STUDY ON REINFORCED CONCRETE USING COCONUT FIBER

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Abstract - *Natural fibers are those fibers which are pollution free, environment friendly and do not have any bad effect on climate. Every year there is ample amount of wastages of natural fiber .If these natural fibers used as a construction material it could save the bio-reserves. They act as green construction material. Amongst all natural fibers, CF is the fiber which has the better physical and chemical property also it is renewable, cheap, resistant to thermal conductivity, more durable, highest toughness, most ductile then the other natural fiber, it is capable of taking strain four time more than other fibers. Hence, CF is a best material to be used in construction.*

In the present study the behavior of specimen with respect to compressive strength and the cracking behavior of concrete and CFRC has been investigated. According to I.S. specification different test is conducted to enhance the workability and strength properties by addition of CF. different test such as slump test and flow table test on fresh concrete is carried out and compressive strength and split tensile strength is carried out on hard concrete.

The present study involves the use of super plasticizer, master glenium 8654 (0.4% by mass cone test) in M30 grade of concrete (grade ratio =1:1.918:2.898) which helps in enhancing the workability without affecting the strength with CF (2%,3.5%,5%) and is compared with the conventional concrete of same grade.

***Key Words*: Fibres, Climate, Coconut fiber, Construction, Master glenium, Super plasticizer**

1. INTRODUCTION

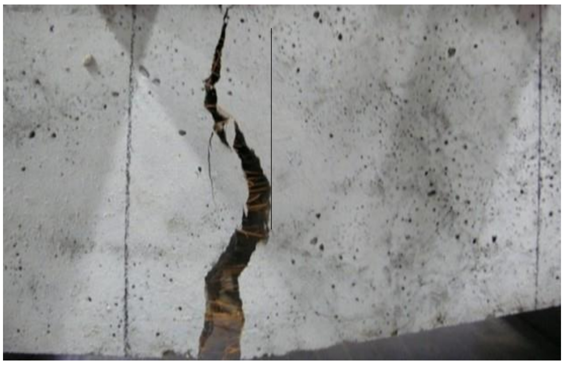
Coconut fibre is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fibre is Coir, Cocos nucifera and Arecaceae (Palm) respectively. There are two types of coconut fibres, brown fibre extracted from matured coconuts and white fibres extracted from immature coconuts. Coconut fibres are stiff and tough and have low thermal conductivity. Coconut fibres are commercial available in three forms, namely bristle (long fibres), mattress (relatively short) and decorticated (mixed fibres).According to official website of International Year for Natural Fibres approximately, 500 000 tonnes of coconut fibres are produced annually worldwide, mainly in India and Sri Lanka. India and Sri Lanka are also the main exporters, followed by Thailand, Vietnam, the Philippines and Indonesia. Around half of the coconut fibres produced is exported in the form of raw fibre.

Matured coconut fibers

1.1 Coconut fiber in construction

Plain concrete is a brittle material with low tensile strength. There has been a steady increase in the use of short and randomly distributed natural fibres to reinforce the matrix (paste, mortar and concrete). Fibres alter the behavior of concrete when a crack occurs by bridging across the cracks

And thus can provide some post cracking toughness. Fibres crossing the crack guarantee a certain level of stress transfer between both faces of crack, providing a residual strength to the composite, whose magnitude depends on the fibre, matrix and fibre matrix interface



Coconut fiber bridging crack

2. METHODOLOGY

A concrete mix was designed to achieve the minimum grade as required by IS 456 – 2000. The investigation done by the different proportion of coconut fibre in the concrete mix design. As the fibre content is increased the mix became more cohesive & the workability is decreased. Therefore the suitability of coconut fibre reinforced concrete with super plasticizer is studied in comparison with different proportion of coconut fiber.

By adding the coconut fibre the workability was not achieved which was required. Therefore a super plasticizer is added which gave the good workability and also not affect on the properties and strength of concrete. The optimum percentage of master gylanium is determined with the help of mass cone test.

Minimum of three test specimen was taken for each analysis. The following tests conducted on the respective specimens.

- Compressive Strength on cube
- Splitting Tensile Strength on cylinder

Concrete mixes of grade M30 was made using OPC. Replacement of cement was made using Supplementary Coconut Fibers, with defined percentage 2%, 3.5%, 5% respectively.

