"A STUDY ON THE EFFECT OF PARTIAL REPLACEMENT OF CEMENT IN CONCRETE PAVER BLOCKS BY FLY ASH AND MIXING NYLON FIBER"

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Abstract - *In this study, Paver blocks of M-40 grade 80 mm thickness are mixed with varying percentage of nylon fibres (0.1 percent, 0.2 percent, 0.3 percent, 0.4 percent& 0.5 percent). After finding the optimal percentage of nylon fibre, Fly ash in varying percentages (15 percent, 20 percent& 25 percent) is added (as cement replacement) to analyse the changes in the compressive strength of the paver block. The use of nylon fibre has been found to increase compressive strength by up to 19.86% when we use nylon fibre by up to 0.3% compared to conventional mixtures; and As compared to other paver blocks, nylon fibre makes the blocks more opaque and the optimal dose of 20 percent of fly ash provides maximum strength to paver block.*

Key Words: Fly ash, Nylon fiber, Compressive strength, Paver block, bulking of sand

1. INTRODUCTION

1.1 General

Cement concrete tiles and paving blocks are common precast solid items made from cement concrete. The item is available in a range of sizes and shapes. Portland cement and aggregates are the basic materials needed to make the product, both of which are readily available in all parts of the country. The rectangle, square, and round blocks of various sizes have interlocking designs for adjacent tile blocks. As a result, the unit can be set up near the market in urban and semi-urban locations. The motorways, as well as the footpaths along the wayside, have all been given a makeover. Concrete paving blocks are ideal for walkways because they are easy to place, have a better appearance, and can be finished quickly. While tiles are widely used outside of large buildings and houses, many of these materials are also used in the open areas of public offices, commercial buildings and residential apartments for flooring. Concrete block pavements (CBPs) are built from solid individual blocks that fit close to each other to form a pavement surface. On a thin bed of sand overlaying a sub layer, a standard CBP is positioned. CBP can be placed with a variety of shapes and patterns.

2. OBJECTIVES

Objective of this research is to form the background knowledge about CBP and Nylon fibre at varying aspect ratios is carried out to find the compressive strength of paving blocks. The prime objective of this research is given below:

- To analyse the effects of varying percentage (0.1, 0.2, 0.3, 0.4 & 0.5) of **Nylon Fibre** on compressive strength of paver block.
- To find the optimum percentage of **nylon fibre** on which maximum compressive strength is achieved.
- To study the compressive strength of paver blocks on effect of varying amount(15%,20% & 25%) of **fly ash** and optimum quantity of **Nylon fibre**.

3. LITERATURE REVIEW

Deshpande and Darade (2015) The effects of fly ash as a partial replacement for cement and dust on the varied properties of a pavement block when used as a partial replacement for fine aggregate. Fly ash is used as a partial cement replacement by weight in the M30 mix. Investigation is used to evaluate the compressive strength, flexural strength, and abrasion resistance of concrete paving blocks.

Atul Thakur et al (2017) Atul Thakur investigated partial replacement (by weight) of cement with RHA in paver blocks to examine differences in compressive strength, water absorption, and abrasion resistance. Partial cement replacement is carried out in various amounts, such as 0 percent, 15 percent, 20 percent, 25 percent, 30 percent, 35 percent and 45 percent. At the end of 7, 28 and 56 days, the compressive strength was estimated, the water absorption test and the abrasion resistance was estimated after 28 days.

Karthik, M. (2017) In India, the use of interlocking paver blocks has been significantly enhanced in recent decades. Parking, pedestrian and car movement zones are all packed with paver blocks these days. Some of the problems in paver block were previously studied as weak in their strength and durability. It was achieved by replacing cement material with fly ash or rice husk ash and swapping aggregates with fibre. This block of paver carries the extraneous aggregates and the binding material which is used in blocks of pavers. The artificial fibre plays a very ideal role in strength characteristics relative to the natural fibre, and water absorption tends to be a medium amount.

