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Study on Steel Fiber and Fly Ash Using in Paver Block

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ABSTRACT

Interlocking Concrete Block Pavement (ICBP) has been extensively used in many countries for quite some time as a specialized problem-solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. ICBP technology has been introduced in India in construction, a decade ago, for specific requirement namely footpaths, parking areas etc. but now being adopted extensively in different uses where the conventional construction of pavement using bituminous mix or cement concrete technology is not feasible or desirable. This paper presents
Keywords : Paver Blocks, Steel Fiber, Fly Ash, Conventional Blocks, Compressive Strength.

I. INTRODUCTION

Concrete paver blocks were first introduced in Holland in the fifties as replacement of paver bricks which had become scarce due to the post-war building construction boom. These blocks were rectangular in shape and had more or less the same size as the bricks. During the past five decades, the block shape has steadily evolved from non-interlocking to partially interlocking to fully interlocking shapes. Consequently, the pavements in which no interlocking blocks are used are designated as 'Concrete Block Pavement (CBP)' or non-interlocking CBP, and those in which partially, or fully interlocking blocks are used are designated as 'Interlocking Concrete Block Pavement.

Interlocking concrete paving blocks are manufactured from semi-dry mixes. During manufacturing process vibration and pressure is applied to the mix. By this process dense and strong concrete paving blocks can be achieved to form strong and durable paving surfaces. Moreover interlocking behaviour of concrete paving block gives the ability of spreading loads to larger areas. Interlocking concrete paving blocks has several advantages over asphalt and concrete pavements in their structural, aesthetics, construction and maintenance, operational and economical characteristics. Like other pavement surfaces, the design of concrete paving blocks is based upon environmental, traffic, sub grade support and pavement materials conditions and their interactive effect. Interlocking Concrete Paving Blocks (ICPB) has been extensively used in a number of countries for quite some time as a specialized problem-solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. Interlocking concrete paving block technology has been introduced in India in construction, a decade ago, for specific requirement viz. footpaths, parking areas, gardens, etc. but now being adopted extensively in different uses where the conventional construction of pavement using hot bituminous mix or cement concrete technology is not feasible or desirable.

It is well known that concrete in paver block is very good in resisting compressive forces, but it is found to be weak against tensile forces. The addition of fly ash to concrete further improves its compressive strength but contributes less to improve its other properties like tensile strength, ductility, resistance to cracking...etc. The potentialities of fly ash concrete can be more exploited by imparting tensile resistance property to it. Investigations carried out prove that the introduction of discrete uniformly dispersed randomly oriented steel fibre's to plain concrete not only improves its resistance against tensile forces, but also imparts greater ductility and delays the onset of first flexural crack. In fly ash concrete composites also, the addition of such ash can improve its resistance against tensile stresses, delay the onset of flexural crack Thus, the addition of two materials; namely steel fibre's and fly ash in paver blocks compressive forces but also resistance to tensile forces.

1.1 Objective

- In my project work at evaluating the performance of paver blocks with curing or without curing by adding superplasticizer.
- The effect on Compressive strength by adding Steel fiber and Fly ash in paver blocks.
- Testing on paver block at M40 grade of mix design.
- The effect on the properties of paver block by adding the different percentage of Steel fibers and Fly ash.
- In comparison of cost of conventional paver block and by using the Steel fibres and Fly ash paver block.

II. MATERIAL AND METHODOLOGY

Preliminary Data Required for Experiment

Paving block specimens of sizes 0.25mx0.20mx0.05m, made of concretewith cement, fine aggregate (sand/coarser dust) and coarse aggregate in the ratio (1:1.62:2.96) by Wight are casted. The test specimens were divided into four main categories depending upon the percentage of volume of steel fibres ranging from 0.0% to 2% in increments of 0.5%, and in each category partial replacement of cement was made by fly ash from 0.0% to 40% in increments of 10%.

Materials Used

a. Cement: In manufacturing of paver blocks, OPC 43 grade have been used.
b. Coarse aggregates: Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and affect economy. The aggregates used for production of paver blocks are sound and free from honeycombed particles. The nominal size of coarse aggregates is 10-12 mm in this work.
c. Fine Aggregates: The conventional sources of fine aggregates for paving blocks are river sand or, alternatively, artificial sand by crushing rocks. Fine aggregates are used as per requirement of IS 383, both river and quarry dust is used.
d. Water: Water quantity is important for the mixture to complete the chemical reaction and provide proper workability. The water used for mixing concrete is potable water of pH lies at 7.5 and water is free from organic matter and the solid contents are within the permissible limits as per IS 456-2000
e. Steel Fibers: Steel fibers of 0.4mm diameter and 32mm length with an aspect ratio of 80 were used in the present study.
f. Fly Ash: Fly ash material from Bhusawal Thermal Power Plant of Jalgaon district in Maharashtra.

