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Analytical Study on Seismic Performance Of Rc Frames In-Filled With Masonry Walls Using E-Tabs

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Abstract

Moderate and severe earthquakes have struck different places in the world, causing severe damage to reinforced concrete structures. Earthquake often effect the bond between the structural elements and masonry in-fills of the building. Masonry in-fills are often used to fill the voids between horizontal and vertical resisting elements of the building frame. An infill wall enhances considerably the strength and rigidity of the structure. It has recognized that frames with in-fills have more strength and rigidity in conditions comparison to the bared frames. Hence the studies about the behavior of 3D-RC frames with or without masonry in-fills are necessary.

1.Introduction

It comes under the thrust area of natural hazards mitigation. The stimuli, which prompted the submission of the project proposal is colossal loss of man and material in Bhuj and Khillari earthquakes.The earthquake is a phenomenon that releases high amount of energy in a short time through the earth. Structures designed to resist moderate and frequently occurring earthquakes must have sufficient stiffness and strength to control deflection and prevent any possible collapse. In other words, a structure not only should dissipate a considerable amount of imported energy by ductile behavior, but also it should be able to control the deformations and transfer the force to foundation through enough lateral stiffness in ground motion. From the observations of damages of the past earthquakes, it is hard to digest the loss of greater number of human lives and to the properties. So this is due to the lack of proper design and understanding construction technique among both public and engineering domain. In order to thrive the knowledge on seismology, forums like NICEE-National Information Centre for Earthquake Engineering, NEEE-National Program for Earthquake Engineering Education has been constituted by the ministry of HRD, India. The buildings, which had already been constructed is susceptible to face more seismic risk, due to the increased seismic vulnerability, hence proper evaluation of the building against seismic hazards is absolutely necessary.

The rapid industrialization and increase in population have called for optimum use of scarce land due to which multi-storey building have become inevitable. Apart from dead and live loads, the structures have to withstand lateral forces. Under the action of natural wind and earthquake a tall building will be continually buffeted by gusts and other dynamic forces.From the extensive review of literature carried out, it has been found that no experimental work on single-bay, multi-storey R.C.C frame subjected to lateral loading has been done so far. In the project work an experimental work was carried out on a two bay, three storey R.C frame subjected to lateral loading. The load points were located at first storey level.

Masonry infill walls are frequently used as interior partitions and exterior walls in low or middle rise RC buildings. In the design and assessment of buildings, the infill walls are usually treated as non-structural elements and they are ignored in analytical models because they are assumed to be beneficial to the structural responses. Therefore their influences on the structural response are generally ignored. However, their stiffness and strength are not negligible, and they will interact with the boundary frame when the structure is subjected to ground motions. This interaction may or may not be beneficial to the performance of the structure.

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Most reinforced concrete(RC) frame buildings in developing countries are in-filled with masonry walls. Experience during the past earthquakes has demonstrated the beneficial effects as well as the ill-effects of the presence of infill masonry walls. In at least two moderate earthquake (magnitude 6.0 to 6.5 and maximum intensity VIII on MM scale) in India, RC frame buildings with brick masonry in-fills have shown excellent performance even though most such buildings were not designed and detailed for seismic response.

2. Literature Review

Shaharbon P.S et al (2014) conducted a "Study On Behavior Of RC Frame With Infill Walls Under Seismic Loads Using E-TABS". This paper deals with the performance of masonry in-filled RC frames under brick wall condition. Analytical investigations were conducted under cyclic loading. Five different types of models were analyzed with four different in-filled conditions. The parameters studied were time period, natural frequency, base shear and storey drift. The results furnished were in case of open storey frame structure, the storey drift is very large than upper storey that may cause collapse during strong earthquake. And so, infill frames will be better to prefer in seismic region and also it results having a less displacement.

Haroon Rasheed Tamboli et al(2014) presented a paper on "Seismic Analysis Of RC Frame Structure With And Without Masonry Infill Walls". This paper deals with the frames with three different infill configurations subjected to dynamic loading. The seismic analysis is performed using equivalent lateral force method and equivalent strut method using E-TABS software. The parameters discussed were time period, natural frequency base shear and storey drift. This paper results that the in-filled frames increases the storey drift and also infill frame increases the strength and stiffness of the structure.

S.Niruba et al(2014) presented a paper on "Analysis Of Masonry Infill In A Multi-Storied Building". This paper deals with the structural effect of brick infill when it is not considered generally in the design of columns and also in other structural elements. Non-linear static analyses were performed on the structural models of the building for both bare framed and in-filled one. And also it explains about the brick walls have significant in-plane stiffness of the frame against lateral load. And it was concluded that there is a significance of infill in increasing the strength, stiffness and frequency of the entire system and that depends on the position and amount of infilling. And also it was noted that the lateral deflection was reduced significantly in in-filled frame compared to the deflection of the frame without infill.

