Survey Paper on Seismic Analysis of Low-rise Soft Storey Frame Building

Ankita Pramod Shelke\textsuperscript{1}, Dr. Rajashekhar S. Talikoti\textsuperscript{2}
\textsuperscript{1}P.G. Student, \textsuperscript{2}Professor (H.O.D), Civil Engineering Department, Late G.N. Sapkal College Of Engineering, Maharashtra, India

Abstract-- There is a general practice of provision of a soft storey as a ground storey in a building for fulfilling functional requirements of community like parking lots, lobbies etc. A buildings with soft storey are inherently vulnerable to collapse during earthquake due to its reduced stiffness. Infill wall in frame building provides stiffness and alters the behavior of building under lateral loads. However, introduction of siporex infill wall in building will reduce the seismic weight of building and therefore reduce the effect of lateral loads on building. This stiffness contribution of masonry infill and siporex infill will be considered and introduced by equivalent stiffness strut with fixed end conditions. Considering above requirements, the study of seismic behavior of building in zone V. The parameters under the study are drift, frequency, base shear, and time period. The equivalent statics analysis is carried out for different finite element models to study the above parameters in ETAB software.

Keywords-- Soft Storey, Infill Wall, Equivalent Strut, Equivalent Static Analysis, ETAB.

I. INTRODUCTION

Due to increasing population since the past few years car parking space for residential apartments in populated cities is a matter of major concern. Hence the trend has been to utilize the ground storey of the building itself for parking. These types of buildings (Fig. 1) having no infill masonry walls in ground storey, but infilled in all upper storeys, are called Open Ground Storey (OGS) buildings. They are also known as ‘open first storey building’ (when the storey numbering starts with one from the ground storey itself), ‘pilotis’, or ‘stilted buildings’.

In other words, this type of buildings sway back and forth like inverted pendulum (Fig. 2) during earthquake shaking, and hence the columns in the ground storey columns and beams are heavily stressed. Therefore it is required that the ground storey columns must have sufficient strength and adequate ductility. The vulnerability of this type of building is attributed to the sudden lowering of lateral stiffness and strength in ground storey, compared to upper storeys with infill walls. The OGS framed building behaves differently as compared to a bare framed building (without any infill) or a fully infilled framed building under lateral load.

A bare frame is much less stiff than a fully infilled frame; it resists the applied lateral load through frame action and shows well-distributed plastic hinges at failure.

II. SCOPE AND OBJECTIVE

Open ground storey (OGS) buildings are commonly constructed in populated countries like India since they provide much needed parking space in an urban environment. Failures observed in past earthquakes show that the collapse of such buildings is predominantly due to the formation of soft-storey mechanism in the ground storey columns.
1. Different RC frame models are analyzed using equivalent static method and response spectrum method.
2. To study the effect of infill strength and stiffness in the seismic analysis of OGS buildings.
3. To assess the effect of support condition on the seismic behaviour of OGS buildings.

III. REVIEW OF LITERATURE

A research work on seismic behaviour of soft storey building has been done by many investigators research are:

H.R. Tamboli and U.N. Karadi (2012), Investigated the behaviour of different reinforced concrete (RC) frame building models using Equivalent lateral force method and the software ETABS is used for the analysis of all the frame models. The comparative study made for different models in terms of base shear, time period, natural frequency, storey drift. Conclude, the presence of infill wall can affect the seismic behaviour of frame structure to large extend and the infill wall increases the strength and stiffness of the structure for G+4 building.

Bhavavathula Lohitha and S.V. Narsi Reddy (2014) Investigate an existing RC framed building (G+3) with soft storey was analyzed for two different cases (a) considering both infill mass and infill stiffness and (b) considering infill mass but without considering infill stiffness using software SAP2000. Two different support conditions were considered to check the effect of support conditions in the multiplication factors. Linear and non-linear analysis were carried out for the models. Concluded that support condition influences the response considerably and can be important parameter to decide the force amplification factor.

