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Comparative Study of Physical Properties of Different types of Bricks Used in Construction

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Abstract *- In this study, an effort has been made to compare mainly three different types of bricks available in the market. Four physical test are performed on the bricks: compressive strength test, water absorption test and thermal conductivity test. All the three bricks have different dry density. From the dry density, dead load from a wall made of these three bricks are compared. End moments on supporting beam are also compared. Moreover, cost comparison is made for constructing a wall made of these different bricks. Different results and properties are discussed and compared in the discussion section. Other characteristics from visual inspections are also discussed.*

Keywords*: compressive strength, dry density, water absorption, thermal conductivity.*

I. INTRODUCTION

Presently, many different types of bricks are being used for building walls.All the bricks vary in their properties and price. The widely used materials for building walls are burnt clay brick, fly ash brick (FAB) and autoclave aerated concrete (AAC) blocks. It is necessary to find the most suitable brick for the construction purpose.

1.1. Burnt Clay brick

Clay is one of the most abundant natural mineral materials on earth. For brick manufacturing, clay must possess some specific properties and characteristics. It has been established that the use of clay bricks provide a superior and comfortable physical living environment than the use of other materials as far as residential construction is concerned. Despite all initiatives to introduce alternative walling materials like compressed earth block, concrete/stone Crete block and fly-ash brick, it is envisaged that burnt clay bricks would still occupy the dominant position. Fig 1 shows the approximate composition of a burnt clay brick with the proportion of the raw materials.

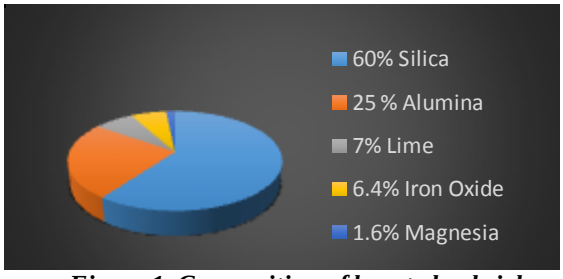

Figure 1. Composition of burnt clay bricks

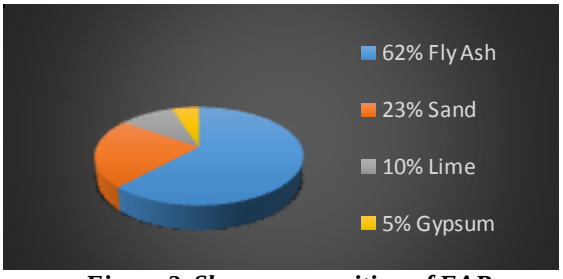

Figure 2. Shows composition of FAB

1.2. Fly Ash Brick

Bureau of Indian standards has issued code IS: 12894-2002 for ash brick.Pulverized fuel ash commonly known as fly ash is a useful by-product from thermal power stations using pulverized coal as fuel and has considerable pozzolonic activity. This national resource has been gainfully utilized for manufacture of FABas a supplement to common burnt clay buildings bricks leading to conservation of natural resources and improvement in environment quality.Fig 2 shows the composition of a FAB with the proportion of the raw materials.

1.3. AACBlocks

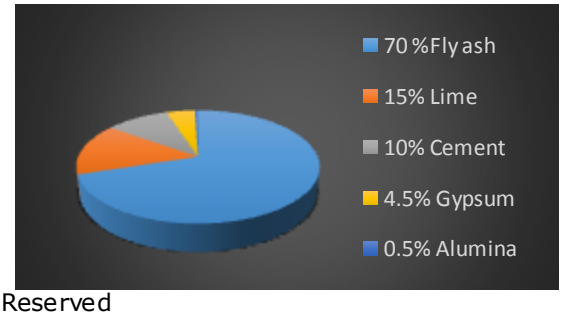

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Figure 3. Composition of an AAC Block

AAC is a steam-cured mix of sand or pulverized fuel ash (PFA), cement, lime, and an aeration agent. The high-pressure steam-curing in autoclaves achieves a physically and chemically stable product with density being one fifth of normal concrete. . Fig 3 shows the composition of an AAC block with the proportion of the raw materials. AAC comprises myriads of tiny non-connecting air bubbles which give AAC its incredibly diverse qualities and make it such a terrific insulator. It offers a unique combination of strength, low weight, thermal insulation, sound absorption, unsurpassed fire resistance and unprecedented build ability. AAC is a natural and non-toxic construction material, saves energy, and is friendly to your environment

II. SCOPE OF THE WORK

The scope of work includes four tests on the three bricks and cost comparison as mentioned below:

A. Determination of compressive strength
(as per IS:3495:part-1:1992)
B. Determination of water absorption
(as per IS:3495:part-2:1992)
C. Calculate dry density
D. Determination of thermal conductivity
E. Comparison of end reactions of supporting beam due to dead load of wall
F. Cost comparison

III. METHODOLOGY

3.1. Compressive strength

The test was performedas per the method mentioned in IS:3495:Part-2:1992. 6 specimens of each type of brick were used. The final results were obtainedby taking the average value of the 6 results.

