Strength Stability of Thirumalaipadi Brick Oasis by Admixtures

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Abstract:- **In this project we have discussed the behavior of brick strength under various admixtures. The use of earth construction is well established in energy efficient housing. Clay bricks consist of red soil, clay, water, and admixtures such as silica or alumina. The advantages of clay brick include its low-cost and great thermal behavior. Although clay brick is considered one of the oldest construction materials, engineers and builders do not have enough information about its mechanical properties. Also there is no accurate design code to follow before construction. This study is devoted to enhance the low compressive strength of mud brick without sacrificing its low thermal conductivity properties. The experimental program in this research includes the use of different admixtures such as silica (0%, 10%, 20%, 30%, 40% and 50%) increase the compressive strength of the basic clay mix. While adding 10% silica as an admixture this experimental results, lead to an optimum compressive strength of the brick.**

1. INTRODUCTION

Earth as clay bricks, has been used in building construction for thousands of years and approximately 30% of the world's present population still live in earthen shelters. Clay brick is an inexpensive, environmentally-friendly and abundantly available building material. It has been used extensively for building construction around the world, particularly in extreme hot, dry desert climates. Silica is added to improve compressive strength, and may prevent clay bricks from cracking. The clay brick is then shaped in a mould of almost any size or shape or by hand. The brick mixtures are then laid to dry in the heat of the sun for about 15 days before use.

Clay bricks have several advantages over other conventional building materials, e.g., concrete masonry. These advantages include: a very minimal manufacturing process; skilled laboris not necessary; clay is available from natural resources; inexpensive construction materials; and clay structures are able to perform satisfactorily under hot environmental conditions. However, there are many disadvantages in using clay bricks as building materials. These include: clay brick may tend to erode under rain impact; absorption of water causes swelling of clay brick, while evaporation of water from the clay brick gives rise to shrinkage and cracking; and clay brick is a relatively fragile material, which cannot resist earthquake.

It is known that clay brick technology has been widely used in desert countries due to the widespread existence of silt and clay deposits in these areas. Theimportanceof using clay brick as a building material however has not been seriously investigated through scientific experimentation. Therefore, this study aims to investigate: improvements in clay brick consolidation by increasing its durability; and imparting water penetration to clay brick. In this research, the effect of different clay brick components on strength and thermal conductivity properties are investigated. The basic mixture consists of clay (red soil and sand), silica and water. Many additives are provided to the basic mixture in order to improve brick properties.

The overall aim of this study is to determine, through extensive experimental investigation, the effect of different clay brick ingredients on strength and absorption, and utilize these results in a forthcoming study on thermal-conductivity properties. With this in mind, the specific objectives of the study are to improve clay brick consolidation by using materials such as soluble silicate, ethoyl silicate, silanes or siloxanes, isocyanates and various polymers agents to treat clay brick permeability. In addition, the effect of using metallic fibers to improve clay brick durability is investigated.

1.1ADVANTAGES OF BRICK

1.1.1 AESTHETIC APPEAL

Brick possesses natural and infinite pleasant colours of burnt clays. Its color formation is achieved through a complicated physio-chemical reaction during the firing process. In contrast to the color of stained body, brick colouris permanent and will not fade during weathering process. Bricks natural colors combined with the extreme flexibility in applications produce aesthetic results which are always personal and everlasting.

1.1.2 THERMAL INSULATION

Brick generally exhibits better thermal insulation property than other building materials like concrete. Perforation can improve the thermal insulation property of bricks to some extent. Besides, theThermal Massand moisture that the brick has absorbed can help to keep the temperature inside the house relatively constant.

1.1.3 FIRE RESISTANCE

The fire resistance of a building material refers to the length of time a walling element is about to resist a fully developed fire. In every case, clay brick walls obtain maximum fire ratings. To the owner of a clay brick

building, this means peace of mind and substantial savings over time on insurance premiums.

1.1.4 ZERO MAINTENANCE COST

Clay bricks do not require maintenance. Clay brick may cost a little bit more cost initially, but the very first time that you paint, you might well spend more than the additional cost of the brick. In addition, you do not need to worry the clay brick from rotting, denting, warping, rusting, splitting, peeling, fading and termites. As your home gets older, it naturally becomes more beautiful.

1.1.5 FLEXIBLE IN APPLICATION

The high compressive strength of fired clay bricks has been exploited for millennia to build structures ranging from single-storey huts to massive public buildings and enormous bridges and viaducts. In particular, it can be used for load bearing structures which greatly simplify the construction process so as to save materials, time, and labor. Besides, brick can be made into convenient shape and size to facilitate the construction work.

1.2 OBJECTIVE OF STUDY

- The main objective of this project is to study the effect of addition of silica in bricks.
- To make the bricks without compromising its strength.
- The objective of present work is to develop bricks with good strength as addition of clay by fly as silica in 10% to 50% for increase the strength.

