Influence of Masonry Infill Walls on Seismic Performance of RC Framed Structures-A Comparison of AAC and Conventional Brick Infill

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***Abstract** - In general design practices in India, the strength and stiffness of infill walls are ignored with the assumption of conservative design. In actual, infill walls add considerably to the strength and rigidity of the structures and their negligence will cause failure of many of multi-storeyed buildings. For the functional and architectural requirements Masonry walls are provided in R.C. structures. The term infilled frame is used to represent a composite structure formed by the combination of a moment resisting R.C. frame & Infill walls. The Infill walls can be of conventional clay brick (CB), concrete block or AAC block. The behavior of in-filled R.C. frames has been studied experimentally and analytically by a number of researchers. It has been recognized that infill materials significantly affect the seismic performance of the resulting in-filled frame structures. Most of the research work carried out in this area is focused on parameters such as the variation of distribution of MI and the stiffness of frame elements. The study of the effect of types of infill materials used (i.e. AAC block versus conventional brick masonry) on the seismic performance of in-filled R.C. frames is however still limited. In the present study seismic performance of AAC blocks & conventional bricks infill panel in R.C. frames are compared using STAAD Pro V8i.*

***Keywords:** RC Frame, RC Bare Frame, RC masonry infill, RC AAC infill, Static Equivalent method*

1. INTRODUCTION

[3]Now-a-days, R.C. frames are widely used for the construction are widely used for the construction of high rise buildings because it helps to minimize serious damage from strong earthquake and other factor. Hence, it is necessary to examine the performance of high- rise R.C. buildings. R.C. frames should provide resistance to both gravity and lateral loads through bending in beams and columns.

R.C. frames built in earthquake- prone regions have to possess ductility, or the ability to sustain significant deformations under extreme loading conditions. These frames are design to resist the effects of gravity loads.

Hence, it is very important that these 3- dimensional R.C. frames are made functional for habitation by building walls which are known as infill walls.

"Infill wall is the supported wall that closes the perimeter of the building (R.C. building etc) with 3-dimensional framework structure. These walls are built throughout the building at desired locations."

1.2 PROBLEMS OF RC FRAME WITH INFILL WALL

It is the myth that the presence of masonry infill in the framed panels which helps to improve earthquake performance but from the past experience this statement proves wrong.
According to the code,

1. A bare frame i.e., frame without infill must be able to resist the earthquake effects.
2. Masonry infill walls should be uniformly distributed in the building.

Masonry infill should not be discontinued at the ground.

1.3 THE ALTERNATIVES

There are many alternatives as an infill material like AAC, Clay Brick, Fly Ash Brick, and Solid Concrete Blocks etc.

which can possess better resistance to lateral loads arising due to lateral loads arising due to seismic forces.

"Concrete is a building material which is made from a mixture of broken stone or gravel, sand, cement & water which forms a stone like mass on hardening."

"AAC (Autoclaved aerated concrete) is a new generation walling material which made with major materials such as fly ash, cement, lime and an aerated agent"

"A Clay brick is a block or a single unit of a kneaded clay-bearing soil, sand and lime, or concrete material, fire-hardened or air-dried, used in masonry construction."

TABLE1. DENSITIES FOR DIFFERENT TYPES OF MATERIALS

Materials	Concrete	Clay Brick	AAC
Density Kg/cum	2500	1800	700-1400

Here, a comparison will be made between two types of infill material i.e., comparison between Masonry infill and AAC infill using Static equivalent method by STAAD Pro V8i software.

2. DESCRIPTION OF BUILDING

a) Type of structure: Multi-storey RC frame structure
b) Number of stories: 9 (G+8)
c) Ground storey height: 3.2 m
d) Intermediate storey height: 3.2 m
e) Depth of foundation: 2 m
f) Type of soil: Hard soil

elevation of the building is given in fig:

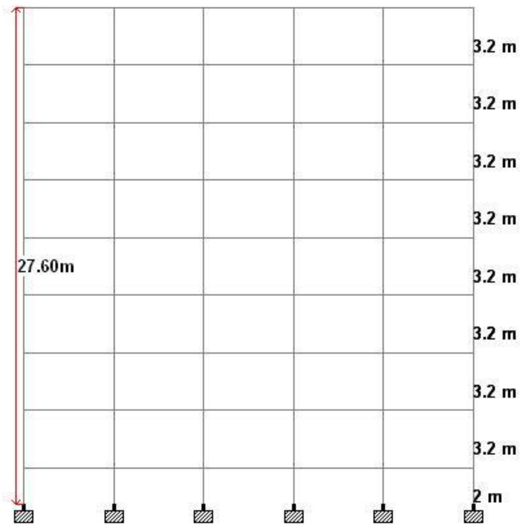


Figure 2: Elevation of Building

3. METHODOLOGY OF PRESENT WORK

Equivalent static frame method is used for analyzing the two different materials of infill with RC frames.

