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Comparative Study of Compressive Strength of Paver Block by Using Silica Fumes

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ABSTRACT: Silica fume is a by-product of electric arc furnace reduction of quartz into silicon and ferrosilicon alloy used in the electronics industry. This is composed mainly by silicon and this by-product can be used as a mineral admixture in mortar and concrete. This waste product is already causing serious environmental pollution which calls for urgent way of handling the waste. In this paper, silica fume has been chemically and physically characterized, in order to evaluate the possibility of their use in industry. Samples of varied amount of silica fume mix with cement at 0, 5, 10, 15, 20, 25&30 % respectively. Aging times were 28 days for compression strength. This study presents an experimental investigation on the effect of silica fume (SF) on various strength properties of replacement of cement.

KEYWORDS: concrete paver block, silica fume, M40 grade.

I. INTRODUCTION

Generally Paver block is produced from the concrete mixture of cement, aggregate, sand and water. Sometimes use the additives such as super plasticizer. First time road is constructed by using paver block in 5000 B.C. by the Minoans. About 2000 years ago, with the help of labor and military group. The purpose of this paper is to investigate the replacement of cement with lime in the production of normal weight concrete with the express objective of reducing the production of greenhouse gas emission by manufacturers of pozzolans. In environmental terms, lime does not generate as much CO2 in its production as does the production of Portland cement. Lime has been used as the basis for the pozzalonic material in concrete for thousands of years. Portland cement's development in the late eighteenth century and its adoption as the primary pozzalonic material in concrete resulted in the displacement of lime as the primary cementations material. Lime has a number of properties that are of interest in the development of long term durability of materials, particularly the slow carbonation rate and resulting self-healing properties.

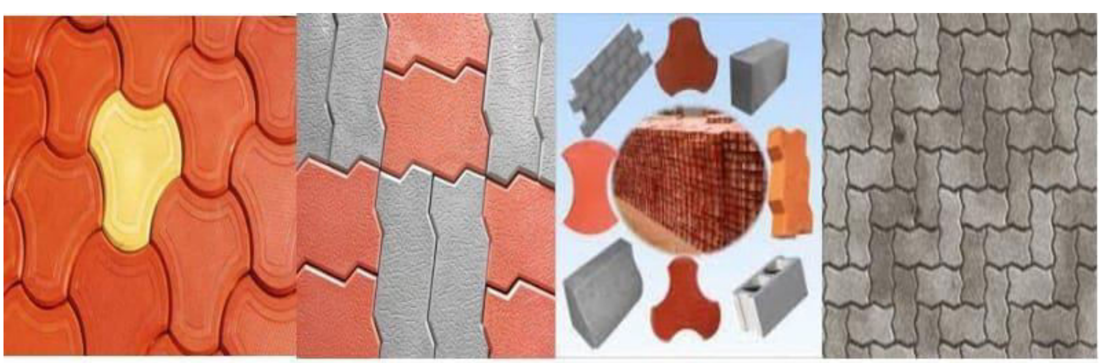

Photo 1: Different types of paver block

Fig 1 Different types of paver block

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II. LITERATURE REVIEW

1)IS 15658:2006 on "Precast Concrete Blocks for Paving": A segmented concrete paving is a system of an individual shaped blocks arranged to form a continuous hardwearing surface overlay. Over the past two decades, paving composed of segmental blocks has become a feature of our towns and cities. It is to be found in commercial industrial and residential areas, in the paving malls, plazas, parking areas and bus stops. It has been successfully used for embankment walls, slope protection and erosion control**. 2) B. R. C. Yeole1, Dr. M. B.Varma:** Concrete paving blocks are ideal materials on the footpaths and roads for easy laying, better look and finish. In this paper, a parametric experimental study for producing paving blocks using waste steel aggregates (the form of rounded bearings of size 6.35 mm) is presented. Waste steel bearings are added in concrete of paver blocks in various percentages**. 3)C. Poonam Sharma, Ramesh Kumar Batra:** Solid unreinforced pre-cast cement blocks concrete paver is a versatile, aesthetically attractive, functional, cost effective and requires little or no maintenance if correctly manufactured and placed. Paver blocks can be used for different traffic categories i.e. Non- traffic, Light-traffic, Medium-traffic,Heavy-traffic and Very heavy traffic**.4)D. Hughes, D.C., et al., Calcination of Roman cemen**t: A pilot study using cement-stones from Whit by Construction and Building Materials, 2008. 22 .**5)E.S Marshal and Sons Ltd UK :**Mix design can be regarded as the process of selections of the proportion of different constituent of concrete to produce the product of required quality. In the past the mix design has been simple as possible and the concrete quality and mix proportion were regarded as been synonymous.

