Comparative Study on Behavior of Regular and Podium structure with shear wall.

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Abstract: Due to increase the population, many metro cities face a congestion of structure and critical to carry a lateral force i.e. earthquake forces are experienced by the structures. High rises building of different shape and size are constructed, Podium structure are the structure is used for multi-purpose usage. Up to certain height of podium structure is used for and commercial structure and after that it is used for a residential purpose. In the present study of the work static analysis and dynamic analysis is been done. In dynamic analysis i.e. response spectrum analysis and time history analysis are been done. All the analysis purposes are been done in Etabs 2016 and also time histories of Bhuj, Chamoli is been shown to study the behavior of the different earthquake in building according to the various zones. Podium structure with shear wall models is prepaid and compared to Regular model with shear wall structure so that the Parameter like Base shear, Storey drift, Storey displacement & Time period can easily study by referencing the regular structure.

Index Terms **– Static analysis, Time history analysis, Regular structure, Podium structures.**

I. INTRODUCTION

Due to increase in the population day by day resulting in construction of more vertical housing due to the shortage of required land. Natural phenomenon like earthquake is common disaster that cause every type of structure to suffer to certain damage. The seismic waves generate from epicenter affect the structures more violently that leads to structure collapse. The main role of structure engineer is knowing the reason behind the collapse due to earthquake and find the appropriate solution for designing the structure to withhold the lateral forces etc. The Podium structure is one of type structure to solve the problem. The Regular structure and Podium structure are prepaid with shear wall to resist the seismic forces.

The Podium structure is one of multi structure in which large variation in plan area and elevation is seen, structure has the stiffness variation while observing the elevation of structure. It leads to creates variation in large drift to podium that results in disturbance of structure. In order to make the structure more stable and withhold the seismic force structure has been analysis by proper techniques in different designing software. The member of structure like beam, column should be properly analyzed and design to withstand large lateral forces even in high magnitude of earthquake.

II. OBJECTIVES

- To compare the Podium structure and Regular structure in static analysis.
- To compare the Podium structure and Regular structure in dynamic analysis.
- To evaluate the response of structural member i.e. beam, column, etc.
- To evaluate the response under the different time history analysis (Maximum storey displacement, Maximum storey drift, Maximum base shear)

III. LITERATURE REVIEW

[3]Bahador Bagheri, Ehsan Salimi Firozabad, Mohammadreza Yahyaei suggest that response spectrum analysis give storey displacement at top of structure than the static analysis.

[13]Xilin Lu, Zhiguo Gong, Dagen Weng, Xiaosong Ren. Suggest the viscous damper solve the eccentricity of structure from the 7th floor to 10th floor.

[6]Lamuo Francis Suglo, Monica Malhotra, Jaiprakash Nayak concluded that the Etabs give more steel reinforcement then the Staad pro.

[7]Mr. S. Mahesh, Dr.B. Panduranga Rao shows that the base shear in zone 5 in soft soil are of irregular structure is more then the regular type structure.

[8]Mr. Soham H. Patel, Mr. Nihil Sorathia, Mr. Vaibhav Patel concluded that the base shear of Bhuj time history analysis is more then the Chamoli time history analysis.

IV. RESEARCH METHODOLOGY

In the present work of static and dynamic analysis of following structures with different types of shapes are been carried out:

a) Regular structure
b) Podium at core structure
c) Podium at back structure

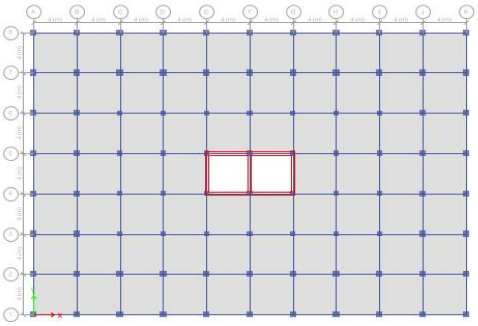
The plan area of the three structures are different for the static and dynamic analysis and the beam, column, storey height is also different. The materials such as Poisson ratio, density of masonry, density of RCC, etc are being constant in all the type of buildings. Following steps are followed to analysis to Regular and Podium structure.

