



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 8, August 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Behavior of the Infill Walls under in Planelateral Loads in Reinforced Concrete Frames

Aditya Avhad¹, Prof. Abhijeet Galatage²

PG Student, Department of Civil Engineering, MIT-SOE, MIT ADT Pune, Maharashtra, India¹

Asst. Professor, Department of Civil Engineering, MIT-SOE, MIT ADT Pune, Maharashtra, India²

ABSTRACT: Observations after several earthquakes revealed that infill walls may significantly alter the response of reinforced concrete frame buildings. They increase the lateral stiffness and strength of frames subjected to low to moderate in-plane seismic excitation, however they may experience sudden failure under the action of in plane seismic demands. Autoclaved aerated concrete (AAC) is a popular choice of infill wall material due to its advantages such as light weight, good insulation and high durability. In this study, behavior of AAC infill walls were investigated by conducting in-plane test. In this research three specimens were tested under the action of in-plane (IP) deformation experimentally. Further, the same specimens were tested on ETABS and ANSYS software for the analytical results. This research focuses on comparison between the experimental and analytical results for the ACC infill walls for in-plane test. During the experimental investigation it was observed that the failure pattern of masonry infill wall in Rc frame subjected to lateral force is in diagonal compression.

KEYWORDS: AAC Infilled Frame, Dynamic forces, lateral load, Shake table

I. INTRODUCTION

The Masonry buildings are widely used for housing construction not only in India but in many other countries of the world. Past earthquake disasters show more destruction of masonry infill wall. At the time when earthquake effect on buildings it was seen that there is highly non-linear inelastic behaviour and there is interaction between masonry infill panel and surrounding frame. Many researchers observed that stability of building is increased because of masonry infill walls. Also found that inertia force is reduced during earthquake

A Building considered being safe, only when people in building and content of building services and utilities can resist earthquake ground motion occurring at base without any loss. When ground shakes Inertia force is induced in building at all location where mass is present then it flows through various mass points through horizontally and vertically oriented structural members to the foundation this chain is call as load path. Member of building that carries inertia force to the ground are structural elements. Some elements assumed as Non-Structural but they take part in seismic behaviours of building by lateral force transfer. Elements which are supported by structural members whose inertia force is also carried by structural elements are called as non-structural elements. Some common non-structural elements are unreinforced masonry infill walls, Partitions, Cladding etc. They attract earthquake forces and acts like diagonal braces.

II. LITERATURE SURVEY

Analysed five models such as model RC bare frame, model, RC frame with fully infill wall, model, RC infill frame with openings, model, RC frame replaced by equivalent strut, model, RC frame replaced by equivalent strut for openings in infill wall having plan dimension 22m x 15m and number of floors G+5. Chandrala S. et al. [1] determined parameters such as drift, shear force and lateral stiffness were determined. Percentage reduction in story displacement with respect to model 1 is 67.48%, 67.5%, 51.22%, 40.65%. Observed that story displacement was maximum in reinforced concrete bare frame and minimum in reinforced concrete frame with fully infill masonry wall.

Studied behaviour and ductility of H.S.R.C frames with infill wall. Experimental programme was conducted on four frames. F1 is bare frame of beam with cross section of 12x20 cm and length 1.85m and two columns with cross section of 12x20 and height 1.5m. second specimen F2 is similar for F1 but used infill wall thickness 12cm from holes red red bricks. specimen F3 infill is used with thickness 12cm from cement bricks. In the fourth specimen F4 infill wall is used



with half scale frames and tested under cycling loading. **Mohamed et al. [2]** Concluded that lateral load resistance for infilled frames F2, F3 and F4 were greater than bare frame F1 by about 184, 61 and 99% respectively. Observed that energy dissipation for the infilled frames is higher than the bare frame.

Observed several parameters experimentally and analytically like opening size and location, aspect ratio of openings, connection between frames and infill wall, material properties, failure modes etc. **H.B Kaushik et al. [3]** proposed article to intended to review and compare past relevant studies and seismic codes of different countries on in-plane lateral load behaviour and modelling approaches for masonry infill RC frames with openings. Review of past studies did large number of experimental and analytical studies in the past, there are many gap areas in this field. Past research has been carried out in parts, and more importantly, addresses only the local concerns in that region.

