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Assesment of split tensile strength on SFRC

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ABSTRACT :

Fiber Concrete (FC) is a composite material made primarily from hydraulic cements, aggregates and discrete reinforcing fibers. Fiber incorporation in concrete, mortar and cement paste enhances many of the engineering properties of these materials such as fracture toughness, flexural strength, resistance to fatigue, impact, thermal shock and spalling. It is a type of building material that is increasing in use. New types of concrete develop continuously and the need to update the knowledge on the use of fiber reinforcement in such concrete increases. The use of fibers is not a particularly recent idea. During ancient times, fibers extracted from organic material were used. Fiber Reinforced Concrete started to come to its modern industrial use during the 1960"s. The first applications were mainly defense related where FC was used in various shelter structures. Research development has led the FC to increase its use as a building material. Nowadays, it is commonly applied in shotcrete, pavements, industrial floors, bridge decks and precast elements.

Keywords:FR , HFRC , RCC , PCC

1.1 Objectives

Limited resources, change in living standard of people, environmental concerns and economy has made it mandatory to search for substitutes for basic constituents of concrete. Along with durability and serviceability of the structures, person also wants aesthetic look and fast erection of the structure. To cater to these requirements new technologies, new construction practices and new concrete making materials are being used. In today"s world, various kinds of civil engineering structures are coming into picture, placing greater demand on material performance, the need for more fundamental information on the behavior of concrete and fiber concrete under different types of loads is of prime importance. The above factors and man"s curiosity for inventing new productshas led to the significant research on this topic.

The objective of this study is to investigate the behavior & strength of concrete with different types of steel fiber with constant volume fractions and different aspect ratioto investigate the following:

1. The study of different types steel fiber.
2. Study of their Engineering properties.
3. Study of Steel Fiber Concrete (SFC) composite with constant volume fractions and different aspect ratio.
4. To investigate the behavior of fresh concrete with steel fibers.
5. To study comparison of mechanical property with different types of steel fibers concrete
6. To study which type of steel fiber is better in work of construction

Fiber Reinforced Concrete:

Fiber reinforced concrete can be defined as a composite material consisting of a cement matrix containing uniformly or randomly dispersed discrete fibers. The fibers act as crack arrestors that restrict the growth of cracks in the matrix, controlling them from enlarging which under stress eventually causes brittle failure.

In the past, attempts have been made to impart improvement in tensile properties of concrete members by way of using conventional reinforced steel bars and also by applying restraining techniques. Although both these methods provide tensile strength to the concrete members, they however, do not increase the inherent tensile strength of concrete itself.

It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to concrete would act as crack arrester and would substantially improve its static and dynamic properties. This type of concrete is known as Fiber Reinforced Concrete. Fiber is a small piece of reinforcing material possessing certain characteristic properties. They can be circular or flat. The fiber is often described by a convenient parameter called "aspect ratio". The aspect ratio of the Fiber is the ratio of its length to its diameter. Typical aspect ratio ranges from 30 to 150. Basically fibers are classified as Metallic fibers and polymeric fibers. Different fibers give different effects such asfollows:

- Metallic fibers:
- Increase of fracture energy, which subsequently improves ductility
- Increase of strength such as compressive strength, tensile strength, etc.
- Reduction of tendency for cracking
- Polymeric Fibers:
- Decrease of microscopic crack growth with high loading
- Gain in fire resistance
- Decrease of early shrinkage
- Glass Fibers:
- Decrease of early shrinkage

Mixing of Fibers:

Mixing of Fiber reinforced concrete needs careful condition to avoid balling of fibers, segregation and in general the difficulty of mixing the materials uniformly. Increase in the aspect ratio, volume percentage and size and quantity of coarse aggregate intensify the difficulties and balling tendencies.

It is important that the fibers are dispersed uniformly throughout the mix; this can be done by addition of fibers before the water is added. When mixing in a laboratory mixer, introducing the Fiber through a wire mesh basket will help even distribution of fibers. For field use, at the time of dry mix, fibers are added.

Fiber Reinforced composites was found to provide notable improvement in the areas of shear, impact, ductility under cyclic loading, and fatigue loading. It shows good potential for earthquake-resistant structures because of the ductility it provides compared to plain concrete.

