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COMPARATIVE STUDY ON PODIUM STRUCTURE AND NORMAL STRUCTURE UNDER SEISMIC BEHAVIOUR

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Abstract-*This study investigates the Earthquakes are natural hazards which cause destructionto life and property. The placement of beams and columns of the podium are very important under both static and dynamic analysis. In this study attempt is made to understand the effect of responsespectra (Dynamic analysis), Static analysis and a time history analysis with 3 different time history Bhuj, chamoli and Uttarkashi taking for study. Present study includes four different podium structure and compare the base shear, storey stiffness, storey displacement short column effect with their normal structure under both the dynamic and static analysis, earthquake data is used as an input motion for different modes to get an acceleration time history of the building as well as response spectra. ETABS was used to perform response spectra and time history analysis. Total 5 models were analyzed like 4 different column placed structure and one normal structure.*

Keywords- *response spectra, Time history, Short column effect, Baseshear, ETABS*

I. INTRODUCTION

Now a day we live in such era where population is a major problem and increasing day by day thus resulting in construction of more vertical housing due to shortage of land. Earthquake is a common disastrous phenomenon that each and every structure on earth may suffer to certain damage. The seismic waves affect the building more violently that leads to building collapse. The aim of the structural engineer is to know the reason of building collapse due to earthquake and find out appropriate solution for that may be designing a structure to withhold the lateral forces etc. Among the different structures available Podium structure is one among them which can solve the above mentioned problem. For the reason engineer has to focused on both the static and dynamic analysis and analysed base shear, storey displacement, short column effect, storey stiffness and so on.

Podium, in terms of architecture, it means various elements form as the “foot” or base of a structure; or it means the structurally or decoratively emphasized the lowest portion of a wall (Oxford, 2012). The word “Podium Structure” is an architectural building typology which a podium in few stories height at the bottom, while one or more towers on top of the podium to form a special building typology. Some of the podium-tower structures will be used as commercial purpose, while many of them are mainly mix-used with the podium as commercial activities and the towers as offices, hotels or residential units.

II. MODELLING

2.1 Problem definition

Static and dynamic methods are adopted in the study and the time histories of some Indian earthquakes have been considered. In the present study time histories of the different locations in India is specified such as Bhuj, Chamoli, Uttarkashi. The magnitude acceleration of each and every earthquake is given in tabular form below:

Location	Year	Magnitude	Time step (s)	Records	Duration (s)
Bhuj	2001	7.9	0.005	26706	133.55
Chamoli	1999	6.6	0.005	8705	227.95
Uttarkashi	1991	6.6	0.02	1066	322.95

Table: 1 Time histories of different location in India

2.2 Different models and position

In the present work the analysis of following structures is been carried out:

