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Experimental Investigation on Partial Replacement of Industrial Waste in Clay Bricks

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ABSTRACT - *Experimental Investigation is carried out partial replacement sugarcane bagasse in order to minimize the industrial waste. Sugar bagasse is fibrous waste product of sugar mill industry. Sugarcane bagasse is partially replaced by 10%, 20% and 30% of red soil in clay brick manufacturing. Bricks were designed and developed in three proportions. The size of the brick is 230 mm × 100 mm × 75 mm. Trial samples have been compared with conventional bricks containing no industrial waste addition. The physical and mechanical properties have been evaluated. Incorporating sugarcane bagasse ash and silica fume in the mix allows the production more resistant, lightweight and ecological.5% of coconut fibre is also added. The bricks are prepared with different amount of sugarcane bagasse ash and coconut fibre ash in red soil clay brick are tested for strength and other properties.*

KEYWORDS - *clay brick, fibrous, resistant, sugarcane bagasse*

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I. INTRODUCTION

Brick is one of the inevitable construction materials in concrete structure. There is a wide range of material available for the construction industries. Brick is the building material is used to make wall, pavements and other elements in masonry construction. Based on type of material used in brick there are several types of bricks. In that red clay bricks are mostly widely used in the construction material. The purchase of low cost material helps to reduce the cost of project, but it should necessary satisfies the quality of material in the market. Bricks shall be hand-moulded and made from suitable soils. They shall be free from cracks and flaws and nodules of free lime. In order to save the red soil from existence, using sugarcane bagasse ash and coconut fibre as a partial filter material in the brick to produce eco friendly brick and low cost.

II. OBJECTIVE OF THE STUDY

The objectives of this project are as follows:

- For determining the possibility of using sugarcane bagasse ash and coconut fibre as a partial filter material in the brick to produce eco friendly brick at low cost.
- The project mainly focuses on compression test and water absorption test and to compare the result with red clay bricks.
- Sugarcane bagasse ash and coconut fibre waste are combined to use as a supplementary filler material in the ratio in 10%, 20%, 30% and to determine the optimal usage of sugarcane bagasse ash and coconut fibre waste in red clay brick.

III. LITERATURE REVIEW

[1]. Prabhu et al 2019 has published a paper on the replacement of bagasse ash. The main aim of this project was to compare the compressive strength of the bricks. So for the purpose of different percentage of materials were separately added 6% 8% 16% & 20 % by the weight and the compressive strength were established. Bagasse ash with alumina sulphate was also verified. After that bricks were made & sundried and some bricks were burnt strength were calculated & then with help of compression testing machine. Finally the compressive strength was calculated from test in this project work it was concluded that the bagasse ash was the waste material which give the acceptable compressive strength. The effects of sbca and alumina sulphate by the percent of clay mix are also investigated.

[2]. Kulkami et al 2013 have published paper in bagasse ash in replacement in fly ash brick. Huge quantity of ash which is the waste product available at negligible rate. It causes chroncing conditions. In this paper, bagasse ash can be utilized by replacing it with th fly ash and lime in fly ash brick. Trial bricks of size 230×100×75mm were tested with different proportion of 10%-60% with the replacement of fly ash. 0%-20% with the replacement of lime. The main aim of this is to maintain environmental balance and avoid problem of ash disposal.

[3]. R. Devaki and S. Saran carried a experimental study on partial replacement of sugar cane bagasse ash in brick manufacturing. The standard size of brick is 19×9×9cm. This project is mainly based on making use of industrial products. Sugar cane bagasse ash is partially replaced of 10 % 20% 30%by the weight in clay brick. Lime is used as a binding material. Mix proportions of brick are clay 80%, sugar cane bagasse ash and lime 10% tests are conducted from this investigation they have observed and reported that increased strength by 20%.

[4]. Manish Detroja published a paper in 2018 on bagasse ash an effective replacement in clay bricks utilization of industrial and agricultural waste products in the industry has been the focus of research for economical, environmental and technical reasons. They have used fine grained natural clay. 30% to 40% of sugar cane bagasse ash is used. The brick were in different proportion. Water absorption test were done and calculation were made as per IS 3495 part-2 and compressive strength test as per IS 3495 part-1.

IV. MATERIAL

4.1 Red Soil

Red soil obtained from and belongs to the areas where the climate is warm and humid, such as in tropical and subtropical regions. Table 1 shows the properties of Red Soil.

Table: 1 Physical properties of Red soil

S.No	Property	Test Result
1.	Specific gravity	2.4
2.	Liquid limit	28
3.	Flow idex	11.35
4.	Plastic limit	12.81

Fig. 1. Red soil

4.2 Clay Soil

Clay is a fine grained soil material that combines clay minerals with traces of metal oxides and organic matter.

Fig.2. Clay soil

4.3 Sugarcane bagasse ash

Sugarcane bagasse ash is a byproduct of sugar industry found after burning of sugarcane bagasse which is found after the extraction of all economical sugar from sugarcane. Table 2 shows the properties of Sugarcane bagasse ash.

Table: 2 Physical properties of Sugarcane bagasse ash

S.No	Property	Test Result
1.	Sieve analysis	300μm
2.	Fineness modulus	6.2

Fig. 3. Sugarcane bagasse

4.4 Coconut fiber ash

Coconut fiber ash is obtained from after burning of coconut fiber. The huge amounts of coconut fiber are produced in the factories.

