STRENGTH PROPERTIES OF SELF COMPACTING CONCRETE USING RECRON FIBER

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Abstract: *Self-Compacting Concrete is a flowing concrete which is suitable for placing in difficult conditions. It had three key properties to evaluating the SCC they are passing ability, filling ability and segregation resistance of the fresh concrete. Recron fiber is a discontinuous short fiber that can be used in concrete to control and arrest cracks. This paper presents mechanical properties of control concrete of M30 grade mixture which is compared with Recron fiber self-compacting concrete. Recron fiber Reinforced Self Compacting Concrete (RFRSCC) made by usual ingredients Cement, Fine Aggregate, Coarse aggregate, Water along with addition of varying proportions (0%, 0.25%, 0.5%, 0.75%,1%)of Recron fiber and also by replacing 25% of cement by Fly ash which is compared with conventional concrete. Workability was determined through slump flow, L-box, and V-funnel flow time tests. Hardened properties were obtained through compressive strength, flexural strength and splitting tensile strength tests with standard cube 150x150x150mm and cylindrical specimens of 150x300 mm and flexural strength test with standard prism 100x100x500mm.*

This paper explains the experimental study on SCC of M30 grade by using Modified Nan Su method. The results revealed that the workability of SCC is reduced by increasing the volume of Recron fiber fraction. From the experimental study compressive strength, splitting tensile strength, flexural strength is decreased beyond the 0.75% addition of Recron fiber.

Keywords: Self Compacting concrete; Workability; Recron fiber; Fly ash; Super Plasticizer

1. INTRODUCTION

Self-compacting concrete (SCC) is considered as a concrete which can be placed and compacted under its self-weight with no vibration, and which is at the same time, cohesive enough to be handled without segregation or bleeding. It reduces the deterioration of concrete quality due to lack of skilled labors. Materials are used to prevent segregation, bleeding and increase flowability .It is used to facilitate and ensure proper filling and good structural performance of restricted areas and heavily reinforced structural members. Recently, this concrete has gained wide use in many countries for different applications and structural configurations. SCC can also provide a better working environment by eliminating the vibration noise. There are many advantages of using SCC, especially when the material cost is minimized. It is also referred as Self leveling concrete, Self consolidating concrete and Non-vibrating concrete.

Chemical admixtures are, however, expensive, and their use may increase the materials cost. Saving in labor cost might offset the increased cost, but the use of mineral admixtures such as fly ash, blast furnace slag, or limestone filler could increase the slump of the concrete mixture without increasing its cost. Addition of Recron fibers into SCC will produce superior properties in fresh and hardened concrete such as high tensile strength. The reinforced fibers in concrete may improve the tensile strength, flexural strength, Impact strength, toughness, drying shrinkage, and failure pattern of the concrete. The use of fly ash improves rheological properties and reduces cracking of concrete due to the heat of hydration of the cement and studied the properties of super flowing concrete containing fly ash and reported that the replacement of cement by 25% fly ash resulted in excellent workability and flowability. In this study included a Conplast SP430 super plasticizer (SP).

2. MATERIALS USED

2.1 Cement

The OPC 53 grade conforming IS 12269 - 2013 was used in this work. The preliminary test for cement conducted is of specific gravity of 3.15, fineness modulus is 2.2% and consistency is 31%.

2.2 Fine Aggregate

Locally available river sand passed through 4.75mm IS sieve was used. The specific gravity 2.62 and fineness modulus of 2.84 were used as fine aggregate. The bulk density of loose state is 1441 kg/m^3. Fine aggregates used are as per specifications IS 383-1970.

2.3 Coarse Aggregate

In this work, 10mm size of coarse aggregate was used. The grading of coarse aggregates should be as per specifications of IS 383-1970. The specific gravity of coarse aggregate is 2.80, Fineness modulus is 3.30, water absorption 0.37% and bulk density of loose state is 1471kg/m^3.

2.4 Recron Fiber

Recron fiber is a secondary reinforcement material. It is improving the quality of plaster and concrete. In this project, Recron fiber straight was used with an aspect ratio 240.

2.5 Fly Ash

Class C Fly ash was used from Tuticorin Thermal Power Plant. Fly ash particles are generally spherical in shape and range in size from 0.5µm to 300µm.Fly ash was used as a replacement for OPC in Self Compacting Concrete. The specific gravity of fly ash 2.20 and Fineness modulus is 3.1%.

2.6 Admixtures

The Super plasticizer is an essential component of self compacting concrete. To provide the necessary workability.Conplast SP430 is a chloride free, superplasticising admixture based on selected sulphonated naphthalene polymers. It is used in prestressed concrete and with sulphate resisting cements and marine aggregates. The product shall have specific gravity of 1.2.

