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SEISMIC ANALYSIS OF RC FRAMED SOFT STOREY BUILDING: A Review

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Abstract - *This research represents the collection of data from various previous studies done on 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*

Key Words: *Soft storey, Static and dynamic analysis, Seismic loads, Multistory building, Seismic Analysis storey drift, storey shear, IS 1893:2002 provisions*.

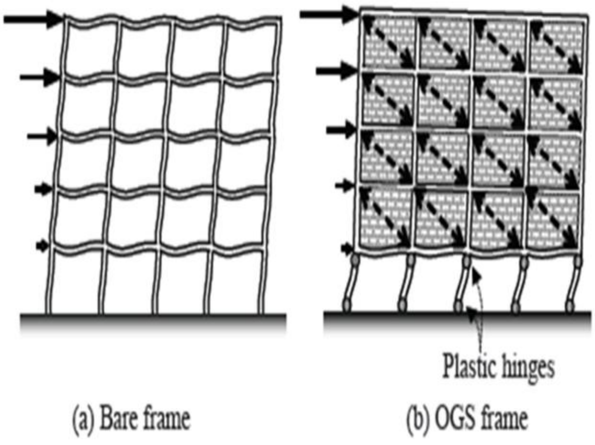
1. INTRODUCTION

Open ground storey (also known as soft storey) buildings are commonly used in the urban environment nowadays since they provide parking area which is most required. This type of building shows comparatively a higher tendency to collapse during earthquake because of the soft storey effect. Large lateral displacements get induced at the first floor level of such buildings yielding large curvatures in the ground storey columns. The bending moments and shear forces in these columns are also magnified accordingly as compared to a bare frame building (without a soft storey). The energy developed during earthquake loading is dissipated by the vertical resisting elements of the ground storey resulting the occurrence of plastic deformations which transforms the ground storey into a mechanism, in which the collapse is unavoidable. The construction of open ground storey is very dangerous if not designed suitably and with proper care. This paper is an attempt towards the study of the comparative performance evaluation of three OGS building case studies.

Fig (a) show open ground storey building

1.1 OPEN GROUND STOREY (OGS) BUILDINGS

The presence of infill walls in the upper storeys of the OGS building increases the stiffness of the building, as seen in a typical infilled framed building. Due to increase in the stiffness, the base shear demand on the building increases while in the case of typical infilled frame building, the increased base shear is shared by both the frames and infill walls in all the storeys. In OGS buildings, where the infill walls are not present in the ground storey, the increased base shear is resisted entirely by the columns of the ground storey, without the possibility of any load sharing by the adjoining infill walls. The increased shear forces in the ground storey columns will induce increase in the bending moments and curvatures, causing relatively larger drifts at the first floor level. The large lateral deflections further results in the bending moments due to the P-Δ effect. Plastic hinges gets developed at the top and bottom ends of the ground storey columns. The upper storeys remain undamaged and move almost like a rigid body. The damage mostly occurs in the ground storey columns which is termed as typical 'soft-storey collapse'. This is also called a 'storey-mechanism' or 'column mechanism' in the ground storey as shown in the figures below. These buildings are vulnerable due to the sudden lowering of stiffness or strength (vertical irregularity) in the ground storey as compared to a typical infilled frame building.



2. Literature Review

Sharany Haque and Khan Mahmud Amanat in 2008 , It was study reveals that such types of buildings should not be treated as ordinary RC framed buildings. It was found that calculation of earthquake forces by treating them as ordinary frames results in an underestimation of base shear. Calculation shows that, when RC framed buildings having brick masonry infill on upper floor with soft ground floor is 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. Since response spectrum method is seldom used in practice for the design of such buildings, it can be suggested that the base shear calculated by equivalent static method may at least be doubled for the safer design of the columns of soft ground floor.

P.B. Lamb and Dr. R.S. Londhe in 2012 , It was carried out on 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 was carried out on the entire mathematical 3D model using the software SAP2000and the comparisons of these models was presented. Finally, the performance of all the building models is observed in high seismic zone V.

Dr. Saraswati Setia and Vineet Sharma in 2012, 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. Soft storey behavior exhibit higher stresses at the columns and the columns fail as the plastic hinges are not formed on the investigates that the influence of some parameters on behavior of a building with soft storey. Parametric studies was displacement, inter storey drift and storey shear was 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.

Dande P. S. and Kodag P. B. in 2014 Soft storey or open ground storey is an unavoidable feature in the multi storey building. This was consider strength and stiffness to the building frame by modified soft storey provision in two ways, (i) By providing stiff column & (ii) By providing adjacent infill wall panel at each corner of building frame. Also study was carried out to compare modified soft storey provisions with complete infill wall frame and bare frame models.

Hiten L Kheni and Anuj K. Chandiwala in 2014 The displacement estimates of the codal lateral load patterns are observed to be smaller for the lower stories and larger for the upper stories and are independent of the total number stories of the models. The uniform lateral load pattern leads to over estimations of displacements for all of the model sand deformation levels. The estimations of the first mode lateral load pattern leads to more accurate displacement, the deviations on the results of this lateral load pattern decreases due to the existence of the soft stories as the number of stories and number of spans increase.

3. CONCLUSIONS

1. The most of the building during earthquakes in open ground floors are well known subject. In this economic factor is important and the construction of such buildings is unavoidable. In this investigations of such buildings during earthquake loads and minimize involved are there in such buildings.

2. In this type of structure masonary infill is found to be not as effective as shear walls, which are most effective in reducing the stiffness irregularity as shear walls increase the stiffness of first storey upto 80% and the moments are decreased by 50-60%.

3. Compare between the first storey and second storey. The first storey always increases at least 40 to 50% stiff as compare to second storey.

4. The displacement and deflections are much considered. In deflections large bending moment and shear force occurs in first storey in columns provide much difficulties. In upper storeys of such buildings provide more hardness than open ground storey as the stiffness of the first storey is more increased due to less displacement.

5. It has been observed that upper storey are much larger than lower storey and the lateral load pattern is always uniform and increase due to displacement is much more accurate.

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