The concrete mixes tested for compressive strength at 3 days, 14days, and 28days of curing.

Following sections describes the experimental programme and the procedures used for conducting various test involved in the programme.

3. TESTS ON MATERIALS

3.1. Tests on coarse aggregate

The coarse aggregate passing through 20mm size sieve and retaining on 10mm sieve is tested as per IS:2386-1963 and properties are listed in table

Sr.no	Property	Value
1	Specific gravity	2.66
2	Water absorption	2.92%

Properties of Aggregate

Tests on Fine aggregate

The fine aggregate passing through 4.75mm size sieve is tested as per IS:2386 and properties are listed below.

Sieve analysis

Sieve analysis helps to determine the particle size distribution of the coarse and fine aggregates. This is done by sieving the aggregates as per IS: 2386 (Part I) – 1963. In this we use different sieves as standardized by the IS code and then pass aggregates through them and thus collect different sized particles left over different sieves. Fig.3a shows the distribution of fine aggregate.

The apparatus used are –A set of IS Sieves of sizes – 80mm, 63mm, 50mm, 40mm,31.5mm, 25mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm,4.75mm, 3.35mm, 2.36mm, 1.18mm, 600μm, 300μm, 150μm and 75μm.

The weight of sample available should not be less than the weight given below: The sample for sieving should be prepared from the larger sample either by quartering or by means of a sample divider.

Procedure to determine particle size distribution of Aggregates.

- The test sample is dried to a constant weight at a temperature of 110C.
- The sample is sieved by using a set of IS Sieves.
- On completion of sieving, the material on each sieve is weighed.
- Cumulative weight passing through each sieve is calculated as a percentage of the total sample weight.
- Fineness modulus is obtained by adding cumulative percentage of aggregates retained on each sieve and dividing the sum by 100

Sieve	Average Weight (gm.)	Percentage Retained	Cumulative % retained	Cumulative % passing
2.36 mm	25	1.23	1.23	98.77
1.18 mm	665	32.75	33.98	66.02
600 micron	760	37.43	71.41	28.59
300 micron	460	22.66	94.07	5.93
150 micron	95	4.67	98.74	1.26
pan	25	1.23	100	0

Sieve Analysis

4. EXPERIMENTAL INVESTIGATION

4.1 Preparation of materials

Sample of aggregate for each batch of concrete shell be of desired grading and in air-dried condition. In general, the aggregate shall be separated into fine and coarse fraction and recombined for each concrete batch in such a manner so as to produce the desired grading..

4.2 Proportioning

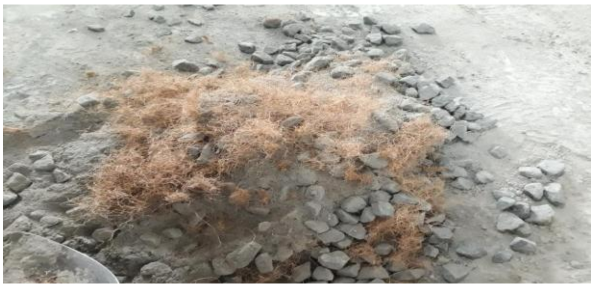
The proportioning of the materials including water in concrete mixes for determining the suitability of the material available shall be similar in all aspects to those to be employed in work. Where the proportions of the ingredient of concrete used on the site are to specified by volume, they shall be calculated from the proportional by weight used in the test cubes and the unit weight of the materials.

4.3 Weighing

The quantities of cement, each size of aggregate and water for each batch shall be determined by weight to an accuracy of 0.1 per cent of the total weight of the batch.

4.4 Mixing of concrete

The concrete shall be mixed by hand or perfectly in laboratory batch mixer in such a manner so as to avoid loss of water or other materials. Each batch of concrete shall be of such a size so as to leave about 10 per cent excess after moulding the desired number of test specimen.



