Seismic Analysis of Masonry Infilling In Multistoried Building

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Abstract: In India, in most of the reinforced concrete buildings, masonry infill walls are used as non-structural partition walls. Since they are used as a non-structural member, during design stage, Present paper describe the nature of RC frame building with G + 13 storey with different masonry infill materials like brick masonry and AAC blocks masonry is taken into considerations. Building is irregular in plan with L shape consider for analysis. Completely fill, unfilled, soft storey and modified infill models are studied. Effect on various parameters like axial forces, bending moment, shear force and torsion are taking into account. Infill walls are modeled as pin-jointed single equivalent diagonal strut. All analysis is carried on software Etabs v 9.7.4

Key Words: Compression Strut, Infill, AAC.

1. INTRODUCTION

Reinforced concrete frame buildings are the widely used in developing countries like India, Due to relatively low cost, fast and rapid progressive constructions. RC moment buildings consist of frame with masonry infill walls. These walls are considered as Non structural elements in construction Practices their contribution to overall building behavior is not well known. Observations made after the earthquakes revealed that these non-structural elements had beneficial effects on the lateral capacity of the building. There are two different approaches for designing masonry in filled concrete frames depending on local construction site. In the first approach, masonry infill is taken as a part of structural system and they are assumed to brace the frame against horizontal loading. In the second approach, the frame is designed to carry the total vertical and horizontal loading. Moreover, masonry infill is uncoupled to avoid load being transferred to them. Due to seismic effect infill in between frame (column and beam) behave in compression, and such force is transferred by forming strut.

C V R Murty and Sudhir K Jain concludes that **buildings** masonry infill wall panels increase Strength, stiffness, overall ductility and energy dissipation of the building. More importantly, they help in drastically reducing the deformation and ductility demand on RC frame members explains the excellent performance of many such buildings in moderate earthquakes.

Haroon Rasheed Tamboli and Umesh.N.Karad suggested that there was a considerable difference in the base shear and hence the lateral forces of bare frame and infilled frame.

Mr. V. P. Jamnekar, Dr. P. V. Durge observed that without infill structure showed early formation of plastic hinges and structures failed at an early load stage itself. Whereas the partial infill structure with brick infill showed a delayed formation of plastic hinge and improving the lateral capacity of the structure.

2. METHODOLOGY

Response Spectrum Method (Dynamic Analysis)

In order to perform the seismic analysis and design of a structure to be built at a particular location, the actual time history record is required. However, it is not possible to have such records at each and every location. Further, the seismic analysis of structures cannot be carried out simply based on the peak value of the ground acceleration as the response of the structure depend upon the frequency content of ground motion and its own dynamic properties. To overcome the above difficulties, earthquake response spectrum is the most popular tool in the seismic analysis of structures. There are computational advantages in using the response spectrum method of seismic analysis for prediction of displacements and member forces in structural systems. The method involves the calculation of only the maximum values of the displacements and member forces in each mode of vibration using smooth design spectra that are the average of several earthquake motions

FEMA 273 method for strut width calculations

The procedure given in this section is applicable to any type of masonry infill, i.e. existing masonry infill, enhanced panel for seismic rehabilitation and new panel added to an existing frame. All types of masonry infill panels shall be considered as primary elements of lateral force resisting system. Stiffness contribution of unreinforced masonry infill shall be represented as an equivalent compression strut. The strut has the same thickness and modulus of elasticity as the infill panel it represents. And the equivalent width, *w*, can be determined by,

$W = 0.175D\,(\lambda_1 H)^{-0.4}$

$\lambda_1 H = H\,[E_m t \mathrm{Sin}2\,/4E_c I_c h_m]^{0.25}$

Where,

H = height of the frame,

θ = angle made by the strut with the horizontal,

Ec = Young's modulus of column

Ic = Moment of inertia of column

Em, t and hm are the Young's modulus, thickness and height of masonry infill respectively.

PROBLEM STATEMENT, RESULT AND DISCUSSION

Following data is used in the analysis of the RC frame building models

- Type of frame: Special RC moment resisting frame fixed at the base Seismic zone: ш
- Number of storey: G+13
- Floor height: 3. m
- Depth of Slab: 120 mm
- Size of beam: (230 × 450) mm
- Size of column: (400 × 600) mm
- Spacing between frames:

  5 m along X directions

  3 m along Y directions
- Floor finish: 2 KN/m2
- Terrace water proofing: 1.5 KN/m2
- Materials: M 25 concrete, Fe 415 steel , Brick infill and AAC block infill
- Thickness of infill wall: 230 mm
- Density of concrete: 25 KN/m3
- Density of brick infill: 18 KN/m3
- Density of AAC block infill : 7 KN/m3
- Poison Ratio of concrete : 0.2
- Poison Ratio of brick masonry : 0.16
- Poison Ratio of AAC masonry : 0.25
- Compressive strength of concrete 5000√25 = 25000 Mpa
- Compressive strength of brick masonry : 5 Mpa
- Compressive strength of AAC masonry : 4 Mpa
- Live load on floor: 3 KN/m3
- Type of soil: Medium
- Response spectra: As per IS 1893(Part-1):2002
- Damping of structure: 5 percent

Table no 1 Length of strut in m using FEMA

Material	5 M length of wall	4 M length of wall	3 M length of wall
Brick masonry	1.40	1.13	0.94
AAC block masonry	1.36	1.10	0.92

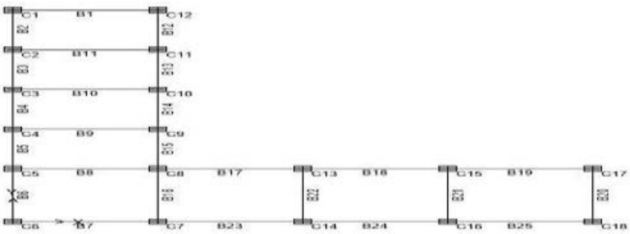
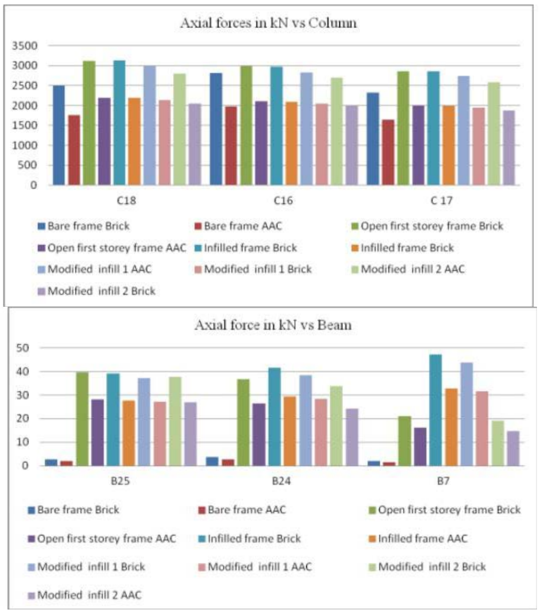
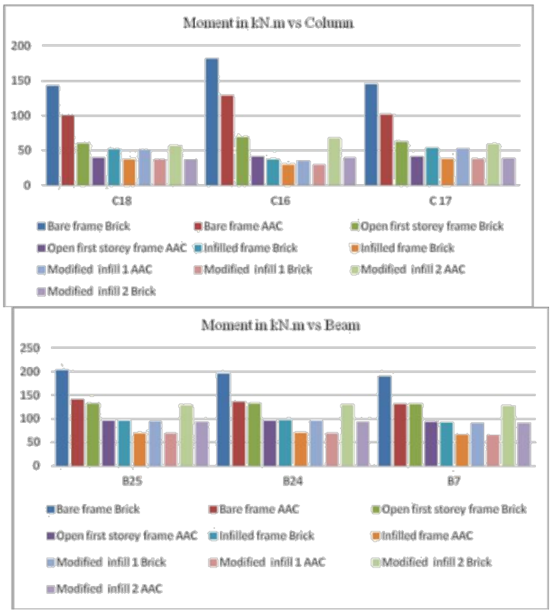


Fig No.1 Position of column and beam

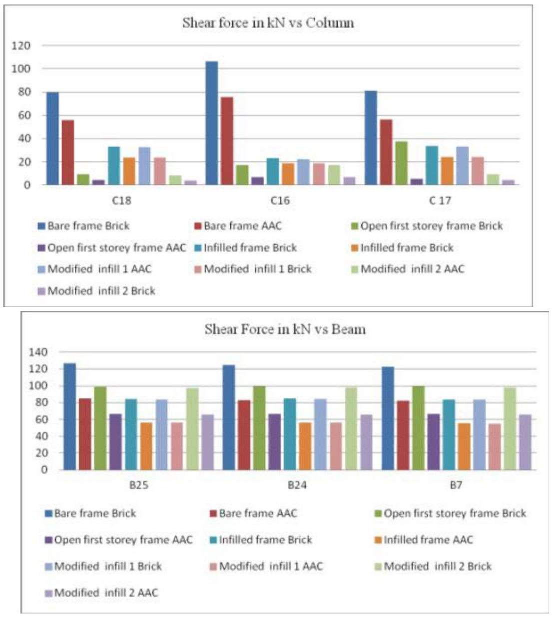


Graph no 1 Comparative study of axial force in column and beam of brick , AAC infill model in kN

