Exprimental Study on Mechanical Properties of Fiber Flyash Reinforced Concrete

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ABSTRACT

Steel fibers are the most commonly used among all the fibers. It is used for resistance of cracks and strengthening of concrete. In this paper, I am going to carry out tests on fly ash fiber reinforced concrete to check the influence of mechanical properties. According to previous literatures, it has been found that a steel fiber gives maximum strength than any other fibers. This paper deals with investigation of M25 grade of concrete with 0.45 water cement ratio to study mechanical properties. Crimped steel fibers of 50 aspect ratio were used. Increasing the percentage of fly ash up to 30% and steel fiber up to 2.5 enhances flexural strength, tensile strength as well as compressive strength. After curing tests were conducted to find mechanical properties for 7 and 28 days of strength.

Keywords: Fiber fly ash reinforced, mechanical properties, crimped steel fibers, resistance.

1. INTRODUCTION

Concrete is composite material made with aggregates, cement, water and admixture.it is man-made product and used for many massive constructions which gives the aesthetic appearance. It is weak in tension and strong in compression. The advantage of using concrete includes high compressive strength, good water resistance, high water resistance, low maintenance and long service life. The tensile strength of concrete is less due to widening of micro cracks in concrete subjected to tensile stresses. Due to presence of fibers the cracks are arrested and are taken as solution to develop the role of enhancing the mechanical strength.

Fly ash is a fine powder produced from thermal plants. Dumping of fly ash as a waste material may cause many environmental problems. Instead of dumping can have many beneficial effets.it can be used in many mass concrete applications where it controls the thermal expansion due to heat of hydration of cement and reduces in thermal and shrinkage cracking of concrete at early stages. The replacement of cement with fly ash helps to conserve energy.

2. ROLE OF FIBER FLYASH REINFORCED CONCRETE

Fiber reinforced concrete is a mixture of cement concrete containing short discrete uniformly distributed fibers which increases its structural integrity. The composite matrix is obtained by combining cement, fly ash, aggregates and fibers is known as fiber fly ash reinforced concrete. The role of fibers is most essential to arrest the cracks by applying forces. It acts as a crack arrester which resists the growth of micro cracks. Steel crimped fibers are used in this experimental investigation.

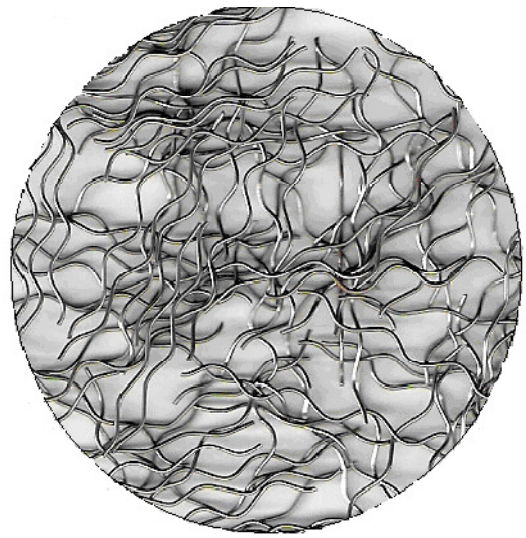

Fig. 1. Crimped steel fibers

Advantages of steel fibers:

- Provides uniform multi – directional concrete reinforcement.
- Provides increased ultimate load bearing capacity which allows possible reduction of concrete section
- High tensile strength fiber bridging joints and cracks to provide tighter aggregate interlock resulting in increased load carrying capacity.
- Increases crack resistance, ductility, energy absorption or toughness of concrete

3. DESIGN MIX MATERIALS

The materials used in this study were ordinary Portland cement of 53 grades conforming to IS: 8112, manufactured sand, locally available coarse aggregate of maximum size 12.5mm, Class C fly ash, portable tap water available in the laboratory. The properties of these materials used in this project are explained below

A. Cement

The most commonly used cement is ordinary Portland cement of 53 grades. Many tests were conducted on cement. Some of them are specific gravity test, consistency test, setting time test, compression test etc.