Mixing and Casting the Specimens

The mix design with target strength of 47 MPa was developed to create paver blocks suitable for highways. The mix proportion of OPC paver blocks was taken as base proportion. Cement, fine aggregate and coarse aggregate for 1m3 of concrete was mixed with 0.4 water to cement ratio. The curing period was increased due to the fact that fly ash concrete gains strength slowly and hence instead of 28 day curing was adopted. After the curing period, the specimens were removed from the curing tank and whitewashed for better visibility of cracks.

Curing

Use of the super plasticizer is one of the admixtures added on the block either to reduce water-cement ratio or to increase the workability of the concrete particularly it's casting in hot weather. Since, the superplasticizer is believed to behave as retarder also to the limited extent which might offset the increased water demand of the concrete when it is manufactured in high temperatures thus reducing the adverse effect on the performance of the concrete. Concrete of proportion was prepared with Ordinary Portland Cement then Super plasticizer in liquid form was added in the concrete from 0% to 2% with an increment of 0.5% by weight of cement. Before the casting of the specimens slump value of the concrete without and with super plasticizer was determined. The cube specimens of standard size were cast and after one day the specimens were demoulded and exposed to the specific curing condition.

As well as water curing are carry. The blocks thus hardened are cured with water to permit complete moisturisation for 14 to 21 days. Water in the curing tanks is changed every 3 to 4 days. After curing, the blocks are dried in natural atmosphere and sent for use.

Testing of the Specimens

Cube compressive strengths at 7-days and 28 days for all the four mix designs with different proportions of Steel fiber 2% and fly ash (10, 20, 30 & 40%) are found to slightly decrease as compared to the control mix with no Steel fiber and fly ash. However, 28-day cube compressive strength for all the mixes, except M-50, with all proportions of Steel fiber 2% and fly ash upto 40% is found to be more than the target mean strength of the mixes. Indicate the decrease / increase in the values of compressive at 7, 14, and 28 days with respect to the control mix values. It is observed that the 28 day strength increases up to the addition of 30% fly ash after which it falls. However, for all mixes with all fly ash proportions, it remains more than the strength of the control mix at 28 days. The lower compressive and flexural strengths at the initial ages can be due to the reason of reduction of the quantity of cement by replacement with fly ash, resulting in weakening the cohesion of the cement paste. It is known that majority of strength rendering primary mineralogical phases are developed at the ultimate hydration of cement. Due to this reason sufficient cementitious action of fly ash is not activated at the initial stages and thus the non-reactive quantity of fly ash, at this stage, reflect insignificant effect on strengths. At the later ages between 28 days onwards, improvement in the strength is observed due to the reason that the surplus lime released from cement hydration becomes the source for pozzolanic reactions contributing for additional mineralogy for additional strength.

III. RESULTS AND TABLES

Figure 1. Testing Bloc

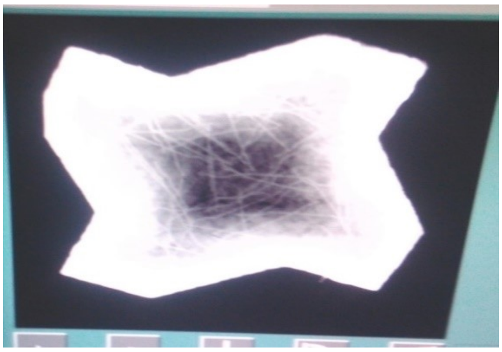

Figure 2. X-Ray Block

Table 1. Compressive Strength At 7 Day

S. N.	% Fly ash	% Steel Fiber	Compressive Strength in M Pa.	Avg. Compressive Strength
1	0	0	26.36	26.83
			27.66	
			26.45	
2	10	0.5	30.56	30.01
			29.64	
			29.85	
3	20	1	31.45	31.72
			31.60	
			32.10	
4	30	1.5	33.15	33.07
			33.42	
			32.65	
5	40	2	34.25	34.23
			33.56	
			34.88	

Table 2. Compressive Strength At 14 Days

S. N.	% Fly ash	% Steel Fiber	Compressive Strength in M Pa.	Avg. Compressive Strength
1	0	0	30.30	31.22
			31.25	
			32.10	
2	10	0.5	34.15	34.10
			33.45	
			34.69	
3	20	1	36.25	36.27
			35.69	
			36.88	
4	30	1.5	37.10	36.73
			36.25	
			36.85	
5	40	2	38.33	38.01
			37.26	
			38.45	

Table 3. Compressive Strength At 28 Days

S. N.	% Fly ash	% Steel Fiber	Compressive Strength in M Pa.	Avg. Compressive Strength
1	0	0	39.68	39.6
			38.91	
			40.21	
2	10	0.5	42.75	42.93
			42.68	
			43.36	
3	20	1	46.13	45.97
			45.23	
			46.56	
4	30	1.5	47.26	47.77
			48.69	
			47.36	
5	40	2	48.36	48.97
			48.61	
			49.64	

IV. CONCLUSION

The compressive strength after 7 and 14 day was observed more as compare to Normal Mix paver block. Similarly the strength at 28 days was increase at 54% as compared to 7 days of normal paver block. The difference of cost is not more but the paver block with fly ash & steel fibers proved to be more effective.

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