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Development of Concrete Paver Block Using Industrial Waste-Fly Ash

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***Abstract:** In the course of recent decades, paving blocks made out of concrete has turned into a component of our towns and urban areas. It is to be found in residential, commercial and industrial locations in the paving like shopping centres, parking areas, stopping zones and transport stops. India is a developing nation so here the development of roadway assumes an essential part. Concrete paving block innovation has been presented in India 10 years back, for particular necessities like pathways, stopping zones, parking zones etc. It gives a hard surface which is stylish, comfortable to walk on, trafficable, extremely tough and easy to keep up. The principle point of this research is to create solid paving blocks from industrial waste. The fundamental purpose behind the utilization of the industrial waste is to decrease the landfill issue and further more to control the consumption of the natural assets. For this reason industrial waste-fly ash was chosen. With various proportions of 20%, 25% and 30% cement was replaced with fly ash, paving blocks were casted and tested according to the guidelines given in the Indian standards for precast concrete blocks for paving (IS: 15658:2006). These test outcomes are then compared with the outcomes of the conventional concrete paving blocks.*

***Keywords:** Fly Ash, Cement, Concrete Paver Block, Compressive Strength, Water Adsorption*

I. INTRODUCTION

The idea of utilizing interlocking paver block is extremely old. The first run of road utilizing paver block was built in 5000 B.C. Around 2000 years prior, with the assistance of military group and labour the first time roman built pavement roads. Since, this procedure is proceeded and culture is taken after for developing paving roads. Concrete paving blocks were first produced in the Netherlands in 1924. It was most likely World War-II that prompted the development of concrete blocks as a paving material. Concrete Block Pavement (CBP) was presented in the Netherlands in the mid 1950's as a replacement for heated mud brick roads. The overall pattern towards beautification of city pavements, the increasing expense of bitumen as a paving material and the quick increment in construction and maintenance cost have urged designers to alter paving material, for example, concrete blocks. The strength, tough and aesthetically pleasing surface of pavers have made CBP perfect for some commercial, metropolitan, municipal and industrial applications. In 1960 German developed high productivity devices for the development of interlocking paver blocks. Assembling innovation immediately took after by countries like South Africa, New Zealand, Australia, Europe and Britain in the 1970's.

II. OBJECTIVES AND SCOPE

1) To study the properties of concrete paving block made by replacement of cement with industrial waste-fly ash in different proportions like 20%, 25% and 30%.
2) To minimize the burden of industrial waste on environmental and landfill issues.
3) To develop low cost concrete paving blocks.

III. NEED OF THE RESEARCH

Industrial solid waste (ISW) is risky to manage in future due to rapid industrialization and also causes degradation of environment. Also, because of population increasing day by day construction industry spreading and developing so that due to more demand raw material cost is increasing. Thus, it is worthy to carry out research like replacement of cement with fly ash for production of concrete paver block and reduce of environmental pollution due to industrial waste.

IV. EXPERIMENTAL PROGRAM

Following are the details and sources of the materials used in this research.

A. *Source of Materials*

In this study, Ordinary Portland cement 43 grade, Fly Ash as partial replacement of cement, fine aggregate and coarse aggregate was used.

TABLE I

SOURCES OF MATERIALS

Experimental Materials	**Source**
Cement	Locally available OPC 43 Grade
Fly Ash	Rajdeep Pvt. Ltd., GIDC, Makarpura, Vadodara
Fine Aggregate	Locally available
Coarse Aggregate	Locally available

1) *Cement*

Ordinary portland cement with 43 grade has taken in this study, the chemical properties are given in table II.

TABLE II

CHEMICAL PROPERTIES OF CEMENT

Properties	**Results (%)**
Lime (CaO)	62.38
Silica (SiO_2)	22.57
Magnesium oxide (MgO)	3.12
Aluminum (Al_2O_3)	5.46
Calcium sulphate ($CaSO_4$)	4.74

2) *Fly Ash*

The Fly Ash was obtained from Rajdeep Pvt. Ltd., GIDC, Makarpura, Vadodara. The chemical properties of the fly ash given in table III.