Specific gravity of Cement	= 3.15.
Normal Consistency of Cement	**= 30**%.
Initial Setting Time of Cement	= 35minutes.
Final Setting Time of Cement	= 7 hrs

B. Class c flyash

The fly ash is normally produced from lignite or sub-bituminous coal is the only material included in this category. This class of fly ash has both pozzolanic and varying degree of self cementitious properties (it contains 15% of cao and some class c fly ash contains 10% of cao). Unlike Class F, self-cementing Class C fly ash does not require an activator. Alkali and Sulphate (SO4) contents are generally higher in Class C fly ashes.

Class C has SiO2 + Al2O3 + Fe2O3 = 50%

C. Fine aggregates

Manufactured sand with fraction passing through 4.75mm sieve was used and tested as per IS: 2386 - 1983. River sand is used

D. Coarse aggregates

Crushed granite coarse aggregate of size 12.5mm was used and tested as per IS: 2386 – 1983.

E. Water

According to IS: 456-2000, water for concrete should be of portable quality (PH- 6.8 to 8.0). Ordinary tap water, which is fit for drinking, has been used in preparing all Concrete mixes and curing in this investigation.

F. Steel fibers

Steel fibers used in concrete to control cracking due to both plastic shrinkage and drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Here the properties of steel fibers are shown below

TABLE 1. Properties of steel

Characteristics	Properties
Cross section	Crimped
Length	30m
Diameter	0.6mm
Aspect ratio	50
Tensile strength	1100
Deformation	Continuously deformed
Density	2.1x105N/mm2

G.mixing and casting

Careful procedure was adopted in the batching, mixing and casting operations. The coarse Aggregates and fine aggregates were weighed first by using weighing machine. The Concrete mixture was prepared by hand mixing on a watertight platform. The fly ash and Cement was mixed dry to uniform colour separately. On the watertight platform, the coarse and fine aggregates were mixed thoroughly. To this mixture, the required quantity of cement, fly ash and fibers were added. These were mixed to uniform colour. Then water was added carefully so that no water was lost during mixing. The molds were filled with 0.0%, 0.5%, 1.0%, 1.5%, 2% and 2.5% fibers. Fly Ash (30% by weight of cement) was added to this. The top surface of the specimen was leveled and finished. After 24 hours the specimens were remolded and were transferred to curing tank wherein they were allowed to cure for 7, 28 days.

H.Mix design

The mix design includes the calculation of the amount of cement, fly ash, fine aggregate and coarse aggregate and other admixtures. Depend on the properties of constituent material. The modifications are made and quantities of constituent materials used to cast Fly Ash Fiber Reinforced concrete.

I. Testing of specimen

Cubes of (150x150x150 mm) cube and (150dia.x300 mm) Cylinders have been used for casting the specimens of 150x300. Beams of (100x100x500) are used.

4. EXPERIMENTAL RESULTS

Results obtained from experimental research to study the mechanical properties of fiber fly ash reinforced concrete in comparison with plain concrete are discussed below.

1. Compressive strength

Cubes specimens were tested for compression and it was determined from its failure load. The values are obtained in table 2.Curves are plotted for compressive strength against percentage of steel fibers as well as 30% of flyash.table 2 shows increase or decrease in compressive strength of steel fibers with plain concrete.

