A REVIEW ON SEISMIC IMPACT ANALYSIS IN MULTI- STOREY BUILDING USING INFILL

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Abstract

The term "soft-story" refers to at least one level of a building that's significantly more flexible or weak in lateral load resistance than the stories above it and also the floors or the inspiration below it (70% or greater reduction from one floor to the subsequent in keeping with the fashionable, International codification (IBC) definition). This condition can occur in any of the standard construction types and is usually related to large openings within the walls or an exceptionally tall story height compared to the adjacent stories. These soft stories can present a really serious risk within the event of an earthquake, both in human safety and financial liability. In present scenario soft story building are generally provided . Primarily to come up with parking or reception lobbies. These varieties of buildings are highly undesirable in seismically active areas because various vertical irregularities are created in such buildings which have consistently performed very poor during past earthquake . The presence of infill walls within the entire upper storeys except within the ground storey makes the upper storeys rather more stiffer than the open ground storey. Thus the upper storeys move almost together as one block, and most of the horizontal displacement of the building occurs within the soft ground storey itself and hence the bottom storey columns and beams are heavily stressed.

The objective of the thesis is to check the effect of infill strength and stiffness within the seismic analysis of mid rise open ground storey building. An existing RC framed building (G+7) with open ground storey located in Seismic Zone-IV is taken into account for this study. This building is analysed for 2 different cases (a) considering both infill mass and infill stiffness and (b) considering infill mass but without considering infill stiffness by equivalent static and response spectrographic analysis methods. Infill weights are modelled through applying static load and also the infill stiffness is modelled by equivalent diagonal strut approach. The results indicates that the magnification factor of two.5 is simply too high to be multiplied to column forces of the bottom storey of the given mid-rise open ground storey building. it's found that the infill panels increases the stiffness of the upper storeys of the structure, thereby increasing the forces, displacement, drift and ductility demand within the soft ground storey. this may possibly become the reason for failure for an open ground storey buildings during the earthquake.

Keywords— Response spectroscopic analysis, Equivalent static analysis ,Seismic design principle, structure modelling , Non-linear dynamic ,soft storey , infill wall, varying infill, lateral load

I. INTRODUCTION

A soft story building may be a multi-story building within which one or more floors have windows, wide doors, large unobstructed commercial spaces, or other openings in places where a shear wall would normally be required for stability as a matter of earthquake engineering design. A typical soft story building is an apartment house of three or more stories located over a ground level with large openings, like a parking garage or series of retail businesses with large windows. concrete frame buildings became common kind of construction with masonry infills in urban and semi urban areas within the world. The term infilled frame denotes a composite structure formed by the mix of an instant resisting plane frame and infill walls. The infill masonry could also be of brick, concrete blocks, or stones. Ideally in nowadays the ferroconcrete frame is filled with bricks as non-structural wall for partition of rooms thanks to its advantages like durability, thermal insulation, cost and straightforward construction technique

Many such buildings constructed in recent times have a special feature - the bottom storey is left open, which suggests the columns within the ground storey don't have any partition walls between them. This styles of buildings having no infill masonry walls in ground storey, but having infill walls altogether the upper storeys, are called as ‘Open Ground Storey (OGS) Buildings’),. This open ground storey building is additionally called as building with ‘Soft Storey at Ground Floor’. they're also referred to as ‘open first storey building’ (when the storey numbering starts with one from the bottom storey it self ‘pilotis’ or ‘stilted buildings’. Open first storey is now a day’s unavoidable feature for the foremost of the urban multi-storey buildings because social and functional needs for vehicle parking, shops, reception etc. are compelling to produce an open first storey in high rise building. Parking floor has become an unavoidable feature for the foremost of urban multi-storeyed buildings because the population is increasing at a really fast rate in urban areas resulting in crisis of car automobile parking space. Hence the trend has been to utilize the bottom floor of the building itself for parking purpose

Severe structural damage suffered by several modern buildings during recent earthquakes illustrates the importance of avoiding sudden changes in lateral stiffness and strength. Recent earthquakes that occurred have shown that an oversized number of existing concrete buildings are at risk of damage or maybe collapse during a powerful earthquake. While damage and collapse thanks to soft story are most frequently observed in buildings, they'll even be developed in other sorts of structures. The lower level containing the concrete columns behaved as a soft story in this the columns were unable to supply adequate shear resistance during the earthquake. there's significant advantage of this sort of buildings functionally but from seismic performance point of view such buildings are considered to possess increased vulnerability. within the current apply of structural design in India infill walls are considered as non-structural components and their strength and stiffness contribution are neglected. The effect of infill panels on the response of ferroconcrete frames subjected to seismic action is well-known and has been subject tovarious experimental and analytical investigations over last five decades.

During an earthquake motion, the soft story behavior is predicated on the factors that the bottom motion will search for all possible weakness within the structure. This weakness could also be a pointy variation within the stiffness, ductility or within the strength parameters. These variations end in the poor distribution of masses throughout the ground, which itself is undesirable.

Fig. 1.1: Building with soft storey

Many structural damages recorded because of earthquake had a serious problem of change in stiffness and strength along their vertical configuration. it's not only essential to own symmetry along the horizontal direction, i.e. within the plan, but also within the vertical direction. this can be an element that assures lateral stiffness. Abrupt changes within the vertical plan should be avoided to the utmost.