TABLE III

CHEMICAL PROPERTIES OF FLY ASH

Properties	**Results(%)**
Silicon oxide(SiO_2)	61.22
Magnesium Oxide(MgO)	6.09
Sulphur trioxide(SO_3)	3.14
Aluminum Oxide(Al_2O_3)	7.63
Ferric Oxide(Fe_2O_3)	7.42
Calcium Oxide(CaO)	5.3

3) Fine Aggregate and Coarse Aggregate

The fine aggregate and coarse aggregate was obtained from locally available. The physical properties of fine and coarse aggregates are given in table IV.

TABLE IV

PHYSICAL PROPERTIES OF FINE AND COARSE AGGREGATE

Properties	**Fine Aggregate**	**Coarse Aggregate**
Specific Gravity	2.68	2.78
Fineness Modulus	2.46	5.82
Water Absorption(%)	0.88	0.44

V. METHODS

Following is the method adopted to make the Concrete Paver Block.

A. Hydraulically Pressed Method

The concrete utilized for hydraulic press method is prepared as per IS 20262:2009 Concrete Mix Proportioning guideline (first revision) with significant water content as this gives best taking care of attributes and results in a high strength concrete. The concrete is conveyed into the steel moulds and levelled out, typically by means of a rake. The surplus concrete is removed and afterward a hydraulically operated press slides down, compacting the concrete and squeezing out overabundance water. Compaction is effective to the point that the steel moulds can be evacuated and re-utilized promptly, leaving the formed concrete paving blocks in place. The products, as of now very firm and strong to the touch, are then carried on a move bed into a curing chamber.

Following fig.1 represents the handling of hydraulic press machine by myself and fig. 2 shows final product i.e. fly ash added paver block.

Fig. 1 Handling of hydraulic press machine

Fig. 2 Final product (Concrete paving block)

VI. EXPERIMENTAL RESULTS AND DISCUSSION

The Concrete Paver Block is designed on the basis of IS: 15658 -2006 as per M-35 Grade Designation of Paver Blocks. The results which are comes out from testing are given below-

A. *Compressive strength test*

Following fig. 3 shows compression strength testing of concrete paving block done by me

Fig. 3 Compression strength testing of concrete paving block

Table V and fig. 4 represents the compressive strength of different percentage of fly ash added Concrete Paver Block at 7, 14 and 28 days. Fig. 5 represents the optimum compressive strength of the paver block with 25% replacement of cement with fly ash. The compressive strength decreases at 30%.

TABLE V

EXPERIMENTAL RESULTS OF COMPRESSIVE STRENGTH TEST FOR FLY ASH PAVING BLOCK MIXES IN DIFFERENT PROPORTIONS AT 7,14 AND 28 DAYS

Sr. No.	Block Mixes (% Fly Ash)	Average Compressive Strength (MPa)		
Duration(Days)		7	14	28
1	0	33.24	33.84	35.73
2	20	30.11	33.87	39.35
3	25	28.24	35.76	42.23
4	30	26.46	32.19	36.46