A) Podium 1
B) Podium 2
C) Podium 3

D) Podium 4
E) Normal

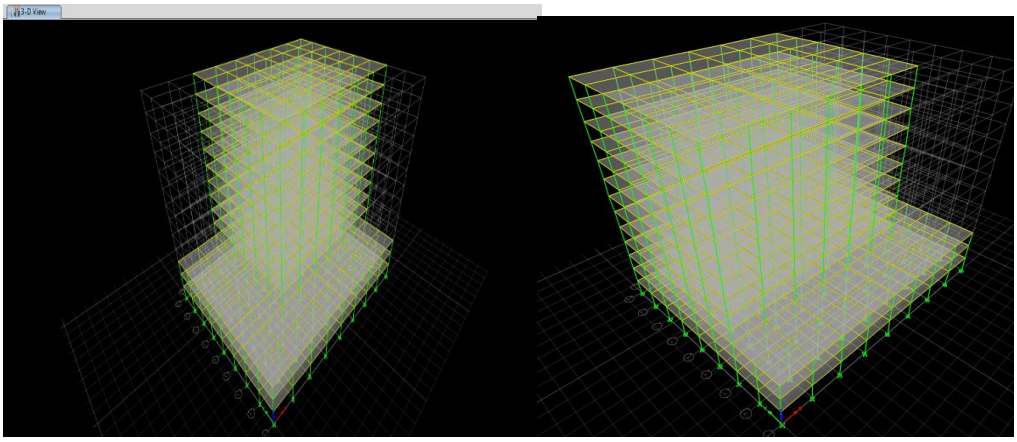


Figure 1. Podium 1Figure 2. Podium 2

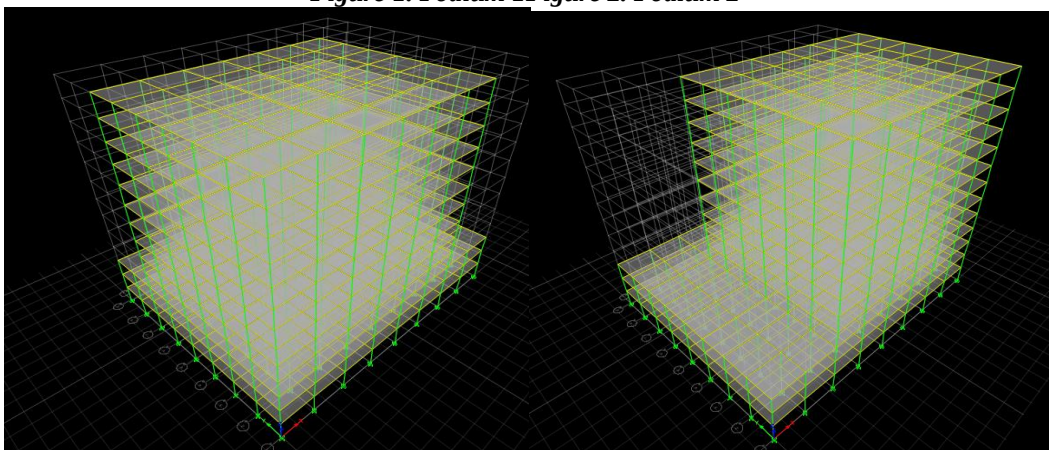


Figure 3. Podium 3 ***Figure 4. Podium 4***

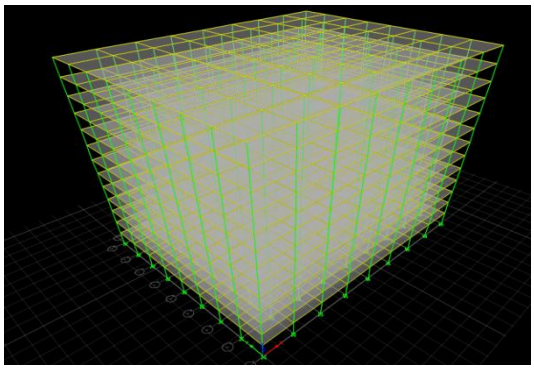


Figure 5. normal

The materials such as Poisson ratio, Density of Rcc, Density of masonry, Young's modulus, compressive strength of steel and concrete etc. are kept constant in all buildings.

Generally, here taking 40 x 32 m plan area for conducting the structure area, after the 3rd floor plan area become 30 x 24 m plan. For the structure we are taking 13th floor.

Table 2: Material Specifications

Grade of Concrete	Fck = 25 N/mm²
Grade of Steel	Fy =415 N/mm²
Density of Concrete	γc =25 kN/m³
Density of Brick wall	γ = 20 kN/m³
Slab thickness	125mm
Column 1	0.6 m X 0.6 m
Column 2	0.5 m x 0.6 m
Beam size	0.3 X 0.45 m
Storey height	3000mm
No. of floors	13 floor

Table 3: Loading

Earthquake zone	II
Importance factor	1
Response reduction factor	5
Wall load	11.73kN/m
Parapet wall load	2.3kN/m
Typical floor live load	4kN/m
Terrace live load	2kN/m
Floor finish on floor	kN/m
Floor finish on terrace	1.5kN/m

III. RESULTS & DISCUSSION

The following are the results derived from the static, response spectrum and time history method. The results show the difference between different types of building and parameters are compared with the normal building structure:

