An Experimental Investigation on Concrete Paver Block by Using Plastic, Flyash and Rice Husk Ash

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ABSTRACT—: The world's growing industrialization and urbanisation have resulted in a lot of infrastructure construction. This process causes a number of issues, including a shortage of building supplies and an increase in the output of garbage as well as other things. In this research work we studied the recycle of garbage like rice husk ash (RHA)**,** fly ash (FA) and plastic. In M20 and M25 concrete, fly ash (FA) and rice husk ash (RHA) are used to partially, in place of cement, and plastic is used to partially replace the aggregate. For most of the construction work both above mix is used. The impact of partially substituting RHA and FA for cement and plastic with aggregate on concrete was thoroughly studied in this extensive experimental study. In this paper, we started with a proportion of 20% FA and 0% RHA mixed together in concrete by replacing cement, and ended with a proportion of 0% FA and 20% RHA, with a steady rise of RHA by 1% and a steady decline of FA by 1%, and waste plastic was added 10% to replace the same amount of aggregate in all proportions. To determine the physical qualities of FA, RHA, plastic, cement, and aggregate, tests were done. Paver blocks with a square shape are investigated experimentally for strength for seven days, fourteen days, twenty-four days, and fifty-four days. The results suggest that M25 concrete with a combination of (16 percent FA + 4 percent RHA) depending on cement weight and 10% plastic depending on aggregate weight has the highest compressive strength and has the potential to be used as an appropriate paver block material. Simultaneously, paver blocks' compressive strength is observed to be dropping as RHA increases.

KEYWORDS: - Plastic, Rice husk ash, Fly-ash, Paver blocks, Environmental effect and quality control.

1.0 INTRODUCTION

Fine aggregates, coarse aggregates (10 mm and below), Cement, water are the essential components of concrete paver blocks. The entire performance of concrete paver blocks is governed by mixing procedure, material properties, w/c ratio, and curing method. Pavers come in a variety of forms, dimensions, and colours to satisfy the imaginations of landscaping designers and naturalists. They're arranged in a variety of patterns. Natural resources are finite over the world, as is the accumulation of garbage from industry, agricultural, and residential areas. This can be avoided by using materials that are unconventional and novel in the construction of sustainable structures. Waste products such as FA, plastic, and RHA can be reused to counterbalance for an absence of renewable sources and to find new methods to safeguard the surroundings.

Fly ash, waste plastic, and rice husk ash are used in paver blocks to diminish aggregate and cement content resulting in higher affordability and strength. It will support in environmental conservation and provide a method for the safe waste disposal like FA, plastic and RHA.

FA and RHA, as well as plastic, are developed as supplementary constituent for cement and aggregate respectively in paver blocks.

- **Fly ash**: - The minerals calcium (Ca), silicon (Si), and Aluminum Oxide (Al2O3) found in fly ash aid in setting and hardening, as well as serving as a workability agent.
- **Rice husk ash**: - It has a silica concentration of 98 percent, which improves strength, hardness and durability.
- **Plastic**: - Crushed plastic can provide reinforce to cement blocks to improving the toughness, strength, load bearing capacity, lowering the block's weight, and reducing the amount of aggregate used, among other things.

The creation of cement paver blocks necessitates the use of resources because materials of origin are plentiful nonetheless, it is in short supply. On the flip side, during the entire production process, there is an imbalance of ecology and habitat. To make a high-quality paver block, you'll need raw materials with specific qualities. It is feasible to replace up to 30% of the raw materials with alternative materials that have the appropriate qualities for a high-quality paver block. Due to its high silica content, rice husk ash provides strength, hardness and strength. Rice husk ash is a left-over commodity from industrial area that is readily accessible. Fly ash is a left-over commodity that stays after coal is burned in a thermoelectric power station and may could be utilised as a paver block material's raw material. During paver block manufacturing, fly ash acts as a workability agent. Plastic is a third essential additional raw material, and as we all know, plastic is a serious environmental issue. Plastic gives reinforcement, increasing the tensile strength and load bearing capability required for paver block or road building fabrication. All three extra components contribute to the paver block's good and necessary qualities. It also aids in the conservation of the earth's finite resources.

The current study's goals and scope are as follows:

- Natural resources and environmentalism can be served by replacing 30% of the resources.
- Utilization of a variety of waste resources and the provision of cost-effective construction materials.
- Examine the characteristics of FA, plastic and RHA.
- Determine the best mix design for the paver block in terms of the amount of FA, plastic, RHA required.