3.2. Water Absorption test

The test was performed as per the method mentioned in IS 3495 part 2 1992. 6 specimens of each type of brick were used. The final results were obtained by taking the average value of the 6 results.

3.3. Dry Density test

Dry density was measured by taking the ratio of dry weight and volume of the bricks. Six samples were weighed and the average of sixsamples was taken as dry density.

3.4. Thermal Conductivity

Tests on thermal conductivity were not performed. The results from published papers were taken directly for the comparison.

3.5. Fire resistance

Tests on fire resistance were not performed. The results from published papers were taken directly for the comparison.

3.6. Sound insulation

Tests on sound insulation were not performed. The results from published papers were taken directly for the comparison.

3.7. Dead load

For dead load comparison a wall 6 m in length, 3 m in height and 0.2m thick is considered. The supporting beam is considered to be a fixed end beam. The total UDL, and end reactions because of the different bricks are discussed in the results section.

3.8. Cost comparison

The average prices per brick in local market in Surat for each type of bricks are ☐6.5(9x19x9cm), ☐4.5(9x19x9cm) and ☐171(65x24x20cm)for burnt clay brick, FAB and AAC respectively. The cost of mortaris taken as 160☐/m^2. The results are discussed in the results section. The cost of one brick includes the transportation charges and additional taxes. The mortar thickness is considered as 10 mm.

IV. TEST RESULTS

4.1. Compressive strength

Results of the test on water absorption of different bricks are mentioned in figure-4:

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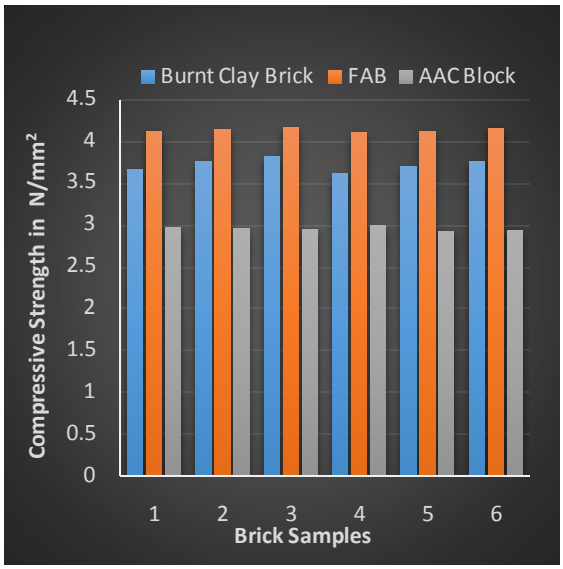

Figure 4. Compressive strength of bricks

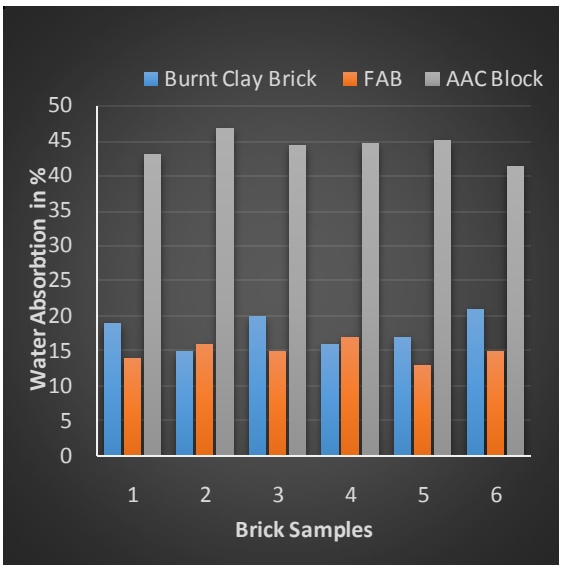

Figure 5.Results of water absorption test

4.2. Water Absorption test

Results of the test on water absorption of different bricks are mentioned in figure-5:

4.3. Dry Density test

Results of the test on dry density of different bricks are mentioned in figure-6:

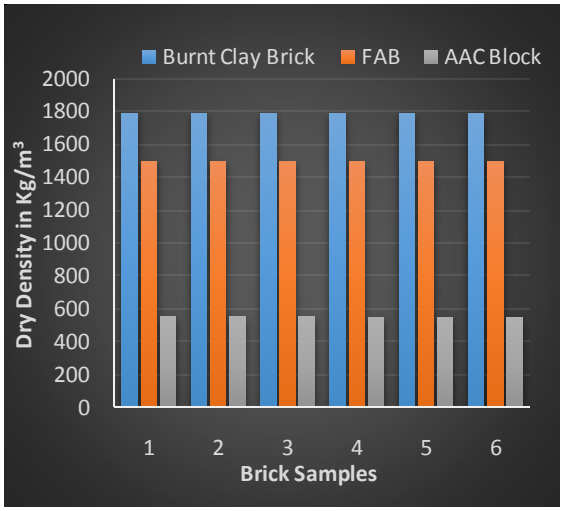

Figure 6.Result of dry density test

V. Discussion

5.1. Compressive strength

From the data analysis it is obtained that AAC blocks has lowest compressive strength as its 80%of volume is made of air. Whereas burnt clay has high compressive strength as it is highly dense. The highest compressive strength was seen in fly ash bricks as it contains 62% by weight of fly ash materials.

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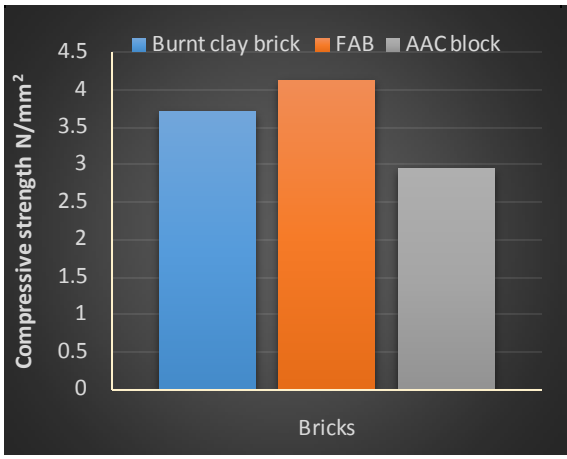

Figure 7. Comparison of compressive strength

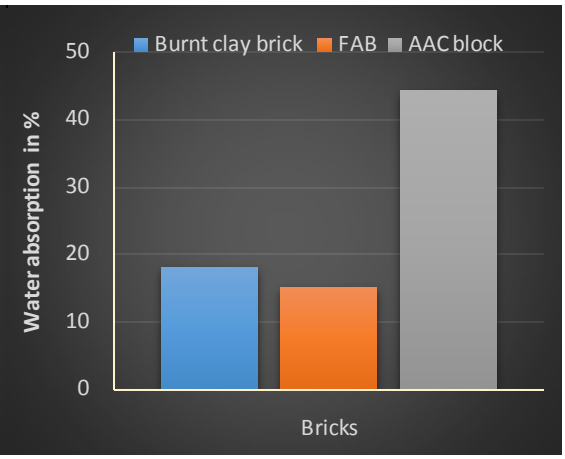

Figure 8. Comparison of Water Absorption

5.2. Water absorption

AAC blocks were found to have highest water absorption as it is highly porous. Whereas fly ash bricks and burnt clay bricks had low water absorption as they are highly dense and least porous.

5.3. Dry Density

Density of burnt brick is highest as it is made of 60% by weight of silica which is heavier than fly ash particles. So Fly ash bricks have lower density then burnt clay bricks as it contains 62% by weight of fly ash and AAC blocks has lowest density as they constitute 80% of air by volume and also 70% by weight of fly ash.

5.4. Thermal Conductivity

As the bulk density of burnt clay bricks is highest, it has the highest thermal conductivity and less for fly as brick as they are less dense and least for A.A.C blocks as they are least dense.