3.1 Base shear

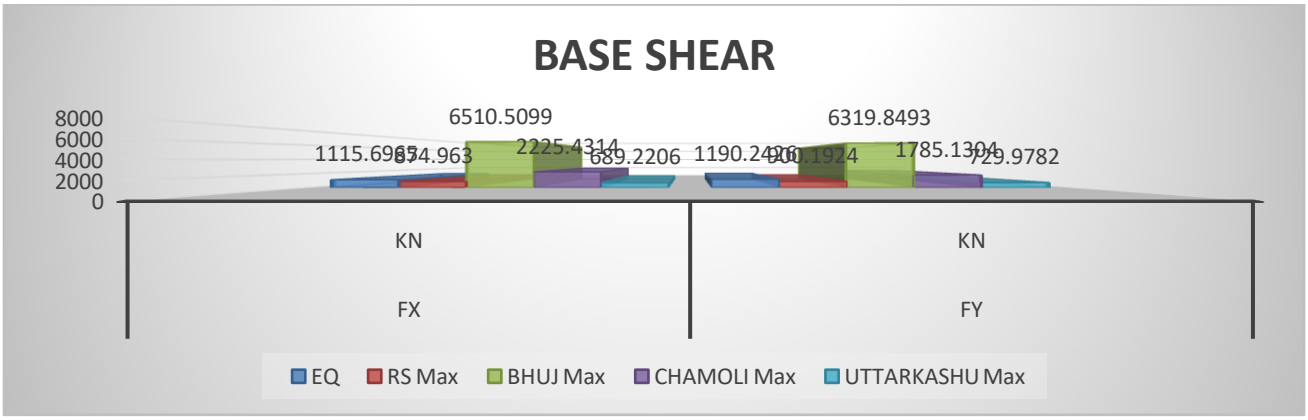


Figure 6.Base shear for podium 1

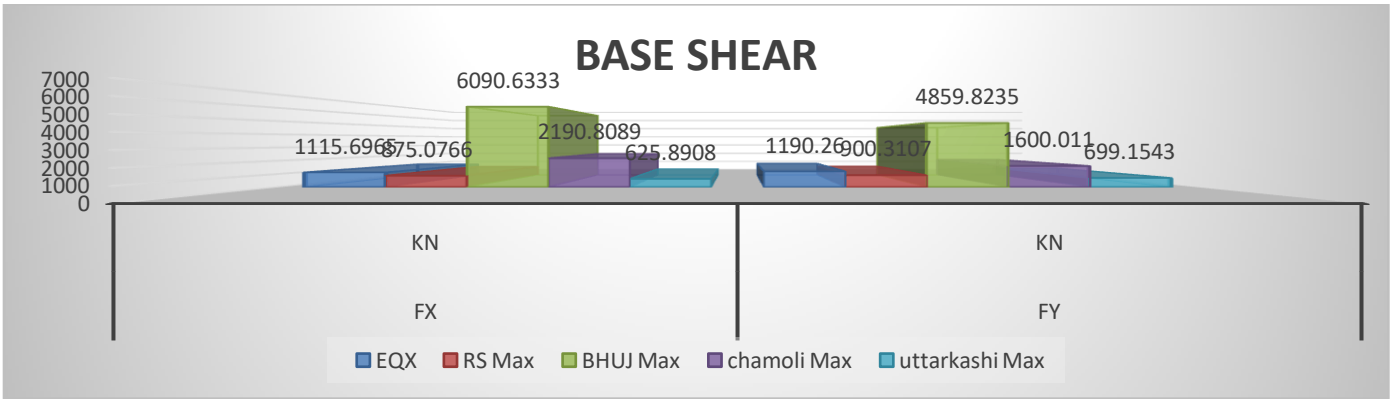


Figure 7. Base shear for podium 2

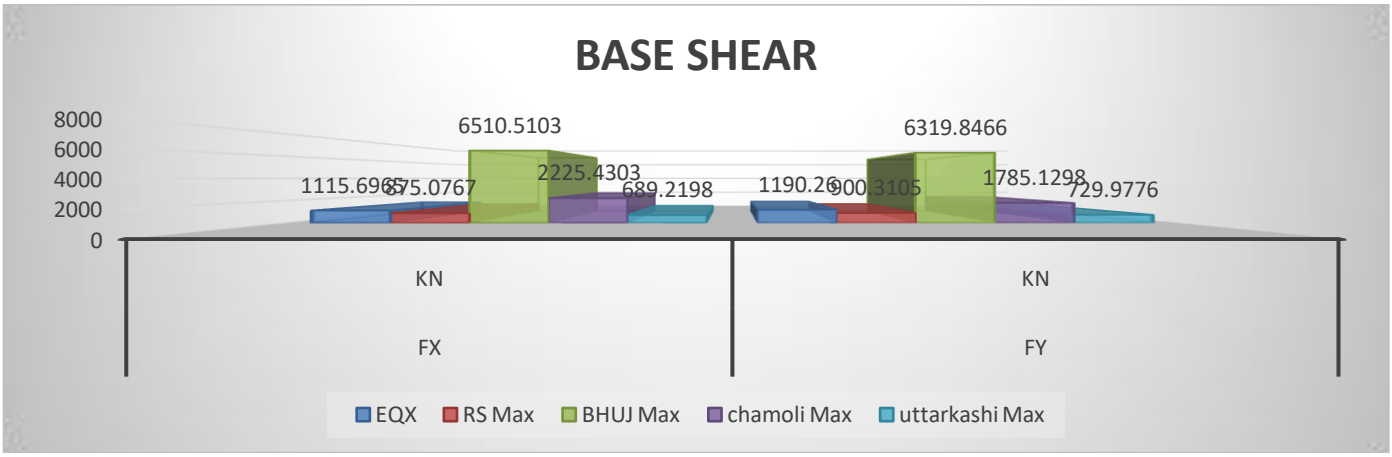


Figure 8. Base shear for podium 1

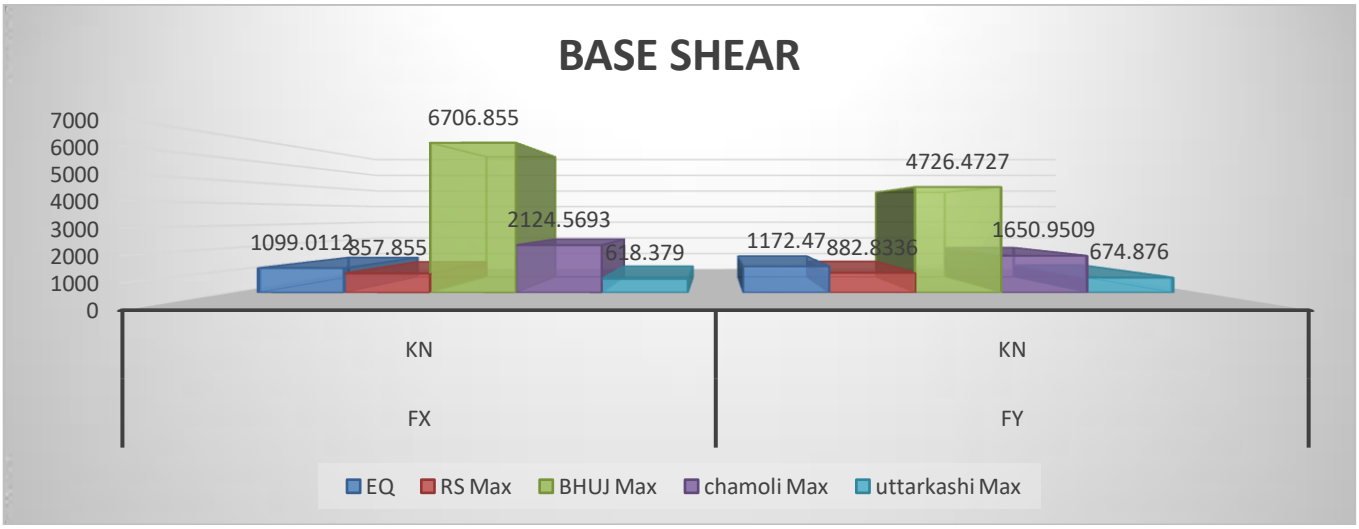


Figure 9. Base shear for podium 4

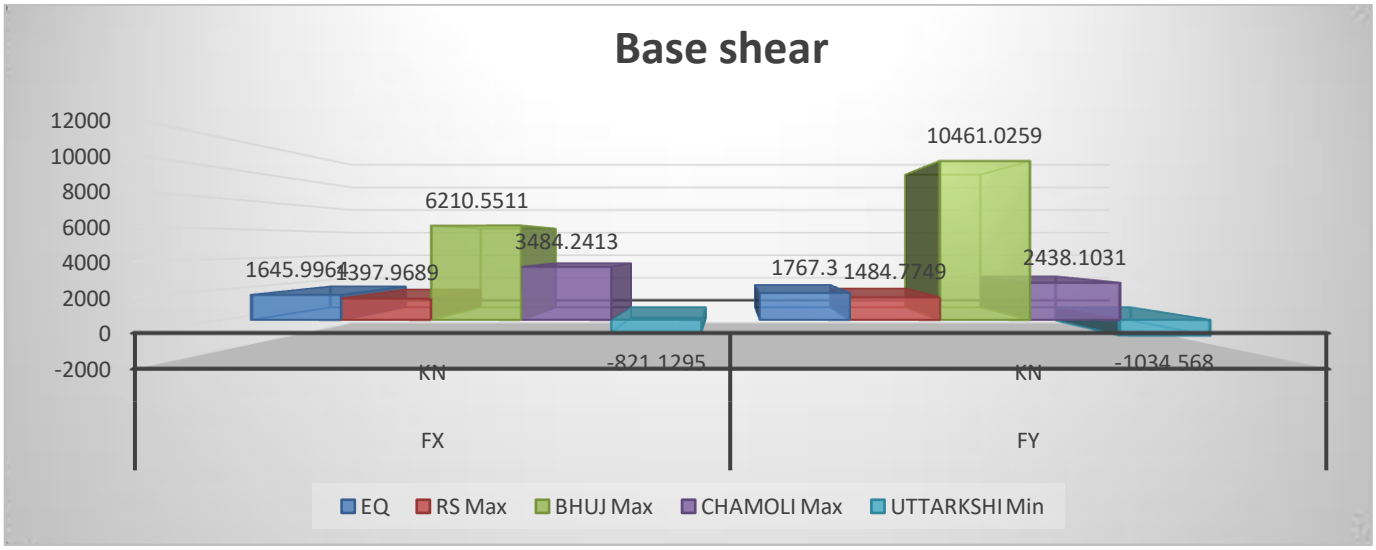


Figure 10. Base shear for normal

Here define that time history gives more values compare to the static and dynamic analysis. Normal structure gives more base shear compare to podium structure.

