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STRENGTH TESTS ON CRIMPED STEEL FIBRES-A STUDY

Aakanksha Patil[1], Dr. P.V. Durge[2]

[1]Post Graduate Student, G. H. Raisoni College of Engineering and Management, Pune, India
[2]Professor, Civil Engineering Department, G. H. Raisoni College of Engineering and Management, Pune, India

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ABSTRACT:- Cement concrete is the most significantly used construction materials in the world. The reason for its large extent use is that it provides good workability and can be molded to any shape. Ordinary cement concrete has a very low tensile strength, limited ductility and little resistance to cracking. Internal micro crack causes the brittle failure of concrete. In order to get control this problem it is now installed materials which are used for resistance to cracking and cracking reproduction. In this investigation, the effects of crimped steel fibers on performance of concrete for grade of M40 have been studied by varying percentage of steel fibers. The tests such as compressive strength and flexural strength have been studied and presented.

Key words: crimped steel fibers, workability, compressive strength, split tensile strength.

1. INTRODUCTION

Concrete is most popularly used construction material having several desirable properties like high compressive strength, stiffness and durability under usual environmental factors. Plain concrete has very low tensile strength, limited ductility and a low strain at fracture. This shortcoming is offset by providing steel bars at appropriate locations at the time of casting the members to bear up the tensile stresses and sometimes the compressive stresses if required. Normally reinforcement consists of continuous deformed steel bars or pre-stressed tendons. The advantage of reinforcing and pre-stressing technology utilizing steel reinforcement as high tensile steel wires have helped in overcoming the incapacity of concrete in tension but the durability and resistance to cracking is not upgrade[1]. These properties can be enhanced using fibers in the concrete. It has been delivered that concrete reinforced with endurable amount of fiber acquires better performance in compression, flexural, toughness and energy absorption[2]. Several experiments have been carried out by several investigators using fibers of steel, glass, plastic, carbon, asbestos, polypropylene etc. moreover fibers also helps to keep under control the growth of micro-cracks at the mortor-aggregate interface thus transforming an instinctively brittle matrix i.e. cement concrete with its low tensile and impact resistances, into a strong composite with superior crack resistance, boost ductility and exclusive post-cracking behavior prior to failure[3]. Steel fibers content were varied by 0.50%, 0.75%, 1.0%, and 1.5%by volume of cement. All specimens were cured for the period of 7 and 28days before crushing. The results of SFRC with varying percentage of crimped steel fibers finally compare with the control specimen.

2. METHODOLOGY

An experimental program was carrying out keeping in mind the objective of the present investigation. The study was divided into various stages. The first stage of program consists of selection of materials to be used such as cement, natural fine aggregate (sand), natural coarse aggregate (NCA), and crimped steel fibres (CSF). In the second stage all these materials are tested for preparation of test specimen in the laboratory to establish the physical and mechanical properties of the materials. All the materials are tested as per the specification of Indian Standards. Concrete Mix design was carried out for the preparation of test samples (cubes, cylinders and Beams) as per the recommended guidelines for concrete mix design IS: 10262-2009.The Mix Design was targeted for M40 Grade of concrete. Various properties of the materials like crushing value, impact value, abrasion value of all ingredients have been listed. The third stage involves designating the specimens on the basis of addition of different percentage of crimped steel fibers in concrete. Compressive strength and split tensile strength tests have been tested.

3. MATERIALS AND PROPERTIES

1) Cement: ordinary Portland cement of 53 grades available in local market is used in the investigation. All properties of cement are tested by referring IS 12269-1987 specifications for 53 grade ordinary Portland cement.

2) Fine aggregate: locally available sand passed through 4.75mm IS sieve is used. Specific gravity of 2.60 and fineness modulus of 2.806 are used as fine aggregate, conforming to IS 383:1970.
3) Coarsed aggregate: the crushed aggregate used were maximum size of aggregate 20mm and minimum size aggregate 12mm having specific gravity 2.78, complying with IS 383:1970 is used.
4) Crimped steel fibre[4]: crimped steel fiber of length 50mm, diameter 1mm, and aspect ratio 50was used. Steel fibers of 0.5% to 2% of volume of concrete were used.
5) Water: ordinary portable water free from organic content, turbidity and salts was used for mixing and for curing throughout the investigation.
6) Superplasticizer: to impart the additional desired properties, a superplasticizer (conplast SP- 430) was used. The dosage of superplasticizer adopted in the investigation was 2% by weight of cement.

4. STRENGTH TEST

The compression test and tensile test was carried out on specimen like cube and cylinder respectively. The cube specimen is of the size 150X150X150mm and cylinder specimen size is 300X150mm is well tightened and oiled thoroughly. They were allowed for curing in a curing tank for 28days. The test procedures are used as per IS 516:1979 and the tests results are shown in the following figures.

