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Experimental Research on the Performance of Blended Clay Bricks

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ABSTRACT: In this project work experimental investigation were carried out to study the performance of blended clay bricks over convectional clay bricks. Four types of bricks with different raw materials were cast and their characteristic properties were tested. The four types of bricks were Type 1 RSS (Red soil + sand), Type 2 RSC (Red soil + cement), Type 3 Cement Brick, Type 4 CPC (Coir Pith + Cement). Comparative studies on the behavior of Compressive strength, Water Absorption, Soundness, Hardness test. The 7, 14, 21, 28 days compressive strength of four types of bricks and conventional clay bricks was observed and tabulated. The comparative study was interpolated graphically.

A realistic approach was adopted by utilizing the locally available natural resources for obtaining raw materials in the making of bricks, cleaning of raw materials included removal of dried vegetation, small stones decayed material, organic substance from the clay soil. Blending of various raw materials in required ratios, kneading of ingredients, burning process of bricks was carried out as codal recommendations.

Thus this reviewed approach on bricks from waste as well as useful materials like coconut fibre provided potential and sustainable solutions.

KEYWORDS: Red soil, Cement, Clay and Coir Pith (coco peat, coconut fibre)

I. INTRODUCTION

An adequate shelter is a basic human need, yet about 80% of the rural populations in still live in spontaneous low quality settlements, as they cannot afford the high cost of building materials. One alternative for the expensive materials is to use natural soil stabilized bricks because they have been identified as low cost material with the potential of reducing the problem of living in sub-standard houses

Masonry material is largely used for construction of structures and infrastructures e.g. buildings, bridges, retaining structures, etc., in most of the underdeveloped and developing countries of the world. It is due to the traditional construction practices employed in these countries, motivated also by the regional climatic conditions. A new combination of brick manufacturing is obtained with high strength so it can be used for main elements of a structure. Dumping of waste is used as a replacement in clay bricks

Brick masonry construction employing solid clay units and cement- mortar can be found in many urban exposure of Pakistan and so also in neighbouring countries like India, Iran, and Bangladesh among others. Most of the structures in these urban exposures are subjected to frequent lateral loads due to heavy winds and earthquakes that consequently induce shear stresses in the structural walls. The behaviour of masonry material under lateral loading is dramatically different than its counterpart materials. In this project different raw materials are to be used which enables to find the effective and economical solution.

This project work involves in the study to improve durability of structure, to invention of new type of brick for improvement in masonry work on present & future construction, to reduce the waste products which are used as useful raw material.

This project is also done to show the comparison between the clay bricks, stabilized soil cement bricks, fiber brick and Red soil Bricks with and without foundry sand in terms of various structural

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properties like compressive strength, durability, etc..,

BRICK HOUSES IN INDIA

A CONTEMPORARY BRICK HOUSE IN MYSURU ARCHITECTUREPARADIGM

Contemporary brick house, located in Mysore city in a municipal layout the site measures 50 X 80 feet with the shorter side facing the road along the southern edge.

An L-shaped plan form helps us organize the diverse programmatic concerns of a house for a family of four which is an amalgamation of function and desires; individual vs. collective, public vs. private, formal vs. informal, immediacy vs. slowness, largeness vs. intimate, openness vs. security etc. The shorter arm along the east-west direction houses the public spaces whereas the longer arm along the north-south direction over two levels houses the more private needs of the house. The L-shaped plan also helped us appropriate the unbuilt into an identifiable private rear courtyard or the outdoor room and the transitional forecourt addressing the street. The private courtyard can be seen as an anchor around. which the house works. These spaces extend out into this outdoor room which is treated as a pleasure garden punctuated with water, trees, and decks encouraging informal engagement with the natural.

Brick House Draws Inspiration From Traditional Kerala architecture

The design developed from the client's brief, which was to have a modern house inspired by the family's roots in Kerala, India. We looked towards traditional palace construction of Kerala for inspiration. We noticed a few key features that most of these structures portrayed, such as – the veranda that wrapped the living spaces all around, the appearance of a heavy masonry base on the ground floor, with thick arches and carved columns and a first floor which appeared to be lighter in terms of materials and overall treatment.