- Compare the expected compressive strength of paver blocks made up of many ingredients of FA, plastic and RHA to cement concrete blocks.
- Protect the environment by properly disposing of rubbish.
- Carry out a water absorption test and compare the results to those of a cement concrete block.

2.0 Materials and Methods

The research described in this study looked into the behaviour of Paver blocks made by combining cement with FA, RHA, and plastic. RHA, FA, OPC, and plastic were studied first for their physical and chemical properties.

2.1 Cement

The OPC (43 Grade) was used, having a specific gravity of 3.15. The cement took 50 minutes to harden initially and 365 minutes to set completely. Table 1 shows its chemical content.

Table 1: The cement (OPC) chemical characteristics, RHA and FA are listed here.

Materials	**Cao**	***Al2O3***	***Fe2O3***	**SiO2**	***MgO***	***LOI***	***SO3***	***K2O***	***Na2O3***
FA	*20.00*	*25.00*	*6.00*	*40.00*	*3.72*	*3.00*	*1.75*	*0.81*	*0.97*
RHA	*0.99*	(SiO2+ *Al2O3+ Fe2O3)* =82.63		*78.21*	*4.90*	--------	--------	---------	---------
Cement	*62.91*	*5.20*		*19.71*	*2.54*	*2.54*	*0.96*	*2.72*	*0.90*

2.2 Rice Husk Ash (RHA)

The RHA for this project collected from Tumsar Bhandara's Ellora Paper Plant. Rice husk ash has a bulk density of 0.781 g/cc and specific gravity of 2.10. RHA, which is formed by burning rice husk (RH), has a good sensitivity and pozzuolana property. The use of RHA in concrete is recommended as per IS 456-2000.

2.3 Fly Ash

Nagpur Koradi Thermal Power Plant provided the fly ash. One of the most common types of ash is fly ash. By-products of the coal-burning process are referred to as FA. FA is typically collected after power plant funnels, whereas bottom ash is collected from the furnace's bottom. Fly ash is on a regular basis used to augment Portland cement in the manufacturing of cement concrete, where it has both scientific and commercial advantages.

2.4 Plastic

One of the most pressing environmental challenges now is plastic pollution. Despite the fact that massive amounts appear to be involved of plastic garbage are inevitable in the environment in which we live. Crushed, and graveled plastic can be used to strengthen cement blocks, providing toughness, strength, and load bearing capacity while reducing the block's weight and reducing the amount of aggregate used.

2.5 Aggregate

As a fine aggregate, decent grade river sand was incorporated. 2.68, 2.32, and 1690 kg/m^3 are the specific gravity, fineness modulus and dry density respectively. The coarse aggregate material was sieved via a 20 mm sieve. The specific gravity is 2.7 and a dry density of 1550 kg/m^3.

2.6 Chemical Admixture

To keeping fresh concrete workable, a chemical limited type hyper plasticizer was introduced. The hyper plasticizer dosage was kept equal on a mass based, ranging from 1 to 1.6 percent of the weight of cement. A commercial AC-Green Slump-GS-02 and Glenium- AG-30 JP – BASF plastisizer used to make concrete more workable.

3.0. Experimental Programme

Tests on RHA, FA, cement, concrete, Plastic, and paver blocks with a partial substitution of cement with FA and RHA and 10% replacement aggregate with plastic are part of the experimental design.

3.1 RICE HUSK ASH

1. Standard consistency is 17%

2. The initial setup time is 195 minutes and the final setup time is 265 minutes.

3. The Compressive Strength of RHA is 11 N/mm^2

4. Specific Gravity is 2.09.

3.2 ORDINARY PORTLAND CEMENT

For the duration of the experiment, OPC 43 grade (IS: 8112-1989) cement was used. On OPC, the physical examination are listed below.

1. Standard consistency is 22% and Specific Gravity = 3.15

2. The initial setup time is 30 minutes and the final setup time is 10 hrs.

4. Specific Gravity is 3.15.

3.3 TEST ON CONCRETE

Based on preliminary investigations done in the constituent materials, an M25 mix is designed according to IS 10262, 1982 specifications. The following are the results of tests performed on fresh concrete.