1.3 SCOPE OF THE PROJECT

- To evaluate the ultimate strength of brick using silica as an admixtures.
- To compare the compressive strength between before and after using admixtures.
- If the ingredients aren't mixed thoroughly, some parts of the brick may be drier than others, and that too can lead to crack

1.4NEED FOR THE PRESENT STUDY

- To determine the resistance of clay bricks under crack due to high temperature.
- To increase the strength by adding the silica powder.
- Producing bricks of superior qualities to those of standard clay bricks are in addition to the environmental solution.

1.5 RESEARCH SIGNIFICANCE

- In order to reduce the water absorption capacity to increase the strength.
- Spreading of ash on the brick after manufacture reduces the crack formation.
- After adding the admixtures the cost will remains constant for brick.

2.MATERIALS AND METHODS

The material and methods used throughout the work are discussed as follows.

2.1 MATERIALS

Various materials including conventional are mentioned with their respective specifications.

2.1.1 RED SOIL

Red soil is a type of soil that develops in a warm, temperate, moist climate under deciduous or mixed forest, having thin organic and organic-mineral layers overlying a yellowish-brown leached layer resting on an illuvial red layer.

2.1.2 CLAY

Clay is a finely-grained natural rock or soil material that combines one or more clay minerals with possible traces of quartz, metal oxides and organic matter. Clays are plastic due to particle size and geometry as well as water content and become hard, brittle and non–plastic upon drying or firing.

TABLE 1 CHEMICAL COMPOSITION OF SOIL IN BRICK

Composition	Percentage (%)
Silica (SiO_2)	50-60
Alumina (Al_2O_3)	20-30
Lime (CaO)	<5
Iron Oxide (Fe_2O_3)	5-6
Manganese Oxide (MnO)	Small amount

2.1.3 WATER

Water used for making masonry mortar shall be clean and free from injurious quantities of deleterious material. Potable water is generally confided tothe requirement of IS 456: 2000 satisfactory for usein masonry mortar.

2.2REPLACED MATERIALS

Admixtures that are used apart from the conventional materials are mentioned below with their respective specifications.

2.2.1 SILICA

It is a hard, unreactive, colourless compound which occurs as the mineral quartz and as a principal constituent of sandstone and other rocks.

FIG. 1 SILICAPOWDER FOR REPLACEMENT OF CLAY IN BRICK

2.3 PRELIMINARY TEST

The following preliminary tests were conducted on the raw materials

- Sieve Analysis
- Specific Gravity
- Liquid Limit and Plastic Limit
- Water Content

2.3.1 SIEVE ANALYSIS

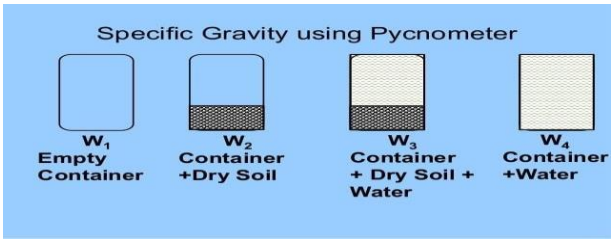
Take the sieves and arrange them in descending order with the largest size sieve on top. If mechanical shaker is using then put the ordered sieves in position and pour the sample in the top sieve and then close it with sieve plate. Then switch on the machine and shaking of sieves should be done at least 5 minutes. After sieving, record the sample weights retained on each sieve. Then find the cumulative weight retained. Finally determine the cumulative passing percentage retained on each sieves.

FIG.2 SIEVE ANALYSIS

2.3.2 SPECIFIC GRAVITY

The Pycnometer is used for determination of the specific gravity of soil particles of both fine grained and coarse grained soils. The code referred for this is IS 2386 (Part3): 1963. The specific gravity of soil is determined using the relation:

$$\text{Specific Gravity} = \frac{W_2 - W_1}{(W_4 - W_1) - (W_3 - W_2)}$$



W_1 = 0.374 gW_3 = 1.192 g
W_2 = 0.710 gW_4 = 1.030 g

SPECIFIC GRAVITY = 2.13

FIG. 3 SPECIFIC GRAVITY USING PYCNOMETER

2.3.3 PLASTIC LIMIT AND LIQUID LIMIT

Select a 200 to 250 gm specimen. Adjust the water content of the specimen by adding distilled water and mixing on a glass plate with a spatula. This specimen should be close to, but not past, the liquid limit of the soil. Place the prepared soil in a container and let the specimen stand for at least 16 hours. The IS 2720 (Part 5): 1985 is used to refer liquid limit.