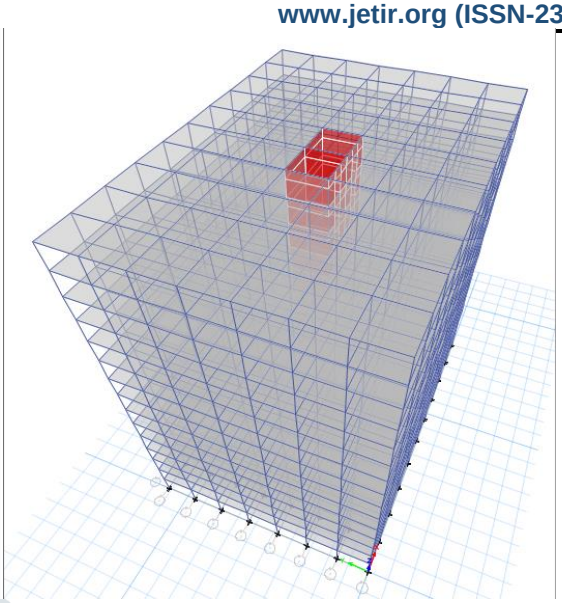
Time history analysis of Regular structure with shear wall of 15,20,25 Storey building and Podium structure (core & back) with shear wall of 15, 20, 25 Storey buildings

Comparison of the parameters considered in study of regular as well as Podium structure

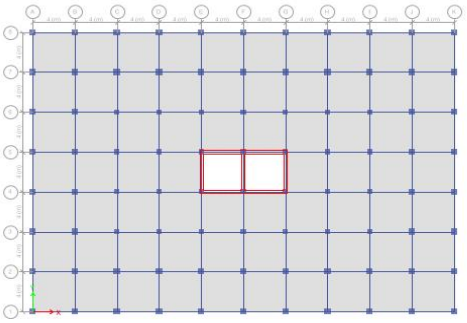
- Static analysis is carried out for both type of structure in zone III, IV, VI.
- Response spectrum analysis is carried out for the both type of structure.
- Time history analysis (Bhuj, Chamoli) is been carried out on both the structure.
- The final parameters include the Base shear, Displacements, Drift and Time Period which are compared.

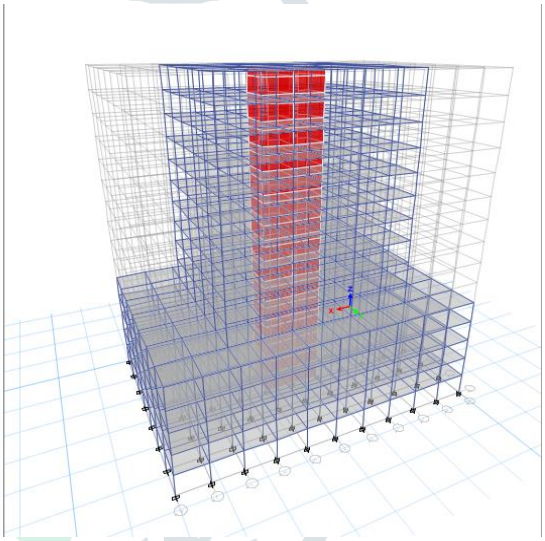
PARAMETERS	REGULAR SHAPE	PODIUM AT CORE	PODIUM AT BACK
Plan dimension	40m x 28m	40m x 28m	40m x 28m
Podium dimension	-	24m x 20m	24m x 20m
Number of arms in x-axis	10	10	10
Shear wall dimension	8m x 4m	8m x 4m	8m x 4m
Number of arms in y-axis	7	7	7
Height of the floor	3m	3m	3m
Grade of concrete	M30, M25	M35, M25	M35, M25
Grade of steel	Fe415	Fe415	Fe415
Column	500mm x 500 mm 600mm x 600 mm	500mm x 500 mm 600mm x 600 mm	500mm x 500 mm 600mm x 600 mm
Beam size	300mm x 450 mm	300mm x 450 mm	300mm x 450 mm
Slab thickness	125 mm	125 mm	125 mm
Live load	4 KN/m^2	4 KN/m^2	4 KN/m^2
Floor finish	1.5 KN/m^2	1.5 KN/m^2	1.5 KN/m^2
Importance Factor, I	1.5	1.5	1.5
Response Reduction Factor, R	5	5	5



