

Experimental Investigation on High Performance Concrete by Using Electric Copper Wire

B.Shobana¹, B.N.Brinila Bright²

P.G. Student, Department of Civil Engineering, Sethu Institute of Technology, Virudhunagar, Tamil Nadu, India¹

Assistant Professor, Department of Civil Engineering, Sethu Institute of Technology, Virudhunagar Tamil Nadu, India²

ABSTRACT: To evaluate the mechanical characterizes of the High performance electric copper wire fiber reinforced concrete .the concrete mix design was done for M40 grade concrete. We used different proportion of electric copper wire fiber and also mineral admixture and cured it at two different levels of 7 days and 28 days. The concrete specimens cubes, cylinders and beam were casted and evaluate the strength properties such as compressive strength , splitting tensile strength and flexural strength of M40 concrete with steel content 0.5%, 1%, 1.5% and 2% has been tested, analyzed and it has been compared in the control mix. Strength predictions were established using regression models to predict the strength such as compressive, splitting tensile and flexural strength of High performance and High performance fiber reinforced concrete containing electric copper wire fibers in different volume fractions. The variation in compressive strength, split tensile strength and flexural strength with respect to changes in the fiber content can be observed. From the results obtained, it is clear that compressive and split tensile strength and flexural strength of concrete is maximum when the fiber content is 2.0 % of the concrete.

KEYWORDS: HPC, HPFRC, Electric copper wire fibre content.

I. INTRODUCTION

High-performance concrete is defined as concrete that meets special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices. Ever since the term high-performance concrete was introduced into the industry, it had widely used in large-scale concrete construction that demands high strength, high flow ability, and high durability. A high-strength concrete is always a high- performance concrete, but a high-performance concrete is not always a high-strength concrete. Durable concrete Specifying a high-strength concrete does not ensure that a durable concrete will be achieved. It is very difficult to get a product which simultaneously full fills all of the properties ⁽¹⁾Fiber reinforced concrete may be defined as the composite materials made with Portland cement, aggregate, and incorporating short discrete discontinuous fibers. Plain reinforced concrete is a brittle material due to this the structure having low ductility, low tensile strength and a low strain capacity. The addition of steel fibers in concrete considerably improves the tensile strength, static flexural strength, durability, Impact strength, Shear and fatigue strength, shock resistance ductility and failure toughness. However the degree of these improvements depends on the type, size, shape and aspect ratio of the electric copper wire fibers. Deformed ECW fibers perform better in fresh concrete than straight fibers and also more efficient than straight ECW fibers in improving the desired hardened concrete properties ⁽²⁾The effect of steel fibers content, high range water reducing admixture and the combined effect of rice husk ash and (HRWRA) in ultra-high strength fiber reinforced concrete. From the tests, control concrete with 0%, 1%, 1.5% and 2% volume fractions of steel fibers showed a minimum- reduction in compressive strength at early period of curing ⁽³⁾.

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This paper evaluates the performance of hybrid fibers in high performance concrete on the fresh and hardened concrete properties ⁽⁴⁾. The authors studied the mechanical properties of normal and high strength concrete with and without steel fibers in volume fractions. From the experimental results, showed that an improvement in compressive, split tensile strength and flexural strength improved to 1.0% steel fiber in volume fractions ⁽⁵⁾. Based on the experiments to assess the durability factors of high performance concrete with electric copper wire fiber ⁽⁶⁾.

Here the concrete with 0.5%, 1%, 1.5% and 2% volume fractions of steel fibers shows marginal increase in strength and toughness of concrete ⁽⁷⁾. The paper researched on sulphate resistance of high performance concrete that containing different percentage of natural pozzolana and concluded that the compressive strength was high for different percentage of pozzolana against sulphate attack than control concrete ⁽⁸⁾.

Commonly, aggregate size also an important parameter to improve the ultimate flexural strength of the concrete. The increase in flexural strength for SFRC not only depends on aggregate size, but also the fiber volume fractions and aspect ratio of the fiber ⁽⁹⁾. Previous investigation shows the behavior of SFRC under various strength and durability test shows better performance than control concrete ⁽¹⁰⁾.

