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Seismic Behavior of Multi-Storey Building With Soft Storey Considering Different Infill Materials: A Review

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ABSTRACT
Now a day's in RCC (Reinforced Cement Concrete) structure as an open first storey is generally provided for social and functional need in multistory building. They are used for parking, communicaton halls, intercourse hall or any other purposes. In RCC framed multistory building the walls are not considered as a part of structures, but from recent studies it shows that partition wall by using different infill materials helps to improve the strength of building against lateral load. An infill material provides stiffness to the RCC framed structures. Soft storey at different levels of multistory building is constructed. Investigations of past and recent earthquake damage have illustrated that the building structures are severe damage or collapse during moderate to strong ground motion. In this paper reviews various research works carried out by several researchers on seismic behavior of multi-storied buildings provided with different infill materials with soft storey.

Keywords: Multistory building, infill materials, seismic behavior, RCC frame.

I. INTRODUCTION

In a recent construction multistory building the soft story provided at base of building. A multi-story building with soft storey, one or more floors are "soft" due to structural design. Soft story buildings are characterized by having a story in which lot of open space such as parking, communication hall or large spaces or floors with a lot of windows [1] in which lateral stiffness is less than 70 percent of that in the storey above or less than 80 percent of the average lateral stiffness of three storey above in buildings [2]. Generally buildings are constructed in recent times considering a special feature - the ground storey is provides open for the purpose of parking, i.e. columns in the ground storey without any partition walls (of either masonry or RC) between them. Such buildings called as open ground storey buildings [3]. Upper stories have brick infill wall panel and open ground storey is provided in building is called as stilt building and the open storey is called as stilt floor or soft storey. A soft storey also known as weak storey [4]. The important reason behind the need is the buildings are designed to existing design codes well performance in earthquakes with respect to safety of human life, loss of economy, usage and extent of damage to structures. The repairing cost of for damaged structures is very high [5]. These soft storeys buildings are collapsed due to irregularities introduced in RC frame buildings. These irregularities are primarily because of uneven distribution of mass [6].

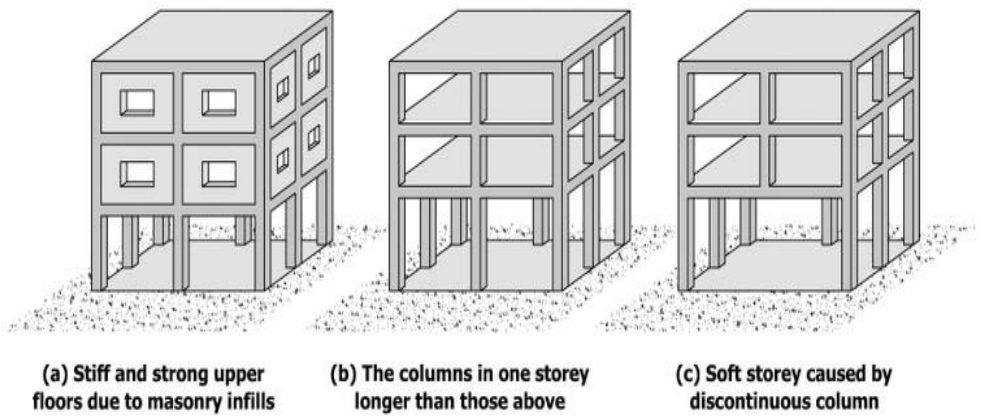

Fig.1 Multistory building with soft storey.

II. PRESENT STUDIES

There are many researches have been carried out to know seismic behaviour of multistorey building for different infill materials to find out the different parameters of building against different conditions.

Storeys of buildings that are significantly weaker or more flexible than adjacent storey are known as soft storey buildings, these are characterized by having a story which has a lot of open space. While the unobstructed space of the soft story might be aesthetically or commercially desirable. Soft-storey is also called as flexible storey. A large number of buildings with soft storey have been built in recent year, but it showes poor performance during earthquake. Structural capacity will reducing under lateral loads. Displacement and relative story drifts are affected by the structural regularities [1].

A large number of buildings with soft storey show weak performance during earthquake. The provided 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. The displacement and force demands (i.e. BM & SF) in the first storey columns are very large for building with soft ground storey. The configuration of infill in the parking frame changes the behavior of the frame [3].

Stiffness irregularity in vertical direction affects the behavior of building. Lightweight infill is very effective in reducing the stiffness irregularity and storey drift. Cross bracings significantly increases the first storey stiffness [4].

A seismic design is based on different performance objectives and related earthquake hazards [5].

Study is carried out to find out the performance of a building with soft storey at different level along with at ground level (GL). Nonlinear static pushover analysis is carried out. It obtains poor seismic performance of building with soft storey at different level along with soft storey at ground level. Displacement reduces when the soft storey is provided at higher level [6,7].

Concluded that when RC framed buildings having brick masonry infill on upper floor with soft ground floor is subjected to earthquake loading, base shear is more than twice to that predicted by equivalent earthquake force method with or without infill [8, 9,10].

Effects of nonstructural masonry infill on the earthquake response of reinforced concrete structure are investigated by considering reinforced concrete structures with different configuration of masonry infill to find the effects of irregular infill masonry structural performance. The diagonal strut model is adopted for modeling masonry infill. Numerical analysis is performed. The lateral stiffness of the soft story frame is large compared to bare frame and infilled frame [11].

