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Analytical Study of Soft Storey effect on Building with both Irregular Plan and Vertical Setback

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ABSTRACT: Soft first storey is a typical feature in the modern multi-storey constructions in urban India. Though multistoreyed buildings with soft storey floor are inherently vulnerable to collapse due to earthquake, their construction is still widespread in the developing nation like India. Setback structures are highly vulnerable during earthquakes due to its vertical geometrical and mass irregularity, but the vulnerability becomes higher if the structures also have stiffness irregularity in elevation. With the availability of fast computers and also Software usage in civil engineering has greatly reduced the complexities of different aspects in the analysis and design of projects. In this paper, seismic analysis of RCC buildings with vertical irregularity at different floor level is carried out. Further, a study is performed on a building with open ground storey and vertical Setback to highlight the importance of their presence in the seismic analysis using program in ETABs.

.KEYWORDS: Soft storey, Torsion, Shear wall, Setback, Response Spectrum Method, Base Shear, Lateral storey drift, Re entrant Corner.

I. INTRODUCTION

Soft storey building plays an important role in development of multistoried buildings in India. Functional and Social requirements to provide car parking space at ground level and for offices open stories at different level of structure far out-weighs the caution and warning against such buildings from engineering Fraternity. With the availability of fast computers systems and software usage in civil engineering has greatly reduced the complexities of different aspects in the analysis and design of projects. The present work has been made to study the seismic behaviour of soft storey building with different arrangement in soft storey building when subjected to static and dynamic earthquake loading.

II. LITERATURE REVIEW

A Literature review has been carried out on various studies of buildings with Soft Storey and seismic design parameters. A review of the work is presented below.

Pavithra R and Dr T.M.Prakash (2018) have studied soft storey effects at different Locations in vertical dimension of the Structure at multiple levels. In this paper, Author has studied optimum location of soft storey over the height of the building and optimum location of multi soft storey over the height of the building. Structural member with elastic deformation during Ground motion depend on capacity of member considered. Floors with soft storey deflection seen to be increased. Open first storey deflection found to be maximum in all the cases considered for analysis. The author concludes that RC frame buildings with open first storeys are known to perform poorly during in strong earthquake

Rahul Ghosh and Rama Debbarma (2017) carried out analysis of Setback Buildings with Open storey. Setback Structures are highly vulnerable during earthquake due to vertical irregularity and mass irregularity. It is aimed to mitigate this soft storey effect and the extreme responses, three individual mitigation techniques have been adopted and the best solution among these three techniques is presented. These structures were observed for differential movement of either sides of the structure, as the taller side moves more than the shorter side along the direction of force. It is aimed to achieve ultimate performance with a poor Configuration. Combination of stiffness, geometric and

elevation irregularity makes the structure highly vulnerable to Seismic forces. Differential movement of either sides of the Structure is observed. Infill wall consideration, 2.5 times Column design forces and RC filled steel tubes have been suggested to increase storey stiffness for the results analysed and studied.

Nakul Singh et al.(2017) has given a review of retrofitting methods for structurally deficient buildings. Buildings with soft storeys need special arrangement to avoid stresses in concrete Columns. These retrofit methods planned to avoid Local such as shear and reinforcement detailing and Global deficiencies such as Plan and Vertical irregularities. Column jacketing, Steel jacketing and FRP sheet wrapping are suggested methods to strengthen soft storey heights. Soft stories are subjected to larger lateral loads during earthquakes and under lateral loading. This lateral force cannot be well distributed along the height of structure. This situation causes the lateral forces to concentrate on the storey having large displacement. Its aim is to evolve strategies to assess the seismic susceptibility of reinforced concrete (RC) G+4 storeyed, dormitory buildings, located in Jaipur and to suggest retrofit measures for the structurally deficient buildings.

Sagar P. Jain, and Dr. M. N. Bajad (2017) carried out model analysis for buildings with set back with different heights considering different Seismic Zones. It highlights the effect of vertical irregularity on-base shear carrying capacity of a structure, time period, story displacement and drift under the severe zone of India. Subsequent floors in building step back towards the hill slope, resulting in unequal column height at a particular story causing stiffness irregularity in both directions. Model with Shear wall provision shows less storey displacement. Taller side behaves more flexible than shorter Face. Drift in building frames may be results of flexural and shear mode contributions, due to the column axial deformations. In the medium to high rise structures, the higher axial forces and deformations in the columns, and the accumulation of their effects over a greater height cause the flexural component of displacement to become dominant. the main objective of this paper is focused on the behavior of RC frame building on plain and sloping terrain under response spectra analysis.

III. METHODOLOGY

In this study, a comparative seismic analysis is done for multi-storeyed building of 20 storeys models with irregular plan and vertical setback. The result of this analysis will include base shear, lateral drift and displacement and finalise structural system depending on their analytical results. 1. In present research we have used two model of Multi-Storeyed Building having irregular plan, soft storey with and without vertical setback .2. Model the structure in E-TABS 3. Seismic analysis is done as per IS1893-2016. 4. Running the model in E-TABS. 5. Obtaining seismic parameters like base shear, lateral drift and displacement. 5. Observation and comparison of result. 6. Conclusion

IV. STRUCTURAL MODELLING

Modeling of frame structure-

Modeling of structure is done in standard software ETAB which is based on finite element method. the space frame of multi-storey building is prepared considering special moment resisting frame. Column base are assigned as fixed support, column and beam are model as line element, slab and shear wall are area section but are assigned as membrane.

Model-1: A multistorey frame building is taken into consideration. Building having a RCC members like slab, beams, and columns. Building having soft storey at ground floor.

Model 2: Building model similar as 1st model with Vertical Setback in Both directions.

V. PRELIMINARY DATA

Following are the data assumed for carrying out this study,

Two Model with 20 Storey height.

1. Model 1 with no vertical irregularity and Model 2 has setback at 10th and 15th floor .

2. Both have soft storey at Ground level

3. Floor Height: 3.2 m and Ground Floor Height: 5 m

Concrete Grade: M45.

Seismic Zone: III as per IS 1893:2016(Part1)



Response Reduction Factor: 4

Importance Factor: 1.2

VI. CONCLUSION

As by reviewing literature it can be concluded that Seismic effect of soft storey on Multi storeyed building has a major effect on behaviour. In this paper, an attempt has been made to highlight the importance of irregular layout, soft storey and setback in elevation which are architectural and space constraints that need to be addressed by design engineers. In such a situation, an investigation has been made to study the seismic behaviour of such building and develop guideline to minimise risk in such type of building. It can be concluded that analysis of multi-storeyed building has given an understanding of seismic behaviour which will be helpful to further research work.

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