

Comparative Study of Conventional Fly Ash Bricks with River Sand, M-Sand and Eco Sand and Eps Beads With Eco Sand

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Abstract— This experimental investigation focuses on the effect of complete replacement of river sand with, M-sand and Eco sand as fine aggregate Green Building is the fast growing concept with high demand for it in several aspects. Brick is an important construction material. Every year 150 billion bricks are manufactured in India. Added to this the uses of clay bricks destroys the top fertile soil. And as we all know that walls are main source of conduction of heat from atmosphere to building. Hence, necessary measures are adopted to insulate them. Walls are mainly composed of bricks. So, if thermal conductivity of brick reduces obviously the insulating property of wall increases which results in less energy consumption. The aim of the project is to replacing and comparing fine aggregate (river sand) with manufacturing sand and Eco-sand and EPS beads with Eco sand in ratios to form light weight fly ash bricks.

Index Terms—: river sand, manufactured sand, Eco sand, EPS beads, compressive strength, water absorption, efflorescence

1 INTRODUCTION

1.1 GENERAL

The purpose of this paper is to evaluate the possibility of using eco-sand and thermocol balls simultaneously to compare the compressive strengths of the bricks. The inherent benefits of using bricks as a construction material are durability, fire-resistance, low maintenance, energy efficiency and environmental friendliness. Flyash brick is a composite material composed of fine aggregate, cement, flyash & water. It is embedded in a hard matrix of material (the cement or binder) that fills the space among the aggregate particles and glues them together. Brick is widely used for making architectural structures & load bearing structures. Brick is a brittle material that is strong in compression and weak in tension. Flyash brick is a friend of the environment in all stages of its life span, from raw material production to demolition, making it a natural choice for sustainable home construction.

1.2 OBJECTIVES OF THE INVESTIGATION

To determine the compressive strength of fly ash brick at 7, 14 & 21 days.

To determine water absorption of fly ash brick at 7, 14 & 21 days

To determine the formation of efflorescence on fly ash brick at 7, 14 & 21 days

1.3 MATERIALS QUANTITY IN PERCENT

All the materials used in this project follows by IS codes. The materials and their properties are discussed.

Materials	Quantity in %
Fly Ash	55
Cement	10
River Sand (Trial1)	35
M-Sand (Trial2)	35
Eco Sand (Trial3)	35
EPS (Expanded Polystyrene)	5% by volume of Eco-Sand

Materials used in %

2 MATERIALS USED

2.1 CEMENT

Cement is a well-known binding material which is used for concreting containing of over burned calcareous and argillaceous materials.

Ordinary Pozzolona Cement (OPC) is one of the cement widely used in field. It is of three types' 33-grade, 43-grade, 53-grade. One of the important benefits is the faster rate of development of strength. Here OPC 53 with the specific gravity of 3.15 is used for casting the specimen.

Property of Cement	Values
Fineness Of Cement	370 m ² /kg
Grade Of Cement	53
Specific Gravity	3.15
Initial Setting time	30 min
Final Setting time	600 min

Properties of cement

2.2 FINE AGGREGATE

To improve the uniformity and workability the fine aggregates were used. It can assist to give better binding with cement. This action promotes plasticity in the mixture and prevents the possible segregation of paste and coarse aggregate.

River sand becoming a scarce commodity and hence an exploration alternative to it has become imminent. Hence manufactured sand is the good alternative to the river sand.

Eco sand is a byproduct of cement. Eco sand is replaced with M-sand at a certain percentage.

M-sand and Eco sand are completely replaced with river sand.

2.3 MANUFACTURED SAND (M-Sand)

Manufactured sand is a suitable of river sand for concrete construction. Manufactured sand is produced from hard granite stone crushing.

Properties	Values
Specific Gravity	2.57
Fineness Modulus	2.83

Properties of M-Sand

2.4 ECO SAND (E-Sand)

Eco sand are very fine particles, a bi-product from cement manufacture which can be used to increase efficiency in concrete. Its micro-filling effect reduces pores in concretes and provides better moisture resistivity and thus durability.

The eco sand has various advantages such as energy efficient, fire resistant, reduction of dead load, environmentally friendly, durable, light weight, low maintenance low construction cost.

Properties	Values
Specific Gravity	2.48
Fineness Modulus	2.8

Physical Properties of Eco-Sand

Properties	Values
SiO ₂	58-60%
Al ₂ O ₃	2-3%
Iron	1-3%
MgO	0.4-1%
CaO	20-25%

Chemical Properties of Eco-Sand

2.5 WATER

Water is an important factor in making of concrete, which doesn't have the acidity and alkalinity. The pH content of the water is to be 6-7. Casting and curing of specimens were done with the potable well and bore water. Water is added until the consistency attains.