III. METHODOLOGY

The study of literature survey and design of mix design of paver block and selecting of material with its physical and chemical properties for manufacturing of paver blocks, with the work plan in action, produce blocks and further test it. After testing of the pervious concrete paver blocks, analyze the test results and note down the conclusions with the recommendations. According to the specification required various materials in construction and waste materials. Generally the blocks are manufactured from cement, coarse aggregate, fine aggregate and silica fume. The manufacturing of blocks includes various steps such as collection, sieving, mixing, placing, tapping and finishing, curing.

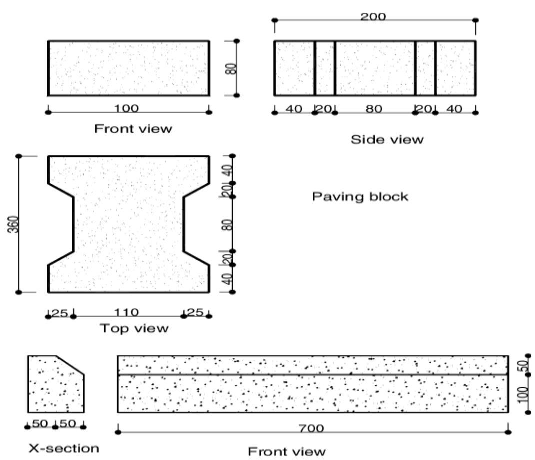

Fig 2 Cross-section of Paver Block

STUDIES ON PROPERTIES OF COLLECTED MATERIALS

The properties of materials such as cement, aggregate, silica fume and crusher stone powder have been studied andtested.

1. **Mixing**

Fig 3 Preparation of specimens

2. **Sampling**
3. **Preparation ofMould**
4. **Casting**
5. **Compaction**

Fig 4 Compaction of specimens

6. **Demoulding**
7. **Curing Of TestSpecimens**

Fig 5. Curing of specimens

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OBSERVATION

WATER ABSORPTION

The water absorption of the ICPB is carried out as per the specifications of IS: 15658: 2006 (clause6.2.4).The water absorption of single ICPB should not be less than 7% or should not be more than 6% by mass i.e., average of three block specimen. The water absorption of all the individual units is well below 7%. After saturation and drying of specimen for 24 hrs each no block unit shows an increase of loss should be less than 0.2 percent as per IS: 15658 (2006).

% replacement of cement with silica fumes	Sample no.	Water absorption percentage	Average water absorption, %
0	1	1.36	1.50
	2	1.64	
	3	1.50	
5	1	2.00	2.15
	2	2.10	
	3	2.35	
10	1	2.91	2.82
	2	2.86	
	3	2.70	
15	1	3.10	2.93
	2	2.99	
	3	2.81	
20	1	3.40	3.21
	2	3.19	
	3	3.04	

Table 1 shows the test results for water absorption test.

COMPRESSIVESTRENGTH

Average strength of the block specimen when cementing the mix is replaced by silica fumes by weight are found out and the outcomes are demonstrated in tables below. The compression testing and failure of the sample is shown in the Fig.4.1.

(a) Cracks during testing

(b) After failure

Fig.6 Compression testing of the concrete block specimen and failure of the block specimen

Age of test	Compressive strength (MPa)									
	Control mix		SF5		SF10		SF15		SF20	
7 Days	43.8	44.3	42.3	42.6	46.80	47.4	49.90	49.8	44.90	45.6
	45.6		45.6		45.90		49.60		46.30	
	42.9		41.2		47.80		48.20		44.30	
	45.00		41.3		48.90		51.60		46.60	
28 Days	52.2	53.2	58.30	57.3	61.2	60.2	66.30	65.9	64.90	64.4
	52.6		55.60		59.6		65.40		63.50	
	53.4		57..4		59.3		67.30		65.90	
	54.6		57.9		60.7		66.20		63.30	
%, increase	-		2.2*		6.9		17.1		14.3	

