iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** V **Month of publication:** May 2017

DOI:

www.ijraset.com
IC Value: 45.98
Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Seismic Performance of Different Types of Infills – A Review

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Abstract: Masonry infilled RC frame buildings are commonly constructed for commercial, residential and industrial buildings in seismic regions. The main aim of these papers investigates the seismic performance of different types of infills. Three types of masonry infills were used, which included solid concrete blocks (SCB), hollow concrete blocks (HCB) and reinforced masonry. The effect of spacing of reinforcement and effects of providing external reinforcement are studied. ANSYS 15 software is used for modeling and analysis.

Keywords: Infilled RC Frame, Masonry infill, Seismic Performance

I. INTRODUCTION

Infill panels are usually considered as non- structural elements. The complex interaction between bounding frame and infill panels are ignored in many cases. But previous studies show that the strength and bracing action of infill have considerable effects on the performance of infilled frames. Strength and stiffness are more for infilled frames, when compared with the bare frame. Lateral deflection, displacement and bending moment of the frame is reduced by adding infills, it also increases the axial forces in column, thus reduced the chances for collapse. In seismically active zones reinforced masonry walls are commonly used. The amount of reinforcement depends on the intensity of seismic loads. Current design codes considering the influence of solid clay brick infill panels. Due to good properties of lightweight, thermal insulation, sound insulation and higher construction efficiency, some new masonry materials are widely used in new-built frame buildings, such as hollow concrete blocks and aerated concrete blocks. Various studies were carried out on the mechanical, thermal and sound installation properties of new masonry materials. But studies on their structural performance are very less. Considering the distinguished difference between clay masonry infill and new masonry infill, it is necessary to carry out research on the seismic performance of frame infilled with new masonry infill.

II. ANALYSIS

Non linear cyclic analysis is carried out to measure the seismic performance of infilled frame. Lateral displacements are calculated for each drift ratio, and it is applied along the longitudinal axis of the top beam with reversals. Masonry SPD Protocol (porter 1987) is used

III. LITERATURE REVIEW

Various literatures reviewed on the topic, seismic performance of different types of infills are described below.

A. Ajay Chourasia, S. K. Bhattacharyya, N. M. Bhandari, Pradeep Bhargava (2016)

This paper presents an experimental study of seismic performance of unreinforced, reinforced and Confined Masonry. Building typologies were 3.01X 3.01 m in plan and 3 m in height, having exactly similar material, geometry, and construction practices. This paper focuses on the analysis of experimental results in terms of lateral load capacity, stiffness degradation, and energy dissipation capacities. The failure mode observed were, sliding of brick at mortar unit interface, discrete shear cracks in masonry wall, crushing of the masonry units and bending of reinforcement in tie columns. Out of the tested specimens, confined masonry building gives good results; it exhibited large initial stiffness, higher strength, ductility, energy dissipation capacity and low level of structural damage.

B. Quanxian Huang, Zixiong Guo, J.S.Kuang (2016)

This paper presents an experimental study of the seismic performance of a category of reinforced concrete (RC) frame with weak infill panel and the complicated interaction between bounding frame and infill panel at different loading stages. Infilled RC frame specimens, were designed in accordance with the provisions of Chinese seismic code (GB50011-2001), were tested under reversed cyclic loading. Aspect ratio and type of materials are the parameters under study. The masonry infill used were, solid clay bricks (SCB), Hollow concrete blocks (HCB) and aerated concrete blocks (ACB).From the results it was concluded that both bare frame

Volume 5 Issue V, May 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

and infilled frame exhibit good seismic performance in terms of energy dissipation and strength.

C. Andreas Stavridis, P B Shing (2010)

.This paper investigates pertinent issues on the development and calibration of nonlinear finite-element models for assessing the seismic performance of infilled RC frame. The modelling scheme considered here combines the smeared and discrete crack approaches to capture the different failure modes of in filled frames, including the mixed-mode fracture of mortar joints and the shear failure of RC members. The accuracy of the nonlinear finite-element models has been evaluated with experimental data. From the comparison of numerical and experimental results, it was concluded that the model can successfully capture the nonlinear behaviour of physical specimens and accurately predict their strength and failure mechanisms.

