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Interlocking Method by using Fly Ash and Lime to Increases the Strength of Brick and Reduce the Cost of Construction

Suyash Subhash Pandare, Ashwin Dattatray Pawar, Anil Sayalu Arote

Abstract

A brick is a block or a single unit of a ceramic material used in a masonry construction. Typically bricks are stacked together or laid as brick work using various kind of mortar to hold the bricks together and make a permanent structure. Asia produces 87% of the total production of bricks. The standard size of brick provided by IS: 2212 (1991) is (19cm × 9cm × 9cm). Interlocking bricks are that have been design to fit into each other. Each bricks have a protrusion at one end and a depression at the other end. Increases strength, but also decrease the quantity of mortar. It Increases resistive property of wall against vertical and lateral force and increase the durability of structure. Black cotton soil has very low bearing capacity, high swelling and shrinkage characteristics due to which in construction site, replacement of the black cotton soil is done with any other soil which has better Geo-technical characteristics, hence it is presumed that it can be partially used for manufacturing of bricks process using additive. There are various problems arises in conventional brick construction like excess usage of mortar and bricks, also more no of labour are required. It leads to increase in cost of construction and takes more time for completion. The scope of the study includes modeling of interlocking brick and its strength parameters are checked by laboratory testing and computations method. Different test like absorption test, crushing test, hardness test are carried out on both Conventional and Interlocking bricks. The main objective of the study is manufacturing of interlocking bricks using black cotton soil with additional stabilizer like fly ash and lime as partial replacement of clay.

Chapter 1

1.1 Introduction

Brick is one of the oldest manufactured construction material used in constructing of various structures around the world and most widely used in all types of civil engineering works, including infrastructure, low and high rise buildings, defense installations, environment protection and local domestic developments. It is obtained by mixing a mud, water and sometimes admixtures in required proportion.

Interlocking brick are brick that have been designed to fit into each other each brick has a protrusion at one end and depression at the other end. Increases strength, and also decrease the quantity of mortar.Black cotton soil has very low bearing capacity, high swelling and shrinkage characteristics due to which in construction site, replacement of the black cotton soil is done with any other soil which has better geotechnical characteristics, hence it is presumed that it can be partially used for manufacturing of bricks process using additive.

1.2 Aim and Objective

1.2.1 Aim

The objectives of the project are to study by interlocking method by using fly ash and lime to increases the strength of brick and reduce the cost of construction.

1.2.2 Objective

1. To check the strength of brick by using fly ash and lime.
2. To reduce the cost of construction.
3. To reduce the no.oflabours.
4. Take less time for construction.

1.3 Subject Background

The interlocking soil compressed brick mainly used as environment friendly material and most modern building technologies. The room temperature is kept cool air they are thermally radiant.

The interlocking brick has have a more benefits are as cost effective, high strength, environmental friendly, customized, durable, design, low maintenance and fast construction.

1.4 Problem Definition

There are various problems arises in convention brick construction like excess usage of mortar and bricks , also more no of labour are required. It leads to increased in cost of construction and takes more time for completion.

Literature Review

Hublikiran ,Beedimanipriyanka , Aishwarya , karalesuneel. UG student, SDM college of engineering and technology. Dhavalagiridharwad.

The main ingredients of brick are clay, lime, magnesia, silica, alumina, iron oxide. So, the brick is produced on a large scale. These ingredients are easily available.

For proportion of mix mud, black cotton soil and red soil are mixed proportionally together. In three trials black cotton soil and red soil are 40%, 50%, 60% and 60%, 50%, 40% respectively with mixing of NaCL solution 0.5% of total clay mass in each constant.

The physical and geotechnical properties of black cotton soil, red soil and water are within the permissible limits as per relevant IS cod.

All three proportions arrived during manufacturing of bricks are found effective, strength is > 35kg/cm^{2}and other properties are satisfactory. As per cost analysis the black cotton with red soil bricks are found to be cheaper than normal red soil bricks for manufacturer.

