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A Study on the Strength of Fiber Reinforced Concrete with Partial Replacement of Cement by Fly Ash

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ABSTRACT: This experimental study aimed to achieve the desired strength of M20 Grade concrete by varying the proportions of fly ash, steel fiber in cement, coarse aggregate, and fine aggregate. By gradually adjusting the content of fly ash and steel fiber while keeping other parameters fixed, various combinations were moulded, cured, tested and evaluated according to prescribed standards (IS Code 456-2000). The optimal combination of 40% fly ash and 1% fiber shows significant enhancements in cube compressive strength. Results suggest that composites with up to 40% fly ash and 1% fiber perform best at 7 and 28 days with conventional ratios.

KEY WORDS: Fly ash, Steel fiber.

I. INTRODUCTION

GENERAL

Concrete is weak in tension but extremely strong in compression. As an When exposed to typical stresses and impact loads, concrete is a moderately fragile material. Because the microcracks in concrete that are subjected to tensile stress have widened, the concrete's tensile strength is reduced. The fiber's presence causes the microcracks to stop. The addition of fibers is typically considered a way to improve the flexural and tensile strength of concrete. The fine powder known as fly ash is a common waste product from thermal power plants. One of the main problems is how to dispose of fly ash because it can seriously harm the environment when dumped as waste. For this reason, using fly ash.

II. LITERATURE REVIEW

B. Vijaya Rangan and A. Sridharan (2019). This review discusses optimization strategies for mix proportions in steel fiber reinforced concrete with fly ash, considering factors such as fiber content, fly ash dosage, and water-to-cement ratio.

A. R. Khaloo, M. Y. Ghani, and A. M. S. Iqbal (2019). This review investigates the influence of steel fiber geometry on the properties of steel fiber reinforced concrete with fly ash, including mechanical performance and workability.

T.Sama et al (2014). showed that the compressive strength flexural strength and split tensile strength Increases with increase in steel fiber content in the research fly ash has a very good effect on compressive strength. The maximum strength has been achieved at 21% steel fiber and 30% fly ash.

III. MATERIALS USED AND PROPERTIES

Cement

Ordinary Portland cement grade 43 is used for this experiment.

Table 1 Test on cement

S. No.	Test	Values
1	Normal consistency	33



2	Initial setting time (min)	90
3	Final setting time (min)	185
4	Specific Gravity	2.92

Fine aggregate

Locally available M-sand is used for experiment.

Table 2 Tests on Fine Aggregate

S.No	TESTS	Values
1	Specific gravity	2.65
2	Fineness modulus	2.79

Coarse Aggregate

Locally available Aggregate are used for this project. The size of the aggregate is 20mm.

Table 3 Tests on Fine Aggregate

S. No	TESTS	Values
1	Specific gravity	2.66
2	Fineness modulus in 10mm,20mm	6.4, 7.6 resp.,

Water

Potable water used for prepare the mixture.

Steel Fiber

The hook-ended type HK0750 steel fiber with aspect ratios of 71 was utilized in the investigation. The entire volume of concrete uses continuous dosages of 0.5% to 1.5% fibers. The fiber has a diameter of 0.7 and a length of 50mm for division.

Table 4 Tests on steel fiber

Property	Value
Density of steel fiber (kg/m3)	7850
Length (mm)	25
Diameter (mm)	0.6
Aspect ratio (L/D)	41.7
Type of steel fiber	Carbon

Fly Ash

Fly Ash is available in dry powder form and is procured mature.

Chemical composition of Fly ash

Chemical composition (%) Sixty-five percent silicon dioxide (SiO₂), eighty-eight percent aluminum oxide (Al₂O₃), and twenty-eight percent iron oxide (Fe₂O₃).

Magnesium oxide (MgO) 2.38 Calcium oxide (CaO) 0.6 Initial loss of 1.1 Chlorides (Cl) <0.01 Sodium oxide (Na₂O) ~0.1

IV. RESULTS AND DISCUSSION

Compression Test

Finding the test specimens' maximal load carrying capability is the goal of this experimental test. A 1000 KN compression testing machine (CTM) was used to test the compression test specimens.

