Effects of Coir Fiber on Self Compacting Concrete

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Abstract— Experimental investigation has been carried out to study the effect of coir fiber on Self Compacting Concrete. M20 grade concrete mix ratio of 1:1.42:3.10 was designed. The main objective of this study is to find appropriate percentage addition of super plasticizer with constant addition of 0.5% volume fraction of coir fiber. The amount of super plasticizer added is 0.40%, 0.60% and 0.80% of weight of cement. Coir fiber is added based on volume fraction of 0.5%. The addition of coir fiber decreases the workability; to impart workability super plasticizer is added. The various workability tests for Self-Compacting Concrete were conducted and their results were compared with Self Compacting Concrete limiting value. The compressive and split tensile strength tests were conducted on 7, 14 and 28 days. The test results shows that addition of 0.80% of super plasticizer satisfies the Self Compacting Concrete limiting value, with maximum increase in strength.

Key words: Self Compacting Concrete, Coir Fiber, Super Plasticizer, Aspect Ratio

I. INTRODUCTION

Concrete is one of the main construction material, its requirement is increasing day by day. It is necessary to improve the properties of concrete by using waste materials and also with admixtures. Self-compacting concrete is one form of concrete which flow under its own weight does not require any external vibration .Self compacting concrete was first developed by Japanese researcher in 1980.It is highly workable concrete that can flow into place and compact under its own weight to form uniform void free mass even in areas of congested reinforcement. Coir fiber is one of waste material used in concrete to improve properties of concrete. Addition of coir fiber arrest micro crack and also increase strength.

II. MATERIAL PROPERTIES

A. Cement

The Ordinary Portland Cement of 53 grade was used in this experimental work.

B. Fine Aggregate

The fine aggregate of zone I with specific gravity of 2.63 and fineness modulus of 3.1, conforming to IS: 383-1970 was used in this experimental work.

C. Coarse Aggregate

The coarse aggregate of particle size which was passed in 20mm sieve size and retained in 4.75mm sieve size with specific gravity of 2.74 and fineness modulus of 6.98 was used in this experimental work.

D. Coir Fiber

The coir fiber of length 15mm and diameter 0.4mm with specific gravity of 0.71 is used in this experimental work. The aspect ratio of coir fiber is 37.5.

Fig. 1: Coir Fiber

E. Super Plasticizer

The poly carboxylate ether form of super plasticizer named, CONXL-PCE with specific gravity of 1.09 is used in this experimental work.

III. EXPERIMENTAL INVESTIGATION

A. Mix Design

M20 grade concrete mix ratio of 1:1.42:3.10 with water-cement ratio of 0.5 was designed. The coir fiber of volume fraction of 0.5% is added as per IRC:SP:46-2013, with addition of super plasticizer from 0.40%, 0.60% and 0.80% by weight of cement. The coarse aggregate is first added in mixer, then cement and fine aggregate is added into it. The water is mixed with super plasticizer separately. The 60% of water- super plasticizer mixture is added into mixer, mixed for 60 minutes and then remaining 40% of water- super plasticizer mixture is added into mixer.

B. Workability Tests

The workability test was conducted on fresh concrete. The various workability test conducted are Slump flow, V-funnel and L-box.

1) Slump Flow Test

This test involves use of slump cone which is used in conventional slump cone test. This test measures the flow of concrete, once cone is lifted. The concrete is filled in cone and raise the cone vertically and allow the concrete to flow freely. Measure the diameter of flow of concrete in two perpendicular directions. Take the average value.

Fig. 2: Slump Flow Test

2) V-Funnel Test

The test involves filling of concrete in funnel with trap door closed .After filling the concrete in funnel, open the trap door within 10 seconds allow the concrete to flow under gravity through the funnel and filled in bucket kept at bottom of funnel. Measure the time taken to concrete to flow and fill in bucket is measured. The whole test is performed within 5 minutes.

Fig. 3: V-Funnel Test

3) L-Box Test

The test involves finding the level of concrete at each end of box. The l-box consists of chimney section and trough section. The concrete is filled in the chimney section and promptly lift the gate to allow concrete to flow into trough section. Measure the height of concrete in trough end as H_2 and height of concrete in chimney end as H_1.The L-Box value obtained by H_2/H_1.

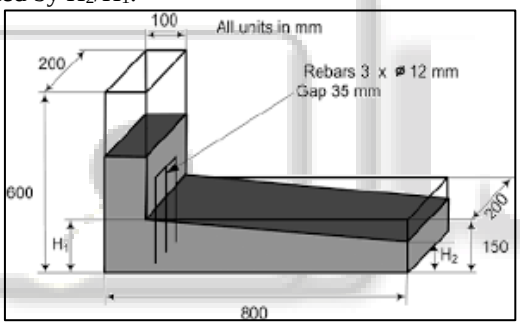

Fig. 4: L-Box test

S. No	Tests	Values
1	Slump flow	650mm-800mm
2	V-Funnel	6-12seconds
3	L-Box	0.8-1.0

Table 1: Recommended Limit for Self-Compacting Concrete

C. Strength Tests

The strength tests were conducted on hardened concrete. The strength tests going to conducted is compression and tensile strength tests.