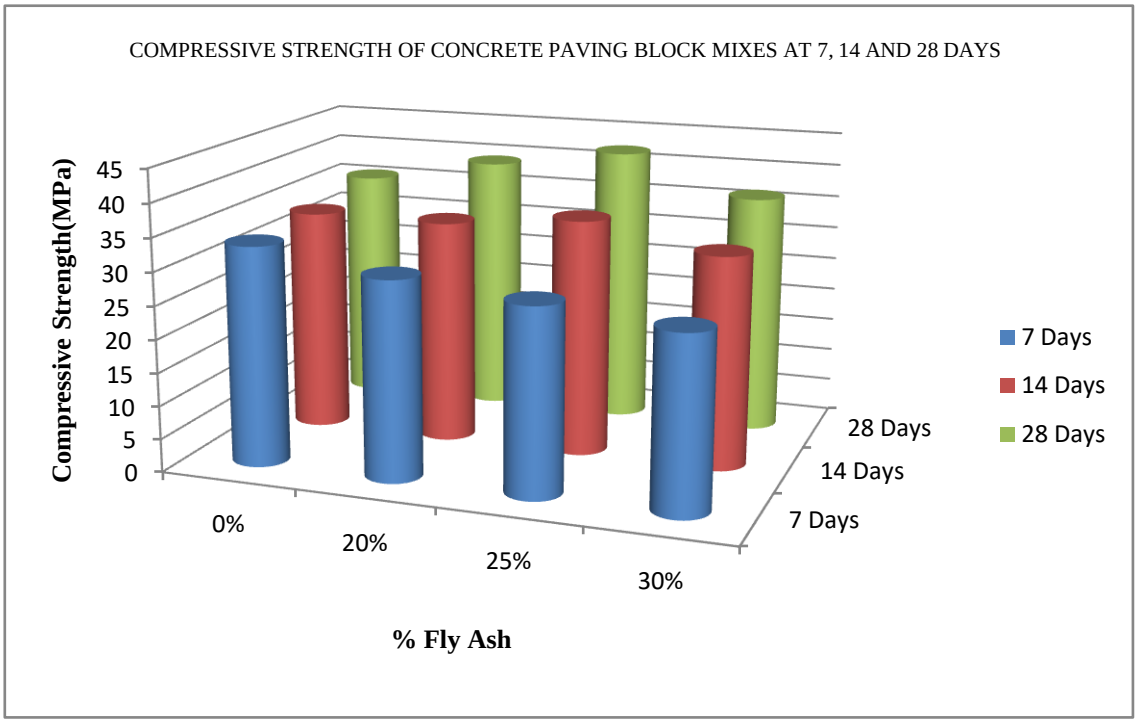

Fig. 4 Compressive Strength of Fly Ash Paving Block mixes in different proportions at 7, 14 and 28 Days

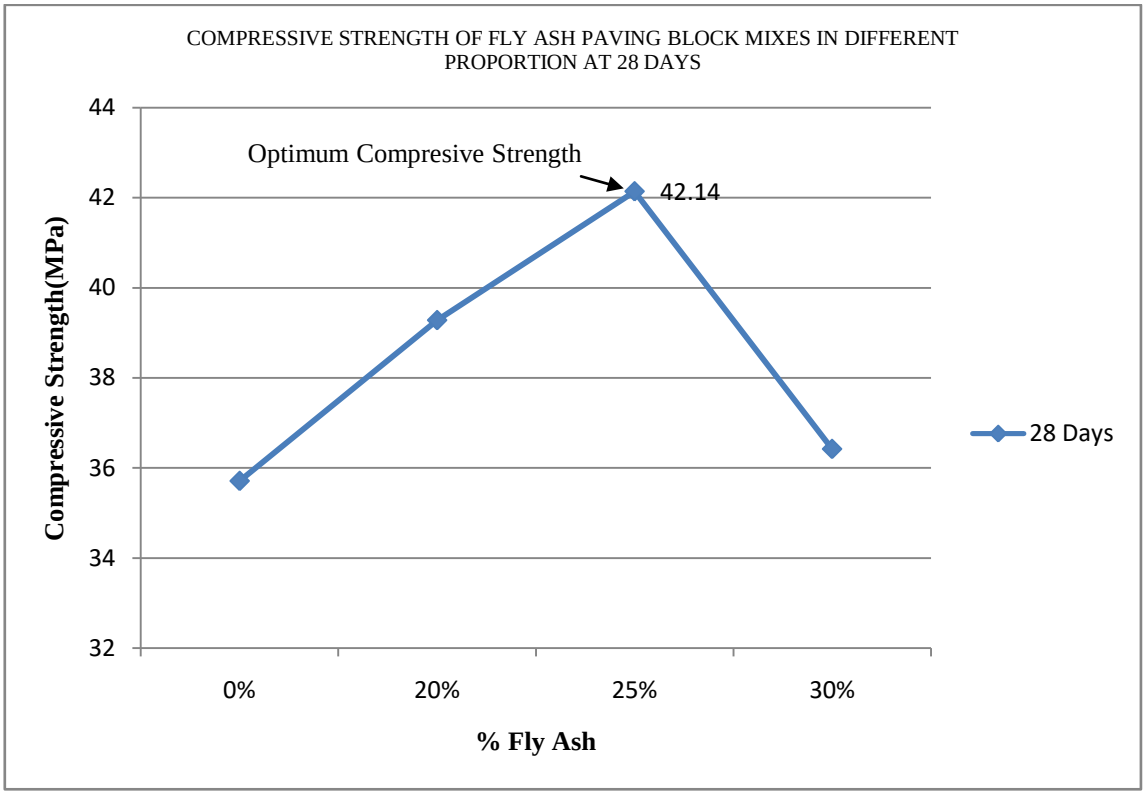

Fig. 5 Compressive Strength of Fly Ash Paving Block mixes in different proportion at 28 Days

B. Water Absorption test

The ability of a specimen to absorb water is known as water absorption of specimen. It mainly depends on size, shape and volume of pores, present in the specimen. The specimen shall be completely immersed in water at room temperature for 24 hr, then removed from water and allowed to water out. The specimen shall be immediately weighed. Now, specimen shall be dried in a oven at 107°C for 24 hr then weighed.

