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# An Experimental Investigation on Concrete Using Flyash as Partial Replacement to Cement and Steel Fibers as Admixture

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**ABSTRACT:** The present Investigation deals with M-50 grade concrete investigate about the mechanical and durability properties of concrete by using Fly ash as a replacement to cement and Steel fibers as admixture. The concrete specimen were study the compressive strength, split tensile strength, Flexural strength and Durability test of RCPT tests are conducted of steel fiber reinforced concrete (SFRC) containing concrete mix with steel fibers at 0%, 0.5%, 1%, 1.5% and 2.5% to the volume of fraction and 50 aspect ratio were used. The percentage of Fly Ash by weight is to be increased by 10% to 20% for the replacement cement. The result shows 15.76% increase in compressive strength at 10% flyash with 2% of steel fibers, 37.39 % increase in Tensile strength at 20% flyash with 2.5% of steel fibers, Also 48.65 % increase in flexural strength at 20% flyash with 2.5% of steel fibers in SFRC. By the durability test the chloride ions penetration shows the highest replacement had the lowest chloride ion penetration and Comparing the results shows the analyzed the sensitivity of the fibers and fly ash with plain concrete.

**KEYWORDS:** Flyash, Steel fibers, steel fiber reinforced concrete (SFRC).

## I. INTRODUCTION

Fly ash is the one of the fine powder major waste material produced from many thermal power plants. the utilization of fly ash as a low cost mineral admixture in concrete instead of dumping it as a waste material can have great beneficial effects.



Fig: 1 Fly Ash

A fiber is a small piece of reinforcing material posses certain properties by its own, where as comparing to different types of fibers, Steel fibres are most common used fiber.



Fig 2. Sample of Steel fiber used in this project



II. LITERATURE REVIEW

Vikrant S. Vairagade, Kavita S. Kene (2012) were carried on a work on Introduction to Steel Fiber Reinforced Concrete on Engineering Performance of Concrete were Fiber reinforced concrete has been successfully used in slabs on grade, shotcrete, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. The usefulness of fiber reinforced concrete in various Civil Engineering applications is thus indisputable. This review study is a trial of giving some highlights for inclusion of steel fibers especially in terms of using them with new types of concrete test

FAISAL FOUAD Wafa (1990) deals with Properties and Applications of Fiber Reinforced Concrete were Fiber reinforced concrete (FRC) is a new structural material which is gaining increasing importance. Addition of fiber reinforcement indiscrete form improves many engineering properties of concrete. Currently, very little research work is being conducted within the Kingdom using this new material. This paper describes the different types of fibers and the application of FRC in different areas. It also presents the result of research about the mechanical properties of FRC using straight as well a hooked steel fibers available in the region.

III. MATERIALS AND METHODOLOGY

FLYASH

The physical properties of Fly ash are taken according to the IS: 3812-part-1:2003 as shown in the Table 2

Table 1 Properties of Fly ash

Sl. No	Properties	Results
1	Specific gravity	2.25
2	Fineness	9%

STEEL HOOK FIBERS

Steel hook fibers compliance to the requirements of ASTM A 820 (type-1 cold drawn wire)

PROPERTIES OF STEEL HOOKE FIBRES

- Type : Hooked End
- Nominal Dimensions
- Diameter : 0.60 mm
- Length : 30 mm
- Aspect Ratio L/D : 50
- Tolerance for D/ L ± 10 %
- As per ASTM
- Yield Strength of Wire : > 1000 MPa
- Wire Mechanical Properties
- Tensile strength of the wire : 1450 Mpa
- Strain at failure : < 4 %

Shape

The ending shapes of Hooked End Steel Fiber are very important to grant adhesion between fiber and concrete



Fig 3: Sampling of concrete above figure shows casting of concrete cubes, cylinders and prisms.

### Curing

Curing the concrete while hydrating, releasing high heat hydration. The heat is harmful from the point of view of volume stability. If the heat generated is removed by some means, the adverse effect due to the generation of heat can be reduced. This can be done by a through water curing. The influence of curing by bonding and wet converging



**Fig4:** Curing tank above figure shows a curing tank in which concrete is kept for 3, 7, 28, 56, 90 days for hydrating of concrete.

### COMPRESSIVE STRENGTH TEST

Cubes with dimension of 150mm×150mm×150mm used for Compression test, durability test (acid).After 24 hours the specimens are removed from the moulds and immediately submerged in clean fresh water. After 3, 7, 28, 56 and 90 days the specimens are tested under the load in a compression testing machine.



**Fig5:** Cube compressive strength test the above figures shows a compressive testing machine in which compressive strength of cube is being tested.

### SPLIT TENSILE TEST

As per IS specifications IS 5816:1999 Split tensile test is to be conducted. The cylinder of size is 150 mm diameter and 300 mm length are taken and cylinders were placed horizontally between the loading plate surfaces of a compression testing machine.



