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SEISMIC ANALYSIS OF PODIUM STRUCTURE CONSIDERING BI-DIRECTIONAL EARTHQUAKE FORCE

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ABSTRACT

In this time situation the space requirement is the major problem in every city which results into the congestion of structures and also they are very dangerous whenever lateral forces for example earthquake forces are experienced by the structures. To ensure safety against seismic forces for podium structure hence, there is need to study of seismic analysis to design earthquake resistance structures. We considered the podium type building of 15 storied structures for the seismic analysis and it is located in zone II, III, IV, V. Different earthquakes Time Histories applied at various angles like 10°, 20°, 30°, 40°, etc and most severe analysis will be study for each cases. In this topic we compared the different shape of podium type building. In the present study time histories of the different locations in India is specified such as Bhuj, Chamoli, Uttarkashi, etc. The models were analyzed using structural software for building analysis SAP 2000 software. Response Spectrum analysis, time history method of podium building will be carried out in SAP 2000 software. This topic was analyzed the Indian standard code IS: 1893-2016.

Keywords: *Static analysis, Response spectrum analysis, Time history analysis, Podium structure.*

I. INTRODUCTION

Nowadays population was a major problem and is increasing day by day, thus resulting in construction of more vertical housing due to shortage of land. There are new innovative architectural techniques are used in high rise buildings and in mega tall structures with the advanced and powerful structural analysis. Podiums are augmented floor area at the lower level of a high rise building which are common in metropolitan areas in regions of low-to-moderate seismicity. Podium was the multi-tasking structures in which large variation in plan and elevation was seen. Among various construction forms, medium/high-rise building constructed with podium structure is a popular engineering scenario, by which a large open space for commercial uses, for instances, car parking, shopping arcade, restaurants or hotel lobbies, at ground level can be achieved. Podium building is very beneficial type of building in terms of residential as well as commercial. In podium type building up to 3 or 4 floors commercial shops are constructed and after third or fourth floor plan area is reduced and residential flats are constructed. Earthquake is a common disastrous phenomenon that each and every structure on earth may suffer to certain damage. Thus the safety of people and contents is assured in earthquake resistant design of buildings, and there by disaster is avoided. One of the biggest challenges of a structural engineer is to design an earthquake resistant building in seismic region.

II. MODELING AND ANALYSIS

Three dimensional space frame analysis is carried out for five different configurations of buildings under the action of seismic load. In the first case, podium structure is considered at centre as shown in fig.1, second case, podium structure is considered on upper side(+Y direction) as shown in fig.2, third case, podium structure is considered on down side(-Y direction) as shown in fig.3, fourth case, podium structure is considered on right side(+X direction) as shown in fig.4 and fifth case, podium structure is considered on left side(-X direction) as shown in fig.5, Buildings have been analyzed for seismic loads including static and dynamic analysis. Dynamic response of these buildings, in terms of base shear, fundamental time period and top floor displacement is presented, and compared within the considered configuration as well as with other configurations.

The following data is been considered for the research work:

- The podium structure is considered for the present research work consist of 15 storied podium building which has beam size of podium building 250X500mm, column size for the commercial building 1st to 3rd floor 450X450 mm and residential building 4th to 15th floor 400X400 mm, slab 125mm, grade of concrete 20Mpa, grade of steel 415. The plan (24mX24m) of podium building and it changes according to the Shape of building.
- The dead load is 1 kN/m², live load is 4 kN/m², storey height of the building is 4m also response reduction factor is 5 and importance factor is 1. The static and dynamic analysis is carried out in SAP-2000 using the parameters for the design as per the IS: 1893-2016 for the zones-2, 3, 4 and 5.
- Time histories are also applied to the podium building such as Bhuj, Chamoli, Uttarkashi, etc. Comparison of parameters like base shear, roof displacement, column moment for static, response and time histories is been done in this research work.

