Effect of Partial Replacement of Cement by Fly Ash with Using Nylon Fiber in Concrete Paver Block

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Abstract: In present study we use Nylon Fibre to increase the compressive strength of Paver Block. We perform compressive strength test on paver block by taking different proportions of Nylon Fibre and find that using 0.3% of Nylon Fibre increases the compressive strength up to 18.86% as compared to conventional mixture. It is also find that it makes the blocks more opaque as compare to other paver blocks. The flyash used in different proportion in the above mixture of Paver block to evaluate its compressive strength. Fly ash produced from the burning of younger lignite or sub bituminous coal, in addition to having pozzolanic properties, also has some self-cementing properties. In the presence of water, fly ash will harden and gain strength over time. The optimum dose of 20 % of fly ash gives maximum strength of paver block.

Keywords: **Flyash, Nylon fibre, Compressive strength, Paver block.**

1. Introduction

Interlocking concrete Pavement has been extensively used in a number of countries for quite something as a specialized problem solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environment constraints. Intermediate concrete block pavement (ICBP) technology has been introduced in India in construction a decade ago, for specific requirements viz. footpaths, parking areas 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.

Interlocking concrete pavements or pavers are a special dry mix pre-cast piece of concrete commonly used in exterior landscaping pavement applications. Unit Pavements or block paving, nick named pavers in the United States were developed before the Second World War by the Dutch and introduced into the United States in the early 1970s. Concrete block pavement (CBP) can be use an alternative pavement to asphalt and concrete pavements. Interlocking paving stones are installed over a compacted stone sub-base and a leveling bed of sand. CBP is formed from individual concrete paving blocks that fit next to one another on a suitable sub base leaving a specific joint space among them to be filled with jointing sand. The sand does not easily wash out with rain or garden hose water. Polymeric Sand or a sealant can be used to further lock or coagulate the sand. Standard thicknesses are 60mm (for light traffic), 80mm (heavy traffic) and 50mm too is common in some countries like Pakistan (used for footpaths etc.).

Fig.1 Paver Block

2. **M**aterials

There are different type of materials used in the construction of paving blocks.

A.Cement

Cement is a binding material, that binds all the materials used in the construction of paver block. It is a material that sets and hardened independently. Portland cement is used in the construction of paver block. . A mixture of sand, coarse aggregate, quarry dust is made along with the cement and water for construction of paving blocks.

B. Fine Aggregate

Locally available river sand is used as a fine aggregate in preparation of concrete and cement mortar. The fine aggregate is consist of natural sand or other inert materials with similar characteristics. In the construction of paver block chunky particle shape and sleek textured aggregate are used. The properties of fine aggregate used in the present work are given in the table1 & 2

Table1: Property of fine aggregate

S. No.	Property	Value
1.	Specific gravity	2.55
2.	% moisture	4.7

Table2: Fine aggregate Grading

Sieve size	% Passing
9.5 mm	100
4.75 mm	99.9
2.38 mm	99.2
1.19 mm	85.4
0.59 mm	51.1
0.297 mm	14.2
0.149 mm	2.3
Pan	0

C.Coarse aggregate

Coarse aggregate is consist of naturally occurring materials such as gravel, or resulting from the crushing of parent rock. The properties of coarse aggregate used in the present work are shown in table 3 & 4

Table3: Properties of coarse aggregate

S. No.	Property	Value
1.	Impact value	15.65%
2.	Specific gravity	2.67
3.	Water absorption	1.4%

Table4: Coarse aggregate grading

Sieve size	%passing
32mm	100
20mm	98
14mm	85
6mm	20
2.8mm	5
63micron	4

D.Nylon Fiber

Nylon fibre is a generic designation for a family of synthetic polymers generically known as polyamides. It is used in construction because of its qualities like it arrests cracks, increases strength and greatly improves quality of construction. Properties of Nylon fibre as shown in table5

Fig.2 Nylon Fiber

Table5: Properties of nylon fiber

S.No.	Property	Value
1.	Cross section	Circular
2.	Diameter	0.30-0.40
3.	Cut length	6-12mm
4.	Melting Point	190-350°C
5.	Density	1.15 g/cm^3

E.Flyash

Flyash is define as the finely divided residue resulting from the combustion powdered coal, which is transported from the firebox through the boiler by flue gases. Flyash is a by-product of coal-fired electric plants. The fly ash used in the work was of class C and the specific gravity was 1.99 g/cm^3.

3. METHODOLOGY

DESIGN MIX METHODOLOGY

There are two common methods of producing precast concrete:

Wet mix, b) Dry mix.

In wet mix fresh concrete is placed and compacted into moulds, stripping the moulds when adequate strength has been reached.

However in a dry mix, a semi-dry cohesive concrete mix is placed in the mould, which is later, compacted and extruded (pushed out) from the mould, right after compaction. The units are then cured and stored. This dry process is commonly used in the manufacture of concrete masonry and paving units as it is large volumes of bricks, blocks and pavers the most economic way of producing. In the present study, we use concrete mix grade M 20.