Fig.2. Compressive testing of cubes

TABLE.2.Results of compressive strength for 7 and 28 days

Mix no	Grade of concrete	% of fibers added	Compressive strength	
			7days	28days
1	M25	0.0%	19.51	33.55
2	M25	0.5%	15.36	19.89
3	M25	1%	22.19	25.46
4	M25	1.5%	16.92	26.66
5	M25	2%	28.67	34.68
6	M25	2.5%	34.66	36.74

Maximum increase in compressive strength is found in 2 and 2.5% of steel fibers with 30%. It got decreased in 1.5% per 0.0% of plain concrete

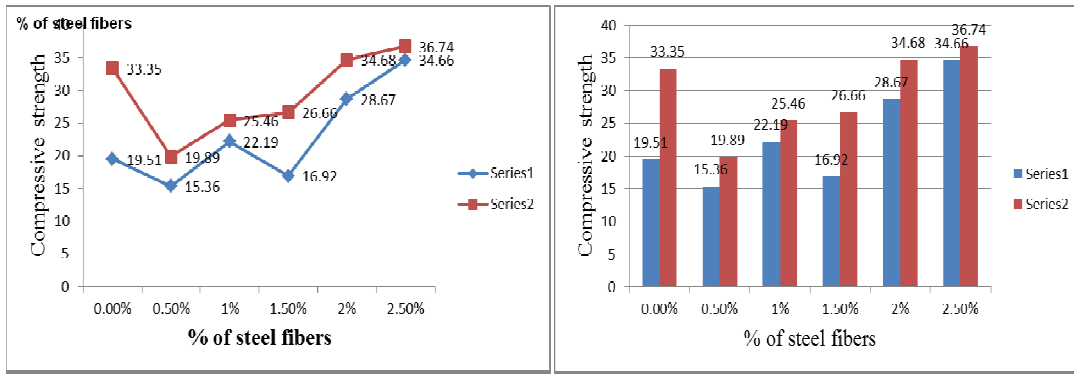

Fig.3. Effect of ompressive strength of cubes

2. Split tensile strength

Cylinders specimens were tested for tensile strength. The values obtained here in given below in table 3. Testing of cylinders are shown in fig.4. From table 3.the sudden increase in tensile strength is found in 2 and 2.5% of steel fibers. Testing of cylinders is determined by

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

FIG.4. split tensile testing of cubes

TABLE 3 .Tensile testing of cubes

Mix no	Grade of concrete	% of fibers added	Tensile strength	
			7days	28days
1	M25	0.0%	1.163	2.746
2	M25	0.5%	0.623	1.712
3	M25	1%	0.896	1.668
4	M25	1.5%	0.936	2.685
5	M25	2%	2.85	3.90
6	M25	2.5%	4.04	4.26

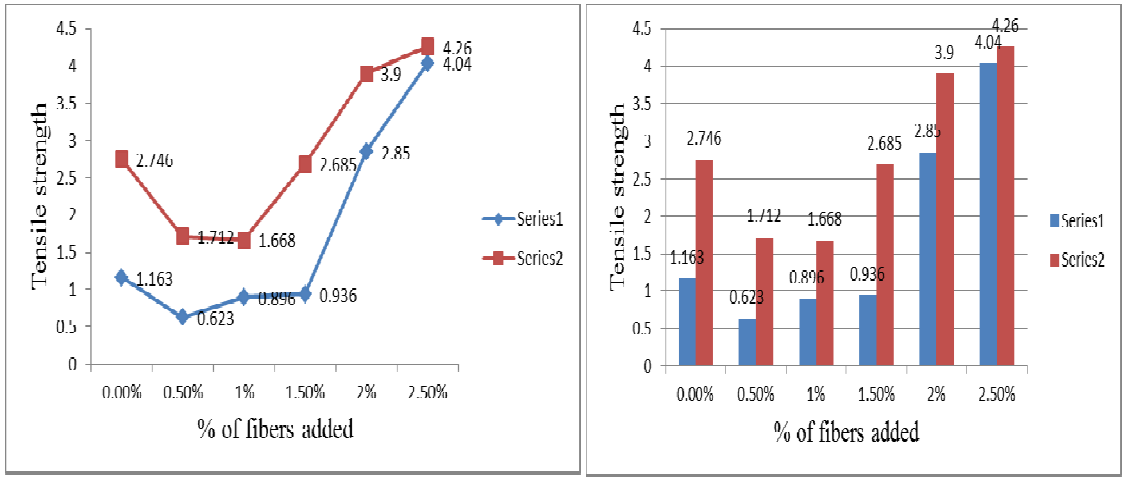

Fig.5.effect of tensile strength of cylinders

From the aboe fig.5.the curves are obtained in increase or decrease in tensile strength against steel fibers for 30% of flyash over plain concrete.

