

# AN INVESTIGATIONAL APPROACH OF USING RECRON-3S IN SELF COMPACTING CONCRETE

Showkat Ahmad Rather<sup>1</sup>, Junaid Bashir<sup>2</sup>, Vikas Garg<sup>3</sup>

<sup>1</sup>P.G Student of Structural Engineering,

<sup>2</sup>Contractual Lecturer Govt. Polytechnic College Ganderbal J&K,

<sup>3</sup>Assistant Professor, Department of Civil Engineering, GRIMT Radaur, Haryana India.

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**Abstract** - Self-Compacting concrete is an advancement of traditional concrete having flow characteristics, passing ability, filling ability, segregation resistance and at the same time gets compacted by its own self weight without using any kind of vibration. Technically we can say that SCC is the same concrete with same constituents but with different proportions like higher proportion of fine aggregates (50%) and addition of superplasticizer and Viscosity enhancing admixtures (VEA) and in general these additions increases the fluidity characteristics of SCC by increasing its flowability and passing ability which makes it different from Normal concrete. Therefore, has find its applications in good structural performance of restricted areas and heavily reinforced structural members. Various admixtures, fibres, VEA are used to increase the overall strength of the SCC so that SCC can find its applications from small structures to large projects and changed the traditional use of concrete. So, this paper is an attempt to review the study of experimental investigation to find out the optimum mechanical properties of Self Compacting Concrete (SCC) with the use of Recron-3s and Masterglenium SKY 8233 (superplasticizer) and comparing the results with normal SCC in all the perspectives. The proportions of adding Recron-3s will be 0%, 0.30%, 0.60%, 0.90% and 1.2% by volume of the self-compacting concrete in addition to other admixtures. For best results various tests are done in fresh state like workability test and slump flow test and at hardened stage like compressive strength test, flexural strength test and split tensile strength test. The size of the specimens in which those are done are 150×150×150 mm cubes for compressive strength tests, 100×100×500 beams for flexural strength tests and 150 mm diameter and 300mm long cylinder for split tensile strength tests. The main theme of this paper is to identify the changes in compressive strength, flexural strength and tensile strength in correspondence with the different proportions of Recron-3s and other admixtures so that there will be a comparison of differentiating strengths of normal SCC and FRSCC(Recron-3s) without altering the basic fundamentals of concrete.

**Key Words:** Self Compacting concrete, passing ability, flow ability, volume fraction, Viscosity enhancing admixtures (VEA) Recron-3s, Masterglenium SKY 8233, compressive strength, flexural strength and split tensile strength.

## 1. INTRODUCTION

Concrete a term that is actually half world of civil engineering i.e. a concoction of cement, aggregates and

water and with the combination of different constituents (Admixtures, fibres, polymers etc) in different proportions turn it into a bold, modified, hard and durable substance that satisfies everything a structural element should have. So we can say that concrete is widely used substance in construction because of its valuable and efficient properties by having high compressive strength and stiffness, low thermal and electrical conductivity, besides being non-combustible and non-toxic in its overall operations. The important properties on which the different forms of every component of concrete is based are workability, setting time, segregation, plastic shrinkage, thermal shrinkage, thermal expansion and water cement ratio (fresh stage), and Mechanical strength, Durability, porosity, density, thermal and acoustic insulation, fire resistance, and impact resistance (in Hardened stage). While these advantages or properties are enough for many small projects or purposes, but ordinary concrete falls short when used in certain important projects. So, in current construction technology methods heavy reinforcement is placed for large and complex structures and where the use of vibrators are difficult to implement and leads to the formation of honey comb structures with lesser respective strengths. To counteract this problem Self Compacting concrete was designed which has the property or ability to flow through congested networks of steel and attain all the nooks and corners of formwork. Thus, Self-Compacting concrete is an advancement of traditional concrete having flow characteristics, passing ability, filling ability, segregation resistance and at the same time gets compacted by its own self weight without using any kind of vibration, saving time, labour and energy. On investigating SCC many researchers have found some problems of developing cracks after final setting time. Upon studying various properties of different fibres I came to the conclusion that the Reliance fibre product "Recron-3s" that I used in this paper is having such properties that can alter various properties of SCC. So, I have made my research and this paper to analyse or to counteract that problem and I have used Recron-3s fibre in different proportions so as to increase the overall strength in different parameters and the Durability of structure as well.

## 2. OBJECTIVE

Today SCC is used in large quantity on new innovative designs as it has many benefits and advantages as described above. It has revolutionized the construction industry in many different aspects of strengths and durability.

