An experimental investigation on characteristic properties of fibered concrete paving blocks; [by using monopp (recron-3s) fibers]

Er. Sahadeo D. Hipparkar.[#1], Dr.Shinde D.N.[#2]

[#1]P.G.Student Department of civil engineering P.V.P.I.T. Budhgaon,Shivaji University Kolhapur.
[#3]Professor and P.G. co-ordinator Department of Civil engineering P.V.P.I.T. Budhgaon,Shivaji University Kolhapur.
[1]hipparkar@gmail.com [2]dhananjay_shinde1967@yahoo.co.in

Abstract --This study presents the results of an experimental investigation on M40 grade, Mono PP [Recron 3s] fibers are used in this investigation. The effect of these fibers on workability, abrasion and various strengths of concrete are studied. Fiber content varies from 0 to 1.25% for Mono PP (Recron 3S) fibers by mass of cement concrete. The various strengths studied in this investigation are water absorption, compressive strength, abrasion test, split tensile strength and flexural strength. All the specimens are water cured and tested after 28 days.

Keywords - Monopp [recron-3s] fibers, Concrete, Frc, Testing, Strength.

I. INTRODUCTION

The history of concrete Paving Block; dates back to 19 the Century when paving stones were used in European countries for construction of roads serving as footpaths and tracks for steel-wheeled vehicles. Concrete Block Pavement (CBP) an environment friendly and labor intensive technology, has been developed for providing pavements footpaths, gardens, passengers waiting sheds, bus stops, industry and other public places; due to easy laying , better look and finish. The product is commonly used in urban and semi urban areas for the above applications. Cement concrete paving blocks are precast solid products made out of cement concrete. The product is made in various sizes and shapes viz, rectangular, square, and round blocks of different dimensions with designs for interlocking of adjacent paving blocks. The raw materials require for manufactures of the product are Portland cement and aggregates which are available locally in every part of the country.

II. OBJECTIVES OF STUDY

- To prepare mix design of M40 grade for Experimental Analysis with 0% to 1.25% Mono PP (Recron 3S) fibers, cement, sand, aggregate, water and superplasticizers.
- To analyse compressive strength, split tensile strength, of fibered concrete mix.

III. MATERIAL, ITS PROPERTIES AND METHODOLOGY

A. Materials

1) *Cement*: Ordinary Portland cement of 53 grade of conforming to IS 8112-1989 was used. Table 1 shows the physical properties.

Table 1: Physical Properties of Cement

Properties	Result
Specific gravity	3.15
Slandered consistency	27.5 %
Initial setting time	60 min
Final setting time	460 min
Fineness	5.5 %

2) *Mono PP [Recron 3s] fibers*

Table no. 2 Properties of Mono PP [Recron 3s] fibers

Sr. No.	Property	Values
1	Elongation of break	20-45 %
2	Ability to Protest friction	Excellent
3	Density	0.91 g/cm2
4	Melting Point	240 – 260^{0}C
5	Luster	Bright to light
6	Diameter/Triangular thickness	30-40 Micron

3) *Fine Aggregate*: Crushed sand of size below 4.75mm conforming to zone II of IS 383-1970 was used as fine aggregate. Table 3 shows the Physical properties of fine aggregates.

Table 3: Physical properties of fine aggregates.

Properties	Result
Specific gravity	2.70
Fineness modulus	2.62
Bulk density (loose)kg/m^3	1560
Bulk density (compact)kg/m^3	1682
Water Absorption	1.1 %
Surface Moisture	Nil

4) *Coarse Aggregate:* Natural crushed stone with 20mm down size was used as coarse aggregate. Table 4shows the physical properties of coarse aggregates.

Table 4: Physical properties of coarse aggregates.

Properties	Result
Specific gravity	2.65
Fineness modulus	4.54
Bulk density (loose)kg/m^3	1470
Bulk density (compact)kg/m^3	1685
Water Absorption	0.6 %
Moisture content	Nil

5) *Water*: Potable water was used in this investigation for workability purpose only.
6) *Superplasticizers:* Superplasticizer used for the workability purpose. It was added by 2% of weight of cement.

IV. LITERATURE REVIEW

Abid A. Shah, Y. Ribakov (1)

