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Analysis and Comparison of Structure having different Infill Material (Red Brick, AAC Block, Hollow Concrete Block) using ETABS Software

Tushar Raju[1], Dr. Rakesh Patel[2]
[1]*M.Tech Student,* [2]*Prof. & H.O.D, Department of Civil Engineering SIRTS, Bhopal*

Abstract: ***Reinforcement concrete structure frame system widely used around the world. In building structure, structure element is generally taken as Beam, column, foundation.***
The dead & live load is transforming from beam to column, column to footing then ultimately load distributed into the soil. The wall load is taken by beam. In building design we mentioned the entire wall over the beam if it is possible, if it is not possible we taken concealed beam into the slab below the wall. During the analysis of frame structure we consider wall as non structural element. But presence of infill wall in the structure analysis is play important role. In the current study deals with the investigation of the effect of infill in building and their behaviour in structure.
In present situation high rise building constructed with the different types of infill wall. Some of them generally use for example Red brick, AAC wall, Hollow concrete block, light weight Aluminium & Steel panels. So, three types of modal create on ETABS software.
In this study 20 storey high rise building is modal in ETABS with taken three types of infill materials Red brick, AAC block, Hollow concrete block considered for analysis which is located in most critical earthquake zone v. Dynamic analysis is done using ETABS software, soil conditions are to be medium and importance factor is to be taken as 1.2. the all three infill wall modals compare with the basic design parameter like moment, shear force, displacement and as well as earthquake parameter like story drift, story shear, base shear, time period etc.
Keywords: ETABS, Structural Analysis, Soft storey, masonry infill, RC frame, earthquake, displacement, drift, base shear, AAC blocks, Hollow concrete block

I. INTRODUCTION

In present condition increasing in the population, housing has developed as a industry due to high rise building is only solution in the metro cities. But the performance of high rise building also important in all weathering condition and design vertical loading condition as well as lateral loading condition .due to frequent occurrence of the earthquake in the world. The demand of earthquake resisting building is increase.

The objective of the study is to analysis the building structure with different type of infill material wall in dynamic loading condition which is analysis by the Time history method.

The infill wall is the supported wall that closes the inner or outer perimeter of a building constructed with reinforcement concrete work like beam & column.

Therefore, the structural frame deals to transform the load to one member to another member due to these is called frame bearing function, whereas the infill wall serves to separate inner and outer space. The infill wall has the unique static function to bear its own weight.

The infill wall is an external vertical opaque type of closure. With respect to other categories of wall, the infill wall differs from the partition that serves to separate two interior spaces, yet also non-load bearing, and from the load bearing wall. The use of masonry infill walls, and to some extent veneer walls, especially in reinforced concrete frame structures, is common in many countries. In fact, the use of masonry infill walls offers an economical and durable solution. They are easy to build, attractive for architecture and has a very efficient cost-performance.

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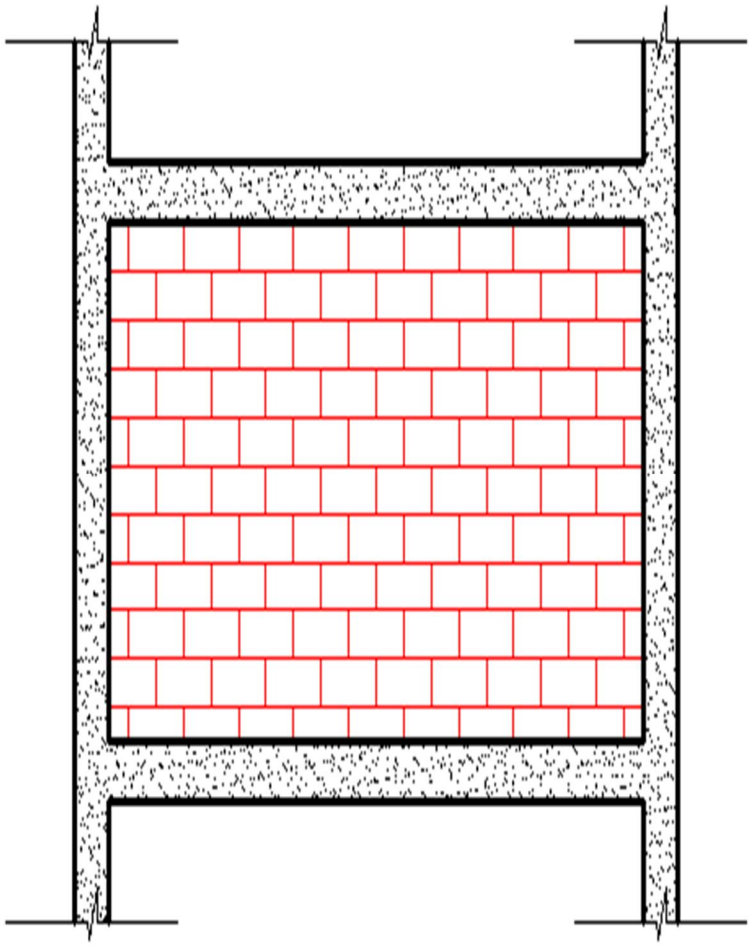

Figure 1: Masonry Infill Wall

Many researchers focuses in the behavior and impact of the infill wall in the structure during the vertical and lateral loading condition.

