Juluri Bhavani* et al.
(IJITR) INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY AND RESEARCH
Volume No.6, Issue No.6, October - November 2018, 9023-9025

Study On RC Framed Structure By Comparing Infill Walls And Shear Walls Numerical Method

JULURI BHAVANI
M. Tech student, Dept of CIVIL, AVN Institute of Engineering and Technology, Hyderabad, TS, India.

T AJITH
Assistant Professor, Dept of CIVIL, AVN Institute of Engineering and Technology, Hyderabad, TS, India.

Abstract: **An improper configuration of masonry infill walls in RC frame may lead to short column effect on the columns, which is harmful to the seismic behavior of the structure. In this study, a bare frame and two single-stories, single-bay RC frames, partially infilled with masonry, were tested under cyclic loading. The failure mechanism and seismic performance of these partially infilled RC frames (with an infill height of 600 mm) with different types of connections were analysed. Based on the experiment, nonlinear finite element simulation and analysis were conducted to study the effects of the infill walls and connections. The results show that both mechanical performance and failure mode are affected by the infill height, the type of connection between the frame and the infill, and the ratio of shear bearing capacity of the frame column to that of the infill. For the masonry-infilled frame with rigid connection, the higher the infill wall is, the lower the shear bearing capacity ratio will be. Thus, the effect of the lateral constraint of the infill wall on the column increases, and the shear span ratio of the free segment of the column decreases, resulting in the short column effect. Based on the analysis results, a value of 2.0 is suggested for the critical shear bearing capacity ratio of the frame column to the infill wall. If the shear bearing capacity ratio is less than 2.0 and the shear span ratio of the column free segment is not more than 2.0, the short column effect will occur. For the infilled frame with flexible connection, both the lateral constraint from the wall to the column and the wall-frame interaction decrease; this reduces or prevents the short column effect. The conclusion can present guidance for the design and construction of masonry-infilled RC frame structure.**

Keywords: **Infilled; RC Frame Structure; Single-Bay RC Frames; Masonry;FEM;**

I. INTRODUCTION:

A large number of earthquake investigations have revealed that nonstructural members, especially the masonry infill walls, may have a large influence on the seismic behavior of the main structure. In some cases, the effect may be positive, but in other cases the masonry infill walls may cause more serious damage to the framed structure. In the recent decades, extensive studies have been conducted on this topic using model experiments or numerical analysis. During an earthquake, failure of structure starts at points of weakness. This weakness arises due to discontinuity in mass, stiffness and geometry of structure. The structures having this discontinuity are termed as Irregular structures. Irregular structures contribute a large portion of urban infrastructure. Vertical irregularities are one of the major reasons of failures of structures during earthquakes. For example structures with soft storey were the most notable structures which collapsed. So, the effect of vertically irregularities in the seismic performance of structures becomes really important. Height-wise changes in stiffness and mass render the dynamic characteristics of these buildings different from the regular building. IS 1893 definition of Vertically Irregular structures Earthquake resistant design of reinforced concrete buildings is a continuing area of research since the earthquake engineering has started not only in India but in other developed countries also. The buildings still damage due to some one or the other reason during earthquakes.

II. RELATED STUDY:

As Bangladesh lies within an active seismic zone, it is exigent to determine the earthquake force on a structure and run a proper seismic analysis. Bangladesh national building code, BNBC provides guidance for seismic analysis of structures, which is based on static analysis. Though static analysis is simple, it cannot provide accurate result like dynamic analysis. Moreover considering structural component like infill wall in analysis shows different result than bare frame analysis. In this study bare frame and other two different configuration of infill frames (100% infilled and irregularly infilled) have been considered (Shown in Fig 3). Both static analysis and dynamic analysis (response spectrum analysis and time history analysis) have been carried for all frames. The main objectives of this study were to review and compare static and dynamic analysis of different frames and also investigate and compare the performance of different frames when subjected to seismic force. In this paper the numerical relationship between infill wall existence in a frame structure and the overall structural response in case of seismic loading is investigated. The existence of infill walls in frame structures as well as their contribution to the seismic response has been a major point of study from various researchers in the past in an attempt to establish the relationship between the frame lateral load capacity and the existence of frame infill. This fundamental research has further been enhanced with tests and observations of actual buildings during earthquakes.