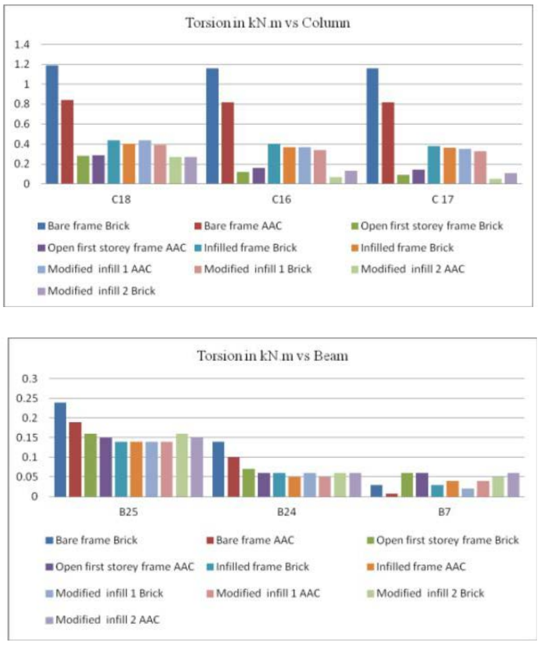
After that the effect of infill on the member forces were studied .It was found that the infill model speculated more axial forces in column and beam.



Graph no 2 Comparative study of moment in column and beam of brick, AAC infill Model in KN.m The corner and middle Columns was chosen for the bare, infill and Modified infill frame of Brick and AAC Model and it was found that the intro Duct ion of infill causes the reduction in Bending moment. Also BM of AAC infill Was much less than brick infill.



Graph no 3 Comparative study of shear force in column and beam of brick, AAC infill model in KN Introduction of Masonry infill in RC frames changes the lateral-load transfer mechanism of The structure from predominant frame action to predominant truss action it was found that the introduction of infill causes the reduction in shear force. Also SF of AAC infill was much less than brick infill.



Graph no 4 Comparative studies of torsion in column and beam of brick, AAC infill model in kN.m it was found that the introduction of infill causes the reduction in tensional moment

CONCLUSION

Primary frame action of a moment resisting frame is converted to the primary truss action due to the introduction of the infill leading to the increased axial forces in column in infill frame model. The response of the structure in terms of bending moments and shear forces is greatly enhanced by the introduction of the infill. Both bending moment and shear force in beams and columns are reduced appreciably due to masonry infill. As the force in member is reduced steel required is also reduced ultimately affect construction cost.

REFERENCES

[1] Agarwal Pankaj and Shrikhande Manish, "Earthquake resistant design of structures", Prentice Hall of India Private Limited

[2] ETABS nonlinear Version 9.7.4 Extended 3D analysis of the Building Systems Computers and Structures Inc. 1995 Berkeley, California.

[3] Haroon Rasheed Tamboli and Umesh.N.Karadi, "Seismic Analysis of RC Frame Structure with and without Masonry Infill Walls", Indian Journal Of Natural Sciences ISSN: 0976 – 0997 Vol.3 / Issue 14/ October2012.

[4] I.S. 1893, "Criteria for Earthquake Resistant Design of Structures (part 1) General Provisions and Buildings (Fifth Revision)", *Bureau of Indian Standards*, 2002.

[5] Lila M. Abdel-Hafez, A.E.Y. Abouelezz , Faseal F. Elzefeary, "Behavior of masonry strengthened infilled

reinforced concrete frames under in-plane load", Housing and Building National Research Center HBRC Journal

[6] Meng-Hao Tsai, Tsuei-Chiang Huang, "Progressive Collapse Analysis of An RC Building with Exterior Non-Structural Walls", Procedia Engineering 14 (2011) 377–384.

[7] Mr. V. P. Jamnekar, Dr. P. V. Durge, "Seismic Evaluation Of Brick Masonry infill" International Journal of Emerging Trends in Engineering & Technology (IJETET)Vol. 02, No. 01, 2013 ISSN No. 2248-9592

[8] Murty, C. V. R. and S. K. Jain (2000) Beneficial influence of masonry infill walls on seismic performance of RC frame buildings. Proceedings of the 12th World Conference on Earthquake Engineering. Paper no. 1790.

[9] NEHRP Guidelines For The Seismic Rehabilitation Of Buildings, Federal Emergency Management Agency FEMA 273 / October 1997

[10] T. Mahdi and V. Bahreini, "Seismic Response of Asymmetrical Infilled Concrete Frames" Procedia Engineering 54 (2013) 341 – 352

[11] Y. Sanada, D. Konishi, Maidiawati, Swezinwin, "Effects of Nonstructural Brick Infills on an

[12] Indonesian Earthquake-Damaged Building", Procedia Engineering 14 (2011)