3. EXPERIMENTAL PROGRAMME

3.1 Mix Proportion

In this paper, various fractions of Recron fiber 0%, 0.25%, 0.5%, 0.75% and 1% with replacement of fly ash by cement were used. In this work, M30 grade concrete was used and the mixture was prepared with the water-cement ratio of 0.4. The mix proportion of materials is 1: 1.14: 2.16 as per IS 10262-2009 and SCC mix proportion is 1:1.61:1.65 using Modified Nan Su Method.

3.2 Casting, Curing and Testing

In this experimental work 53 grade OPC, fine and coarse aggregates were used. The process of making SCC is done with Recron fiber being added and also by replacing 25% of cement by Fly ash during the mixing process. After the materials were mixed, fresh concrete tests were performed to determine the workability of the SCC. In order to achieve these characteristics, there are some tests in EFNARC [6] such as slump flow, V-funnel flow and L-box. Immediately after the completion of fresh concrete tests, the fresh concrete was poured into the oiled molds to form 150x150x150 mm cubes for compressive strength testing at 7 and 28days and 150mm diameter x300mm height cylinders splitting tensile strengths testing at 28days and into 100x100x500 mm prisms for flexural strength testing at 28days. The samples were de-molded after 24 hours and then cured into a water tank for 7 and 28 days. After that, Compressive, Flexural and splitting tensile strengths were determined.

4.RESULTS AND DISCUSSION

4.1 Workability

Workability is the ease to work with concrete. At every batch of mixing, the concrete Slump flow, V-Funnel and L-box values were measured and recorded. The workability was maximum at the addition of 0.75% Recron Fiber with 25% replacement of Fly Ash. The workability was decreased beyond the 0.75% addition of Recron Fiber. It is concluded that the Recron fiber reinforced concrete values are higher than the nominal mix.

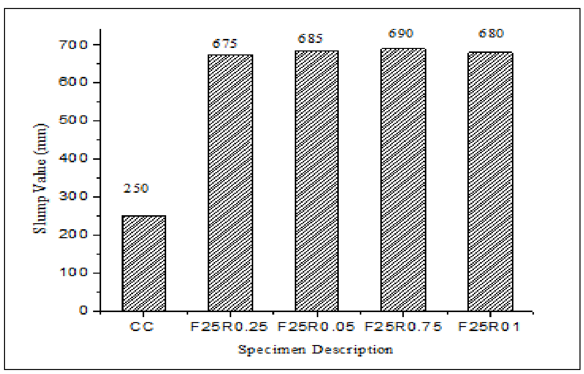

Fig.1 Slump Value of Concrete

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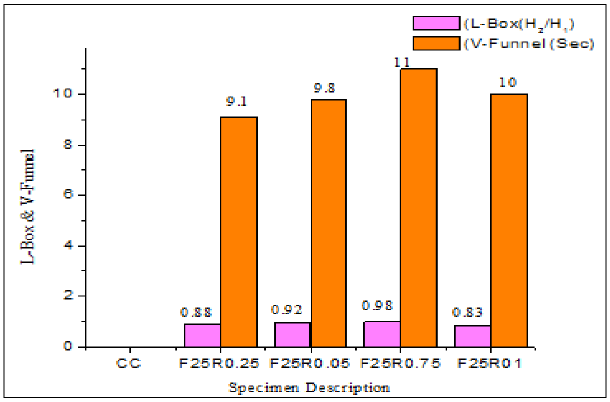

Fig.2 L-Box & V-Funnel Value of Concrete

4.2 Compressive Strength

The compressive Strength of nominal mix is 34.83N/mm²whereas with addition of 0.75% Recron Fiber with 25% replacement of Fly Ash in SCC is 38.06N/mm².From 7th and28th days Compressive Strength for the various percentage addition of Recron fiber in SCC, the optimum value obtained at 0.75% is Recron fiber is higher than the nominal concrete by 9.72%.The decrease in compressive strength is observed when percentage of fibers increases beyond 0.75%. The increase in the compressive strength is due to the increase in bonding effect of fiber with matrix.. It is concluded that Recron Fiber at 0.75 % has higher strength than the nominal mix.