2.1 Split Tensile Test on Cylinder:

The split tensile test is well known indirect test used to determine the tensile strength of concrete. Due to difficulties involved in conducting the direct tension test, a number of indirect methods have been developed to determine the tensile strength of concrete. In these tests, in general a compressive force is applied to a concrete specimenin such a way that the specimen fails due to tensile stresses induced in the specimen.

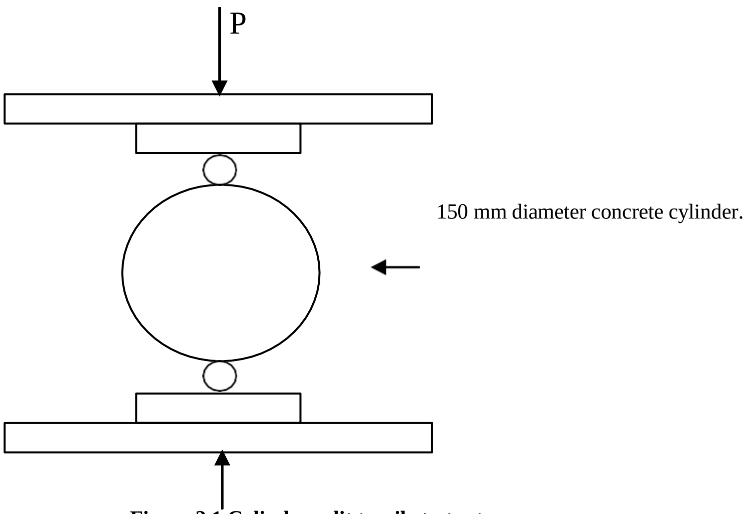


Figure 2.1 Cylinder split tensile test setup

The tensile strength at which failure occurs is the tensile strength of concrete. In this investigation, the test is carried out on cylinder by splitting along its middle plane parallel to the edges by applying the compressive load to opposite edges. The arrangement for the test is shown in photo with the pattern of failure. The split tensile strength of cylinder is calculated by the following formula.

$f_t = 2P / \pi LD$

where

f_t = Tensile strength, MPa

P = Load at failure, N

L = Length of cylinder, mm

D = Diameter of cylinder, mm

Table 2.1: Experimental results of PCC are presented below:

Days	Sample	Load at Failure in KN	Splitting strength in Mpa	mean Strength in Mpa
28	0/C1	251	3.553	3.454
	0/C2	237	3.355	
	0/C3	244	3.454	

Table 2.2: Experimental results of HK-80 are presented below:

Days	Sample	% of Steel Fiber	Load At Failure in KN	Splitting strength in Mpa	Mean Strength in Mpa
28	HK-80/C1	2.5	512	7.247	7.424
	HK-80/C2	2.5	537	7.601	
	HK-80/C3	2.5	525	7.424	

Table 2.3: Experimental results of HK-50 are presented below:

Days	Sample	% of Steel Fiber	Load At Failure in KN	Splitting strength in Mpa	Mean Strength in Mpa
28	HK-50/C1	2.5	485	6.865	6.745
	HK-50/C2	2.5	468	6.624	
	HK-50/C3	2.5	477	6.745	

Table 2.4: Experimental results of CR-50 are presented below:

Days	Sample	% of Steel Fiber	Load At Failure in KN	Splitting strength in Mpa	Mean Strength in Mpa
28	CR-50/C1	2.5	412	5.832	5.940
	CR-50/C2	2.5	427	6.044	
	CR-50/C3	2.5	420	5.938	

Table2.5: Experimental results of SF-80 are presented below:

Days	Sample	% of Steel Fiber	Load At Failure in KN	Splitting strength in Mpa	Mean Strength in Mpa
28	SF-80/C1	2.5	318	4.501	4.657
	SF-80/C2	2.5	340	4.812	
	SF-80/C3	2.5	329	4.657	

