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Seismic Behavior of RC Framed Open Ground Storey Building With & Without Infill Wall

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ABSTRACT: Open ground storey (OGS) buildings are known to be vulnerable under seismic loading due to early formation of collapse mechanism in the ground storey RC columns. A reinforced concrete building with masonry infill is most common type of construction in India. Traditionally, conventional clay bricks or AAC blocks which are heavy rigid materials have been used as infill wall. Infill walls in RC framed buildings provide lateral stiffness to the structure. AAC (autoclaved aerated light weight concrete) blocks are one of the available light weight and flexible infill materials. In this study, response spectrum analysis has been carried out using ETABS software to understand the seismic behaviour of open ground storey RC framed building with & without infill walls. The experimental result will show that the AAC blocks infilled RC frame exhibits better performance subjected to lateral loads than that of conventional bricks infilled frames. In this paper, G+30, G+25, G+20, G+15, G+10 storeyed building is analysed by using response spectrum method for seismic zone III for three different cases using bare frame, AAC block infill wall & brick masonry infill wall. The final results and conclusion will be based on the behaviour of building to the seismic forces and the comparative seismic parameters like base shear, lateral storey drift, displacement, scale factor etc of three cases.

KEYWORDS: AAC Block infill wall, bare frame, brick masonry infill wall Response Spectrum Method, Base Shear, Lateral storey drift, Displacement, etc.

I. INTRODUCTION

Open ground storey buildings are commonly used in the urban environment nowadays since they provide parking area which is most required. This type of building shows comparatively a higher tendency to collapse during earthquake because of the soft storey effect. Large lateral displacements get induced at the first floor level of such buildings yielding large curvatures in the ground storey columns. With the infill wall the strength and stiffness of bare frame is increases but at the open ground storey is not, then the fundamental time period component to bare frame and consequently increases the base shear demands in the ground storey beams and column. One of the widely use material is AAC blocks. Dr. Johan Eriksson developed Autoclaved Aerated Concrete block in 1923 and was patented for manufacturing in 1924. These blocks lower the environmental impact. The density of AAC is around 1/3rd of conventional clay bricks hence reduces the seismic forces on the structure. Experiments show that much lesser deflections takes in the structure when AAC blocks are used instead of clay bricks.

II. LITERATURE REVIEW

The present work is aimed at comparative study of behaviour of RC framed open ground Multi-Storeyed Buildings with & without infill wall. Various studies have been carried out till date for with & without infill wall in RC framed Open Ground Multi Story Building below as follows:

Mohammed Nauman, Nazrul Islam (2014) was studied about Behaviour of RC framed Multistorey Structure With and Without Infill Walls. Framed reinforced concrete structures are most commonly types of structures constructed all over the world due to ease of construction and rapid progress of work. Generally brick or block work masonry is done in these frames which act as an infill panels in the framed structure. Infill walls provide the lateral stiffness to the structure. Its behaviour is very different from the bare frame structure. He was concluded that Lateral deflection in both

the direction decreases considerably with the introduction of in fill walls. It indicates that the stiffness of the structure is increased. Remarkable reduction in the storey drift has also been observed. Maximum reduction in the storey drifts in X and Z direction is 69.64% and 76.1% respectively. Drastic reduction in the storey shears has been observed in both the structures. Storey shears increases considerably after the addition of infill walls. After the addition of infill walls the building become stiff as compared to the bare frame structure, it will attract large amount of lateral forces as compared to the bare frame structure.

Kumbhar S. S, Rajguru R. S (2015) was studied about Seismic Analysis of Masonry Infill in Multi-Storey RC Buildings. In this paper masonry infill is the most common structural system of construction of RC frame who behaves as the exterior walls as well as partition walls. So it is important to study the significance of infill in the structure. The assumed structure is an apartment building of G+3 storeys in seismic zone III with a medium soil strata. Seismic coefficient method of analysis is adopted. Influence of AAC blocks on various responses of RC framed structure is studied. Values of base shear, storey displacements and inter-storey drift are derived and compared to evaluate the effect of infill on the structure. AAC block has a significant effect on the performance of a RC building. Compared to bare frame, infilled frame has less storey displacement as well as storey drift. If partially infilled frame is compared with fully infilled frame, partially infilled frame is more subjected to storey displacement as well as storey drift. Infilled frame has more storey shear compared to bare frame. Storey shear is maximum in fully infilled and then infilled frame with opening, partially infilled frame and minimum in bare frame.

Ashitosh C. Rajurkar and Neeta K. Meshram (2016) are concluded as the Maximum axial force is found in bare frame model. In interior columns, with considering infill wall effects and open ground storey the value of shear force is maximum. In interior columns, without considering infill wall effects and stiffer size column the value of moments is maximum. Soft storey building exhibits deficient performance during earthquake. Damage induced for ground floor columns and ground storey are very large for soft storey building. Soft storey at ground level in RC frame building shows deficient performance during earthquake as the stiffness of soft storey is less.

