Experimental Study on Recron 3S Fiber in Concrete

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Abstract- *Concrete is a versatile engineering material used in most of the civil engineering structures, so that considerable attention is taken for improving the property of concrete with respective to strength and durability. In the present scenario, Recron-3s is used which is a polypropylene monofilament, discrete, discontinuous short fiber that can be used in concrete to control and arrest cracks. During the present study, an attempt is made to study the various mechanical properties of concrete containing Recron 3s fibers. The mix proportions were casted using M40 Grade concrete.*

For workability parameters slump cone method, compaction factor method is taken into consideration. For strength parameters the tests are compressive strength, split tensile strength, flexural strength are performed on hardened concrete of M40 grade with addition of Recron 3s fiber of varying percentages i.e. 0%, 0.25%, 0.50%, 0.75% to that of cement weight at the age 28 days are performed and the test results were compared. It is found that Recron 3s fibers have the maximum compressive strength, split tensile strength and flexural strength is obtained when the fiber content is 0.25%at 28 days curing.

I. INTRODUCTION

Concrete is widely recognized as a cost-effective, versatile construction material. Its popularity as a basic building material in construction is because of its economy, good durability, ease with which it can be manufactured, the ability to mould it into any shape and size and its high compressive strength. Yet it is also beset with a number of drawbacks that are inherent to its composition.

Civil structures made of steel reinforced concrete normally affected from corrosion of the steel by the salt, which results in the failure of those structures. Constant maintenance and repairing is needed to enhance the life cycle of those civil structures. There are many ways to minimize the failure of the concrete structures made of steel reinforce concrete. The custom approach is to adhesively bond fiber polymer composites onto the structure. This also helps to increase the toughness and tensile strength and improve the cracking and deformation characteristics of the resultant composite. Various research works have been conducted on the glass fibers, steel fibers and polypropylene fibers in concrete. However, very little is known about the behavior of Recron 3s fibers as secondary reinforcement in concrete. This has paved way for research in Recron 3s fiber reinforced concrete.

RECRON 3S FIBER

Recron 3S is a secondary reinforcement product for construction developed in house by Reliance Industries Limited at State of Art R&D facility at Patalganga. Representing a quantum technological leap in fibers for concrete, the high performance recron fibers are made from revolutionary modified polyester, which has been especially designed to form an internal support system for concrete when it needs the most.

The uniqueness of Recron 3S fiber is its substantially triangular shape, which give better anchoring with concrete, which is not found in most of the fibers available worldwide. Mixing of Recron 3s fibers with concrete can be done by both machine mixing and manual mixing.

In case of machine mixing, fibers are put in the mixer along with some water (5-10 liters) and then other ingredients are added and mixing is continued till entire fibers are dispersed in few minutes. In case of manual mixing, half the fibers are mixed and stirred in a bucket of water and then mixed with other ingredients.

II. REVIEW OF LITERATURE

Sivakumar and Manu Santhanam (2007) found that among hybrid fiber combinations, only the steel polypropylene combination performed better in all respects compared to the mono- steel fiber concrete.

Machine Hsie (2008), et al. used polypropylene hybrid fiber for making concrete. It was reported that the strength of concrete with polypropylene hybrid fiber was better than that of the single fiber reinforced concrete.

Rakesh Kumar (2014), et al. investigated suitability of concrete reinforced with synthetic fiber for the construction of pavements. Author briefly discussed the effects of addition of polypropylene discrete and fibrillated fiber on the properties of a paving grade concrete mix of 48 Mpa compressive

strength at 28-days. Six concrete mixes were casted with fiber dosages 0.05%, 0.10% and 0.15%. The properties such as settlement, compressive strength, drying shrinkage, and abrasion resistance of the concrete were evaluated.

Ashish Kumar Dash (2015), et al. used Recron 3s fiber and silica fume for making concrete. The compressive strength and the flexural strength of the concrete specimens were determined and were found to be increased. The optimum strength was obtained at 0.2% fiber content

III. EXPERIMENTAL WORK

MATERIALS AND THEIR PROPERTIES:

The properties of various materials used in making the concrete are discussed in the following sections.

Cement:

The Ordinary Portland Cement of 53 grade is used specifying all the properties from IS12269-1987.

Coarse Aggregate:

20mm and 10mm coarse aggregate are selected by passing the aggregate through 20mm and 10mm sieves respectively. Particle shape of both the aggregate is angular. Different test are to be conducted like specific gravity, fineness modulus and water absorption. Coarse aggregate is dust free and free from surface moisture.

Fine Aggregate:

Natural Sand is selected as fine aggregate. Sand is sieved from 4.75 mm sieve and also washed to reduce the silt content. Here, water demand is slightly less for natural sand, which is therefore more preferable. The specific gravity, fineness modulus and water absorption test are conducted on Natural sand.

Super Plasticizers:

Fosroc Auramix 400 is used as super plasticizers. Auramix 400 is a unique combination of the latest generation super plasticizers, based on a polycarboxylic ether polymer with long lateral chains. This greatly improves cement dispersion. At the start of the mixing process, an electrostatic dispersion occurs but the cement particle's capacity to separate and disperse.

