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STUDY AND PERFORMANCE OF HIGH STRENGTH CONCRETE

B. Ajitha[1], M. Hima Bindu[2]

Assistant Professor[1], M.Tech student [2]

Department of Civil Engineering

JNTUA College of Engineering , Ananthapuram, AP, India

Abstract:

This experiment describes the behavioral study of coconut fiber in concrete structure. The addition of coconut fiber in concrete improves various properties of concrete. Addition of coconut fiber improves the Flexural strength of concrete. The experiment was conducted on high strength concrete (M60) with the addition of coconut fiber with 5 different mix proportions 1%, 2%, 3%, 4%, and 5% by the weight of cement. The Flexural strength of cured concrete evaluated for 3, 7 and 28 days. Test results indicate that addition of coconut fiber by 1% concrete attains maximum strength. Test results indicate that addition of coconut fiber gradually increases Flexural strengths for 3, 7 and 28days. This results show coconut fiber can be used in construction.

Keywords: Coconut coir fiber, workability, Flexure strength.

1.INTRODUCTION:

During the past few years, high-strength concrete (HSC) has been generating increased interest amongst civil and structural engineers. The expanding commercial use of this relatively new construction material can be explained partially by the life cycle cost-performance ratio it offers, as well as its outstanding engineering properties, such as higher compressive and tensile strengths, higher stiffness and better durability, when compared to the conventional normal strength concrete (NSC). From a historical point of view, in the middle of the 20th century concrete with characteristic strength ($f'c$) of 25MPa was considered high-strength. In the 1980s, 50MPa concrete was considered high-strength. About two decades ago, HSC was mostly specified for projects as an alternate design.

Historically, concrete member reinforced with continuous reinforcing bars to withstand tensile stresses and compensate for the lack of ductility and strength. Furthermore, steel reinforcement is adopted to overcome high potentially tensile stresses and shear stresses at critical location in concrete member. Even though the addition of steel reinforcement significantly increases the strength of concrete, the development of micro cracks must be controlled to produce concrete with homogeneous tensile properties. The introduction of fibers is brought in as a solution to develop concrete with enhanced flexural and tensile strength, which is a new form of binder that could combine Portland cement in bonding with cement matrices. Fibers are most generally discontinuous, randomly distributed throughout the cement matrices.

2. MATERIALS AND METHODOLOGY:

The following materials were used for preparing the concrete mix.

1. ACC cement of 53 grade.
2. Fine aggregate i.e. sand
3. Coarse aggregate
4. Coconut fibers
5. SP430
6. Water

Ordinary portland cement of 53 grade ACC cement was used in the project. The fine aggregate was natural sand which is freely available and the coarse aggregate having a size of 20mm and 12mm. The fiber were coconut fibers with length 6mm with approximate mean aspect ratio.

Coconut Coir Fiber:

Fibers were collected from the local temples, cleaned, sun dried, removed dust to analyze its properties. Coconut fibers require no pre-treatment, except for water treatment. Coconut fiber Coconut has high water absorption. Due to this property, the coconut fibers were pre soaked in water for 24 hours.

Details of test: The following tests are performed on concrete blocks reinforced with coconut fiber

- Workability
- Flexure strength

Three beams (150*150*600) for each mix were casted and tested for flexural strength for 3, 7 and 28days. After casting specimens were tested with the of machine.

3. TESTING PROCEDURE:

3.1. Mixing Procedure:

Firstly the coarse aggregates were placed on the floor and it is mixed with the fine aggregate. After that a layer of coconut fiber was mixed with coarse and fine aggregates after that a second layer of coconut fiber is mixed along with the cement. It is thoroughly mixed and at the last water is added to form concrete mix.

3.2. Curing:

The specimens were removed from the moulds after 24 hours of casting and they are put in a water pond until for testing. Some of the specimens were removed from the water after 3, 7 and 28 days of submersion in water for testing the specimens of flexural strength.

3.3. Workability:

3.3.1. Slump:

slump value is zero for all the mixes.

3.3.2. Vee-Bee:

Due to the increase in the fiber content the time will also increases.

Vee - Bee	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
	6	9	13	16	19

3.3.3. Compaction factor:

Compaction factor will decreases with the increase of the coconut fiber.

