Experimental Investigation on Effects of Steel And Polypropylene Fiber Concrete

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Abstract- *The research proceed with the effects of adding various proportion of steel and polypropylene fiber on the properties of high performance concrete* M_{30}*. The experimental effects considered on compressive, tensile and flexural strength under various curing conditions. The aim of this research is study the effects of steel and polypropylene fiber mix with different content ratio like 0.4, 0.8, 1.2 finding the results. The entire study was carried out for different curing conditions steel and polypropylene fiber this are increased compressive, tensile and flexural strength. However, further study is strongly prepared and carried out to understand more mechanical properties of steel and polypropylene fiber reinforced concrete. The research proceeds with the result of an action of adding various proportion of steel and polypropylene fiber on the properties of concrete* M_{30}*. An experimental effect considered on compressive, tensile and flexural strength under various curing conditions like 7, 14,28days. The aim of this research is study the effects of steel and polypropylene fiber mix with different content ratio like 0.4, 0.8, 1.2 and finding the optimum steel and polypropylene fiber content. The entire tests were carried out for different curing conditions with steel and polypropylene fiber these are increased compressive, tensile and flexural strength. However, further study is strongly prepared and carried out to understand the Non – Destructive Test properties of steel and polypropylene fiber concrete.*

Keywords- Polypropylene fiber concrete, compressive strength, split tensile strength, NDT test.

I. INTRODUCTION

Fiber reinforced concrete displays improved flexural strength, toughness, and ductility and crack resistance. The mechanical properties of FRC can be affected when exposed to heat.Polypropylene is an economical material that offers a combination of outstanding of physical, mechanical, thermal and electrical properties not found in any other synthetic fibers.Polypropylene fibers are hydrophobic, that is they do not absorb water. They need only long enough to insure dispersion in the concrete mixture .the mixing time of concrete enough long to minimize the shredding of the fibers.These type of fiber used in monofilament type (45mm long)polypropylene fiber and crumbled type steel fiber (30mm long).Current theory on fiber dispersion and bonding the manufacture of monofilament fiber product for following purpose in paving to reduce the plastic shrinkage, permeability to increase impact resistance, abrasion resistance fatigue and steel fiber product for following purpose reduce slab thickness, joints spacing replacement of structural steel reinforcement, risk of deterioration and spalling , to increase structural strength and external stress.Fiber manufactures only provide control of cracking caused by shrinkage cracking and thermal stress occurring at early ages. These fibers provide no post – crack benefit and are used only for shrinkage cracking and not provide improvements to other engineering properties.Fibers to concrete would act as crack resistance and substantially improve its static dynamic properties.

II. LITERATURE REVIEW

MILIND.V.MOHOD(JUN-FEB2015,PP28-36 VOLUME-12), studied the performance of polypropylene fiber reinforced concrete tensile strength was significantly improved only for 0.5 fiber dosage and high volume dosage rate above 1% showed that the concrete was significantly stiff and difficult compact so we are tried to adding admixtures like conplast SP-430.

ARCHANA.P (IJERT –ISSN :2278-0181 VOLUME 6 ISSUE 06,JUNE 2017) – study of strength of polypropylene reinforced concreteThe fiber dosage is 1.2% used time decrease the strength so we used fiber dosage 0.4, 0.8, 1.2 and 1.6 compare the strength results.

KULKARNI .S.M(ISSN:0975-6744 VOLUME 2 ISSUE 02, NOV 2015)- studied the effect polypropylene fiber on the high strength concreteThe workability of polypropylene fiber concrete has been found to decrease with increase in polypropylene fiber content replacement. Used of long fiber with same volume of fraction gives maximum split tensile strength over fiber short cut length.

III. MATERIALS SPECIFICATION

1. Cement

Cement is the important binding material in concrete. It is obtained by burning the mixture of calcareous material such as lime stone and argillaceous materials such as clay at a very high temperature. It is the basic ingredient of concrete, mortar, and plaster. It consists of mixture of oxides of calcium, silicon and aluminum. Cements of various strengths are available. Depends on the requirement concrete it is to be chosen. Pozzolanic Portland Cement (PPC) of 53 Grade is used in this investigation. Specific gravity of cement is 3.15

2. Fine aggregate

Fine aggregate shall consist of natural sand or manufactured sand or a combination. The finest fractions of fine aggregate are helpful to prevent segregation. The river sand conforming to zone II as per IS 383-1987 was used. It passes through 4.75mm IS sieve with a specific gravity of 2.65.

3. Coarse Aggregate

A maximum size of 20mm is used as coarse aggregate in concrete. Aggregates should be strong and free of internal flaws or fractures. An aggregate of high intrinsic strength is generally preferred. Granites, basalt, limestone and stone are being successfully used in concrete. Machine crushed granite broken stone angular in shape was used as coarse aggregate. The specific gravity of coarse aggregate is 2.7.