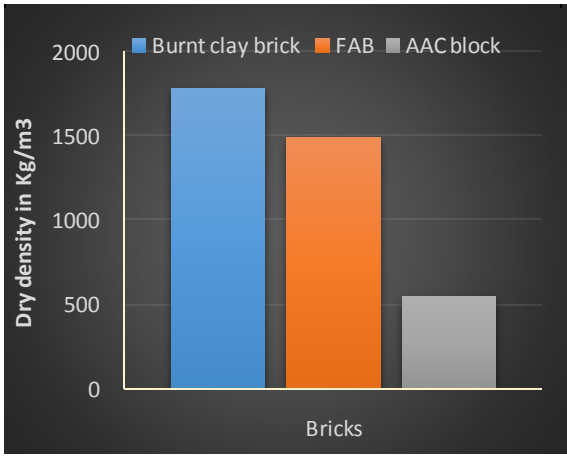

Figure 9. Comparison of Dry Density

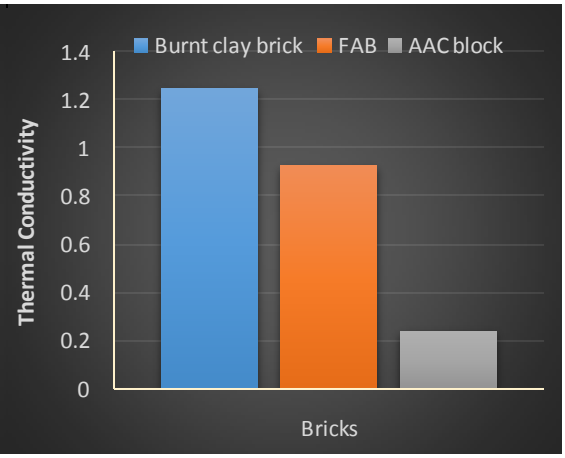

Figure 10. Comparison of Thermal Conductivity

5.5. Fire resistance

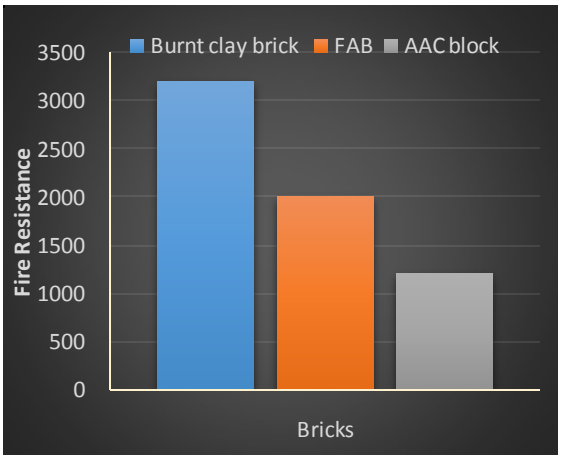

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Figure 11. Comparison of Fire Resistance

Table 1. Bending moments in beam supporting wall constructed from different bricks

Wall material	Bending Moment at ends KN-m	Bending Moment at centre KN-m
Burnt clay bricks	48.24	24.12
FAB	40.35	20.17
AAC blocks	14.877	7.43

5.6. Dead load

From the volume of the wall and the dry density of the bricks, UDL on the supporting beam turns out to be 10.72 KN/m, 8.97 KN/m and 3.31 KN/m for the burnt clay bricks, FAB and AAC blocks respectively. The bending moments at ends and at the centre of the beam is mentioned in table-1:

5.7. Costcomparison

The cost comparison of different bricks for constructing a wall of 6 m length, 3 m height and 0.2 m thickness is shown in table-2.

Table 2. Cost comparison for 6x3x0.2 m wall

Type of brick	**Size HxLxt cm**	**No of bricks reqd.**	**Cost Of plaster** □	**Total Cost** □
Burnt Clay Brick	9x19x9	1858	2880	13550
FAB	9x19x9	1858	2880	11241
AACBlocks	65x24x20	112	0	19152

5.8. Other Characteristics

Apart from the tests, other characteristics of the different bricks are mentioned in table-3.

Table 3 other characteristics of different bricks

Charact-eristic	**Burnt Clay brick**	**FAB**	**AAC block**
Shape	Uniform	Rough	5 times more in edge
Solidity	Excellent	Uniform	Optimum
Product-ivity In Construction	Less Compared To AAC	Same as Burnt clay	More Compared To others
Plaster Finish quality	Excellent	Bad	Good

VI. CONCLUSION

From the cost comparison, it is observed that the cost of constructing a wall with Fly ash brick is the least, whereas for autoclaved aerated blocks it is the highest. But at the same time, AAC blocks have smooth finish which does not require plaster. So the cost of plaster can be saved in case of AAC blocks. AAC blocks gives higher rate productivity as they are the lightest. Because of its light nature, shifting of material on site becomes easier. Another advantage of a

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wall constructed with AAC blocks is the reduced dead load on the supporting beam. Because of the reduced dead load, the RCC design becomes lighter.

VII. REFERENCES

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