Effect of Partial Replacement of Cement by Rice Husk Ash Using Nylon Fiber in Concrete Paver Block

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Abstract— Pre-cast cement concrete paver blocks is solid and unreinforced these material is a versatile, aesthetically attractive, functional, cost effective; if correctly manufactured and laid it requires little maintenance. Paver blocks can be used for different traffic categories i.e. Non-traffic, Light-traffic, Medium-traffic, Heavy-traffic and Very heavy traffic. In present study work paver blocks of M-35 grade of 60mm thickness for light traffic with varying percentage of nylon fiber (0.1%, 0.2%, 0.3%, 0.4% & 0.5%) is used to improve the compressive strength is casted. After finding optimum percentage of nylon fiber, the same is used as constant and Rice Husk Ash (RHA) in varying percentage (10%, 20% & 30%) is added (as cement replacement) to examine the changes in compressive strength of paver block. It has been found that using Nylon Fiber increases the compressive strength up to 18.86% when we use Nylon fiber upto 0.3%, as compared to conventional mixture; and Nylon Fiber makes the blocks more opaque as compare to other paver blocks and The optimum dose of 20 % of Rice Husk Ash (RHA) gives maximum strength of paver block.

Key words: Rice Husk Ash, Nylon Fibre, Compressive Strength, Paver Block

I. INTRODUCTION

Now a Days Paver Blocks uses is increasing day by day, Interlocking concrete Pavement has been extensively used in a number of countries like india, China, Japan, Pakistan etc. Intermediate concrete block pavement (ICBP) technology has been introduced in India in construction a decade ago, 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 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 pavement applications. As per IS 15658 Standard thicknesses of paver blocks are 60mm (for light traffic), 50mm (no-Traffic), 80mm (heavy traffic) is common used in India . Paver block required high compressive strength, tensile and flexure strength to use it in paver blocks and to increase the compressive strength of paver blocks several efforts have been made. In this distinct study M35 paver blocks have been cates of 60 mm thickness for light traffic and to increase its compressive strength Nylon fiber is added to concrete.

II. EXPERIMENTAL PROGRAM

A. Materials Used:

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

B. Cement:

Ordinary Portland Cement of Grade 53 is used, which conforming IS 12269. 53 grade cement is used with a remarkably high CS3 which provide long-lasting durability to concrete and Produces highly durable and sound concrete due to very low percentage of alkalis chlorides, magnesia; with specific gravity 3.15

C. Fine Aggregate:

Natural river sand is used in this study which conforming to Zone III as per IS 383 (1987). The fineness modulus of sand used is 2.60 with a specific gravity of 2.70.

D. Coarse Aggregate:

In this Project Natural Crushed Stone conforming to IS: 383 (1987) is employed. Coarse aggregate of size 20 mm, having the specific gravity of 2.80 and fineness modulus of 7.20.

E. Nylon Fiber:

20 mm nylon fiber is used in this project. Nylon fiber 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.

F. Rice Husk Ash:

Rice husk are the hard protecting covrerings of grains of rice. Rice husk is taken from Agricultural Farm, where rice is taken from farm and then by help of thrasher rice and rice husk are separated, and then this rice husk is burn. The burning process of rice husk continues approximately 48 hours. After 48 hours rice husk ash remain untouched for 12 hours due to cooling process. Then rice husk ash goes through a mechanical process of grinding to make rice husk fine, because finer husk gives better result when it is replaced by cement in concrete

1) Mix Proportions:

The mixture proportions for the controlled concrete of M35 grade were arrived at from the trail mixes. Concrete mix of M35 grade was designed as per specification of IS 10262 : 2009, for water cement ratio 0.45. In this method, firstly five mix proportion of varying percentage of nylon fiber i.e 0.1%, 0.2%, 0.3%, 0.4% & 0.5% by cement as an admixture is made and then varying percentage of *Rice Husk Ash (RHA)* mix Proportion is also prepared as a cement replacement with constant percentage of nylon fiber i.e 0.3%.

