NOVATEUR PUBLICATIONS
International Journal Of Research Publications In Engineering And Technology [IJRPET]
ISSN: 2454-7875
VOLUME 2, ISSUE 12, Dec. -2016

COMPARATIVE STUDY OF POLYPROPYLENE, STEEL AND HYBRID FIBER IN CONCRETE PAVING BLOCKS

ASHISH B. DAYMA
PG Scholar, Department of Civil Engineering,
Padmashri Dr. Vithalrao Vilke Patil College of Engineering, Ahmednagar, India
Email: ashish.dima @gmail.com

PROF. U.R. KAWADE
PG Guide, Department of Civil Engineering
Padmashri Dr.Vithalrao Vilke Patil College of Engineering Ahmednagar, India
Email: urmilanagar@gmail.com

ABSTRACT:

Most of the studies on fiber reinforced concrete contain use of only single type of fiber with different percentage and combination of materials. The use of two or more type of fibers in their suitable combinations may potentially not only improve the quality of concrete but may also improve performance. This process of mixing more than one fiber is called hybridization and mixture of fiber is known as hybrid fiber.

Now days, paving block has remarkable demand because of their wide application in parking area, footpath, and petrol stations and also for their aesthetics etc. Paving block should have sufficient strength to bear heavy compressive load and offer good resistance to impact load.

In this study, the comparison of polypropylene, steel and combination of both the hybrid fiber with percentage varying from 0 to 1 percent in paving block. The comparison is based on compression test, flexural test.

KEYWORDS: Polypropylene, Hybrid fiber, fiber reinforced Concrete, paving block, Compressive Strength.

INTRODUCTION:

In history, paved road was exposed in summer of 1994, in Giza, Egypt. This street was constructed over 4,600 years ago as a path to attach a prehistoric basalt quarry to Lake Moeris and used to move large stones for the creation of the temples of Giza. This prehistoric road measures 7 miles (12 km) in length and 6 feet (2 m) in width. The road was paved with thousands of slabs of sandstone and limestone and some logs of petrified wood

Over period of time newer technique developed for making paving block and its application also rapidly changed in last few years. Considering all the facts and requirement of current time the need of newer technique in paving block is must be incorporate. Hence in this study, the use of fibers in making of paving block is compared with steel,

Following are the main objectives of the investigation:

1) To study the performance of paving block containing different percentages of fibers and to identify the optimum fiber percentage.
2) To compare the performance of polypropylene, steel and combination of both that is hybrid fiber.

MATERIALS AND SPECIFICATION:

The material details are as follows:

A. CEMENT:

For this research, locally available cement which is of the ordinary Portland cement type (53 grade) was used throughout the work.

B. FINE AGGREGATE AND COARSE AGGREGATE:

Locally available fine aggregate used was 4.75 mm size confirming to zone II with specific gravity 2.66. The testing of sand was conducted as per IS: 383-1970. Coarse aggregate used was 12mm and less size with specific gravity 2.70. Testing of coarse aggregate was conducted as per IS: 383-1970.

C. WATER:

The water used was potable, colourless and odourless that is free from organic impurities of any type.

D. PROPERTIES OF FIBER:

1) Polypropylene fiber:

Fibrillated polypropylene fiber has high tenacity with high chemical resistance used as micro reinforcement.
Physical property of Polypropylene fiber
Fiber type –Monofilament
Diameter –0.03mm.
Melting point -170 degree Celsius
Density -0.91 (g/cm3)
Aspect ratio - 40
Tensile strength-450 Mpa.
Length -12 mm.

2) Steel fiber:

This exhibits qualities of high tensile strength and high melting point also adherence to reaction against most of chemical make it good reinforcing material .mechanical properties are as follows.

Fiber type –Metallic (crimp)
Diameter – 0.6 mm
Aspect ratio– 60 (used for study)
Tensile strength- 800mpa
Available length – 38 mm

3) Hybrid fiber:

The process of mixing more than one fiber is called hybridization and mixture of fiber is known as hybrid fiber. This process of hybridization which means mixing of fiber has 3 method of mixing listed below.

a) Hybrids Based on Fiber Constitutive Response :

One type of fiber is stronger and stiffer and provides reasonable first crack strength and ultimate strength, while the second type of fiber is relatively flexible and leads to improved toughness and strain capacity in the post-crack zone.

b) Hybrids Based on Fiber Dimensions:

One type of fiber is smaller, so that it bridges micro cracks and therefore controls their growth and delays coalescence. This leads to a higher tensile strength of the composite. The second fiber is larger and is intended to arrest the propagation of macro-cracks and therefore results in a substantial improvement in the fracture toughness of the composite.

c) Hybrids Based on Fiber Function:

One type of fiber is intended to improve the fresh and early age properties such as ease of production and plastic shrinkage, while the second fiber leads to improved mechanical properties. Some such hybrids are now commercially available where a low (<0.2%) dosage of polypropylene fiber is combined with a higher (-0.5%) dosage of steel fiber.