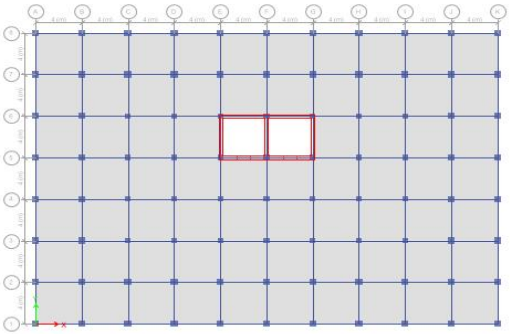


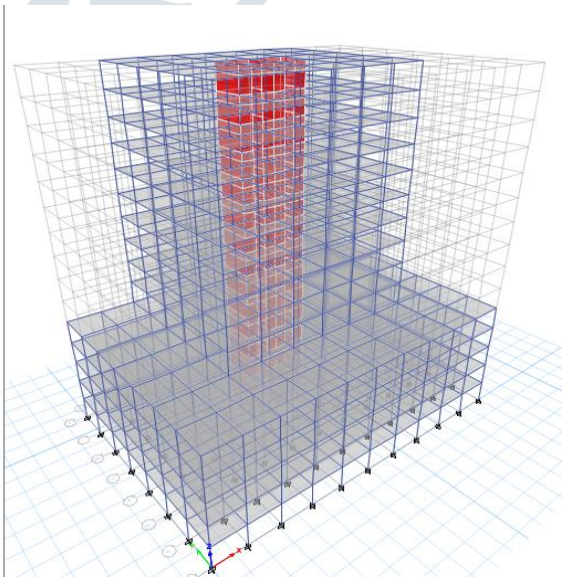
15 Storey Regular structure.





15 Storey Podium at core structure.



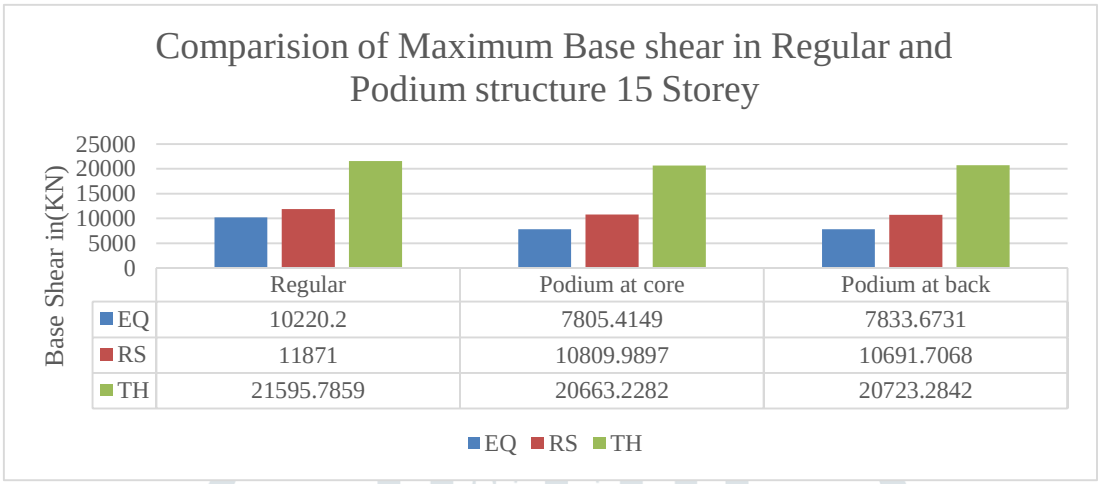


15 Storey Podium at back structure.

V. RESULTS

The analysis results of Regular and Podium structure subject to seismic force in Zone III, IV & V are below of with shear wall.