1) *Md Irfanullah et. al. (2013):* Masonry infill wall treated as non structure element in India . & their strength and stiffness contribution are neglected. But present of infill wall change behavior of the frame action into truss actions. In these paper three type of model as had been created , first is building without infill wall & with infill wall load , second is full infill masonry model with all story & below the plinth level , third is full infill masonry but expect below the plinth level. Provision of infill wall enhances the performance in the terms of story displacement & drift control and increases in lateral stiffness.
2) *Omprakesh et. al. (2017):* Paper focus on the investigation of the effect of infill in building & their behavior in structure using different type of infill walls. Four types of model has been modeled in the ETABS software , first is RCC frame taking infill masonry weight neglecting effect of stiffness , second is effect of stiffness is considered , third is weight of infill excluding soft ground story , fourth is weight of infill including soft ground story . Modeling has been done by equivalent brace frame as equivalent diagonal strut provided as in place of infill wall. All model perform under the static analysis, AAC block and hollow concrete block give appropriate results compare to other infill walls.
3) *Devi Priya et. al. (2017):* Paper focus on the E Shaped high rise building behavior under the consideration of effect of infill wall or without infill wall . Dynamic analysis is done for the structure . Infill wall taken as in the form of the bricks , AAC blocks , GFRS panels . Under these The model without infill wall experiences high storey displacement, storey drift and larger time period than the models with infill wall. Model with GFRG panel has comparatively less storey displacement, storey drift and time period. Base shear of models with AAC blocks and GFRG panels was significantly smaller than that with conventional clay bricks, which results in reduction in member forces which leads to reduction in required amount of area of steel to resist member forces.

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The main objective of this study is to determine the following:

a) To Determine the Analysis of a Building structure with various types of infill walls
b) To determine performance of building structure with infill walls in zones v.
c) To analyse the implementation of SRSS Method in tall structure using ETABS.
d) To compare normal conventional building with building with different infill wall building with behaviour in loading and other structure parameter.

Table 1: material description

S.NO	Description	Value
1	RED BRICK	Y= 18 KN/m^3
2	AAC BLOCKS	Y= 8 KN/m^3
3	HOLLOW CONCRETE BLOCK	Y= 14 KN/m^3
4	Tensile Strength, Ultimate Steel	500 MPa
5	Young's modulus of steel, Es	2.17x10^4 N/mm^2
6	Poisson ratio	0.17
7	GRADE OF CONCRETE	M25

Table 2: Building geometry

S.NO	Description	Value
1	Area	20 X 25 m
2	Number of bays in X direction	4
3	Number of bays in Z direction	5
4	Height of Floors	3.0 m
5	Overall height	33 m

Table 3: Load assignment

S.No.	Load Type	As per I.S.
1	Dead Load	I.S. 875-PART-1
2	Superimposed Load	I.S. 875-PART-2
3	Seismic (dynamic) response reduction	I.S. 1893-PART-1
4	Load Combinations	I.S. 875-PART-5

II. IN THIS PRESENT STUDY WE CREATE 3 TYPES OF MODEL

Table 4: TYPES OF MOADL FORMATION IN ETABS

SR NO.	TYPE OF MODAL FORMULATION IN ETABS
1.	RCC FRAME TAKING WITH INFILL WALL LOADING. (CALCULATED VALUE)
2.	RCC FRAME WITH ASSIGN INFILL WALL PROPERTIES IN ETABS.
3.	RCC FRAME WITH DIAGONAL STRUT MEMBER METHOD.

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III. LOADING CALCULATION

A. Dead Load

1) Wall Load

a) FLY ASH Brick = 0.2X 18X (3-0.5) = 9 KN / m^2

b) AAC Block = 0.2 X 8 X (3-0.5) = 4 KN / m^2

c) Hollow Concrete = 0.2 X 14 X (3-0.5) = 7 KN / m^2

2) Slab Load

a) 0.125 X 25 X 1 +1 = 4.2 KN / m^2 (Including floor finish)

3) Live Load: ASSESSABLE AREA – 2 KN / m^2

Live Load (Seismic calculation) 25% of Live load :- 0.5 kN/m^2

4) Sesmic Load: All frames are analyzed for (V) earthquake zone. The seismic load calculation are as per IS: 1893 (part-1)-2016.Seismic force parameters for proposed issue.

