EXPERIMENTAL INVESTIGATION ON RECRON FIBRE REINFORCED SELF COMPACTING CONCRETE USING SILICA FLOUR AND M-SAND

Arun Raja L[1], Dr. M. Shahul Hameed[2]
[1]Assistant Professor, [2] Dean (Research) & Professor
Department of Civil Engineering, P.S.R. Engineering College, Sivakasi, India
E-mail: [1]arunraja@psr.edu.in, [2]dean_research@psr.edu.in

Abstract

A liquefied combination which is suitable for crammed reinforcement is called self-compacting concrete (RFRSCC). It should possess a good equilibrium between the deformability and rightness. RFRSCC with diverse materials other than those used universally like firmed basalt, Quartz sand, Quartz powder etc., Exploration is conceded on mechanical properties of Concrete. A simple mix design for SCC was designed by ACI Method, IS guidelines and offered description on RFRSCC has been used for deception the trial mix. As per IS guidelines the fresh concrete properties of the trial mix chequered and the one which gives the greatest potency has been used in the present work. Slump flow, V-funnel, U-Box L-Box tests are chequered beside the specifications known by IS guidelines for qualifying RFRSCC properties. This venture presents the results of the mechanical properties of Fibre reinforced self-compacting concrete with M-sand, silica flour and super plasticizer. Thus, the exactness in the physical properties of a concrete mix.

Keywords: Recron Fibre, Self-Compacting Concrete, Admixtures, M-sand, Slica Flour

1. INTRODUCTION

Self-Compacting Concrete (SCC) is a remarkable impact on the concrete construction industry, especially in the precast concrete industry. Self compacting concrete can also be called as a high-performance concrete because it flows under its own weight without requiring vibrators to achieve consolidation by the complete filling of formworks even when access is hindered by narrow gaps between the reinforcement bars. In Denmark Concrete is produced with reduced environmental impact for some years. In SCC there are two primary properties are there, they are ability to flow or deform under its own weight and the ability to remain homogeneous while doing so. The use of SCC reduced the construction period, since SCC allows faster placement and less finishing time, leading to improved productivity. Being able to build with green concrete the potential environmental benefit to the society is vast. Self-compacting concrete acquires the concrete properties of sufficient workability, very high strength and durability properties. Efforts are taken in the field of concrete technology to extend the properties of self-compacting concrete with special considerations.

Fibre reinforced self-compacting concrete has denser microstructure with low inborn “porosity” and “permeability”, because of lower water cement ratio and use of mineral admixture in concrete. Usually Fibre reinforced self-compacting concrete mixture have a high cement content that enhance the heat of hydration and may cause increased shrinkage that result in a prospective of cracking and low durability. To beat these problems cement can be replaced by pozzolanic material which can reduce heat of hydration and hence shrinkage. The SCC mix always contain a powerful super plasticizer which produces a highly fluid concrete mix, while powder materials in the self-compacting concrete are essential to maintain sufficient stability of the mix, hence reducing bleeding, segregation and settlement. Fibre reinforced self-compacting concrete having proceed viscosity and workability can easily fill the mould without the necessity of using vibrators. High volume of mineral

crushed is necessary for a proper self-compacting concrete design. An attempt was made to develop fibre reinforced self-compacting concrete by using silica flour, M-sand and admixtures in concrete to certain proportions. Consumption of SCC has been generally expanded in the construction area . It can be successfully placed without trembling.

This project presents the durability characteristics of fiber reinforced self-compacting concrete by partially replacing cement by and silica flour and fine aggregate by M-sand. The cement was replaced with 20% Silica flour and 20% of M-sand. Water-cement ratio was kept constant for all the mixtures. The Objectives of study is to investigate producing fiber reinforced self-compaction concrete and inspect the physical properties strength [5].A range of test such as, Compressive strength, Tensile Strength and flexural strength were conducted and check their physical properties against IS One way to increase concrete flowing ability is minimizing the voids among particles of the powder mixture poised with cement, silica flour and other fine components.

2. METHODOLOGY

Statistics was collected from the study area, review of literature and secondary source of information were collected. The main aim of this research work is to identify the material properties and check the parameter of materials. Material parameters are mainly used for design the mix as per code practices. Mix design can be calculated from the procedure for practice the specimen. Fresh concrete will be casted and cured. Finally, specimen will be tested to get results.

3. MATERIAL PROPERTIES AND EXPERIMENTAL PROGRAMME

The objectives of this experimental study are given below. To study the compressive, flexural strength and split tensile strength behavior at 7days and 28, days form 40 grade Fiber reinforced Self Compacting Concrete Mix.

