Seismic analysis of podium structure using static and dynamic methods

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ABSTRACT: **Nowadays the space requirement is the major problem which results into the congestion of structures and also they are very unsafe whenever lateral forces i.e. earthquakes forces are experienced by the structures. Podium is the structure which is used as a multi-usage platform for making the regular or irregular structures. Podium may consist of commercial to certain height, residential and also for many other purposes. The stiffness variation can also be seen throughout the height of the structure, which results in large oscillation of the building. Hence in order to fulfil the space requirement and also for the safety purpose the podium structure and its analysis is been made. In the present study the static analysis and the dynamic analysis is been done. Also the dynamic analysis is been carried out by the response spectrum method. The whole analysis is been carried out in the SAP 2000 and also the time histories of Bhuj, Chamoli, Uttarkasshi and Nepal is been shown to study the behaviour of the different earthquake in the building according to the various zones. Also the model so prepared is been compared to the normal building so that the base shear, storey drift, moments can be easily studied by referencing the normal building.**

***Keywords*—Static analysis, response spectrum analysis, Time history method, Podium structure.**

INTRODUCTION

Nowadays population is a major problem and is 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.

Podium is the multi-tasking structures in which large variation in plan and elevation is seen. Structure has the stiffness variation while observing the elevation of the podium structure. This stiffness variation creates a large drift to the podium that results in the disturbance of the structure. Thus in order to make the structure more stable and to withstand desirable seismic forces engineer has to design the structure by using proper techniques and many design software. By using proper design techniques and software, stability of the building can also be achieved if each and every member of the structure are properly analyzed and designed for the worst condition of seismic forces. The member such as beam, column, slab etc., which are the main part of structure, must withstand large lateral forces even in the high magnitude of earthquake.

MODELLING AND ANALYSIS

❖ Modelling

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, Nepal etc. 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	21.42
Nepal	2015	7.8	0.005	64591	322.95

Table: 1 Time histories of different location in India

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

a) Normal building
b) T-Shaped building
c) C-Shaped building

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.

The following data is been considered for the research work:

- The podium structure is considered for the present research work consist of 15 storied and 20 storied building which has beam size of 350X450mm, column size of 500X500 mm, slab 150mm, grade of concrete 30Mpa, grade of steel 500. The plan (20mX20m) of podium building and it changes according to the Shape of building i.e. T shape and C-shape building.
- The dead load is 1.5 kN/m^2, live load is 4 kN/m^2, Floor finish and terrace water proofing is 2.5 kN/m^2, storey height of the building is 3m also response reduction factor is 3 and importance factor is 1.5. The static and dynamic analysis is carried out in SAP-2000 using the parameters for the design as per the IS-1893- 2002-Part-1 for the zones-2, 3, 4 and 5.
- Time histories are also applied to the podium building such as bhuj, chamoli, Uttarkashi, Nepal etc. Comparison of parameters like base shear, roof displacement, column moment for static, response and time histories is been done in this research work.

RESULT AND 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:

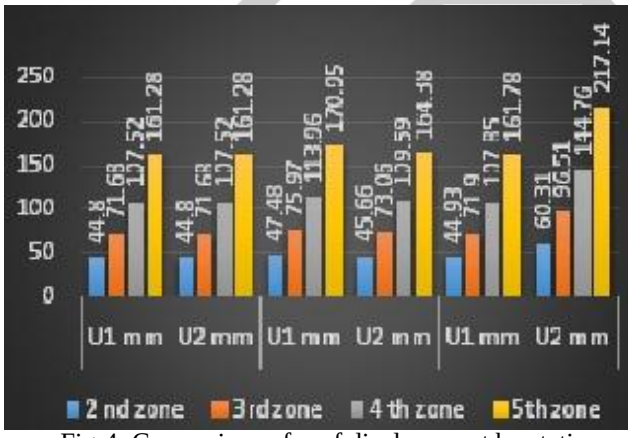

Fig-4: Comparison of roof displacement by static method (15 storey)