II. MATERIALS AND METHODS

The material used for this experimental work are cement, sand, water, steel fibers, and super plasticizer.

Cement:

Cement is a binder that sets and hardens and can bind other materials together. Ordinary Portland Cement (OPC) 53 grade is used. Cement is a binder that sets and hardens and can bind other materials together. A powdery substance made by claiming lime and clay, mixed with water to form mortar or mixed with sand, gravel and water to make concrete.

Fine aggregate:

Aggregate which passed through 4.75 mm IS sieve and retained on 75 micron IS sieve is termed as fine aggregate. The specific gravity of fine aggregate was 2.6.

Coarse aggregate:

Angular shape aggregate which passes through 20 mm sieve and retain on 10mm are used as coarse aggregate in this project work. The specific gravity of coarse aggregate was 2.64 and fineness modulus of 7 was found out 12.5mm.

Super plasticizer:

To impart additional workability a super plasticizer 0.5 % to 0.8% by weight of cement was used. To improve the workability of the mixes, a high range water reducing and SP400 is used

Fibers:

The electric copper wire fibers have a length of 20mm, diameter of 0.1mm, and the density of 8.96 g/cm³ with an aspect ratio of 20.

III. TESTING METHODS

To determine the hardened properties of concrete standard tests like compression test on cubes for compressive strength, split tensile test on cylinders for tensile strength and flexural test on beams for flexural strength of concrete were carried out at 7days and 28days of curing.

COMPRESSIVE STRENGTH OF CONCRETE CUBES

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M40 grade of concrete. Super plasticized (0.6% to 0.8% by weight of cement) was added to this. The moulds were filled with 0%, 0.5%, 1.0%, 1.5% and 2% fibers. Vibration was given to the moulds using table vibrator. The top surface of the specimen was levelled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank wherein

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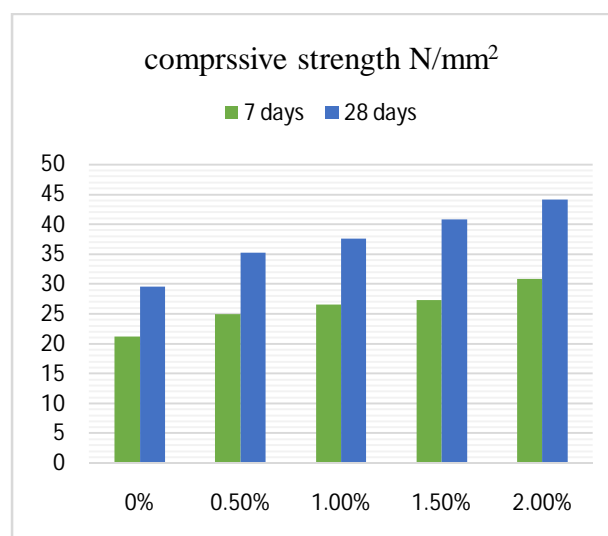
they were allowed to cure for 7 and 28 days. After 7 and 28 days curing, these cubes were tested on digital compression testing machine as per I.S. 516-1959. The failure load was noted. In each category three cubes were tested and their average value is reported.

The compressive strength was calculated as follows in Table: 1 and Figure: 1
Compressive strength (MPa) = Failure load / cross sectional area.

TABLE 1: COMPRESSIVE STRENGTH OF CONCRETE CUBES

% of fiber	Compressive strength N/mm ²	
	7 days	28 days
0%	21.2	29.5
0.5%	25.00	35.2
1.0%	26.54	37.62
1.5%	27.31	40.81
2.0%	30.82	44.14

Fig1: COMPRESSIVESTRENGTH



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SPLIT TENSILE STRENGTH OF CONCRETE CYLINDERS

For Split tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank wherein they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category three cylinders were tested and their average value is reported.