Above figure 6,7,8,9,10 are shows the Bhuj, chamoli and Uttarkashi time history base shear are found different values as per their magnitude and duration of earthquake. Maximum base shear found in bhuj time history for heavy seismic force over there.

3.2Storey displacement for dynamic analysis:

Storey	X dir.	Y dir.
13	10.30	10.33
12	10.6	10.8
11	9.66	9.67
10	9.10	9.12
9	8.40	8.42
8	7.58	7.61
7	6.65	6.69
6	5.61	5.67
5	4.48	4.56
4	3.28	3.38
3	2.13	2.22
2	1.27	1.33
1	0.47	0.50
Base	0	0

Table 5 storey displacement podium 1

Storey	X dir.	Y dir.
13	10.30	10.33
12	10.06	10.8
11	9.66	9.67
10	9.10	9.12
9	8.40	8.42
8	7.30	7.65
7	6.64	6.69
6	5.61	5.67
5	4.48	4.56
4	3.29	3.33
3	2.13	2.22
2	1.27	1.33
1	0.44	0.50
Base	0	0

Table 6 storey displacement podium 2

Storey	X dir.	Y dir.
13	10.34	10.33
12	10.10	10.12
11	9.65	9.60
10	9.09	9.10
9	8.40	8.42
8	7.55	7.54
7	6.66	6.68
6	5.66	5.67
5	4.50	4.55
4	3.28	3.38
3	2.10	2.12
2	1.27	1.33
1	0.48	0.55
Base	0	0

Table 7 storey displacement podium 3

Storey	X dir.	Y dir.
13	10.15	10.17
12	9.11	9.93
11	9.51	9.53
10	8.96	8.98
9	8.27	8.30
8	7.46	7.50
7	6.54	6.59
6	5.52	5.58
5	4.41	4.49
4	3.23	3.33
3	2.09	2.18
2	1.24	1.31
1	0.46	0.49
Base	0	0

Table 8 storey displacement podium 4

Storey	X dir.	Y dir.
13	10.59	10.85
12	10.38	9.64
11	10.02	10.30
10	9.81	8.82
9	8.87	8.82
8	8.11	7.50
7	7.23	6.68
6	6.25	5.77
5	4.17	4.77
4	4.00	3.69
3	2.76	2.54
2	1.63	1.52
1	0.60	0.58
Base	0	0