Abhinandan R. Gupta, Dr S.K. Deshmukh, Civil Engineering Department, Principal, C.O.E.T. Akola

Modeling of interlocking brick and its strength parameter are checked by laboratory testing and computations method. When the comparison is done between conventional clay wall and interlocking brick wall, the strength, durability is to be much more as compared to initial one.

The conventional brick to be weak when lateral force acting on it. If geometrical

design of brick is changed such that its interlocking property in vertical and horizontal direction increases then the wall will become more durable and resistive. With proper interlocking it may further reduce the quantity of mortar.

When the brick masonry wall is subjected to lateral or horizontal forces, it fails due to overturning as the bonding is weak in horizontal direction. This further leads to human hazard at the time of disaster like earthquake. To reduce all this limitations of conventional clay brick wall, the concept of interlocking brick as proves to be very effective.

Jaya PrakashBabu, Satyanarayan P.V.V. Surya Manikantha Abdul Moin PG student Professor, PG student and civil engineering department & Andhra university Visakhapatnam, India

Studies on strength of expansive soil stabilized with fly ash & cement mixes 30 to 40 % fly ash and 6 to 10 % cement mixes are added to expansive soil and effect of this mixes was studied in term of plasticity, compaction, swell and strength characteristics.

Expansive soil can be effectively utilized as a geo technical material and bulk utilization of fly ash reduces its disposal problem.

Project Methodology

The process used to collect information and data for the purpose of making the project decisions. The methodology may include publication research and other research techniques.

Principle of operation

The interlocking brick could be achieved by using one of the following methods or a combination of some or many of following,

- Maximum fly ash content.
- Minimum lime content.

The Construction of modern days has become fast track where the economics and the investment on the brick work are considered the use of high strength brick is in variable and has become a must.

The construction today is crucial when it comes to economics very fine aspects are considered to achieve, saving in construction work. The speed of construction and its technology is measured in terms of the number of cycle of the use of brick.

Applied methodology

Material collection

Collect the material required like black cotton soil, water, fly ash, lime.

Data required for mix proportion

1. Type of soil
2. Water content
3. Fly ash content
4. Lime content
5. Specific gravity of all materials.

Theoretical Analysis

Brick

Brick is building material used to making walls, pavements and other elements in masonry

construction. Traditionally the terms brick referred to unit composed of clay but it is now used to denote rectangular unit made of clay bearing soil, sand and lime materials. Ingredients of bricks are water and soil.

Properties of brick

Physical properties of brick

These properties of brick include shape, size, color and density of a brick

Shape

The standard shape of an ideal brick is truly rectangular. It has well defined and sharp edges. The surface of the brick is regular and even.

Size

The size of the brick used in construction varies from country to country and from place to place in the same country. In India is recommended standard size if ideal brick is 19cm X 9cm X 9cm, which with mortar joint gives net dimensions of 20cm x 10cm x10cm.

Color

The most common color of building bricks is red.

Density

The density of the bricks or weight per unit volume depends mostly on the types of clay used and the method of brick molding.

Black cotton soil

Black cotton soil deposits of India. They exhibit high rate of swelling and shrinkage when exposed to changes in moisture content and hence have been found to be most troublesome form engineering consideration black soils are formed by lava basaltic rock.

Properties of black cotton soil

Structure

The structure is a consequence of variation of pressure exerted under swelling shrinkage process due to seasonal change.

Bulk density

Black cotton soil shows high bulk density in dry condition and low value at swollen stage. Depending on moisture condition bulk density of these soils may be(1~2) gm/cm^3

Indian black cotton soil was found to swell up to 60% when get saturated from dry state.

Adsorption

We know water molecule behaves as electrical dipole, of which positive charge is situated near atoms two hydrogen and have negative charge near oxygen atom. This enables water molecules to interact / attract neighbor charged particles. The mechanism of adjoining water molecules with clay crystals is termed as adsorption.

Shrinkage

Black cotton soil is usually known as expansive soil; but the mass that expand under wetting will shrink after drying.

Water is the transparent and nearly colorless chemical substance that is the main consistent of earth streams, lakes and ocean, and the fluids of most living organism. Its chemical formula is H_2O, meaning that its molecules content one

oxygen and two hydrogen atoms, that are connected by covalent bonds.