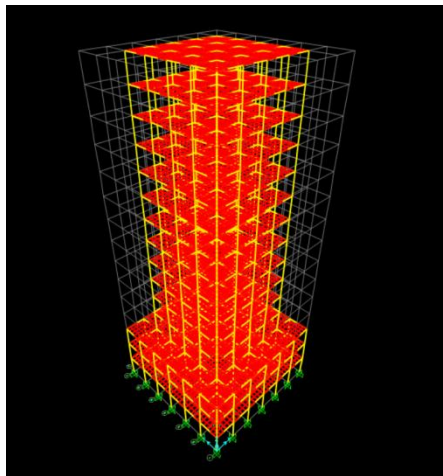


Fig 1 Center podium building

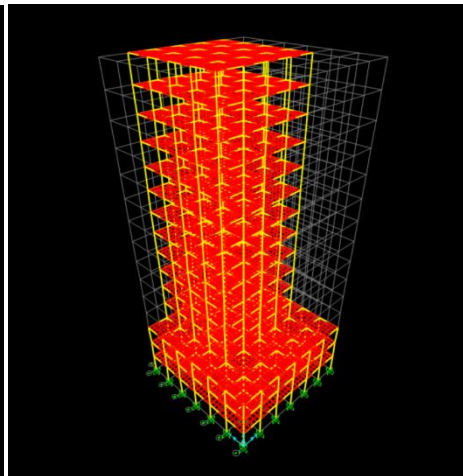


Fig 2 Upper (+Y) podium building

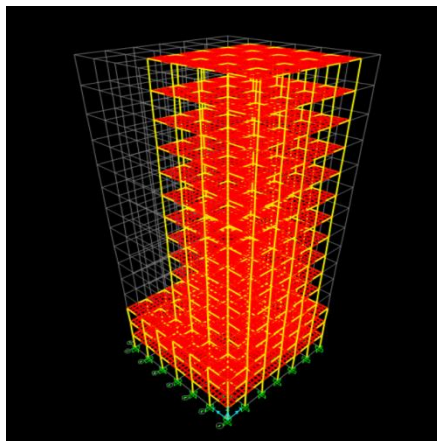


Fig 3 Down (-Y) podium building

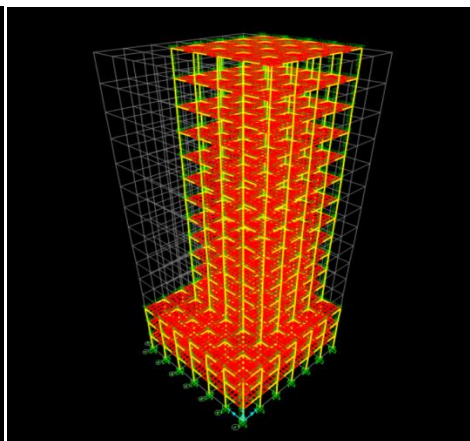


Fig 4 Right (+X) podium building

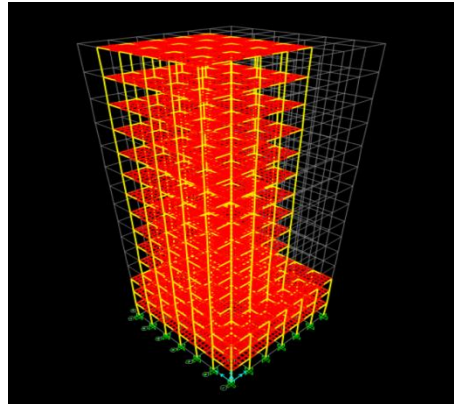


Fig 5 Left (-X) podium building

III. RESULTS AND DISCUSSION

The following are the results derived from the static, response and time history method.