Md. Irfanullah et al(2013) conducted a study on "Seismic Evaluation Of RC Framed Buildings With Influence Of Masonry Infill Panel". This paper deals with study on behavior of RC frames and to observe the effect of masonry infill panel, it is modeled as an equivalent diagonal strut using E-TABS. In order to study, six RC framed buildings with brick masonry in-fills were designed with different configurations, subjected to earthquake loading and comparison of results is made between them. The results observed were, providing infill below plinth and in swastika pattern in the ground floor improves earthquake resistant behavior of the structure when compared to soft storey. And it was concluded that the provision of infill wall enhances the performance in terms of storey displacement and storey control and increase in lateral stiffness.

P.B Kulkarni et al (2013) suggested a paper on "Linear Static Analysis Of Masonry In-filled RC Frame With And Without Opening Including Open Ground Storey". In this paper, symmetrical frame of building (G+5) located in seismic zone III is considered. With reference to FEMA 273 and ATC 40 the provision of calculation of stiffness of in-filled frames by modeling infill as an equivalent diagonal strut method. And the frames were subjected to linear static analysis performed using STAAD PRO and different parameters were computed. The results obtained from this study was it shows that infill panels increases the stiffness of the structure and while the increase in the opening percentage leads to decrease on the lateral stiffness of in-filled frame.

Mulgund G.V (2012) investigated a paper on "Seismic Assessment Of RC Frame Buildings With Brick Masonry In-fills". Is this paper deals with five reinforced RC framed building with brick infill were designed foe seismic hazard in accordance with is code taking into consideration of effect of masonry. And also investigation has been made to study the behavior of RC frames with various configuration of infill when subjected to dynamic earthquake loading. The comparison is made between the results of bare frame and frame with infill effect. The results furnished were the calculation of earthquake forces by treating RC frames as ordinary frames without

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regards to infill leads tom under estimation of base shear. Therefore it is essential for the structural system to be selected with in-filled walls

Wackchaure M.R et al(2012) published a paper on "Earthquake Analysis Of High Rise Buildings With And Without In-filled Walls". In this study, for the analyses G+9 RCC frames building is modeled and effect of masonry walls on high rise building is studied. Linear dynamic analysis on high rise building with different is carried out. Earthquake time history is applied to the models and various cases of analysis are carried out using E-TABS. Base shear, storey displacement, storey drift is calculated and compared with models. The results concluded that the infill walls reduce displacement, time period and increases base shear. And so it is essential to consider the effect of masonry infill for the seismic evaluation of moment resisting reinforced concrete frame.

G.C Manos et al (2012) presented a paper on "The Behavior of Masonry Assemblages and Masonry In-filled RC Frames Subjected to Combined Vertical and Horizontal Seismic Type Loading". In this study the masonry in-filled reinforced concrete frames are subjected to combined vertical and horizontal loads. And to validate different modeling techniques for the numerical simulation of non linear behavior of masonry joints under shear loading. And also it examined the influence of different forms of interface between the masonry infill and the surrounding RC frame and also examines the influence of stiffness, load bearing capacity. From the analysis it is observed that numerical simulation of masonry in-filled RC frames having their infill repaired with reinforced plasted and there is a increase in stiffness strength and energy dissipation due to presence of partially reinforced masonry in-fills.

Kashif Mahmud et al (2010) presented a paper on "Study The Reinforced Concrete Frame With Brick Masonry Infill Due To Lateral Loads". This paper studies about the behavior of reinforced concrete frames with brick masonry infill for various parametric changes and their influence in deformation patterns of the frame were observed. And also it deals to find the effect of soft storey on frame structures due to horizontal loading. The analysis of the frame structures is carried out by using ANSYS 5.6. And this analyses results that when the number of bay increases the deflection eventually decreases. And also it is found that when the beam and column size increases the deflection pattern decreases with increased stiffness. And it recommends to analyze the cost-benefit to find out the relative economy that may be achieved if infill is considered as a structural element.

Ozgur Anil et al (2007) performed a study on "An Experimental Study On Reinforced Concrete Partially In-filled Frames". This paper studies the behavior of partially in-filled reinforced concrete frames subjected to lateral cyclic loading. And also it investigates the behavior of ductile reinforced concrete frames strengthened by introducing partial in-fills. The test results that partially in-filled RC frame exhibits significantly higher ultimate strength and higher initial stiffness than bare frame. And also it is observed that the aspect ratio of infill wall was increased, the lateral strength and rigidity were also increased. And it shows that the partial infill walls both connected to the column and beam of the frame showed the most successful behavior.

3. conclusion

- The presence of the in-fill wall increases the strength and stiffness of the structure.
- A considerable difference in the base shear, time period, natural frequency and storey drift is observed between bare frame and in-filled frame.
- Top storey displacement is reduced due to presence of infill walls.
- The presence of infill walls alters the displacement and base shear of the building.
- When bare frames are subjected to cyclic loading they failed in displacement.
- In-filled frames have about 70% higher strength than the bare frames.
- The lateral stiffness are increasing with addition of infill to the frames.
- The behavior of fully in-filled frame is most favorable for all seismic regions.
- The displacement increases with storey height.
- The infill walls reduce displacement, time period and increases base shear.
- When the aspect ratio of infill wall was increased, the lateral strength and rigidity were also increased.
- When the partial infill walls are connected to both column and beam of the frame it shows the most successful behavior.

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