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An Experimental Study of Steel Fiber Reinforced Concrete with Fly Ash for M35 Grade

Khadake S.N.*, Konapure C.G. **
*(P.G. Student, Department of Civil Structure, Solapur University, Solapur-413006)
** (Assistant Professor, Department of Civil Structure, Solapur University, Solapur-413006)

ABSTRACT

This paper deals with Experimental investigation for M-35 grade of concrete having mix proportion 1:1.23:2.95 with water cement ratio 0.43 to study the compressive strength, and tensile strength of steel fiber reinforced concrete (SFRC) containing fibers of 0.0%,1.0% and 1.5% volume fraction of hook end Steel fibers of 71 aspect ratio were used. The percentage of Fly Ash by weight is to be from 00%, 10% and 20%. A result data obtained has been analyzed and compared with a control specimen (0.0% fiber and 00% fly ash). A relationship between workability, compressive strength and flexural strength represented mathematically and graphically. Result data clearly shows percentage increase in 28 days Compressive strength and Flexural strength for M-35 Grade of Concrete.

Keywords - **Concrete mix, fly-ash, Steel fiber concrete, Strength, Workability.**

I. INTRODUCTION

Concrete is mostly wide construction material in the world due to its ability it can be mould and shape. However concrete has some deficiencies as listed below, Low tensile strength, Low post cracking capacity, Brittleness and low ductility, Limited fatigue life, not capable of accommodating large deformations, Low impact strength. These properties can be improved by the use of steel fiber reinforced concrete. The fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties in all directions. The fiber helps to arresting the internal widening cracks and fly ash helps as an admixture for improving the properties of concrete. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

II. MATERIAL SPECIFICATION

1. Cement:-

The cement used in this experimental work is 43 grades Ordinary Portland Cement. All properties of cement are tested by referring IS 12269 - 1987 Specification for 43 Grade Ordinary Portland cement. The specific gravity of the cement is 3.15. The initial and final setting times were found as 90minutes and 180 minutes respectively. Standard consistency of cement was 31.25%.

2. Water:-

Potable water used for the experimentation.

3. Fine aggregate:-

Locally available sand passed through 4.75mm IS sieve is used. The specific gravity of 2.75 and fineness modulus of 3.338 are used as fine aggregate. The loose and compacted bulk density values of sand are 1094and 1162 kg/m3 respectively, the water absorption of 1.538%.

4. Coarse Aggregate:-

20MSA:-Crushed aggregate available from local sources has been used. The coarse aggregates with a maximum size of 20mm having the specific gravity value of 2.885and fineness modulus of 7.386 are used as coarse aggregate. The water absorption of 0.504%.
10MSA:-Crushed aggregate available from local sources has been used. The coarse aggregates with a maximum size of 10mm having the specific gravity value of 2.895and fineness modulus of 5.953 are used as coarse aggregate. The water absorption of 1.425%.
The loose and compacted bulk density values of coarse aggregates are 1463 and 1696kg/m3 respectively.

5. Fly Ash (F.A.):-

Fly Ash is available in dry powder form and is procured from Dirk India Pvt. Ltd., Nasik. The light gray, fly ash under the product name “Pozzocrete 60” is available in 30kg bags. The Fly ash produced by the company satisfies all the requirements of the IS 3812: 1981, BS 3892: Part I: 1997.

6. Steel Fiber (S.F.):-

The steel fiber is procured from precision Drawell Pvt. Ltd., Nagpur. The steel fiber used in the study is the hook ended type HK0750 having aspect ratios 71. The constant dosages of 0.5 % fibers up to 1.5% are used by total volume of concrete. The length of dividing fiber is 50mm and the diameter of fiber is 0.7.

III. EXPERIMENTAL PROCEDURE

1. Mix Design:-
The proportions for normal mix of M35 Normal Mix are 1:1.23:2.95 with water cement ratio 0.43.
In the present study method for mix design is the Indian Standard Method. The mix design involves the calculation of the amount of cement, fine aggregate and coarse aggregate in addition to other related parameters dependent on the properties of constituent material. The modifications are made and quantities of constituent materials used to cast Fly Ash Fiber Reinforced concrete.

2. Batching, Mixing and casting:-
Batching, mixing and casting operations was carefully done. The Concrete mixture was prepared by hand mixing on a watertight platform. The coarse Aggregates and fine aggregates were weighed first with an accuracy of 0.5 grams. On the watertight platform, the coarse and fine aggregates were mixed thoroughly. The fly ash and Cement was mixed dry to uniform colour separately. To this mixture, the required quantity of cement, fly ash and fibers in percentage were added. These were mixed to uniform colour. Then water was added carefully so that no water was lost during mixing. The moulds were filled with 0.0%, 0.5%, 1.0% and 1.5% fibers. Fly Ash 00% to 20% by weight of cement was added to this. Vibration was given to the cube moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank where in they were allowed to cure for 7 & 28 days.
The entire specimen was tested in the Structural Engineering laboratory of Walchand Institute of Technology, Solapur.

3. Workability Test:-
Workability is carried out by conducting the slump test and compaction factor test. As per I.S. 1199-1959 on ordinary concrete and fiber reinforced concrete.

4. Compressive strength test:-
The compressive strength of concrete is one of most important properties of concrete in most structural applications. For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M35 grade of concrete. After curing, these cubes were tested on Compression Testing machine as per I.S. 516-1959. The failure load was noted. In each category two cubes were tested and their average value is reported. The compressive strength was calculated as follows, Compressive strength (MPa) = Failure load / cross sectional area.

