finish**	1.5 KN/m^2

V. RESULT



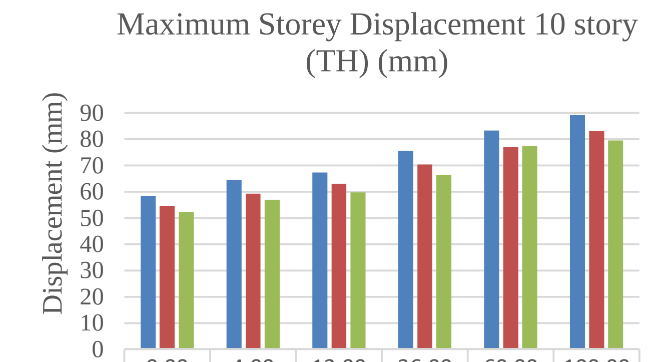
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	31.034	31.599	32.634	35.347	37.622	40.981
S S	24.265	24.744	25.661	28.07	30.173	33.462
S C	22.113	22.509	23.256	25.558	27.711	30.59

Maximum Storey Displacement 10 story (RS-ZONE4) (mm)



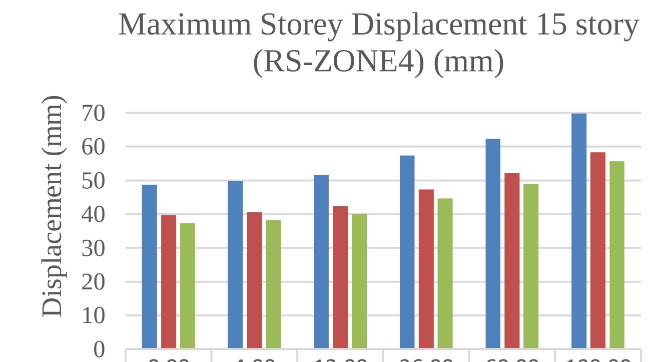
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	46.55	47.40	48.95	53.02	56.43	61.47
S S	36.40	37.12	38.49	42.11	45.26	50.19
S C	33.17	33.76	34.89	38.34	41.57	45.89

Maximum Storey Displacement 10 story (RS-ZONE5) (mm)



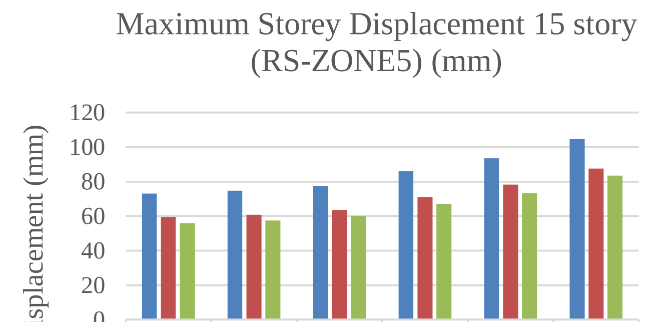
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	58.435	64.447	67.261	75.601	83.254	89.211
S S	54.616	59.198	63.035	70.384	76.921	83.11
S C	52.288	56.884	59.701	66.468	77.304	79.468

Maximum Storey Displacement 10 story (TH) (mm)



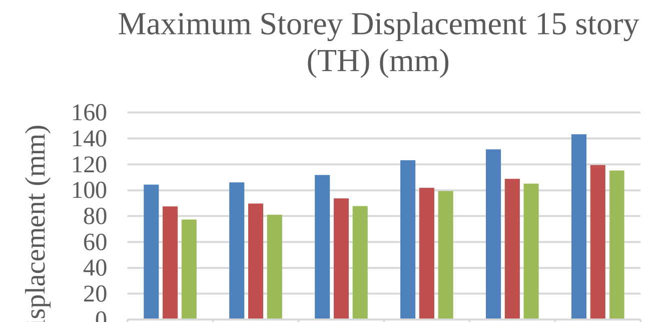
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	48.709	49.79	51.721	57.373	62.332	69.781
S S	39.688	40.568	42.419	47.324	52.162	58.358
S C	37.314	38.255	40.018	44.711	48.893	55.698

