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Comparative Study on Black Cotton Soil Bricks using Fly Ash and Crusher Waste

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Abstract - An Experimental Investigation has the carried out of Study the Feasibility of Producing Bricks from locally available Black Cotton Soil (also called black soil) using Industrial Waste materials such as fly ash. In order to Study the various Engineering properties of Bricks, a total of 54 numbers of brick specimens of 210 x 110 x 80 mm size were prepared in two series by combining black soil, fly ash in different proportions. The brick specimens were then air dried, baked in kiln and tested for Compressive Strength, Water Absorption, Efflorescence and Weight Density as per IS 3495 code procedure. Test results obtained in the present investigation indicate that it is possible to manufacture good quality bricks using locally available black soil by suitably adding either Fly ash, Bricks can be used in the lieu of conventional burnt clay bricks or pressed type water cured cement fly ash bricks presently in use for various construction activities across the country.

Key words: Black cotton soil, Fly Ash, Crusher waste

1. INTRODUCTION

The common burnt clay brick is one of the oldest building materials, and is being extensively used even today as a leading construction material because of its strength, durability and low cost. Demand for this brick in our country is increasing day-by-day because of the aforesaid favorable characteristics and brisk construction activities. Black soil is one of the major soil deposits in India covering an area of about 5.4 lakh square kilometer. 16.6% of the total land area of our country. Ramanathapuram district in Tamilnadu state has a total land area of 4123 square kilometer, and the black soil deposits in the district constitute about 46% of the land area. Because of the extensive black soil deposits in the Ramanathapuram district, at present, there are no large-scale brick manufacturing kilns available to cater to the needs of various construction activities in and around Ramanathapuram and Rameswaram regions, and people living in these regions rely on kilns available in the nearby areas which are about 40 to 100km away from the Ramanathapuram and Rameswaram city. This increases the cost of bricks, and hence the overall cost of projects in these regions by about 15 to 20%. Generally, quality of bricks mainly depends on the type and quality of raw materials used for manufacturing them. It is a well-established fact that good quality bricks can be manufactured from alluvial or red soil, whereas it is not feasible to manufacture bricks from raw black soil. This is mainly due to the following two reasons: (i) the black soil is highly expansive and sticky in nature when it comes in contact with water, and hence it is very difficult to mix and pug the soil, and (ii) the black soil shrinks heavily and develops large number of wide cracks when allowed to dry, and hence bricks made from black soil lose their dimensional stability and overall integrity. Therefore, in order to overcome the above two major problems, mineral admixtures are commonly added to treat and stabilize the black soil to manufacture bricks.

2. MATERIALS USED

2.1 BLACK COTTON SOIL

1. Black Cotton Soil (BCS) is also known as expansive soil
2. Expansive soils have a relatively high percentage of clay minerals and subjected to changing in volume with changing moisture condition.
3. The soil under a house swells and shrinks with season.

2.2 FLY ASH

Fly ash is a fine, glass-like powder recovered from gases created by coal-fired electric power generation. Fly ash material is solidified while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5 µm to 100 µm. They consist mostly of silicon dioxide (SiO_2), aluminum oxide (Al_2O_3) and iron oxide (Fe_2O_3)

2.3 CRUSHER INDUSTRY WASTE

- It is a waste material
- It is obtained from the Crusher unit.
- It contains a large amount of silicates and alumina silicates.
- In appearance, it has a greyish with very fine aggregate particles, like soft sand.

3. EXPERIMENTAL INVESTICATION

Black cotton soil and fly ash are manually mixing where water is added in the required proportion for intimate mixing. The proportion of the raw material selected for the present study is given Fig.3.3, 3.4, 3.5.The materials are mixed manually. After mixing, the mould is prepared with a non-water absorbing plywood material in the size of 230mm x 110mm x 80 mm. After the mould was removed, the bricks were allowed to dry under sundry for a period of 2 weeks. The bricks were burnt and tested.

