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# PARAMETRIC ANALYSIS OF CONVENTIONAL CLAY BRICK vs AAC BLOCK IN G+3 RCC FRAMED STRUCTURE

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***Abstract:*** In today's conditions, the importance of economical design in buildings is even more significant. With rising construction costs and limited resources, designing buildings that are cost-effective is crucial. It allows for the efficient use of materials and resources, reducing waste and environmental impact. Additionally, economical design promotes energy efficiency, which is essential in today's focus on sustainability and reducing carbon footprint. By incorporating economical design principles, we can create buildings that are not only affordable but also environmentally responsible.

This project includes the analysis, design of structure, comparing between autoclave aerated concrete and conventional brick in the form of steel consumptions. We have structurally designed a building, each time using AAC blocks and clay bricks separately. After the complete analysis, we witnessed various differences.

***Index Terms* – economical design, efficient use of materials, autoclave aerated concrete, conventional brick.**

## I. INTRODUCTION

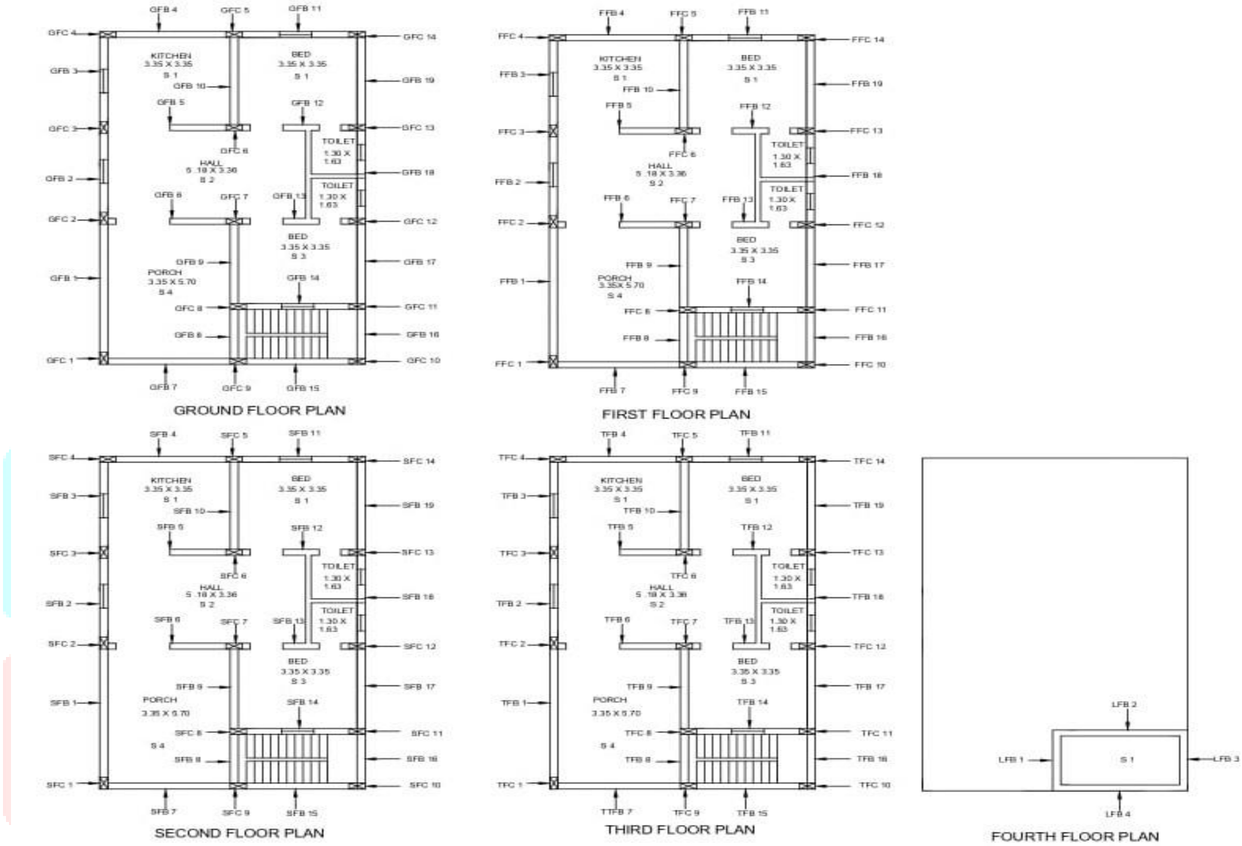
The importance of economical design in buildings is that it helps to minimize construction costs while maximizing efficiency. It involves finding ways to optimize materials, layout, and energy usage to achieve cost savings without compromising safety or functionality. The materials we have used are AAC blocks and burnt clay bricks and compared them throughout in and out. Clay bricks have been used in construction for centuries and are known for their strength and durability. Clay bricks provide excellent load-bearing capacity and are resistant to fire, pests, and weathering. They have a longer lifespan and can withstand harsh conditions. They have a higher compressive strength compared to AAC blocks, making them suitable for load-bearing structures. Clay bricks also have a longer lifespan and require less maintenance compared to AAC blocks.