Select 20 gm specimen of the same sample used for the preparation for the liquid limit test. This sample should be dry enough so that it will not be sticky. Place this sample in the same container and on top of the water specimen.

2.3.4 WATER CONTENT

Take about 30 to 50gm of soil sample if it is fine grained and about250 to 300gm if it is fine grained soil in to the container and weigh it (W_1). Place the container in the oven and dry for 24 hours at temperature of 105^0 – 110^0C. Remove the container from the oven replace the lid and cool it, after cooling weigh the container along with lid (W_2), clean and dry the container and weigh it (W_3).

2.4 TESTING OF BRICK

It is necessary to check the quality of brick before using it in construction activities. There are some field tests that we can conduct in the field in order to check the quality of bricks. These tests are as follows

- Compressive Strength Test
- Water Absorption Test
- Shape and Size Test
- Hardness Test

- Soundness Test
- Efflorescence Test

2.4.1 COMPRESSIVE STRENGTH OF BRICK

Brick specimen shall be of size 23cm x 11cm x 7cm for non-modular brick and the range should be 3.5 to 14MPa. Compressive strength of brick made with 23cm x 11cm x 7cm, brick mixed and cured with reference to Indian standard code specification IS1077: 1992 and for testing IS 3495:1992.

2.4.2 WATER ABSORPTION FOR BRICK

The bricks, when tested in accordance with the procedure in IS 3495 (Part 2): 1992. Dry the specimen in a ventilated oven at a temperature of 105 to 115°C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weight. Specimen warm to touch shall not be used for the purpose. Immerse completely dried specimen in clean water at a temperature of 27f 2°C for 24 hours. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 minutes after the specimen has been removed from water. The water absorption should be less than 20% .Water absorption; percent by mass, after 24hour immersion in cold water is given by the following formula:

$$W = [(M_2 - M_1) / M_1] \times 100$$

TABLE 2 WATER ABSORPTION OF BRICK FOR REPLACEMENT OF SILICA

Percentage of replacement	Water absorption
0%	6.8
5%	7.4
10%	7.9
15%	8.3
20%	8.6
25%	8.9

4.1.3 SHAPE AND SIZE TEST

In this test, a brick is closely inspected. It should be of standard size and its shape should be truly rectangular with sharp edges. For this purpose, the bricks are selected at random and they are stacked lengthwise, along the width and along the height. A good quality brick should have bright and uniform color throughout.

4.1.4 HARDNESS TEST

In this test, a scratch is made on brick surface with the help of a finger nail. If no impression is left on the surface, the brick is sufficiently hard.

2.4.5 Soundness Test

In this test, the two bricks are taken and they are struck with each other. The bricks should not break and a clear ringing sound should be produced.

2.4.6 EFFLORESCENCE TEST

The presence of alkalis in bricks is harmful and they form a gray 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 is immersed in fresh water for 24 hours and then it's taken out from water and allowed to dry in shade.

If the whitish layer is not visible on surface it proofs that absence of alkalis in brick. If the whitish layer visible about 10% of brick surface then the presence of alkalis is of acceptable range. If that is about 50% of surface then it is moderate. If the alkalis presence is over 50% then the brick is severely affected by alkalis.

TABLE 3 VALUES OF EFFLORESCENCE FOR BRICKS

OBSERVATION	RESULT
No deposition	Nil efflorescence
10% area covered with salt	Slight efflorescence
25% area covered with salt	Moderate efflorescence
50% area covered with salt	Heavy efflorescence
>50% area covered with salt	Serious efflorescence

4. RESULTS AND DISCUSSION:

In this research silica is used to replacement of soil in various proportions such as 10%, 20%, 30%, 40% and 50% .The brick tested for compression test and water absorption. The quantity of water chosen as per IS 456:2000 for an exposure condition of severe for brick. The optimum strength obtained at a replacement of 10% of brick. The silica added brick made with the optimum strength gained replacements.

5. CONCLUSION

The aim of the project is to control the crack and increase the strength of building materials that is brick in construction work, by having more or less similar physical and chemical properties. By this research we have proved that the use of silica in part of soil can improve the compressive strength and water absorption of brick. We can produce a cost effective brick, and by controlling usage of conventional building materials, the increase in cost can be controlled, Environmental pollution caused by manufacturing of building materials can be controlled. By the test results of replacement in soil, we have analyzed that the silica can be effectively replaced for 10% - 50% of soil, hence the

optimum percentage of strength achieved for these percentages. And finallybrick produced by replacing 10% of silica in a same mix, and strength achieved for compressive strength and water absorption are 12.3 and 7.9 respectively.

5.1 SCOPE OF FUTURE STUDY

Hence, different innovations can be done by changing the parameter of the brick. It is recommended that further experimental and numerical research is needed to develop the brick with more natural admixture.

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