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Effect of Fiber Addition on Mechanical Properties of Concrete

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Abstract - *The present work deals with the effect of different types of steel fibers on various strengths of concrete are studied. The different fibers at a constant rate of 2.5 % by the weight of cement are used for the experimental work. Various strengths considered for investigation are compressive strength and split tensile strength. Results obtained are of different researchers and their experimental comparison of results of steel fiber reinforced concrete with that of normal concrete showed the significant improvements in the results of compressive strength and split tensile strength of concrete with different types of steel fiber with various constant volume fractions and different aspect ratio.*

Fibers are generally used as resistance of cracking and strengthening of concrete. In this project, I am going to carry out test on steel fiber reinforced concrete to check the influence of fibers on strength of concrete. According to various research papers, it has been found that steel fibers give the maximum strength in comparison to glass and polypropylene fibers. Hence, in this project I was interested in finding the effect of steel fibers in concrete. An experimental investigation on the behavior of concrete specimens reinforced with steel fibers and subjected to compressive and flexural loading is presented. Tests were conducted on specimens with three different fiber volume fractions. It was observed that SFRC specimens showed enhanced properties compared to that of normal specimens.

Key Words: Concrete, Steel Fibre, Glass Fibre Compressive strength, Split tensile strength.

1.INTRODUCTION

Fibre Reinforced Concrete (FRC) is a composite material made primarily from hydraulic cements, aggregates and discrete reinforcing fibres. Plain concrete is a brittle material. Under impact and dynamic loading plain concrete exhibits extensive cracking and undergoes brittle failure. The concrete is weak in tension and hence to overcome this problem cement concrete is reinforced using steel bars and thus called as reinforced cement concrete (R.C.C.) In this modern age, civil engineering constructions have their own structural and durability requirements. Every structure has its own intended purpose and hence to meet this purpose, modification in traditional cement concrete has became mandatory.

Concrete can be modified to perform in a more ductile manner by the addition of randomly distributed discrete fibers in the concrete matrix, which prevent and control initiation, propagation and coalescence of cracks. A variety of materials such as steel fibre, glass, can be used in fiber reinforced concrete. The fibers are dispersed and distributed randomly in the concrete during mixing and thus improve concrete properties in all directions. Fibers help to improve the post peak ductility performance, pre-crack tensile strength, fatigue strength, impact strength and eliminate temperature and shrinkage cracks.

Hence, this study explores the feasibility of used of glass fibers ,aim to do parametric study on compressive strength, tensile strength and flexural strength study for a given aspect ratio and various percentages of glass fiber. Presently, a number of laboratory experiments on mechanical properties of GFRC have been done. The conducted experimental investigation to study the effect of using the alkali resistance glass fibers on compressive, split tensile on M20 grade of concrete. The mechanical properties of glass fiber reinforced polyester polymer concrete were evaluated. The author observed that the modulus of rupture of polymer concrete containing 20 per cent polyester resin and about 79 per cent fine silica aggregate is about 20 MPa. The addition of about 1.5 per cent chopped glass fibers (by weight) to the material increases the modulus of rupture by about 20 per cent and the fracture toughness by about 55 per cent.

The addition of steel fibers to concrete considerably improves its properties of concrete in the hardened stage such as flexural strength, impact strength, tensile strength, ductility and flexural toughness. These fibers have already been used in many large projects involving the construction of industrial floors, pavements, highway-overlays, etc in India.

1.1 OBJECTIVES

(1) To enhance the tensile, compressive strength and flexural strength of concrete.

(2) To overcome adverse effect due to use of conventional fiber (natural fiber).

(3) To enrich the properties such as durability, flexibility and stiffness.

(4) To make concrete more resilience to chemical attack, thermal expansion.

2. METHODOLOGY

1. Materials:

Cement, fine aggregate, coarse aggregate, water, steel fiber and glass fibers were used in experimental work.

2. Methods:

2.1 Compressive Strength

Compressive strength of a concrete is a measure of its ability to resist static load, which tends to crush it. This test was performed to find the increase and differences of strength according the increasing percentage of fibre in the concrete. The compressive strength of concrete with different mixture proportions was determined at the age of 28 days according to IS 516-1959.

2.2 Split Tensile Strength

Split tensile strength was found according to IS: 5816–1999 and the same three cylindrical specimens were casted and tested after 28 days of water curing. The cylindrical specimens were of diameter 150 mm and of height 300 mm.

3. RESULTS AND DISCUSSIONS

Table No.1: Compressive strength of conventional cube

Sr no	Grade of concrete	Ultimate load (KN)	Compressive Strength (MPA)	Avg
1	M20	459	20.4	20.81
		467	20.7	
		480	21.33	

Table No.2: Split tensile strength of conventional cube

Sr no	Grade of concrete	Ultimate load (KN)	Split tensile Strength (MPA)	Avg
1	M20	111	1.57	1.98
		130	1.83	
		180	2.54	

Table No.3: Compressive strength of FRC with different volume fraction of steel fiber

Sr no	Grade of concrete	Volume of fraction	Ultimate load (KN)	Compressive Strength (MPA)	Avg
1	M20	1 %	900	40	40.38
			910	40.44	
			916	4071	
2	M20	2%	950	42.22	45.99
			1063	47.24	
			1092	48.57	
3	M20	3%	1230	54.66	51.45
			1093	48.57	
			1150	51.11	

Table No.4: Split tensile strength of FRC with different volume fraction of steel fiber

Sr no	Grade of concrete	Volume of fraction	Ultimate load (KN)	Split tensile Strength (MPA)	Avg
1	M20	1 %	235	3.32	3.11
			203	2.87	
			222	3.14	
2	M20	2%	240	3.39	3.58
			257	3.63	
			265	3.74	
3	M20	3%	274	3.87	3.88
			280	3.96	
			270	3.81	

Table No.5: Compressive strength of FRC with different volume fraction of glass fiber

Sr no	Grade of concrete	Volume of fraction	Ultimate load (KN)	Compressive Strength (MPA)	Avg
1	M20	2 %	510	22.66	23.21
			527	23.42	
			530	23.55	
2	M20	4%	641	28.48	29.24
			653	29.02	
			680	30.22	
3	M20	6%	835	37.11	39.34
			887	39.42	
			934	41.51	

Table No.6: Split tensile strength of FRC with different volume fraction of glass fiber

Sr no.	Grade of concrete	Volume of fraction	Ultimate load (KN)	Split tensile Strength (MPA)	Avg
1	M20	2 %	200	2.82	2.87
			202	2.85	
			208	2.94	
2	M20	4%	220	3.11	3.21
			223	3.15	
			239	3.38	
3	M20	6%	290	4.10	4.37
			308	4.35	
			327	4.62	

3. CONCLUSIONS

Following conclusion are drawn based on the result. The mechanical properties of concrete are enhanced with the addition of steel fiber and glass fiber. All the properties of concrete like compressive strength and split tensile strength is increased.

From the results and discussion it shows that for 3% addition of steel fiber concrete showing overall improvement .

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