III. METHODOLOGY AND MATERIALS:

Three single-story, single-bay masonry-infilled RC frames were tested under low reversed cyclic loading. The masonry infill wall was built with fly-ash thermal insulation consisting of a hollow block of grade MU3.5 and masonry mortar of type M5. Concrete types of grades C30 and C20 was used for fabrication of the RC frames and core columns, respectively. The stirrups and longitudinal bars of the RC frames were made of HPB300 and HRB335, respectively. The axial compression ratio of the frame columns was 0.25. For the specimen with flexible connection, a gap of 30 mm between the walls and the frames was reserved to meet the displacement angle of the weak layer in the case of frequent earthquakes and rare earthquakes, and the gap was infilled with 32 mm thick polystyrene foam boards between the walls and the frames. According to the design codes, shear walls cannot be used as both gravity and seismic bracing systems; in fact, very tight criterions should be satisfied. A seismic bracing system, conceptually, should have a level of ductility; therefore the decrements of the bracing elements ductility under axial loads should be considered in conceptual design. In this tower, it seems that designer assumed main walls as a seismic bracing system and sidewalls to carry gravity loads. This tower has a considerable behavior complexity because of its especial geometric specifications such as high aspect ratio of sidewalls (about 9), especial architectural plan form and some unknown facts about coupled wall system behavior. To quantify effects on gravity load distribution due to mentioned facts, numerical models of the tower assuming different number of stories over the foundation were developed. Based on analysis results, main walls bear about 35% up to 60% of gravity loads varying with the story.

Fig.3.1.Expermental Test setup.

IV. EXPERIMENTAL ANALYSIS:

The longitudinal bars of the frame yielded first at the ends of the beam and columns at the drift ratio of $\Delta = h/200$ (h = 1380 mm). With the increase in amplitude, plastic hinges developed at the ends of the beam and columns. Yielding of stirrups was not observed during the entire test. Thus, the failure mode of this specimen was a typical flexural failure.

Fig.4.1. Specimen PF.

Because of the stiffness effect of the infill wall on the column, at the drift ratio of $\Delta = h/300$, the longitudinal bars yielded first at the ends of the beam prior to the columns. At the drift ratio of $\Delta = h/100$, diagonal cracks appeared at the lower part of the frame column, and the stirrups yielded. These phenomena occurred owing to the presence of the infill wall that was rigidly connected to the frame. Then, the longitudinal bars of the columns yielded at the lower part at the drift ratio of $\Delta = h/70$.

Fig.4.2. Specimen GFW.

As the gaps were infilled with polystyrene foam boards, the stiffness effect and the constraint effect of the infill wall on the column decreased, and hence the longitudinal bars yielded at the ends of the beam and the column at the drift ratios of $\Delta = h/200$ and $\Delta = h/100$, respectively. Subsequently, plastic hinges developed progressively at the ends of the beam and the column with the increase in cyclic load. As there was no yielding of stirrups during the entire test, the failure mode of this specimen was a typical flexural failure. Because of the minor thrust between the frame and the wall, the masonry suffered only minor damage.To sum up, for the specimen with rigid connection, the wall-frame interaction may give rise to additional shear on the frame column, which affects the failure modes and makes the structure vulnerable to damage under seismic action. For the specimen with flexible connection, the additional shear and short column effect can be reduced or even avoided. In this experiment, the infill wall which was rigidly connected to the RC frame did not have a significant effect on the behavior of the frame column because of the low strength of the infill wall. Otherwise, the short column effect may occur in the frame columns.

