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"Eco-Friendly Building Materials: A Study of AAC Blocks Utilizing Waste Materials"

Prof. Pramod R. Thorat[1], Miss. Priyanka D. Salunkhe[2], Mr. Siddhant S. Waghmare[3], Mr. Kiran L. Shinde[4], Mr. Sagar S. Nangare[5], Mr. Pramod M. Pukale[6].

Asst. Professor, Dept. of Civil Engineering, AITRC, Vita, Maharashtra, India.[1]

Students, Dept. of Civil Engineering, AITRC, Vita, Maharashtra, India.[2,3,4,5,6]

Abstract: This study use of foundry sand, sugarcane bagasse ash, and fly ash may be used to create AAC blocks. This study's goal was to identify the created blocks' qualities and contrast them with those of standard bricks. The ideal mix of waste materials for creating blocks was another goal of the study. Fly ash, foundry sand, and various amounts of SCBA were used in different ratios, and examples were cast and cured in accordance with industry standards. At 28 days, the specimens underwent tests for compressive strength, density, and water absorption. The findings demonstrated that the recently created AAC blocks had favourable comparisons with concrete Block and had sufficient qualities.

Keywords: Baggase ash, Foundry sand, Compression, Water absorption, AAC Block

I. INTRODUCTION

Industrial waste is any substance that is made unusable during a production process, including that of factories, mills, and mining operations. It is a waste product of industrial activity. Solid, semi-solid, or liquid industrial waste are all possible. It might be either harmful or non-hazardous trash. Industrial waste may affect ground water, lakes, streams, rivers, and coastal waters in addition to damaging the local soil and adjoining water bodies. The trash produced includes press mud, bagasse, fly ash from bagasse, sugar cane, sugar beet mud, sugar beet pulp molasses, and other materials. If these wastes are kept in open areas, they pollute the ecosystem and put the public's health at risk for various diseases.

II. OBJECTIVE

1. To identify the Compressive Strength AAC with different proportion of bagasse ash and Foundry Sand.
2. To identify the water absorption of AAC with different proportion of bagasse ash and foundry Sand.
3. To determine the weight of AAC with different proportion of bagasse ash and Foundry Sand.
4. To compare the production cost between AAC block and Concrete block.
5. To find out the proportions of bagasse ash and foundry sand to get better strength.

III. EXPERIMENTAL WORK

1. Materials used

1.1. Cement - The cement used in this project had an IS mark 53 grade and was tested in accordance with IS: 8112-1989 Table 1.

1.2. Foundry sand (FS) is an industrial by-product that was previously disposed of but is now being evaluated for useful use. Foundry sand is a by-product of the ferrous and nonferrous metal casting industries. It consists of a blend of premium size-specific silica sand, various binders, and small quantities of ferrous and nonferrous casting process impurities. Additionally, the FS's physical & chemical properties are discussed in the Table 2.

1.3. A fibre known as sugarcane bagasse (SCBA) is made from the day-old sugar cane that is still present after sugar has been extracted from it. In fact, it may even be used in place of certain Portland cement. The FS's physical and chemical properties are explained in the Table 3

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Figure1.1- Row material used in AAC Block

1.4 Fly ash (FA) A by-product of industry called fly ash (FA) is utilised in building to save expenses. The density of fly ash ranges from 400 to 1800 kg/m3. It provides thermal insulation, fire protection, and sound absorption. The fly ash utilised is Class C, has an ignition loss of no more than 6%, and contains 20% lime (CaO).

1.5 Limestone includes calcite and aragonite. You may either buy powdered limestone from a merchant or crush it to a fine powder at an AAC factory.

1.6 Aluminium is an expansion agent. When the raw material reacts with aluminium powder, air bubble introduced due to reaction between calcium hydroxide, aluminium and water and hydrogen gas is released.

1.7 Gypsum is added in a small of quantity because the use of the gypsum is the casting material is workable and the block cutting process is done by smoothly and carefully.

Figure1.1- AAC Block

2. Mix proportion, procedure:-
To find the ideal blend of waste materials for building blocks, the SCBA, foundry sand, and fly ash were combined in a variety of ratios. The specimens were cast in conventional blocks measuring 150x100x70mm [IS 2185 (Part 3) - 1984] each. Compressive strength, density, and water absorption tests were performed on the specimens after a 28-day curing period.

Analysis of the test findings led to a comparison between the generated blocks' qualities and those of concrete blockThese blocks were analysed for both mechanical & durability properties of the concrete blocks. And the mix proportions were shown in the Tables 4 & 5.