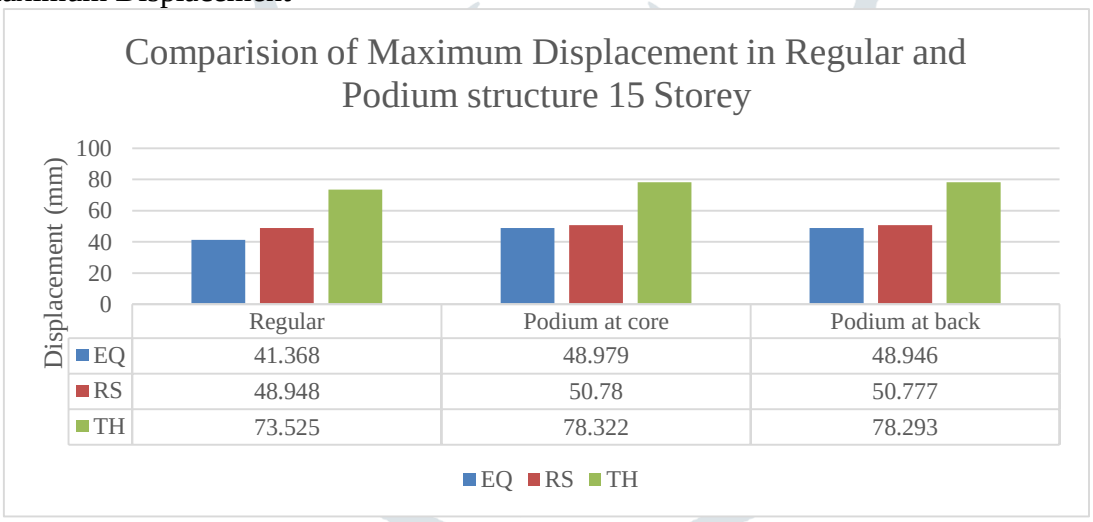
- Maximum Base shear



	Regular	Podium at core	Podium at back
EQ	10220.2	7805.4149	7833.6731
RS	11871	10809.9897	10691.7068
TH	21595.7859	20663.2282	20723.2842

Maximum Base Shear of 15 Storey

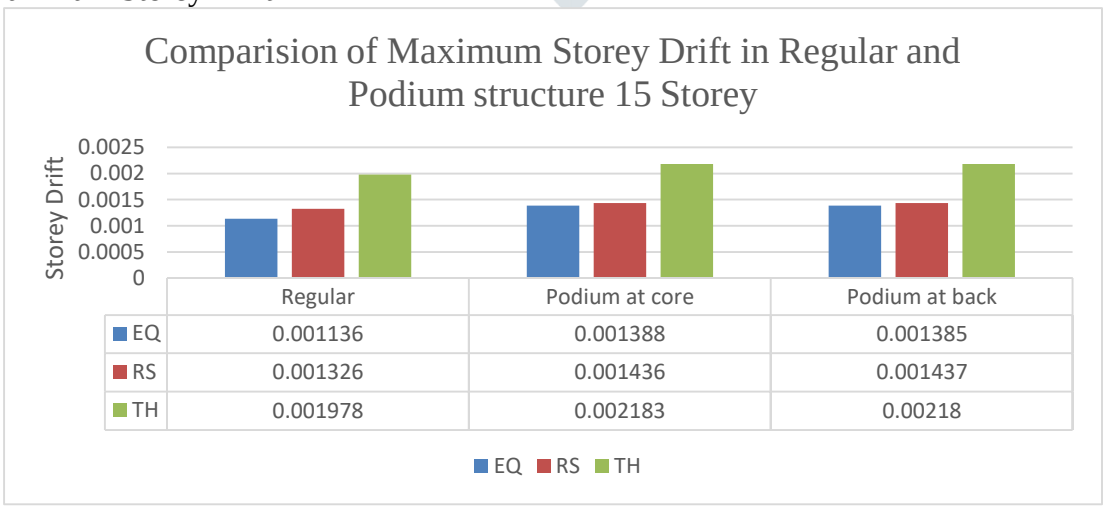
- Maximum Displacement



	Regular	Podium at core	Podium at back
EQ	41.368	48.979	48.946
RS	48.948	50.78	50.777
TH	73.525	78.322	78.293

Maximum Displacement of 15 Storey

- Maximum Storey Drift



	Regular	Podium at core	Podium at back
EQ	0.001136	0.001388	0.001385
RS	0.001326	0.001436	0.001437
TH	0.001978	0.002183	0.00218

Maximum Storey Drift of 15 Storey

VI. CONCLUSION

- Base shear result is 14%, 53%, 28%, 62%, 27%, 62% for 15 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Base shear result is 39%, 57%, 41%, 65%, 43%, 66% for 20 storeys will be higher in case of EQ, RS and TH in Regular,

Podium in core, Podium at back respectively.