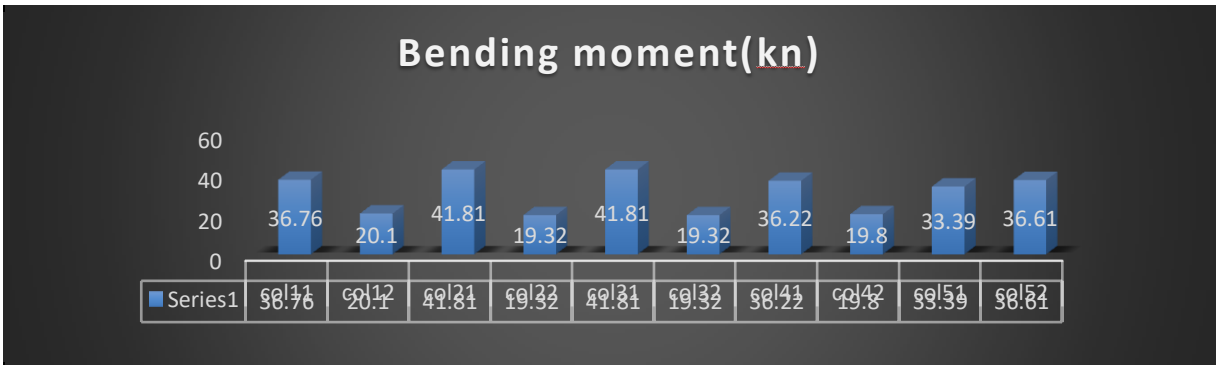
Table 9 storey displacement normal

Here are the 5 tables of the storey displacement of the structure. It should found that displacement is increase as number of floors increase.

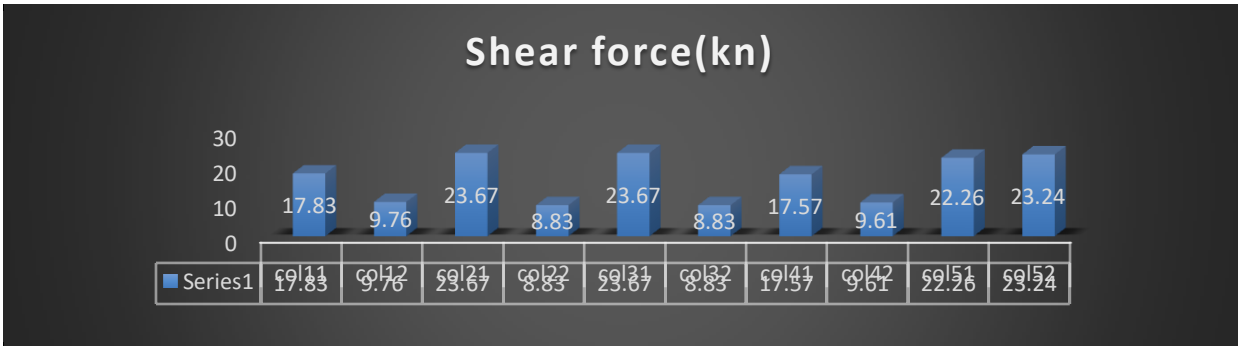
3.3 Comparison of short column effect:

For the analysis here taking Bending moment and Shear force for the structure.

A) Static analysis

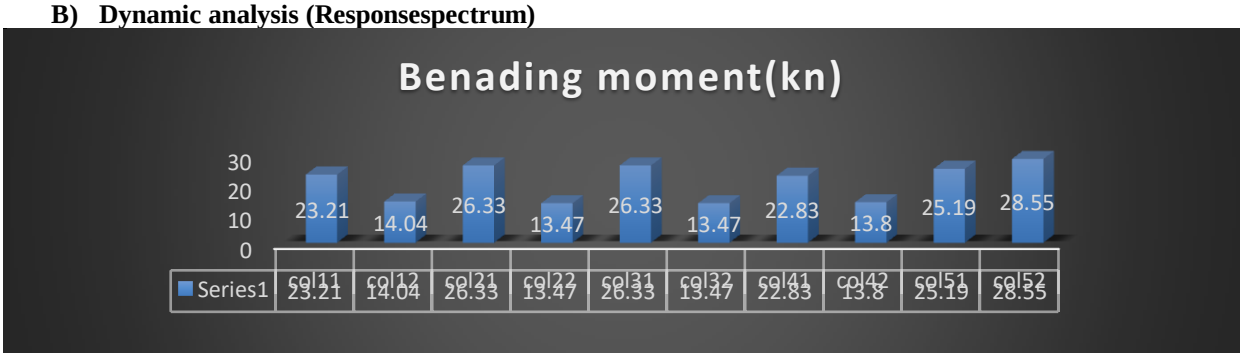


Bending moment (Static analysis)