B. Diagonal Strut Member

For the presence of infill in our building frame modal, we can create a diagonal (strut) member in frame structure , The width of strut depends on the length of contact between the wall & the columns (αh) and between the wall & the beams (αL). The formulations for αh and αL on the basis of beam on an elastic foundation has been used given by Stafford Smith (1966). Hendry (1998) proposed the following equation to determine the equivalent or effective strut width w, where the strut is assumed to be subjected to uniform compressive stress.

$$\alpha_h = \frac{\pi}{2}\sqrt[4]{\frac{4E_f I_c h}{E_m t \sin 2\theta}}$$

$$\alpha_L = \pi\sqrt[4]{\frac{4E_f I_b L}{E_m t \sin 2\theta}}$$

$$w = \frac{1}{2}\sqrt{\alpha_h^{\,2} + \alpha_L^{\,2}}$$

Where, Em is elastic modulus of masonry wall, Ef is elastic modulus of frame material, t is thickness of infill, h is height of infill and L is length of infill, Ic is moment of inertia of the column, Ib is moment of inertia of the beam and θ = tan-1 (h/L).

SR. NO.	Parameter	Value
1.	Zone (V)	0.36
2.	Damping ratio	0.05
3.	Importance factor	1.2
4.	Response Reduction Factor	5
5.	Soil site factor	MEDUIM SOIL

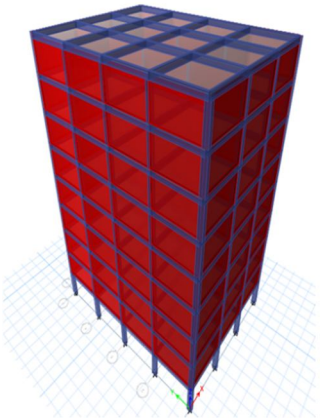

Figure 2: 3D View OF Building With Infill Wall Property

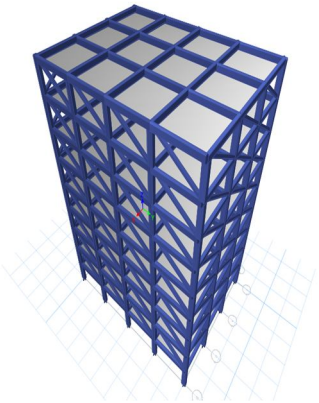

Figure 3: Etabs Modal With Strut Member

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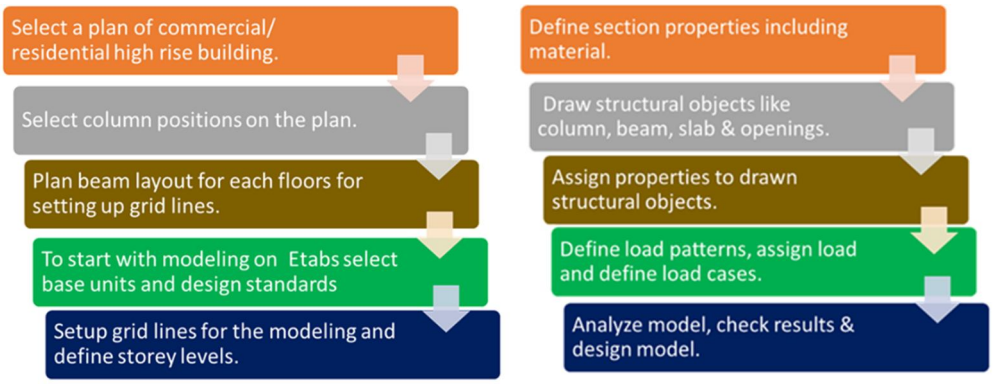
IV. FLOW CHART OF THE STUDY



A. Analysis Results

For this research work following outcomes are observed:

1) It is observed in above results that bending moment is comparatively more in bare frame, thus green sustainable frame case results in stable structure with less reinforcement requirement.

2) As bending moment is higher in bare frame results thus heavy section is required which will result in less unbalance (shear) force.

3) In the above chapter results shows that green sustainable structure is comparatively economical than bare frame by 8.4%.

V. SUMMARY

A. From the results, it has been found that displacement of structure with AAC block in all three modal cases is found less than conventional brick masonry.