AGRAHARAM HOUSE

The Agraharam House was designed for Srikanth and Gita who were looking for a traditional South-Indian 'agraharam' house, well ventilated with courtyards. This was the design cue that was taken forward in Srikanth House. A traditional agraharam house is a long rectangular temple street house stacked around the four streets that bound the temple. These street-fronted houses have a deep social and cultural value in their organization of space – being narrow and linear, the hierarchy of rooms range from public areas up front to the more private family spaces deeper in.

THE BRICK HOUSE

The brick house was much inspired by works of Laurie baker and Nari Gandhi Designed by I studio architecture. The spaces were designed in such a way that every of the room connects to the central open courtyard beautiful play of jallis and arched openings allow light and the wind to penetrate inside. The entire house gives an earthy feel while also contributed to the low cost of the project. The Brick House is located in rural areas of Mumbai. The composition of Brick grid and use of traditional material sets an example of vernacular architecture the non- linear form of the building adds to the whole look and feel of the House concrete and steel, due to high non-homogeneity and composite nature of masonry components.

II. METHODOLOGY

The brief description of the methodology and the sequence of the works to be carried out in this complete duration of project are presented. Red soil, fine aggregate, cement and coir are the materials used for casting bricks. Proper mix designs calculations and required material testing is also done, before the casting process. Finally the compressive strength, water absorption were tested & calculated. The mould was handmade by us in the college laboratory. The size of mould is (190 x 90 x 90) all dimensions are in mm.

Various bricks namely:-

TYPE 1 - RSS BRICK (Red Soil + sand)

TYPE 2 - RSC BRICK (Red Soil + Cement)

TYPE 3 - CEMENT BRICK (Cement + Sand)

TYPE 4 – CPC BRICK (Coir Pith + Cement)

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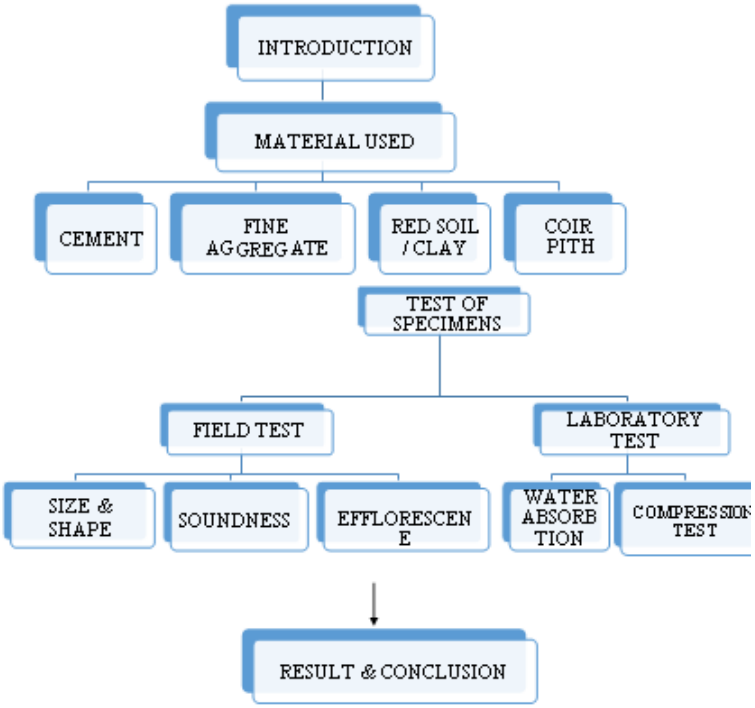

III. MATERIALS USED

The various materials used for this investigation are

- Clay
- Fine aggregate
- Cement
- Coir pith

CLAY

Clay is the chief ingredient and should contain of 20-30%. It imparts plasticity to brick earth for easy moulding. It becomes very hard on burning. Clay is a fine grained natural rock or soil that combines one or more clay minerals with traces of metal oxides and organic matter. Clay soil consist soil particles having size between 0.001-0.01mm

FINE AGGREGATE

Sand is a naturally occurring granular material, composed of finely divided rock and mineral particles. The major composition of sand is silica. Natural river sand was used as a fine aggregate. The properties of sand were determined by conducting tests as per IS: 2386 (Part-1). The results are shown in test data of materials. The results obtained from sieve analysis are furnished. The results indicate that the sand conforms to zone 11 of IS: 383-1970.