Equivalent static force analysis

The equivalent lateral force for an earthquake is a unique concept used in earthquake engineering. The concept is attractive because it converts a dynamic analysis into partly dynamic and partly static analyses for finding the maximum displacement (or stresses) induced in the structure due to earthquake excitation. For seismic resistant design of structures, only these maximum stresses are of interest, not the time history of stresses. The equivalent lateral force for an earthquake is defined as a set of lateral static forces which will produce the same peak response of the structure as that obtained by the dynamic analysis of the structure under the same earthquake. This equivalence is restricted only to a single mode of vibration of the structure. Inherently, equivalent static lateral force analysis is based on the following assumptions,

Assume that structure is rigid.[1]

- Assume perfect fixity between structure and foundation.
- During ground motion every point on the structure experience same accelerations
- Dominant effect of earthquake is equivalent to horizontal force of varying magnitude over the height.
- Approximately determines the total horizontal force (Base shear) on the structure However, during an earthquake structure does not remain rigid, it deflects, and thus base shear is disturbed along the height.

4. ANALYSIS OF RESULT AND DISCUSSION

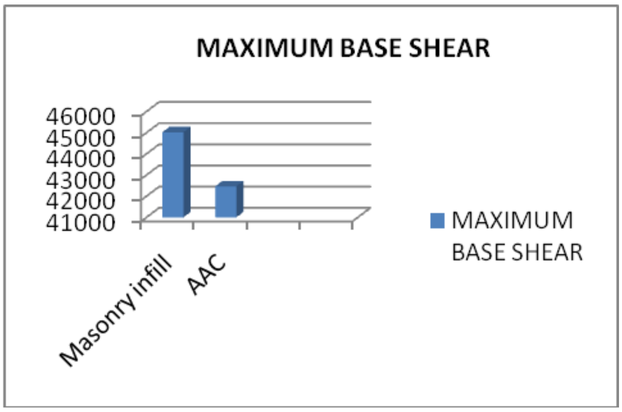
After analyzing the two alternative structures located in seismic zone V by equivalent static lateral force method conforming to IS 1893:2002 using STADD Pro V8i, the results are extracted and compared in terms of critical earthquake response parameters such as shear force, deflection, lateral displacements and moments along Z- Axis.

4.1 *Base Shear*

It has been also observed that the base shear for model with conventional clay bricks (masonry) was 45020.56 KN whereas for model with AAC blocks it was 42464.96KN. Thus the lateral forces experienced by model with AAC blocks are less as compare with model with conventional bricks. Also the dead load on building with AAC blocks is less as compared to model with clay bricks. Thus Lesser the lateral forces and lesser dead load will results in lesser member forces which ultimately results economical design.

TABLE2: Base shear for various models with Conventional clay brick masonry

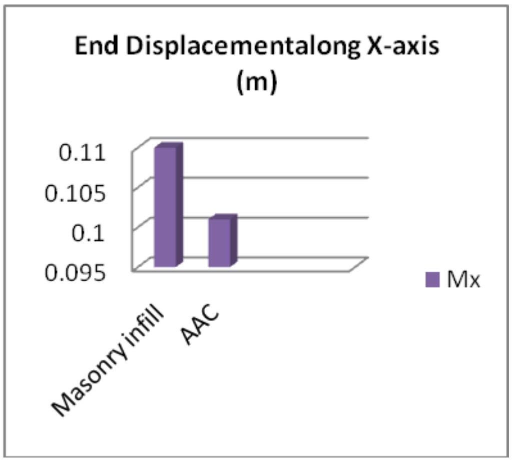
BASE SHEAR	With Conventional Bricks	With AAC BLOCK
VBx	45020.56	42464.96
VBy	45020.56	42464.96