2) Preparation of Test Specimen:

For manufacturing of paver block first we have decide that size of the paver block according to manufacturer. Specification of paver blocks is given below:

Shape: I section
Length: 200 mm
Width: 160 mm
Thickness = 60 mm
Aspect ratio (L/T) = 200/80 = 3.33 < 4.0 as per IS 15658 : 2006

Its not easy to calculate area of the paver blocks by conventional way or method because of its shape, so to calculate the area of paver block we adopted plan area method as per IS 15658. In plan area method the specimen shall be placed, wearing face facing up, on cardboard and its perimeter is traced with the pencil. The shape shall be cut accurately with the scissors and weighted to the nearest 0.0001N, and the result recorded as mass (m_{sp}). A rectangle measuring 200mm x 100mm cut out from same cardboard shall also be weighted to nearest 0.0001 N, and result recorded as mass (m_{std}). the plan area for the block shall be calculated from the formula:

$$A_{sp} = \frac{20000\, m_{sp}}{m_{std}}\ mm^2$$

As per method reading recorded is Msp= 0.017 Kg, Mstd= 0.012 Kg therefore the Area (Asp) is 28333.33 or 28572 mm^2. Now Mix has been prepared for different mix proportions and for all mix hand mixing is done, after this I section paver blocks is casted and its dimension is given in figure 1, For paver block the rubber mould is used. It shall be constructed in such a manner as to facilitate the removal of the molded specimen without damage, and shall be so machined that, when it is assembled ready for, the dimensions and internal faces shall be accurate within the following limits. As per IS: 516:1959, the height of the mould and the distance between opposite faces shall be the specified size + 0.2mm. The angle between adjacent internal faces and between internal faces and top and bottom planes of the mould shall be 90^o+-0.5^o. The interior faces of the mould shall be plane surface with a permissible variation of 0.03mm. Each mould shall be provided with a metal base plate having a plane surface. The base plate shall be such dimensions as to support the mould during the filling without leakage and it shall be preferably attached to the mould by spring or screws. The part of the mould when assembled shall be positively and rigidly held together, and suitable methods of insuring this, both during the filling and on subsequent handling of the field mould, shall be provided. In assembling the mould for use, the joints between the sections of mould shall be thinly coated with mould oil and a similar coating of mould oil shall be applied between the contact surfaces of the bottom of the mould and the base plate in order to insure that no water escape during the filling. The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the concrete. After 24 hours of moulding, paver are taken out from mould by simple push and the curing of the specimen done as per IS 516 : 1959, The test specimen shall be stored on the site at a place free from vibration, under damp matting, sacks or other similar material for 24 hours +- ½ hour from the time of adding the water to the other components. The temperature of the place of storage shall be inside the range of 22^o to 32^o C. After the period of 24 hours, they shall be noted for later identification, taken away from the molds and, unless required for testing within 24 hours, stored in clear water at a temperature of 24^o to 30^oC until they are sent to the testing lab. They shall be committed to the testing laboratory well packed in damp sand, damp socks, or other suitable material so as to arrive there in a damp condition not less than 24 hours before the time of the trial. On arrival at the testing laboratory, the specimen shall be stored in water at a temperature of 27^o+-2^oC until the time of the trial. A platter of the daily maximum and minimum temperature shall be kept both during the menstruation of the specimen remain on the website and in the laboratory, and test conducted for the specimen after 7, 14 and 28 days.