CEMENT

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. Cement is made up of four main compounds: tricalcium silicate ($3CaO \cdot SiO2$), dicalcium silicate ($2CaO$.$SiO2$), tricalcium aluminate ($3CaO \cdot Al2O3$), and a tetra-calcium aluminoferrite ($4CaO \cdot Al2O3Fe2O3$).

COIR PITH

A spongy material that binds the coconut fibre in the husk. Coir pith is finding new applications. It is an excellent soil conditioner and is being extensively used as a soil-less medium for Agri-horticultural purposes. The coir pith is washed, heat-treated, sieved to remove large particles, and graded. Very often it is compressed into blocks or bricks, which need to be soaked before using. You may also find bags or bales of coir.

IV. EXPERIMENTATION

PREPARATION OF MOULD

Mould dimension of brick is (190X90X90) mm. For every mix of sample three trials are conducted. These bricks are dried naturally in sun-light for 14 days and then placed for oven heating for 2 days. After oven heating then it is cooled at room temperature for 2 days.

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TYPE 1 RSS BRICK

In this Type 1 RSS (Red Soil + River Sand) brick, the Red soil & Sand are used as raw materials. The ratio we have selected to casting is 3R:2FA. No chemicals were added.

RSS Brick

TYPE 2 RSC BRICK

In this Type 2 RSC (Red Soil + Cement) brick, the Red soil & Cement are used as raw materials. The ratio we have used is 1:3 i.e.: 1 part of cement & 3 part of Red soil. Additionally no chemicals were added.

RSC Brick

TYPE 3 – CEMENT BRICK

In this Type 3 Cement brick, we have selected the raw materials are cement (OPC) & Fine Aggregate. The mix ratio we used 1:2 (i.e.) 1 part of cement & 2 part of sand.

Cement Brick

TYPE 4 – CPC BRICK

In this Type 4 CPC (Coir Pith + Clay) brick, we used Coconut fibre, Coir rope wastage & Clay as raw materials. The ratio we selected is (1:100) 10 g of coir for 1kg of clay.

CPC Brick

EXPERIMENTAL TEST RESULTS

Testing of materials

The specific gravity test is done on all materials to determine its specificgravity values, which are used to find the calculation of mix ratio by using theirdensity value. Where the specific gravity test is used for cement, FA and Clay is done by using specific gravity bottle.

Specific Gravity Test Result

1. Cement

The specific gravity of the cement is found out using specific gravity bottle apparatus. 10 grams of cement, kerosene is taken to conduct this experiments. Then the average specific gravity of cement is 3.09.

Trail no	1	2	3
Sp.Gr	3.07	3.12	3.09

2. Fine Aggregate

The specific gravity of the Fine aggregate is found out using specific gravity bottle apparatus. 10 grams of sand, water is taken to conduct this experiments. Then the specific gravity of river sand is 2.8.

Trail no	1	2	3
Sp.Gr	2.85	2.80	2.76

3. Red Soil

The specific gravity of the Red soil is found out using specific gravity bottle apparatus. 10 grams of

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soil, water is taken to conduct this experiments. The specific gravity of soil is 2.70.

Trail no	1	2	3
Sp.Gr	2.75	2.67	2.76

Testing On Bricks

1. Size & shapetest

- In this test should be of standard size and it should be truly rectangular with sharp edges.
- For this purpose, 20 bricks of standard size are selected at random and they are stacked lengthwise, along the width and along the height.
- Sizes of brick = 190mm × 90mm × 90mm.

2. Soundness Test

- Two bricks are taken one in each hand and they are struck with each other lightly.
- The bricks should not break and clear ringing sound be produced.

3. Efflorescence Test

- The presence of alkalis in bricks is harmful and they form a grey or white layer on brick surface by absorbing moisture.
- To find out the presence of alkalis in bricks this test is performed.
- In this test a brick immersed in fresh water for 24 hours and then it taken out from water are allowed to dry state.
- If the whitish layer is not formed on surface it proves the absence of alkalis in bricks.
- If the whitish layer is formed about 10% of brick surface then the presence of alkalis in brick.