1. Vee-Bee test as per IS Code (1199:1959) = 13sec.

2. Slump test as per IS Code (1199-1959) = 55mm

3. Flow test as per IS Code (1199-1959) =78 %.

4. Compaction factor as per IS Code (1199-1959) = 0.95.

3.4 Mixture Proportioning

The mix proportion of the paver block mixture adopted IS 10262-1982. The OPC control mixture's objective mean strength was 32.1 N/mm^2, with an entire cement content of 435.45 kg per m^3, FA of 476 kg per m^3, and CA of 1242.61 kg per m^3. The water/cement ratio was kept continuous at 0.444, while the plasticizer quantity was changed to keep all mixes at a slump of (200-240 mm). Before water was added FA, RHA, cement, sand, fine aggregate, coarse aggregate, and plastic were appropriately mixed as per the ratio 1:1.1:2.85 by weightiness in line with (BS 8110)19 to achieve homogeneous mixture. After a 5-minute total mixing time, the paver block samples are prepared and before demoulding, the mould was left for 24 hours. Paver blocks was put in curing tank till the testing day arrived. RHA and FA were utilize to substitute cement in percentages of 2, 4, 6, and up to 20%, while plastic was used to replace 10% of the replacement aggregate.

For casting, 100mm x 100mm x 100mm paver block moulds were used. For each layer, twenty-five strokes of a 16 mm rod were used to compact the concrete in three layers. Before the blocks were demolded and placed in the curing tank, the concrete was left in the mould for 24 hours to set. For 7, 14, 28, and 54 days, the paver blocks were cured in the tank.

3.5 Testing methods

Testing is carried out in accordance with the IS code. The compression strength of cubes was tested according to IS: 516 – 1959.

4.0 Test Result

To determine the strength related parameters, such as compressive strength, an experimental examination is carried out on paver block test specimens. The experimental outcomes of the tests evaluation acted upon on test specimens to explore the optimum proportion of cement replacement with FA & RHA and aggregate replacement with waste plastic were offered in this paper.

4.1 Testing of Compressive strength (IS 15658: 2021)

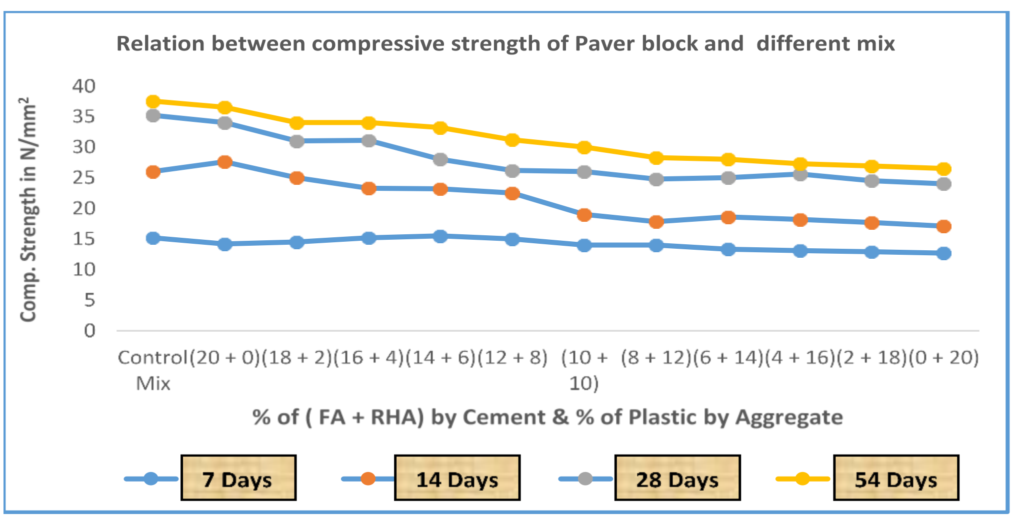
The strength of paver block samples is measured for 7, 14, 28, and 54 days using a compressive testing machine. The test results are tabulated once compressive strength testing has been completed.

Table No. 2 Table for compressive strength of paver block.