3.1. Cement

Ordinary Portland cement of grade 53 available in the local market is used in this project work. The cement is tested for various proportions as per IS 4031 – 1988 and found to be confirming to various specifications of IS 12269-1987.

Table 3.1: Properties of Cement

Standard Consistency	Specific gravity	Initial setting time in minutes	Final setting time in minutes
32.2%	3.12	31	550

3.2. Coarse Aggregate

A River gravel was used as coarse aggregate with minimum size of 10mm.

Table 3.2: Properties of Fine Aggregate

Size	Fineness modulus	Water absorption	Specific Gravity
Passing through 4.75mm	3.5	1.15%	2.6

3.3. Water

As per IS: 456-200 Portable water is used for concreting Water to be used for mixing and curing should be liberated from harmful materials. In this investigation, tap water was used for both mixing and curing purposes.

3.4. Silica flour

It is an ultrafine powder obtained from the alloys of silicon and ferrosilicon invention and consists of particle diameter of 150 nm with average spherical particles. It should have the high level of fineness have the possessions of good cohesion and improved resistance to segregation. It should be successful in eliminating bleeding.

Table 3.3: Physical Properties of Silica flour

Particle size	Bulk Density	Specific Gravity	Specific Surface
Less than 1 micro meter	480 to 720 kg/m^3	2.21	15000 to 3000 m^2/kg

Table 3.4: Chemical Properties* of Silica flour

SiO_2	Al_2O_3	Fe_2O_3	CaO	Loss of Ignition
91	0.4	2.1	1.5	4.1

3.5. M-sand

During quarrying behavior it is obtained as a byproduct. M-sand is the smaller aggregate particles. Hence was sieved and then used for the replacement of fine aggregate.

Table 3.5: Physical Properties* of M-sand

Finess Modulus	Absorption	Maximum Size	Specific Gravity
4.2	0.5	4.75mm	2.6

3.6. Super plasticizer

In this investigation super plasticizer- rheobuild. It is an admixture based on modified poly carboxylic ether. This has been principally developed for applications in fiber reinforced concrete where the strength and utmost durability is required. It is free of chloride & low alkali. It is compatible with all types of cements.

3.7. Recron Fibre

The characteristic of the Recron fibre which is used in this work is given below

1. Shape – Triangular provide higher surface bonding and results in three dimensional crack controls.
2. It improves bonding by 40% over circular fiber.
3. Circular fiber tends to slip out from cement matrix when load is applied.
4. Aspect ratio – 175, Ratio of length to diameter.

4. MIX PROPORTIONS

Mix proportions were arrived for M60 grade of fiber reinforced self-compacting concrete. Trial mix based on the formulated mix design procedure by adding 0.5 lit of water with water-cement ratio of 0.29. A total of four trial mixes were arrived at. The quantities of dissimilar materials necessities per m³ of M60 grade of fiber reinforced self-compacting concrete is done as per mix design.

Table 4.1: Mix Proportions

Mix	Cement (kg/m³)	F.A (kg/m³)	C.A (kg/m³)	Water (litre/m³)	% SF	% QD	VMA (0.1 % of Water+ M-sand) in ml
HSSCC	495.21	721.21	955.24	172	20	20	816

5. EXPERIMENTAL INVESTIGATIONS

This chapter presents the mechanical properties of workability are carried out on the test specimen and strength-related properties of fiber reinforced concrete were studied. To produce fiber reinforced concrete a substantial reduction in water cement ratio is required.

5.1. TESTS ON FRESH CONCRETE

5.1.1 Slump Flow Test: Flow ability of self-compacting concrete is obtained from the slump flow test. This test is done to assess the horizontal free flow of concrete in the horizontal surfaces. Filling ability is assessed by this method. At site, it can be used. After lifting the cone to the concrete reaching a diameter of 50 cm is measured as a time at T50cm. The deformation rate or viscosity of the self-compacting concrete is measured in T50cm and results were tabulated. The value should confirm to EFNARC Guide lines.

5.1.2 L-Box Test: Passing ability of self-compacting concrete is obtained from the L-Box test. In L-Box test, fresh concrete is filled in the vertical section. The gate is lifted, then the concrete flow into the horizontal section. The vertical section represents h1 (mm) is height of the concrete and at the end of horizontal section represents h2 (mm). Blocking ratio is represented by ratio of h2/h1 and the result were tabulated and the value should confirm to EFNARC Guide lines

5.1.3 V-Funnel Test: Filling ability self-compacting concrete is obtained from the V-Funnel test. In this test, V-Funnel is completely filled with fresh concrete and trap door is closed at the bottom of V-Funnel. From opening the trap door and complete emptying the funnel V-Funnel time is measured. Again the concrete is filled in V-Funnel and kept for 5 minutes, and then trap door is opened. V-Funnel time is measured again. V-Funnel time at T5min and the result were tabulated and the value should confirm to EFNARC Guide lines.