Experimental program was performed on masonry-infilled frame specimens with varied construction precision and masonry thickness. A total of five portal frame specimens, which consist of four masonry-infilled frames and a bare frame **Minjae Kim et al. [13]** Performed experimental tests and the results were analysed to investigate the effects of construction precision and interaction between the masonry infill and the frame. The test results indicated that the gap in the masonry infill decreased strength by 75% to 80% and stiffness by 55% to 70%. A comparison between the measured and predicted peak strength using the current code shows that the code equations underestimate the strength by up to 70%. The maximum strengths of the specimens calculated using the proposed model were in good agreement with the experimental results.

III. METHODOLOGY

- a) Selecting a structure to study response.
- b) Collecting experimental data based on the response of a structure.
- c) Applying earthquake force for predicting the response of the similar structure.
- d) Testing of specimen
- e) Verifying results.

A detailed investigation is carried out through a comprehensive experimental programme followed by analysis of results. Prism test was performed on Autoclaved Aerated Concrete bricks on Universal Testing Machine. To know the compressive strength of Autoclaved Aerated Concrete Bricks experimental investigations were performed. To find out modulus of elasticity RC frame with infilled wall as an Autoclaved Aerated Concrete infill was modelled on ETABS by time history analysis where EL CENTRO place Earthquake was applied. Performed dimensional analysis by Buckingham π Theorem on prototype structure. 1/10 scaled steel frame tested on shake table for different frequencies. Lateral load resisting capacity Autoclaved Aerated Concrete infilled wall was analysed. Also, studied possible damage limitations.

IV. RESULTS

Table 1 Dimensions of Prototype and Model

Parameters	Dimensions of prototype	Dimensions of model
Length	4 m	1.5m
Height	3 m	1.5m mm
Beam	200X380 mm	0.15x0.15 mm
Column	200X380 mm	0.15x0.15 mm

Table 2 Stiffnesses of the Members

Structure	Dimension (m)	Shear force (kN)	Displacements (mm)	Stiffness (N/mm)	Aspect Ratio
RC infill wall Full Scale	3x4	1.92	0.278	6906	0.52
RC infill wall Half Scale	1.5x1.5	0.391	0.0538	7123	0.56
S.S frame with Strut	10X20	0.0069	0.001	6890	0.5



Figure 1 Prism Test Results

Table 3 Results of Compressive Strength of AAC Blocks

Model No.	Applied Load (kN)	Failure Load (kN)	Area (mm ²)	Compressive Strength (MPa)
1	48 X 0.8	38.4	200 X 230 = 46000	0.83
2	52.1 X 0.8	41.6	46000	1.105
3	56 X 0.8	44.8	46000	0.97
Average Compressive Strength of Prism- (f'm)				0.301MPa

Table 4 Comparisons of Results Obtained by the Scaling Law and Analytical Study

Sr. No.	Lateral Force (kN)	With Infill		Without Infill	
		Deformation (mm)	Stiffness (kN/mm)	Deformation (mm)	Stiffness (kN/mm)
1	50	2.03	24.63	2.68	18.65
2	100	4.13	24.21	5.4	18.51
3	150	6.2	24.19	8	18.75
4	200	8.32	24.03	10.7	18.69
5	250	10.4	24.04	13.4	18.65
6	300	12.5	24	16	18.75
7	350	14.55	24.05	18.7	18.75
8	400	16.26	24.6	21.33	18.75