Aggregate, cement and other additives were added in the drum mixer first and were mixed thoroughly. Concrete mix were filled in the mould and put on the vibro forming machine, after that concrete mix in the mould dried, for compression test a set of three paver blocks is prepared. After one day, the blocks were removed from their moulds and placed at safe surface. The blocks were tested after an interval of 7, 14 and 28 days.

The main aim of present study is to examine the changes in the properties of paver blocks, when we add different amount of fly ash in them with 0.3% of nylon fiber. In the study we prepare a series of paver blocks with 0.3% nylon fiber and Portland cement replaced by fly ash in the interval of 10%, 20% and 30%. Fly ash is a cementations material and contributes in the hydration process of concrete. We examine blocks in duration of 7 days, 14 days and 28 days. In each duration we examine changes that occurs in the

compressive strength of paver block and then compare these changes with the conventional block.

Table6: Dose of nylon fiber in standard paver concrete block

S. NO.	Paver Block	Description
1	A	Standard
2	B1	Standard+0.1% NF
3	B2	Standard+0.2% NF
4	B3	Standard+0.3% NF
5	B4	Standard+0.4% NF
6	B5	Standard+0.5% NF

NF = Nylon fiber

Standard mix (M20) (1:1.5:3)

Table7: Dose of nylon fiber and fly ash in standard concrete

S. NO.	Paver Block	Description
1	A	Standard
2	C1	Standard + ONF %+ 10%FA
3	C2	Standard + ONF %+ 20%FA
4	C3	Standard + ONF % + 30%FA

Where ONF = Optimum Nylon fiber & FA= Fly Ash

Standard mix (M20) (1:1.5:3)

EXPERIMENTAL METHODOLOGY

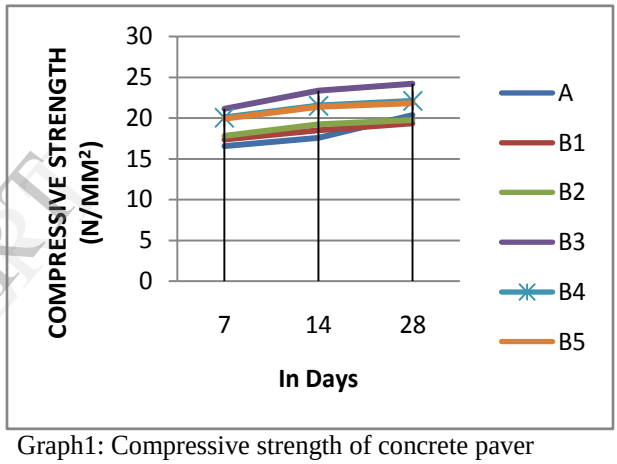
Compressive Strength Test

Compressive strength is an important parameter in evaluation of paving block quality. The compressive strength of the specimens was determined at 7, 14, 28 days of age. Three sample of paving block were tested using Standard compression testing machine, average strength value reported in this paper.

4. RESULT

Table8: Compressive Strength of Concrete Paver Block with nylon fiber dose

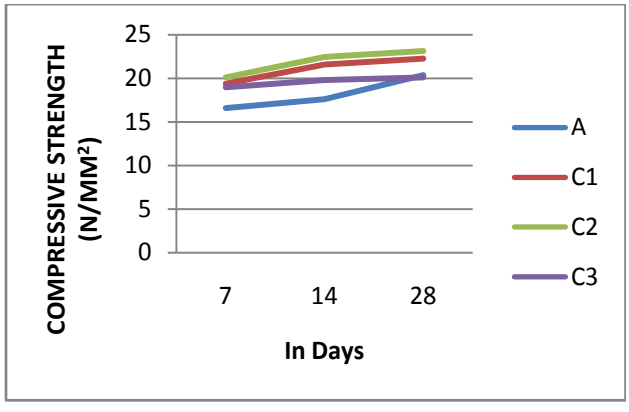
Paver Block	Compressive Strength (N/mm²)		
	7Days	14Days	28Days
A	16.56	17.59	20.36
B1	17.37	18.51	19.33
B2	17.79	19.23	19.74
B3	21.12	23.35	24.20
B4	20.05	21.51	22.10
B5	19.90	21.33	21.79



Graph1: Compressive strength of concrete paver block with nylon fiber dose

Table9: Compressive Strength of Concrete Paver Block with optimum nylon fiber and fly ash dose

Paver Block	Compressive Strength (N/mm²)		
	7Daybs	14Days	28Days
A	16.56	17.59	20.36
C1	19.36	21.54	22.24
C2	20.11	22.45	23.12
C3	18.95	19.80	20.10



Graph2: Compressive strength of paver block with optimum nylon fibre and fly ash dose

After performing compressive strength test on the paver blocks. It is observed that in paver block with 0.3% nylon fiber and 20% fly ash gives the maximum compressive strength at 7, 14 and 28 days.

5. CONCLUSION

From the above study, It is concluded that addition of optimum nylon fiber and fly ash in the construction of paver block increases its compressive strength up to 13.55% as compared to standard mix. It is also realized that it also make blocks more opaque as compared to other paver blocks.

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