Table 1 Properties of Cement

Sr.no	Property of cement	Result
1	Normal consistency	29.1%
2	Initial setting time	85 min
3	Final setting Time	380Min
4	Specific gravity	3.20

Table 2 Properties of Foundry Sand FS.

S. No.	Properties	Value
1	Specific gravity	2.52
2	Bulk relative density kg/m3	2489
3	Finesses Modulus	1.95
4	Moisture content	0.12

Table 3 Property of Sugar Cane Bagasse ash SCBA.

S.No.	Properties	
1	Colour	Burnish Black
2	Specific Gravity	2.53
3	Density	1.90 g/cm^3

Table 4 Mix proportions for Baggasse ash

Mixes Coarse	Cement (gm)	Fly ash (gm)	Gypsum (gm)	Limestone powder (gm)	Aluminium Powder (gm)	Baggasse ash (gm)	Water (ml)
0%	480	2350	30	240	5	0	1500
5%	480	2292	30	240	5	58	1500
10%	480	2233	30	240	5	117.9	1500
15%	480	2174	30	240	5	176	1500
20%	480	2115	30	240	5	235	1500

Table 5 Mix proportions for Foundry sand

Mixes Coarse	Cement (gm)	Fly ash (gm)	Gypsum (gm)	Limestone powder (gm)	Aluminium Powder (gm)	Foundry sand (gm)	Water (ml)
0%	480	2350	30	240	5	0	1500
10%	480	2115	30	240	5	235	1500
20%	480	1880	30	240	5	470	1500
30%	480	1645	30	240	5	750	1500
40%	480	1410	30	240	5	940	1500

IV. RESULTS AND DISCUSSION

4.1. Compression strength
Blocks are moulded with a 500x200x100 mm of size to define the compression strength of blocks. This testing was done for a period of 28 days as per IS 2185 (Part 3) - 1984.

The compressions strength is done for all the specimens for 28 days. Table 5 & 6 shows the compression strength of concrete blocks. The test results showed that the developed blocks had satisfactory properties. The study also found that the optimal proportions of SCBA & foundry sand or making blocks were 5%, 30%, and 40%, respectively.

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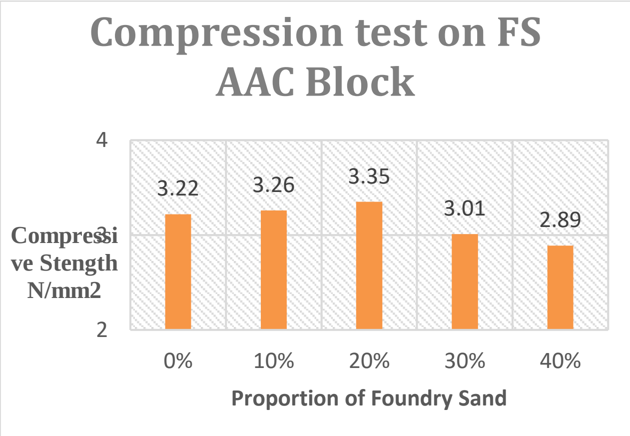
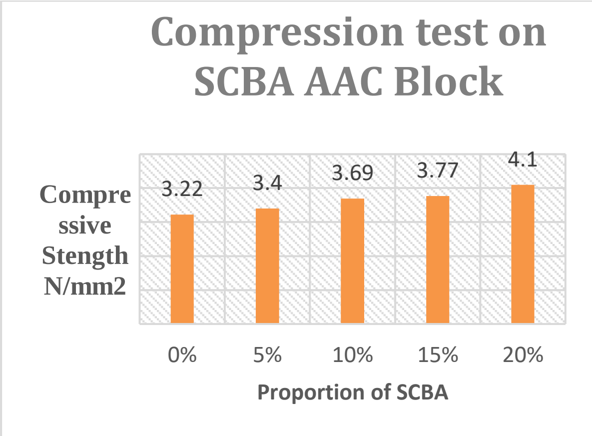
Table 5 Compression strength test for SCBA & FS Blocks

Mixes of SCBA	Compression strength (N/mm^2)
0%	3.22
5%	3.26
10%	3.35
15%	3.01
20%	2.89

Mixes of FS	Compression strength (N/mm^2)
0%	3.22
10%	3.40
20%	3.69
30%	3.77
40%	4.10





Graph No.1 Compression strength of AAC Block with varying % of SCBA

Graph No.2 Compression strength of AAC Block with varying % of FS

4.2. Water absorption.

The water absorption of several concrete block mixtures was tested, and based on the findings, we concluded that adding more fly ash and foundry sand decreased water absorption. As foundry sand and fly ash were added, water absorption gradually reduced. The table also displays the outcomes. In essence, this test is done to find out how well a block can absorb water.