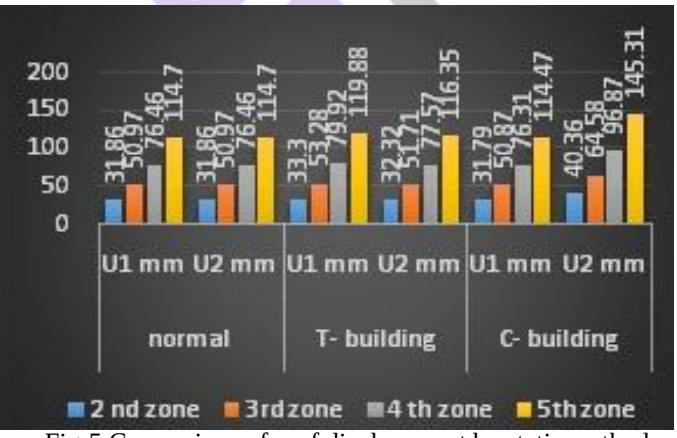

Fig-5 Comparison of roof displacement by static method (20 storey)

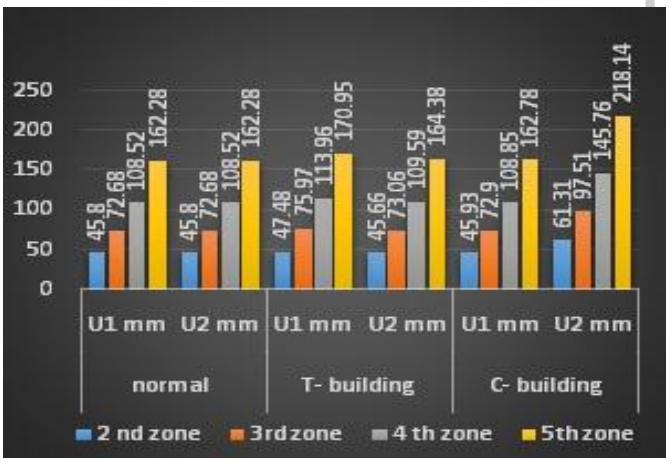

Fig-6: Comparison of roof displacement by response method (15 storey)

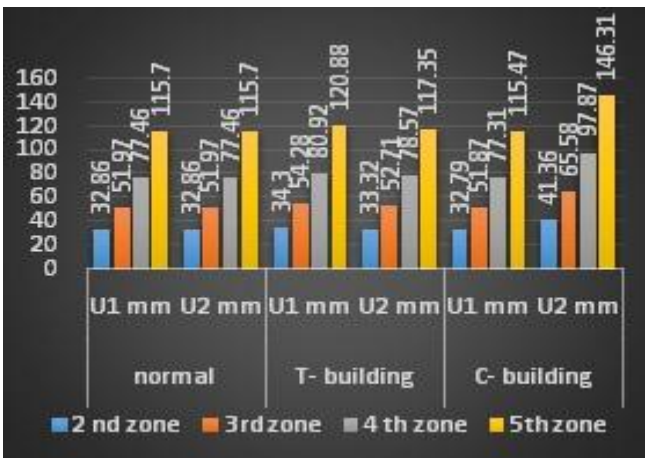

Fig-7: Comparison of roof displacement by response spectrum method (20 storey)

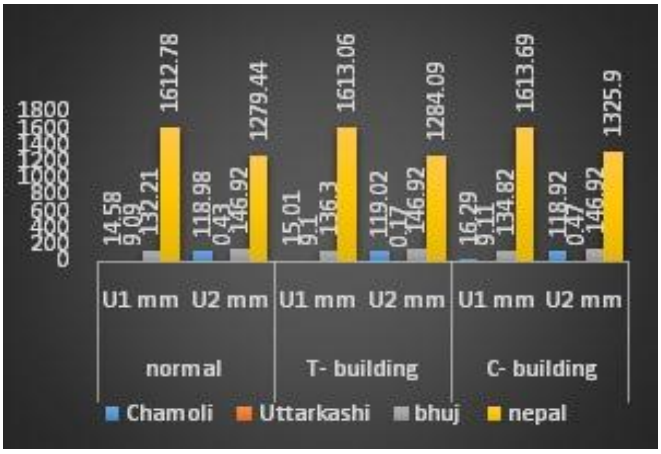

Fig-8: Comparison of roof displacement by time history method (15 storey)

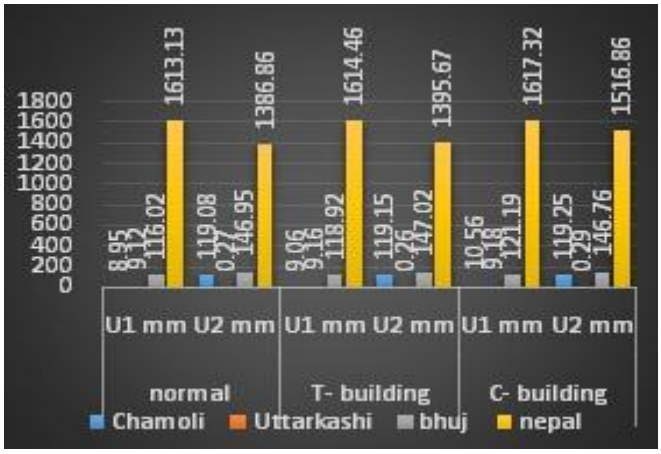

Fig-9: Comparison of roof displacement by time history method (20 storey)