Maximum Storey Displacement 15 story (RS-ZONE4) (mm)



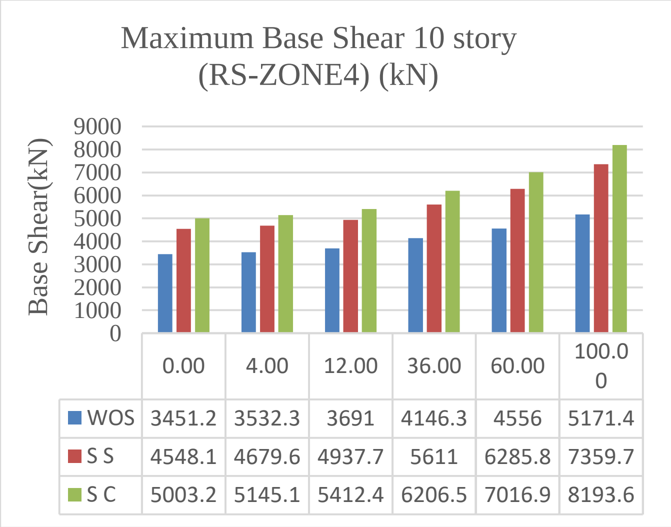
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	73.063	74.685	77.581	86.059	93.498	104.672
S S	59.532	60.853	63.629	70.986	78.243	87.537
S C	55.971	57.383	60.027	67.067	73.339	83.547

Maximum Storey Displacement 15 story (RS-ZONE5) (mm)

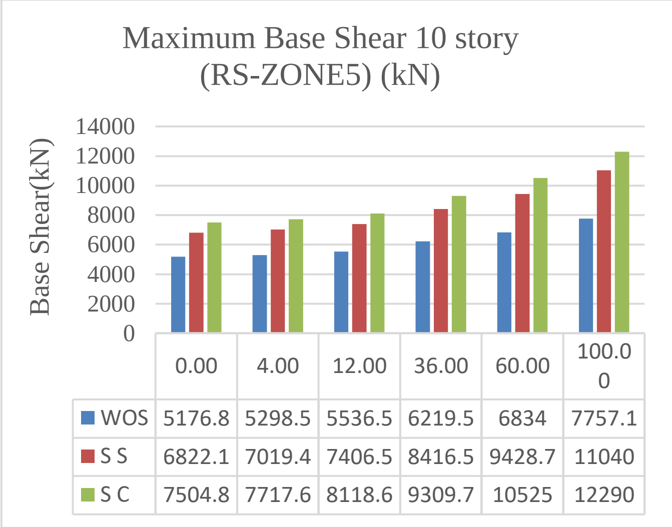


	0.00	4.00	12.00	36.00	60.00	100.00
WOS	104.35	106.028	111.871	123.129	131.63	143.237
S S	87.536	89.829	93.807	101.896	108.772	119.412
S C	77.473	81.018	87.746	99.331	104.992	115.193

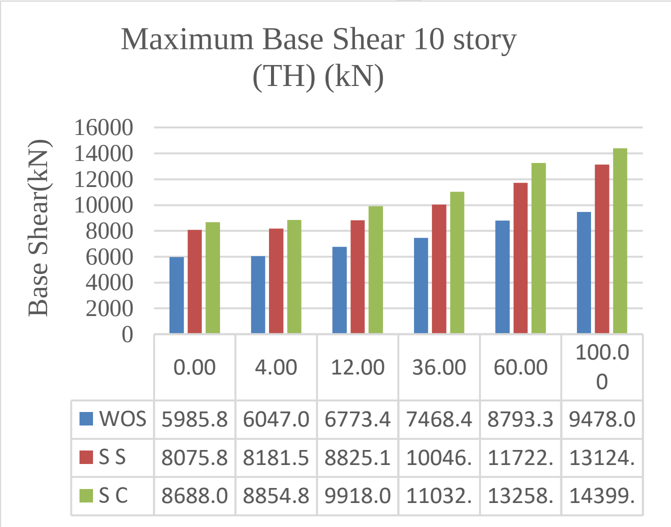
Maximum Storey Displacement 15 story (TH) (mm)