4. Super plasticizer

In modern concrete practice it is essentially impossible to make high performance concrete at adequate workability in the field without the use of super plasticizer conplast -SP430 (200ml/50kg) was used for the experimental work.Propertiesfollowing as.

Specific gravity- 1.220 to 1.225 @ 300C
Chloride content- nil to IS: 456

Air entrainment- approx. 1% additional air is entrained.

5. Polypropylene Fiber

Polypropylene is available into two forms such as monofilament fiber and fibrillated fiber. Monofilament fiber are produced an extrusion process through the orifices in a spinneret and then cut to the desired length. Monofilament fibers were the first type of polypropylene fiber introduced as an additive in PFRC. Monofilament fibers are available in length of 1/2, 3/4and 1-2 inches. The monofilament fibers have also been produced with end buttons or in twisted form to provide for greater mechanical anchorage and better performance. It is an economic material that offers a combination of outstanding physical, mechanical, thermal and electrical properties not found in any other synthetic fiber.

6. Steel Fiber

Typically steel fibers have equivalent diameters 0.15 to 2 mm and length from 7 to 75 mm. aspect ratio generally ranges from 20 to 100. Aspect ratio defined as the ratio between the fiber length and equivalent diameter which is the diameter of a circle with an area equal to the cross section area of the fiber steel fibers have high tensile strength ranges from 0.5 – 2.0 Gpa with modulus of elasticity of 200 Gpa.

Mix proportion

Table 1 Mix Proportion

Constituent	Water	Cement	Fine aggregate	Coarse aggregate
Weight/ volume	166 lit	370kg/ m^3	836.02kg/m^3	1064.74kg/ m^3
Proportion	0.45	1	1.4	2.42

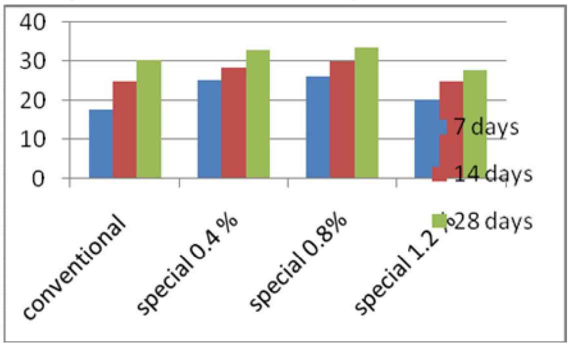
Comparison of conventional and special concrete compressive strength test results

table 2 comparison of conventional and special concrete compressive strength test results

Testing days	Sample (nos)	Conventional concrete comp	0.4 %		0.8 %		1.2 %	
			Load (kN)	Comp. strength (N/mm2)	Load (kN)	Comp. strength	Load (kN)	Comp. strength (N/mm2)
7	1	17.92	570	25.3	580	26.4	460	20.3
	2		580		590		450	
	3		560		610		460	
14	1	25.18	650	28.5	670	30.2	560	25
	2		660		680		570	
	3		650		690		580	
28	1	30.42	730	32.88	770	33.78	610	28
	2		740		750		600	
	3		750		760		620	

Fig no 1 Compressive Strength Test

Fig no 2 Compressive Strength Test Results



Split tensile strength test

For 3 specimens of cylindrical shape of diameter 150 mm and length 300 mm were tested under a compression testing machine of 2000 kN capacity under a compressive load across the diameter along its length till the cylinder splits tensile strength. The tension develops in a direction at right angles to the line of action of the applied load. The split tensile strength was calculated as follows:

Split tensile strength (Mpa) =2P / π DL

Where,

P – failure load,
L – length of the cylinder,
D – diameter of cylinder

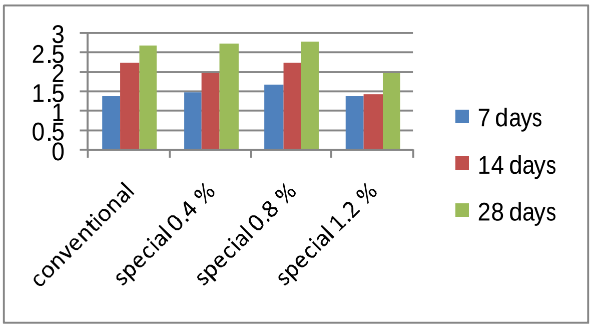
Fig no 3 Split Tensile Strength Test

Comparison of conventional and special concrete split tensile strength test results

Table 3Comparison Of Conventional And Special Concrete Split Tensile Strength Test Results

