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Investigation on strength parameters of lateritic interlocking block strengthened with fly ash and cement.

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Abstract - *Over a past few decades, there are wide ranges of alternatives available in the field of construction with the changing in the raw material for the particulars. As concern with the brick there are some invention like fly ash brick, concrete blocks and brick. Here, we are using laterite soil as a raw material for the bricks and also using fly ash and cement as an admixture to alter the properties of the laterite soil. This research study describes the feasibility of using locally available laterite soil as a raw material with some additional stabilizer in the brick production as partial replacement of clay in Indian context. The minimum requirement of strength for bricks used as load bearing wall is 3.5 N/mm2. Compressive strength of Z-shape interlocking lateritic block for mix proportion as [Cement (10): Fly ash (20): Laterite (70)] was found to be 4.5 N/mm2 which is 28.57% more than standard clay brick.*

***Key Words*: Interlocking Z-shape brick, Fly ash, cement, Laterite, compressive strength.**

1. INTRODUCTION

The construction industry is acknowledging the strong need to accelerate the masonry construction process, as the traditional method is Labour intensive, and hence slower, due to the presence of a large number of mortar joints. With construction costs going up sharply in recent times due to the increase in the price of materials, people are trying to innovate new materials to prevent their budgets from going out of hand. One way is to find building materials that cost less but are strong at the same time. Lateritic brick is perhaps one such material that is strong and relatively cheap too. One can save the construction cost by using lateritic brick. The use of interlocking bricks is not common because there is no specific standard regarding to this system. In addition, limited study conducted in the production and installation of the system for local requirements have all hindered the use of this system in the construction. Hence there is a need to hasten the effort to determine the effectiveness construction system using interlocking brick.

2. OBJECTIVES

The main objective of this study is to obtain an optimum proportion of fly ash and cement that can be added with lateritic soil to manufacture interlocking bricks at a low cost.

1. To prepare interlocking bricks from locally available laterite soil and to prevent excessive air pollution during burning of bricks.
2. To compare the strength of the interlocking block with locally available clay brick.
3. To determine a suitable mix satisfying the codal provisions (IS: 456 - 2000) by trial and error method that provides workability, strength, suitable surface finish and economy.
4. To investigate compressive strength, water absorption, soundness of the Lateritic interlocking block.
5. To provide the better employment in local areas.

3. METHODOLOGY

Steps which were followed for this research work are listed below.

1. Collection of raw material
2. Crushing of large laterite stones
3. Material testing
4. Z-shape mold fabrication
5. Mix design of Z-shape lateritic block
6. Casting and testing of blocks
7. Comparison between Laterite block and Interlocking block.

4. MATERIALS

Laterites: Laterites are soil types rich in iron and aluminum, formed in hot and wet tropical areas. The majority of the land areas with laterite soil are between the tropics of Cancer and

Capricorn. The laterite soil was collected from Laterite Stone Cutting Industries from Islampur, Maharashtra, India and conforming to IS: 3620 – 1979 [Methods of Laterite soil]. When the laterite stone is cut from the quarry nearly 20-30% of laterite waste is obtained. This laterite soil was sieved using a 4.75 mm IS sieve. This sieved laterite soil was brought to our laboratory for preparation of bricks. This soil was sundried to reduce the water content.

Fly ash: Fly ash is the by-product of coal combustion collected by the mechanical or electrostatic precipitator (ESP) before the flue gases reach the chimneys of thermal power stations in very large volumes. All fly ash contain significant amounts of silicon dioxide (SiO2), aluminum oxide (Al2O3), iron oxide (Fe2O3), calcium oxide (CaO), and magnesium oxide (MgO). However, the actual composition varies from plant to plant depending on the coal burned and the type of burner employed.

Cement: For this project, Portland Pozzolans Cement of Ultratech has been used. It was procured from a single source and stored as per IS: 4032 – 1977.

Water: Water used for mixing and curing was potable water, which was free from any amounts of oils, acids, alkalis, sugar, salts and organic materials or other substances that may be deleterious to concrete or steel confirming to IS :3025 – 1964 part22, part 23 and IS : 456 – 2000

6. EXPERIMENTAL STUDIES

Following are the properties of laterite, fly ash, and cement obtained after laboratory testing.

1. Properties of Laterite soil:

Water Content (%) =1.07

Specific Gravity =2.49

Unit Weight (g/cc) =1.33

Liquid Limit (%) = 38.50

2. Properties of Cement:

Fineness of cement =1.25 %

Specific Gravity of cement = 2.84

Normal Consistency of Cement = 32%

Initial setting time = 32min

3. Properties of Fly ash:

Specific Gravity of fly ash = 2.1

Normal Consistency of Cement = 26%

Initial setting time = 40 min

Figure -1: Crushed laterite stone

A mold of size 30*20*12cm was prepared. Bricks of different mix proportions were prepared, for each brick varying percentage of laterite soil and fly ash where added with 16% of water by the weight of soil based on the test done on laterite soil and w/c=0.6. Of each mix proportion, six bricks were prepared and then tested.

