Experimental Study on Bricks using Fly Ash & Rice Husk

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Abstract— The proposed study involves the experimental investigation of effect of fly ash and rice husk the properties of burnt clay bricks. Determination of properties of the bricks casted with varying proportions of raw materials is taken up to ascertain whether the fly ash and rice husk can be used for the production of brick with use of black cotton soil. On seeing the present day demand for the bricks an attempt is made to study the behaviour of bricks manufactured by using different waste materials like fly ash and rice husk. The main aim of this project is to compare compressive strength, so for this purpose different percentage of materials were separately added fly ash- 5%, 10%, 15%, 20% and 25% and rice husk- 2%, 4%, 6%, 8% and 10% by weight of brick.

Key words: Bricks, Fly Ash, Rice Husk

I. INTRODUCTION

Brick is a block made of clay burnt in a kiln. It is one of the primary building materials known to mankind. Bricks are composed of inorganic non-metallic material and are widely used as building components all over the world. Over time, bricks have appeared, gained prominence, lost importance and then come to the forefront again with various styles of architecture. Burnt bricks were used in ancient Indian, Babylon, Egypt and Roman civilizations. Bricks find mention in the Bible; the tower of Babel was built with burnt bricks.

The need for locally manufactured building materials has been emphasized in many countries of the world because of their easy availability and low cost. Bricks also have been regarded as one of the longest lasting and strongest building materials, made from locally available sources, used throughout history. Ordinary building bricks are made of a mixture of clay, which is subjected to various processes, differing according to the nature of the material, the method of manufacture and the character of the finished product. After being properly prepared the clay is formed in moulds to the desired shape, then dried and burnt. Burnt bricks are usually stronger than sundried bricks, especially if they are made of clay or clayey material. Burnt clay bricks are weaker compared to bricks made of cement in terms of strength and durability. Another important factor adding to the disadvantages of burnt clay brick is the environmental impact involved in the manufacturing process of clay bricks. To overcome these drawbacks an attempt has been made to increase the overall efficiency of clay brick by adding other suitable materials along with clay in the manufacturing process. In this project, we have tried to study the effects of adding fly ash and rice husk ash to the conventional clay bricks. The effect of addition of fly ash and rice husk ash, in varying percentages, to different properties of clay bricks such as compressive strength, water absorption etc. is investigated.

A. Objectives and Scope

The main objective of this study was to assess the suitability of bricks made of Black Cotton Soil Using Fly Ash and Rice Husk, as to whether they can be used for the construction of strong, safe and reliable low cost houses.

The specific objectives were

1) To check the suitability of using fly ash and rice husk in the production of bricks.
2) To determine the optimum percentage of fly ash and rice husk in the production of bricks.
3) To determine the mechanical properties of produced bricks-Compressive strength and Water absorption.
4) To compare the obtained results of bricks made using fly ash and rice husk with IS code: IS: 3495-1992

The scopes were

1) The replacement of black cotton soil in Brick can be tried for different percentages of Brick Mix.
2) The black cotton soil can also be used in the manufacture of cement and glass which contains silica in more percentage rather than in the manufacture of brick.
3) The black cotton soil can be stabilized using ceramic tile powder and then it may be used any construction purposes.

II. MATERIALS AND METHODOLOGY

A. Black Cotton Soil

Black cotton soils accounts about 20% of land area in India and are predominantly located in the Deccan trap covering the states. Most Indian Black cotton soils are rich in iron, magnesium and aluminium, this mineral is responsible for swell-shrink behaviour of the soil. It is highly sensitive to moisture changes properties of Black cotton soils which have Liquid limit 40%-100%, Plastic limit 20%-60%. Differential Free Swell index 20%- 100%.Structures located on these soils subjected to differential settlements due to moisture variations.

B. FLY ASH

Fly ash is a useful by-product from thermal power stations using pulverized coal as a fuel and has considerable pozzolanic activity. This national resource can be gainfully utilized for manufacture of fly ash-lime bricks as a supplement to common burnt clay building bricks leading to conservation of natural resources and improvement in environmental quality. Fly ash-lime bricks are obtained from materials consisting of fly ash in major quantity, lime and an accelerator acting as a catalyst.

C. RICE HUSK

Rice husk can be obtained from the grains of rice. Mainly rice milling industry generates lots of rice husk during milling of paddy which comes from the fields. Rice husk can absorb the water range from 5% to 16% and the unit weight of rice husk

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is 83-123Kg/m^3. Because of these properties of rice husks, they provide important benefits in brick production. These wastes reduces the unit weight and improve thermal properties in clay bricks By adding 2% of rice husk by weight is the best of bricks properties which 6.20MPa of compressive strength, 1.68g/cm^3 of density, and 15.20% water absorption may achieve.

1) Characteristics of Soil:

Soils are a composition of mineral particles 45%, organic matter 5%, air 25%, and water 25%. Brown earths are fertile and very suitable for agriculture. Their suitability for agriculture is due to their characteristics of good texture, dark color and pH value.