Physical properties of water

1. Its attraction to polar molecules.
2. High specific hit.
3. High heat of vaporization.
4. The lower density of ice.
5. High polarity.

Fly ash

Fly ash is a finely divided byproduct resulting from the combustion of coal in power plant.It contains large amounts of silica, alumina and small amount of unburned carbon, which pollutes environment.It is grey in color and alkaline in nature. The particle size ranges between 1-100 microns.

Lime

Lime is utilized as an effective way to modify soils, improving both workability and load-bearing characteristics while increasing stability and impermeabilityand.the rock minerals from which these materials are derived, typically limestone or chalk, are composed primarily of calcium carbonate.in the lime industry, limestone is general term for rock that contain 80% or more of calcium or magnesium carbonates, including marble, chalk, oolite, and marl.

Experimental analysis

Experimental analysis of collected material required for brickwork were carried out for knowing various parameter of soil. The experiment conducted are as listed below.

Test on soil

Soil are tested for moisture content, atterberg limit. In order to decide the suitability of the soil for use in process of manufacturing of brick. Following test are carried out,

Plastic limit

The plastic limit of a soil is the moisture content at which soil begins to behave as a plastic material. At this water content (plastic limit), the soil will crumble when rolled into threads of 3.2mm(1/8in) in diameter**.**

Need: The test is carried out todetermination of Plastic Limit is as important as Liquid Limit so as to ascertain Plasticity Index, I_p of the soil. The plasticlimit of a soil is the moisture content, expressed as a percentage of the weight of the oven-dry soil, at the boundary between the plastic and semi-solid states of consistency.

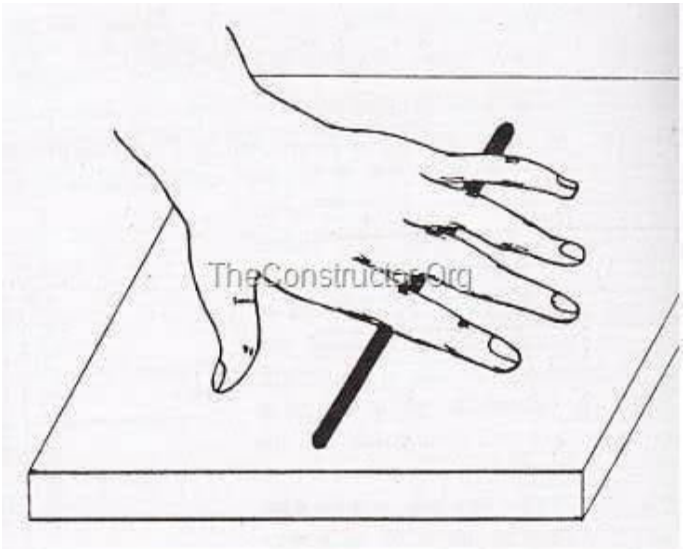

Fig.4.1 Plastic Limit State

Observations and Calculations

Table no. 4.1 Observations of Plastic Limit Test

Sr.No.	Observations	Determination no.	
1	Moisture content container no.	105	106
2	Mass of empty container (m1)	19.7	20.2
3	Mass of container + Wet soil (m2)	24.7	26
4	Mass of container + Dry soil (m3)	23.4	24.4

Table no. 4.2 Calculation of Plastic Limit Test

Sr.No.	Calculations	determination no.	
1	Mass of water = M2-M3	1.3	1.6
2	Mass of dry soil = M3-M1	3.7	4.2
3	Water content W = 5/6x100	35.14	38.1

Liquid Limit

The liquidlimit is the moisture content at which the groove, formed by a standard tool into the sample of soil taken in the standard cup, closes for 10 mm on being given 25 blows in a standard manner. This is the limiting moisture content at which the cohesive soil passes from liquid state to plastic state

Need: From liquidlimittest, the compression index may be estimated, which is used in settlement analysis. If the natural moisture content of soil is higher than liquidlimit, the soil can be considered as soft and if the moisture content is lesser than liquidlimit, the soil is brittle and stiffer.

