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A CRITICAL REVIEW: SEISMIC BEHAVIOUR OF FIRST SOFT STOREY EFFECT IN R.C.C BUILDING

LAVANYA P[1],MONISHA M[1], SATHIYA K[1], VANITHA R[1], RAMYA S[2], MATHIYALAKAN. R[3]

[1] UG Scholar at BHARATHIYAR INSTITUTE OF ENGINEERING FOR WOMEN.DEVIYAKURICHI.

[2] ASST. PROFESSOR, BHARATHIYAR INSTITUTE OF ENGINEERING FOR WOMEN.DEVIYAKURICHI.

[3] ASST. ENGINEERING MANAGER, L&T CONSTRUCTION,CHENNAI.

Email Id:k.sakthi511298@gmail.com, monishacivil53@gmail.com.

ABSTRACT

With urbanization and rising unbalance of required space to accessibility, it isbecoming very important to provide open earth storey in commercial and residentialbuildings. Functional and Social need to provide car parking space at ground level andfor offices open story at different level of organization far out-weighs the warning against such buildings from engineering community. These provisions reduce the inflexibility ofthe lateral load resisting structure and a progressive subside becomes inescapable in astrict earthquake for such buildings due to elastic storey. Soft storey behavior revealhigher stresses on the columns and the columnare unsuccessful as the forced hinges are not formedon predetermined position. Therefore, the vulnerability of soft storey consequence has causestructural engineers to rethink the design of a soft storey structure in areas of far above the groundseismicity. The near analytical studies investigate the influence of some parameters on activitiesof a building with elastic storey. In the current study the focus is on the investigation of the effect of a soft storey on the behavior of a structure and effect of masonry infill on structure.

Keywords— Multistory building, Seismic Analysis, Storeyfloat, Storey shear, Soft story,equal static analysis, Storey dislocation, Time stage Forces, winding moment.

1. INTRODUCTION

Reinforcedconcreteframebuildings are becoming progressivelycommon in India.Due to increasing population since the past few years so that car parking space for residential apartments in populated cities is a matterof major problem. So that constructions of multistoried buildings with open first storey is a common practice in all over world. Hencethe trend has been to utilize the ground storey of the building itself for parking or reception lobbies in the first storey.

The two distinct characteristic of the building having stilt parking are as follows -

1. Difference in flexibility, i.e. the relative horizontal displacement in the ground storey is much larger thanupper story having both columns

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as well aswall.Thisflexiblegroundstoreyis also called softstorey.

2. Ground storey having only columns are weaker thanupper storey having both column and walls i.e. thelower storey can bear the horizontal earthquake forceless efficiently than the upper storey.

A yieldingstorey is also acknowledged as a weak storey or stilt storey. It is astorey in a building with significantly less stiffness than thestories above or beneath. It also has inadequate shearresistance and ductility to refuse to accept the earthquake forces. These features are highly discarded especially when thestructure is constructing in high seismic zone. IS 1893:2002defines the elastic story as the single in which the lateralstiffness is less than 70% of that in the story directlyhigher than, or less than 80% of combined stiffness of threestories above. The Masonry infill walls are normally used in thestructure and measured as a non-structural component. Belowthe seismic excitations, the presentation of structure ismostly affected by such non-structural elements. Thestiffness contribution of infill walls can be careful inanalysis by equivalent strut approach. The soft storey hasinsufficient lateral load fight due to its reducedstiffness.

2. SOFT STOREY BEHAVIOR

Many building structure having parking or commercial areasin their first stories, suffered major structural damages andcollapsed in the recent earthquakes Fig.1 & Fig.2. Large open areas with lessinfill and exterior walls and higher floor levels at the groundlevel result in soft stories and hence damage. In suchbuildings, the stiffness of the lateral load resisting systems atthose stories is quite less than the stories above or below. InFig.3, the failure mechanism of a building with asoft storey under lateral loading is shown.

Soft first storey collapsed, upper part of the building fall onto the ground, (kachchh, 2001)

Fig.1 Soft Storey Collapse

Soft Storey (Open Plinth), Vertical Split between two blocks (Bhuj)

Fig.2 Soft Storey Collapse

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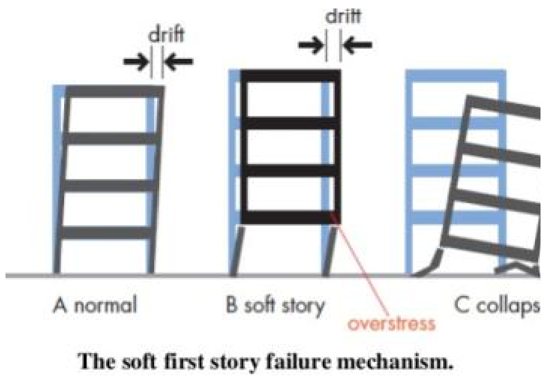

Fig.3 Soft Storey Collapse

3. REVIEW OF LITERATURE

A significant amount of research work on seismic behavior of soft storey building has done by many investigators research area Such as

[1] 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 arrangements 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 observedthat, providing infill below plinth improves earthquake resistant behavior of the structure when compared to softbasement.