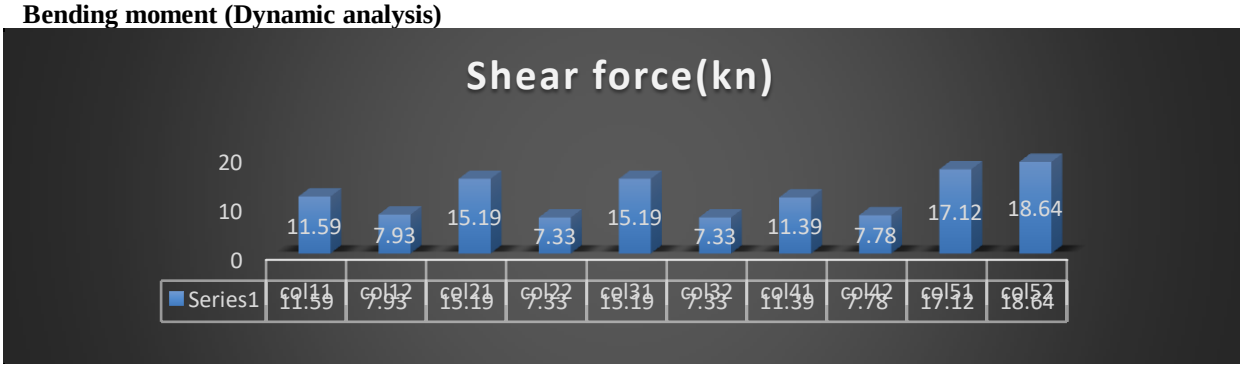


Shear force (Static analysis)

B) Dynamic analysis (Responsespectrum)

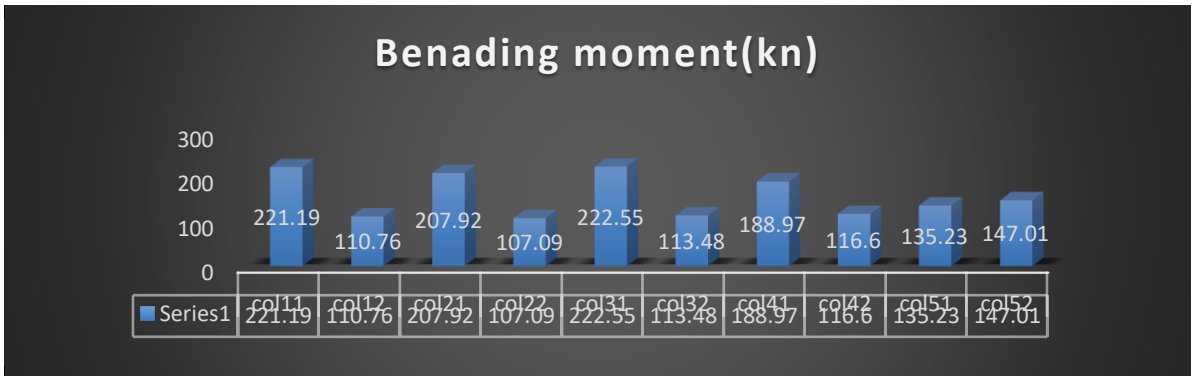


Bending moment (Dynamic analysis)

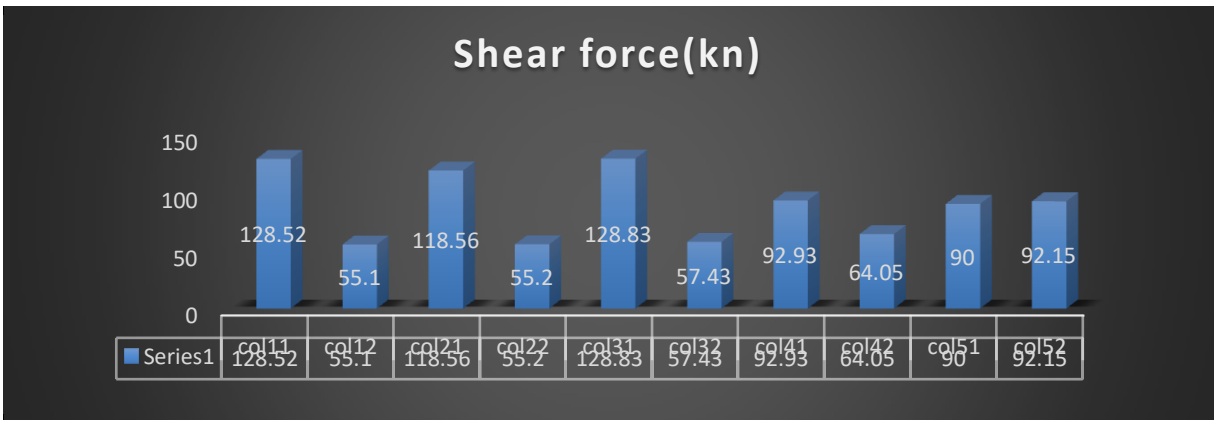


Shear force (Dynamic analysis)