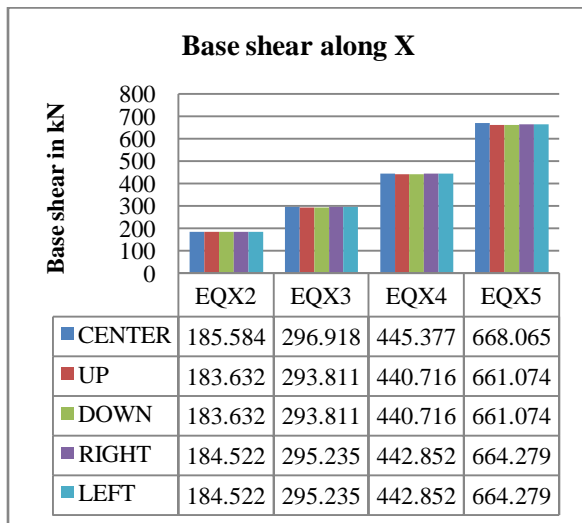


Fig 6 Comparison of base shear by static method along X

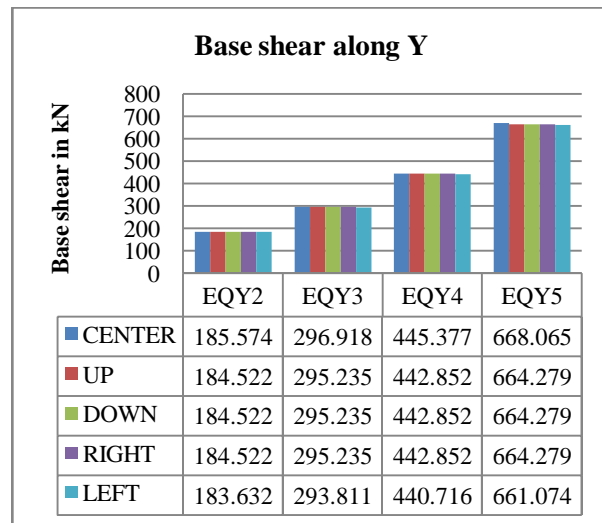


Fig 7 Comparison of base shear by static method along Y

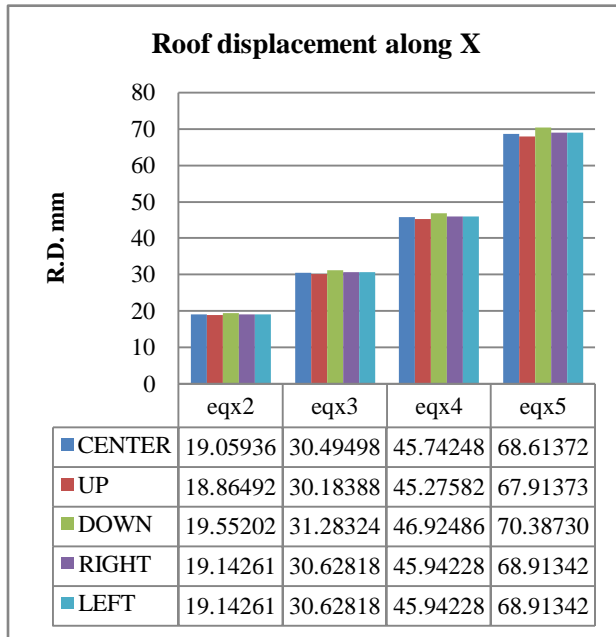


Fig 8 Comparison of Roof displacement by static method along X

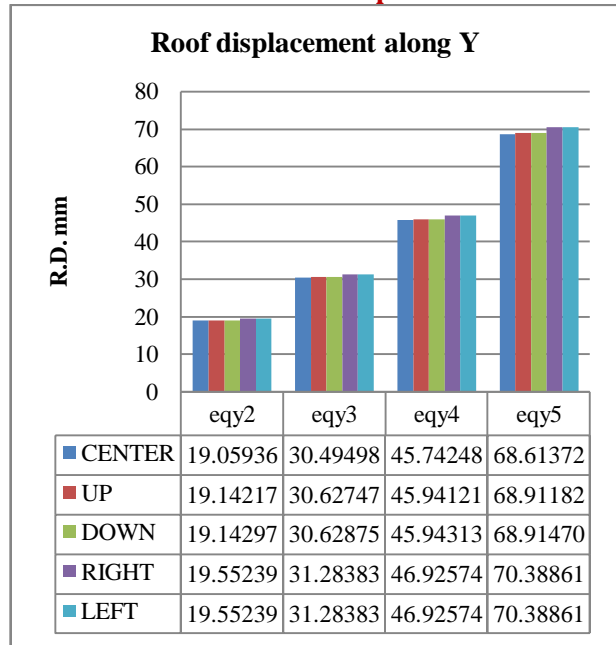


Fig 9 Comparison of Roof displacement by static method along Y

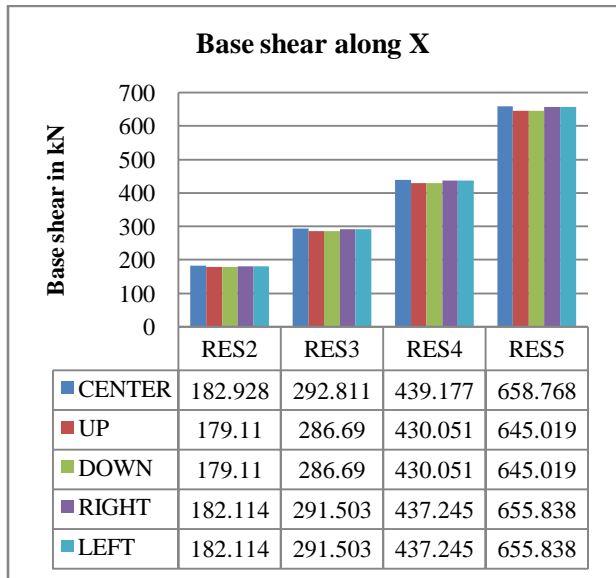


Fig 10 Comparison of base shear by response method along X

