Study on Dynamic Properties of RC Buildings with Brick and AAC Walls

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***Abstract*: Buildings with masonry infill wall are the most common type of structures used for multi-storey constructions in the developing countries. Masonry Brick infill walls have been used in Reinforced concrete Frame structures as interior and exterior partition walls. Infill walls now a day are considered to be non-load bearing member. Reinforced concrete framed buildings with infills are usually analysed as bare frame, without considering the strength and stiffness contributions of the infills. Nowadays, infills are provided as walls and strut. Here it was provided as a diagonal strut. The width of strut is calculated by equivalent diagonal strut method. For this purpose response spectrum method is taken into consideration and results are obtained in ETABS. The study includes the modelling of building having plan area 25m×15m,the heights are varied from G+3, G+8, G+12 storey and the infill used are Autoclave Aerated Concrete(AAC) and brick . Zone V was considered for this analysis. This paper deals with the comparison of brick infill and AAC infill in low rise, medum rise and high rise buildings and concluded that AAC was good in high rise building and brick was good in low rise and medium rise buildings.**

Keywords: Infills, AAC, E-tabs, Diagonal strut

1. INTRODUCTION

An earthquake (also known as a quake, tremor or temblor) is the perceptible shaking of the surface of the earth, resulting from the sudden release of energy in the earth's crust that creates seismic waves. Earthquakes can be violent enough to toss people around and destroy whole cities. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

In multi-storey buildings, the RC frame structures are constructed initially due to ease of construction and rapid work in progress. The masonry infilled RC frame buildings are commonly constructed for commercial, residential and industrial buildings in seismic regions. Infilled frames are composite structures formed by the combination of moment resisting plane frame and infill wall. The infills are mostly used as interior partition walls and external walls which are protecting from outside environment to the building according to the requirements. The failure or collapse of buildings during earthquake is due to geological effects, poor form, inadequate design and detailing and poor quality of construction. The infill increases strength and stiffness to the structure. While during analysis, not considered the effect of infill due to lack of knowledge between infill and frame. Proper consideration of stiffening effect of infill on the frame is often important as it can considerably alter the behaviour of building in elastic range. Infill reduces the lateral deflection of the building, displacement, bending moments in frame and increasing axial forces in columns this leads to decreasing of probability of collapse.

The study includes the modelling of building having plan area 25m×15m, the heights are varied from G+3, G+8, G+12 storey and the infill used are AAC and BRICK .The analysis was done by Response Spectrum. Comparison of infill walls in low rise, medium rise and high rise buildings were done on the rest of the chapters.

2. OBJECTIVES

1) To determine the effect of brick infill on low rise, medium rise and high rise buildings.

2)To find the effect of Autoclaved Aerated Concrete (AAC) on low rise, medium rise and high rise buildings.

3)To compare the base shear and storey drift of varying building height obtained from the dynamic analysis and to obtain better infill.

3. MODELLING OF BUILDING

Here the study was carried on G+3, G+8 and G+12with brick and AAC infills on a plan area of 25m×15m.Each storey of 3m height with RC framed structure. Six models including G+3, G+8 and G+12 building were created. Properties are different for different models.

3.1 Building Plan And Dimension Details

The details of frame are obtained from literature review. Material properties include modulus of elasticity, poisson's ratio, weight density, thermal coefficient, damping ratio and shear modulus.

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Figure 1 :plan view 25m×15m

Table 1:Dimension of the building

Plan Area	Structure	Member Properties	Size B × D (mm)
	G+3	Beams parallel to X axis Y axis Columns Slab	300 × 450 300 × 300 450 × 450 Thickness=125mm
25m x15m	G+8	Beams parallel to X axis Y axis Columns Slab	300 × 450 300 × 300 650 × 650 Thickness=125mm
	G+12	Beams parallel to X axis Y axis Columns Slab	300 × 450 300 × 300 750 × 750 Thickness=125mm

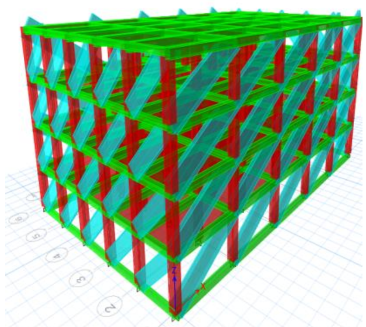
Figure 2.Three dimensional view of G+3 Building with infill(brick and AAC)

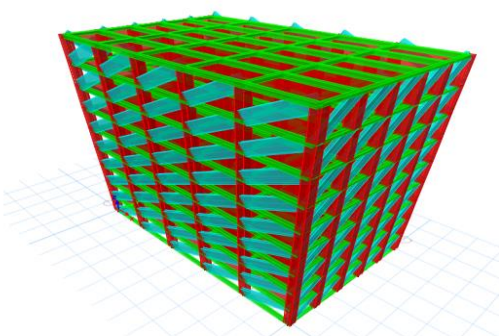
Figure 3.Three dimensional view of G+8 Building with infill(brick and AAC)