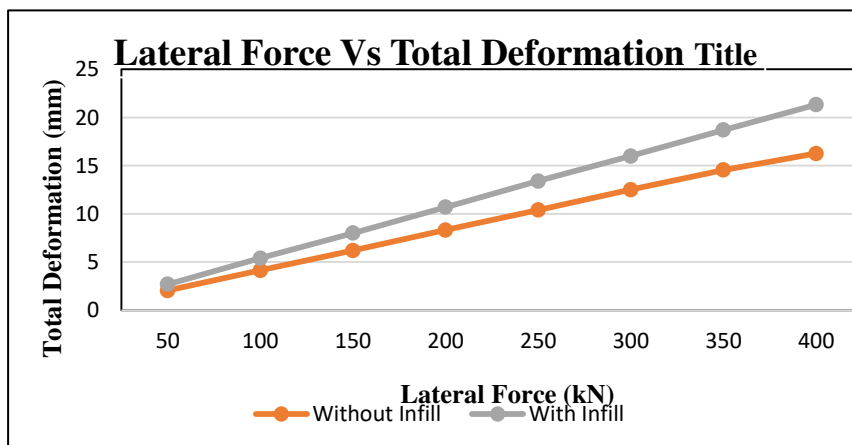


Figure 3 Lateral Force Vs Total Deformation

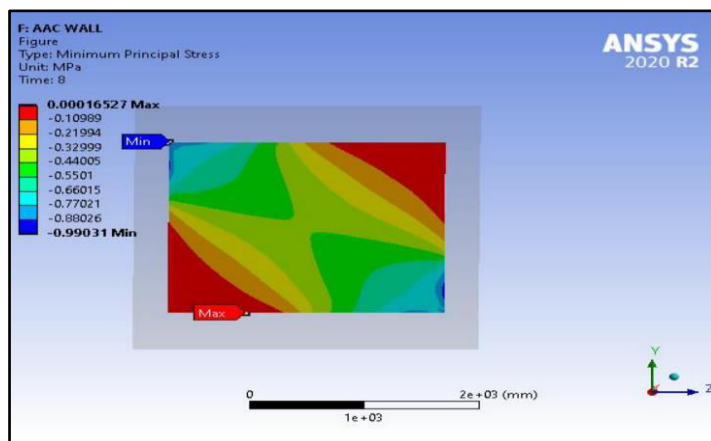


Figure 4 Failure pattern of AAC infill wall subjected to lateral force



Table 6 Lateral Force Vs Bending Moment

Sr. No.	Lateral Force (kN)	Maximum Bending Moment (kN.m)	
		With infill	Without infill
1	50	24.5	34.1
2	100	49.18	67.8
3	150	73.76	101
4	200	98.35	135.79
5	250	122.94	169.75
6	300	147.53	203.68
7	350	172.72	237.63
8	400	196.7	277.58

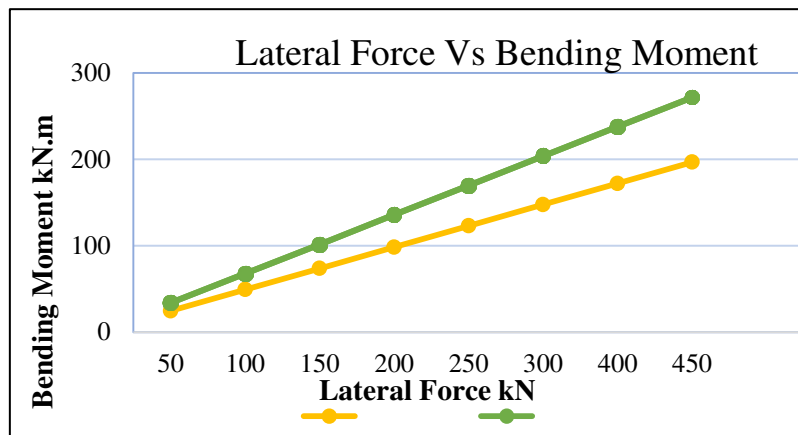


Figure 5 Lateral Force Vs Bending Moment

V. DISCUSSION

Deformation is decreased because of frame with infill wall.Reduction in deformation up to 40% by frames with infill wall.At lateral force of 300kN deformation is 11.851mm it is within limit of deformation. According to IS 1893 this deformation is within the limit of storey drift.Here, for RC frame with AAC infill wall at lateral force of 300kN the minimum principal stress is 0.99MPa which is less than 1.78MPa calculated by experiment within limit of storey drift. Deformation refers to modifications of the shape or size of an object due to applied forces or a change in temperature. Basically, deformation is nothing but the change in shape to its original shape of an object. SI unit of deformation is mm.For RC frame without infill wall carries lateral force of 200kN having deformation of 11.73mm within a limit of storey drift as per IS 1893: 2016.If we consider effect infill wall in RC frame it provides 40% more resistance to the RC frame within limit of storey drift.Current studycarried out for single bay frame; the results for multi bay frame will vary according to stiffness of frame

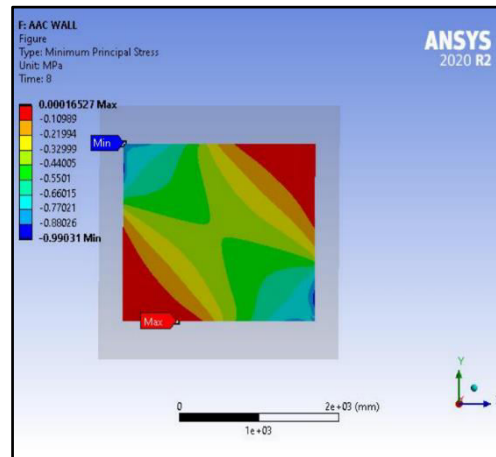


Figure 6 Failure pattern of AAC infill wall subjected to lateral force

When lateral force act on RC frame with infill wall there is interaction between reinforced concrete frame and infill material. Force is transferred from infill material diagonally from top corner to bottom corner. Maximum compression occurs at corners if infill frame. In figure 6 blue colour indicates that maximum compression. Variation of lateral force and bending with and without infill wall in RC frame shows that, bending moment is decreased in RC frame with AAC infill wall. Bending moment is 277.58 nm. for RC frame without infill wall and 196.7 kN/m for RC frame with infill wall at 400 kN lateral force. Reduction in bending moment by 41% with infill in RC frame.