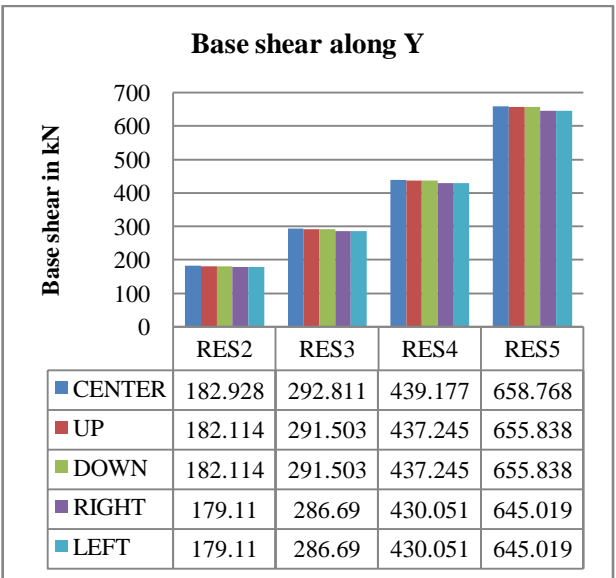


Fig 11 Comparison of base shear by response method along Y

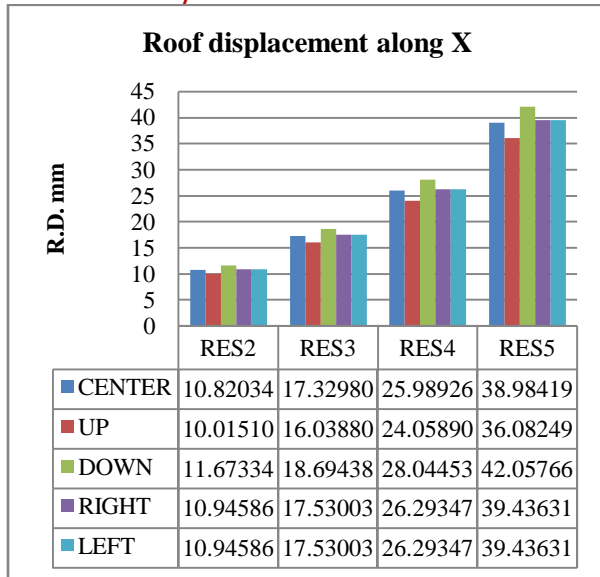


Fig 12 Comparison of Roof displacement by response method along X

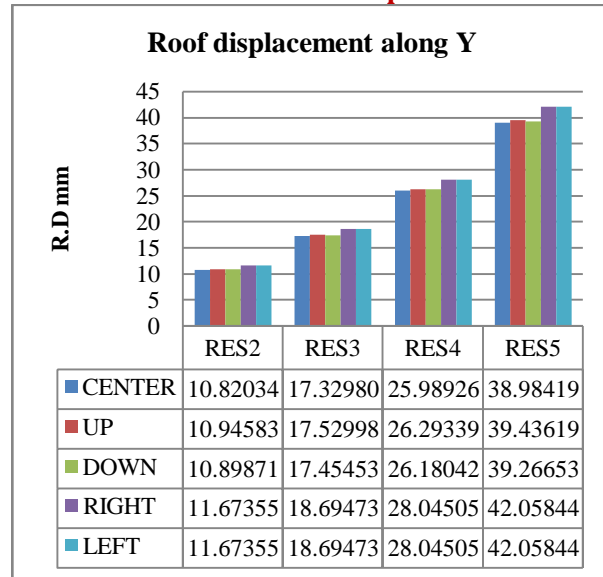


Fig 13 Comparison of Roof displacement by response method along Y

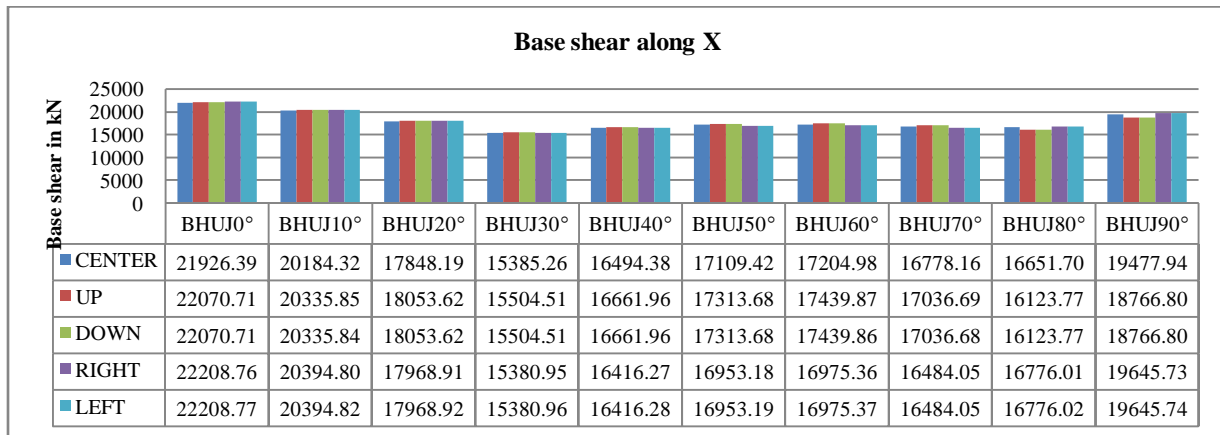


Fig 14 Comparison of base shear by T.H method along X in Bhuj

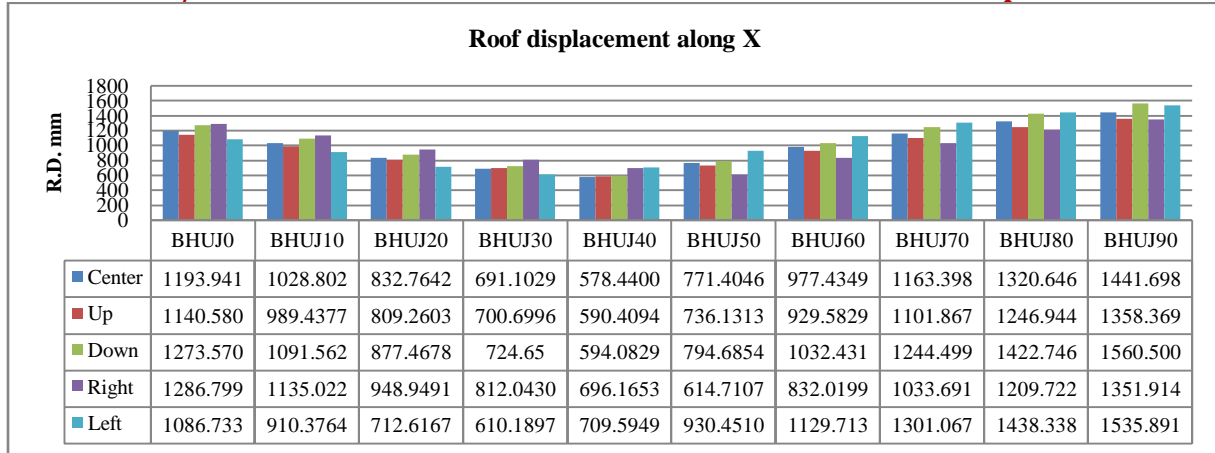


Fig 15 Comparison of Roof displacement by T.H method along X in Bhuj

