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Seismic Response of Vertical Irregular Structures with Soil Structure Interaction

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ABSTRACT

In the past, several major earthquakes have exposed the deficiencies of buildings, which lead to damage or collapse. The buildings with regular geometry and uniformly distributed mass and stiffness in plan and in elevation suffer much less damage compared to irregular configurations. The structural irregularities cause non-uniform load distribution in various members of a building. Regular structures may be defined as having nearly uniform distributions of storey strength, stiffness, weight and geometry over their height. In contrast, setback structures are characterized by abrupt reductions in floor area in the upper stories. Because of the functional and aesthetic architecture, these types of buildings are preferred in modern multi-storeyed building construction. The main advantages of this type of buildings are: they provide good ventilation with adequate sunlight to the lower storey's; and they also provide for compliance with building byelaw restrictions related to 'floor area ratio.

Keywords: Seismic Force , Setback Building, STAAD PRO V8i

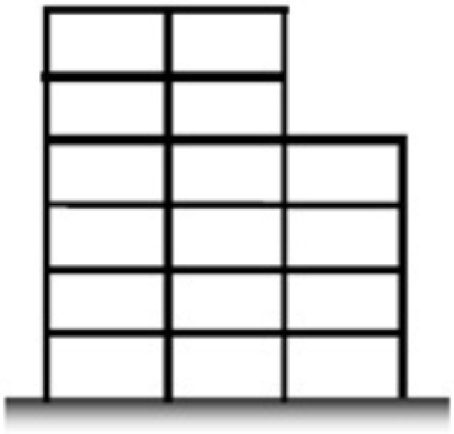
I. INTRODUCTION

The magnitude of lateral force due to an earthquake depends mainly on inertial mass, ground acceleration and the dynamic char-acteristics of the building.

To characterize the ground motion and structural behaviour, design codes provide a Response spectrum. Response spectrum conveniently describes the peak responses of structure as a function of natural vibration period, damping ratio and type of founding soil..

The determination of the fundamental period of structures is essential to earthquake design and assess- ment. Seismic analysis of most structures is carried out using Linear Static (Equivalent Static) and Linear Dynamic (Response Spectrum) methods. Lateral forces calculated as per Equivalent Static Method depends on structural mass and fundamental period of structure. The empirical equations of the fundamental period of buildings given in the design codes are function of building height and base dimension of the buildings. Theoretically Response Spectrum Method uses modal analysis to calculate the natural periods of the building to compute the design base shear. However, some of the interna- tional codes (such as IS 1893:2002 and ASCE 7:2010) recommend to scale up the base shear (and other response quantities) corresponding to the fundamental period as per the code specified empirical formula, so as to improve this base shear (or any other response quantity) for Response Spectrum Analysis to make it equal to that of Equivalent Static Analysis. Therefore, estimation of fundamental period using the code empirical formula is inevitable for seismic design of buildings. Setback in buildings introduces staggered abrupt reductions in floor area along the height of the building. This building form is becoming increasingly popular in modern multi-storey building con- struction mainly because of its functional and aesthetic architecture. In particular, such a setback form provides for adequate daylight and ventilation for the lower storey in an urban locality with closely spaced tall buildings.

Regular building

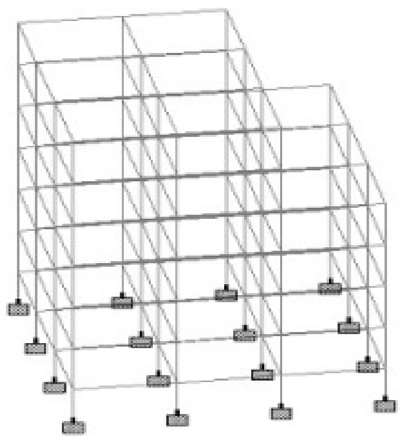


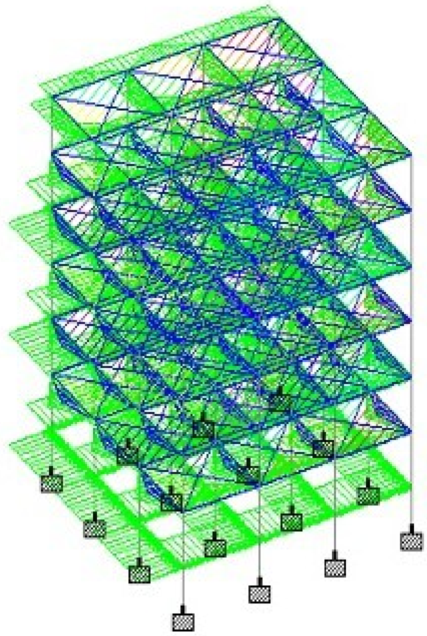
Setback building

II. METHODS AND MATERIAL

The steps undertaken in the present study to achieve the above-mentioned objectives are as follows:

a) Carry out extensive literature review, to establish the objectives of the research work.
b) Select an exhaustive set of setback building frame models with different heights (6 to 18 storeys), Bay width in both horizontal direction (5m, 6m and 7m bay width) and different irregularities.
c) Perform free vibration analysis for each of the building models.
d) Analysing the results of free vibration analysis.

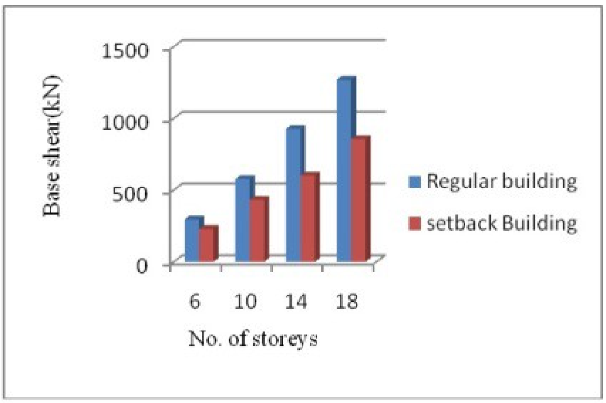




III. RESULTS AND DISCUSSION

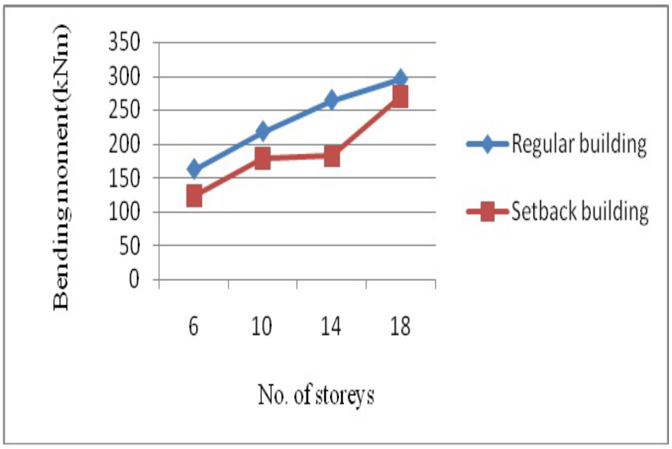
The results are presented in the form of tables and graphs considering the effect of soil flexibility with that of the fixed base condition representing the Natural periods, Base shear, Axial force, Displacement & Bending moment as a function of various influential parameters. The results for two different types of building namely, Regular building and setback building with brick infill on alternate stories are presented respectively. The trends observed in the results are also discussed in these sections. The following results are obtained after multiplying the scaling (factor) ratio of VB .The base shears are shown for equivalent static analysis (ESA) and response spectrum analysis (RSA) for the buildings.

FIGURES AND TABLES :



7m bay width using ESM

No. of storey	Regular building	Setback Building
06	382.5	305.28
10	1014.75	566.6
14	1404.89	800.0
18	1885.73	1100



IV. CONCLUSION

On the basis of the present study, following conclusions are made:

1. The Displacement for the Setback structure are less as compared to Regular struc- ture, but the difference can be ignored if the designer wants to provided the Displacements are obtained within the permissible limits.
2. The effect of Axial Force on Setback buildings increases the lateral stability as compared to the Regular building.
3. The Natural period decreases as the stiffness of the building increases and their by leading increase in base shear for Regular and Setback building.
4. The effect of Soil Flexibity when not considered gives critical results when compared to Soil flexibity considered.
5. The effect of SSI increases the seismic response of the structure.
6. Irregularities in upper stories has very little influence on the floor Displacements.
7. The effect of Bending moment varies depending upon the shape of the structure

V. REFERENCES

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