After the casting process is complete, the specimen must spend 24 hours in an oven set at a constant temperature of 105 °C, during which time it must be weighed and recorded as w1. Next, the specimen must be removed and submerged in water for 24 hours. The specimen should be taken out, dry-wiped, weighed, and the value should be recorded as W2. And the formula will allow you to calculate the percentage of water absorption. The water absorption of the blocks ranged from 18.20% to 20.10%.

The formula for finding the percentage of the water absorption,

Water absorption % = 100(W2-W1)/W1

Table 6 Water absorption test for SCBA & FS Blocks

Mixes of SCBA	Water Absorption (%) 28 Days
0%	18.35
5%	19.36
10%	20.12
15%	17.58
20%	18.56

Mixes of FS	Water Absorption (%) 28 Days
0%	18.35
10%	22.42
20%	23.72
30%	21.86
40%	19.03

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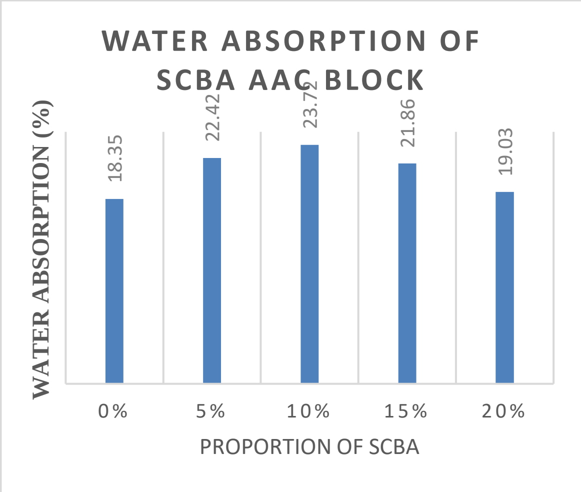
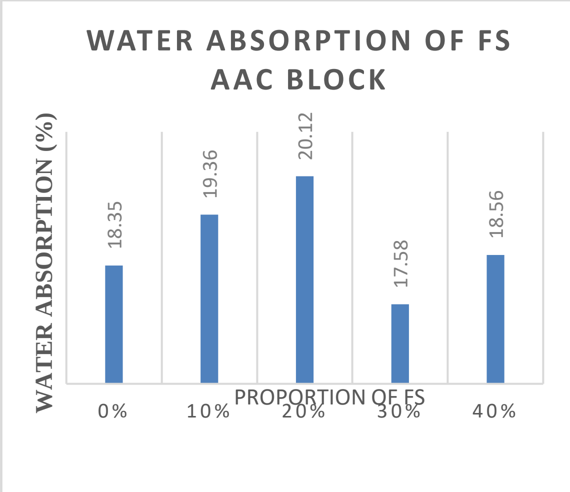


Graph No.3 Water Absorption of AAC Block with varying % of SCBA



Graph No.4 Water Absorption of AAC Block with varying % of FS

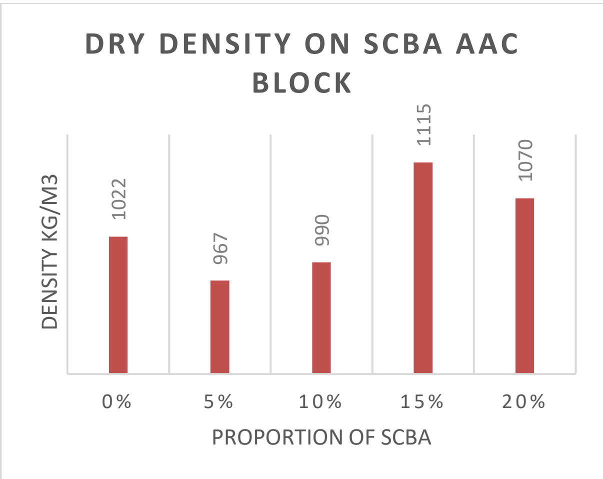
4.3. Dry Density-

The dry weight of the blocks ranged from 0.950 to 1.105 kg with use of different % of SCBA while 1.022 to 1.9 kg with use of different % of FS as shown in Table No.09 & 10 respectively.