B. While comparing the modals 1,2,3 for displacements in all the three models model 3 (infill frame) is having least displacement. In model 3 we have considered the strength and stiffness of material is replaced by a equivalent diagonal strut hence it has got least deflections.

C. It is observed from the results that storey shear with AAC and hollow concrete masonry is significantly less when compared to brick masonry infill panel. It is due to the light weight of AAC blocks and hollow concrete.

D. Model M-2 has more storey shear than M-1, and M-3 because Storey shear depend on stiffness of the frame. The struts in masonry infill resist the lateral seismic forces through axial compression along the strut. The contribution of infill increases the stiffness of the frame this resulting increase in seismic forces. Model M-1 has the least value of storey shear with all three types of infill materials because stiffness has not been considered in case M-1.

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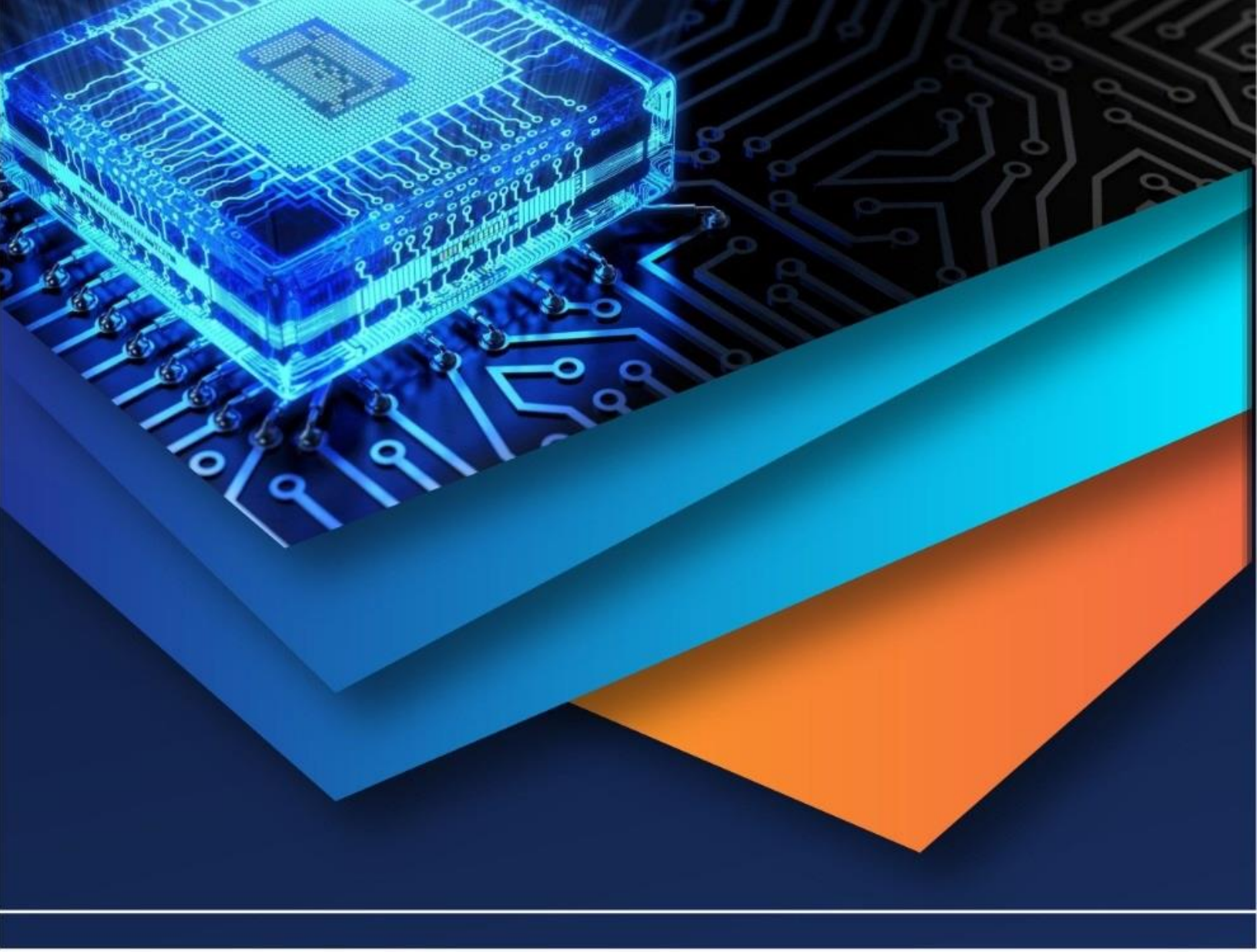

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