III. METHODOLOGY

The following steps are undertaken within the present study are as follows: 1. In present research 3 different model 10 storey building structure using with infill wall that is AAC Block & brick masonry infill wall & without infill wall that is bare framed is done. 2. Modelling of the structure is done using ETABS. 3. Seismic analysis as per IS 1893-2016. 4. Design and analysis of structure using IS 456-2000. 5. Obtaining seismic parameters like base shear, lateral drift, displacement & scale factor. 6. Design and analytical work is been carried out by method using response spectrum analysis. 7. Observation and comparison of result. 8. Conclusion.

IV. PRELIMINARY DATA

Following are the data assumed for carrying out this study, 1. Length in X direction=40m. 2. Length in Y direction=32m. 3. Typical storey height=3m. 4. Ground storey height=3.5m. 5. No. of storey for G+10, G+15, G+20, G+25 & G+30. 6. Height of bldg as per different storey building. 7. Bay spacing in X & Y direction= 8m Load consideration are as follows: 1. Dead load: as per calculation of changes in density, compressive strength, Poisson's, modulus of elasticity. 2. Live load: 3 N/m². 3. Earthquake load as per IS-1893:2016 4. Seismic zones: III.

V. STRUCTURAL MODELLING

A reinforced concrete frame structure i.e G+10, G+15, G+20, G+25 & G+30 is to be modeled using ETABS software with storey height of 3.5 m at ground floor, and above ground floor height 3 m and center to center spacing along X & Y direction is 8m the member size are varied as per the design requirements. The modeling is done to examine various parameters such as base shear, shear wall, storey displacement and storey drift. The open ground storey model is analysis with AAC infill wall, brick masonry infill wall, and bare frame using the parameters for the design as per IS-1893-2016 for the seismic zone III. The models are analyzed by Linear Elastic, Dynamic Analysis (Response Spectrum analysis) with the help of ETABS software.

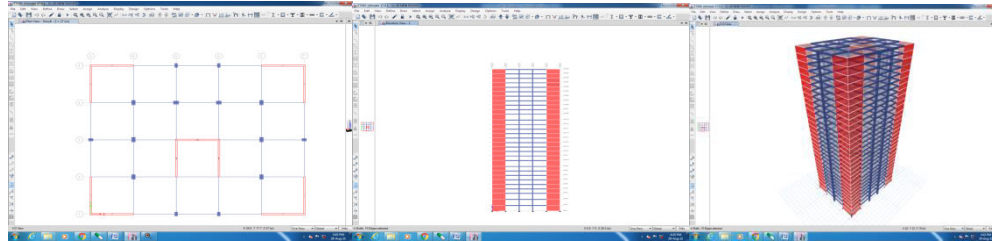


Fig. Plan elevation and 3d view for bare frame with shear wall

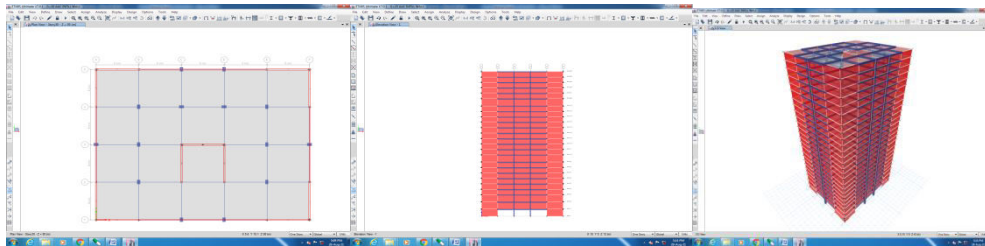


Fig. Plan elevation and 3d view for bare frame with AAC block with shear wall

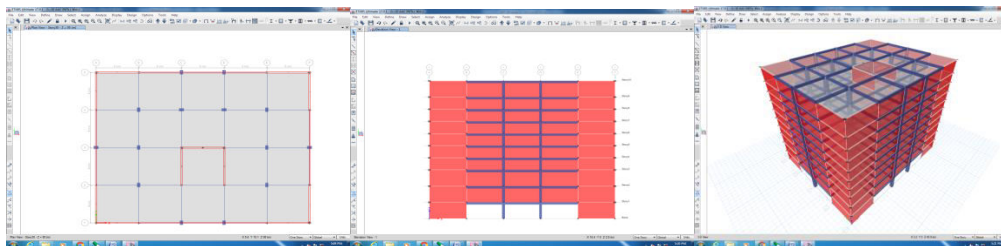


Fig. Plan elevation and 3d view for bare frame with brick masonry infill wall with shear wall