Five reinforced RC framed building with brick masonry infill were designed for the same seismic hazard, in accordance with IS code. RC frame structures behavior with various arrangement of infill when subjected to dynamic earthquake loading providing infill below plinth improves earthquake resistant behavior of the structure when compared to soft basement. Provision of infill wall improves the performance of building in terms of displacement control, storey drift and lateral stiffness [12].

Infill in RCC structures play important role in enhancing the lateral stiffness of complete structures. The effect of infill wall is to change the predominantly a frame action of a moment resisting frame structure towards a truss action. Lesser base shear result gives lesser lateral forces. The response of a structure in terms of bending moments is greatly improved in an infill model. The bending moments is reduced greatly by the introduction of infill panels [13].

A structure combining the frame with the infill within the frame gives better lateral resistance potential. The walls may act as vertical bracing to transfer the lateral loads to the ground while the floors provide horizontal bracing to transfer the lateral loads [14].

The behaviour of RC frame with G+6 storey with different masonry infill such as complete filled (CF), Bared frame (BF), Soft storey (SS), Partially Infilled (PI) were analysed. The total multistirey building with soft storey for infilled materials. It shows that the filled frame gives least displacement at top and bottom, Soft Story give largest displacement [15].

Response reduction of cases ordinary moment resisting frame and special moment resisting frame values with deflection diagrams in static and dynamic analysis. The special moment of resisting frame structured is good as compare to ordinary moment resisting frame (OMRF) structure in resisting the seismic loads. Displacement in static analysis of OMRF values are more compared to that of dynamic analysis values of same columns [16].

The earthquake response of symmetric multistoried building is studied by manual calculation and with the help of ETABS 9.7.1 software. Gradually increases value of lateral forces from bottom floor to top floor [17].

First soft story of building in which the columns were unable to provide adequate shear resistance during the earthquake therefore shear walls and steel bracings at the first storey is required to provide. Inter-storey drift is minimum for shear

wall when comparing with other systems. Building with shear wall is maximum storey force than other systems [18].

The fundamental design concept of earthquake resistance design of structures is to make strong column- weak beam construction to ensure safety but many buildings that collapsed during the earthquake because of soft storey it behaves exactly opposite strong beam weak column behaviour means columns failed before the beams yielded. The buildings with soft storey are very susceptible under earthquake load which create disasters. displacement of lateral load patterns are obtained to be smaller for the lower stories and larger for the upper stories and are independent of the total number stories of the models. [19].

Behaviour of different RC frame building models using Equivalent lateral force method and the software ETABS is used for the analysis of all models. The comparative study made for different models in for base shear, time period, natural frequency, storey drift. Concluded presence of infill wall increases the strength and stiffness of the structure for G+4 building [20].

Infill wall in frame building provides stiffness and alters the behavior of building under lateral loads. Introduction of siporex infill wall in building will reduce the seismic weight of building and therefore reduce the effect of lateral loads on building. no bracing or shear wall for a building , then strength is very week and easily fails during earthquake [21].

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. From above it observs that infill panels increase the stiffness of the structure [22].

Study is carried out on effect of infill strength and stiffness in seismic analysis of OGS buildings by using commercial Etabs Software. Linear and Non-Linear analysis is carried out. infill wall in upper storeys increases column forces at the ground storey [23].

Due to infill walls in the High Rise Building top storey displacement is reduces. Base shear is increased. The presence of non-structural masonry infill walls helps to improve seismic behavior of R.C.C Framed High Rise building. In case of infill having irregularities in elevation damage occur at level where change in infill pattern [24].

Dynamic analysis of the building models is performed in ETABS. It obtains that the steel bracing system at open bottom storey effectively contributes to the structural stiffness and reduces the maximum inter story drift, lateral displacement of R.C.C building [25].

The infill walls in all the upper stories except ground storey makes the upper stories much stiffer as compared to the open ground storey. Thus the upper stories move almost together as a single block and most of the horizontal displacement of the building occurs in the soft ground storey itself and hence the ground storey columns are heavily stressed. When glass is used as infill material in the ground storey for aesthetics other than brick masonry infills, the building becomes weak in that storey. lateral deflection and drift affects the entire building [26].

Finding the best place of soft stories in high rise buildings. As soft storey moves towards higher level the intensity of hinge formation becomes lower and lower and at the same time displacement increases and also increases base shear [27].

The seismic analysis of midrise building with soft storey to study the performance of building and subsequently adopting the control measures to reduce the effect of soft storey like that storey drift, storey displacement, forces, bending moment and time period. Bracing is better option to reduce soft storey effect in case of construction cost. [28].

Applied Element Method is used to study the behavior of infill frames. One, two and three storey frames with and without openings are also analyzed to understand the differences in drift ratios and the strength of the frame, bare frame carries lesser drift when compared to the frame with infill. This clearly shows that the infill wall effectively participates in resisting the lateral forces along with the RC frame. Number of storeys increases, the strength of the bare frame increases, alternately whereas the strength of the frame with infill decreases [29].

Response spectrum analysis has been carried out using STAAD. Pro software to understand the seismic behavior of open ground storey RC framed building. An investigation has been made to study the behavior of RC frames with both ALC block and conventional clay bricks infill when subjected to dynamic earthquake loading. The performance of ALC block infill was superior to that of Conventional brick infill in RC frame [30].

III. CONCLUSIONS

Based on the studies literature so far carried out by several researchers following conclusions can be drawn.

1) Infill materials increase the seismic resistance to the building.
2) Lightweight infill is very effective in reducing the stiffness irregularity and storey drift.

3) Infilled frame gives least displacement at top and bottom, Soft Story give largest displacement.

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