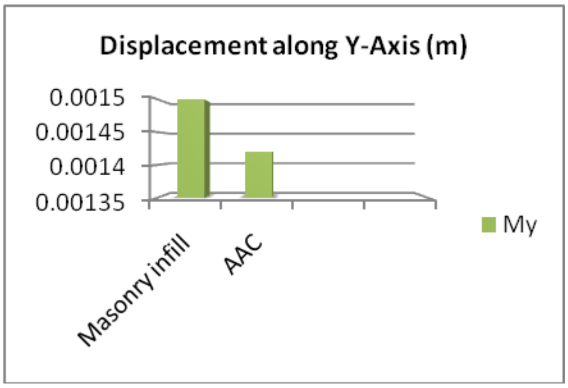
GRAPH 1: BASE SHEAR

4.2 END DISPLACEMENT

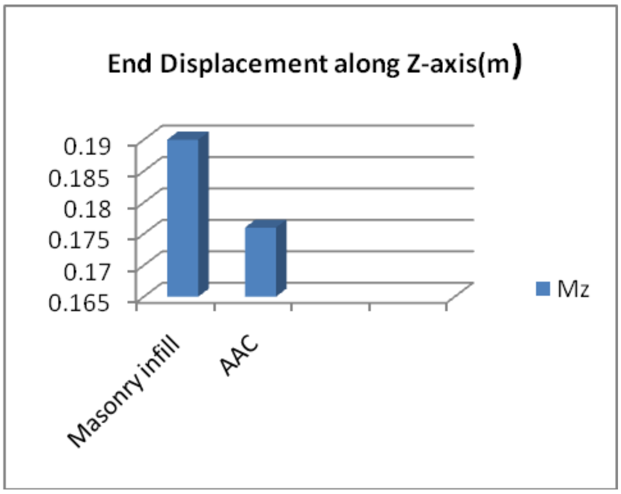
Next, the effect of infill on the lateral end displacement is studied for masonry infill frame model and model with AAC infill. The variation in the value of end displacement is shown with the help of graphs (M_x, M_y, M_z) which shows that frame with conventional brick infill was more displaced as compare to AAC infill.



GRAPH 2: END DISPLACEMENT ALONG X-AXIS



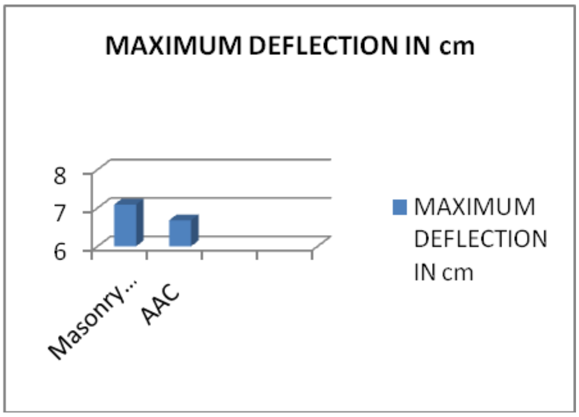
GRAPH 3: END DISPLACEMENT ALONG Y-AXIS



GRAPH 4: END DISPLACEMENT ALONG Z-AXIS

4.3 DEFLECTION OF FRAMES

It has been also observed that the deflection for model with conventional clay bricks (masonry) was 7.086 cm whereas for model with AAC blocks it was 6.68 cm. Thus the shape of model with AAC blocks are less deflected as compare with model with conventional bricks.



GRAPH 5: DEFLECTION IN FRAME (cm)

5. CONCLUSIONS

In this study the influence of masonry infill on the seismic response of multi-storeyed building under seismic loading is illustrated through typical examples. It has been found that the Indian standard codal provisions do not provide any guidelines for the analysis and design of RC frames with infill panels. It has been also found that the presence of infill reduces the displacement capacity of structure and modifies the structural force distribution significantly. The base shear experienced by models with AAC blocks was significantly smaller than with conventional clay bricks which results in reduction in member forces which leading to reduction in required amount of Ast to resist member forces. So economy in construction can be achieved by using AAC blocks instead of conventional clay bricks. The performance of AAC block infill was superior to that of Conventional brick infill in RC frame. Therefore, the ACC block material can basically be used to replace conventional bricks as infill material for RC frames built in the earthquake prone region. If we compare the performance of frame with full infill as conventional clay bricks and AAC blocks was significantly superior to that of bare frame.

6. REFERENCES

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