VI. RESULTS AND DISCUSSIONS

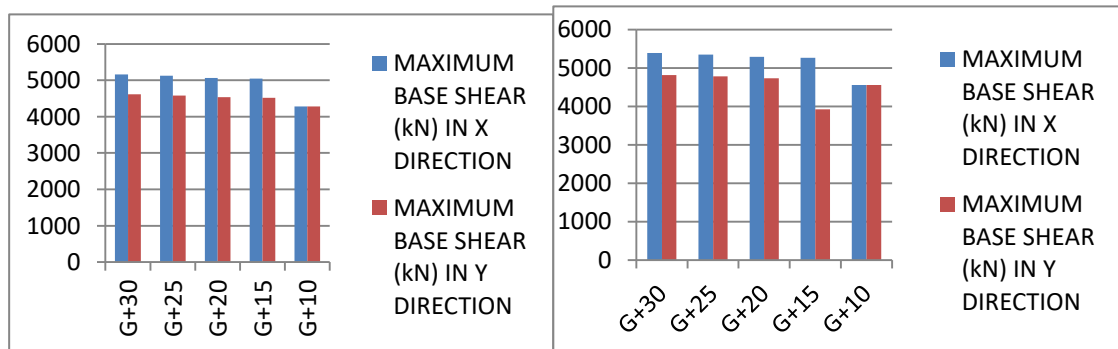


Fig. Base shear for bare frame

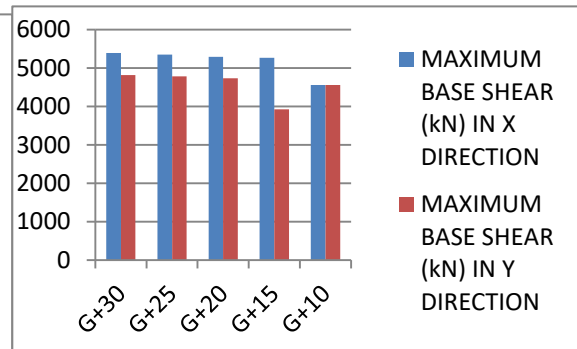


Fig. Base shear for AAC block infill wall

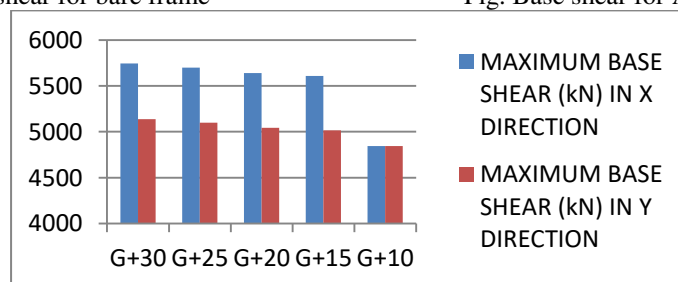


Fig. Base shear for brick masonry infill wall

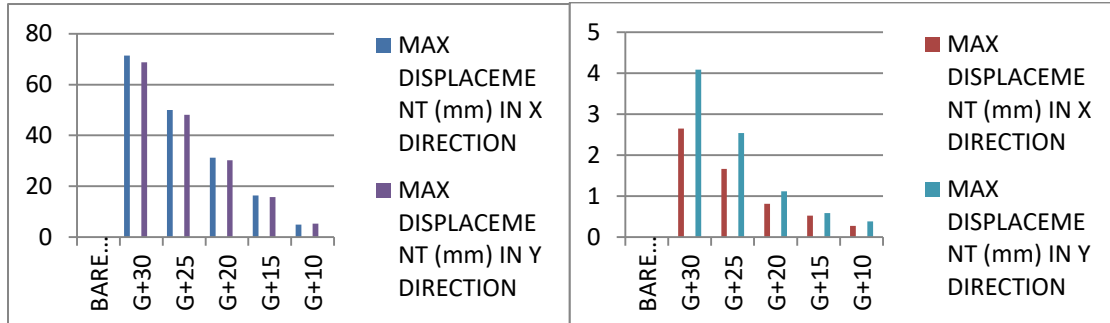


Fig. Max displacement for bare frame

Fig. Max displacement for for AAC block infill wall

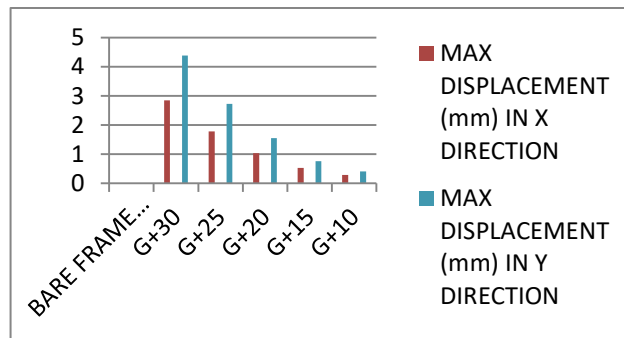


Fig. Max displacement for brick masonry infill wall

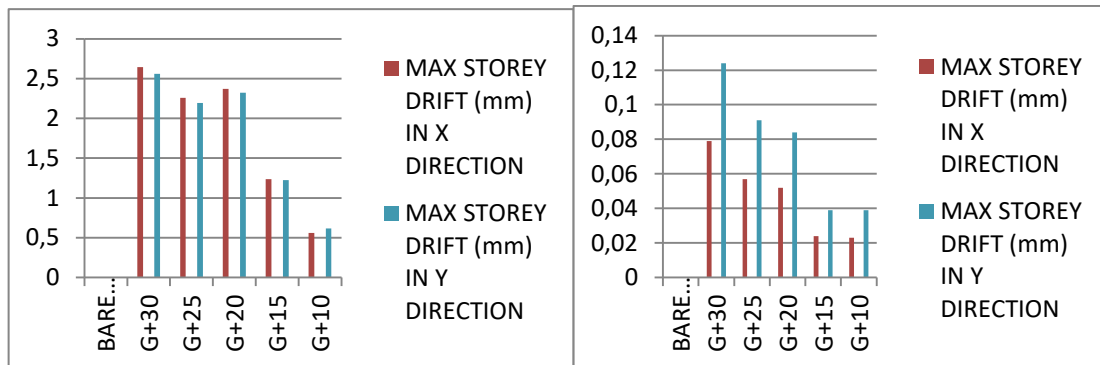


Fig. Storey drift for bare frame

Fig. Storey drift for for AAC block infill wall

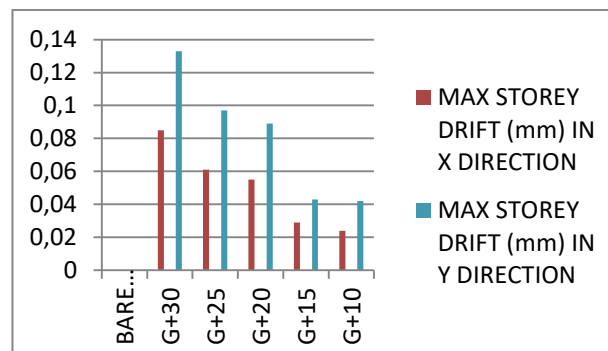


Fig. Storey drift for brick masonry infill wall

VII. CONCLUSION

Based on the analytical results of all the models, following conclusions are made :

- An experimental investigation was carried out to study the seismic behavior of OGS building with shear wall an appropriate analytical model of AAC infilled RC frame.
- Use of lateral load resisting systems like Shear wall and increases stiffness and is more effective as compared to structures without any load resisting system i.e. Bare frame.
- Compressive strength and elastic modulus of AAC masonry was observed to be approximately one-half of the conventional brick masonry.
- These results suggest that the response reduction factor, R of 5 for the design of ductile RC frame members is acceptable for OGSRC buildings with AAC masonry infills in upper stories, however, a lower value of R should be used if conventional brick masonry infills are provided.
