Non Linear Analysis of RC Multi-Storey Irregular Building for Seismic Load by using Response Spectrum Method

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Abstract— A structure can be classified as irregular if it contains irregular distributions of mass, stiffness and strength or due to irregular geometrical configurations. Many buildings in the present scenario have irregular configurations both in plan and elevation. This in future may subject to devastating earthquakes. Codes suggests the different limits for these irregularities like as per IS 1893:2002, a storey in a building is said to contain mass irregularity if its mass exceeds 200% than that of the adjacent storey. In case, it is necessary to identify the performance of the structures to withstand against disaster for both new and existing one. This study is concerned with the effects of various vertical irregularities on the seismic response of a structure. The objective of the project is to carry out Response spectrum analysis (RSA) of vertically irregular RC building frame structure by the use of STAAD.PRO software of structure design. This study is limited to reinforced concrete framed structures subjected to seismic loads (dead load, live load and earthquake load). For this, RC frames of G+9 multi-story buildings are considered. All the frames are assumed to be located in zone V. The seismic parameters such as storey drift, base shear, peak story shear and top node displacement of irregular buildings are compared with that of a regular building. Result found from the response spectrum analysis that in irregular shaped building displacements are more than that of regular shaped building. The overall performance of regular building is found better than irregular building. This study may be used for designing new irregular building structures and for analyzing existing irregular building.

Keywords: setback building, vertical irregular, response spectrum analysis, story drift, displacement, base shear, peak story shear

I. INTRODUCTION

Earthquake is one of the most critical or we can say the most signal phenomenon for engineers from earlier since now and obviously to future, many researches and investigations with the help of technology is done and somehow the effect of earthquake is reduced but still we know that there is much work to do in earthquake especially for engineering. During earth motion mostly the waves which arise, effect on structures at the weak points of structure to collapse or damage the structure, in irregular structures these weakness points are define as mass irregularity, stiffness irregularity, strength irregularity in both horizontal and vertical directions, the behavior of irregular structures than regular is different during earthquake, in regular structures the distribution of mass stiffness and strength is uniform and there is no discontinuity in mass, stiffness and strength the structure works as a one part and face much lesser damage during earthquake. But, in irregular structures because of irregular distribution of mass, stiffness, strength, discontinuity and the un uniform load pattern or distribution these structures face more damages and even these structures collage or damages from these irregular points.

II. OBJECTIVES

As this study deals with structures which have vertical irregularity with setback and the objective which are carrying out are:

1) Linear static Analysis of regular structure by Response spectrum analysis using STAAD.PRO in term of story drift, displacement, peak story shear, base share.
2) Non-linear Analysis of vertical irregular building with setback spectrum analysis using STAAD.PRO in term of story drift, displacement, peak story shear, base shear.
3) Comparison of vertical irregular building with setback with regular building frame structure.

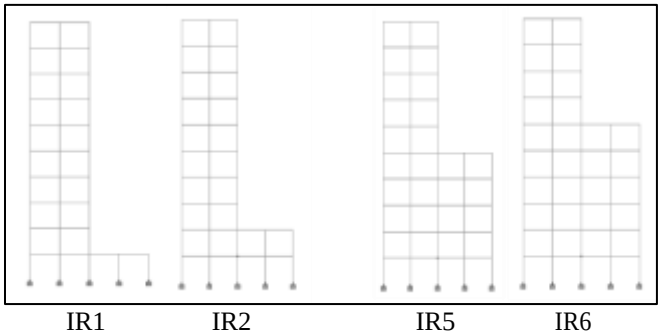
III. METHODOLOGY

The steps undertaken in the present study to be are as follow:

1) Study of literature review.
2) Select a set of one regular and nine vertical irregular building models with G+ 9 stories, with equal story height of 3m.
3) Perform response spectrum analysis by using STAAD.PRO for each of building models taken in this study.
4) Analysis and comparison of the results and outcomes of the analysis.
5) Detailed discussion on the result with the help of graphs and tables for each building models and reaching to the conclusion.

IV. STRUCTURAL MODELING

The height of the story is constant which is 3m, bay width is 4m in both x and z directions, with 4 number of bay in both directions. All irregular and regular building is modelled and analyzed using STAAD.PRO V8i SS6 software. Total nine vertical irregular building with setback, one regular building in considered in the resent study. Irregular frames are named as IR1, IR2, IR3, IR4, IR5, IR6, IR7, IR8, IR9 and RB.



