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

Kailash Deepak Mayani, Mr. Nirav Katarmal, Mr. Pratik Parekh.
1 P. G. Student of structural Engineering HJD-ITER - Kutch, 2 Assistant professor of Civil Engineering Department HJD-ITER - Kutch, 3 Assistant professor of Civil Engineering Department HJD-ITER - Kutch
1 Civil Engineering Department HJD-ITER - Kutch,
1 HJD Institute of Technical Education and Research-Kutch, India.

Abstract: Due to increase the population, many metro cities face a congestion of structure and critical to suffer 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
1. Bahador Bagheri, Ehsan Salimi Firozabad, Mohammadreza Yahyaei suggest that response spectrum analysis give storey displacement at top of structure than the static analysis.
2. Xilin Lu, Zhiguo Gong, Dagen Weng, Xiaosong Ren. Suggest the viscous damper solve the eccentricity of structure from the 7th floor to 10th floor.
3. Lamuo Francis Suglo, Monica Malhotra, Jaiprakash Nayak concluded that the Etabs give more steel reinforcement then the Staad pro.
4. 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.
5. 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.


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.

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>REGULAR SHAPE</th>
<th>PODIUM AT CORE</th>
<th>PODIUM AT BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan dimension</td>
<td>40m x 28m</td>
<td>40m x 28m</td>
<td>40m x 28m</td>
</tr>
<tr>
<td>Podium dimension</td>
<td>-</td>
<td>24m x 20m</td>
<td>24m x 20m</td>
</tr>
<tr>
<td>Number of arms in x-axis</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Shear wall dimension</td>
<td>8m x 4m</td>
<td>8m x 4m</td>
<td>8m x 4m</td>
</tr>
<tr>
<td>Number of arms in y-axis</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Height of the floor</td>
<td>3m</td>
<td>3m</td>
<td>3m</td>
</tr>
<tr>
<td>Grade of concrete</td>
<td>M30, M25</td>
<td>M35, M25</td>
<td>M35, M25</td>
</tr>
<tr>
<td>Grade of steel</td>
<td>Fe415</td>
<td>Fe415</td>
<td>Fe415</td>
</tr>
<tr>
<td>Column</td>
<td>500mm x 500 mm x 600mm x 600mm</td>
<td>500mm x 500 mm x 600mm x 600mm</td>
<td>500mm x 500 mm x 600mm x 600mm</td>
</tr>
<tr>
<td>Beam size</td>
<td>300mm x 450 mm</td>
<td>300mm x 450 mm</td>
<td>300mm x 450 mm</td>
</tr>
<tr>
<td>Slab thickness</td>
<td>125 mm</td>
<td>125 mm</td>
<td>125 mm</td>
</tr>
<tr>
<td>Live load</td>
<td>4 KN/m²</td>
<td>4 KN/m²</td>
<td>4 KN/m²</td>
</tr>
<tr>
<td>Floor finish</td>
<td>1.5 KN/m²</td>
<td>1.5 KN/m²</td>
<td>1.5 KN/m²</td>
</tr>
<tr>
<td>Importance Factor, I</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Response Reduction Factor, R</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
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

Comparision of Maximum Base shear in Regular and Podium structure 15 Storey

<table>
<thead>
<tr>
<th></th>
<th>EQ</th>
<th>RS</th>
<th>TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>10220.2</td>
<td>7805.4149</td>
<td>7833.6731</td>
</tr>
<tr>
<td>Podium at core</td>
<td>11871</td>
<td>10809.9897</td>
<td>10691.7068</td>
</tr>
<tr>
<td>Podium at back</td>
<td>21595.7859</td>
<td>20663.2282</td>
<td>20723.2842</td>
</tr>
</tbody>
</table>

Maximum Base Shear of 15 Storey

Maximum Displacement

Comparision of Maximum Displacement in Regular and Podium structure 15 Storey

<table>
<thead>
<tr>
<th></th>
<th>EQ</th>
<th>RS</th>
<th>TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>41.368</td>
<td>48.979</td>
<td>48.946</td>
</tr>
<tr>
<td>Podium at core</td>
<td>48.948</td>
<td>50.78</td>
<td>50.777</td>
</tr>
<tr>
<td>Podium at back</td>
<td>73.525</td>
<td>78.322</td>
<td>78.293</td>
</tr>
</tbody>
</table>

Maximum Displacement of 15 Storey

Maximum Storey Drift

Comparision of Maximum Storey Drift in Regular and Podium structure 15 Storey

<table>
<thead>
<tr>
<th></th>
<th>EQ</th>
<th>RS</th>
<th>TH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>0.001136</td>
<td>0.001388</td>
<td>0.001385</td>
</tr>
<tr>
<td>Podium at core</td>
<td>0.001326</td>
<td>0.001436</td>
<td>0.001437</td>
</tr>
<tr>
<td>Podium at back</td>
<td>0.001978</td>
<td>0.002183</td>
<td>0.00218</td>
</tr>
</tbody>
</table>

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%, 5%, 4% 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
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).

IS Codes:
1. IS 456-2000, Indian standard code of Plain and Reinforced Concrete -Code of Practise.