**Fig6:** Split tensile test of cylinder

### FLEXURAL STRENGTH TEST

The ultimate flexural strength analysis is based on conventional compatibility and equilibrium conditions used for normal reinforced concrete except that the contribution of the fibers in the tension is recognized.



Fig 7: Flexural strength test on beam

**THE RAPID CHLORIDE PENETRATION TEST**

The rapid chloride penetration test (Figure 8) is carried out as per AASHTO T277, (ASTM C1202) test. Standard cylindrical disc specimen of size 50-mm thick, 100-mmdiameter concrete specimen is prepared after 60 days curing were used in the test. The apparatus consists of variable D.C power supply to the voltage of the cell. The concrete specimens are kept in between the cells. The specimen can be fit into open faces of the cells. In one of the cells sodium chloride (NaCl) solution (2.4M concentration) is filled and the other cell is filled with sodium hydroxide (NaOH) solution (0.3M concentration)



Fig. 8. RCPT Test

**IV. EXPERIMENTAL RESULTS**

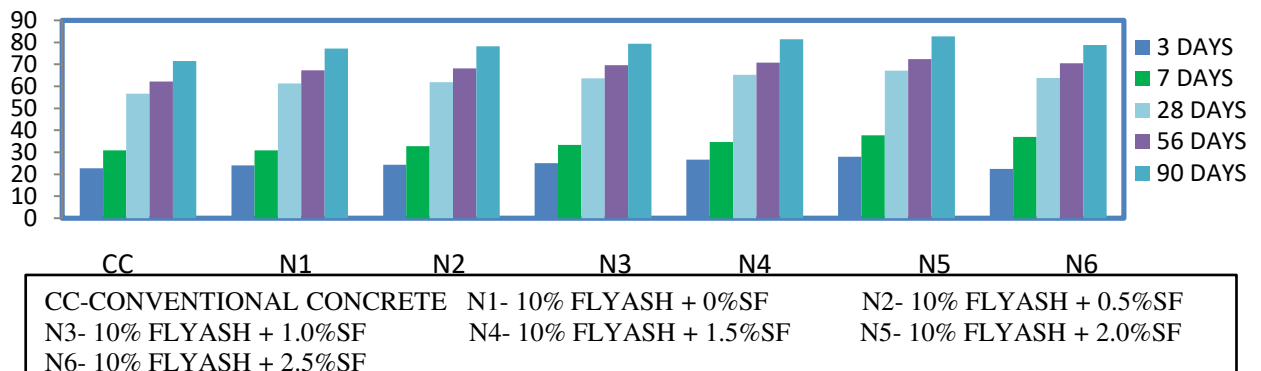
Designed mixes are recommended by “the bureau of Indian standards (BIS)(IS10262-1982)”. IS-10262-2009 .

Mix Ratio: 1: 1.65: 3.05

Table 2. Mix Proportion

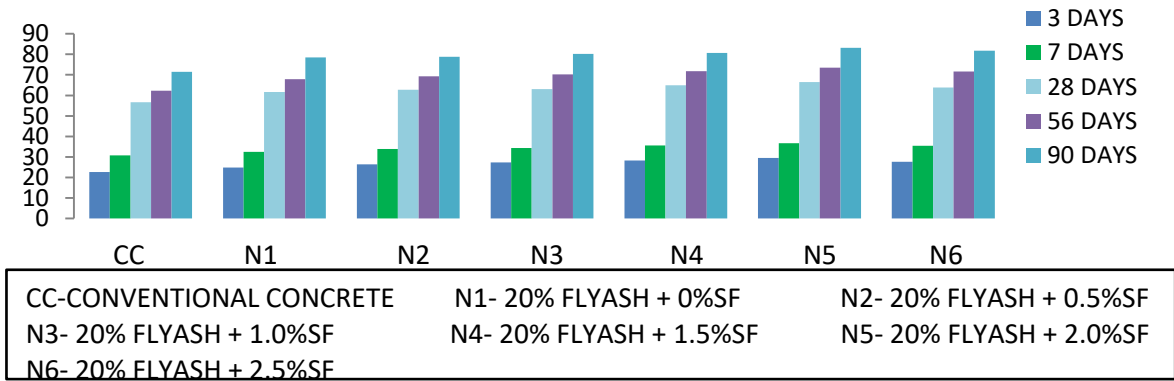
	Water	Cement	Fine aggregate	Coarse aggregate
Proportion by Weight	160kg	400	661.51	1220.19
Proportion by Ratio	0.4	1	1.65	3.05