II .OVERVIEW OF WORK

The methodology followed out to achieve the above-mentioned objectives is as follows:

(i) Review of the present literatures by different researchers and also by the Indian design code provision for designing the OGS building
(ii) Selecting the building models for the case study.
(iii) Modelling of the chosen buildings with and without considering their infill strength and stiffness. Models must consider the above mentioned two styles of end support conditions.
(iv) Performing nonlinear analysis of the chosen building models and a comparative study on the results obtained from the analyses.
(v) Finally the observations of results and discussions

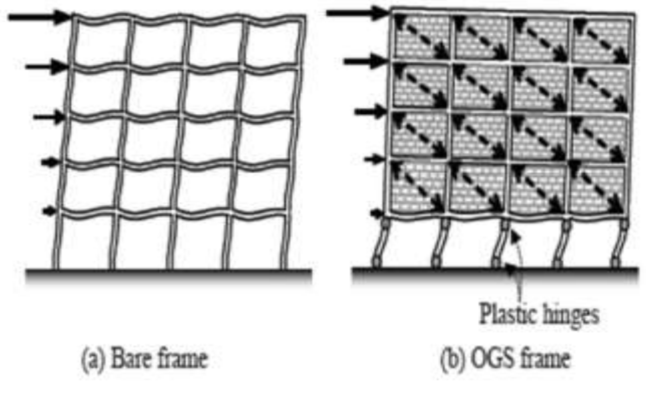

Fig. 2.1: showing difference in behavior between bare, infill and OGS building frame

III. LITERATURE REVIEW

Infill is generally considered to be the non-structural elements, inspite of its significant contribution of lateral stiffness and strength against the lateral load resistance of the frame structures. Conversely, there's a general misconception among the designers that the infill will increase the general lateral load carrying capacity. this could result in undesirable performance of the instant resisting frames because the infill which wasn't considered during design stage would modify the inherent properties of the concrete frame members. As a consequence, failure in numerous forms would be the result because of additional loads on the stiffened members.

Sattar and Abbie (in 2010) in their study concluded that the pushover analysis has showed a rise in initial stiffness, strength, and energy dissipation of the infilled frames, as compared to the bare frames, despite the wall's brittle failure modes. Similarly, dynamic analysis results indicates that fully-infilled frames has rock bottom collapse risks and therefore the bare frames were found to be the foremost prone to earthquake-induced collapses. the higher collapse performance of fully-infilled frame was related to the larger strength and energy dissipation of the systems, related to the added walls.

J. Dorji and D.P. Thambiratnam (2009) concludes that the strength of infill in term of its Young's Modulus (E) has significant influence on global performance of the structures. The stresses within the infill wall decreases with increase in (E) values because of increase in stiffness of the models. The stresses varies with building height for a given E and seismic hazard.

Hashmi and Madan (2008) conducted non-linear time history and pushover analysis of OGS buildings. The study concluded that the MF prescribed by IS 1893(2002) for such buildings is adequate for preventing collapse. D Menonet. al. (2008) concluded that the MF increases with the peak of the building, primarily thanks to the upper shift within the fundamental measure. Also when large openings are present and thickness of infills is a smaller amount, there's a discount in MF. The study proposed a multiplication factor ranging from 1.04 to 2.39 because the number of storey will increases from four to seven

Kaushik (2006) conducted a comparative study of the seismic codes particularly on the look of infilled framed structures. The study concealed that the foremost of the trendy seismic codes lack the vital information required for the planning of such buildings. Moreover, the relevant clauses of codes aren't consistent and vary from country to country. Such variations were attributed to the absence of an adequate research information on important structural parameters like determination of natural period of vibration of infilled structures, soft storey phenomenon related to the presence of infill, exclusion of strength and stiffness of infill and considerations of openings. the most reason of not considering the beneficial effects of the infill is because of variation in material property further as brittle nature of failure.

Doudoumis (2006) studied the importance of contact condition between the infill and frame members on one storey finite element model. He reported that the interface condition, friction coefficient, size of mesh, relative stiffness of beam to column, relative size of infill wall have significant influence of the response of infilled frame, whereas the effect of orthotropy of infill material was reported to be insignificant. which means that the infill may be treated as homogeneous material. When the mesh density was made finer the strain pattern among the infill was conjointly improved, with the utmost values of stresses at the compressive corners. The existence of friction coefficient at the interface was reported to extend the lateral stiffness of the system. However, friction coefficient relies on the standard of fabric and workmanship, which is difficult to define accurately. The response parameters were also exaggerated with the stiffness of frame and infill and thus the relative size of frame and infill plane. However, this study was conducted for one storey model under monotonic loading, thus, it's necessary to conduct similar studies for more number of stories under earthquake load.

IV. NEED FOR THE PROPOSED WORK

The presence of infill walls in upper storeys of open ground storey (OGS) buildings accounts for the following issues:

i) Will increases the lateral stiffness of the building frame.

ii) Decreases the natural period of vibration.

iii) Increases the bottom shear.

iv) Increases the shear forces and bending moments within the groundfloor columns.

The present study try to estimate typical variations in magnification factor of a midrise open ground storey building accounting for the variability of compressive strength and modulus of elasticity of infill walls with numerous infill arrangements in order that it can facilitate designers facing trouble with heavy designs for a structure of midsize, with the given material properties, geometry and loadings specifically

V. OBJECTIVE OF THE WORK

The objectives of the study as follows:

i) to review the effect of infill strength and stiffness within the seismic analysis in soft storey building.

ii) to test the effect of varying the infill arrangements on the analysis results by taking various combinations of infill thickness, strength, modulus of elasticity and openings.

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