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Parametric Study & Seismic Analysis of AAC Block using STAAD. Pro V8i SS6

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Abstract - *In India, Now a days lightweight brick is most important component of building construction. In each seismic zones we cannot predict earthquake intensity which can affect the structures. As impact of earthquake is directly proportional to weight of building, So the building constructed using AAC block are more reliable and safer. Also AAC blocks are highly superior in terms of strength. To understand the seismic performance of autoclaved aerated concrete block in different earthquake zones for that we are doing parametric study and seismic analysis of AAC block using STAAD.Pro V8i SS6.*

Key Words: Aereated Autoclaved Concrete Block (AAC Block), STAAD.Pro V8i SS6

1. INTRODUCTION

Aerated Autoclaved Concrete block is also one of the ecofriendly and green building material. AAC block was invented in 1920s by swedish architect. Most of the part of europe used AAC block as a building material. And also it is used in other countries. Materials which has good thermal insulation capability can reduce energy consumption for indoor cooling. AAC block is currently widely used because it has good thermal capability. It has a porous structure so it lowers density and good thermal insulation. Smallest thermal conductivity value better its insulation capacity. AAC block has porous structure so it has lower density and good thermal insulation. Thermal insulation capability of materials including lightweight brick is determined by thermal conductivity and smaller conductivity value indicates better thermal insulation capacity. Autoclaved aerated concrete is a mixture of sand, cement, lime, quartzite and gypsum with minimum amount of aluminum powder as a binding material. Autoclaved manufacturing process and aluminum gas it becomes porous in nature. The round hole structure formed by following ways: By producing air bubbles, by chemical reactions also mixing with a foaming agent and mixing with air bubbles. At present most of countries used hydrogen air bubbles to produce holes by adding aluminum metal powder. It has many advantages such as lightweight, high performance thermal insulation, sound absorption and so on. Autoclaved aerated concrete block is also a new energy saving building structure. It also has good physical properties like load bearing capacity of structure. So it clear that the AAC structural system has good performance and development prospects.

2. METHODOLOGY

1. Collecting information and studying various research papers of IEEE papers
2. Collecting required materials such as AAC Blocks (Aereated Autoclaved concrete), Clay Bricks
3. Performing different Field and Laboratory Tests on AAC Blocks & Clay Brick
4. From results we compare AAC block Structure & Clay brick Structure
5. Using STAAD.Pro V8i we done Seismic Analysis of AAC Block

2.1 Collecting Required Materials

2.1.1 AAC Blocks

Fig. No. 2.1.1 AAC Blocks (From Actual Site)

AAC Blocks are Light Weight concrete Blocks this blocks are mainly compostion of Cement, sand, and Flyash. This blocks are Environmental Eco-Friendly.

2.1.2 Clay Bricks

Fig. No. 2.1.2 Clay Bricks (Google Image)

2.2 Experimental Studies:-

We perform lab test on AAC block and clay brick. The test like compressive strength test and water absorption test. The result we get then compare with each other to get expected result.

Fig. No.2.2.1 Water absorption test

Fig. No.2.2.2 Compressive test

2.3 Seismic analysis

To do seismic analysis on AAC block and clay brick we us STAAD.Pro software. STAAD.pro is a structural analysis and design software application. It can make use of various forms of analysis from the traditional static analysis to more recent analysis methods.

2.4 Analysis of Building and Building Description

It is common practice in India to adopt rectangular, circular and square shape column in any reinforced concrete structures. However this columns are subjected to moment along with axial load. Mostly the rectangular columns are used and the moments of resistance of rectangular columns are less in shorter dimensions of column. Generally rectangular shape columns are provided for low medium rise public building.

This building is planned on the basis of seismoresistant concept of planning and three dimensional analysis are carried out using equivalent static analysis method. Comparative study is done with two different cases. For this, two different models, one for clay brick and one for AAC block are considered. Analysis of the models has been carried out using software STAAD.ProV8i. The description of the cases along with the models is as follows;

Case I: building with clay brick wall

Case II: building with AAC block wall

2.5 Building Plan

Fig. 3.1 shows the plan of an building with rectangular shape of column which is consider for earthquake analysis and design. All rectangular column sizes 350 x 450 mm for all floors. All beam sizes 230 x 450 mm for all floors. At ground floor, slab is not provided and the flor is directly rest on ground. Therefore, the outer beam are provided at ground level and inner beams are provided at plinth level.

This building is located at palghar has plan dimension as shown in fig. 3.1. The analysis and design of building has been carried out for G+4 storeys. The building is located in seismic zone III on the site with hard soil.