Steel Fibered High- Strength Concrete (SFHSE) became in the recent decades a very popular material in structural engineering. High strength attracts designers and architects as it allows improving the durability as well as the esthetics of a construction. As a result of increased application of Steel fibered high- strength concrete (SFHSE); many experimental studies are conducted to investigate its properties and to develop new rules for proper design. One of the trends in SFHSE structures is to provide their ductile behavior that is desired for proper structural response to dynamic loadings, an additional goal is to limit development and propagation of micro cracks in the body of Steel fibered high- strength concrete (SFHSE) elements. Steel fibered high- strength concrete (SFHSE) is tough and demonstrates high residual strengths after appearance of the first crack. Experimental studies were carried out to select effective fiber contents as well as suitable fiber types; to study most efficient combination of fiber and regular steel bar reinforcement. Proper selection of other materials like silica fume, fly ash and super plasticizer has also high importance because of the influence the fresh and hardened concrete properties. Combination of normal- strength concrete with Steel fibered high- strength concrete (SFHSE) composite two- layer beams leads to effective and low cost solutions that may be used in new structures as well as for retrofitting existing ones. Using modern nondestructive testing techniques like acoustic emission and nonlinear ultrasound allows verification of most design parameters and control of Steel fibered high- strength concrete (SFHSE) properties during casting and after hardening. This paper presents recent experimental results, obtained in the field Steel fibered high- strength concrete (SFHSE) and non-destructive testing. It reviews the experimental data and provisions of existing codes and standards. Possible ways for developing modern design techniques for Steel fibered high-strength concrete (SFHSE) structures are emphasized.

P. Asokan a, Mohamed Osmani b, ADF Price b (2)

There are various types of fibers being used for reinforcement in composite materials and glass fiber is the most renowned one. In glass fiber reinforced plastics (GRP) composites, polyester resin is reinforced with glass fiber. GRP waste is a reject product of GRP manufacturing process and also described at the end of its service life, from construction, aerospace, automobile and locomotive industries.

The mean compressive strength of concrete (without GRP waste) with 2% superplasticiser was 61 N/mm2. Application GRP waste powder along with 2% superplasticiser increased the compressive strength about 10% as compared to the concrete specimens.

The tensile splitting strength of concrete developed using 15% GRP waste powder with additives was 4.2

N/mm2, which is higher than the normal concrete tensile splitting strength.

The initial surface absorption was reduced (by 16 %) with GRP waste addition. The mean total water absorption of concrete specimen with 15% GRP waste was 0.42 % which is considerably lower than the 6% for normal concrete.

The use of 5% and 15% GRP waste powder (substitute to fine aggregates) with additives in concrete improved compressive strength, tensile splitting strength, shrinkage, initial surface absorption and water absorption of concrete.

V. TESTS

Compressive strength test

Compression test were performed on specimen as per Annex –D of IS-15658-2006

APPARATUS

(A) Testing Machine

The apparatus shall comprise of compression testing machine which shall be equipped with two steel bearing blocks for holding the specimen. It is desirable a that the blocks have a minimum hardness of 60 (HRC) and a minimum thickness of 25 mm. The block on top through which load is transmitted to the specimen shall be spherically seated. The block below on which the specimen is placed shall be rigidly fitted, when the bearing area of the steel blocks is not sufficient of cover the bearing area of the paver block specimen, two steel bearing plates meeting the requirements of (B) shall be placed between the steel plates fitted on the machine and the specimen.

Table no. 5 Compressive strength of Mono Polypropylene (Recron 3 S) Fiber

Sr. No.	% Mono pp fiber	W/C Ratio	Load (KN) - P	Area of Specimen –A (mm^2)	Comp. strength h(P/A) x 1.18 in MPa	Avg. Comp. Strength
1	0.00	0.42	1085	22500	54.26	54.98
		0.42	1155	22500	57.69	
		0.42	1117	22500	55.83	
2	0.25	0.42	1294	22500	64.52	62.05
		0.42	1225	22500	61.13	
		0.42	1212	22500	59.49	
3	0.50	0.42	1040	22500	52.05	49.74
		0.42	1025	22500	51.31	
		0.42	914	22500	45.86	
4	0.75	0.42	800	22500	40.27	41.41
		0.42	840	22500	42.23	
		0.42	830	22500	41.74	
5	1.00	0.42	750	22500	37.81	37.19
		0.42	725	22500	36.59	
		0.42	737	22500	37.18	
6	1.25	0.42	675	22500	34.13	34.95
		0.42	690	22500	34.87	
		0.42	710	22500	35.85	

Graph no. 2 Compressive strength of Mono Polypropylene (Recron 3 S) Fiber

Split Tensile Strength

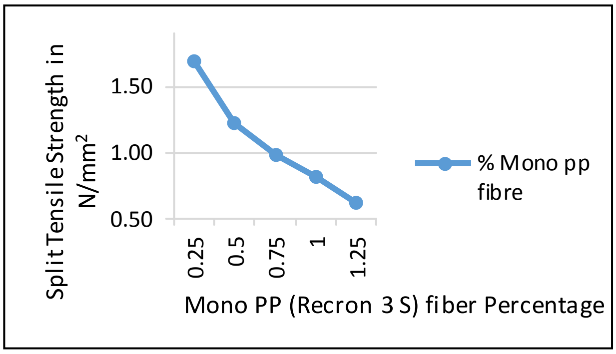
Split tensile strength measurements were performed on specimen according to Annex-F of IS -15658-2006.