Mixing of concrete

4.5 Compaction

When compaction by hand, the standard tamping rod shall be used and the stokes of the rod shall be distributed in a uniform manner over the cross section of the mould. The number of stokes per layer required to produce specified condition will vary according to the type of concrete. For cubical specimen, the concrete shall be subjected to 35 stokes per layer for 15cm cubes. The stokes shall touch the surface of underlying layer. Where voids are left by tamping rod, the sides of the mould shall be tapped to close the voids.

4.6 Curing of test specimens

The test specimens shall be stored on the site at a place free from vibration, under damp matting, sacks or other similar materials for 24 hours + half hour from the time of adding the water to the other incidents. The temperature of the place of storage shall be within the range 22-32 Celsius. After the period of 24 hours, the specimen shall be marked for the later identification removed from the mould and unless required for testing within 24 hours store in clean water at temperature of 24 – 30 Celsius until they are transported to the testing laboratory. They shall be sent to the testing laboratory well packed in a damp sand, damp sack or other suitable materials so as to arrive there in a damp condition not less than 24 hours before the time of test.

5. Test on fresh concrete

5.1 Slump test:

The slump test is used to determine the workability of concrete mix prepared at the laboratory or construction site. The slump value was determined for the various mix to be prepared in the project. Generally concrete slump value is used to find out the workability of concrete which indicates water –cement ratio.

Procedure:

- Clean the internal surface of the mould and apply oil.
- Place the mould on smooth horizontal non –porous base plate.
- Fill the mould with the prepared concrete mix in four approximate equal layers.
- Tamp each layer with 25 stokes of the rounded end of the tamping rod in a uniform manner over the cross-section of the mould. For the subsequent layers the tamping should penetrate into the underlying layer.
- Remove the excess concrete and level the surface with a trowel.
- Clean away the mortar or water leaked out between the mould and the base plate.
- Raise the mould from the concrete immediately and slowly in vertical direction.
- Measure the slump as difference between the height of the mould and that of highest point of specimen being tested.

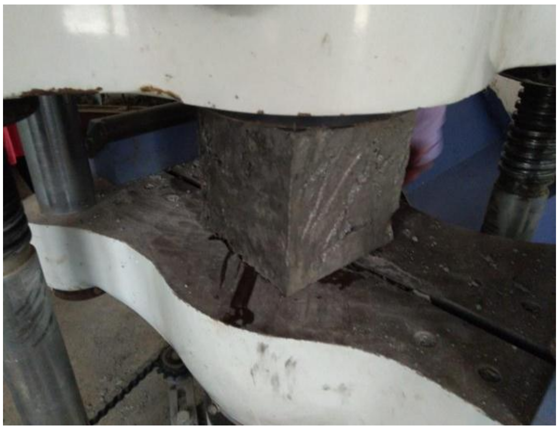
Slump test

6. Tests on hardened concrete

6.1 Compressive strength test

- One of the most important and useful property of concrete.
- Primarily meant to withstand compressive stress and can be used as an approximate qualitative measure for other properties of hardened concrete.
- Compressive strength test is carried out on cubes for various mixes M1, M2, M3 and M4.
- The compressive strength of cubes was tested on 3, 7 and 28 days.
- Formula for compressive strength of concrete:

= Load applied(P)/Cross sectional area (A)= N/mm^2



Compressive strength test

6.2 Split tensile strength test

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete.

Need: The concrete is weak in tension due to its brittle nature and is not expect to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus it is necessary to determine the tensile strength of concrete to determine the load at which the concrete member may crack.

Procedure:

- Draw diametric lines on each end of the specimen using a suitable device that will ensure that they are in the same axial plane.
- Determine the diameter of the test specimen by averaging the three diameters and the length of the specimen by averaging at least two length measurements taken in the plane containing the lines marked on the two ends.
- Place the specimen on the plywood strip and align so that the lines marked on the ends of the specimen are vertical and centered over the plywood strip. Place a second plywood strip lengthwise on the cylinder, centered on the lines marked on the ends of the cylinder.
- Apply the load continuously and without shock at a constant rate within the range 100 to 200 psi/min [0.7 to 1.4 MPa/min] splitting tensile stress until failure of the specimen. Record the maximum applied load indicated by the testing machine at failure. Note the type of failure and the appearance of the concrete.