Therefore, a new aspect in civil engineering is always fascinating like the addition of Recron-3s in Self Compacting Concrete (SCC) has reduced various drawbacks that were seen and analysed during the performance of the SCC. These reasons helped me to research and analyse the different proportions of mixing Recron-3s in Self Compacting Concrete and to find the necessary data in terms of strength improvement and durability requirements and are described in the results section.

1. An experimental approach is to be done on Self Compacting Concrete using Recron-3s in different proportions as 0%, 0.30%, 0.60%, 0.90% and 1.2% in the concrete mix of M25 SCC.
2. To calculate the strength in self-compacting Concrete in all the forms with and without Recron-3s corresponding respectively in strength and durability of the structure.
3. To calculate the strength in Self Compacting Concrete mixed with Recron-3s and analyse these strengths with the above calculated strengths (i.e. compressive strength, flexural strength and split tensile strength).

### 3. MATERIALS AND METHODOLOGY

#### 3.1 Cement

A cement is a substance composed of different chemical compounds acts as a binding agent in the construction when hydrated with optimum water gets hard and sets according to the requirement and helps to fix together all the materials mixed in the construction procedure. The OPC 43 grade conforming IS 12269-1987 was used in this research to achieve the desired results as is expected and with brand name SAIFCO CEMENTS. Various preliminary tests were conducted and the results are given in the table:

**Table -1:** Properties of OPC 43 grade cement

S. No	Physical properties	Results
01	Specific Gravity	3.16
02	Consistency	31.5%
03	Fineness m <sup>2</sup> /kg	250
04	Initial Setting time	32 minutes
05	Final Setting time	580 minutes
06	Soundness	3.12mm

#### 3.2 Fine aggregates

Locally available in Ganderbal Sindh river, which is then passed through 4.75mm IS sieve and is then brought under various testing procedures. As we are well known of the fact that almost 50% fine aggregates are used in SCC so it has been carefully categorized fine aggregates and the requirements of fine aggregates as per IS 383-1970 are being tabulated below with the results as shown below:

**Table -2:** Properties of Fine Aggregates

S. No	Properties	Results
01	Specific Gravity	2.67
02	Fineness modulus	2.75
03	Bulk Density	1620 kg/m <sup>3</sup>
04	Water Absorption	0.4%

#### 3.3 Coarse aggregates

These are also available locally in same Ganderbal Sindh river, which is passed through 12.5 mm IS sieve and the aggregates retained on 4.75 mm sieve are used in this research and the quantity of coarse aggregates in SCC is very much less as compared to fine aggregates. These aggregates should be round, properly graded and smaller in maximum size which increases the flow ability and passing ability of SCC during the placement and avoids necessary bleeding and segregation. The important properties of coarse aggregates required for maintaining strength in SCC can be tabulated as:

**Table -3:** Properties of Coarse Aggregates

S. No	Properties	Results
01	Specific Size	10mm
02	Specific Gravity	2.68
02	Fineness modulus	6.70
03	Bulk Density	1565 kg/m <sup>3</sup>
04	Water Absorption	0.51%

#### 3.4 Recron-3s

Recron-3s fibres are the advanced type of engineered microfibers with a special cross-section of "triangular" to be used as secondary reinforcement to steel in the concrete. It actually helps the main steel in increasing SCC's resistance against various difficulties like cracking, shrinkage and also shows increase in various strengths as flexural strength, transverse strength and split tensile strength of normal concrete as well as SCC. It also helps both the concrete forms to achieve desired improvements in Abrasion as well as impact strengths. Recron-3s is a reinforcing material which has find its applications not only in construction industry but also in others like asbestos cement sheets, automotive battery, papers, filtration fabrics, cement-based products in which there is a considerable increase in the strength.

#### Properties, Features and Benefits

- Plastic and drying shrinkage is highly reduced in both normal concrete and in SCC.
- It stops the development of micro and macro cracks in the concrete.
- Increases the overall strength in compression, flexure and split tensile strength.

- It increases the homogeneity of the concrete structure.
- It also decreases permeability to a larger extent.
- In the end increases the Durability and life span of the structure which is the most requirement in every case.
- The most important feature of Recron-3s is that it is compatible with all commonly used admixtures in concrete.