Table – 1: Details of brick specimens cast

S. No.	Specimen designation	% combination of black cotton soil, fly ash and crusher waste			No.of specimens		
		Black soil	Fly ash	Crusher	Strength test	absorption test	Efflorescence test
1	$BS_{100}A_0$	100 %	0 %	-	3	3	3
2	$BS_{80}A_{20}$	80 %	20 %	-	3	3	3
3	$BS_{60}A_{40}$	60 %	40 %	-	3	3	3
4	$BS_{40}A_{60}$	40 %	60 %	-	3	3	3
5	$BS_{20}A_{80}$	20 %	80 %	-	3	3	3
6	BS_0A_{100}	0 %	100 %	-	3	3	3
Grand total							54

Fig - 1: Brick Specimen $BS_{100}A_0$

Fig – 2: Brick Specimen $BS_{80}A_{20}$

Fig – 3: Brick Specimen $BS_{60}A_{40}$

Fig – 4: Brick Specimen $BS_{40}A_{60}$

Fig – 5: Brick Specimen $BS_{20}A_{80}$

Fig – 6: Brick Specimen BS_0A_{100}

4. RESULTS AND DISCUSSION

Table – 2: Summary of test results

S. NO	Specimen	% Combination of Black Soil, Fly Ash and Crusher Waste			Compression test (N/mm²)	Water Absorption (%)	Efflorescence Test
		Black soil	Fly ash	Crusher waste			
1	$BS_{100}A_0$	100%	0%	-	-	-	-
2	$BS_{80}A_{20}$	80%	20%	-	-	-	-
3	$BS_{60}A_{40}$	60%	40%	-	3.62	6.52	Nil

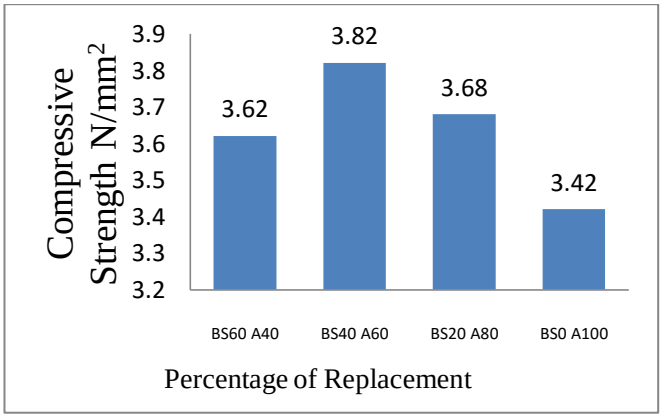
4	B S_{40} A_{60}	40%	60%	-	3.82	10.63	Nil
5	B $S_{20}A_{80}$	20%	80%	-	3.68	12.32	Nil
6	B S_0A_{100}	0%	100%	-	3.42	10.94	Nil

4.1 Compression Test

1. From the Fig. 6.2, comparing the values of fly ash bricks with the nominal compressive strength, we can say that with brick containing60% Black Cotton Soil and 40% Fly Ash. It is 3.42% higher than ordinary burnt clay bricks.

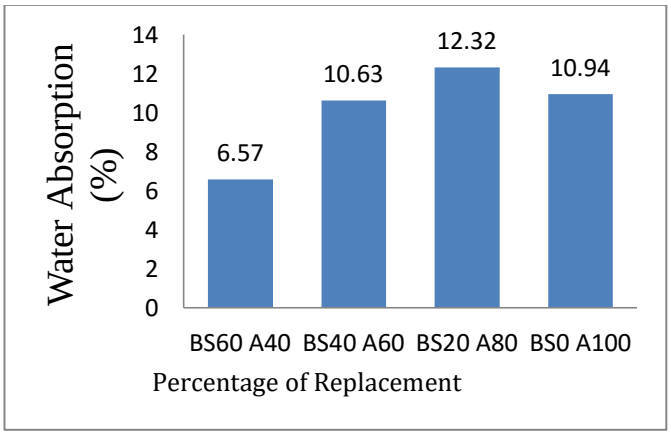
2. In the next mix having 40% Black Cotton Soil and 60% Fly Ash, it showed maximum strength. It showed 9.14 % higher compressive strength than the burnt clay bricks.