2.6 General Description

- The building has been isolated into main block and a staircase block connected by expansion joint. The analysis and design for main block has been performed using STAAD.ProV8i.
- The main beam placed centrally on column to avoid eccentricity.
- For beam M20 grade of concrete is considered and for column M25 grade of concrete is considered.

- Sizes of beam and column are kept same for all the floors.
- Centerline dimensions are followed for analysis and design.
- The building lies in zone III.
- Seismic loads are considered to be acting in the horizontal direction and not along the vertical direction, since it is not considered to be significant.

2.7 Data for the Building

The design data is as follows:

• Dead load	
1) For all floors	1 kN/m^2
2) Floor load	3.75 kN/m^2
3) Terrace load	6.25 kN/m^2
• Live load	
1) For all floors including terrace	2 kN/m^2
2) For staircase	2.82 kN/m^2
• Location	Palghar
• Earthquake loads	As per IS-1893(part- 1): 2002
• Depth of foundation below ground	1.2m
• Type of soil	Hard soil
• Storey height	3m
• Floors	G+4
• Walls	
1) External wall	200mm thick
2) Internal wall	100mm thick
• Material properties	

Concrete:

All components unless specified in design: M20 and M25 grade

Steel:

HYSD reinforcement of grade Fe 250 and Fe 415.

2.8 Modeling of Building

2.8.1 Case I: modeling of building with brick wall

Building plans shown in fig 3.1 and fig.3.2 are considered for following model.

(a) Model 1

It is shown in fig. 3.6 is bare framed building with rectangular column.

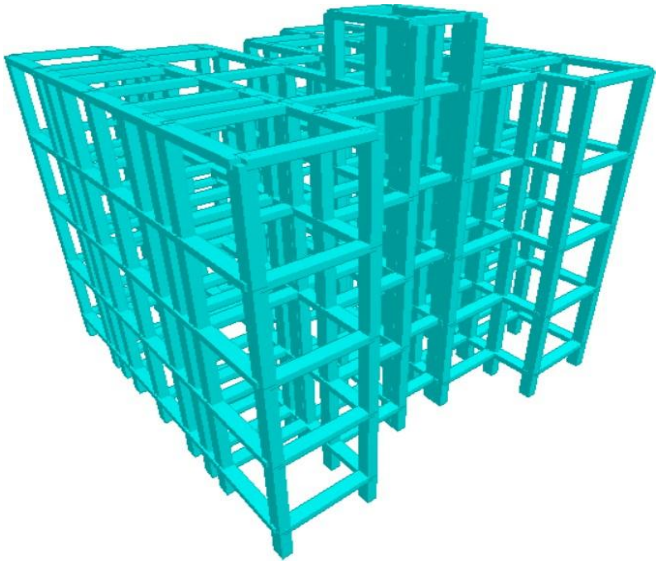

Fig. 2.8.1 bare framed building with rectangular column

2.8.2 Case II: Modeling of building with AAC blocks

Building plans shown in fig 3.1 and fig.3.2 are considered for following model.

(b) Model 2

It is shown in fig. 3.7 is bare framed building with rectangular column.

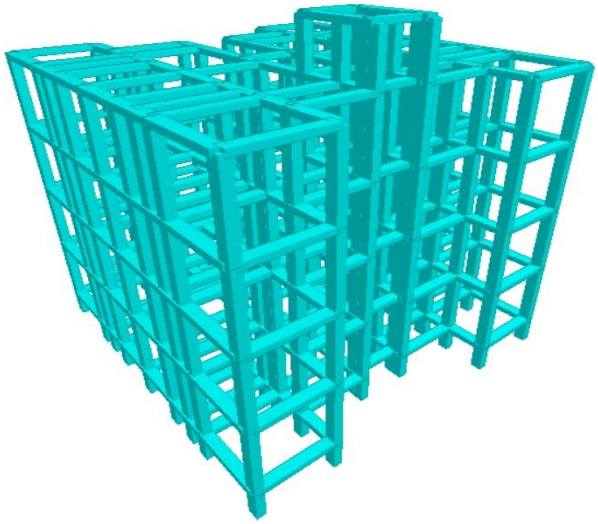

Fig. 2.8.2 bare framed building with rectangular column

2.9 Seismic Weight Calculation

All the above cases and respected models are analyzed by equivalent static analysis method. A comparative study for the following parameter: seismic behavior, quantities of reinforcement required. The calculations are shown for case I i.e. bare framed building.