**Table -4:** Properties of Recron-3s

S. No	Properties	Units	In the form of Polyester	In the form of Poly-propylene
01.	Shape		Triangular	Triangular
02.	Cut length	Mm	3 /4.8/6 /12 /18 /24	3 /4.8/6 /12 /18 /24
03.	Effective Diameter	Micro ns	20-40	25-40
04.	Specific Gravity		1.34-1.39	0.90-0.91
05.	Melting Point	°C	250-265	160-165
06.	Tensile Strength	MPa	4-6*	4-6*
07.	Elongation	%	20-60	60-90
08.	Young's Modulus	MPa	>5000	>4000
09.	Alkaline Stability		Very good	Very good

### 3.5 masterglenium sky 8233

Masterglenium SKY 8233 is a newly developed admixture that has also find its use in all the forms of concrete. It is actually a modified form of polycarboxylic ether which has enhanced the properties of concrete in its Performance and Durability to a larger extent. The important feature of this admixture is that it is free from chloride and alkalis and is compatible with all cement types. This was the reason I have chosen this admixture in my thesis as well as in this journal as the cements produced in J&K state contain one or different forms of chlorides and alkalis.

#### Features and Benefits

- It eliminates vibration and labour cost in placing that is the most important requirement and property of Self Compacting Concrete.
- It helps the SCC to gain early and ultimate strength.
- In this superplasticizer the value of young's modulus is high.
- It has resulted in the increment of adhesion to stressing and reinforcing steel.
- And the important one it lowers permeability and increases Durability.

## 4. RESULTS

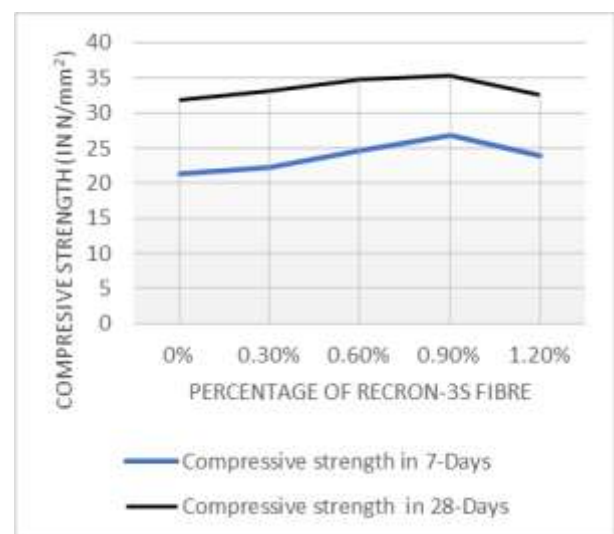
In this research, I have taken different beams and cubes with different proportions of Recron-3s mixed by volume for experimental work to understand the behavior of design mix M25SCC. The testing of every cube of size 150 × 150 × 150 mm, beam of size 100 × 100 × 500 mm and 150 dia × 300 long cylinder specimens are used to check compressive strength, flexural strength and split tensile strength respectively. In this research I have analysed three samples of each test in which I have taken the average as the final test value in all the strengths correspondingly. The test results were calculated at 7 days and at 28 days correspondingly according to the requirements.

### 4.1 Compressive test results

Compressive strength test of concrete mixed with different proportions of Recron-3s was done by taking the cube samples of size 150 × 150 × 150 mm in the compression testing machine as per the guidelines set by IS-516 (1959). In this test I have taken three samples and the average of three values was taken as the final result of compressive strength in MPa after 7 days and 28 days respectively.

**Table -5:** Compressive strength test results

S. No.	Percentage of Recron Fibre	Compressive Strength (N/mm <sup>2</sup> )	
		7 days	28 days
01.	0.00%	21.40	31.80
02	0.30%	22.30	33.10
03	0.60%	24.55	34.70
04	0.90%	26.81	35.25
05	1.2%	23.90	32.55



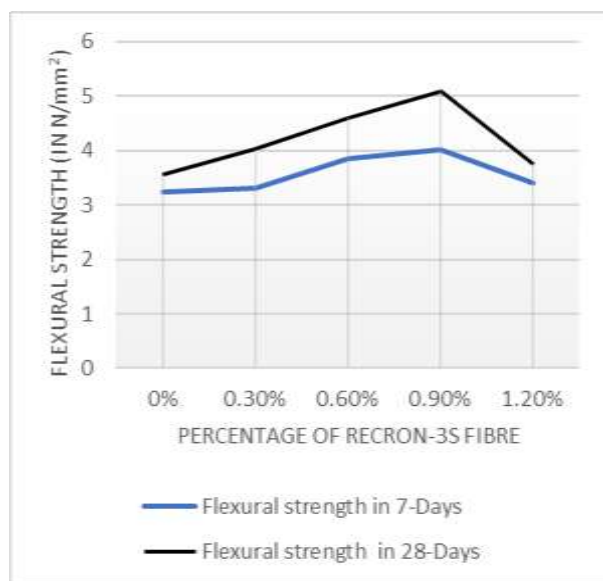
**Chart -1:** Graph showing Compressive Strength vs Percentage of Fibres