D. Andre Furtado, Hugo Rodriues,Antonio Arede ,HumbertoVarum (2015)

Infill masonry (IM) walls when subjected to earth-quakes, they tend to interact with the surrounding RC (reinforced concrete) frames, which resulting different failure modes depending on the combination of the in-plane and out-of-plane behaviour. Full-scale IM walls were tested with the realization of three experimental (cyclic and monotonic) out-of-plane tests with and without previous in-plane damage. The experiments, material characterization and the test setup will be described in this paper as well as presenting and discussing the main test results, namely in terms of hysteretic force–displacement curves, damage evolution, stiffness degradation and energy dissipation. The failure modes observed in each of the tests reveal a different out-of-plane behaviour of the IM walls with and without previous in-plane damage. The tests on original IM walls showed vertical cracking, with detachment between the infill panel and the surrounding RC frame in the top and bottom joints. For the test with previous in plane damage, detachment was observed between the infill panel and the surrounding top beam and columns.

E. Ovidiu Boleu (2015)

This paper investigates the seismic behaviour of infilled frame structures and analyses the seismic response using dynamic non linear analysis. The results discussed with respect to the displacement demand of the elements and masonry behaviour. The results demonstrate that the presence of masonry infill changes the dynamic characteristics of RC buildings, and increases structural resistance against seismic action, thus reduces the deformation and damage of structural elements.

F. Ahmed Sayed Ahmed Tawfik Essa, Mohamed Ragai Kotp Badr,Ashraf Hasan El-Zanat (2013)

This paper investigates the behaviour and ductility of high strength reinforced concrete frames with infill wall, under the effect of cyclic load. Four frame specimens were used for the study. Change panel of frame from non infill to infill, change in thickness of infill wall and change in type of bricks are the parameters under study. The frame dimensions are selected to represent half scale frames and are tested under cyclic loading. The main conclusions are the lateral load resistance for infilled frames with infill wall with red bricks, thickness 12, 6 cm and cement bricks 12 cm, respectively was greater than the bare frame by about 184%, 61% and 99%, respectively. The ductility factor for infilled frames was less than that of the bare frame. The percentage decreases in ductility factor were about 57%, 51% and 46%, respectively.

G. Vladimir G. Haach, Graca Vasconcelos, Paulo B Lourenco (2010)

This paper proposed an innovative system with combination of horizontal and vertical trussed reinforcement for Reinforced concrete masonry walls. Static cyclic tests carried out on panels with appropriate geometry. The different variables impacting the in-plane cyclic behaviour of concrete masonry walls, such as the horizontal reinforcement, pre compressions, and masonry bond pattern, were talked about. Failure modes and force versus displacement diagrams were developed and from which the seismic performance is evaluated based on the ductility and energy capacity dissipation. From the results it is concluded that the stiffness and brittle lateral behaviour of the masonry walls get increased with the increase in pre compression .The presence of horizontal reinforcement guarantees better control and better distribution of cracking, regardless of minor increment of lateral strength was found in the specific testing program.

H. R. Allouzi, A. Irfanoglu,G. Haikal(2014)

This study was to investigate the ability of numerical non-linear finite element modelling to predict the performance of RC frames infilled with masonry wall. ABAQUS 6.11-1 were used to develop the 3D non-linear finite element models. It has ability to model Strength and stiffness degradation. It also simulates various types of in-plane failure modes of infilled frames under monotonic and cyclic loadings. Continuum material models are used for concrete, steel, mortar, and bricks elements and cohesive-friction interfaces

Volume 5 Issue V, May 2017
ISSN: 2321-9653

along mid-thickness of mortar bed joints. Hysteresis models of infilled RC frames developed are failed by shear.

I. Eurocode6(1996)

This code discussed about the design of reinforced masonry. The criterion for selecting the proper diameter, spacing, and area of horizontal and vertical reinforcement is discussed, and the specifications for selection of grout, arrangement of bricks are also discussed.

IV. CONCLUSIONS

Study of various literature paper the infilled frame has good seismic performance than that of the bare frame. Seismic performance is measured in terms of stiffness and energy dissipation .The values of lateral load resistance, stiffness and energy dissipation are higher for infilled frame than the bare frame. Considering the effects of different types of infill on seismic performance, hollow concrete block has poor performance. Failure modes observed were sliding of brick at mortar unit interface, shear cracks and crushing of masonry unit. Better control and better distribution of cracking is observed with reinforced masonry.