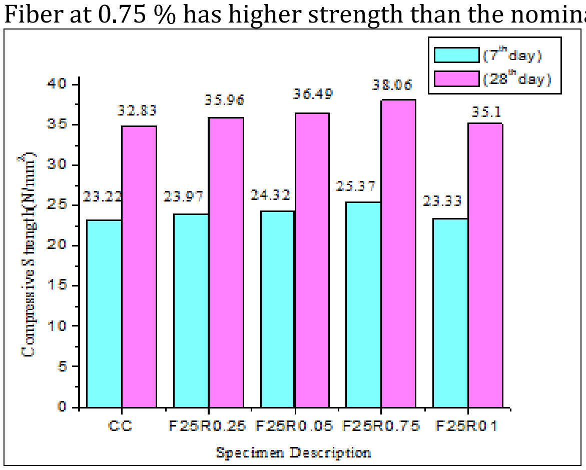

Fig.3 Compressive Strength at 7th & 28th days

4.3 Split Tensile Strength

The split tensile strength of nominal mix is 1.81 N/mm²whereas with addition of 0.75% Recron Fiber with 25% replacement of Fly Ash in SCC is 2.61 N/mm².From 28th day Split Tensile Strength for the various percentage addition of Recron fiber in SCC, the optimum value obtained at 0.75% is Recron fiber is higher than the nominal concrete by 44.19%. This is due to the holding capacity of the fibers which helps in preventing the splitting of concrete. However, after increasing the percentage of Recron fiber beyond the optimum value (0.75%) improper mixing of fibers

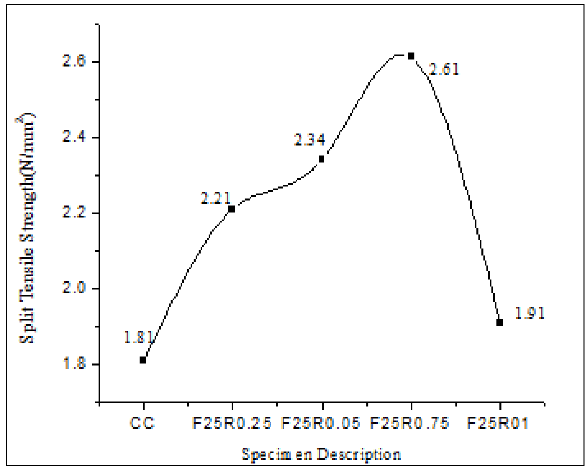

Fig.4 Split Tensile Strength at 28th days

4.4 Flexural strength

The Flexural strength of nominal mix is 5N/mm² whereas with addition of 0.75% Recron fiber with 25% replacement of Fly Ash in SCC is 6.8 N/mm².From 28th day Flexural Strength for the various percentage addition of Recron fiber in SCC, the optimum value obtained at 0.75% is Recron fiber is higher than the nominal concrete by 36%. However, after increasing the percentage of Recron fiber the strength decreases due to improper mixing of fibers.

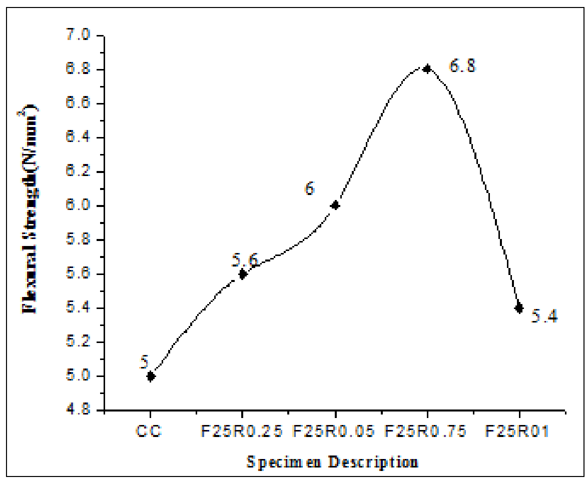

Fig.5 Flexural Strength at 28th days

5.CONCLUSION

From the above test results, the following conclusion has been made,

1. It is found that the compressive strength for 0.75% Recron fiber and 25% fly ash showed an increase of about 9.72% increase than control mix. This is because of fly ash which fills the voids between the aggregates and improves the strength.
2. There is an increase of 44.19% more split tensile strength than that of the SCC control mix for 0.75% Recron fiber and 25% fly ash.
3. The flexural behavior results showed an ultimate increase of 36% for 0.75% Recron fiber and 25% fly ash.
4. Based on the results, it is found that the Recron fiber in SCC mixes prevent the dampness, leakages and also control cracks.
5. Using fly ash in SCC reduces the possibility of bleeding, segregation and increases flow ability of concrete.
6. At 25% replacement of cement by fly ash along with 0.75% addition of fibers the strength results are found to be maximum and beyond that the strength gets decreased for successive SCC mixes.

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