- Base shear result is 38%, 65%, 41%, 67%, 41%, 68% for 25 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Maximum base shear is in less in Zone III compared to Zone IV & Zone V.
- Base shear of podium structure of 15 storey, 20 storey, 25 storey is less compared to Regular structures.
- Storey Displacement result is 15%, 44%, 4%, 37%, 4%, 37% for 15 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Storey Displacement result is 24%, 41%, 2%, 28%, 2%, 28% for 20 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Storey Displacement result is 24%, 68%, 2%, 55%, 2%, 55% for 25 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Maximum storey displacement is at the Zone V in static analysis and at Bhuj Time history in Dynamic analysis compared to Zone III, Zone IV and Chamoli Time history.
- Storey Drift result is 14%, 43%, 3%, 36%, 4%, 36% for 15 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Storey Drift result is 26%, 56%, 5%, 31%, 2%, 34% for 20 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Storey Drift result is 21%, 68%, 8%, 57%, 6%, 57% for 15 storeys will be higher in case of EQ, RS and TH in Regular, Podium in core, Podium at back respectively.
- Maximum Storey Drift is at Zone V in static analysis and at Bhuj Time History in Dynamic analysis compared to Zone III, Zone IV and Chamoli Time History.
- So overall Podium at Core is good structure in comparison with Regular and Podium at back.

VII. References

1. Ali Kadhim sallal, “Design and analysis ten storied building using Etabs software 2016”, international Journal of research in Advanced Engineering and Technology (May 2018).
2. Axay Thapa, Sajal Sarkar, “Comparative study of multi storey RCC building with and without shear wall”, International Journal of Civil Engineering (March 2017).
3. Bahadur Bagheri, Ehsan salami Firozabad, Mohammadreza Yahyaei, “Comparative study of static and dynamic analysis of multi-storey irregular buildings”, World academy of Science engineering and Technology, Vol 6.
4. C.V.S Lananya, E.P. Dailey, Md. Sabreen, U.P.B.C Sekhar, “Analysis and design of G+4 Residential building using Etabs”, International Journal of Computer Engineering and Technology (April 2007).
5. K. Senthil, Sk Gupta, S. Rupali, M. Gupta, A.P Singh, “Evaluation of RC Frames in shifting on seismic zone 3 to 5 and Retrofitting Techniques in Etabs”, International Journal of structural engineering and analysis (Volume 3, Issue 2).
6. Lamuo Francis suglo, Monica Malhotra, Jaiprakash Nayak, “A Comparative seismic analysis and design using Etabs and Staad Pro”, The Indian Concrete Journal, May-2009.
7. Mr. S Mahesh, Dr.B. Panduranga Rao, “Comparison of analysis and design of regular and Irregular configuration of multi storey building in various seismic zones and various types of soils using Etabs and Staad Pro”, ISOR Journal of Mechanical & Civil Engineering (Dec 2019).
8. Mr. Soham H Patel, Mr. Nikhil Sorathia, Mr. Vaibhav Patel, “Comparative study on Podium Structure and Normal Structure under Seismic behaviour”, International Journal of advance engineering and Research development (May 2017).
9. Rajesh P. Dhakal, Sheng-Lin Lin, Alexander k. Lage, Scott J. Evans, “Seismic design spectra for different soil classes”, Earthquake Engineering Practise (Dec 2015).
10. Ramanand Shukla, Rathish saha, “Comparative study of G+10 storied building using Etabs and Staad Pro”, International Journal of Scientific Research in Science and Technology (Volume 3, Issue 6).
11. Rohit Kumar, B.R. Sachin P, Dyavappanavar, Sushmita N.J, Sunita V, Vinayak yadward, “Analysis and design of multi-storeyed structure using Etabs”, International Research of Engineering and Technology (May 2017).
12. Sayad A ahad, Hashmi s Afzal, Pathan tabrej, Shaikh Amar, Shaikh vikhal, Shivaji Bidve, “Analysis and design of multi-storeyed apartment building using Etabs”, International Journal of Engineering and Computer Science (May 2017).
13. Xilin Lu, Zhiguo Gong, Dagen Weng, Xiaosong Ren, “The application of new structural concept for tall building with large Podium structure”, Elsevier Publication (November 2006).

IS CODES:

1. IS 456-2000, Indian standard code of Plain and Reinforced Concrete -Code of Practise.
2. IS 800-2007, General Construction in Steel-Code of practise.
3. IS 1893-2016, Criteria for Earthquake Resistant Design of Structure.
4. IS 13920-1993, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces-Code of practise.