Fig.4.3. Specimen RFW.

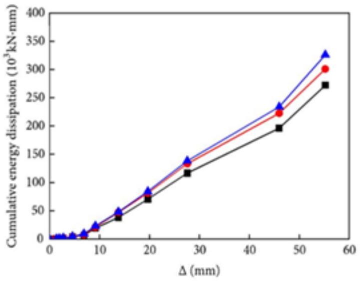

Fig.4.4. Graphical flow graph.

After yielding, however, the behaviors of the specimens were slightly different from each other. For specimens PF and GFW, the hysteresis loop became bow-shaped initially, and the energy dissipation increased; when the maximum load was reached, pinching effect was significant, and the bearing capacity as well as the energy dissipation capacity decreased. It may be noted that the area bounded by the hysteresis loop of specimen GFW was larger than that of specimen PF, implying higher energy dissipation at the same drift ratio. Finally, the hysteresis loop of specimen PF had a reversed S-shape, while that of specimen GFW had a shape lying between bow-shape and reversed S-shape. It can be inferred that the energy dissipation capacity of the structure improved because of the infill wall. For specimen RFW, the pinching effect was not significant initially owing to the flexible connection. Hence, the hysteresis loop was basically bow-shaped, and the area bounded by the hysteresis loop was large. On reaching the maximum load, the pinching effect could be observed, and the loop had a shape lying between spindle-shape and bow-shape. Compared with specimen GFW, the energy dissipation capacity of specimen RFW had improved.

V. CONCLUSION:

The infill wall can increase the strength, stiffness, and ductility of the frame structure. However, in the case of a partially infilled frame with rigid connection, when the masonry strength and the infill height are increased, the ductility of the frame structure may decrease owing to short column effect. The infill height and the shear bearing capacity ratio of the frame column to the infill wall have influence on mechanical performance and failure modes of the frame column. In the case of rigid connection between the wall and frame, with the increase in and decrease in ξ, the lateral restraint on the frame column increases, and the shear span ratio of the free segment of the frame column decreases; this results in short column effect and leads to the occurrence of brittle shear failure. A value of 2.0 is suggested for the critical shear bearing capacity ratio ξ_0. When $\xi < 2.0$ and the shear span ratio of the free segment of the column $\lambda \leq 2.0$, short column effect will occur, and hence appropriate measures should be taken to avoid failure.(iii)The mechanical performance and failure modes of the frame column are affected by the connection mode between the wall and frame. With flexible connection, the interaction between the wall and frame is insignificant, and the lateral constraint from the wall to the frame is weakened, which reduces or eliminates the short column effect that occurs in case of rigid connection, resulting in a better seismic performance.

VI. REFERENCES:

[1] BSI (British Standards Institution). 1997. Essential Use of Concrete, Part 1: 1997—Code of Practice for Design additionally, Construction. BS 8110-1: 1997. London: BSI.

[2] Makunza, J. K. 2006. "Program for the Analysis of Plane Backings." Tanzania Journal of Engineering and Development (1): 1-16.

[3] Wong, M. B. 2009. Plastic Analysis and Design of Steel Structures. Amsterdam: Butterworth-Heinemann.

[4] The Institution of Structural Engineers. 2000. Manual for the Design of Reinforced Concrete. London: The Association of Structural Engineers.

[5] Buchanan, G. 1995. Restricted Element Analysis. USA: Schaum's Outlines.

[6] BSI. 1985. Essential Use of Plain Masonry. BS 5628 Segment 1. London: BSI.

[7] Hendry, A. W., Sinha, B. P., and Davies, S. R. 2004. Plan of Masonry Structures. Third Edition of Load Bearing Brickwork Design. London: Taylor and Francis.

[8] Moldovan, M. D. 2012. "The Behavior of Reinforced Strong Frames with Masonry Infills." Ph.D. hypothesis, Staff of Civil Engineering, Technical University of Cluj-Napoca, Romania.