C) Bhuj time history analysis:



Bending moment (Bhuj time history analysis)



Shear force (Bhuj Time history analysis)

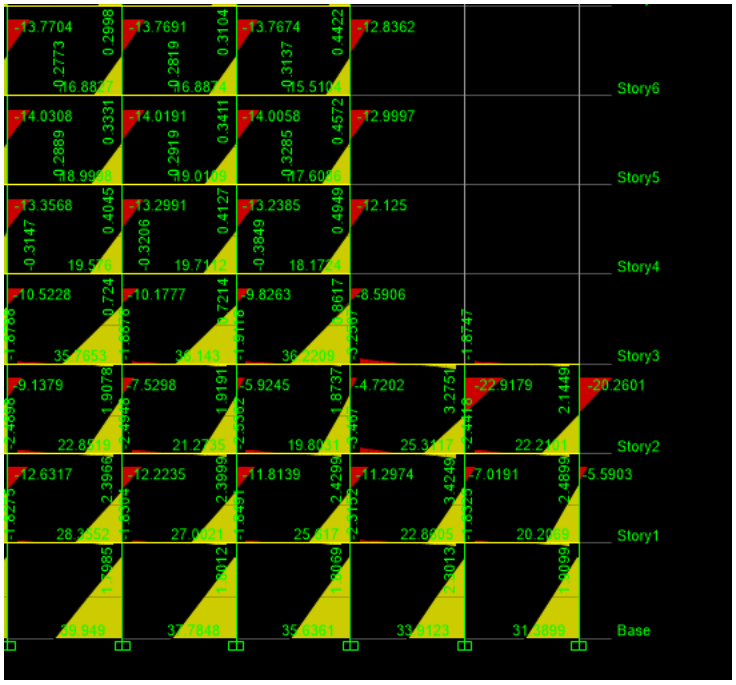


figure*11*

Here the above all graph shows that comparison of bending moment and shear force between podium and normal structure for the Static , Dynamic, and Bhuj time history analysis .

Column11,12,21,22,31,32,41,42 are for the 4 podium and remaining for the normal.

Here shows in fig11 Bending moment sudden change due to change in stiffness.

IV. CONCLUSION

1. Comparison of base shear values for time histories are shown in which the values for time history are higher than the Static and Dynamic (response spectrum) method, also the normal structure has more base shear compare to the podium structure.
2. In case of bhuj near field earthquake base shear is 329% higher than chamoli, keep in with chamoli is 135% higher value compare to Uttarkashi field earthquake, In addition Static analysis is 17% more than the dynamic analysis for podium structure.
3. For the Storey displacement it is clearly found that under seismic behavior the value of displacement is rise as increase the number of floors. Highest value found at the top floor.
4. For the static analysis podium structure has bending moment 82%, 116%, 116%, 82%difference happen for podium structure as well as Shear force 82%, 168%, 168%, 82% difference happen for podium structure between upper and lower column.
5. For the Dynamic analysis podium structure has bending moment 65%, 95%, 95%, 72%difference happen for podium structure as well as Shear force 46%, 107%, 107%, 46% difference happen for podium structure between upper and lower column.
6. For the Bhuj time history analysis podium structure has bending moment 99%, 94%, 96%, 62%difference happen for podium structure as well as Shear force 113%, 114%, 124%, 45% difference happen for podium structure between upper and lower column.
7. Short column effect for Bhuj, Dynamic analysis, and static analysis of structures, it is found that column located near the podium placement there is huge change in stiffness, for the reason it is more increase the bending moment and shear force for upper column compare to the below column. There comparatively graphs are shown above structure Normal structure has no any problem.
8. So we can conclude that the time history analysis is exact analysis is give us idea about the actual force developed in structure during ground shaking. The column near corner levels are subjected to short column effect so they must be properly placed and proper designed to resist earthquake force.

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