SAMPLE	EFFECTS
Type 1	Slight
Type 2	Nil
Type 3	Nil
Type 4	Nil

4. Water Absorption Test

The water absorption of bricks is not related directly to the porosity of the bricks. Some of pores may be through pores which permit air to escape and allow free passage of water in absorption test. The test is done by immersing the brick in water for 24 hours.

% of water absorption

(W2 –W1) / W1) × 100

W1 =Dry weight of brick in Kg

W2= Wet weight of brick in Kg

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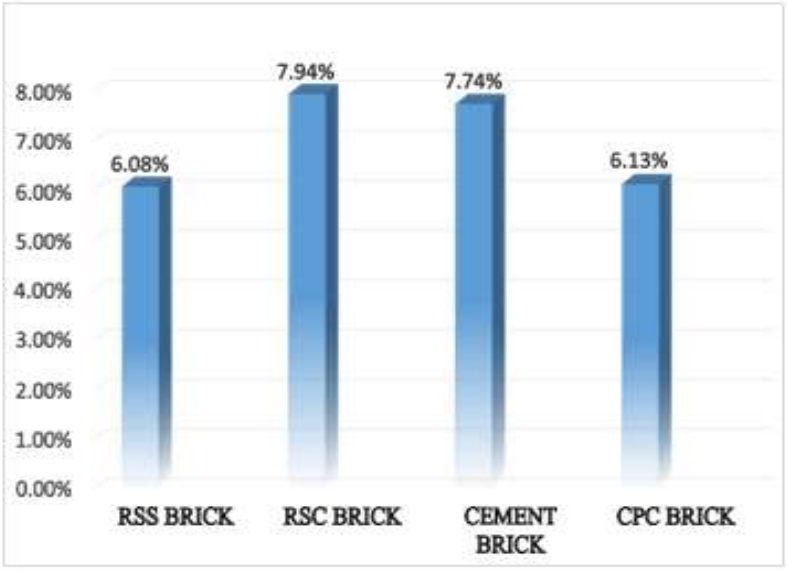

5. Compression Test

The compressive stress formula is CS = F ÷ A, where CS is the compressive strength, F is the force or load at point of failure and A is the initial cross-sectional surface area. Minimum crushing strength of brick is 3.5 N/mm².

$$\text{Compressive Strength} = \frac{\text{Load at failure (N)}}{\text{Area of bed face } (mm^2)}$$

Type1 Compression Test for RSS Bricks.

SPECIMEN NO	PERFECTIONAL AREA	ALLOWABLE LOAD(KN)	COMPRESSIVE STRENGTH (N/mm²)
1. (07days)	0.19x0.09	81.6	**4.77**
2. (14days)	0.19x0.09	83	**4.85**
3. (21days)	0.19x0.09	88	**5.15**
4. (28days)	0.19x0.09	90	**5.26**

Type 2 Compression Test for RSC Bricks

SPECIMEN NO	PERFECTIONAL AREA	ALLOWABLE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm²)
1. (07days)	0.19x0.09	115	**6.72**
2. (14days)	0.19x0.09	121	**7.05**
3. (21days)	0.19x0.09	130	**7.60**
4. (28days)	0.19x0.09	135	**7.89**