The seismic weight are calculated using axial forces from 3D analysis of building. The weight of the columns and walls at any storey are equally distributed to the floors above and below the storey.

2.9.1 Design seismic load

For both the cases fundamental time period (Ta) is taken as 0.5 sec zone factor (Z) = 0.16 importance factor (I) = 1 for residential building. Medium soil site and 5% damping. Response Reduction factor R is taken equal to 5

3. Loading Diagrams

The dead load diagram on frame are shown in fig. 3.8 and 3.9 respectively

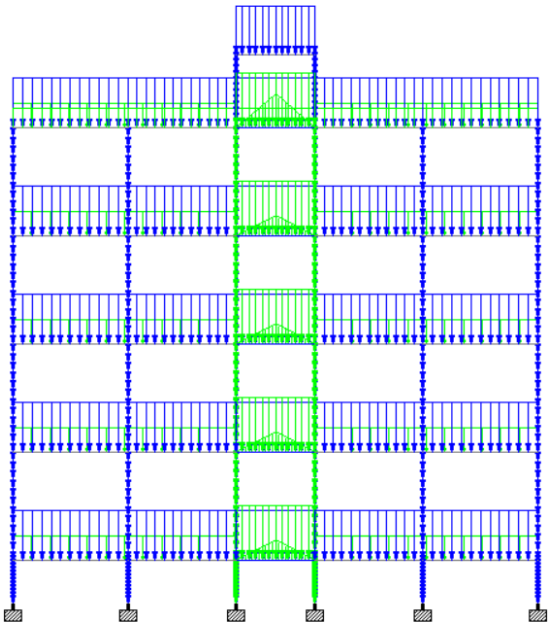

Fig. 3 Dead load diagram on frame

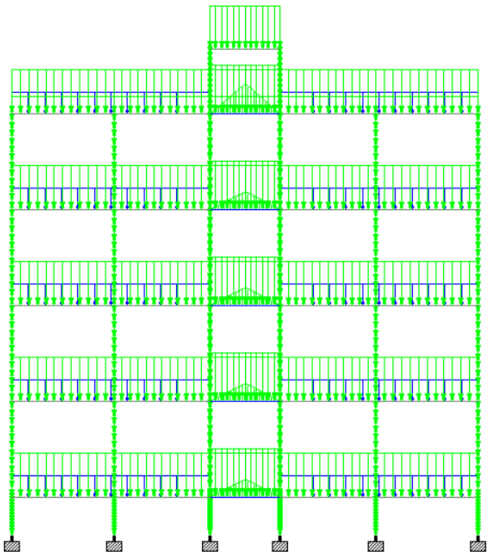

Fig. 3.1 Dead load diagram on frame

The live load diagram on frame are shown in fig. 3.10 and 3.11 respectively

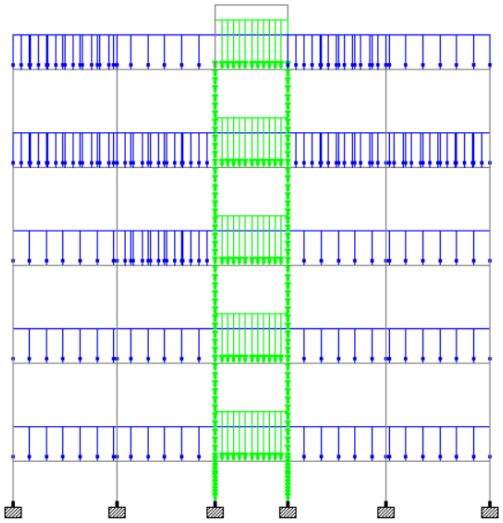

Fig. 3.2 live load on frame

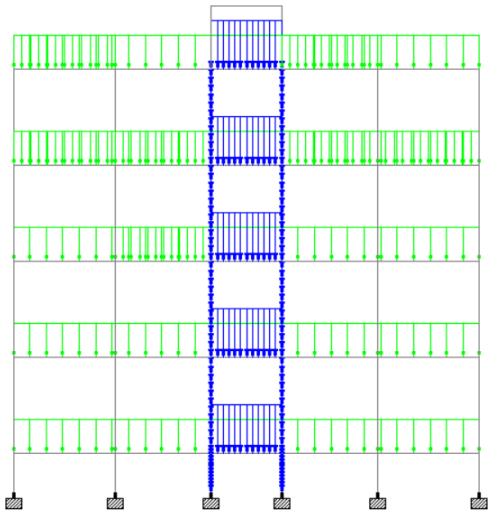

Fig. 3.3 live load on staircase

3.1 Space Frame Analysis

Two different models have been analyzed by using software STADD.ProV8i. fro each model we use four load combination is considered as shown below.