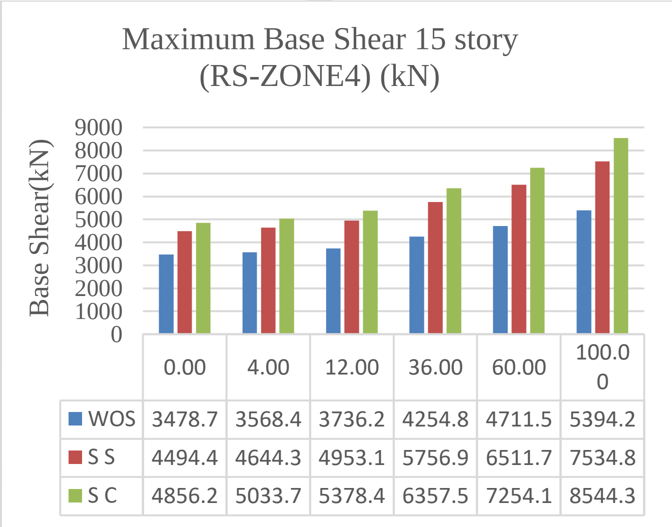
Maximum Base Shear 10 story (RS-ZONE4) (kN)



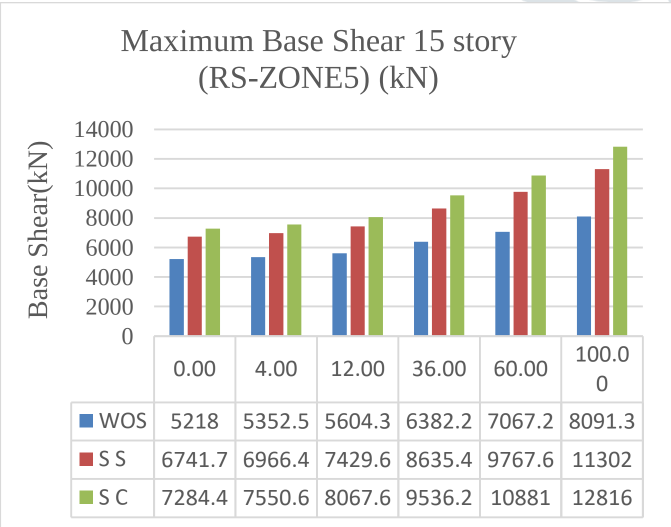
Maximum Base Shear 10 story (RS-ZONE5) (kN)



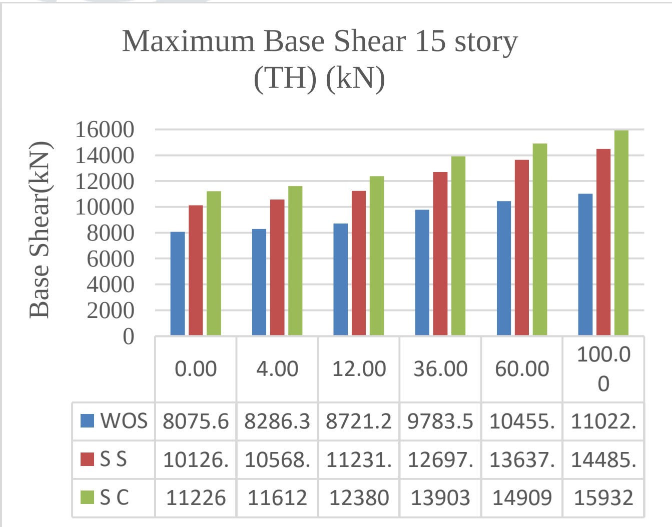
Maximum Base Shear 10 story (TH) (kN)