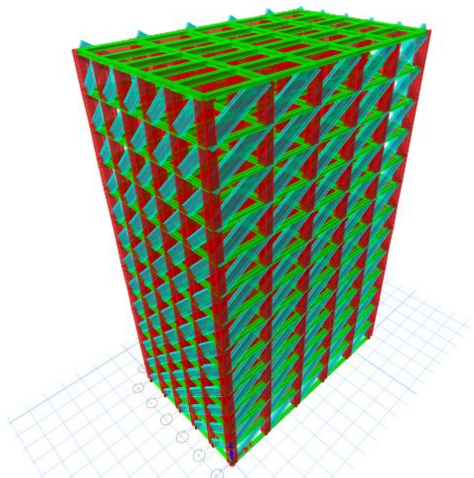
Figure 3.Three dimensional view of G+12 Building with infill(brick and AAC)

3.2 Load Formulation

Present study were considered for Response Spectrum Analysis. Present study were considered for Response Spectrum Analysis. Dead Loads (IS- 875 PART 1) and Live Loads (IS 875 PART 2). In addition to the above mentioned loads, dynamic loads in form of Response Spectrum method were also be assigned.

- *Dead load*

Dead load intensity = 1.5 kN/m^2

- *Live Load*

Live Load Intensity specified (Public building) = 4kN/m^2
Live Load at roof level =1.5 kN/m^2

3.3.Calculation of Width of Diagonal Strut

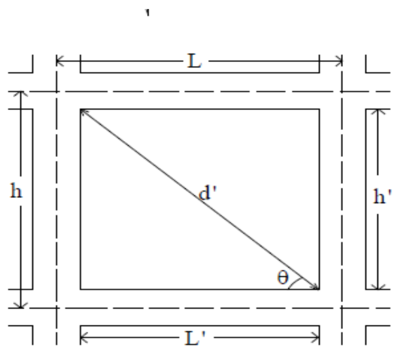

Figure 4.Showing calculation of diagonal strut

According to Paulay and Priestley,strut width= 0.25d '

3.4 Analysis

The RC structues with infills were analyzed by Response Spectrum Analysis. The analysis were compared to study the behaviour of the structures. It is a linear dynamic statistical analysis method to indicate the likely maximum seismic response of an elastic structure. A response spectrum is simply a plot of the peak or steady-state

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response (displacement, velocity or acceleration) of a series of oscillators of varying natural frequency that are forced into motion by the same base vibration or shock.

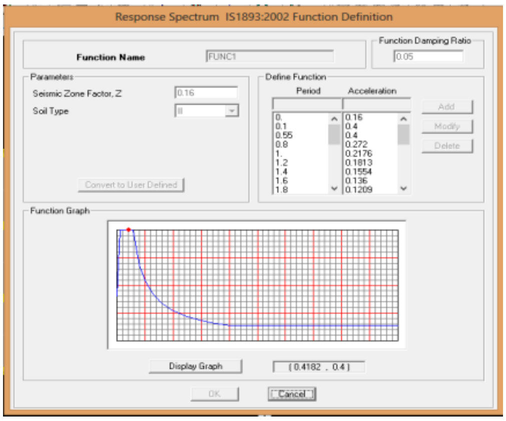

Figure 5. Response Spectrum Curve

4.COMPARISON OF RESULTS

The analysis result obtained were compared to study the seimic performance of RC frame structure with various infills.

4.1. Base shear and storey drift

The results obtained from ETABS software is tabulated below. Zone V is considered for the analysis.The base shears of the building were acquired from seismic analysis using the Response Spectrum Analysis corresponding to 5% critical damping considering soil condition medium. Table 5.2 to 5.4 shows the values of storey shear and storey drift for G+3,G+8 and G+12 buildings respectively. The base shear and storey drift at each storey level for both infills in X and Y directions presented in charts by response spectrum analysis below.

(a) Base shear

Graphical representation of base shear values are shown in Fig: 5.1 and Fig: 5.2.The result indicate that, the value of storey shear decreases from bottom to top story for all soreys. RC framed structures with brick infills shows better performance than building with AAC infill walls in both X and Y direction in low rise (G+3) and medium rise buildings(G+8).In high rise buildings, AAC was better.