IR1 IR2 IR5 IR6

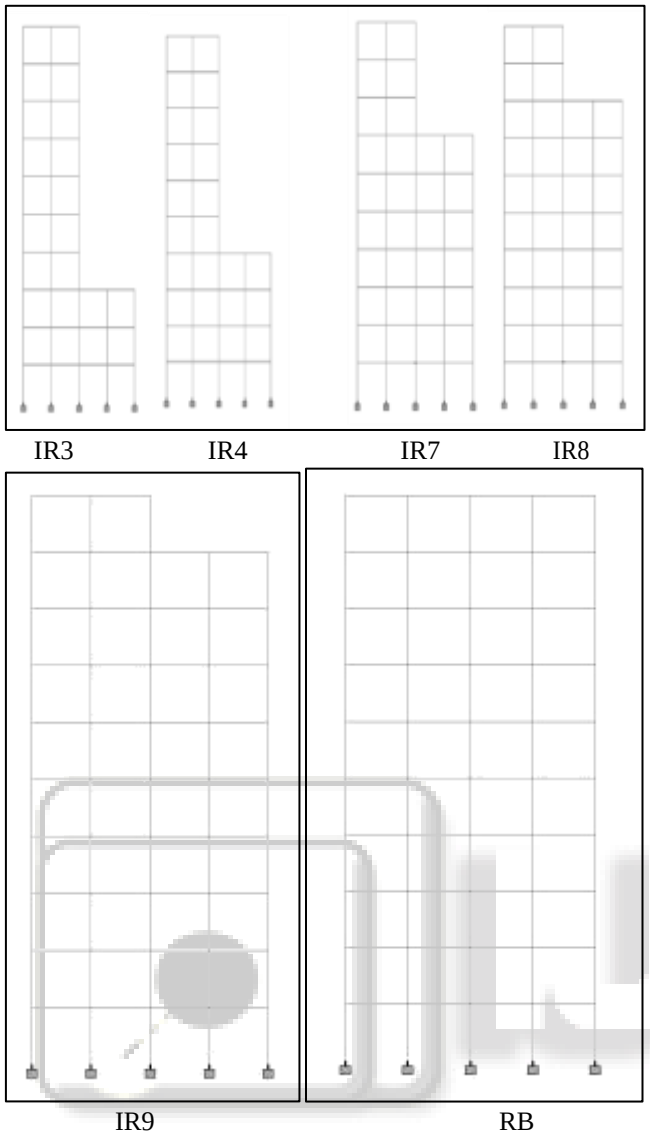


Fig. 1: Configuration of different building models

Seismic load corresponding to seismic zone 5 of IS 1893:2002 is considered for the analysis.

The properties of material and and building are shown below.

1) Material property

Concrete grade = M25

Density or concrete = 25 KN/m^3

2) Dimension of structural

elements Column size = 450mm x 450mm Beam size = 450mm x 300mm Slab thikness = 125mm

Story height = 3m

3) Seismic parameters

Zone : 5

Important factor : 1

Response reduction factor (R) : 5

4) Loads on building

Live load on floor = 3KN/m^2

V. Results and Discussion

Response spectrum analysis of all the models revels that setback effects significantly influence the seismic parameters. All parameters shows maximum value at the level of setback, the setback is mostly the main result of collapse of buildings,

The result shows that building is weak at the setback level when earthquake happens the response of vertical irregular building with setback is weak, and even it cause to collapse. Result of response spectrum analysis for IRs and RB are obtained and mentioned below.