3. MATERIAL AND METHODS

3.1 Material

3.1.1 Cement

Ordinary Portland Cement Grade 53 conforming to IS 12269 is used in compliance with IS 15658:2006. Ultra tech 53 grade cement with a surprisingly strong cs3 (tri-calcium that provides long-lasting) durability for concrete structures. Because of the very low percentage of alkalis, chlorides, magnesia Cement used in the experimental work produces extremely durable and sound concrete.

3.2.2 Coarse Aggregates

The aggregates that remained on 4.75 mm IS Sieve are called coarse aggregates. Coarse aggregate is uncrushed gravel or stone that occurs from crushing gravel, hard stone or from the natural disintegration of rocks, crushed gravels or stones. IS 383 confirms the coarse aggregates that are used in paver blocks. Crushed/semi-crushed aggregates are mostly used. The aggregate used for the manufacture of blocks must be sound and free of soft or honey-combed particles in order to ensure sufficient durability.

3.2.3 Fine Aggregates

Aggregate passing from 4.75 mm sieve and containing only as much coarser material as permitted, fine aggregate is natural sand formed from natural disintegration of the rock and deposited by streams or glacial agencies, crushed stone sand obtained by crushing hard stone, crushed gravel sand obtained by crushing natural gravel.

3.2.4 Fly Ash

Fly ash in Portland cement concrete (PCC) provides a number of advantages and improves the performance of the concrete in both the fresh and hardened states. Fly ash improves the workability of flexible concrete and the strength and durability of hardened concrete when used in concrete. The utilization of fly ash is also cost-effective.

3.2.5 Nylon Fiber

Nylon is particularly good at imparting impact resistance and flexural toughness to concrete, as well as sustaining and enhancing its load carrying capacity after a first crack. The Nylon Fibers are made with 100% purity provided as a filament fiber for secondary reinforcement of concrete.

4. METHODOLOGY

4.1 Compressive Strength Test

Blocks should be stored in water maintained at a temperature of 20 ± 5°C for a period of 24h. The bearing plates of the testing machine must be neatly washed. The specimens are aligned with those of the bearing plates. The load is applied without the shock and steadily increased at the rate of 15 ± 3 N / mm² / min until no higher load can be supported by the sample. The maximum load applied to the specimen should be noted in N.

5. EXPERIMENTAL WORK

PROCEDURE	PROPERTIES
1. Mix design	• Concrete mix design of grade M30 as per IS:10262-2009
2. Test on cement	• Normal consistency test • Initial and final setting time test • Specific gravity test • Fineness test
3.Test on Aggregate	• Water absorption test • Sieve analysis test • Water content test • Specific gravity test
4. Slump test	• Slump cone test is carried out of freshly prepared concrete to determine the Workability of concrete.
5. Cube casting	• Concrete cubes specimen of special and normal concrete were casted separately as per mix design.
6. Curing	• 28 days water curing were carried out of Cube specimen.
7. Compression Test	• Compressive strength is measure of each cube specimen after completion of curing period by compression testing machine.

Table 1: Mix Proportion using Fly Ash

6. RESULTS

Material	%	Mix	Ingredient	Mix Design (Kg/m3)
Fly Ash (FA)	15	FA 15	Cement	416.5
			fly ash	73.5
			Nylon Fiber	1.47
			Water	192
			Coarse aggregate	892.33
			Fine aggregate	648.65
	20	FA 20	Cement	392
			fly ash	98
			Nylon Fiber	1.47
			Water	192
			Coarse aggregate	892.33
			Fine aggregate	648.65
	25	FA 25	Cement	367.5
			fly ash	122.5
			Nylon Fiber	1.47
			Water	192
			Coarse aggregate	892.33
			Fine aggregate	648.65
	—	Standard	Cement	490
			Water	192
			Coarse aggregate	892.33
			Fine aggregate	648.65

6.1 Compressive Strength of Nylon Fibre Paver Blocks:

Table 1: Compressive Strength of the Nylon Fiber Paver Blocks

PAVER BLOCK	COMPRESSIVE STRENGTH (N/MM2)		
	7 Days	14 Days	28 Days
STANDARD	25.95	36.59	39.32
FB1	26.80	37.51	39.33
FB2	27.12	38.23	39.74
FB3	30.20	41.85	44.20
FB4	28.12	39.51	42.10
FB5	27.90	40.33	41.79