[2] D. B. Karwar and Dr. R. S. Londhe(2014), Investigate the behaviour of Reinforced Concrete framed structures by usingnonlinear static procedure (NSP) or pushover analysis in finite element software "SAP2000".and the Comparative study made fordifferent models in terms of base shear, displacement, performance point. Concluded base shear is minimum for bare frame andmaximum for frame with infill for G+8 building.

[3] SharanyHaque and Khan Mahmud Amanat (2009), Investigate the effect of masonry infill in the upper floors of a buildingwith an open ground floor subjected to seismic loading. The number of panels with infill is varied from bare frame condition (zeropercent infilled panels) and 10, 30, 50 and 70 percent of panels with infill on the upper floors and Comparison of base shear.Concluded the design shear and moment calculated by equivalent static method may at least be doubled for the safer design of thecolumns of soft ground floor.

[4] SevalPinarbasi and DimitriosKonstantinidis(2007), Investigate the hypothetical base-isolated building with a soft groundstory. Comparison is made with how soft-story flexibility affects the corresponding fixed-base building. Concluded performance of asoft-story building, is also effective in particularly reducing the seismic demand (i.e., interstory drift) on the soft-story level, which isthe primary cause of catastrophic collapse in these types of buildings.

[5] Nikhil Agrawal, Prof. P.B kulkarni, PoojaRaut, carried out analysis of masonry infilled RC frame with & withoutopening including soft storey by using "equivalent diagonal strut method. According to fema-273, & atc-40 whichcontain the provisions of calculation of stiffness of infilled frames by modelling infill as "equivalent diagonal strutmethod". 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 arecomputed. In which it shows that infill panels increase the stiffness of the structure.

[6] Dr. SaraswatiSetia and VineetSharma,investigated the influence of some parameters on behavior of a building withsoft 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 staticanalysis to investigate the influence of these parameter on the behavior of buildings with soft storey. The selectedbuilding analyzed through five numerical models.

[7] G.V. Mulgund and D.M. Patil(2010), Investigate the behaviour of RC frames with various arrangement of infill whensubjected to dynamic earthquake loading and result of bare and infill frame are compared. Concluded masonry infill panels in theframe substantially reduce the overall damage.

[8] A. Wibowo and J.L. Wilson, (2009), Analysis an analytical model has been made to predict force-displacement relationship ofthe tested frame. The experimental investigation the load deflection behaviour and collapse modelling of soft storey building withlateral loading. Concluded the large drift capacity of the precast soft storey structure was attributed to the weak connections whichallowed the columns to rock at each end.

[9] SharanyHaque and Khan Mahmud Amanat (2009), Investigate the effect of masonry infill in the upper floors of a buildingwith an open ground floor subjected to seismic loading. The number of panels with infill is varied from bare frame condition (zeropercent infilled panels) and 10, 30, 50 and 70 percent of panels with infill on the upper floors and Comparison of base shear.Concluded the design shear and moment calculated by equivalent static method may at least be doubled for the safer design of thecolumns of soft ground floor.

[10]Mr.D.Dhandapany(2014), Investigate the seismic behaviour of RCC buildings with and without shear wall under different soilconditions. Analyzed using ETABS software for different soil conditions (hard, medium, soft). The values of Base shear, Axial forceand Lateral displacement were compared between two frames. Concluded the design in STAAD is found to be almost equal results tocompare in ETABS for all structural members

3. CONCLUSION

RC frame buildings with soft story are known to perform poorly during in strong earthquake shaking. Because the stiffness at lowerfloor is 70% lesser than stiffness at storey above it causing the soft storey to happen. For a building that is not provided any lateralload resistance

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component such as shear wall or bracing, the strength is consider very weak and easily fail during earthquake. In sucha situation, an investigation has been made to study the seismic behaviour of such buildings subjected to earthquake load so that someguideline could be developed to minimize the risk involved in such type of buildings.

From the above it is seen that, when the effect of soft storey is considered then the deflection has increase at thatparticular floor.It has been found earthquake forces by treatingthem as ordinary frames results in an underestimation of base shear. Investigators analysis numerically and use various computerprograms such as Staad Pro, ETABS, SAP2000 etc.

Calculation shows that, when RC framed buildings having brick masonry infill onupper floor with soft ground floors subjected to earthquake loading, base shear can be more than twice to that predicted by equivalentearthquake force method with or without infill or even by response spectrum method when no infill in the analysis model.

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