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EXPERIMENTAL INVESTIGATION OF FLY ASH IRON DUST BLOCKS

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Abstract: The population of India is experiencing rapid growth, leading to increased demand for construction materials. Cement bricks, a common construction material, typically consist of cement, fine aggregate, coarse aggregate, and water. India generates substantial industrial, mining, and agricultural waste, which poses significant environmental challenges due to the space needed for disposal. However, this waste presents opportunities to partially or fully replace traditional materials in construction, such as cement bricks

Index Terms **–** Fly ash, Iron Dust, Compressive Strength, Prism Test.

I. INTRODUCTION

One abundant waste product is fly ash, which has various applications in construction, including eco-friendly cement production.Utilizing industrial waste as additives or substitutes in construction materials can mitigate environmental harm while reducing material costs. Additionally, incorporating industrial waste improves the physical and mechanical properties of cement bricks.

Research is underway to explore the potential applications of industrial waste, particularly fly ash, in cement bricks. Various blends of fly ash and cement (ranging from 0% to 40% fly ash content) are being tested for compression strength and water absorption to evaluate their suitability for construction purposes. This approach not only reduces cement consumption but also promotes the use of eco-friendly and sustainable resources in construction.

II. PROBLEM STATEMENT

FLY ASH

Every year almost 270 million tons of fly-ash was produced in India in the year 2021-2022. By the year 2025 it is predicted that this number will reach to almost three to four hundred million tons. As we all know, fly-ash endangers the environment in various ways one of which is the large area of land it takes to dispose it. So it is important to use the fly-ash instead of dumping it in various industries.

IRON DUST

Iron ore mining affects the environment in various ways. Apart from air pollution it causes it is necessary to safely get rid of the byproducts it produces. One of the things made from byproducts is iron dust. We use the iron dust in construction industry to replace the fine aggregate used in construction industry. It can also be used to produce bricks alongside fly ash in fly ash bricks. Need arises to study the properties of bricks thus formed.

III. OBJECTIVES

1.To investigate the strength of Fly ash- Iron dust bricks

2.The structure of fly ash- iron dust bricks needs to be compared to that of traditional bricks

3.Various tests like Hardness test, Soundness test, Shape and size test, Efflorescence test, Water absorption test, Compression test using CTM, Prism test needs to be done

4.To find out the cost of bricks thus made and compare it to traditional bricks

5.To finding out sustainable option than using traditional bricks.

IV. SCOPE OF THE PROJECT WORK

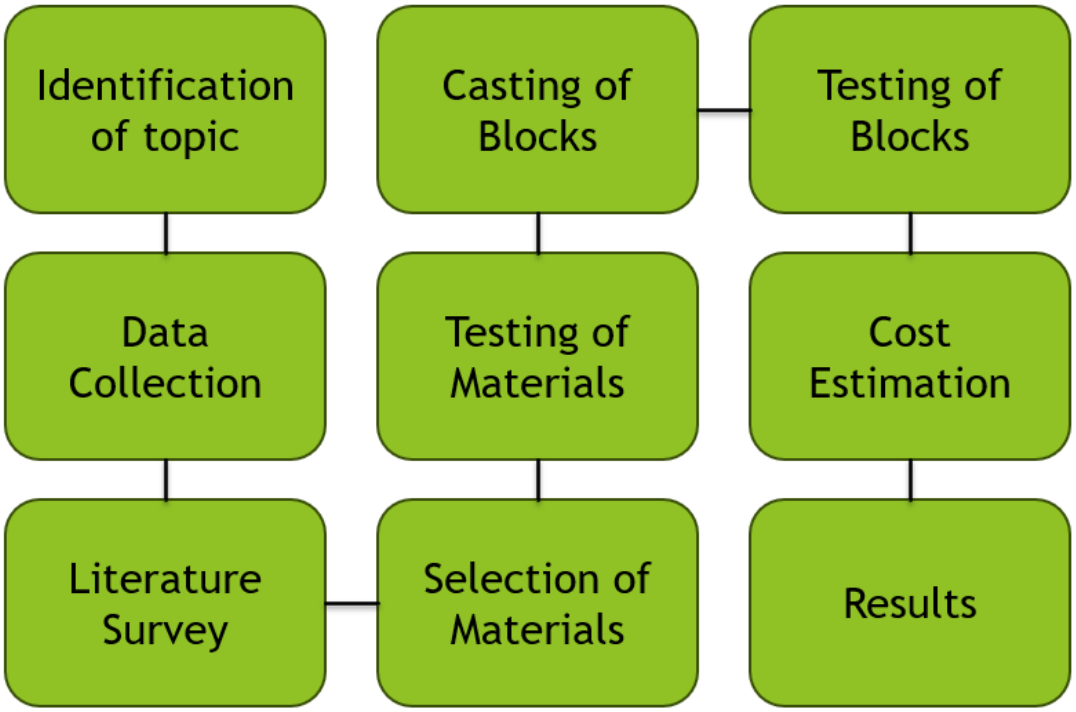
Bricks can be tested by changing the proportion of materials used