MIX				Compressive Strength of Paver Block in mpa respective number of days			
Sr. No.	**FA as a % of cement weight**	**RHA as a % of cement weight**	**Plastic as a % of aggregate weight**	**7**	**14**	**28**	**54**
1	control mix concrete			18.7	26.7	33.2	42.3
2	20	0	10	14.2	27.6	34	36.5
3	18	2		14.5	25	31	34
4	16	4		15.2	23.2	31.1	34
5	14	6		15.5	23.2	28	33.2
6	12	8		15	22.5	26.2	31.2
7	10	10		14	19	26	30
8	8	12		14	17.8	24.8	28.3
9	6	14		13.3	18.6	25	28
10	4	16		13.1	18.2	25.6	27.3
11	2	18		12.9	17.7	24.5	26.9
12	0	20		12.7	17.1	24	26.5

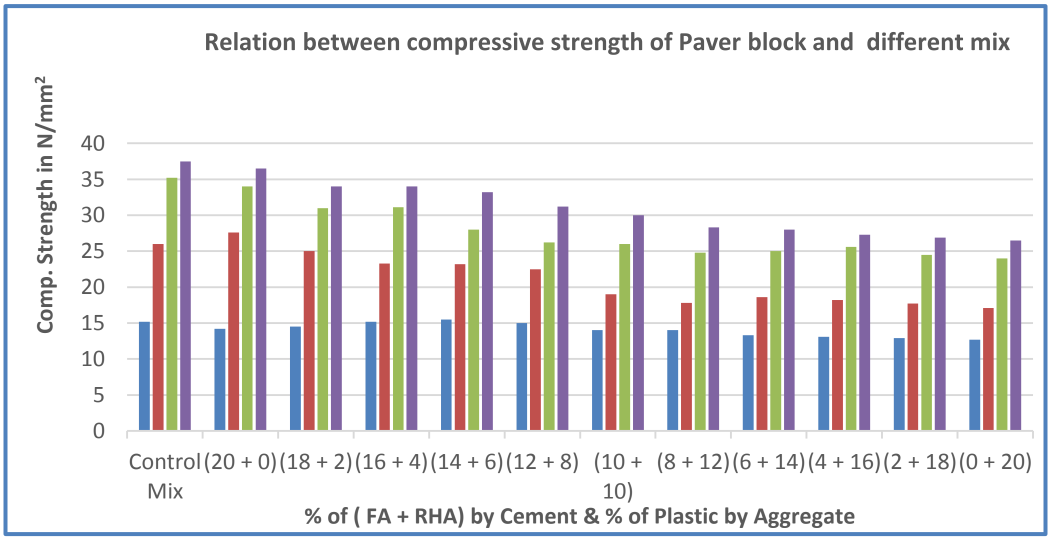
Paver blocks with a square shape are tested experimentally for strength for seven days, fourteen days, twenty-four days, and fifty-four days, according to table no. 2. According to the findings, M25 concrete with a mix of (16 percent FA + 4 percent RHA) based on cement weight and 10% plastic based on aggregate weight has the highest compressive strength and could be used as a suitable paver block material. Simultaneously, the compressive strength of paver blocks is shown to be decreasing as RHA increases.

4.1.1 Relation between different mix and compressive strength of paver block in days.

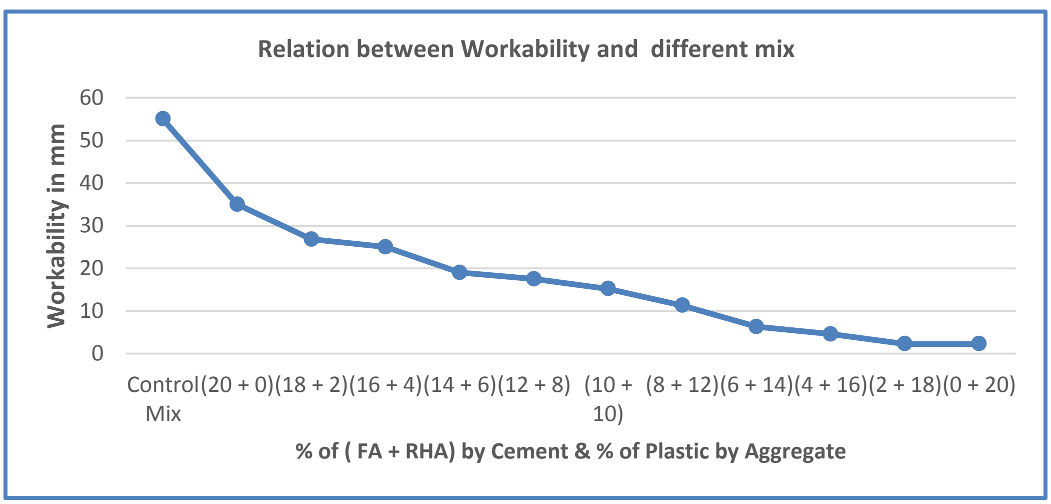


M25 concrete with a ratio of (16 percent FA + 4 percent RHA) based on cement weight and 10% plastic based on aggregate weight has the maximum compressive strength, according to the observations, and could be used as an appropriate paver block material. Simultaneously, as RHA grows, the compressive strength of paver blocks is revealed to be diminishing.