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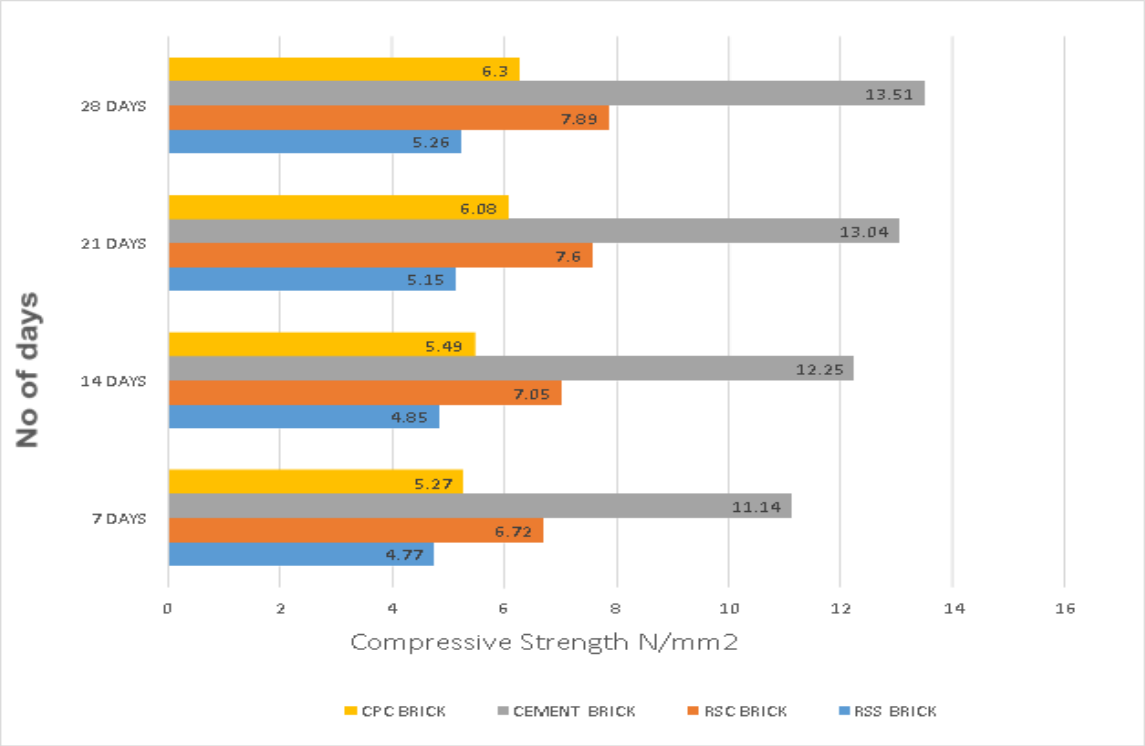
Type 3 Compression Test for Cement Brick

SPECIMENNO	PERFECTIONAL AREA	ALLOWABLE LOAD (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1. (07days)	0.19x0.09	190.5	**11.14**
2. (14days)	0.19x0.09	215	**12.25**
3. (21days)	0.19x0.09	223	**13.04**
4. (28days)	0.19x0.09	231	**13.51**

Type4 Compression Test for CPC Bricks

SPECIMEN NO	PERFECTIONAL AREA	ALLOWABLE LOAD(KN)	COMPRESSIVE STRENGTH (N/mm^2)
1. (07days)	0.19x0.09	90.5	**5.27**
2. (14days)	0.19x0.09	94	**5.49**
3. (21days)	0.19x0.09	104	**6.08**
4. (28days)	0.19x0.09	108	**6.30**



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V. CONCLUSION

The general objective of this project was to investigate the various types of bricks produced by adding different raw materials which is locally available. The colour, shape and size were found to be satisfactory. The brick gives metallic sound when banged with other brick. The min compression strength of standard brick is 3.5 n/mm2. The result of our investigation has proved that all the four types of brick have compressive strength more than 3.5 n/mm2 establishing used for masonry construction work. The brick did not absorb more than 20% of water by dry weight. The brick with less mix ratio better compression result as compared to conventional brick.

The results of experimental and analytical study of comparison of bricks were studied. The experimental setup models have the same structural conditions stipulated as per Indian Standards.

Based on the above experimental and analytical studies the following conclusions are drawn.

Type 1 RSS Brick – It attains the strength of 5.26 N/mm2. It gives the result of low compression value which is not suitable for high load structure

Type 2 RSC Brick - It attains the strength of 7.89 N/mm2. It gives the result of high durability and average compression value.

Type 3 Cement Brick - It attains the strength of 13.51 N/mm2. It gives the result of normal strength, durability etc

Type 4 CPC Brick- It attains the strength of 6.30 N/mm2 .It gives an additional protective strength from cracks and also increase the durable. It was concluded that the compressive strength of bricks achieves the maximum value be Type 3 River sand + Cement Brick when compared to Type 1, 2 and 4 bricks.

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