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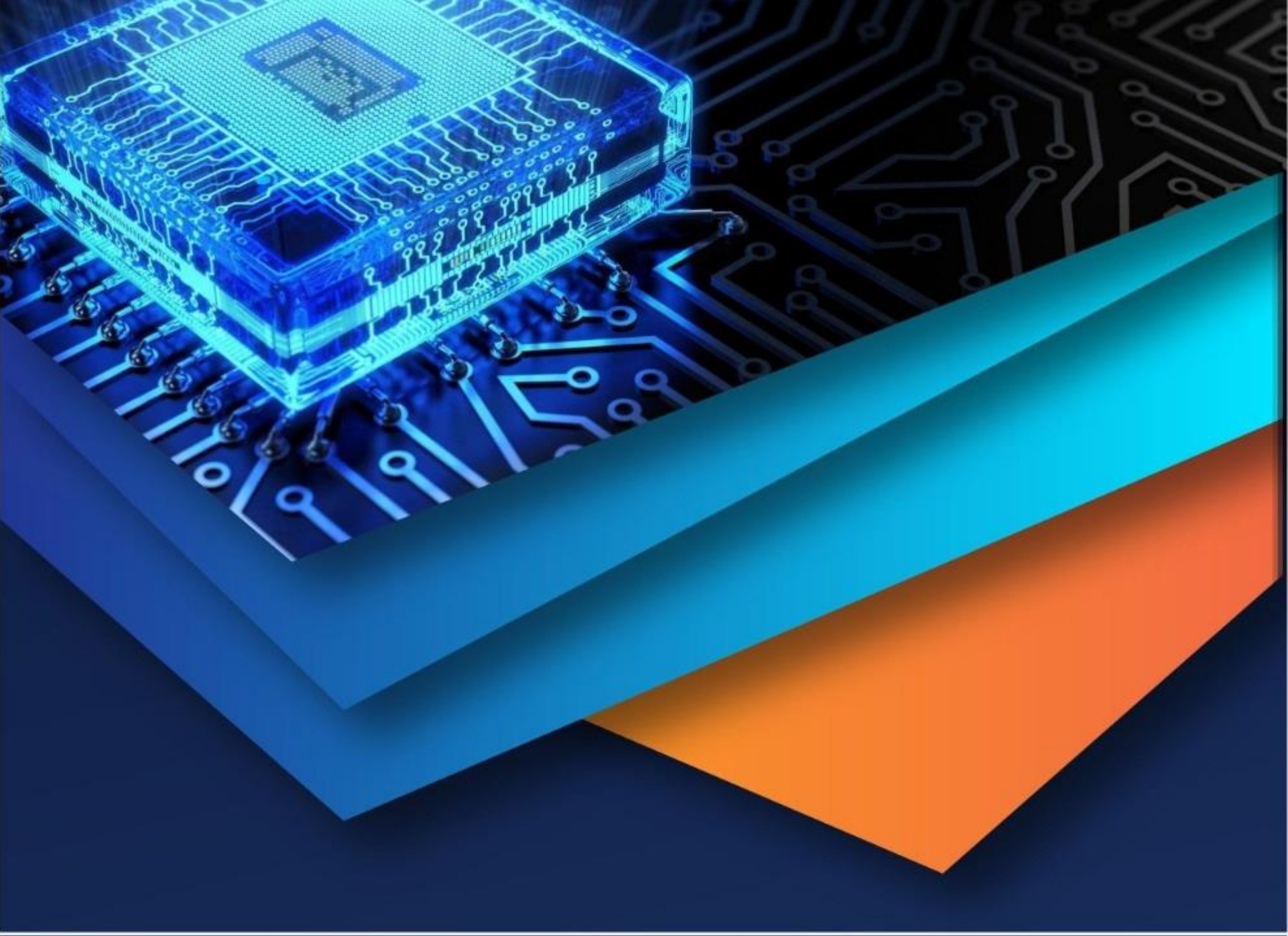

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