3. Flexural strength

Beam specimens are tested for flexural test under two point loading and the ultimate flexural tensile stress was determined by failure flexural loads. The values are obtained in table 4.

Fig. 6. Flexural testing of beams

TABLE 4.Flexural strength results of beams

Mix no	Grade of concrete	% of fibers added	flexural strength	
			7days	28days
1	M25	0.0%	4.31	5.29
2	M25	0.5%	4.31	5.29
3	M25	1%	4.63	5.86
4	M25	1.5%	4.74	5.94
5	M25	2%	6.68	7.47
6	M25	2.5%	6.83	7.62

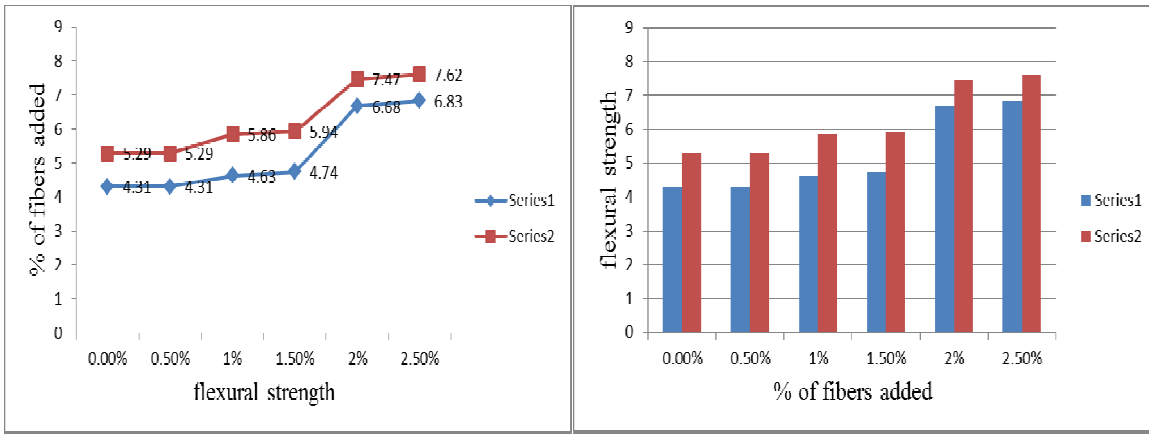

Fig.7. Effect of flexural strength of beams

Curves are plotted as the flexural strength against percentage of steel fibers as well as 30% offlyash.From the table 4 we can found that slight increase at 2 and 2.5% of steel fibers.from the fig.7.the values of the curves is increased.

5. RESULTS AND DISCUSSION

1. The maximum increase in flexural strength is found in specimens 2 and 2.5% of steel fibers as well as 30% of fly ash.
2. Specimens in flexural strength is more effective in compressive strength.
3. Density of concrete is more as the percentage of steel increases with 30% of fly ash content.

4. Higher percentage of steel slump was losing
5. Marginal increase is observed in the workability of increase percentage in fly ash
6. Compressive strength is more for 2 and 2.5% of steel fibers.
7. As a result of experimental study, it has been found that the ductility of concrete will get enhanced by the addition of steel fibers as well as fly as

6. CONCLUSION

1. The Steel fibers (crimped) used in this paper has shown considerable improvement in all the properties of concrete.
2. The steel fibers are free from water absorption.
3. Because of fly ash and steel fibers stiffness of specimens was increased.
4. Stiffness of specimens is increased because of Steel Fibers & Fly Ash.

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