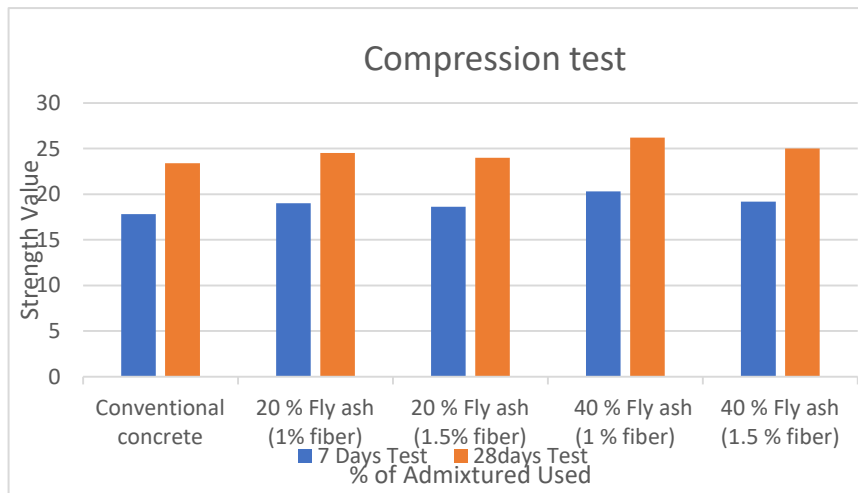


Fig No. 1 compression Test 7 and 28 days

Split Tensile Strength

Finding the test specimens' maximum load carrying capability is the major goal of this experimental test. For the split tensile test, 150 mm diameter and 300 mm height cylinders were cast. For 28 days, two sets of specimens were tested. The splitting tests are widely recognized as an indirect method for assessing the concrete's tensile strength.

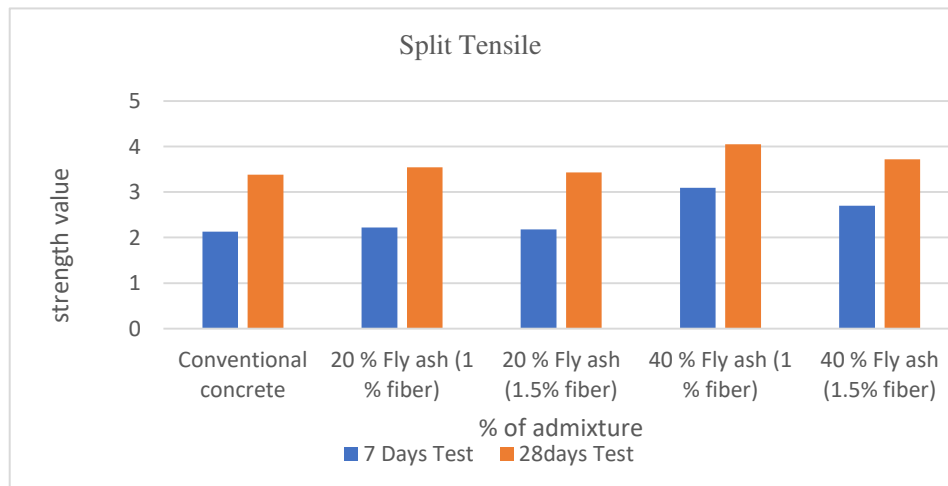


Fig No.2 Split Tensile Test 7 and 28 days

Flexural strength

Two points of loading are applied to the specimen, and the load at the site of failure is recorded. 100 x 100 x 500 mm prisms were cast. For a period of 28 days, two specimens from each set were tested. A 400 kN universal testing machine (UTM) was used to test these specimens.

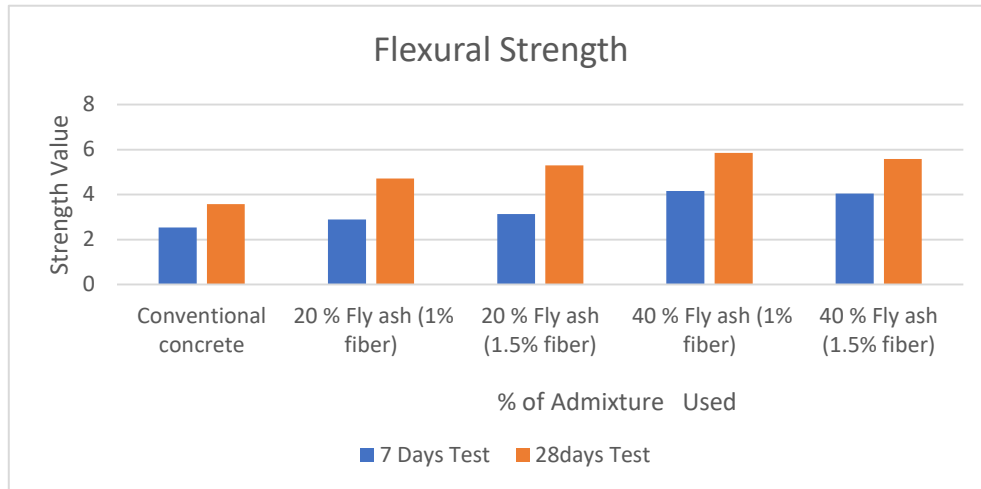


Fig No. 3 Flexural strength 7 and 28 days

V. CONCLUSION

According to experimental testing, when used in appropriate volume ratios, fly ash may effectively replace cement, and any shortcomings that may arise can be quickly fixed with the use of steel fiber.

Generally speaking, steel blade composition performs better up to 40% fly ash and 1% fiber content.

With the addition of fly ash and fiber materials and technology, comparable improvements in tensile strength and flexural strength are noted, making these composites an effective material over concrete.

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