Water:

Portable water is available in laboratory; it is used for mixing and curing of concrete. Water is free from unwanted substances and chemical oxides.

Recron 3s:

It is a modified polyester fiber manufactured by Reliance Industries Limited. Recron 3s fibers of 12 mm length are used.

Chemical composition of Recron 3s fiber

Chemical Identity	Concentration
Polymer (Polyethylene terephthalate)	>94.0%
Additives (Titanium dioxide, optical brighteners)	<0.5%
Spin finish	<0.5%
Hazardous ingredient	None

MIX PROPORTIONS ADOPTED:

The concrete of M40 grade was designed using the IS Code 10262-1982 of mix design and proportions were obtained after applying necessary corrections to suit field conditions. The final mix ratio for M40 was expressed as parts of water: cement: fine aggregate: coarse aggregate as **0.4**: **1:1.55:2.81**.

IV. LABORATORY TESTS AND RESULTS

Various tests were carried out in the laboratory for finding the strength and durability and other important properties of the concrete used during the study. Slump cone test, Compaction test, compressive strength, split tensile strength and flexural strength were conducted and the details of these tests are given in the following sections.

WORKABILITY TESTS:

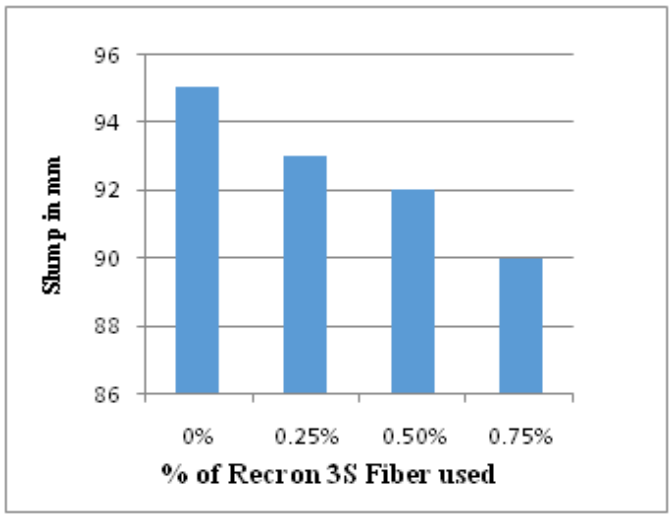
FIG.1.Slump Test

Slump cone and compaction factor test results

S. No	Mix	Slump (mm)	Compaction factor
1	0%	95	0.9
2	0.25%	87	0.89
3	0. 50%	85	0.89
4	0.75%	84	0.88

The slump and compaction factor tests showed that there is no much change in physical nature of concrete although Recron 3S fiber is added.

Graphical representation of Slump Test:

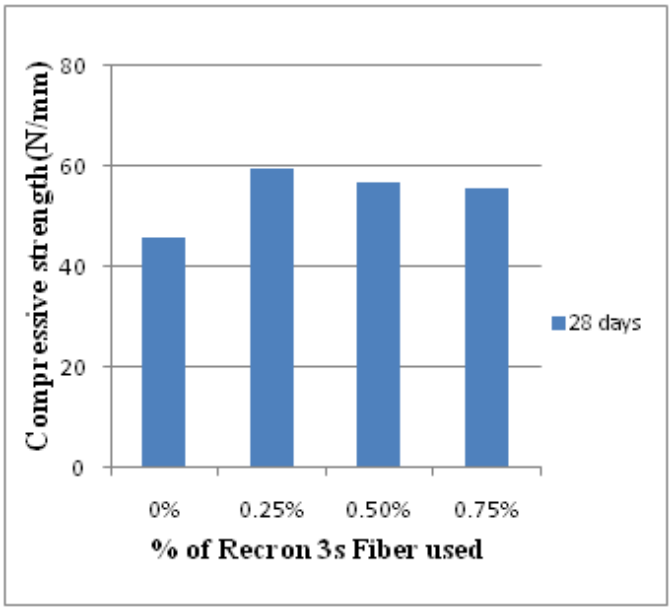


COMPRESSIVE STRENGTH:

The Compressive strength tests were conducted in the laboratory as per IS Code 516-1959. Different percentages of Recron 3S was replaced with Cement and result were presented. The cement, sand, coarse aggregate, super plasticizer and Recron 3S mixed thoroughly. Nearly 25% of water required is added and thoroughly mixed with an aim to obtain uniform mix. After that balance of 75% water was added and mixed thoroughly with a view to obtain uniform mix. Compression test on the cube is conducted on 2000 KN compression Testing Machine as shown in fig 2. The cubes dimensions are 150x150x150mm.