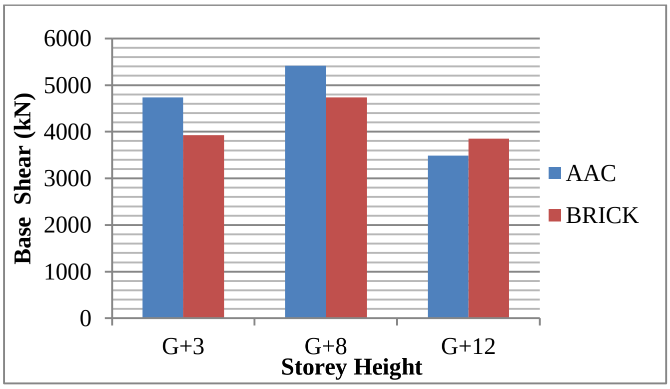

Figure 6.Graph showing Base shear in X direction

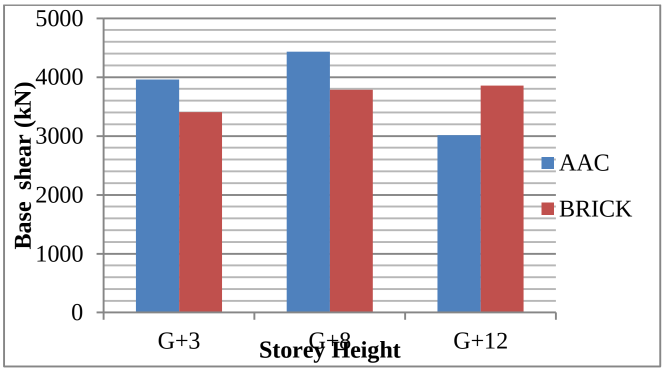

Figure 7 .Graph showing Base shear in X direction.

(B) Storey Drift

Graphical representation of storey drift values are shown in Fig: 5.3 and Fig: 5.4.The result indicate that, the value of storey drift is maximum at intermediate storey for low rise, medium rise and high rise buildings. RC framed structures with brick infills shows better performance than building with AAC infill walls in both X and Y direction in low rise (G+3) and medium rise buildings(G+8).In high rise buildings, AAC was better.

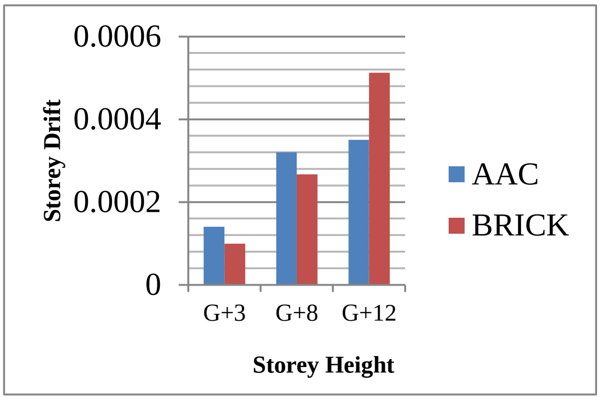

Figure 8 .Graph showing Base shear in X direction

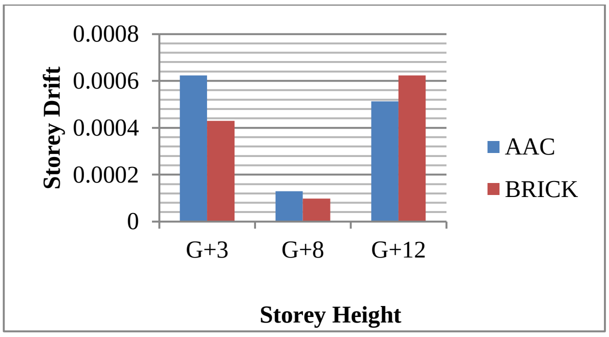

Figure 9.Graph showing storey Drift in Y direction

5. CONCLUSION

In this study Response Spectrum Analysis was done. To analyse the performance of RC framed structure with better infill.

- The value of storey shear decreases from bottom to top story for all soreys.

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- The value of storey drift is maximum at intermediate storey for low rise,medium rise and high rise buildings.
- The storey drift and base shear were compared to study the dynamic performance of buildings with brick and AAC infills.
- The various conclusions obtained from this study are:
  - From maximum storey drift and base shear view,
    - RC framed structures with brick infills shows better performance than building with AAC infills in X and Y direction in low rise(G+3) and medium rise buildings (G+8).
    - RC framed structures with AAC infills shows better performance than building with brick infills in X and Y direction in high rise buildings (G+12).
    - In G+3 building, RC framed structures with brick infills shows better dynamic behaviour based on base shear (percentage reduction of 17.17% in X direction and 13.99% in Y direction compared to AAC infill walls) and storey drift (percentage reduction of 28.92% in X direction and 31.10% in Y direction compared to AAC infill walls)
    - In medium rise buildings , RC framed structures with brick infills shows better dynamic behaviour based on base shear (percentage reduction of 12.5% in X direction and 14.65% in Y direction compared to AAC infill walls) and storey drift (percentage reduction of 16.56% in X direction and 23.8% in Y direction compared to AAC infill walls)
    - In high rise building (G+12), RC framed structures with AAC infills shows better dynamic behaviour based on base shear (percentage reduction of 9.45% in X direction and 21.79% in Y direction compared to brick infill walls) and storey drift (percentage reduction of 31.64% in X direction and 17.8% in Y direction compared to brick infill walls).
- Hence we conclude that brick was good for low rise and medium rise building and AAC shows better performance in high rise buildings.

6.FUTURE SCOPE

Further study can be carried out in irregular buildings with various infill walls.

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