6.2 Compressive Strength of the Fly Ash Paver Blocks with Nylon Fibre

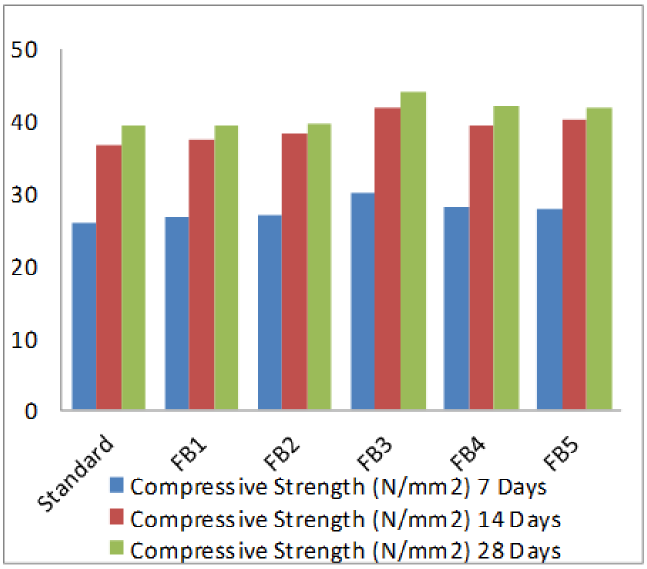
Table 2: Compressive Strength of the Fly Ash Paver Blocks with Nylon Fibre

PAVER BLOCK	COMPRESSIVE STRENGTH(N/MM^2)		
	7 Days	14 Days	28 Days
STANDARD	26.80	37.51	39.33
FA15	28.41	39.51	42.24
FA20	29.32	40.45	43.12
FA25	26.90	37.80	40.10

1.18 is multiplied for the arrised and the chamfer blocks with measured compressive strength.

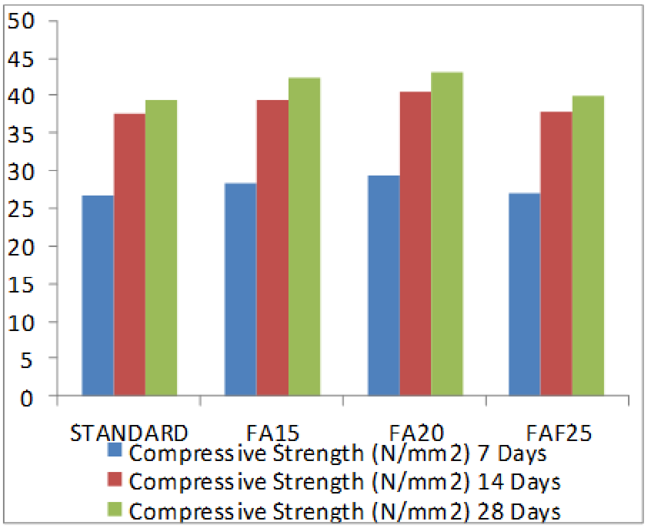
7. GRAPHICAL REPRESENTATION

7.1 Compressive Strength of Nylon Fiber Paver Blocks



Graph 1: Compressive Strength of Nylon Fiber Paver Blocks

7.2 Compressive Strength of Fly Ash Paver Blocks with Nylon Fibre



Graph 2: Compressive Strength of Fly Ash Paver Blocks with Nylon Fiber

8. CONCLUSIONS

We have found following conclusion from present study.

1. After conducting a compressive strength test on the paver blocks with a varying percentage of nylon fibres, it is observed that the maximum compressive strength at 7 , 14 and 28 days (each) is provided by adding 0.3 percent nylon fibre.
2. It is found that addition of the nylon fibre to concrete paver block construction increases its compressive strength by up to 19.86% relative to the standard mix.
3. It is observed that the maximum compressive strength is achieved at 7, 14 and 28 days when concrete paver block contain optimum nylon fibre content and by replacing 20% cement with Fly Ash.
4. It is also observed that in the manufacturing of the concrete paver blocks, the addition of optimum nylon fibres and fly ash increases its compressive strength by up to 13.55 percent relative to the normal mix.

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