On the other hand, AAC (Autoclaved Aerated Concrete) blocks are a relatively newer alternative. They are made from a mixture of cement, lime, sand, and water, with the addition of a foaming agent. The mixture is then poured into molds and cured in an autoclave, which creates air pockets within the blocks. This makes them lightweight and provides good thermal insulation properties.

## II. OBJECTIVES:

1. TO STUDY THE PHYSICAL AND MECHANICAL PROPERTIES OF BOTH MATERIALS.
2. TO STUDY THE STAAD PRO. SOFTWARE FOR RCC DESIGN
3. COMPARATIVES ANALYSIS OF MULTI-STORY RCC BUILDING WITH ACC BLOCKS AND CONVENTIONAL BLOCKS.

## III. PLAN OF BUILDING.




## IV. DESIGN CALCULATION LIMIT STATE METHOD OF DESIGN

THE LIMIT STATE METHOD OF DESIGN IS ALSO KNOWN AS THE LOAD AND RESISTANCE FACTOR METHOD OF DESIGNING STRUCTURES. THE LIMIT STATE METHOD OF DESIGN IS BASED ON A FEW LIMIT STATE PARAMETERS OF STRUCTURES, WHICH CONSIST OF THE LIMIT OF THE STRENGTH OF THE MATERIAL USED FOR THE DESIGN. A LIMIT STATE IS A STATE OF IMPENDING FAILURE, BEYOND WHICH A STRUCTURE CEASES TO PERFORM ITS INTENDED FUNCTION SATISFACTORILY, IN TERMS OF EITHER SAFETY OF SERVICEABILITY I.E. IT EITHER COLLAPSES OR BECOMES UNSERVICEABLE.

- DESIGN OF SLAB: ALL FLOOR

Table 1 Schedule of slab: ALL FLOOR

| Slab NO. | Depth mm | Short span steel Dia. (mm) – Spacing (mm) | Short span steel Dia. (mm) – Spacing (mm) | Remark |
|---|---|---|---|---|
| S1 | 150 | # 10 - 300 | # 10 - 300 | Two Way |
| S2 | 150 | # 10 - 300 | # 10 - 340 | One Way |
| S3 | 140 | # 10 - 170 | # 10 - 300 | Two Way |
| S4 | 110 | # 10 - 240 | # 10 - 240 | Two Way |

- DESIGN OF BEAM: ALL FLOOR

Table 2 Schedule of beams: ALL FLOOR

| Beam No. | Size (mm) | AAC Block | |
|---|---|---|---|
| | | Steel in Compression | Steel |
| 1 | 230 x 450 | 3 # 16 + 1 # 10 | 4 # 20 + 1 # 12 |
| 2 | 230 x 300 | 2 # 10 | 3 # 16 |
| 3 | 230 x 300 | 2 # 10 | 3 # 16 |
| 4 | 230 x 300 | 2 # 10 | 3 # 16 |
| 5 | 230 x 300 | 2 # 10 | 3 # 16 |
| 6 | 230 x 300 | 3 # 10 | 3 # 16 + 1 # 12 |
| 7 | 230 x 300 | 2 # 10 | 3 # 16 |
| 8 | 230 x 300 | 2 # 10 | 3 # 16 |

| | | | |
|---|---|---|---|
| **9** | 230 x 300 | 3 # 12 + 1 # 10 | 4 # 16 + 1 # 12 |
| **10** | 230 x 300 | 2 # 10 | 3 # 16 + 1 # 12 |
| **11** | 230 x 300 | 2 # 10 | 3 # 16 |
| **12** | 230 x 300 | 2 # 10 | 3 # 16 |
| **13** | 230 x 300 | 2 # 10 | 3 # 16 |
| **14** | 230 x 300 | 2 # 10 | 3 # 16 |
| **15** | 230 x 300 | 2 # 10 | 3 # 16 |
| **16** | 230 x 300 | 2 # 10 | 3 # 16 |
| **17** | 230 x 300 | 2 # 10 | 3 # 16 |
| **18** | 230 x 300 | 2 # 10 | 3 # 16 |
| **19** | 230 x 300 | 2 # 10 | 3 # 16 |

- DESIGN OF COLUMN AND FOOTING OF AAC BLOCK BUILDING:

Table 3 Schedule of column and footing of AAC Block building.

