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# Review on Behaviour of Soft Storey Effect in Building

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**ABSTRACT**: In high rise building or multi storey building, soft storey construction is a typical feature because of urbanization and the space occupancy considerations. These provisions reduce the stiffness of the lateral load resisting system and a progressive collapse becomes unavoidable in a severe earthquake for such buildings due to soft storey. This storey level containing the concrete columns which were unable to provide adequate shear resistance, hence damage and collapse are most often observed in soft story buildings during the earthquake. In the current study the focus is on the investigation of the effect of a soft storey on the behaviour of a structure and effect of masonry infill on structure.

**KEYWORDS**: Soft Storey.

## I. INTRODUCTION

Many urban multi storey buildings in India today have open ground story as an unavoidable aspect, basically to generate parking or reception lobbies. The upper storeys have brick infilled wall panels with various opening percentage in them. These types of buildings are not desirable in seismically active areas because various vertical irregularities are induced in such buildings which have performed consistently poor during past earthquakes. It has been known since long time that masonry infill walls affect the strength and stiffness of infilled framed structures. Infill walls are generally seen as a non-structural element and their effect is neglected by ignoring the stiffness of the infill wall during the modelling phase of the structure (analysed as a 'linear bare frame') leading to substantial inaccuracy in obtaining the actual seismic response of framed structures

## II. SOFT STOREY

Reinforced-concrete framed structure in recent time has a special feature i.e. the ground storey is left open for the purpose of social and functional needs like vehicle parking, shops, reception lobbies, a large space for meeting room or a banking hall etc. Such buildings are often called open ground storey buildings or soft story buildings.
Again when a sudden change in stiffness takes place along the building height, the story at which this drastic change of stiffness occurs is called a soft story. The Indian code (clause no. 4.20) classifies a soft storey as, It is one in which the lateral stiffness is less than 70 percent of that in the storey above or less than 80 percent of the average lateral stiffness of the three storeys above(IS 1893:2002). Soft storey can form at any level of a high rise building to fulfill required functional necessity and serve various.

## III. LITERATURE REVIEW

**M.R. Amin, P. Hasan. B.K. and M.A. Islam**, have been investigated the effect of soft storey for multistoried reinforced concrete building frame, four building models (3, 6, 9 and 12 storey) with identical building plan were analyzed. Equivalent diagonal struts were provided, as suggested in FEMA-273, in place of masonry to generate infill effect. Earthquake load was provided at each diaphragm's mass centre as a source of lateral load as set forth by the provision BNBC (1993). Soft storey level was altered from ground floor to top floor for each model and equivalent static analysis was carried away using ETABS 9.6.0 analysis package. Results show a general changing pattern in lateral drift irrespective to building height and location of soft storey. Inter-storey drift ratio was found increasing

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below the mid storey level and maximum ratio was obtained where the soft storey was located. The rate of increase in drift ratio at any particular floor (kept soft) for different building height increases linearly from bottom to top floor. As the building height increases, location of soft storey goes downwards from mid storey level to produce maximum lateral drift.

**A.S.Kasnale and Dr. S.S.Jamkar**, studied, The Seismic performance of soft basement of RC framed Buildings. The five reinforced RC framed building with brick masonry infill were designed for the same seismic hazard, in accordance with IS code. In the present paper an investigation has been made to study the behavior of RC frames with various arrangement of infill when subjected to dynamic earthquake loading. The result of bare frame, frame with infill, soft ground flour and soft basement are compared and conclusion are made in view of IS 1893(2002) code. It is observed that, providing infill below plinth improves earthquake resistant behavior of the structure when compared to soft basement.

**Jaswant N. Arlekar, Sudhir K. Jain and C.V.R. Murty**, highlight the importance of explicitly recognizing the presence of the open first storey in the analysis of the building. The error involved in modeling such buildings as complete bare frames, neglecting the presence of infills in the upper storeys, is brought out through the study of an example building with different analytical models. This paper argues for immediate measures to prevent the indiscriminate use of soft first storeys in buildings, which are designed without regard to the increased displacement, ductility and force demands in the first storey columns. Alternate measures, involving stiffness balance of the open first storey and the storey above, are proposed to reduce the irregularity introduced by the open first storey. The effect of soil flexibility on the above is also discussed in this paper.

**P.B.Lamb, Dr R.S. Londhe**, studied a building with the help of different mathematical models considering various methods for improving the seismic performance of the building with soft first storey. Analytical models represent all existing components that influence the mass, strength, stiffness and deformability of structure. The equivalent static and multimodal dynamic analysis is carried out on the entire mathematical 3D model using the software SAP2000 and the comparisons of these models are presented. Finally, the performance of all the building models is observed in high seismic zone V.

**Prof. Patil S.S. and Mr. Sagare S. D**., studied a building with open ground storey to bring out the importance of explicitly recognizing the presence of soft ground storey in the analysis. Usually the most economical way to eliminate the failure of soft storey by adding shear walls. The shear walls are one of the most efficient lateral force resisting elements in high rise buildings. This paper deals with occurring of soft storey at lower level at high rise building subjected to earthquake has been studied. Also has been tried to investigate on adding of shear wall to structures in order to reduce soft storey effect on seismic response of building.

**Dr. Saraswati Setia and Vineet Sharma** investigated the influence of some parameters on behavior of a building with soft storey. The modeling of the whole building is carried out using the computer program STAAD.Pro 2006. Parametric studies on displacement, inter storey drift and storey shear have been carried out using equivalent static analysis to investigate the influence of these parameter on the behavior of buildings with soft storey. The selected building analyzed through five numerical models.

**Mehmet Alper Altuntop** presented a paper in which the main objectives to carry out and determine the nonlinear behaviour of building structures with soft stories by utilizing nonlinear static pushover and time-history analyses for various deformation levels,Evaluation of the accuracy and efficiency of the nonlinear static pushover analysis by considering various lateral load patterns and Evaluation of the provisions that are defined in various earthquake codes for soft story irregularity.

**Nikhil Agrawal, Prof. P.B kulkarni, Pooja Raut** carried out analysis of masonry infilled r.c.frame with & without opening including soft storey by using “equivalent diagonal strut method. According to fema-273, & atc-40 which contain the provisions of calculation of stiffness of infilled frames by modelling infill as “equivalent diagonal strut method”. This analysis is to be carried out on the models such as bare frame, strut frame, strut frame with 15% centre &corner opening, which is performed by using computer software staad-pro from which different parameters are computed. In which it shows that infill panels increase the stiffness of the structure.

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## IV. CONCLUSIONS

- From the above it is seen that, when the effect of soft storey is considered then the deflection has increase at that particular floor.
- RC frame buildings with soft storeys are known to perform poorly during in strong earthquake shaking.
- The measures should take to improve capacities of the columns in the soft first storey.
- Since the behaviour of the soft storey is different during a quake, the structural member undergoes damage and to provide member to withstand that additional forces due to soft storey heavy or bulky member need to be provided.
- Investigators analysis numerically and use various computer programs such as Staad Pro, ETABS, SAP2000 etc. Calculation shows that, when RC framed buildings having brick masonry infill on upper floor with soft ground floors subjected to earthquake loading, base shear can be more than twice to that predicted by equivalent earthquake force method with or without infill or even by response spectrum method when no infill in the analysis model.
- An investigation has been made to study the seismic behaviour of such buildings subjected to earthquake load so that some guideline could be developed to minimize the risk involved in such type of buildings. It has been found earthquake forces by treating them as ordinary frames results in an underestimation of base shear.

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