Fig-10: Comparison of moments by time history method (15 storey)

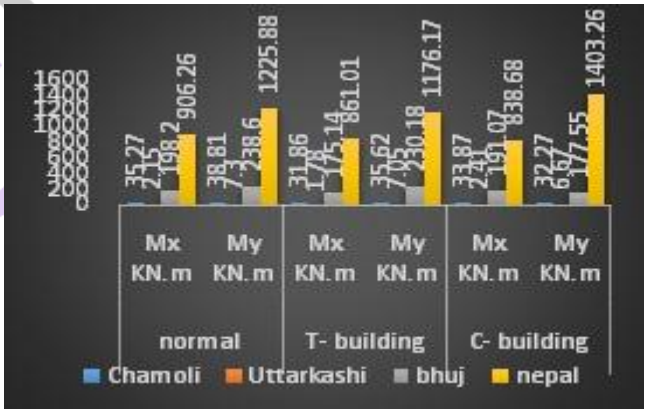

Fig-11: Comparison of moments by time history method (20 storey)

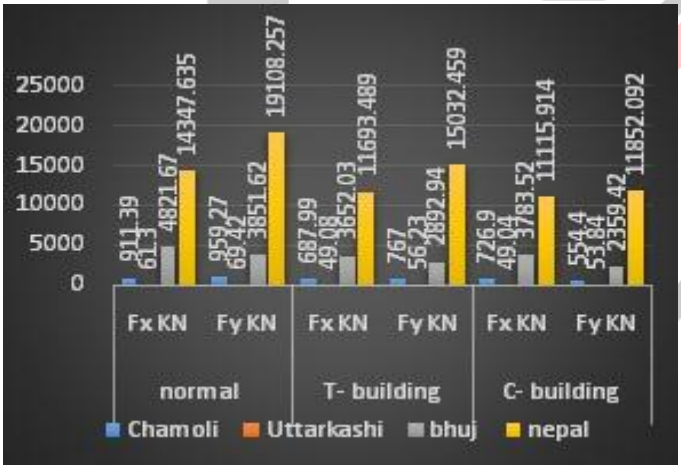

Fig-12: Comparison of base shear by time history method (15 storey)

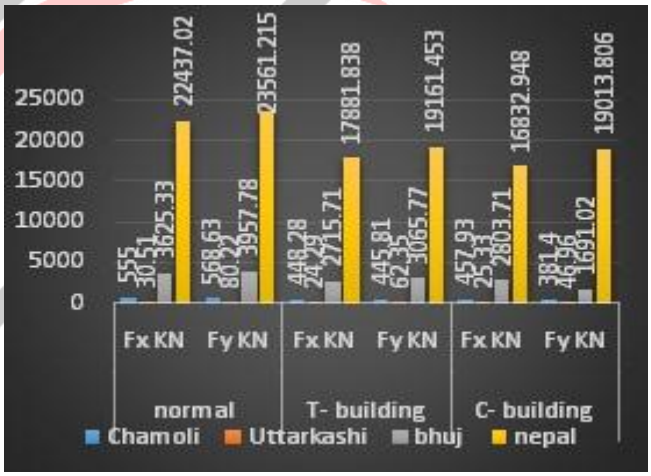

Fig-13: Comparison of base shear by time history method (20 storey)

CONCLUSION

- **Comparison of roof displacement:**
- The values of static and response spectrum method roof displacement for c shape building is more about **20-25 %** in Y direction than the normal and T shape building. Also the time history values for C shape building is higher in Y direction than the normal and T shape building.
- **Comparison of column moment:**
- While comparison of column moments by static and response spectrum method the normal building has higher values then the T-shape and C-shape building.

- In the Nepal time history method the 20 storey C-shape building has higher values in about **12-15%** in Y direction than the normal and T shape building.

▪ **Comparison of base shear:**

- Here the comparison of base shear values for time histories are shown in which the values for time histories are higher than the static and response spectrum method. Also the normal building has more base shear than the T and C shape building

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