EXPERIMENTAL WORK AND TEST:

A MIX DESIGN:

Mix design carried out for M40 grade of concrete by IS 10262:2009, having mix proportion of 1:1.4:1.94 with water cement ratio of 0.40. The addition of fiber is done with percentage varying from 0-1% for 80 mm uni regular paving block.

B COMPRESSIVE, FLEXURAL STRENGTH TEST:

Concrete paving block prepared with different percentage of steel polypropylene and hybrid fiber each was cured under normal condition as per recommendations of IS and were tested at 3 ,7days and28 days for determining the compressive, flexural strength and compared with the test results of conventional concrete paving block.

Figure1: Compressive and Flexural Strength Tests

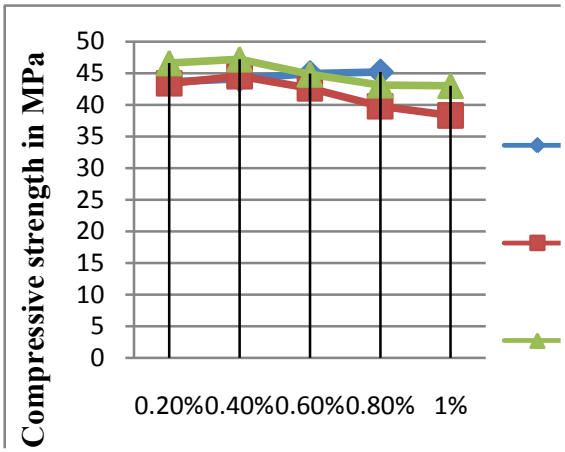
TEST RESULTS:

A. COMPRESSIVE STRENGTH:

Three UNI shaped paving block of depth 80mm were casted for each fiber with varying percentage of fiber to work out the 28th day compressive strength of all the proportions.

Table1: Test results for compressive strength

Nomenclature Of sample	Percentage Fiber content (%)		28th day compressive strength In Mpa
	Steel	polypropylene	
P2	--	0.2	43.40
P4	--	0.4	44.55
P6	--	0.6	42.60
P8	--	0.8	39.75
P10	--	1	38.30
S2	0.2	--	42.3
S4	0.4	--	43.6
S6	0.6	--	44.10
S8	0.8	--	44.95
S10	1	--	45.20
SP0	--	--	40.2
SP2	0.8	0.2	46.6
SP4	0.6	0.4	47.2
SP6	0.4	0.6	44.8
SP8	0.2	0.8	43.1



Graph 1: Results for compressive strength

It is clear from table I compressive strength obtained for concrete with sample SP4 showed a higher value by 20% compared to normal concrete. Hence hybridization shows better result over single type of fiber used in concrete paving block in compression.

B FLEXURAL STRENGTH:

The flexural strength of paving blocks can be expressed in term of flexural stress or in from of breaking load.

This breaking load is calculated by,

$$\text{Breaking load } (F_b) = \frac{3PL}{bd^2}$$

as per IS 15658: 2006, ANNEX G, CLAUSES 6.3.2 & 7.3

F_b= Flexural strength, in N/mm2,

P = maximum load in N,

L = Span length in mm,

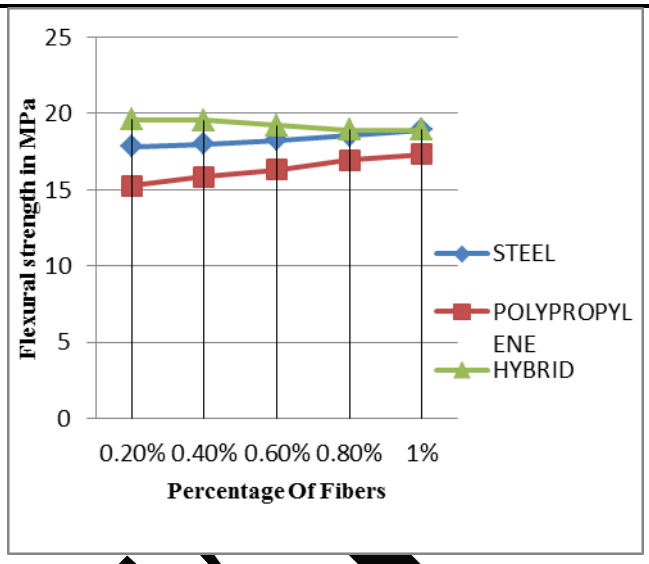
b = Average width of block

d = Thickness of block.