Effect of using different heights for the prism test can be carried out

V. RESEARCH METHODOLOGY

This research focuses on using various tests to determine the effect of using iron dust as fine aggregate replacement in fly ash bricks. For this the steps that are involved are as follows:

- Collection of the required material
- Testing of the required material
- Proportional and compatible mixing of material
- Casting of the specimen
- Testing of the specimen



COLLECTING MATERIAL

Fly ash:

Combining of fly ash with water gives us the fly ash slurry. Proportional mixing of the said slurry with water, iron dust and cement gives us the fly ash- iron dust blocks. As fly ash has greater percentage of calcium oxide; it makes it more efficient in structural strength of blocks made this way.

Iron Dust:

Iron dust when completely substitutes the fine aggregate the obtained result is increase in compressive strength as well as split tensile strength of the blocks obtained compared to traditional methods.

Cement:

Ordinary Portland cement of grade 53 is a higher strength cement which is used as binding material.

Water:
Ordinary potable water is used for the tests to be conducted

TESTING OF MATERIAL

1.Fineness of fly ash

Percent of fly ash retained on sieve = (w2/w1) x 100 = 23%

2.Consistency of fly ash

Standard Consistency of fly ash as Percentage % = (Weight of Water Added / Weight of fly ash) x 100 = 41%

3.Specific gravity of Fly ash

The formula for specific gravity is (m1 / (m1 - m_water)) * (V_water / V_solid), where m_water is the mass of the displaced water and V_water is the water's density = 2.42

PROPORTIONAL AND COMPATIBLE MIXING OF MATERIAL

1.Mix Design
Designing of mix required for various batches and preparing the moulds required.
2.Batching
Batching of various blocks according to proportions and days after which they are tested ie. 7, 14, 21.
3.Mixing
After the batching is done the next step is to mix all the ingredients. Thorough mixing of the materials is essential for the production of uniform blocks. The mixing should ensure that the mass becomes homogenous, uniform in colour and consistency.
There are two methods adopted for mixing of concrete:
Hand mixing and Mechanical mixing

CASTING

a) Casting of cube specimens
Cube moulds are prepared.
Mix is to be filled in three layers and each layer has to be compacted with the help of tamping rod.
Mix must be allowed to set for 24 hours before removing mould.
b) Casting of specimens for prism test
Cuboidal moulds are prepared.
Mix is filled in three layers and each layer has to be compacted with the help of tamping rod.
Mix must be allowed to set for 24 hours before removing mould.

TESTING OF THE SPECIMENS

1.Hardsness test
Hardness test is done by making a scratch on the surface of the blocks with help of fingernail or sharp object
2.Soundness test
Soundness test is done by striking two blocks together and analysing the sound made
3.Shape and size test
Shape and size test is done by breaking the prepared block and check for defects such as holes, lumps, etc.
4.Effloresence test
Efflorescence test is done by soaking the blocks in water for 24 hours and checking for deposits salts on the surface of the blocks.
5.Water Absorption test:
An absorption test is performed on Block to determine the amount of moisture absorbed by Block under harsh conditions. Sample dry Blocks are obtained and weighed in this test.
6.Compressive strength:
The average compressive strength of concrete masonry block is determined by taking nine blocks. After being collected at the lab, the blocks should be analyze within three days. Each block shall be 28 days old. The compressive strength testing machine is made up of two steel bearing blocks, one rigid on which the masonry unit is put and the other movable, which transmits the load to the masonry unit when applied.

If the bearing area of the masonry unit exceeds the bearing area of the steel blocks, then separate steel plates are utilized. The plates are mounted on steel blocks in such a way that the centroid of the masonry unit coincides with the centre of thrust of the blocks.