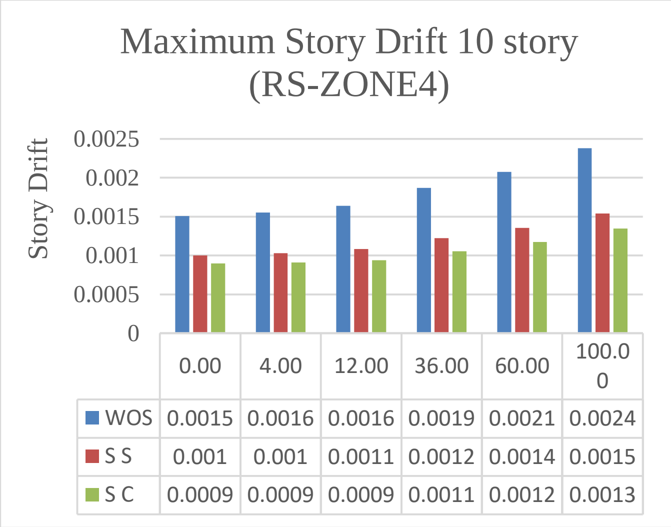
Maximum Base Shear 15 story (RS-ZONE4) (kN)



Maximum Base Shear 15 story (RS-ZONE5) (kN

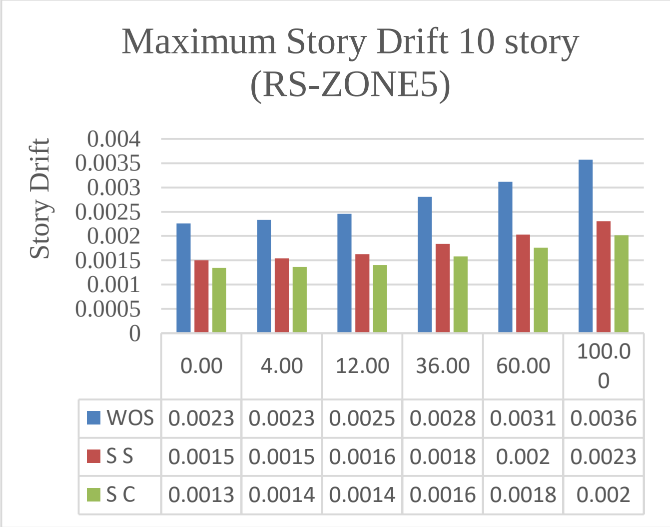


Maximum Base Shear 15 story (TH) (kN)



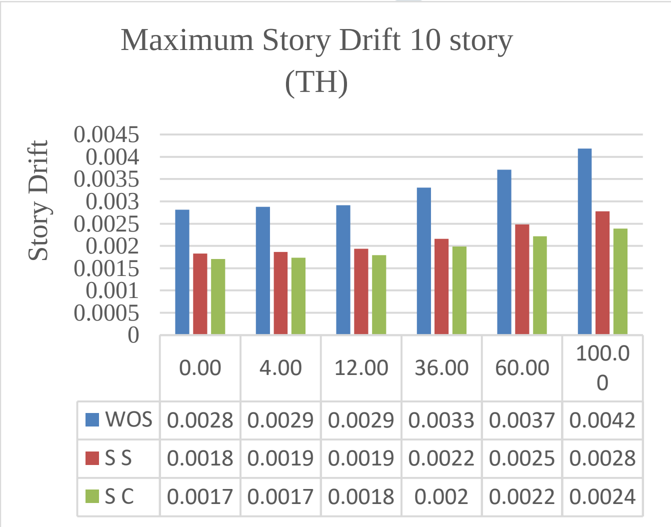
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	0.0015	0.0016	0.0016	0.0019	0.0021	0.0024
S S	0.001	0.001	0.0011	0.0012	0.0014	0.0015
S C	0.0009	0.0009	0.0009	0.0011	0.0012	0.0013

Maximum Story Drift 10 story (RS-ZONE4)