Sl. No.	Property	Value
1	Dry density(γ_d)	1300-1800Kg/m^3
2	Liquid Limit(L.L.)	40-120%
3	Plastic Limit (P.L.)	20-60%
4	Activity	0.8-18%
5	Specific Gravity(G)	2.60-2.75
6	Proctor Density	1350-1600 Kg/m^3
7	OMC at MDD	20-35%
8	Free Swell Index	40-180%
9	Swelling pressure	50-800 KN/m^2
10	C.B.R.(soaked)	1.21 – 4.0
11	Compression Index	0.2-0.5
12	Fines(<75μ)	>51%
13	Fraction	0-49%
14	Soil Classification	CH or MH

2) Index Property of Soil:

The properties of soil, which are not of primary interest to the geotechnical engineering, but are indicative of the engineering properties are called index properties. This includes-

1) Particle Size Analysis: This is method of separation soils into different fraction bases on particles present into soils. It can be shown graphically on a particle size distribution curve.
2) Specific Gravity: It can be classified as the ratio of the weights of a given volume of soil solid at a given temperatures of the weight of an equal volume of distilled water at that temperature both weight being taken in air.
3) Atterberg's Limit: The water content at which the soil changes from one state to other state are known as consistency limits or Atterberg's limit .The Atterberg's limit which are useful for engineering purposes are; Liquid limit, plastic limit and shrinkage limit. These limits are expressed as percent water content.

– Liquid limit: -It is defined as the minimum water content at which the soil is still in liquid state but has a small strength against flowing which can be measured by standard available means.
– Plastic limit:- It is defined as minimum water content at which soil will just begin to crumble water rolled into a thread approximately 3mm in diameter, Plasticity index is determined as difference of liquid limit and Plastic limit.

3) Engineering Property of Soil

The main engineering properties of soil are permeability, plasticity, compaction, compressibility and shear strength. This includes-

1) Permeability: The permeability is defined as the property of a porous material which permits the passage or seepage of water through its interconnecting voids
2) Plasticity: It is defined as the property of a soil which allows it to be deformed rapidly, without elastic rebound, without volume change.
3) Compaction: Compaction is a process by which the soil particles artificially rearrange and packed together into a closer state of contact by mechanical means in order to decrease the porosity of the soil and thus increase its dry density.
4) Compressibility: The property of soil mass pertaining to its susceptibility to decrease in volume under pressure is known as compressibility.
5) Shear Strength: This is the resistance to deformation by continuous shear displacement of soil particles or on masses upon the action of a shear stress.

III. CASTING OF BRICKS

The bricks were casted according to the IS standards, of Mould size (190x90x90cm). For the casting of one brick it requires about 3000g. The raw materials comprises of, Red soil, Laterite soil, Black cotton soil, Charcoal (for burning) in appropriate proportions of each material. (According to the availability of material in different locality in casting of bricks) Manufacturing of Brick Using Black cotton soil As a Material in the Brick Mix

On considering the Black cotton soil as one of the raw material among the Total Brick Mix, replaced with various percentage of Total Brick mix corresponding to the 3000g. (For casting of one Brick) Thus the Brick were casted by replacing fly ash in the various percentages of 5%, 10%, 15%, 20%, and 25% of the total Weight of the Brick mix. And 2%, 4%, 6%, 8%, and 10% of total weight of brick mix. Based on compaction test we got 14% of OMC. During the time of casting of bricks in each proportion of brick mix (which is obtained in the result of Optimum Moisture content determination, which is required quantity of water in casting of one brick sample). 3 Bricks samples were casted for each proportion of Brick Mix.

Initially Brick mix was placed in Pan and required quantity of water is added in casting of Bricks (say 14% of water, by Total weight of brick Mix) thoroughly mixing with water, and the sample was filled in the Brick Mould, and by providing a gentle Tapping to the each layer (say, 3 layer) the bricks were casted on the levelled surface, by removing the Mould upright Gently without any disturbances.

Percentage of Replacement		Replacement Amount of Fly Ash And Rice Husk		Remaining Amount of Brick Mix In (g)	Total Amount Of Bricks Corresponding To 3000g
Fly Ash	Rice Husk %	Fly Ash (g)	Rice husk (g)		
5	2	150	60	2790	2790+210=

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					3000
10	4	300	120	2580	2580+420= 3000
15	6	450	180	2370	2370+630= 3000
20	8	600	240	2160	2160+840= 3000
25	10	750	300	1950	1950+1050= 3000