1) Compressive Strength Tests

For compressive strength tests, cube specimen of size 150mmx150mmx150mm was casted. The cube mould is demoulded after 24 hours of moist curing and transfer to curing tank, allowed to cure for 7,14 and 28 days. After Curing, the test specimens were tested in compressive testing machine as per IS: 516-1959.The compressive strength can be determined as follows;

Compressive Strength=Load at failure/surface area of specimen

2) Split Tensile Strength

For split tensile strength, cylinder specimen of height 300mm and diameter of 150mm was casted. The cylinder mould is demoulded after 24 hours of moist curing and transfer to curing tank, allowed to cure for 7,14 and 28 days. After Curing, the test specimens were tested in testing machine as per IS: 516-1959.Ther split tensile strength can be determined as follows;

Split Tensile Strength=2P/3.14DL

P=Load at failure

D=Diameter of test specimen

L=Length of test specimen

IV. RESULTS AND DISCUSSIONS

A. Workability Tests Results

S. No	Tests	Addition of Super Plasticizer (%)		
		0.40	0.60	0.80
1	Slump Flow	600	680	720
2	V-Funnel	35	23	10
3	L-Box	0.3	0.6	0.8

Table 2: Workability Tests Results

In slump flow test, addition of 0.40%, 0.60% and 0.80% of super plasticizer satisfies the self-compacting concrete limiting value. In L-box and V-funnel tests, 0.80% of super plasticizer satisfies the self-compacting concrete limiting value. The addition of 0.40% and 0.60% of super plasticizer in L-box and V-funnel tests fails to satisfy the limiting value of self-compacting concrete.

B. Compressive Strength Test Results

S. No	Addition of Super Plasticizer (%)	Compressive Strength (N/mm^2)		
		7 days	14 days	28 days
1	0	14.6	15.5	17.7
2	0.40	15.5	18.6	22.6
3	0.60	16.4	22.6	25.3
4	0.80	21.3	24.8	28

Table 3: Compressive Strength Test Results

The addition of 0.40%, 0.60% and 0.80% of super plasticizer shows 28%, 43% and 59% increase in compressive strength.

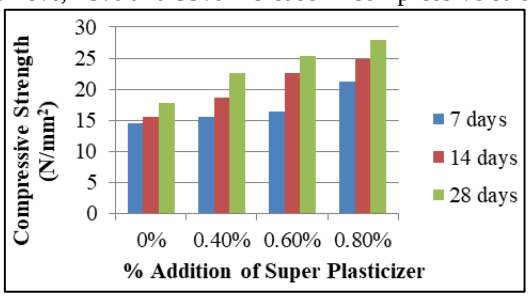

Fig. 5: Compressive Strength VS % Addition of Super Plasticizer

C. Split Tensile Strength Results

S. No	Addition of Super Plasticizer (%)	Split Tensile Strength (N/mm^2)		
		7 days	14 days	28 days
1	0	1.37	1.46	1.59
2	0.40	1.47	1.64	1.84
3	0.60	2.17	2.28	2.51
4	0.80	2.43	2.65	2.72

Table 4: Split Tensile Strength Test Results

The addition of 0.40%, 0.60% and 0.80% of super plasticizer shows 16%, 58% and 71% increase in tensile strength.

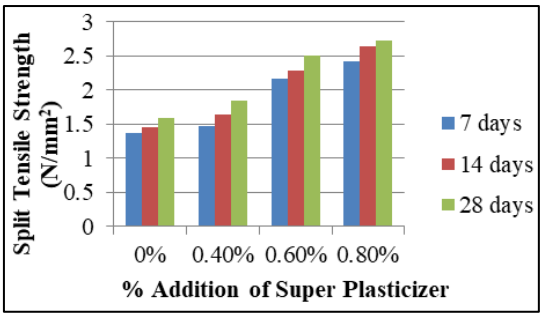

Fig. 6: Split Tensile Strength VS % Addition of Super Plasticizer

V. CONCLUSIONS

- The test results indicate that concrete mix of 0.5% volume fraction of coir fiber with 0.80% addition of super plasticizer satisfies the self-compacting concrete limiting value.
- Addition of 0.80% of super plasticizer with 0.5% volume fraction of coir fiber shows 59% increase in compressive and 71% increase in tensile strength at 28 days.
- Addition of 0.40% and 0.60% of super plasticizer with 0.5% volume fraction of fiber fails to satisfy the self-compacting concrete limiting value.
- From this experimental work, it is concluded appropriate addition of super plasticizer is 0.80% by weight of cement.

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