3. Upto 80% replacement of fly ash there was increase in compressive strength in bricks compared to standard brick of 5.14%. For 100% fly ash bricks decrease in strength of 2.33% was obtained.



4.2 Water adsorption test

1. From the results of water absorption test, it can be seen that the mix having higher amount of fly ash absorbs more water and decreases after 80% use of fly ash. However all the water absorption values were obtained were within



4.3 Efflorescence Test

1. As a result of efflorescence test, all the bricks showed good performance and the efflorescence was nil in all the variation of bricks.

2. Efflorescence is harmless deposit of white crystals of salts on the face of brick masonry. An understanding of the nature and mechanisms of efflorescence, as well as the possible sources of soluble salts and moisture, is essential to the prevention of efflorescence. Efflorescence test was conducted to find out the salt content of the specimen.

3. This test was find out the possibilities of the specimen to make reaction with salts. This test also not requires mechanical setup. This test is carried out by using simple apparatus with plate and water. It can takes place in room temperature.

4. Distilled water to be filled in a dish of suitable size. Place the end of the bricks in the dish, the depth of immersion in water being 25 mm place the whole arrangements in a warm (20° c to 30°c) well ventilated room until all the water the dish with suitable cover, so that excessive evaporation from the dish may not occur. This test consists of partially immersing representative samples of brick in distilled water for a period of 7 days.

5. When the water has been absorbed and bricks appear to be dry, place a similar quantity of water in the dish and allow it to evaporate as before. Then the area with salt precipitate was noted and the value of efflorescence is noted.

6. CONCLUTION

Based on the test results obtained, following conclusions were made.

- The maximum compressive strength of brick using black cotton soil and fly ash is obtained in BS_{60} A_{40} is 3.82 N/mm^2. But the conventional brick compressive strength is 3.5 N/mm^2. The compressive strength of black cotton soil and fly ash brick is more than 9.14 %.

- Maximum water absorption should not exceed 20 %. In the black cotton soil and fly ash brick the water absorption is 12.3 %. Hence the brick is suitable for building work.

- In all cases investigated in this project, there is no efflorescence found in the black cotton soil and fly ash brick.

- In dimensional tolerance test, hardness test, soundness test, and structure test, in the test result shows that the black cotton soil and fly ash brick is suitable for the building work.

6. REFFERENCE

1. Amarjit Singh (1967), "Substitution of quarry dust to sand for mortar in brick masonry works" International Journal on Design and Technologies, Vol.3, no.1, January 2009.

2. Sivapullaiah, Manasseh Joel (1996), "Comparative study of compressive strength of bricks made with various material to clay bricks" International Journal of Scientific and Research publications, Volume 2, Issue 7, July 2012.

3. G.A.P.Gampathi (2009), "Effect of class-f fly ash as a partial replacement with cement and fine aggregate in mortar"' Indian Journal of Engineering & Material Science, Vol: 17April.

4. Appukutty.P,Murugesan.R,(2009),Ahmad Farhan.H, "Development of lightweight sand-cement bricks using quarry dust, rice husk and kenaf powder for sustainability", International journal of civil & environmental engineering (IJCEE-IJENS), Vol:12, No:06

5. Prof. Sameer mistry (2011) IS: 3495 (part 1 to 4)-1992, "Indian standard methods of tests of burnt clay building bricks", Bureau of Indian standards, New Delhi.

6. N. Sivalingam (2011) IS: 383-1970, "Specification for coarse and fine aggregates from natural source for concrete", Bureau of Indian standards, New Delhi.

7. A. P. Jivani., ET, Rajasekaran, (2011) IS: 3346-1980, "Method of determination of thermal conductivity of thermal insulation materials", Bureau of Indian Standards, New Delhi.

8. Gidigasu S.S.R., Rajurkar, (2012) Soils in India: Indian geography, "Bit4all", Retrieved, from http://www.bit4all.com/topic/soils-types-indian-geography

9. Subir Shri Singh (2012) Geographical features, "Ramanathapuram district", retrieved from http://www.ramnad.tn.nic.in/geo.htm.