Testing days	Sample (nos)	Conventional concrete tensile	0.4 %		0.8 %		1.2 %	
			Load (kN)	Tensile strength (N/mm²)	Load (kN)	Tensile strength (N/mm²)	Load (kN)	Tensile strength (N/mm²)
7	1	1.4	110	1.5	120	1.7	100	1.4
	2		100		110		120	
	3		110		130		110	
14	1	2.26	140	2.02	160	2.26	130	1.46
	2		150		170		120	
	3		140		150		130	
28	1	2.68	200	2.75	210	2.80	150	2
	2		190		200		130	
	3		200		210		140	

Fig no 4 Split Tensile Strength Test Results



Flexural strength test

For the flexural strength of concrete, beam specimens size of 500x100x100 mm were casted. The samples are demouled after 24 hours from casting and kept into water tank for 28 days curing. The specimens were placed in UTM and tested for flexural strength. The average value is reported. This flexural strength calculated by following formula,

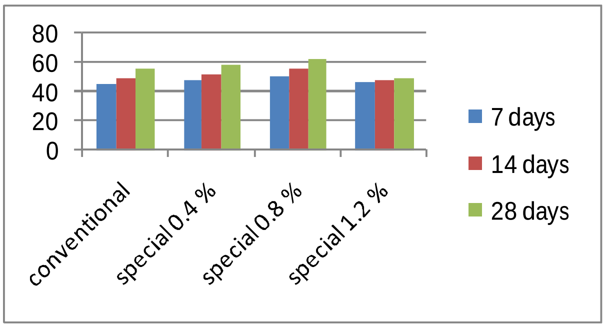
Flexural strength = 2 PL/D

Fig No 5 Flexural Strength Test Results

Table 4 Comparison Of Conventional And Special Concrete Flexural Strength Test Results

Testing days	Sample (nos)	Conventional concrete flexural	0.4 %		0.8 %		1.2 %	
			Load (kN)	Flexural strength (N/mm²)	Load (kN)	Flexural strength (N/mm²)	Load (kN)	Flexural strength (N/mm²)
7	1	45.6	39	48.5	42	50.6	38	46.2
	2		41		43		37	
	3		40		44		35	
14	1	49.2	42	52.4	47	55.6	39	48.4
	2		43		48		40	
	3		44		49		41	
28	1	56.4	45	58.8	51	62.6	41	49.7
	2		47		53		39	
	3		46		54		42	

Fig no 5Flexural Strength Test Results



Non destructive test (NDT)

Rebound hammer test
Ultrasonic pulse velocity

Rebound hammer test

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring controlled mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. The surface hardness and therefore the rebound is taken to the compressive strength of the concrete. The rebound is read off along a graduated scale and is designated as the rebound number.

Table No 5 Rebound Hammer Test Results

Testing days	Sample	Conventional concrete	0.4 %		0.8 %		1.2 %	
			Load (kN)	Comp. strength (N/mm²)	Load (kN)	Comp. strength	Load (kN)	Comp. strength
7	1	18.2	25.3	24.9	26.5	27.2	20.5	21.5
	2		24.6		27.4		21.3	
	3		25		27.7		22.7	
14	1	25.7	28.3	28.9	30.5	30.9	25.6	25.9
	2		28.7		31.7		26.8	
	3		29.8		30.6		25.8	
28	1	30.2	31.5	32.23	34.5	34.8	28.9	28.96
	2		32.3		35.4		28.6	
	3		32.9		34.8		29.4	

Ultrasonic pulse velocity test

The ultrasonic pulse is generated by an electroacoustical transducer, when the pulse is induced in to the concrete from a transducer, it undergoes multiple reflections at the boundaries of the different material phases within the concrete. A complex system of stress waves is developed which includes longitudinal (compressional), shear (transverse) and surface (Rayleigh) waves. The receiving transducer detects the onset of the longitudinal waves, which is the fastest.

Table No 6 Ultra Sonic Pulse Velocity Test Results

Testing days	Sample (nos)	Conventional concrete strength	0.4 %		0.8 %		1.2 %	
			Load (micro sec)	strength (km/sec)	Load (micro sec)	strength (km/sec)	Load (micro sec)	strength (km/sec
7	1	3.42	39	3.72	33	4.54	40	3.63
	2		40		32		42	
	3		42		34		43	
14	1	4.29	36	4.28	31	5.12	39	3.68
	2		34		28		38	
	3		35		29		40	
28	1	4.65	32	4.79	30	5.51	36	4.13
	2		30		27		38	
	3		32		25		35	

IV. CONCLUSION

Compressive, split tensile strength and flexural strength properties of conventional and special concrete strength compared at various proportions like 0.4,0.8&1.2% of steel and polypropylene fiber added finally get results are drawn graph.The strength properties of fiber reinforced concrete increased as the percentage of steel and polypropylene fiber on 0.8% and therefore gradually decrease the strength properties at 1.2%. The NDT test result gives for best performance of the concrete FRC mix is 0.8% . (it gives for quality of concrete is 5.51 km/sec [excellent]).The special concrete gives 10-15% more strength compare with conventional concrete.

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