Figure.2.Testing of Compressive strength of specimen

Graphical representation of Compressive Strength Values:

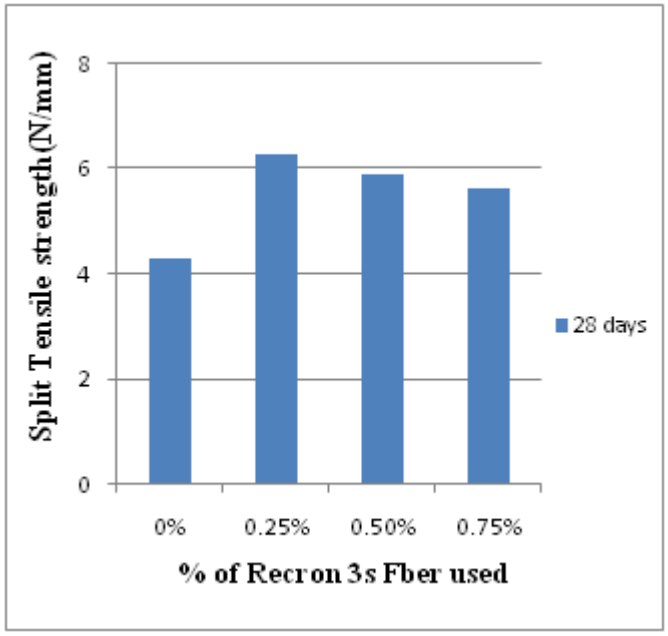


SPLIT TENSILE STRENGTH:

The Split tensile strength tests were conducted in the laboratory as per IS Code 516-1959. This test is conducted on 2000KN Compression machine as show in Fig 3. The cylinders prepared for testing are 150mm diameter and 300mm in height

Figure 3 Testing of split tensile strength of specimen

Graphical representation of Split Tensile Strength Values:



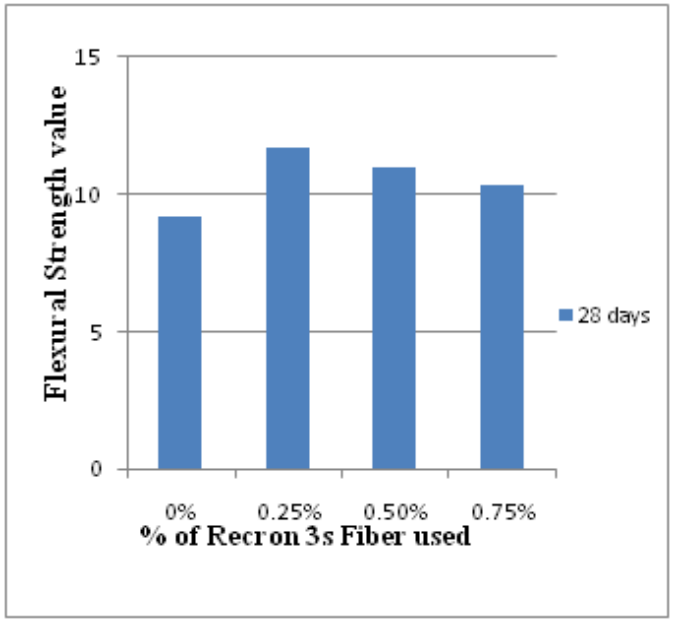
FLEXURAL STRENGTH:

The Flexural strength tests were conducted in the laboratory as per IS Code 516-1959.Different percentages of Recron 3S was replaced with cement and result were presented.

This test is conducted on 40T Universal Testing Machine as show in FIG.4. The flexural beams dimensions are 700x150x150mm.

FIG.4 Testing of flexural strength of specimen

Graphical representation of Flexural Strength Values:



COMPARSION OF COST ESTIMATION BETWEEN ORDINARY CONCRETE AND RECRON3S CONCRETE:

After finding the optimum percentage of Recron 3S in concrete as 0.25%, the cost of ordinary and 0.25% Recron 3S concrete were estimated for 1 m^3 of volume.

S.No.	Ordinary Concrete Grade(M_{40})		0.25% Recron 3S concrete Grade(M_{40})	
	Weight (Kg)	Cost (Rs/-)	Weight (Kg)	Cost (Rs/-)
Cement	415	2822	413.4	2815
Fine Aggregate	645	175.3	645	175
Coarse Aggregate	1170	466.27	1170	466
Super Plasticizer	2.075	317.65	2.075	317
Recron 3S	-	-	1.037	412
Total		3781.22		4185

A minute variation of 400Rs/- is found between ordinary concrete and0.25% of Recron 3S concrete. Hence, it is suggestible to adopt 0.25% of Recron 3s concrete rather than ordinary concrete.

V. CONCLUSIONS

1. The maximum Compressive strength of Recron 3s fiber reinforced concrete is obtained when fiber content is 0.25% at 28 days curing.

2. The maximum Split tensile strength of Recron 3s fiber reinforced concrete is obtained when content is 0.25% at 28 days curing.

3. The maximum flexural strength of Recron 3s fiber reinforced concrete is obtained when fiber content is 0.25% at 28 days curing.

4. Formation of cracks can be minimized.

5. No dramastic change is observed in physical properties of concrete even though Recron 3S fiber is added.

6. It is suggestible to adopt 0.25% of Recron 3S rather than ordinary concrete based on estimation considered.

From the overall assessment, it can be traced that addition of recron 3s will improve the strength of concrete.

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