**COMPRESSIVE STRENGTH**

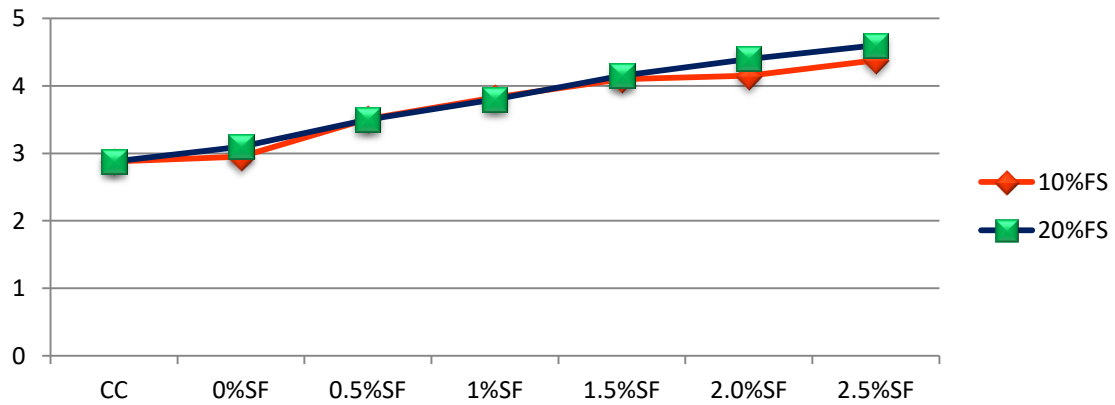




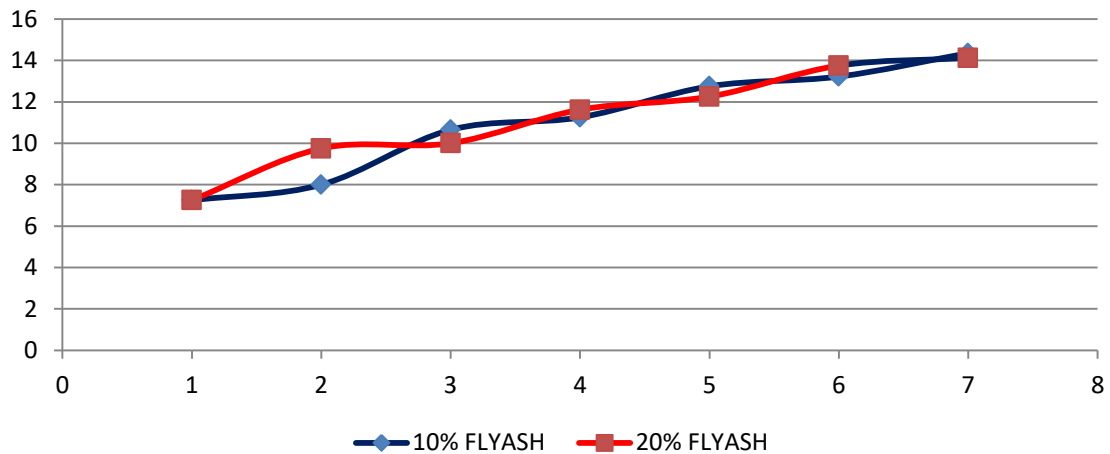
By the above graphs indicated that the compressive strength increases at 10% fly ash and addition of steel fibers at 2% the maximum value gets when compared to the other proportion and at 2.5% the compressive strength value decreases



**SPLIT TENSILE TEST**



**FLEXURAL STRENGTH TEST RESULTS**



## RAPID CHLORIDE PERMEABILITY TEST

S. NO	SAMPLE	I <sub>cum</sub> In mA	I <sub>avg</sub> in coulombs	Penetrability of chloride
1	C.C	2.23	2232	Moderate
2	10% FS + 0%SF	2.36	2124	Moderate
3	10%FS+0.5%SF	1.99	1791	Low
4	10%FS+ 1% SF	1.62	1458	Low
5	10%FS+1.5%SF	1.48	1332	Low
6	10% FS+ 2% SF	0.90	810	Very low
7	10%FS+2.5%SF	1.08	972	Very low
8	20% FS + 0%SF	2.73	2457	Moderate
9	20%FS+0.5%SF	2.92	2628	Moderate
10	20%FS + 1% SF	1.82	1638	Low
11	20%FS+1.5% SF	1.39	1251	Low
12	20%FS + 2% SF	1.54	1386	Low
13	20%FS+2.5% SF	0.62	556	Very low

## V. CONCLUSION

1. With the increasing of fly ash 10% & 20% into the cement the increasing the life of concrete structures by improving concrete durability, besides exhibiting good workability and better strength.
2. Workability is decreased gradually when concrete mix is done with the steel fibers as compared to the controlled concrete.
3. When the cement is replaced with 10% & 20% fly ash and addition of the steel fibers gives and increases the optimum compressive strength, split tensile strength and flexural strength.
4. By using the hooked end steel fibers in to the concrete control of cracking and increase the mechanical properties of the concrete especially when split tensile and flexural test is conducted on concrete.
5. Increasing the maximum compressive strength at 2% of steel fibers with 10% of fly ash replacing to the cement and gradually 15.76 % increased when compare with controlled concrete.
6. Split tensile strength increase at 2.5 % addition of steel fibers at 20% fly ash is replacement to cement and gradually 37.39 % increased when compare with controlled concrete
7. The flexural values increase as steel fibers increases its proportion maximum at 4% utilization of steel fibers taken by earlier researches and gradually 48.65 % increased when compare with controlled concrete.

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