Load combination used for the design.

Load combination

- DL+LL
- DL+LL+WL
- 1.2 (DL+LL)
- 1.5 (DL+LL+WL)

The building is planned and analyzed for the two different cases as mentioned in this section. Equivalent static analysis method is adopted for the office building as described earlier. The results of the analysis are obtained from the various models by considering above mentioned load cases so as perform the design.

4. RESULT

4.1 General

Various models as explained in chapter 3 are design and analysed for all 4 load combination. The results are shown in fig. 4.1 to 4.4 forms along with cost comparison.

4.2 Comparative result of both the cases

Seismic analysis of high rise building are most important in Earthquake prone zones. Seismic analysis will help to civil engineers and contractor before construction and after construction of the structure. Which give actual strength and behavior of structure and it directly minimize the risk of Human lives.

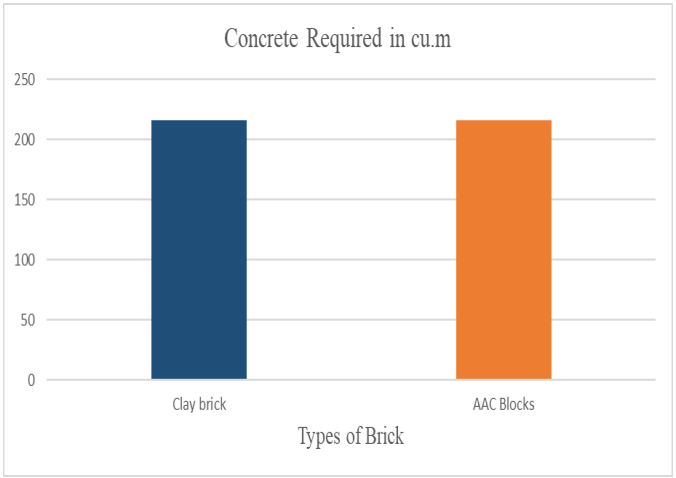

Fig. 4 Comparison of concrete requirement in both the cases

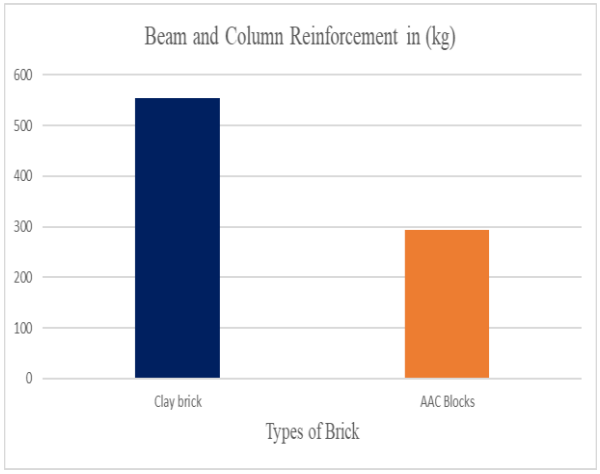

Fig. 4.1 Comparison of reinforcement requirement in both the cases

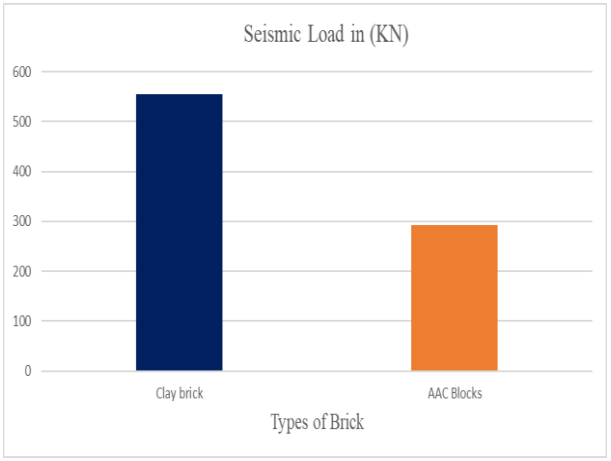

Fig. 4.2 Comparison of seismic load on both the cases

4.3 Comparison of Result

Through our analysis and comparison, we have managed to find conclusions. As our aim is to find the seismic behaviorof clay brick and AAC block we find that the result that is clay brick take more seismic load than AAC block. But according to reaction time, requirement of reinforcement, number of block requirement is less so we can use AAC block in future construction.

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