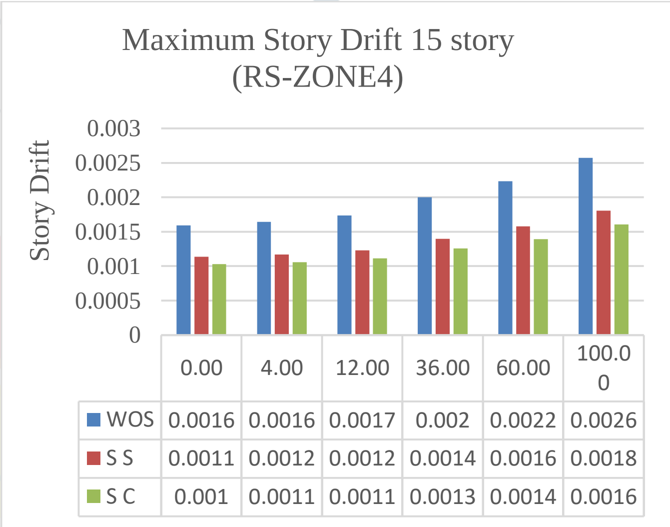
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	0.0023	0.0023	0.0025	0.0028	0.0031	0.0036
S S	0.0015	0.0015	0.0016	0.0018	0.002	0.0023
S C	0.0013	0.0014	0.0014	0.0016	0.0018	0.002

Maximum Story Drift 10 story (RS-ZONE5)



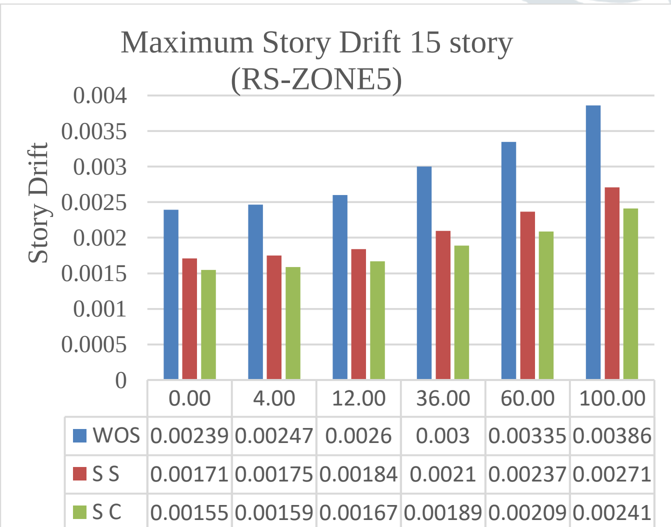
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	0.0028	0.0029	0.0029	0.0033	0.0037	0.0042
S S	0.0018	0.0019	0.0019	0.0022	0.0025	0.0028
S C	0.0017	0.0017	0.0018	0.002	0.0022	0.0024

Maximum Story Drift 10 story (TH)



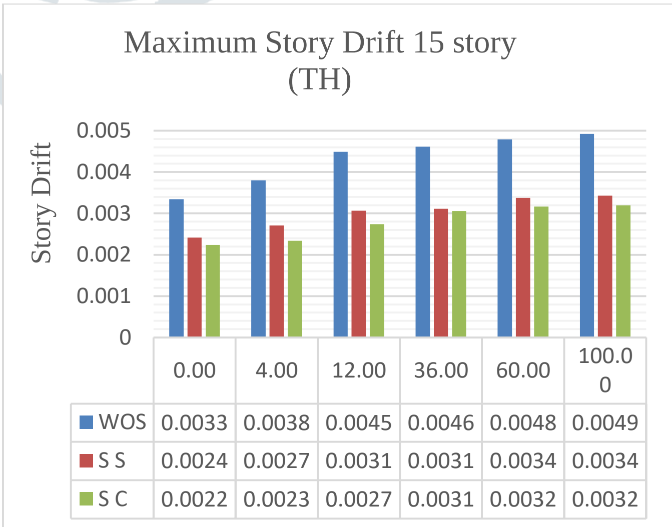
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	0.0016	0.0016	0.0017	0.002	0.0022	0.0026
S S	0.0011	0.0012	0.0012	0.0014	0.0016	0.0018
S C	0.001	0.0011	0.0011	0.0013	0.0014	0.0016