Figure 2: Flexural Test Detail

Table 2: Test Results for Flexural Strength

Nomenclature Of sample	Percentage Fiber content (%)		28th day Flexural strength
	Steel	polypropylene	
P2	--	0.2	15.25
P4	--	0.4	15.68
P6	--	0.6	16.33
P8	--	0.8	16.94
P10	--	1	17.33
S2	0.2	--	17.83
S4	0.4	--	17.98
S6	0.6	--	18.26
S8	0.8	--	18.55
S10	1	--	18.93
SP0	--	--	14.81
SP2	0.8	0.2	19.61
SP4	0.6	0.4	19.54
SP6	0.4	0.6	19.22
SP8	0.2	0.8	18.91



Graph 2: Test Results for Flexural Strength

For flexural test the hybrid reinforced concrete shows good result compare to single type of fiber used in the concrete. Hybrid fibers reinforced concrete shows 22% higher flexural strength than ordinary concrete paving block.

CONCLUSION:

The effect of addition of fiber on the Properties of concrete such as the compressive strength, flexural strength is studied. A Remarkable increase in the compressive strength is observed with the hybridization with the combination of 0.4% polypropylene fiber and 0.6% of steel fiber. The Test result for flexural strength is also considerably improved for hybrid fiber for combination of 0.4% polypropylene fiber and 0.6% of steel fiber and 0.2% polypropylene fiber and 0.8% of steel fiber is also have good flexural resistance. Comparing all the result the strength criteria, the combination of 0.4% polypropylene fiber and 0.6% of steel fiber has best result. Usage of hybrid fiber in concrete paving block can prove to be economical as it is having less cost and have improved result. Hence from above discussion we can conclude that,

1) Fiber addition in concrete paving block increases the compressive, tensile and flexural strength as compared with the conventional concrete
2) As the Percentage of fiber in concrete increases workability of concrete decreases.
3) Hybrid fiber has best result as compared to conventional single type of fiber addition.

ACKNOWLEDGMENT:

Experimental work was carried out using the facilities in Civil Engineering Department laboratory of P.D.V.V.P.COE, Ahmednagar. I wish to thanks HOD and my guide Prof. U.R. Kawade, ME Co-ordinator Prof. P.B. Autade, for their valuable Suggestions and authorities for their

kind support. I also wish to thank the laboratory staff for their help and support during experimental work.

REFERENCES:

1) G. Selina Ruby, Dr. P. Muthu Priya, Dr. R. Venkatasubramani**,** "*Study on Performance of HFRC flexural member under cyclic loading*", IJSETR, Volume 3, Issue 5, May (2014).
2) Selina Ruby G., Geethanjali C., Jaison Varghese, P. Muthu Priya, "*Influence of Hybrid Fiber on Reinforced Concrete*", ISSN 2319-5347, Vol. 03, No. 01, January (2014).
3) Rajarajeshwari B Vibhuti, Radhakrishna, Aravind N., "*Mechanical Properties Of Hybrid Fiber Reinforced Concrete For Pavements*", **I**SSN: 2319-1163(2013).
4) K. Sasikala, Dr. S. Vimala, "*A Comparative Study of Polypropylene, Recron and Steel Fiber Reinforced Engineered Cementitious Composites*", IJERA-(2013).
5) S. C. Patodi, C. V. Kulkarni, "*Performance Evaluation of Hybrid Fiber Reinforced Concrete Matrix*", IJERA-(2012).
6) Eethar Thanon Dawood, and Mahyuddin Ramli, "*Contribution of Hybrid Fibers on The Hybrid Fiber on the Properties of High Strength Concrete Having High Workability*", Elsvire publication (2011).
7) Yang H. Huang, 1993 "*Pavement Analysis and Design*" Prentice-Hall, Inc. Englewood Cliffs New Jersey.(2011).
8) G. Murali, a. S. Santhi* and g. Mohan ganesh, "*Effect of crimped and hooked end steel fibres on the impact resistance of concrete*", JASE (2014).
9) IS 15658: 2006 "*Precast concrete blocks for paving-specification*" Bureau of Indian Standards, New Delhi, 2006.
10) Specifications for manufacturing, supplying and laying Of precast cement concrete as per IS 15658:2006 ,HPCL
11) Concrete Technology, M .L Gambhir, third edition.Tata McGraw-Hill Education, 01-July-2004
12) Concrete Technology, M .L. Gambhir, third edition.Tata McGraw-Hill Education, 01-July-2004
13) Al-Robaidi, A., (Resheidat), M.R. "*Experimental investigation of polypropylene fiber reinforced concrete*." (1999).