Diana M. Samoila (2012), Investigated linear analysis of a masonry infilled concrete frame with a single storey and a single bay was carried out by modelling masonry infill through five different modelling techniques, and the results were compared so as to arrive at a rational modelling scheme for masonry infilled concrete frames.

Hiten L. Kheni and Anuj K. Chandiwala (2014) Investigated many buildings that collapsed during the past earthquake exhibited exactly the opposite strong beam weak column behaviour means columns behaviour means columns failed before the beams yielded mainly due to soft storey effect. For proper assessment of the storey stiffness of buildings with soft storey building, different models were analyzed using software. Concluded the displacement estimates of codal lateral load patterns are observed to be smaller for the lower stories and larger for the upper stories and independent of the total number stories of the models.

Amit and S. Gawande (2013), Investigate the seismic performance and design of the masonry infill reinforced concrete structure with a strong ground motion.

Jaswant N. Arlekar, Sudhir K. Jain and C.V.R. Murty (1997) Investigate the behaviour of reinforced concrete framed structures by using ETABS software. The nine models of building compare stiffness. Concluded such buildings will exhibit poor performance during a strong shaking. Solution to this problem is in increasing the stiffness of the first storey.

P.B. Lamb and Dr. R.S. Lonhe (2012) Analysis of multistoried building with soft first storey, located in seismic zone 4. It is intended to describe the performance characteristics such as stiffness, bending moment, drift. Concluded shear wall and cross bracings found to be very effective in reducing moment in the columns.

Narendra Pokar and Prof. B.J. Panchal (2013), Investigate the behavior of RC frames with the testing of scaled models is essential to arrive at optimal analytic model and special design provisions for such structures. Structure is modeled and analyzed using SAP platform including seismic effect. Concluded both steel and RCC model gives nearest result for full scale model.

Saraswati Setia and Vineet Sharma (2012), Analysis seismic response of RCC building with soft storey. Equivalent static analysis is performed for five different models by using computer software such as STAA Pro. Concluded minimum displacement for corner column is observed in the building in which a shear wall is introduced in X-direction as well as Z-direction.

Rakshith Gowda K.R and Bhavani Shankar (2014), Investigate the soft storeys are provided at different level for different load combinations and ETABS software for modeling and analysis RC buildings. Concluded the inter storey drift was observed to be maximum in vertically irregular structure when compared with that of regular structure.

A.S. Kasnale and Dr. S.S. Jamkar (2013), Investigate the behavior of five reinforced RC frames with various arrangement of infill when subjected to dynamic earthquake loading. Concluded providing infill wall in RC building controlled the displacement, storey drift and lateral stiffness.

IV. METHODOLOGY OF WORK

1) Review the existing literature and Indian design code provision for designing the OGS building.
2) Identification of need of research.
3) Formulation of stages in analytical work which is to be carried out. Data collection.
4) Analytical work of modelling is to be carried out using software.
5) Interpretation of results & conclusion.

V. CONCLUDING REMARK

RC frame building with open ground storey are known to perform poorly during strong earthquake shaking. Because the lateral stiffness is less than 70 percent of that in the storey above or less than 80 percent of the average stiffness of the three storeys above it causing the soft storey to happen. For a building that is not provided any lateral load resistance component such as bracing or shear wall, the strength is very week and easily fails during earthquake. In such cases, an investigation has been made to study the seismic behaviour of such buildings subjected to earthquake loads so that some guideline could be provide to minimize the risk involved in such type of buildings. Researchers use various computer programs such as Staad Pro, ETABS, SAP2000 etc. Calculation shows that, when RC frame building with masonry infill wall on upper floor with soft first storey subjected to earthquake loads, base shear can be more than twice to that predicted by equivalent earthquake force method with or without infill or by response spectrum method when no infill in the analysis of model.

REFERENCES