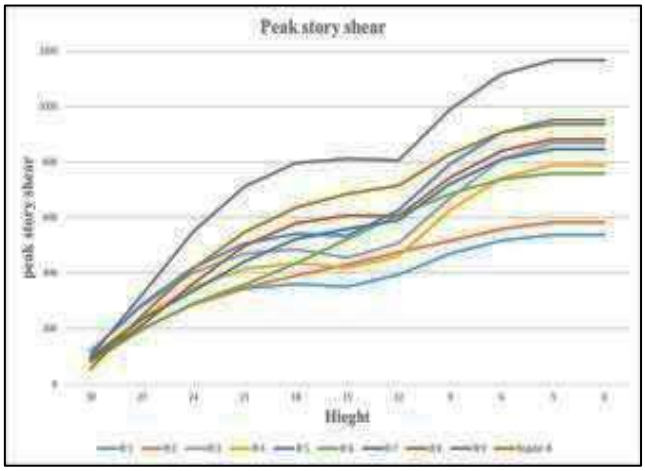


Chart 1: Peak story shear

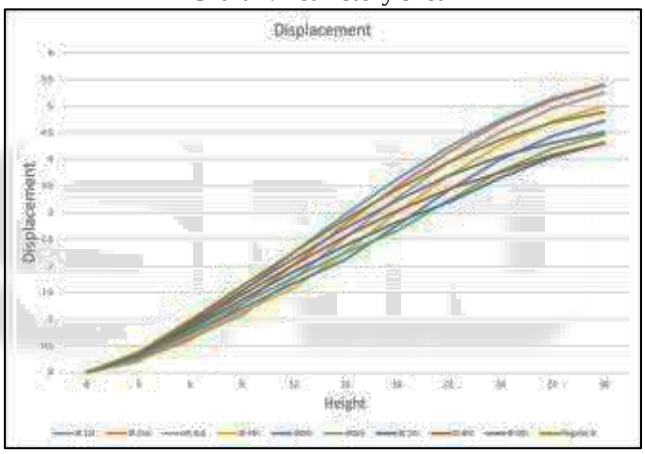


Chart 2: Displacement

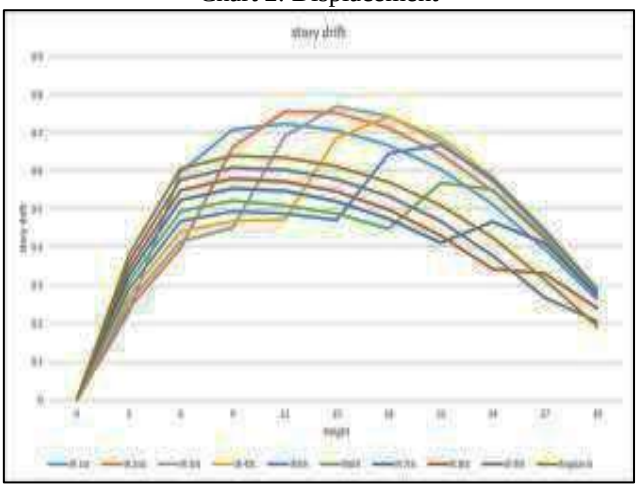


Chart 3: Story drif

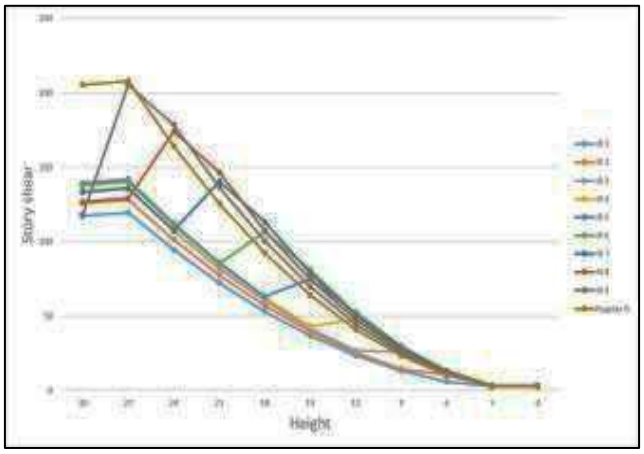


Chart 4: Story shear

VI. CONCLUSIONS

Based on thesis word done following conclusions can be express according seismic evaluation of building with setback.

1) Response spectrum method allows a clear understanding of the contributions of different modes of vibration. It is also useful for approximate evaluation of seismic reliability of structures.
2) For all vertical irregular frames with setback considered, displacement value for IR1, IR2, IR3, IR4, IR5, IR6, IR7, IR8 and IR9 at the level of setback increases, and the result shows that the top node displacement in case of irregular frames in more than that of the RB, except for IR5, IR6, IR7, IR8 and IR9.
3) Comparing the maximum base shear for both regular building and irregular building the maximum shear is obtained for regular building.
4) In case of setback irregular frames, a sudden extreme change in story drift due to setback has been observed, it indicates that in setback floor the story drift value extremely goes higher, while story drift for RB is normal. Peak story shear for irregular structures is less than regular structure but for IR 9 its higher than regular building.
5) The analysis shows that the vertical irregularities widely effect the performance of RCC buildings under seismic loading, as for as possible these irregularities must be avoided, but if it introduced they must be properly designed.

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