4.1.2 Relation between % of Mix and compressive strength of paver block.

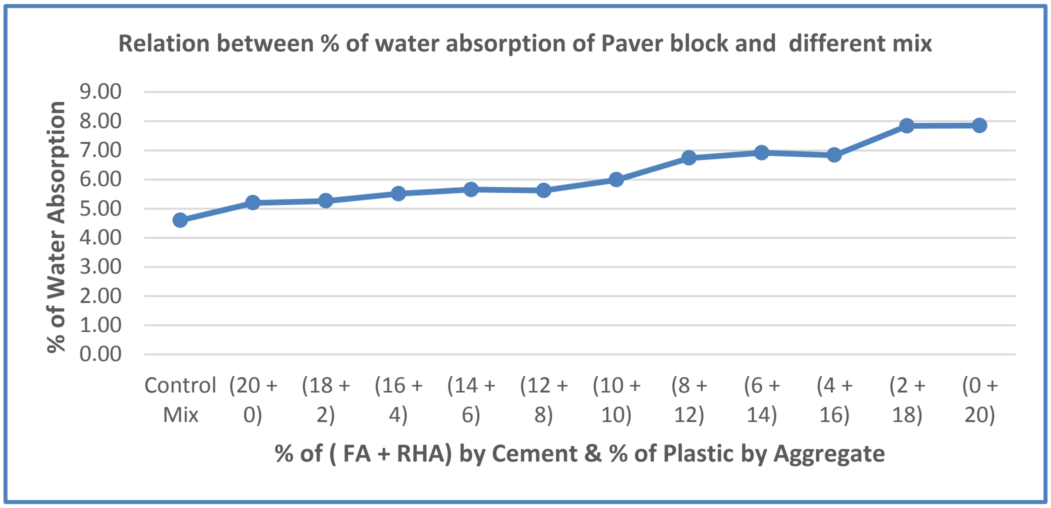


4.1.3 Relation between workability and different mix.



The workability of RHA concrete has been seen to deteriorate with the addition of RHA.

1.4 Relation between different mix and % of water absorption of Paver block.



The water absorption of paver block increases after the addition of percentage increase of rice husk ash as compare to control mix.

4.2 Result and Discussion

The highest strength findings were found to be (16 percent FA + 4 percent RHA) by the weight of cement and 10% plastic by the weight of aggregate in the current study. According to the test results it is observed that the addition of fly ash, rice husk ash, and waste plastic to the paver block reduced the compressive strength of the paver block. At the same time, it has been discovered that rising the proportion of RHA in concrete affects its workability.

5.0 Conclusion

The following are some of the inferences that can be derived from the above research results:

1. For varying mix proportions, the strength of paver blocks increases as the percentage of FA and RHA increases up to exchanging (16 percent FA and 4 percent RHA) of cement and 10 percent plastic of aggregate in Concrete.

2. Due to the higher percentage of RHA in paver block concrete, a slight increase in the water cement ratio is required. Because RHA is a permeable substance.

3. With increasing rice husk ash replacement, concrete workability in paver blocks has also been discovered to decline.

4. The water absorption of paver block increases after the addition of percentage increase of rice husk ash as compare to control mix.

5. It was noticed that when rice husk was burned, it created a significant amount of silica (more than 80 percent). As a result, it offers great insulation value.

6. Because rice husk ash contains more silica, we may choose to utilize RHA in concrete paver blocks to enhance durability.

7. Although RHA is dangerous to humans and RHA has no cost, we prefer it to silica fumes in concrete paver blocks.
8. RHA concrete's workability has been observed to diminish, but FA increases concrete's workability, therefore RHA and FA are used together in concrete paver blocks to reestablish concrete's workability.

9. It is possible to employ RHA with plasticizers and admixtures in paver blocks to increase strength while substantially replacing cement.

10. The current research focuses on creating both underweight and high-density concrete.

11. Construction costs will be decreased, and waste plastic will be disposed of in a more environmentally friendly manner.

12. The average weight of a paver block can be reduced by 15% by using rice husk ash and plastic.

13. To summarise, using FA, RHA and plastic in a paver block is the greatest alternative for disposing of FA, RHA and plastic and as a result eliminates environmental pollution.

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