III. Experimental Program

The paver block specimen selected as per sampling procedure specified in IS 15658 : 2006 shall be tested for compressive strength. Compressive Strength test is performed on pavers block as per specification given in IS 15658 : 2006. Firstly nylon fibers pavers blocks are tested and after a deep discussion on result new pavers which was casted with fix percentage of Nylon Fibers and varying percentage of rice husk ash is tested, for test blocks are taken out from water tank after specified curing days and their temperature is maintained 20 +- 5^oC. The bearing plates of the testing machine shall be wiped clean. The specimens are aligned with those of the bearing plates. The load shall be applied without shock and increased continuously at a rate of 15 ± 3 N/mm^2/min until no greater load can be sustained by the specimen or delamination occurs. The maximum load applied to the specimen shall be noted in Newton or kilo Newton. The apparent compressive strength of individual specimen shall be calculated by dividing the maximum load by the bearing cross section area (in mm2). The corrected compressive strength shall be calculated by multiplying the apparent compressive strength by the appropriate correction factor from given in IS 15658 : 2006. The strength shall I be expressed to the nearest 0.1 N/mm^2. in project arrised / Chamfered I section blocks of 80mm thickness is casted so correction factor which is used here is 1.18.

IV. Result and Discussion

When paver blocks goes through compressive strength test it has been observed that compressive strength of paver blocks increases in the nylon fiber content upto 0.3%; when we increase the nylon fiber content further 0.4% and 0.5% it posses comparatively lower compressive strength. 0.3% of nylon fiber paver blocks possess 39.2 N/mm^2 compressive strength, when we correct it according to 15658 : 2006 it goes to 41.72 N/mm^2 (table 2); after testing the nylon fiber pavers for their compressive strength we get the optimum percentage of nylon fiber is 0.3%. with this optimum percentage of nylon fiber we replace cement by *Rice Husk Ash (RHA)* upto 30% at regular interval of 10% in paver blocks mixes and after compressive strength test it has been observed that RHA20 mix i.e. 20% *Rice Husk Ash (RHA)* replacement mix with optimum nylon fiber content gives maximum compressive strength 38.12 N/mm^2 and when

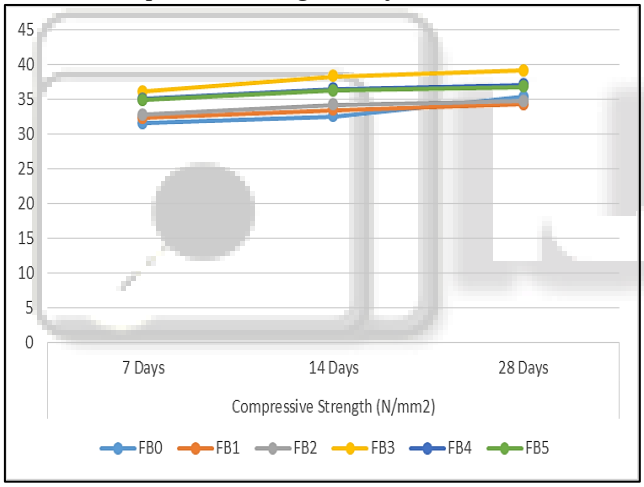
corrected it gives 48.98 N/mm^2 (table 3) as per IS 15658 : 2006.

V. CONCLUSION

When optimum percentage of Nylon Fiber is added to concrete i.e. 0.3% of cement, it gives maximum compressive strength when it is compare to conventional concrete paver blocks and also other nylon fiber paver blocks (0.1%,0.2%,0.4%,0.5%). When we prepare mix of concrete with 0.3% Nylon Fiber by cement, also with *Rice Husk Ash (RHA)* as cement replacement, we observe that 20% of cement replacement by *Rice Husk Ash (RHA)* (RA20 mix) gives maximum strength.

Paver Block Mix	Compressive Strength (N/mm^2)			
	7 Days	14 Days	28 Days	Corrected Compressive Strength (IS 15658)
FB0	31.56	32.59	35.36	41.7248
FB1	32.37	33.51	34.33	40.5094
FB2	32.79	34.23	34.74	40.9932
FB3	36.12	38.35	39.2	46.256
FB4	35.05	36.51	37.1	43.778
FB5	34.9	36.33	36.79	43.4122