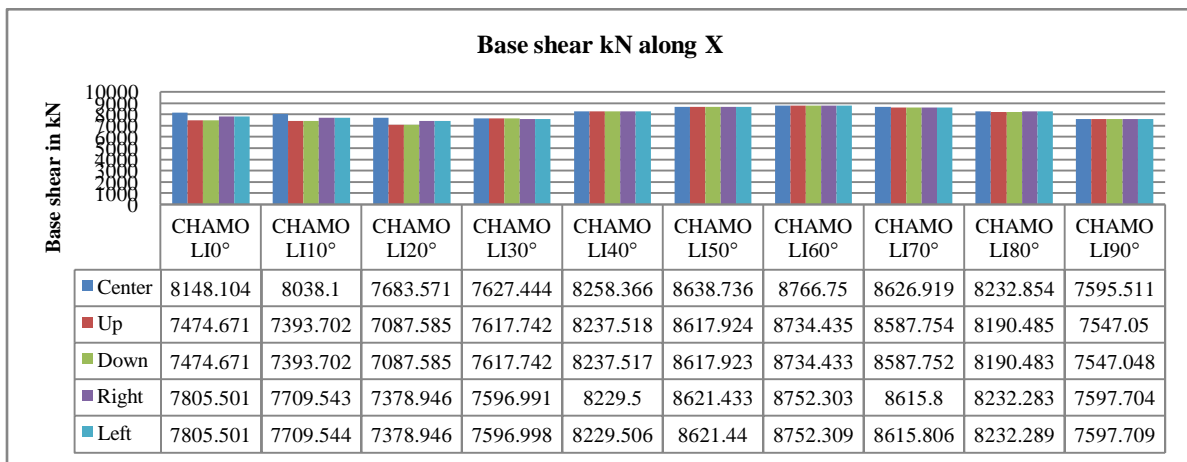


Fig 16 Comparison of base shear by T.H method along X in Chamoli

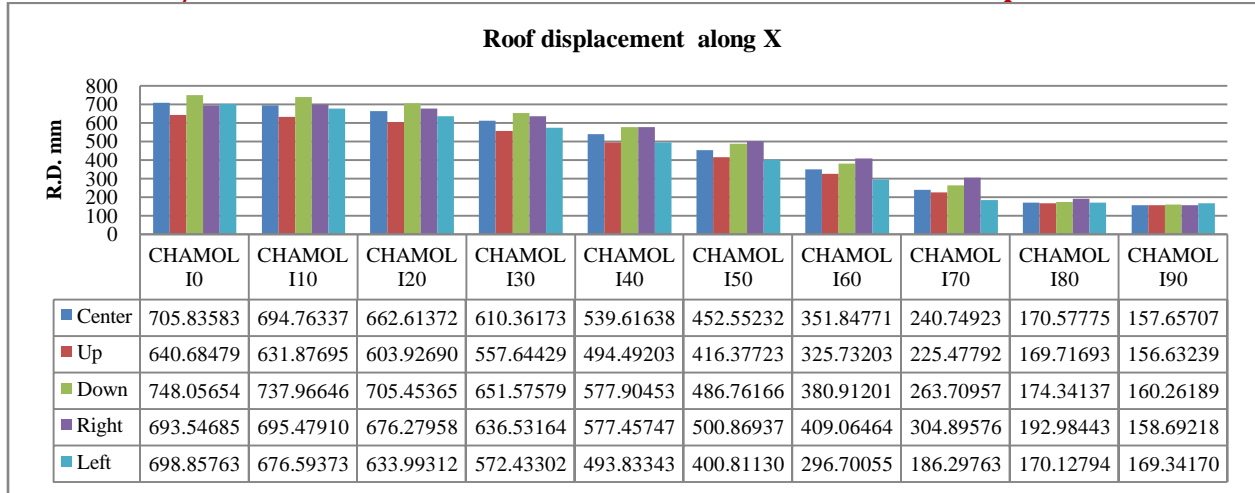


Fig 17 Comparison of Roof displacement by T.H method along X in Chamoli

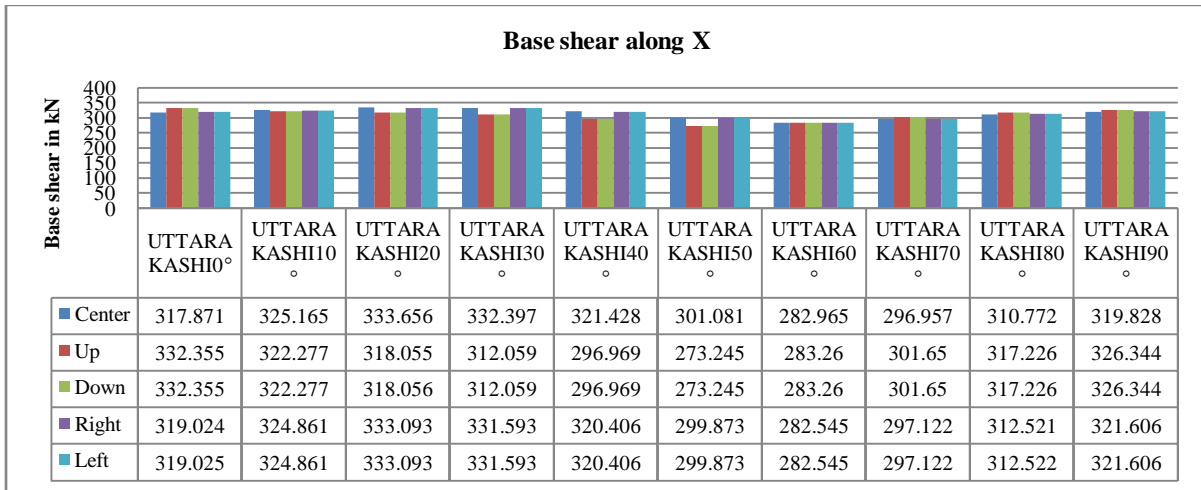


Fig 18 Comparison of base shear by T.H method along X in Uttarakshi

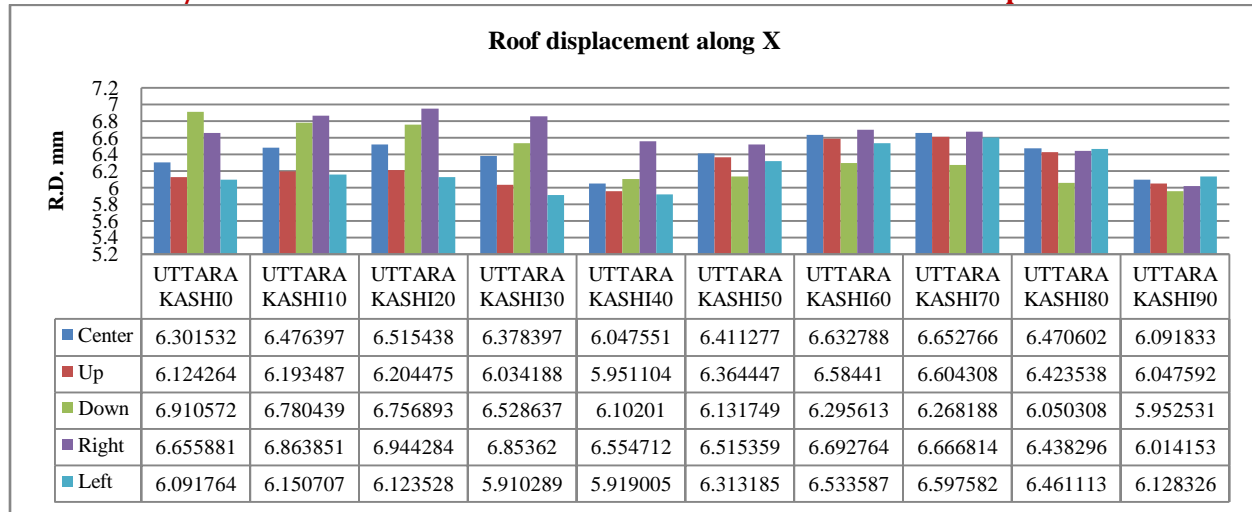


Fig 19 Comparison of Roof displacement by T.H method along X in Uttarakashi

IV. CONCLUSION

1. In static method value of base shear is almost same all building configuration.
2. In static method displacement measured at top node is same for all building configuration.
3. We are getting 5% to 10% variation in base shear and roof displacement by response spectrum method.
4. In Bhuj earthquake base shear is 10% higher for unsymmetrical building compared to symmetrical building and roof displacement is higher when earthquake is applied at 90 degree to building axis in all building configuration.
5. In Chamoli, time history base shear is 8 to 10 percentage higher when earthquake is applied at 60 degree to building axis in all building and roof displacement is higher when earthquake is applied at 0 degree to building axis in all building.
6. In Uttarakashi, time history base shear is 4 percentages higher when earthquake is applied at 20 degree to building axis in symmetrical building and roof displacement is higher when earthquake is applied at 60 and 70 degree to building axis in all building configuration.

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