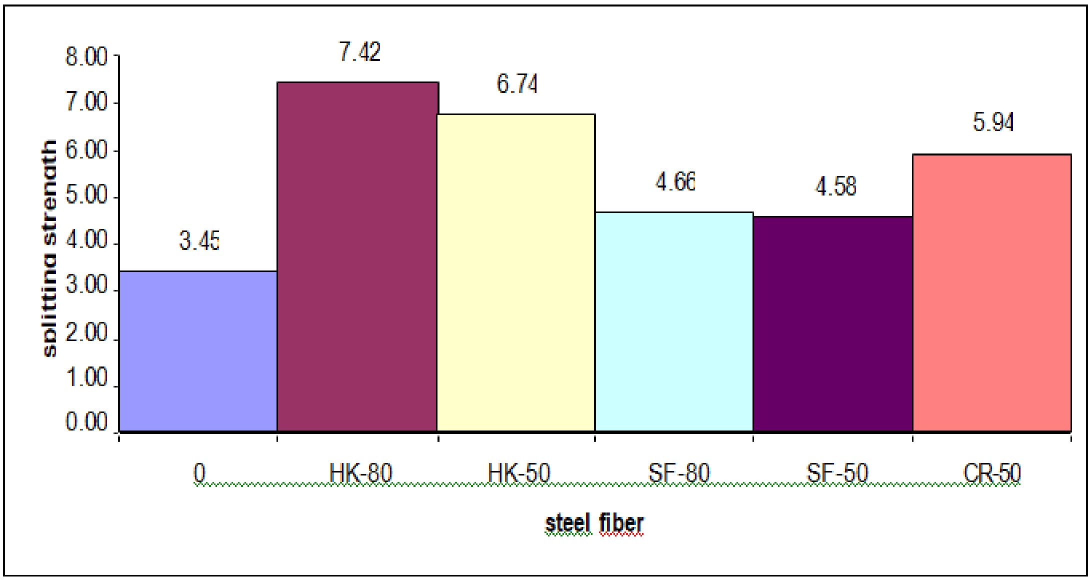
Table 2.6: Experimental results of SF-50 are presented below:

Days	Sample	% of Steel Fiber	Load At Failure in KN	Splitting strength in Mpa	Mean Strength in Mpa

28	SF-50/C1	2.5	319	4.515	4.579
	SF-50/C2	2.5	328	4.643	
	SF-50/C3	2.5	324	4.579	

Table 2.7: Comparative statement of steel fibers Experiment Result of Splitting Strength

Sr. No.	Type of steel fiber	Sample Designation	% of Steelfiber	Water cementratio	Splitting strength, Mpa
					28 days
1	0	0%	0	0.38	3.45
2	HK-80/60	HK-80	2.5	0.38	7.42
3	HK-50/30	HK-50	2.5	0.38	6.74
4	SF-80/130	RD-80	2.5	0.38	4.66
5	SF-50/80	RD-50	2.5	0.38	4.58
6	CR-50/30	CR-50	2.5	0.38	5.94



Graph 2.1 Comparative chart of splitting strength

3.1 Result and Discussion:

This chapter presents a summary of research, the major conclusions and future scope of the investigation with the applications of SFC.
Discussion of observations and graphs:

1. In general, the significant improvement in various strengths is observed with the inclusion of hooked end steel fibres in the plain concrete as compared to crimped & straight types of steel fiber.
2. 2 Split tensile strength: (from Table:4.14), strength comparison between same types aspect ratio HK-80 & SF-80 is 7.42 Mpa and 4.66 Mpa respectively and HK-50, SF- 50 and CR-50 is 6.74 Mpa, 4.58 Mpa and 5.94Mpa respectively.

Conclusion:

1. From above discussion it is conclude that, all mechanical properties viz. compressive strength, flexure strength and splitting strength are improved by addition of fibers.
2. All strength likes compressive strength, flexure strength and splitting strength are improved with increasing aspect ratio.
3. Also it is observed that for same aspect ratio the hook ended fibre showing pronounce improvement in properties of concrete as compare crimped & straight fiber.

Scope for Future Work:

The present work has good scope for future research. Some of the research areas areas follows:

1. Investigation of ductility characteristics of SFRMC for potential application inseismic design and construction
2. Behaviour under creep and shrinkage.
3. Behaviour of mechanical and physical properties of SFRMC at low temperatures
4. Study the coatings for steel fiber to modify bond with the matrix and to providecorrosion protection.
5. Same parameters with recycled aggregates.
6. Fracture analysis.
7. Stress transfer mechanism.
8. Study of impact resistant, abrasion resistant and permeability of SFRMC andresistant to chemical attack.

Applications:

Steel Fiber Concrete is being used widely nowadays. SFC has found number ofapplications, some of which are listed below:

- Construction of runway slabs, highway paving and industrial floors.
- Impact resistant encasement of turbines.
- Repairs and new construction on major dams and other hydraulic structures toprovide resistance to cavitations and severe erosion.
- Repairs and rehabilitation of marine structures.
- Tunnel lining.
- Construction of Vaults and Safes.

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