Table 2 shows Age of test and compressive strength

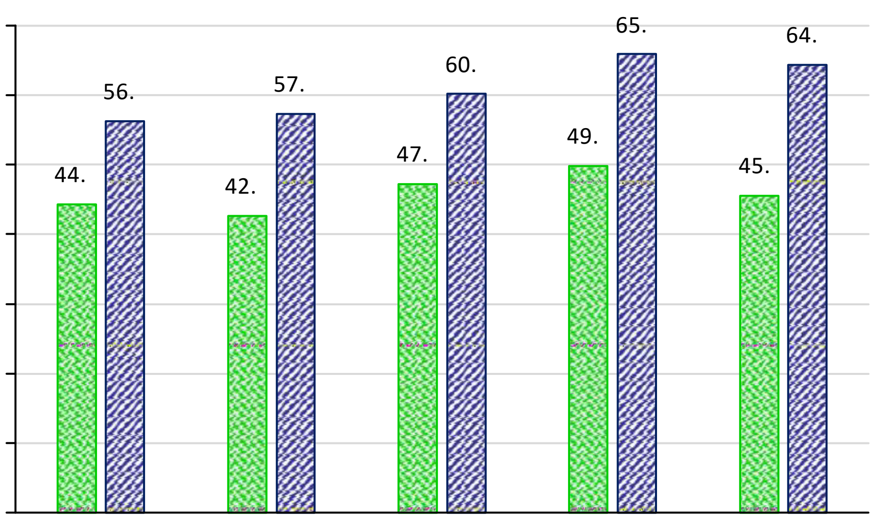

Fig 6 Shows Coloumn Chart of compressive strength

FLEXURE STRENGTGH

Flexural strength of the block units is tested as per IS: 15658 (2006). The average flexural strength of the concrete when cement and sand in mix is replaced by different materials by weight are found out and the outcomes are denoted in tables below. The flexural testing and failure of the sample is shown in theFig.

A. Sideview

B. Topview

Fig. 7 Flexural testing of the concrete block specimen and failure of the block specimen

Age of test	Flexural Strength (MPa)									
	Control mix		SF5		SF10		SF15		SF20	
7 Days	2.36	2.38	1.80	1.9	2.10	2.12	2.30	2.27	2.10	2.32
	2.30		1.90		2.00		2.20		2.20	
	2.48		1.90		2.20		2.40		2.60	
	2.40		2.00		2.20		2.20		2.40	
28 Days	2.76	2.74	2.40	2.65	3.00	2.82	2.90	2.93	2.90	2.97
	2.68		2.60		2.60		2.70		2.80	
	2.86		2.70		2.90		3.10		3.20	
	2.40		2.90		2.80		3.02		3.00	
%, increase			-2.50		3.67		7.72		9.19	

Table 3 Flexural strength of paver blocks when cement is replaced with silica fumes.

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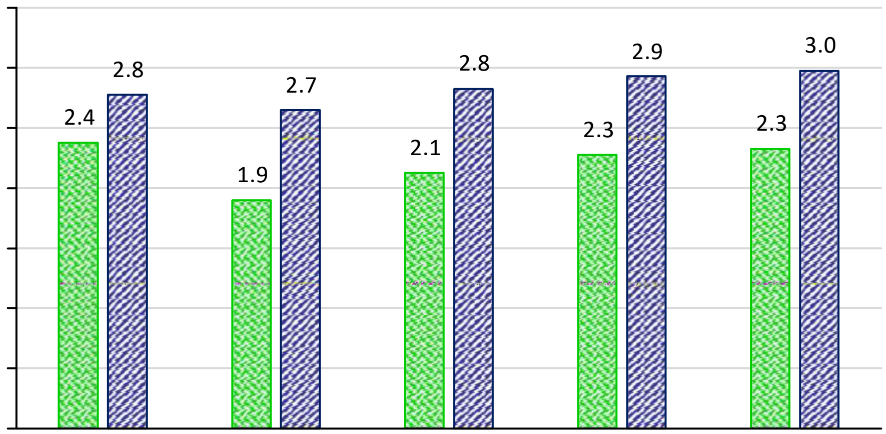

Fig 7 shows coloumn chart of flexural Strength

IV. RESULT AND CONCLUSION

The review of earlier studies related to partial replacement of Cement with Silica fume reveals that there is a significant change in the strength properties of concrete such as compressive strength, flexural strength, split tensile strength. These experiments were carried out in various grade concrete to find out the result. From the above literature reviews optimum percentage of Silica Fume varies from 5% to 15%. Up to these Percentage Replacement improvement in the strength of concrete has been observed in terms of Compressive Strength, Flexural Strength and Tensile Strength on partial replacement of Cement with Silica fume .Previous studied also shows that Silica Fume concretes possess superior durability.

Test result indicate that addition of silica fume by 30% paver block attains maximum compressive strength .The paper also shows the cost comparison per each block.

a) Preparation cost will bereduced.
b) High strength can be attained at the optimum percentage of silica fume andcrusher stone. Industrial waste will be reused and the pollution to bereduced.
c) The use of industrial waste (silica fume, crusher stone powder) in place ofconventional raw material will help to decrease the environmental pollution and also conserve our naturalresources.
d) To use silica fume and crusher powder by replacing it by cement and fineaggregate
e) To identify various industrial waste suitable for utilization in cementmanufacture.
f) To increase the strength of the paver block by adding silica fume and crusher stonedust.
g) Replacement of 20 % of silica fume gives the value of high strengthduring compression.

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