VI. CONCLUSION

From the discussion based on experimental and analytical results, the following conclusions are drawn:

1. Deformation is reduced with consideration of RC frame with infill wall.
2. The effect of infill wall in RC frame provides more resistance to the earthquake force.
3. The failure pattern of masonry infill wall in RC frame subjected to lateral force is in diagonal compression.
4. Cracks are occurred in compression zone diagonally because of maximum compression at corners of masonry infill wall.
5. If we consider effect infill wall in RC frame it provides 40% more resistance to the RC frame within limit of storey drift.
6. Comparing masonry infill wall in RC frame with AAC infill wall in RC frame, Effect of masonry infill wall in RC frame provides more resistance to earthquake force.
7. Stiffness is increased up to 35% because of infill masonry wall in RC frame.
8. Whenever thickness of infill wall decreases the lateral load resistance of frame decrease by significant value, because infill wall with small thickness takes over more buckling of which to do its failure at small lateral load.
9. Bending moment is reduced up to 41% because of infill wall.

REFERENCES

1. Dixit, M. C. S., Thakai, R. J., & Chougule, V. Parametric study on the percentage opening in infill wall including shear wall at building.
2. Ahmed Sayed Tawfik, Mohamed Ragaei Badr & Ashraf ELZanaty (2014) Effect of infill wall on ductility and behaviour of HSRC frames. HBRC Journal · March 2014
3. Sachin Surendran and Hemant B. Kaushik (2012). Masonry infill RC frames with openings: Review of in-plane lateral load behaviour and modeling approaches. The Open construction and building technology journal, 2012, 6, (Suppl 1-M9) 126-154



4. Chidananda HR1, Raghu K2, G Narayana, “Analysis of RC framed structures with central and partial openings in masonry infill wall using diagonal strut method”. IJRASET, Volume 4 Issue IV, Apr 2015
5. Abdelaziz, M. M., Gomaa, M. S., & El-Ghazaly, H. (2017). Effect of unreinforced masonry infill walls on seismic performance of reinforced concrete framed structures. *The Open Civil Engineering Journal*, 11(1).
6. Pradhan, P. M. (2012). Equivalent strut width for partial infill frames. *Journal of Civil Engineering Research*, 2(5), 42-48.
7. Lu, X., & Zha, S. (2021). Full-scale experimental investigation of the in-plane seismic performance of a novel resilient infill wall. *Engineering Structures*, 232, 111826.
8. Kong, J., Zhai, C., & Wang, X. (2016). In-plane behavior of masonry infill wall considering cut-of-plane loading. *Periodica Polytechnica Civil Engineering*, 60(2), 217-221.
9. Kulkarni, S. K., Shiyekar, M. R., Shiyekar, S. M., & Wagh, B. (2014). Elastic properties of RCC under flexural loading-experimental and analytical approach. *Sadhana*, 39(3), 677-697.
10. Nassif Nazeer Thaickavil, Job Thomas (2018). Behaviour and strength assessment of masonry prisms. *Case studies in construction materials* 8 (2018) 23-38.
11. J. Centeno, C.E. Ventura, S.foo (2008). Shake table testing of gravity load designed reinforced concrete frames with unreinforced masonry infill walls. *World Conference on Earthquake Engineering* October 12-17, 2008, Beijing, China
12. Albayrak, U., Ünlüoğlu, E., & Doğan, M. (2018). Effect of infill walls on the seismic performance of an old building. *Int. J. Eng. Technol*, 10, 127-131.
13. Minjae Kim and Eunjong Yu (2021). Experimental study on lateral-load-resisting capacity of masonry-infilled reinforced concrete frames
14. IS 1893 (Part 1): 2002 Criteria for earthquake resistant design of structures. Bureau of Indian Standards, New Delhi
15. IS 1905 (1987) Code of Practice for Structural use of Unreinforced Masonry. Bureau of Indian Standards, New Delhi
16. Structural analysis volume 1 by **Dr. R. Vaidyanathan and Dr. P. Peruma**



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.118



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details