Table 2: Compressive Strength of Nylon Fiber Paver Blocks



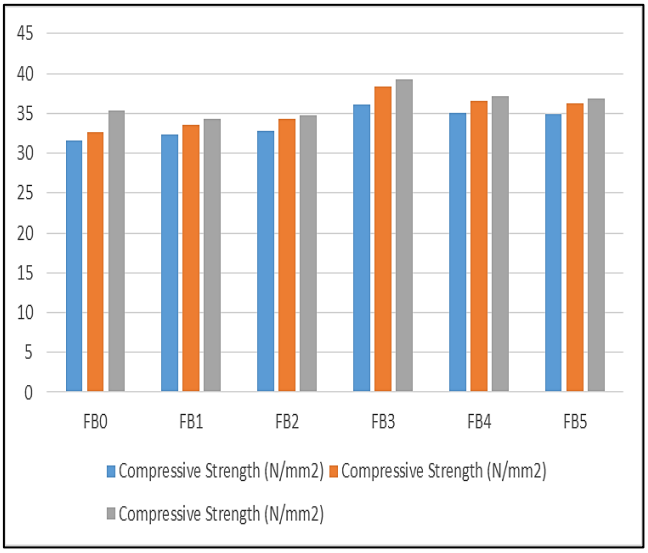
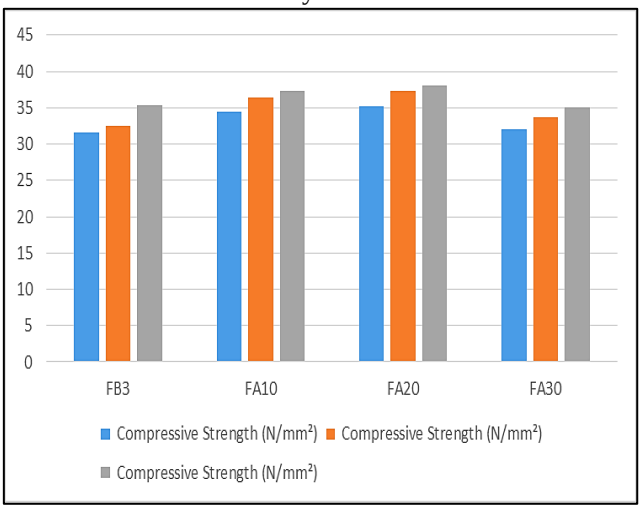


Fig. 1: & 2: Graph 1 and Graph 2: Compressive Strength of Nylon Fiber Paver Blocks

Paver Block Mix	Compressive Strength (N/mm^2)			
	7 Days	14 Days	28 Days	Corrected Compressive Strength (IS 15658)
FB3	31.66	32.49	35.36	41.7248
RHA10	34.46	36.44	37.24	43.9432
RHA20	35.21	37.35	38.12	44.9816
RHA30	32.05	33.7	35.1	41.418

Table 3: Compressive Strength of Fly Ash Paver Blocks with Nylon Fiber



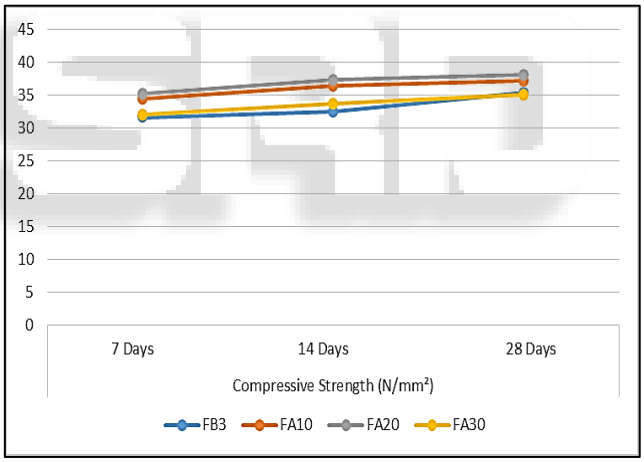


Fig. 3: & 4: Graph 3 and Graph 4: Compressive Strength of Fly Ash Paver Blocks with Nylon Fiber

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