ESP IJCETA
ESP International Journal of Civil Engineering Technology Advancements
Volume 1 / Issue 1 Paper Id: IJCETA-V1I1P104 / Page: 23-26

Original Article

Experimental investigation on Compressive Strength and Flexural Strength of High Strength Concrete by using Alcofine, Fly Ash, and Steel Fibers

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Received Date: 03 July 2023 Revised Date: 26 July 2023 Accepted Date: 31 July 2023

Abstract: *This experimental investigation looked at how the addition of steel fibres, fly ash, and alcofine to concrete sample affected some of its mechanical properties. This project's goal is to use steel fibre, ash, and aluminium fines to generate concrete that is more ductile and strong. The trials included two different types of steel fibres, with steel fibre volume percentages ranging from 0.5% to 4.0%. By weight of the cementitious material composition, Alcofine and fly ash were added to the concrete in quantities of 5 and 10, respectively. The ratio of water to cement was 0.27. Concrete specimens that had been hardened underwent testing for both flexural and compressive strength. The use of Alcofine improved the concrete's mechanical strength.*

Keywords: *Steel fibres, Alcofine, and Compressive Strength.*

I. INTRODUCTION

Due to the development of larger and higher concrete structures, the study of high-strength concrete has gained interest. Alcofine can be used in concrete as a Supplementary Cementitious Material (SCM) to increase durability, decrease permeability, and increase strength and the rate at which strength is gained. Concrete's porosity is reduced with alcofine. Concrete has very little elasticity and very little crack resistance. The concrete naturally contains internal micro-cracks, and as a result of these micro-cracks spreading, the concrete has a low durability that finally leads to brittle fracture. It has been suggested that adding small, evenly dispersed fibres will significantly increase the concrete's compressive and flexural strength qualities and act as a crack preventer.

II. MATERIAL USED

A. Cement

In the investigation, regular hydraulic cement of Grade 53 complying with IS: 12269-1987 was used. Cement has a specific gravity of 3.10.

B. Course Aggregate

The substance was broken stone metal from a local source with a maximum particle size of 12.5 mm and an accurate gravity of 2.7.

C. Fine Aggregate

It was decided to use locally available river sand that had been graded in accordance with IS: 383-1970's grading zone II and had gone through a 4.75 mm IS sieve. The specific gravity of the fine aggregate was 2.54.

D. Alcofine 1203

Alcofine 1203 is a cementitious ingredient that can successfully take the place of silica fume in high performance concrete. Patented mineral supplement Alcofine 1203, based on low calcium silicate. Controlled granulation produces a certain distribution of particle size.

E. Fly Ash

Fly ash is available from Dirk India Pvt. Ltd. in Nasik in the form of dry powder. The light grey ash sold under the brand name "Pozzocrete 83" can be bought in 30 kg bags. The company's ash production conforms with all IS: 3812-1981 requirements.

F. Super Plasticizer

Fosroc Chemicals (India) Pvt. Ltd. supplied the sulphonated naphthalene formaldehyde condensate CONPLAST SP-430 superplasticizerutilised. It complies with IS: 9103-1999 and has a 1.20 relative density.

G. Steel Fiber

The main variables of the study are Round Crimped Steel Fibre (RCSF) and Flat Crimped Steel Fibre (FCSF), two different forms of steel fibers. Depending on the weight of the cementing material, different dosages of these fibers are utilized.

Table 1: Utilized Steel Fiber Characteristics

Types	Lengths L (mm.)	Diameters d (mm)	Factor Ratio (L/d)
RCSF	25.00	0.55	45.00
FCSF	30.00	2 mm thickness	15.00

H. Water

Fresh portable water free of concentrated acids and organic materials is utilized for mixing and curing the concrete.

III. MIXTURE PROPORTION AND SPECIMEN PREPARATION

The features of grade M70 high-strength concrete made utilizing a method devised by the British Department of Environment were investigated experimentally. Alcofine 1203 was added in addition to fly ash, which accounts for 10% of the cementitious material. In this study, two varieties of steel fiber—Round Crimped Steel Fibre (RCSF) and Flat Crimped Steel Fibre (RCSF)—are used in cementation materials at doses of 0.5%, 1%, 1.5, 2%, 2.5%, 3.5%, and 4% of their weight. Table 3.1 displays the mixtures employed and their compositional elements.