Table 5.1: Slump Flow, L-Box & V-Funnel Values

Mix Code	Slump Flow (mm)	L-box (h2/h1)	V-Funnel time (s)
RFRSCC01	670	0.92	9.0
RFRSCC 02	685	0.94	9.1
RFRSCC 03	675	0.9	9.3
RFRSCC 04	670	0.96	9.2

Fig. 5.1 Slump and V-funnel test

5.2. TESTS ON HARDENED CONCRETE

5.2.1 Compressive Strength Test: The cube compressive strength results at the 28 days for different replacement levels such as 20% of silica flour and M-sand of cement and fine aggregate respectively. Three specimens were casted for each mix and average value was taken. They were tested on compressive testing machine as per IS 516:1959.Compressive strength = P/A Where,

P = Maximum load in N applied to the specimen

A = Cross sectional area of the specimen in mm2

Fig.5.2 Cube under Compression Test

Table 5.2: Compressive Strength Results for 7th Day& 28th Day

Mix Code	Percentage replacement of SF & QD	7 Days Compressive Strength (N/mm2)	28 Days Compressive Strength (N/mm2)
RFRSCC01	20	30.24	47.4
RFRSCC02	20	33.1	49.14
RFRSCC03	20	30.4	47.86
RFRSCC04	20	30.6	47.53

5.2.2 Split Tensile Strength: It is an indirect test to determine the tensile strength of cylindrical specimens. It was carried out in compression testing machine as per IS 5816:1999. Three specimens were casted for each mix and average value was taken.

F = 2P/ LD

Where,

P = Load in N

L = Length of the specimen in mm

D = diameter in mm

Fig.5.3 Specimen under Split Tensile Test

Table 5.3: Split Tensile Strength Results for 7th Day& 28th Day

Mix Code	Percentage replacement of SF & QD	28 Days Split Tensile Strength (N/mm2)
RFRSCC01	20	3.70
RFRSCC 02	20	3.96
RFRSCC 03	20	3.80
RFRSCC 04	20	3.60

5.3 Non Destructive Test for Self Compacting Concrete

5.3.1 Rebound Hammer Test:

The Rebound hammer test measures the elastic rebound of self compacting concrete concrete and is primarily used for estimation of concrete strength and for comparative investigations.

The rebound values R of the sample cubes were measured using the concrete test hammer. The compressive strength was then determined with the pressure testing machine.

Table 5.4: Rebound hammer Results for 7th Day

S.No	Mix Code	Rebound No.(R) 28-Days	28 Days Compressive Strength (N/mm2)
1.	RFRSCC01	55	47.17
2.	RFRSCC 02	57.5	49.34
3.	RFRSCC 03	56	48.08
4.	RFRSCC 04	55.5	47.57

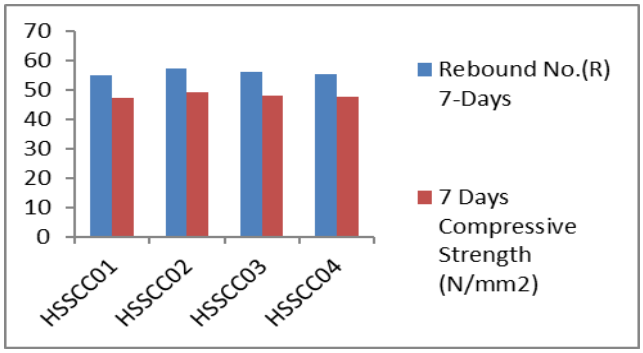

Fig.5.4. Rebound Number and Comparative Test Results for 7 Days

6. CONCLUSION

It is to be observed that the considerable increases in Compressive Strength has been obtained by using 20% of silica flour and M-sand in concrete when compared to conventional concrete. Using silica flour and M-sand 20% by weight of cement and fine aggregate respectively shows good result of water absorption. It was observed that the workability tests performed in this investigation were as per EFNARC guidelines. The tests were slump flow, L-box, V-funnel.

A. The use of mineral admixtures improves the performances of fiber reinforced SCC in fresh state and also avoids the use of VMAs.
B. At the water/cement ratio of 0.32, slump floe test, V-funnel test, and L-box test results were found satisfactory, i.e. passing ability; filling ability and segregation resistance are well within the limits as per the EFNARC.
C. The results of hardened properties of RFRSCC such as compressive strength have shown that higher strength is obtained.
D. The presence of Silica flour and M-sand improved both early ages and long term compressive strength of RFRSCC. Based on the Non Destructive Tests it is concluded that quality of concrete was excellent.

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