5. Flexural strength test:-
For flexural strength test beam specimens of dimension 150x150x700 mm were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in 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 600 mm divide into three equal parts and rest on Flexural testing machine. The load is normally increased & failure load is noted at cracking of beam specimen. In each category two beams was tested and their average value is reported. The flexural strength was calculated as follows. Flexural strength (MPa) = $(P \times L) / (b \times d^2)$,
Where, P = Failure load, L = Centre to centre distance between the support = 600 mm, b = width of Specimen=150 mm, d = depth of specimen= 150 mm.

IV. EXPERIMENTAL RESULTS

1. Fresh Concrete: -
The fresh concrete properties slump, compaction factor & Density are shown in table No.1.
Table No.1:- Result of Slump, Compaction Factor & Density of Fresh Concrete

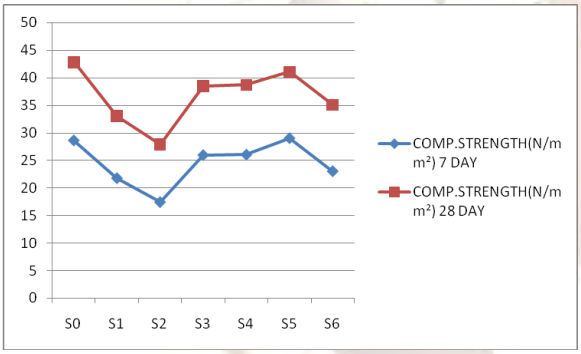
Mix Type (S.F. %&F.A. %)	Slump Value (mm)	Compaction Factor	Density (kg/m^3)
S0 (0.0%&00%)	165	0.903	2503.23
S1 (0.5%&10%)	48	0.824	2540.88
S2 (0.5%&20%)	114	0.86	2534.47
S3 (1.0%&10%)	36	0.725	2585.33
S4 (1.0%&20%)	75	0.736	2536.79
S5 (1.5%&10%)	14	0.702	2589.91
S6 (1.5%&20%)	25	0.717	2583.24

2. Hardened Concrete: -
The hardened concrete specimen properties are checked by compressive strength& Flexural strength.
2.1. Compressive Strength: -
The compressive strength of cube specimen is checked after 7 & 28 days in compressive testing machine. The result of compressive strength in table no.2 and Fig. No.1.

Table No.2:- Result of Compressive Strength at 7 Day & 28 Day

Mix Type (S.F. %&F.A. %)	Compressive Strength(N/mm^2)	
	7 Days	28 Days
S0 (0.0%&00%)	28.63	42.86
S1 (0.5%&10%)	21.81	33.03
S2 (0.5%&20%)	17.48	27.83
S3 (1.0%&10%)	25.98	38.46
S4 (1.0%&20%)	26.05	38.69
S5 (1.5%&10%)	29.02	41.07
S6 (1.5%&20%)	23.06	35.07

Figure No.1:- Type of Mix vs. Compressive Strength at 7 Day & 28 Day



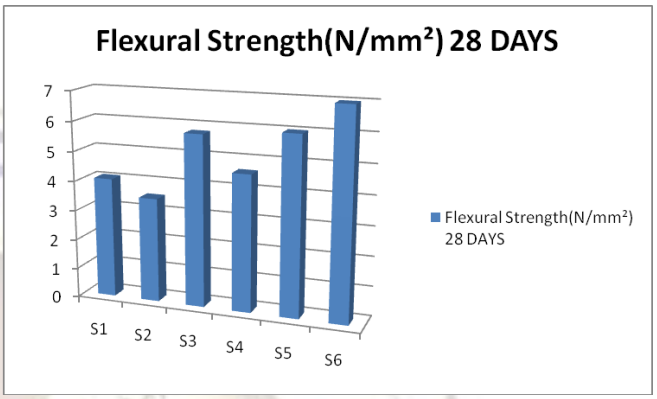
2.2. Flexural Strength

The Flexural test of beam specimen is checked after 28days. The result of flexural strength is shown in Table No.3 and Fig. No.2.

Table No.3:- Result of Flexural Strength at 28 Day

Mix Type (S.F. %&F.A. %)	Flexural Strength(N/mm^2)
	28 Days
S1 (0.5%&10%)	4.06
S2 (0.5%&20%)	3.52
S3 (1.0%&10%)	5.77
S4 (1.0%&20%)	4.60
S5 (1.5%&10%)	5.99
S6 (1.5%&20%)	6.98

Figure No.2:- Type of Mix vs. Flexural Strength at 28 Day



V. CONCLUSION

The study on the effect of steel fibers with Fly Ash can still be a promising work as there is always a need to overcome the problem of brittleness of concrete. The following conclusions could be drawn from the present investigation.

1. Density of concrete is more as the percentage of steel fiber increases.
2. Slump will lose at the higher percentage of steel fiber & lesser fly ash content.
3. Workability of concrete is improves when fly as percentage increases.
4. The specimen strength is about 80% of target strength at 28th day and 95 to 100% at 45 days, because of steel fiber & Fly Ash.
5. The specimen S3, S4 & S5 gives better compressive strength.
6. The specimen S3, S5 & S6 gives better Flexural strength.
7. The specimen S3 & S5 gives good Compressive strength and Flexural strength.
8. The Super-plasticizer is necessary for higher grade to get required slump & workable mix.

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