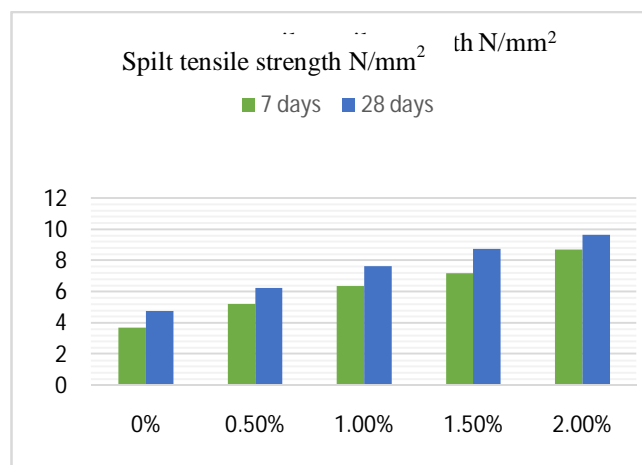
Split Tensile strength was calculated as follows in Table: 2 and chart in Figure: 2

Split Tensile strength (MPa) = $2P / \pi DL$, Where, P = failure load, D = diameter of cylinder, L = length of cylinder

TABLE 2: TENSILE STRENGTH OF CONCRETE CYLINDERS

% of fibre	Spilt tensile strength N/mm ²	
	7 days	28days
0%	3.71	4.78
0.5%	5.22	6.25
1%	6.38	7.65
1.5%	7.19	8.74
2%	8.71	9.67

Fig: 2 SPILT TENSILE STRENGTH



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FLEXURAL STRENGTH OF CONCRETE BEAMS

For flexural strength test beam specimens of dimension 1600x150x100 mm were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank wherein they were allowed to cure for 28 days. These flexural strength specimens were tested under two point loading as per I.S. 516-1959, over an effective span of 400 mm on Flexural testing machine. Load and corresponding deflections were noted up to failure. In each category three beams were tested and their average value is reported.

The flexural strength was calculated as follows in Table: 3 and chart in Figure: 3

$$\text{Flexural strength (MPa)} = PL / bd^2$$

Where,

P = Failure load,

L = Centre to center distance between the support = 400 mm,

b = width of specimen=150 mm,

d = depth of specimen= 100 mm.

TABLE: 3 FLEXURAL STRENGTH OF CONCRETE BEAMS

% of fiber	Flexural strength (N/mm ²)
	28 days
0 %	8.9
0.5 %	9.7
1 %	11.3
1.5 %	13.8
2 %	16.4

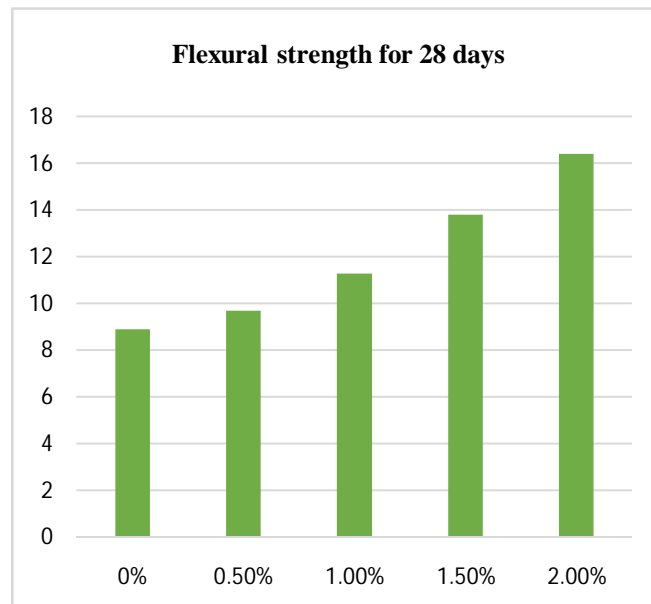
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Fig: 3 FLEXURAL STRENGTH



IV. CONCLUSION

- The workability of concrete can be increased by addition of super plasticizer. However, very high dosage of super plasticizer tends to impair the cohesiveness of concrete.
- Compressive strength is improved by super plasticizer compared with control.
- It was concluded that the strength was increased due to the increased in fiber content.
- The compressive strength at 2% is higher than that of the normal concrete both in 7 days and 28 days.
- The tensile strength at 2% gives higher strength than that of the control concrete cylinder.
- The flexural strength at 2% gives higher strength than that of normal concrete beam.

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