Split tensile strength

Percentage of steel fibres added	7days strength			28 days strength		
	Failure load (KN)	Tensile strength (MPa)	Average tensile strength (MPa)	Failure load (KN)	Tensile strength (MPa)	Average tensile strength (MPa)
0%	345	4.88	4.85	465	6.58	6.57
	339	4.80		457	6.46	
	344	4.87		472	6.68	
0.5%	352	4.98	5.01	496	7.01	7.00
	359	5.08		499	7.06	
	352	4.98		490	6.93	
0.75%	362	5.12	5.11	546	7.72	7.73
	365	5.16		541	7.65	
	358	5.06		553	7.82	
1.0%	371	5.25	5.26	580	8.20	8.22
	368	5.20		579	8.19	
	377	5.34		584	8.26	
1.25%	356	5.04	4.96	528	7.47	7.55
	347	4.90		533	7.54	
	349	4.94		540	7.64	
1.5%	258	3.65	3.72	438	6.20	6.17
	266	3.77		430	6.08	
	264	3.74		441	6.24	

Compressive strength test

Percentage of steel fibres added	7days strength			28days strength		
	Failure load (KN)	Compressive strength (MPa)	Average compressive strength (MPa)	Failure load (KN)	Compressive strength (MPa)	Average compressive strength (MPa)
0%	720	32.00	32.08	1052	46.75	46.16
	715	31.78		1034	45.96	
	730	32.45		1030	45.78	
0.5%	755	33.56	33.16	1055	46.89	46.74
	745	33.12		1038	46.14	
	738	32.80		1062	47.20	
0.75%	786	34.94	34.45	1054	46.85	47.58
	767	34.09		1084	48.18	
	772	34.32		1073	47.69	
1.0%	795	35.34	35.71	1080	48.00	48.53
	805	35.80		1092	48.54	
	808	36.00		1103	49.03	
1.25%	724	32.2	33.90	1088	48.36	47.48
	768	34.14		1047	46.54	
	796	35.38		1070	47.56	
1.5%	760	33.78	33.29	1060	47.11	46.34
	742	32.98		1046	46.48	
	745	33.12		1022	45.42	

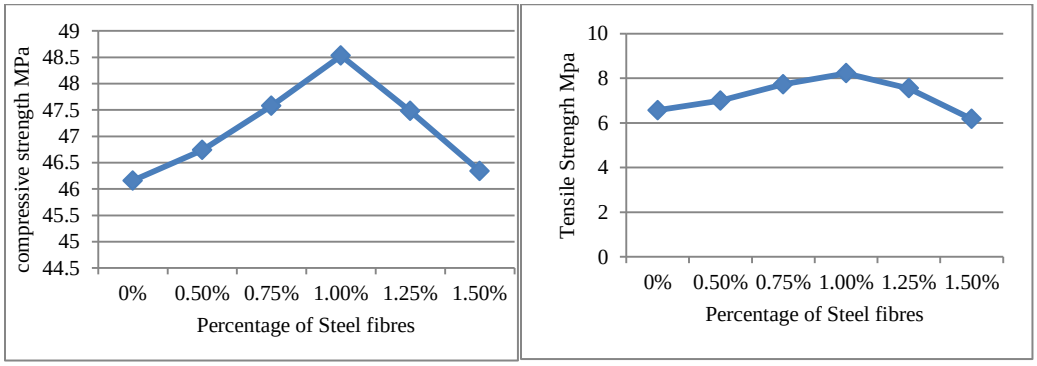

Fig.1 Percentage of Steel Fibers and Strengths

5. RESULT AND DISCUSSION

1) It is found that with the increase in fiber content up to 1%, the strength is increasing i.e. compressive strength is found to be higher at 1% steel fiber content and with further increase in steel fiber content the strength is decreasing. It is found that 1% addition of steel fibers result in 11.30% and 5.14% increase in 7days and 28dayscompressive strength respectively.
2) Similarly, it is found that 1% addition of steel fibers results in 8.45% and 25.11% increase in 7days and 28days tensile strength respectively. Higher percentage addition of steel fibers substantially decreases the tensile strength.

6. CONCLUSIONS

Addition of 1% of crimped steel fibers results in higher compressive strength and use of more than 1% steel fibers will bring down the compressive strength.

Addition of 1% of crimped steel fibers result in higher tensile strength and use of more than 1% steel fibers will bring down the tensile strength.

FUTURE SCOPE

- The decrease in strength when percent of steel fibers is increased above 1% needs to be studied.

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