Table 1: Material Composition

Fig. : Dry Mix

Fig. : Wet Mix

Fig. : Moulding

Fig. : Drying

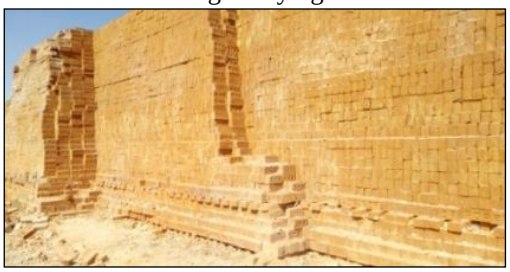

Fig. : Burning in Kiln

IV. TESTS CONDUCTED ON BRICKS

1) Absorption Test on Bricks
2) Compressive strength test on Brick
3) Hardness Test on Bricks
4) Shape and Size Test on Bricks
5) Color test on Bricks
6) Soundness Test on Brick
7) Structure of Bricks
8) Efflorescence Test on Bricks

A. Absorption Test

Absorption test is conducted on bricks to find out the amount of Moisture content absorbed by brick under extreme conditions. In this test sample dry bricks are taken and weighed. After weighing these bricks are placed in water with full immersing for a period of 24 hours. Then weigh the wet brick and note down its value. The difference between dry brick and wet brick will gave the amount of water absorption for a good quality of bricks the amount of water absorption should not exceed 20% of its weight of dry.

Fig. : Water Absorption of Bricks

Percentage of fly ash and Rice husk		Dry weight of brick (W_1) g	Wet weight of brick (W_2) g	Percentage of water absorption (W_2-W_2/W_1)x100
Fly Ash	Rice Husk			
5%	2%	3016	3456	14.58%
10%	4%	2910	3339	14.74%
15%	6%	2934	3396	15.74%
20%	8%	3706	3466	15.30%
25%	10%	3056	3513	14.95%

Table 2: Water Absorption

B. Compressive strength

This test is done to know the compressive strength of brick. It is also called crushing strength of brick. Generally 5 specimens of brick are taken to laboratory for testing and tested one by one. In this test a specimen is put on compressive machine and applied pressure till it breaks. The ultimate pressure at which brick is crushed is taken into account. All five brick specimen are tested one by one and average result is taken as bricks compressive strength.

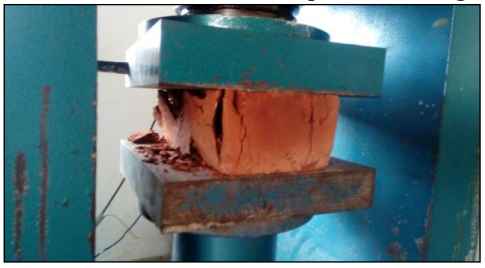

Fig. : Compressive strength of brick

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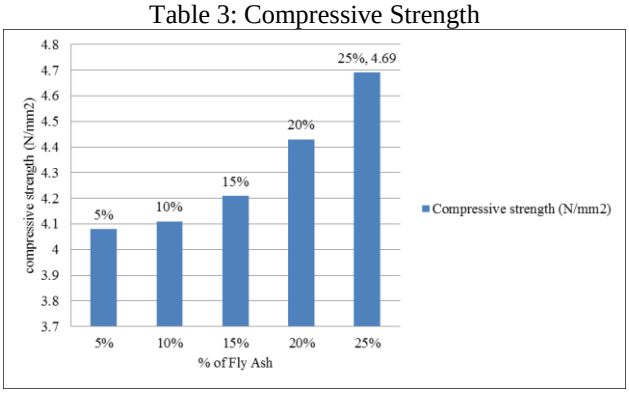
Percentage of fly ash and rice husk		Load in kN	Load in N	Area of Brick mm^2	Compressive strength (N/mm^2)
Fly ash	Rice husk				
5%	2%	69.8	69800	17100	4.08
10%	4%	70.4	70400	17100	4.11
15%	6%	72.1	72100	17100	4.21
20%	8%	75.8	75800	17100	4.43
25%	10%	80.2	80200	17100	4.69

Table 3: Compressive Strength



V. Result and Discussion

Sl. No.	Test conducted on bricks	IS Specification	For 25% of Fly ash & 10% Rice husk
1	Water Absorption	<20%	14.95%
2	Compression	$3.50N/mm^2$	$4.69N/mm^2$

As per the results obtained from the various tests. All test results were greatly achieved as per IS specification, the Compressive strength test which is very much essential in deciding whether the casted bricks were of good quality or not. As per the test results obtained, the compressive strength value of the casted brick is very good. According to the IS specification the compressive value should be of $3.50N/mm^2$ and above which is satisfied by the casted bricks.

VI. Conclusions

1) Fly ash and rice husk is much suitable for production of brick because of its high strength.
2) The test conduction for various proportion of fly ash and rice husk 5%, 10%, 15%, 20% and 25% and 2%, 4%, 6%, 8% and 10% respectively. Compressive strength for various percentages is 5%-4.08N/mm2, 10%-4.11N/mm2, 15%-4.21N/mm2, 20%-4.43N/mm2, and 25%-4.69N/mm2.
3) The optimum percentage of Fly ash and Rice husk are 25% and 10% respectively for the production of bricks.
4) The compressive strength of the brick is 4.69N/mm2 which achieved the IS code specification standard of 3.5N/mm2.
5) The water absorption of brick is 14.95% which is lesser than the 20% of IS standard specification.

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