- AAC block fully and partially infill building attract less base shear then Brick fully and partially infill building due to light weight of AAC block which reduced self weight of structure.
- AAC block fully infill building with shear wall has less displacement then Brick fully infill building with shear wall and bare frame with shear wall.
- AAC block RC frame infill building with shear wall is safer, light weight and low cost then brick infill building with shear wall and should be preferred over brick wall RC frame building.
- Axial forces in AAC block RC frame infill building with shear wall is less then brick wall RC frame infill building with shear wall and bare frame with shear wall.
- By using shear wall in three cases i.e bare frame, brick masonry infill and AAC block infill wall found base shear equal in X and Y direction on G+10 storey in all cases.
- Hence, AAC block infill OGS-RC framed building with shear wall performed in all cases better than brick masonry infill building with shear wall and bare frame with shear wall.

VIII. FUTURE SCOPE OF WORK

- Various studies can be carried for design of this lateral load resisting shear wall.
- The study can be carried for horizontally as well as vertically irregular building.
- The study can be carried by increasing height of building as well as for different zones.
- Loading at different levels of the building could be changed.
- Introduction of other lateral load resisting system like belt truss and outrigger system can be done and their results can be compared.
- Opening in shear wall can be used and research can be carried by studying their effects.
- Different types of infill wall can be used.
- Combination types may be changed.

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