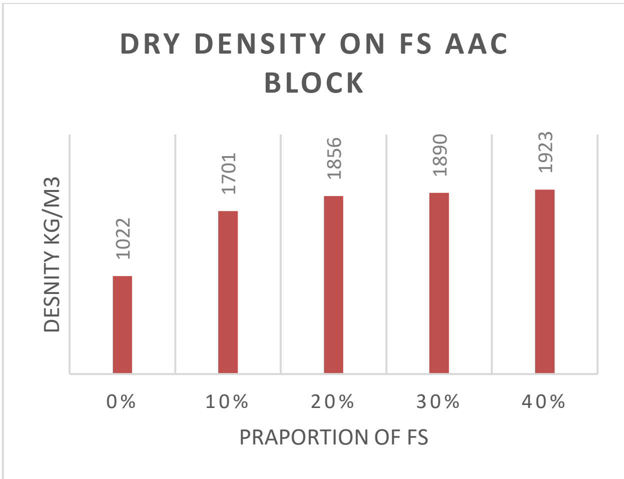
Table 6. Density of newly block (Oven Dry)

Mixes of SCBA	Dry Density (kg/m^3)
0%	1022
5%	967
10%	990
15%	1115
20%	1070

Mixes of FS	Dry Density (kg/m^3)
0%	1022
10%	1701
20%	1856
30%	1890
40%	1923



Graph No.5 Dry Density of AAC Block with varying % of SCBA



Graph No.6 Dry Density of AAC Block with varying % of FS

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4.4 Cost Comparison

For the cost analysis purpose, a room of size 3m x 3m x 3m. The size of both the materials i.e., clay bricks and AAC blocks have been taken asper IS codes. To keep the calculations simpler, reduction of openings has not been considered.

Cost Analysis for Room Size 3m x 3m x 3m:
AAC Block masonry = 4 x [3 x .02 x 3] = 7.2 cumec
Concrete block masonry = 4 x [3 x .02 x 3] = 7.2 cumec

FOR AAC: -
Dimension = 500 x 200 x 100mm
Assume = 9 mm thick mortar

Number of blocks in cum = 1/.50×.20×.10 = 100
Let us assume 5% waste= 5
Total no of block required = 100+5 = 105 =say 105 no.
Rate of one block= 55 Rs
Amount of 105 blocks = 105 x 55 = 5775 Rs.
Quantity of cement & sand in 9 mm thick cement mortar (1:4): -
Volume of mortar = 1 – (105 x 0.50 x 0.20 x 0.10) = 0.05 $m3$
Add of 40% for dry volume = 0.05 x .40 = 0.02 $m3$
Total volume of mortar = 0.05 + 0.02 = 0.07 $m3$
No. of cement bag = 0.07/1+4= 0.014 $m3$
No. of cement bag = 0.14/0.35=0.4 say 1 bag
Amount of cement = 360 Rs.
Sand in $m3$ = 0.07/1+4*4= 0.056 $m3$
Amount of sand = 0.056 x 5000 = 280 Rs.
Total material cost = 5773 + 360 + 280 = 6415 Rs.
Add 5% transportation cost = 6415 x 0.05 = 320.75 Rs.
Safety 1% = 6415 x 0.01 = 64.15 Rs.
Subtotal =6415 + 373.25 + 74.65 = 6799.9 Rs.

Labour required
1 Mistri = 800 Rs. /Day
2 mazdoor = 2 x 550 Rs. /Day
Subtotal = 6799.9 + 800 + 1100 = 8699.9 Rs.

Name of item	Rate per Cumec masonry (Rs.)	Total Cost (Rs.)
AAC block masonry (7.2 cumec)	10,004.88	**72035.136**
Concrete block masonry (7.2 cumec)	18260.56	**131476.032**

Add 15% OH & Profit = 8699.9 x 0.15 = 1304.93 Rs.

Rate per cumec for AAC Block masonry = 8699.9+ 1304.93 = 10,004.88 Rs.

V. CONCLUSION

According to the study, solid AAC blocks with acceptable characteristics may be made from waste foundry sand, sugarcane bagasse ash, and fly ash. Regarding compressive strength, density, and water absorption, the recently designed blocks outperformed concrete block. The ideal mix of waste materials to use in block production was established. The utilisation of waste materials in block manufacturing can help lessen the environmental effects of concrete block manufacture and offer a practical, affordable construction alternative. The study also discovered that the ideal ratios of SCBA and foundry sand for manufacturing blocks were, respectively, 5%, 30%, and 40%.

FUTURE SCOPE

The impact of altering waste material ratios on the characteristics of block and blocks may be studied further through study. It is also possible to look into the usage of other waste products, such as rice husk ash and quarry dust. A life cycle analysis may be used to determine how the freshly created block and blocks will affect the environment. Investigating the viability of utilising waste materials to produce brick and blocks commercially is another option.

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