Table VI and fig. 6 represents percentage water absorbed in fly ash paving block mixes in different proportion at 28 days.

TABLE VI

WATER ABSORPTION TEST RESULTS FOR FLY ASH PAVING BLOCK MIXES IN DIFFERENT PROPORTIONS AT 28 DAYS

Sr. No.	Block Mixes (% Fly Ash)	Wet Weight (Kg)	Dry Weight (Kg)	% Water Absorption
1	0	3.17	3.08	2.92
2	20	3.22	3.13	2.87
3	25	3.28	3.19	2.82
4	30	3.16	3.06	3.26

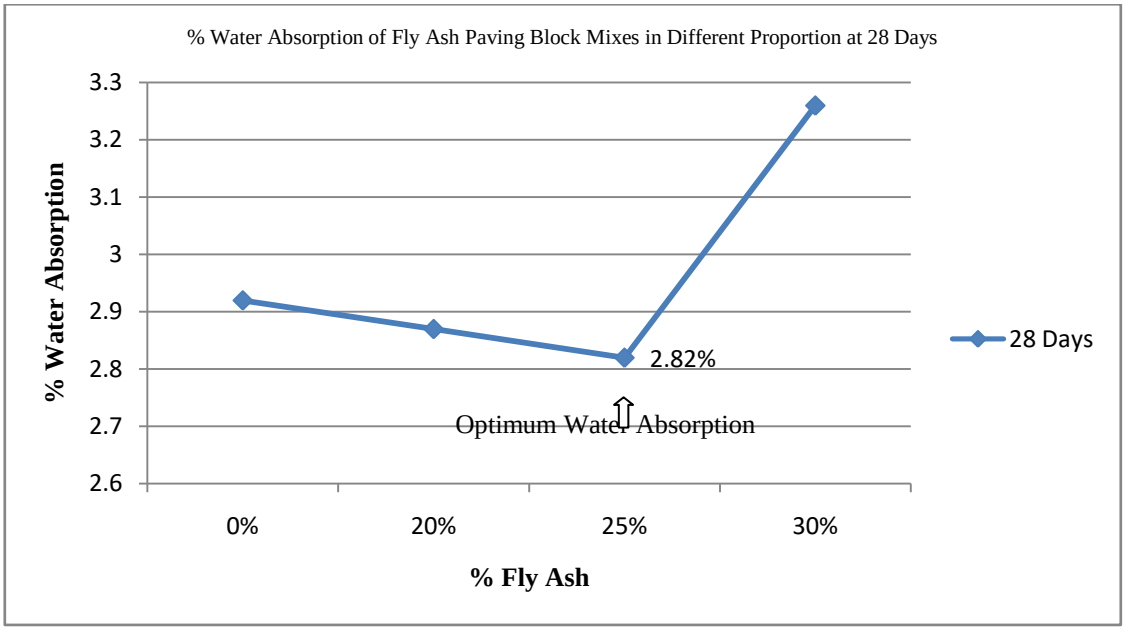

Fig. 6 Percentage Water Absorption in Fly Ash Paving Block Mixes in different proportions

VII. CONCLUSION

Based on the experimental research following conclusions are drawn:

1) Compressive strength of fly ash paving block was increasing by replacement of fly ash in different proportion for block mixes as compared to conventional paving block.
2) Results shows that highest compressive strength is obtained for 25% replacement of cement with fly ash in paving block mixes of M-35 grade concrete.
3) All paving block mixes which are made with replacement of fly ash gives acceptable compressive strength results. So that all paving block mixes are used for street paving.
4) Fly Ash Paving Block mixes percentage water absorbed was gradually decrease with increase in fly ash. But after increasing the quantity of fly ash to 30% shows maximum percentage of water absorbed.
5) Optimum water absorption was at 25% fly ash mix.
6) All paving block mixes which are made with replacement of fly ash gives desirable percentage of water absorption test results.
7) Environmental effects of fly ash and disposal problems of fly ash can be reduced through use of fly ash in Paver block that will reduce cost, also.

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