Maximum Story Drift 15 story (RS-ZONE4)



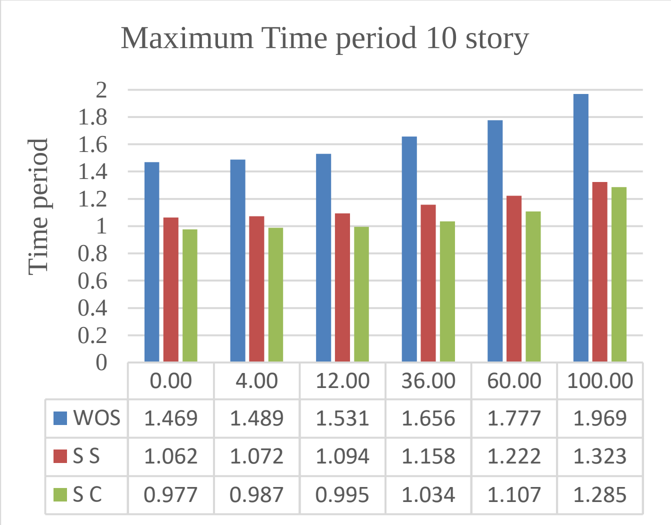
	0.00	4.00	12.00	36.00	60.00	100.00
WOS	0.00239	0.00247	0.0026	0.003	0.00335	0.00386
S S	0.00171	0.00175	0.00184	0.0021	0.00237	0.00271
S C	0.00155	0.00159	0.00167	0.00189	0.00209	0.00241

Maximum Story Drift 15 story (RS-ZONE5)

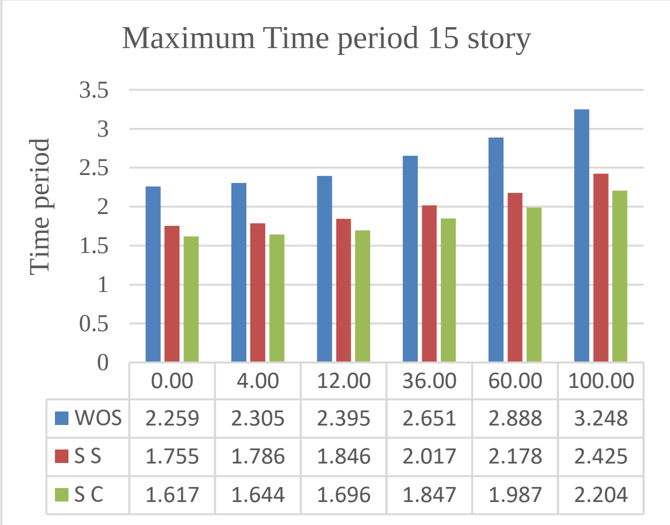


	0.00	4.00	12.00	36.00	60.00	100.00
WOS	0.0033	0.0038	0.0045	0.0046	0.0048	0.0049
S S	0.0024	0.0027	0.0031	0.0031	0.0034	0.0034
S C	0.0022	0.0023	0.0027	0.0031	0.0032	0.0032

Maximum Story Drift 15 story (TH)



Maximum Time period 10 story



Maximum Time period 15 story

VI. Conclusion

- Maximum storey displacement is observed least in case of core shear wall and maximum in bare frame model.
- Maximum storey displacement is increases up to 24%, 37% and 38% respectively for bare frame, shear wall at outer side and core shear wall respectively for live load percentage increase from 0 to 100%.
- Maximum Base shear is observed least in case of bare frame model and maximum in core shear wall.
- Maximum Base shear is increases up to 55%, 67% and 75% respectively for bare frame, shear wall at outer side and core shear wall respectively for live load percentage increase from 0 to 100%.
- Maximum storey drift is observed least in case of core shear wall and maximum in bare frame model.
- Maximum Base shear is increases up to 57%, 53% and 49% respectively for bare frame, shear wall at outer side and core shear wall respectively for live load percentage increase from 0 to 100%.
- Time period is observed least in case of core shear wall and maximum in bare frame model.

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