Calculation:

The splitting tensile strength of the specimen are given below:

$$T = 2P/\pi ld$$

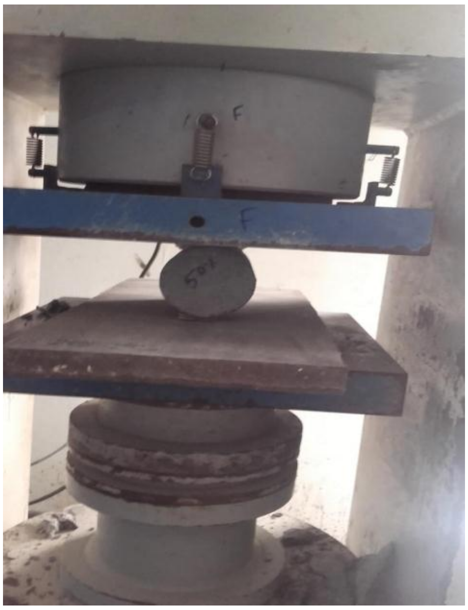
Where,

T = split tensile strength in MPa

P = maximum applied load indicated by the testing machine in N

l = length in mm

d = diameter in mm



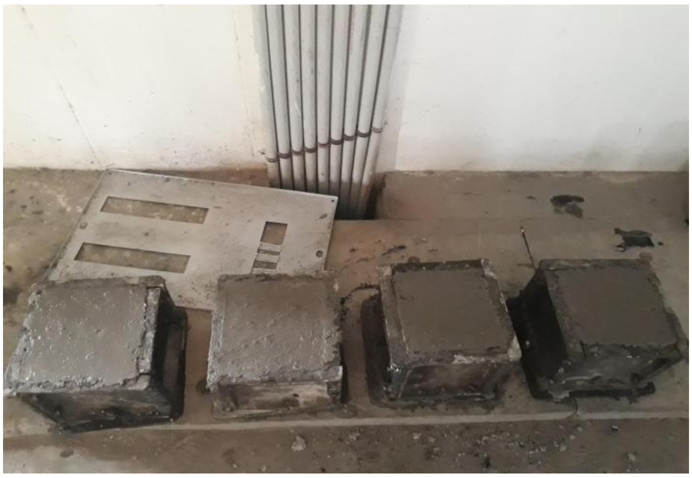
Split tensile strength test

7. CASTING OF CUBES

Table given below show the quantity of cubes required for different mixes.

Days	Conventional	1.5% CF	2% CF	2.5%CF
3 Days	1	1	1	1
7 Days	1	1	1	1
28 Days	1	1	1	1

Quantity of cubes required for different mixes.



Test specimen

8. TEST RESULTS

The observations of the various tests on Fresh And Hard CFRC was conducted such as flow tests, slump test, compressive test of concrete and split tensile tests have been analyzed and the behavior is studied. The results of the analysis are discussed in the subsequent sections. The various types of cubes and cylinders of different mix were tested under compression testing machine.

8.1 Compressive strength of concrete

S.No	M20+ Coconut Fibre+Superplacticizers	Compressive strength (N/mm^2)		
		7 days	14 days	28 days
1.	0%	16.52	18 .36	20 .94
2.	1.5%	21.24	23 .72	24 .85
3.	2%	22.68	24 .88	26 .66
4.	2.5%	24.44	26 .46	28 .78

Compressive Strength Results

9. CONCLUSIONS

From the experimental study, the following results were obtained:

- With respect to compressive strength, incorporating a small amount of CF 2% enhances the performance of concrete, as expected and counters harmful shrinkage effects in concrete.
- The results suggest that short coconut fibers are more effective in enhancing the performance of concrete.
- The recommended threshold value of the fiber content that will benefit the long term durability of the concrete in all environments is 2.0 %.
- The properties can increase or decrease depending upon fiber length and its content. As a result of this CFRC strengths can be greater than that of plain concrete.
- By replacing cement content with CF, decrement in the weight thus INERTIA OF STRUCTURE may result in to low density, slender and economical as well as green structures.
- With the addition of admixture cohesive mix can be made suitably workable.
- It is a versatile material reported as most ductile and energy absorbent have wide scope in earthquake prone areas as well as in marine structures.

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BIOGRAPHIES

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