- DESIGN OF COLUMN AND FOOTING OF BURNT CLAY BRICK:

| COLUMN NUMBERS | | 10,4,14 | 13,12,11,9,3 | 1,2,5,6,8 | 6 | 7 |
|---|---|---|---|---|---|---|
| PCC M10 | Thickness:100mm | 2250x2250 | 2250 x 2250 | 2500x2500 | 2500x2500 | 2500x2500 |
| RCC Footing | Size : L x B | 1950x1950 | 1950 x 1950 | 2300x2300 | 2300x2300 | 2300x2300 |
| | Depth : | 1300 | 1300 | 1600 | 1600 | 1600 |
| | Steel: along length | Φ10 @220 | Φ10 @220 | Φ10 @220 | Φ10 @220 | Φ10 @220 |
| | along width | Φ10 @220 | Φ10 @220 | Φ10 @220 | Φ10 @220 | Φ10 @220 |
| Column between footing to plinth | Size : b x D | 230 x 450 | 230 x 600 | 230 x 750 | 230 x 600 | 230 x 900 |
| | Steel : | 6 # 16 | 8 # 16 | 6 # 20 | 6 # 20 | 8 # 20 |
| Plinth to ground floor | Size : b x D | 230 x 450 | 230 x 600 | 230 x 750 | 230 x 600 | 230 x 900 |
| | Steel : | 6 # 16 | 8 # 16 | 6 # 20 | 6 # 20 | 8 # 20 |
| Ground floor to 1st floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 525 | 230 x 600 | 230 x 675 |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 8 # 16 | 8 # 16 |
| 1st floor to 2nd floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 |
| | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 |

| COLUMN NUMBERS | | 4,14 | 10 | 3,9,11,12,13 | 1,2,5,6,8 | 7 |
|---|---|---|---|---|---|---|
| PCC M10 | Thickness:100 mm | 2200 x2200 | 2200x2200 | 1950x1950 | 1950x1950 | 1950x1950 |
| RCC Footing | Size : L x B | 900x1900 | 1900x1900 | 1650x1650 | 1650x1650 | 1650x1650 |
| | Depth : | 1310 | 1310 | 1100 | 1100 | 1100 |
| | Steel: along Length | Φ10 @260 | Φ10 @260 | Φ10 @220 | Φ10 @220 | Φ10 @220 |
| | along width | Φ10 @260 | Φ10 @260 | Φ10 @220 | Φ10 @220 | Φ10 @220 |
| Column between footing to plinth | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 600 | 230 x 600 |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 8 # 16 | 8 # 16 |
| Plinth to ground floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 600 | 230 x 600 |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 8 # 16 | 8 # 16 |
| Ground floor to 1st floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 600 |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 | 8 # 16 |
| 1st floor to 2nd floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 |
| 2nd floor to 3 rd floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 | 230 x 450 |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 |
| 3rd floor to top floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | | |
| 2nd floor to 3rd floor | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 | 6 # 16 |
| 3rd floor to top floor | Size : b x D | 230 x 450 | 230 x 450 | 230 x 450 | | |
| | Steel : | 6 # 16 | 6 # 16 | 6 # 16 | | |

Table 4 Schedule of column and footing of Burnt Clay Brick building.

After the manually calculation of design of building components, we verify this calculation with STAAD-Pro Software design calculation to check whether any mistakes happened during manual calculation.

- **Validation of calculations:**

Table 5 Validation of calculations.

| Sr. No. | Component | | Manual calculation | | STAAD. Pro calculation | |
|---|---|---|---|---|---|---|
| 1 | Slab (S1) Top level | Depth | 150 mm | | 150 mm | |
| | | steel | #10 @ 300 mm | | #8 @ 275 mm | |
| 2 | Beam (B2) Ground beam | Size | 230 x 300 mm | | 230 x 380 mm | |
| | | Steel | 2 # 10 | 3# 16 | 2 # 16 | 2 # 16 |
| 3 | Column between footing to plinth (C4) | Size | 230 x 450 | | 230 x 380 | |
| | | Steel | 6 # 16 | | 8 # 12 | |
| | Plinth to ground floor | Size | 230 x 450 | | 230 x 380 | |
| | | Steel | 6 # 16 | | 8 # 12 | |
| | Ground floor to 1 1st floor | Size | 230 x 450 | | 230 x 380 | |
| | | Steel | 6 # 16 | | 8 # 12 | |
| | 1st floor to 2nd floor | Size | 230 x 450 | | 230 x 380 | |
| | | Steel | 6 # 16 | | 8 # 12 | |
| | 2nd floor to 3rd floor | Size | 230 x 450 | | 230 x 380 | |
| | | Steel | 6 # 16 | | 8 # 12 | |
| 4 | Footing (F4) | Size | 1900 x 1900 mm | | 1300 x 1150 mm | |
| | | Steel | #10 @ 220 mm | | #10 @ 220 mm | |

## V. RESULTS AND DISCUSSION

After doing the comparison between use of AAC blocks and burnt clay brick materials in building construction. We conclude the percentage of steel quantity is reduced up to 25 – 30 % in structure. As per IS specification for minimum size of section there is no change in section for both conditions. So, we can prefer AAC block material in high rise building construction to achieve economy and to minimize the time of completio After doing the comparison between use of AAC blocks and burnt clay brick materials in building construction. We conclude the percentage of steel quantity is reduced up to 25 – 30 % in structure. As per IS specification for minimum size of section there is no change in section for both conditions.

So, we can prefer AAC block material in high rise building construction to achieve economy and to minimize the time of completion.

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