IV. METHODOLOGY

A. Compressive Strength

Steel cell samples of 100 mm by 100 mm by 100 mm were cast for the compressive strength test. After being cast for 24 hours, the samples were demolded and kept in a curing tank for 28 days. The compressive strength of concrete was evaluated using Indian Standard IS516-1959(10). The outcomes are displayed in Table 4.1.

Table 2: 28-Day Compressive Strength

Sl. No.	Vf (%) Fiber Volume Fraction	Strength of Compression at 28 Days (MPa)	
		RCSF	FCSF
1	0	72.5	72.5
2	0.5	76.8	74.5
3	1.0	80.5	77.80
4	1.5	84.25	82.3
5	2.0	85.8	84.60
6	2.5	87.25	85.20
7	3.0	88.5	85.8
8	3.5	86.30	83.
9	4.0	84.30	81.5

B. Flexural Strength

For the flexural strength test, prism specimens with dimensions of (500 mm x 100 mm x 100 mm) were cast. The specimens were demolded and placed in a curing tank for 28 days after casting for 24 hours. A general testing device was used to inspect these samples. For each concrete mixture, three prisms were tested; the average value is shown. The flexural strength of concrete was evaluated using the Indian Standard IS: 516-1959[10].Table B presents the findings.

Table 3: 28-Day Flexural Strength

Sl. No.	Vf (%) Fiber Volume Fraction	Flexibility after 28 days (MPa)	
		RCSF	FCSF

1	0	7.9	7.9
2	0.5	8.38	8.5
3	1.0	8.74	8.25
4	1.5	8.97	8.40
5	2.0	9.08	8.5
6	2.5	9.17	8.6
7	3.0	9.39	8.8
8	3.5	9.29	8.6
9	4.0	9.2	8.4

V. RESULT AND DISCUSSION

A. Compressive strength of high strength concrete and fibre volume percentage Vf (%)

Up to a volume percentage of 3.0%, concrete reinforced with steel fibers has improved compressive strength before it starts to deteriorate. The highest compressive strengths for RCSF and FCSF, respectively, are 88.5 N/mm2 and 85.8 N/mm2, at 3.0% fibre volume percentage. Figure 5.1 demonstrates the impact of Alcofine, fly ash, and steel fiber on concrete's compressive strength.

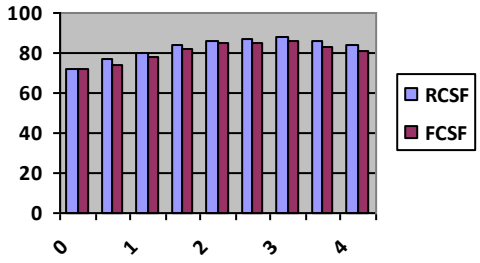

Figure 1: Compressive Strength of Concrete

B. Flexural Strength of High Strength Concrete with Fiber Volume Fraction Vf (%)

The conclusion from Table 4.2 shows that adding more fiber to concrete considerably boosts its ability to bend into a prism. Strength is seen to steadily increase up until a limit. The 3.0% fiber component gave concrete the greatest increase in flexural strength when compared to normal concrete. Round Crimped Steel Fibre (RCSF) offers the maximum flexural strength in compared to Flat Crimped Steel Fibre (FCSF).Figure 5.2 shows how the concrete's flexural strength is impacted by Alcofine, fly ash, and steel fiber.

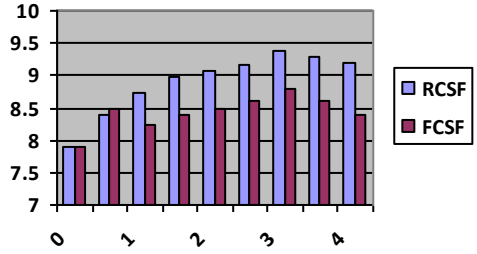

Figure 2: Flexural Strength of Concrete

VI. CONCLUSION

Simple concrete is a brittle substance that breaks down suddenly. Concrete's brittle failure mode is transformed into a more ductile one by the addition of steel fibres, increasing the ductility of the material. Concrete gains compressive and flexural strength when fibre content rises up to a particular percentage. The RCSF has a 3.0% fibre content and a maximum value of compressive strength and flexural strength.

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