The bearing area of concrete masonry units is coated with Sulphur and granular materials coating or gypsum plaster capping. After inserting the unit in the testing machine, one-half of the predicted maximum load is applied at a constant rate, and the remaining load is applied in no less than 2 minutes.

Take note of the load at which the masonry unit fails, and the maximum load divided by the gross sectional area of the unit will give the compressive strength of the block. Similarly, test the remaining 7 blocks, and the average of the 8 block strengths is the ultimate compressive strength of the concrete masonry unit.

7. Prism Test:

The main objective of the present study is to determine the optimum mix ratio of cement-sand mortar to obtain maximum compressive strength.

Compressive Strength (MPa) = [Failure load (KN)/Area (Width x Length)] x Correction Factor

VI. RESULTS

Hardness Test:

No impression after scratching on the surface using fingernail. This shows Fly ash Iron Dust blocks passes the hardness test.

Soundness Test:

The Fly ash- Iron dust blocks produce clear ringing sound when struck together. This shows that Fly ash- Iron dust blocks passes the soundness test.

Shape and size test:

The Fly ash- Iron dust blocks were broken and it was observed that there were no holes or lumps in the cross section. This shows that the Fly ash- Iron dust blocks pass the test.

Efflorescence test:

The Fly ash- Iron dust blocks were soaked in water and were checked for any deposits of salts on the surface. No such deposits were formed so the Fly ash- Iron dust blocks pass the efflorescence test.

Water absorption test:

It was discovered that the weight of block was greater than requirement after curing

As a result, we applied the admixture to minimize the weight. We utilized an admixture called Conplast AEA.

Sr. No.	Type of Block	Weight of Block (in kg)
1	ACC Block	10
2	Fly Ash- Iron Dust Block	13.95
3	Fly Ash- Iron Dust Block with Admixture	9.460

Fig VI.1 Water Absorption test

Compressive strength:

AAC Block = 8.57 N/mm^2

Fly ash- Iron Dust Block = 13.566 N/mm^2

It is seen that compressive strength has significant improvement in the fly ash- iron dust blocks compared to AAC blocks.

Proportion	No. of Blocks	Days	Avg Compressive Strength (N/mm^2)	Final Compressive Strength After 21 Days (N/mm^2)
1:2:3	3	7	4.105	13.566
	3	14	8.221	
	3	21	13.566	
1:1.5:3	3	7	3.518	11.928
	3	14	6.591	
	3	21	11.928	
1:3:6	3	7	3.810	12.398
	3	14	7.658	
	3	21	12.398	

Fig VI.2 Compressive Strength

	Fly ash- Iron Dust	AAC
Size of Blocks	150mmx150mmx150mm	150mmx150mmx150mm
Compressive Strength after 21 Days	13.566 N/mm^2	8.57 N/mm^2

Fig VI.3 Comparison between fly ash iron dust blocks and ACC blocks

Prism Test:

1.Compressive Strength with mortar ratio 1:3 = 1.93 MPa (1.83 MPa for AAC Blocks)
2.Compressive Strength with mortar ratio 1:4 = 1.78 MPa (1.68 MPa for AAC Blocks)
3.Compressive Strength with mortar ratio 1:5 = 1.70 MPa (1.58 MPa for AAC Blocks)
It is seen that as the mortar ratio increases the compressive strength of blocks decreases.
It can also be seen that the fly ash- iron dust blocks perform better than AAC blocks in this test.

Mortar type	Prism Size (Width x Length x Height)	Correction factor	Failure load for Fly Ash-Iron Dust Blocks (KN)	Basic compressive Stress of Fly Ash-Iron Dust Blocks (MPa)	Failure load for AAC Blocks (KN)	Basic Compressive Stress of AAC Block (MPa)
1:3	600x230x685	0.86	310	1.93	295	1.83
1:4	600x230x685	0.86	287	1.78	271	1.68
1:5	600x230x685	0.86	273	1.70	254	1.58

Fig VI.3 Comparison between fly ash iron dust blocks and ACC blocks

VII. CONCLUSION

It is observed Fly ash- Iron dust Blocks pass the Hardness test, Soundness test, Shape and size test and Efflorescence test according to standards

Admixture needs to be added to the blocks as water absorbed is more than the permissible limit

Compressive strength of the Fly ash- Iron dust blocks was found to be higher than that of AAC blocks

Fly ash- Iron dust blocks performed better in prism test compared to AAC blocks of same size

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