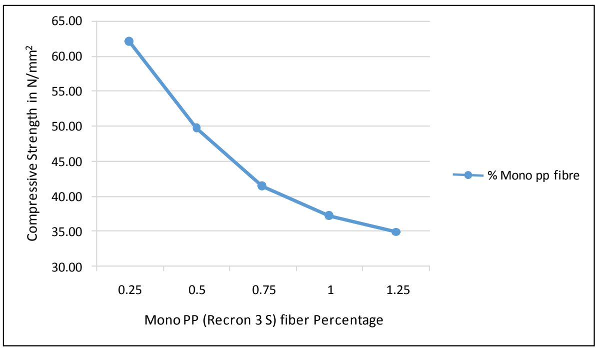
1) APPARATUS

(A) – The testing machine shall have a scale with an accuracy of ± 3 percent over the range of the anticipated test loads and be capable of increasing the load at specified rates. The machine shall be equipped with a device composed of two rigid bearers whose contact surface has a radius of 75 ± 5 mm. The two bearers shall be held in the same vertical plane with a tolerance of +1 mm at the bearers end. The upper bearer shall be able to rotate in its transverse axis. The two packing pieces shall be 15 ± 1mm wide 4 ± 1 mm thick and at least 10 mm longer than the anticipated fracture plane. The packing pieces shall be made of a material that meets the hardness criterion given in F-1.2.

(B) When submitted to a punching test by means of a rod of circular cross- section having a diameter of 16 ± 0.5 mm and applying a force at the rate of 48 ± 3 kN/min, the instantaneous penetration when the force of 20 ± kN is achieved shall be equal to 1.2 ± 0.4 mm.

Table no. 1.2 Split Tensile strength of Mono Polypropylene (Recron 3 S) Fiber





No.	% Mono PP Fiber	W/C Ratio	Load (KN) - P	Dimension			Split Strength Mpa	Avg. Split Strength MPa
				L	S	C/S Area		
1	0.00	0.42	14.81	120	80	9600	1.53	1.56
		0.42	15.33	120	80	9600	1.60	
		0.42	15.19	120	80	9600	1.59	
2	0.25	0.42	15.76	120	80	9600	1.65	1.69
		0.42	16.35	120	80	9600	1.71	
		0.42	15.93	120	80	9600	1.67	
3	0.50	0.42	10.97	120	80	9600	1.15	1.22
		0.42	11.77	120	80	9600	1.24	
		0.42	11.99	120	80	9600	1.26	
4	0.75	0.42	8.87	120	80	9600	0.93	0.98
		0.42	9.25	120	80	9600	0.97	
		0.42	9.86	120	80	9600	1.04	
5	1.00	0.42	7.30	120	80	9600	0.77	0.82
		0.42	7.87	120	80	9600	0.83	
		0.42	8.26	120	80	9600	0.87	
6	1.25	0.42	5.30	120	80	9600	0.56	0.62
		0.42	5.97	120	80	9600	0.63	
		0.42	6.47	120	80	9600	0.68	

Graph no. 2 Split Tensile strength of Mono Polypropylene (Recron 3 S) Fiber

VI. CONCLUSION

1) Split tensile test indicates that for 0.25% addition of Mono PP (Recron 3S) fibers gives maximum tensile strength 1.68 Mpa. So, the optimum percentage Mono PP (Recron 3S) fiber by mass fraction is 0.25%.
2) As per flexural strength criteria minimum breaking load a per IS recommendation for Heavy duty/Industrial road is 7 KN and our test indicates that for 0.25% addition of Mono PP (Recron 3S) fibers give maximum flexural strength is about 35 KN.
3) Optimum percentage fiber by mass fraction is 0.25% for Mono PP (Recron 3S) fibers shows increase in strength in all parameters considered above; but having about 4% increase in manufacturing cost by every increase in 0.25% of fibers and reduces about 10% to 12% breakage during handling and transport.
4) All failures of blocks casted with Mono PP (Recron 3S) fibers in different tests found ductile instead of brittle failure which shows better resistance for different kinds of load.

REFERENCES

1. ABID a. Shah, Y. Ribakov "Recent trends in steel fibered high – strength concrete" materials and Design 32 (2011) 4122 - 4151 March 2011.

2. Anne – Mieke Poppe and Geert De schutter "Cement hydration in the presence of high filler contents" Cement and Concrete Research, Volume 35, Issue 12 , March 2005 Paes 2290 -2299.

3. Andreas Leemann, BeatMunch, Philippe Gasser and Lorenz Holz "Indluence of Compaction on interfacial transition zone" Cement and Concrete Research,Volume 36,Issue 8 ,August 2005.

4. Burak Felekoglu, Selcuk Turkel and Bulent Baradan "Effect of water / cement ratio on the fresh and hardened properties of self-compacting concrete" Building and Environment, January 2006 .

5. Burcu Akcay (October 2011) Mechanical behavior and fiber dispersion of hybrid steel fiber reinforced self-compacting concrete"

6. P. Asokan a , Mohamed Osmani b ADF Price b Improvement of the mechanical properties of glass Fiber reinforced plastic waste powder filled concrete" Construction and building Materials 24 (2010) 448 -460 Available online 10 November 2009.