### 4.2 Tensile/ flexural test results

The determination of flexural tensile strength is necessary to calculate the total load at which the SCC member may crack or fail. As we know the general representation of flexural strength is about 12-20% compressive strength. The flexural strength at various ages such as 7 days and 28 days and at different percentages of Recron-3s are calculated by taking three samples of beam size 100 × 100 × 500 mm and the average value of those three are considered for the final result and are presented in the following table:

**Table -6:** Flexural strength Test Results

S. No.	Percentage of Recron Fibre	Flexural Strength (N/mm <sup>2</sup> )	
		7 days	28 days
01.	0.00%	3.25	3.55
02	0.30%	3.32	4.02
03	0.60%	3.86	4.60
04	0.90%	4.01	5.10
05	1.2%	3.40	3.75



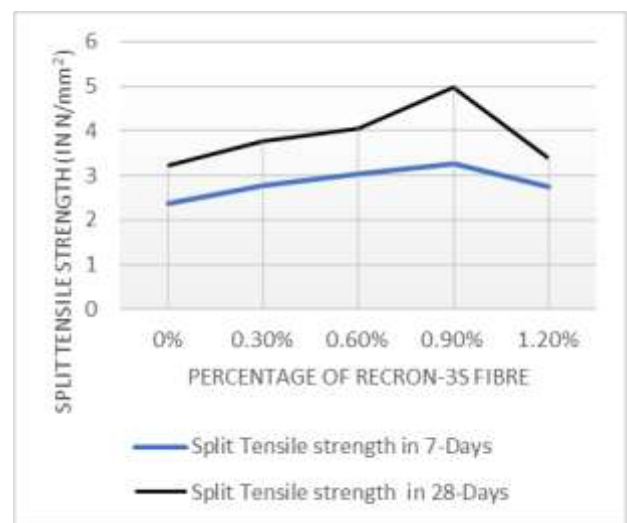
**Chart -2:** Graph showing Flexural Strength vs Percentage of Fibres

### 4.3 Split tensile strength

Actually, it is an indirect method of calculating tensile strength in which the concrete specimen is cylinder type which splits across the vertical diameter when subjected to loading conditions. This test is done to ensure that if uniaxial tension develops during loading conditions the specimen should behave properly under the permissible limits. The procedure for this test is provided by ASTM C496 of cylindrical concrete specimen and is supported by IS-5816 (1999). The specimen of size 150mm dia and 300mm height conforming IS: 10086-1982 was used in calculating strength in testing machine and the results are given in table 7.

**Table -7:** Split tensile strength Test Results

S. No.	Percentage of Recron Fibre	Split Tensile Strength (N/mm <sup>2</sup> )	
		7 days	28 days
01.	0.00%	2.38	3.23
02	0.30%	2.76	3.78
03	0.60%	3.02	4.06
04	0.90%	3.26	4.98
05	1.2%	2.74	3.40



**Chart -3:** Graph showing Split Tensile Strength vs Percentage of Fibres

### 5. CONCLUSIONS

The results obtained from the various mix designs were analysed and obtain some useful conclusions regarding the strength characteristics of Fibre Reinforced Self Compacting Concrete (FRCSCC) especially when mixed with Recron-3s for M25 grade Self Compacting Concrete. There were so many analyses and conclusions that can be described in the following lines:

- By the addition of various percentages of Recron-3s fibres i.e., 0.30%, 0.60%, 0.90%, 1.2% by volume decreases the slump flow but there is much increase in the compressive strength and tensile strength as well.
- By increasing the percentages of recron-3s above 0.90% leads to the more decrease in the Slump flow and goes against the EFNARC guidelines.
- With the increase of Recron-3s fibres from 0% it has shown efficient increase in the compressive strength as shown in the above observation tables but when the concentration is increased beyond 0.90% it shows decline in the strength.
- Further it has been found that with increase of the compressive strength, the flexural strength has also got increased to a greater strength at an optimum value of 0.70% of Recron-3s.

- Also, it has been found that Splitting Tensile strength of cylinder components with 0.90% of Recron-3s fibres content increases by 54.17% with respect to 0% content of Recron-3s fibre.

Also it was noticed that the maintenance cost of SCC is greatly reduced by the addition of Recron-3s by reducing micro cracks and becomes almost impermeable.

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