Table: 3 Physical properties of Coconut fiber ash

S.No	Property	Test Result
1.	Sieve analysis	150µm
2.	Fineness modulus	4.8

Fig. 4. Coconut fiber

V. CASTING AND TESTING

Both sugarcane bagasse and coconut fiber were used partially replace the filler material, red soil in clay brick. The project involves the replacement of 10%, 20%, 30% red soil. One of the purposes of testing brick is to confirm that the brick used at site has developed the required strength. Mostly when correct materials are used, careful steps are taken at every stage of the work and brick normally gives the required strength. The result of the test on the brick even if they are known late, help to reveal the quality of brick and enable the adjustments to be made in the production of further bricks and modification of the already done one. Tests are made up of moulding bricks. It is to be remembered that standard compression test specimen gives a measure of potential strength of brick in structure cannot be directly obtained from test on separately made bricks.

Fig. 5. Casting on Bricks

Fig. 5. Testing of Bricks

VI. EXPERIMENTS CONDUCTED

COMPRESSION STRENGTH TEST

The average compressive strength of well burnt brick of size 220mm x 110mm x 80mm are listed below in the table 4.

Table 4 Discussion for Compressive Strength of Brick Made From Sugarcane Bagasse Ash

Percentage of Replacement	Compressive Strength (N/mm^2)	Inference
0%	3.75	Nominal compressive strength
10%	4.0	Increases up to 6.67 %
20%	3.27	Decreases up to 3.467 %

WATER ABSORPTION TEST

The average water absorption of well burnt brick size of 220mm x 110mm x 80mm.

Table 5 Water Absorption Test of Brick Made From Partial Replacement of Sugarcane Bagasse Ash

Percentage of Replacement	Water absorption (%)	Inference
0%	9.033	Water absorption for nominal brick
10%	10.25	Increases up to 1.24%
20%	12.5	Increases up to 3.46%

BRICK WITH COCONUT BAGASSE ASH COMPRESSIVE STRENGTH TEST
The average compressive strength of well burnt brick of size 220mm x 110mm x 80mm.

Table 6 Compressive Strength of Brick Made From Coconut Fibre Ash

Percentage of Replacement	Compressive Strength (N/mm^2)	Inference
0%	3.75	Nominal compressive strength
10%	4.0	Increases up to 4 %
20%	3.27	Decreases up to 2.73 %

WATER ABSORPTION
The average water absorption of well burnt size of 220mm x 110mm x 80mm listed below in table

Table 7 Water Aborption of Brick Made from Coconut Fiber Ash

Percentage of Replacement	Water absorption (%)	Inference
0%	9.033	Water absorption for nominal brick
10%	10.75	Increases up to 1.71%
20%	9.92	Increases up to 0.887%

BRICK WITH SUGARCANE BAGASSE ASH AND COCONUT FIBRE ASH COMPRESSIVE STRENGTH
The average compressive strength of well burnt brick of size 220mm×110mm×80mm

Table 8 Compressive Strength of Brick Made with Sugarcane Bagasse Ash and Coconut Fibre Ash

SCBA	CFA	Total	Compressive strength (N/mm^2)	Inference
0	0	0	3.75	Nominal compressive strength
2.5	2.5	5	3.55	Decreased up to 5.33%
5	5	10	3.23	Decreased up to 16.53%
7.5	7.5	15	3.50	Decreased up to 15.66%
10	10	20	3.23	Decreased up to 13.9%
12.5	12.5	25	4.40	Increased up to 17.33%
15	15	30	3.50	Decreased up to 15.66%

WATER ABSORPTION TEST:
The average water absorption of well burnt brick size 220mm × 110mm × 80mm

Table 9 Water Absorption of Brick Made From Partial Replacement with Sugarcane Bagasse Ash and Coconut Fibre Ash

SCBA	CFA	Total	Water absorption (%)	Inference
0	0	0	9.033	Nominal compressive strength
2.5	2.5	5	9.629	Increased up to 0.596%
5	5	10	10.27	Increased up to 1.237%
7.5	7.5	15	10.53	Increased up to 1.467%
10	10	20	10.98	Increased up to 1.947%
12.5	12.5	25	10.67	Increased up to 1.637%
15	15	30	11.5	Increased up to 2.467%

VII. CONCLUSION

Based on the experimental investigation made in the brick with the sugarcane bagasse ash and coconut fibre ash as the partial replacement of red soil, the following results are obtained.

- The partial replacement of red soil with sugarcane bagasse alone, the optimum percentage of replacement was arrived at 10%which results an increase in compressive strength by 6.67%

- The water absorption for 10 %of sugarcane bagasse ash was found to be 10.28%which is well within 20 %as per IS:3495:1992
- The partial replacement of red soil with coconut fibre ash alone, the optimum percentage of replacement was arrived at 10% which results in an increase in compressive strength by 4%
- The water absorption for 10%of coconut fibre ash was found to be 10.27% which is well within 20%as per IS 3495:1992
- For replacement in combination of sugarcane bagasse and coconut fibre ash,25% replacement was found to be optimum which had an increase in compressive strength by 17.33%
- For replacement in combination of sugarcane bagasse and coconut fibre ash, 25% replacement was found to be optimum which had a water absorption of 10.67% which is well less than 20%as per IS 3495:1992
- The reason behind the increase in compressive strength could be particle packing due to variation in grain size distribution.

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