Figure -2: Fabricated Z-shape mold

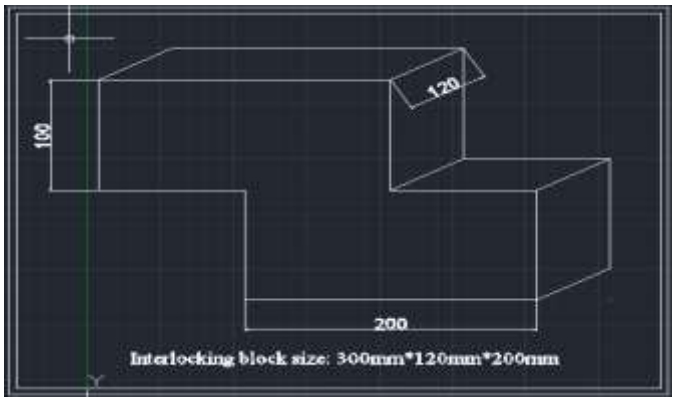

Figure -3: Schematic view of Z-shape interlocking lateritic block

Raw materials were manually compacted in mold at optimum moisture content of laterite soil. After compaction mold was kept for drying for 24 hours and then curing was done by using wet gunny bags. The weight of Z-shape interlocking lateritic block was found brick 9.12 kg. Water absorption is the ratio of dry weight of brick to the weight of brick after immersing in water for 24 hours. The average water absorption should not be more than 20% of dry weight of brick. Water absorption of Z-shape interlocking lateritic block obtained was 18.45 %.

Tests performed: Compressive strength test as per IS: 3495(Part 1) 1992, water absorption test as per IS: 3495(Part 2) 1992, efflorescence test as per IS: 3495(Part 3) 1992, hardness test, size, shape and color test, soundness test, structure test.

Figure -4: Mixing of raw materials

Mix Design:

The compressive strength for various mix design for Z-shape interlocking lateritic block are as follows:

Cement (10): Fly ash (20): Laterite (70) =4.5 N/mm2

Cement (0): Fly ash (50): Laterite (50) =2.1 N/mm2

Cement (5): Fly ash (45): Laterite (50) =3.8 N/mm2

These interlocking blocks can be used for internal wall as well as external wall construction

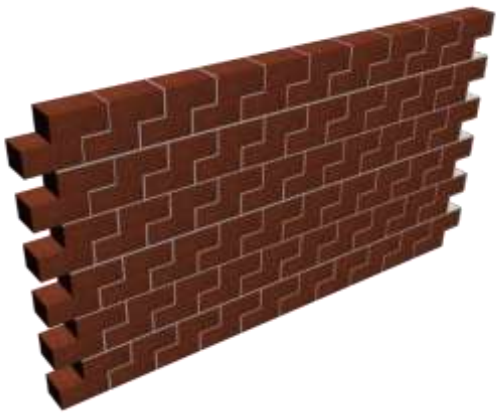

Figure -5: 3D view of 120 mm thick internal wall

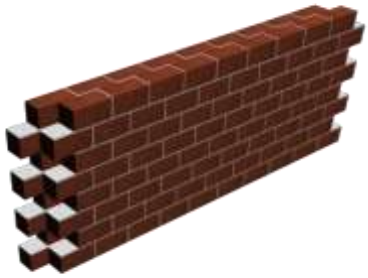

Figure -6: 3D view of 200 mm thick external wall

6. RESULTS AND DISCUSSION

Below are the test results obtained on Z-shape interlocking lateritic block with different proportions of fly ash and cement.

Sr. No.	Tests	C:F:L 10:20:70	C:F:L 0:50:50	C:F:L 5:45:50
1	Compressive strength(N/mm2)	4.5	1.8	3.8
2	Water Absorption	18.45	Fail (Dissolved)	17.27
3	Soundness	Sound	Unsound	Sound
4	Height of fall from 1m	Pass	Fail	Pass

Cost of one Z-shape interlocking lateritic block in INR

Sr. No.	Materials for C:F:L (10:20: 70)	Weight in Kg	Rate in Rs. Per Kg	Cost in Rs.
1	Laterite	5.46	1.1	6.006
2	Flyash	0.9	0.1	0.09
3	Cement	0.864	6	5.184
4	Total			11.28

Comparison between Laterite block and Interlocking Brick:

1. Available laterite blocks (Chira / Jambha):

Size: 18cm*23cm*36cm

Shape: Rectangle

Weight in Kg per piece: ~35 kg

For 10 m^2 wall (23 cm thick) – No of Chira used: 155

Total weight of wall on structure: 5.4 tons

Economy: Cost of 1 Chira Rs 38

2. Interlocking bricks

Size: 30cm*20cm*12cm

Shape: Z shape

Weight in Kg per piece: ~9.12 kg

For 10 m^2 wall (23 cm thick) – No of Bricks used: 250

Total weight of wall on structure: 2.28 tons.

Economy: Cost of 1 Interlocking brick ~ Rs 11

Effective cost of one block of interlocking unit is much less than the bricks covering up the same volume.

7. CONCLUSIONS

The important findings of this research are summarized below which shows the enhancement in strength parameters of Z-shape interlocking lateritic block when stabilized with fly ash and cement.

1. The interlocking blocks have very high compressive strength as compared to ordinary bricks. Compressive strength of fly ash mixed laterite-cement brick was found 4.5 N/mm2 which is 28.57% more than standard clay brick.
2. Due to the higher compressive strength the fly ash mixed laterite-cement brick can be used as a load bearing walls.
3. Can be used for both internal & external wall construction i.e. either use 12cm or 20cm side of brick as a base of wall.
4. Construction of these blocks comprises of easy and feasible process.
5. Plastering is not required, as the interlocking laterite-cement brick gives an aesthetic appearance and also prevents from non-structural cracks.
6. Utilizing Fly ash has made the brick Eco- Friendly.

8. FUTURE WORKS

This particular project was tested for water absorption in unburnt condition. However, this can also be tried by burning the bricks in the hot furnace for better results. The bricks in this project were made by mixing the fly ash and laterite–soil with cement which is a stabilizing agent. However, it can be tried with other stabilizing agents lime, steel scrap, etc.

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