2.6 EXPANDED POLYSTYRENE BEADS (EPS)

Properties	Values
Size of EPS	Passes through 4.75 mm sieve

Physical properties of EPS Beads

3 TESTS ON CONVENTIONAL BRICKS

3.1 COMPRESSIVE STRENGTHS OF BRICK

The red and fly ash bricks were tested on the compressive testing machine of capacity 100 tones which read to the nearest 0.5 tons. The load was applied steadily and uniformly. 3 bricks of each type were tested for compressive strength. The average compressive strength was calculated.

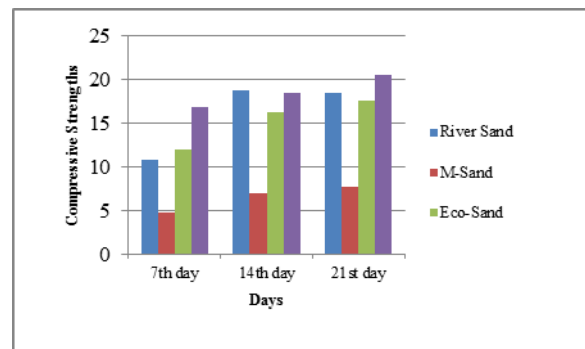
Formula used:

Compressive Strength (N/mm²) =

Maximum Load at failure in N / Avg. area of the bed faces in mm²

Type of fine aggregate / compressive strength on standard days	7 th DAY (N/mm ²)	14 th DAY (N/mm ²)	21 st DAY (N/mm ²)
River Sand	10.83	18.71	18.44
M-sand	4.77	6.98	7.64
Eco-sand	11.99	16.21	17.52
5% EPS with Eco-Sand	16.79	18.38	20.43

Compressive Strengths of Brick at 7, 14 & 21 Days



Graphical Representation of Compressive Strengths of Brick

3.2 WATER ABSORPTION TEST

The red and fly ash bricks were dried and weighted. These were then immersed in water for 24 hours and then weighted again. The bricks were tested in accordance with procedure laid down in IS 3495 (Part-II) 1976 (36).

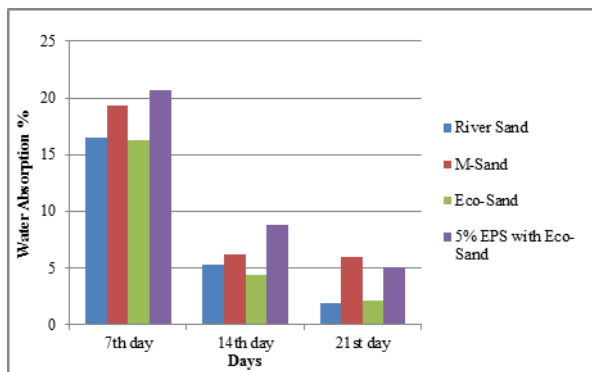
Water Absorption Test is used to find out the water absorption ratio. Because the brick, which are absorbing more water cannot be used in water logging area or exterior walls which is open to sky. The bricks from all the proportion were tested.

Formula used:

Water Absorption % = $(M_2 - M_1) / M_1 \times 100$

Type of fine aggregate / Water absorption % on standard days	7 th DAY (%)	14 th DAY (%)	21 st DAY (%)
River Sand	16.45	5.29	1.97
M-sand	19.34	6.17	5.96
Eco-sand	16.25	4.38	2.1
5% EPS with Eco-Sand	20.65	8.85	5.05

Water Absorption Test on 7, 14 & 21 Days



Graphical Representation of Water Absorption test of Brick

3.3 EFFLORESCENCE TEST

Fly ash bricks 3 numbers each were selected at random out of the samples of Fly ash bricks.

Then each bricks was placed on edge in dish containing distilled water, the depth of immersion of the brick was not less than 2.5 cm.

The whole arrangement was placed to in a ventilated room at 20 to 30 °C until whole of water in the dish evaporated.

When the water has been absorbed and bricks appeared to be dried, a similar quantity of distilled water was put in the dish and same was allowed to evaporate as before.

At the end of this period, the brick was examined for efflorescence.

River Sand	slightly efflorescence occurs
Eco-sand	slightly efflorescence occurs
M-sand	slightly efflorescence occurs
5% EPS with Eco-Sand	slightly efflorescence occurs

Efflorescence Test on Bricks

4 CONCLUSIONS

Based on the above results, following conclusions are drawn:

Brick produced by river sand, manufactured sand and eco sand and 5% EPS with eco sand. Bricks made with eco-sand had given High Compressive strengths than the M-Sand but lesser than the river sand. Due to lack of river sand and high cost, efficiently eco sand can be used. By Adding EPS Beads in the brick with Eco sand, it also achieves a good compressive strength.

In water absorption test, the brick made with eco sand absorbs less water than M-Sand. Hence on comparing the water absorption eco sand is moreover equal to the river sand.

Since the cement is added to the brick, the efflorescence slightly occurs on all type of brick which leads to the failure of this test, but it will not affect the nature of the brick.

Hence, on comparative studies we have eco sand good, economical and strength moreover equal to the river sand. But by adding EPS beads, the brick produces cracks initially. Hence to eliminate that EPS are used in powdered form.

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