Fig.4.2 Liquid Limit Test

Observations and Calculations

Table No. 4.3 Observation of Liquid Limit Test

Sr.No.	Observations	Determination No.			
1	No. of blows (N)	57	16	24	9
2	Water content can No.				
3	Mass of empty can (M1) gm.	20.5	21.5	23	21.2
4	Mass of can + wet soil (M2) gm	29.9	29.1	35.5	34.5
5	Mass of can + dry soil (M3) gm.	26.2	26	30.5	28.8

Table No. 4.3 Calculation of Liquid Limit Test

Sr.No.	Calculations	Determination No.			
1	Mass of Water = M2-M3	3.7	3.1	5	5.7
2	Mass of dry soil =M3-M1	5.7	4.5	7.5	7.6
3	Water content W= 6/7x100	64.91	68.89	66.67	75

Interlocking of bricks.

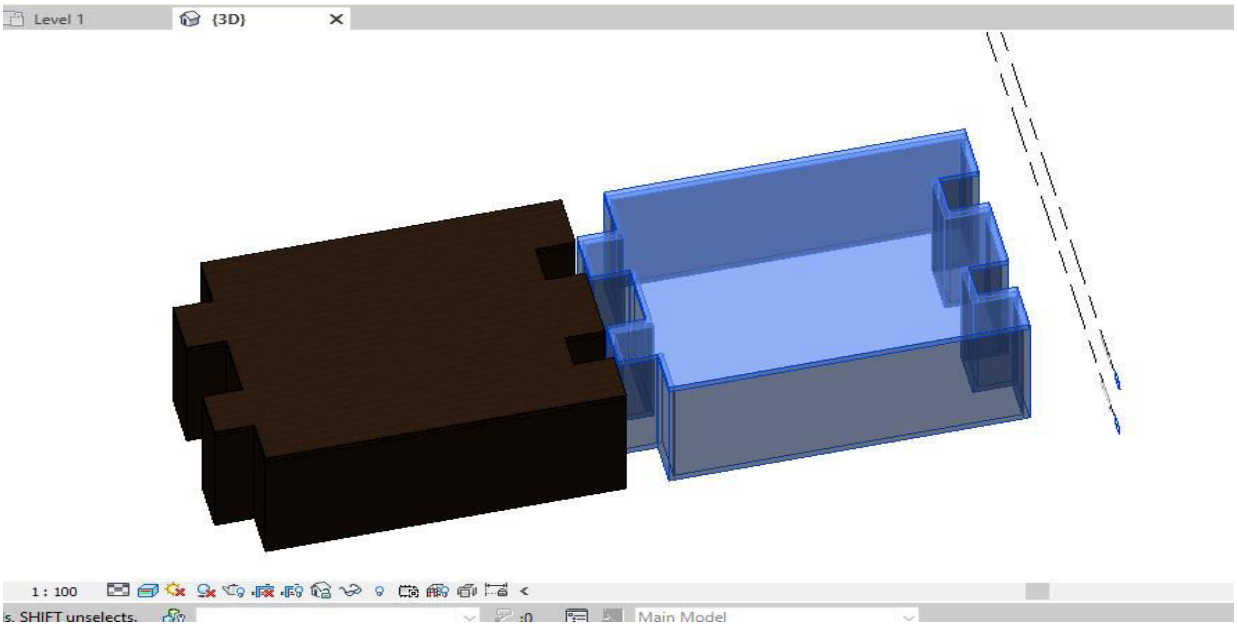

Fig.4.3 Interlocking of bricks.

This is how bricks interlocks with each other.

CTM Testing-

Fig.4.4 Testing Of brick Under CTM

CTM test readings

% of Lime and Ash	Compressive Strength in N/mm2
25	1.29
50	0.93
75	1.17

Result and calculation

Result

Result for soil

1. Water content for plastic limit = 36.62%
2. Water content for Liqiid limit =31%
3..Water content for Shrinkage limit =16%

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