Compaction factor	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
	0.743	0.736	0.722	0.714	0.706

TEST RESULTS:

Flexure strength:

In this study, the beam specimens of size 150X150X600mm were used. The concrete beams were prepared as per design mix. These beams are placed in curing pond for 28 days. Then these are removed from curing pond and rested in shade for surface dry. The beams are carried to the Flexural testing machine. The test is conducted on a loading frame. The beam specimen is simply supported on two rollers. The beam is checked for its alignment horizontally and is adjusted if necessary. Care has to be taken to ensure that the two loading points were at the same level. The load is applied on the specimen through hydraulic jacks and was measured using a 25 tones pre-calibrated proving ring. The load is transmitted to the beam specimen through the I-section. Using dial gauges, the deflections at the center of span was recorded for each increment of loading. Continuous observations were made until the cracks are identified. The deflecto meters were removed and the loading is continued up to failure of beam takes place. The loading noted at failure is the ultimate load. The apparatus of the Flexural strength test can be shown in the following figure.

Fig.3.1 Flexural strength test

The results that are calculated from the Flexural strength test are tabulated in the following tables 3.1

Table 3.1. Flexural Strength values obtained for HSC Mix M60

% of Coir Fiber	Flexural Strength in N/mm^2		
	3 Days	7 Days	28 Days
0	3	4.35	6.28
1	3.25	4.7	6.62
2	2.9	4.12	6.03
3	2.5	3.9	5.91
4	2.34	3.76	5.74
5	2.2	3.66	5.51

The test results of Flexural strength are shown in tables 5.6. From the obtained results, it is clearly observed that the 28 days Flexural strength has improved up to 1% inclusion and gradually declined to 5%. For 1% inclusion, there is an increase (3.25) of Flexural strength compared to normal conventional concrete. The variation of Flexural strength with 1% Coir fiber can be easily known with the graph. Due to the presence of Coir fiber sudden breaking of beam into two pieces at the time of failure is avoided at ultimate load. Fibers will hold the beam.

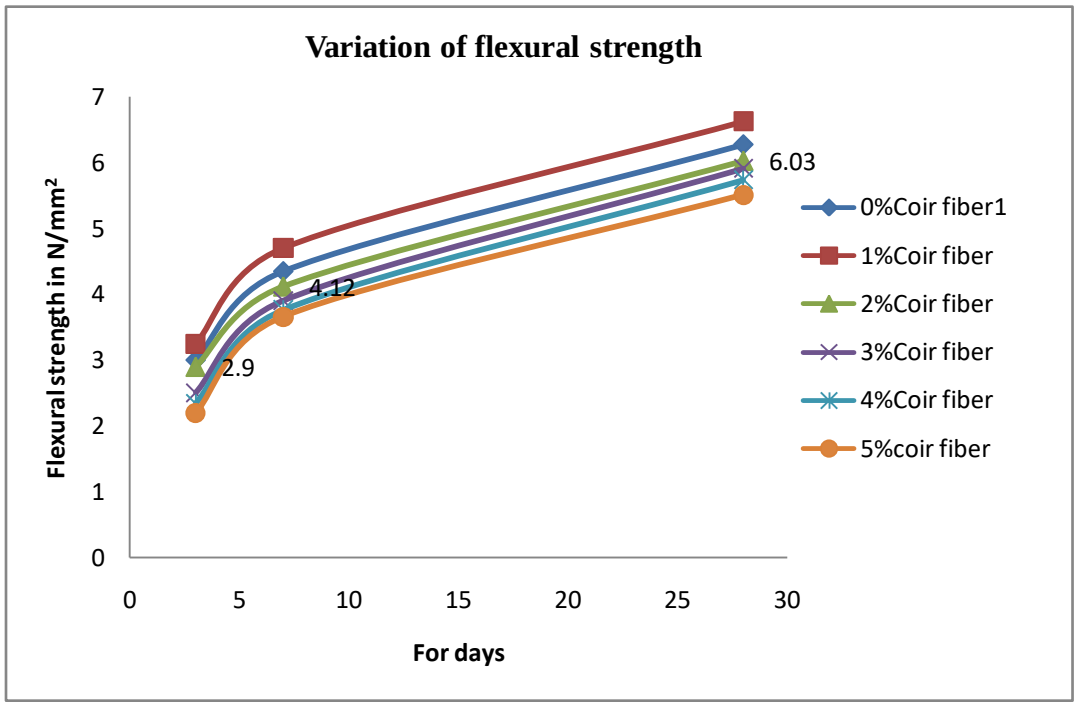

Fig 3.2. Variation of Coir fiber for curing period v/s Flexural strength

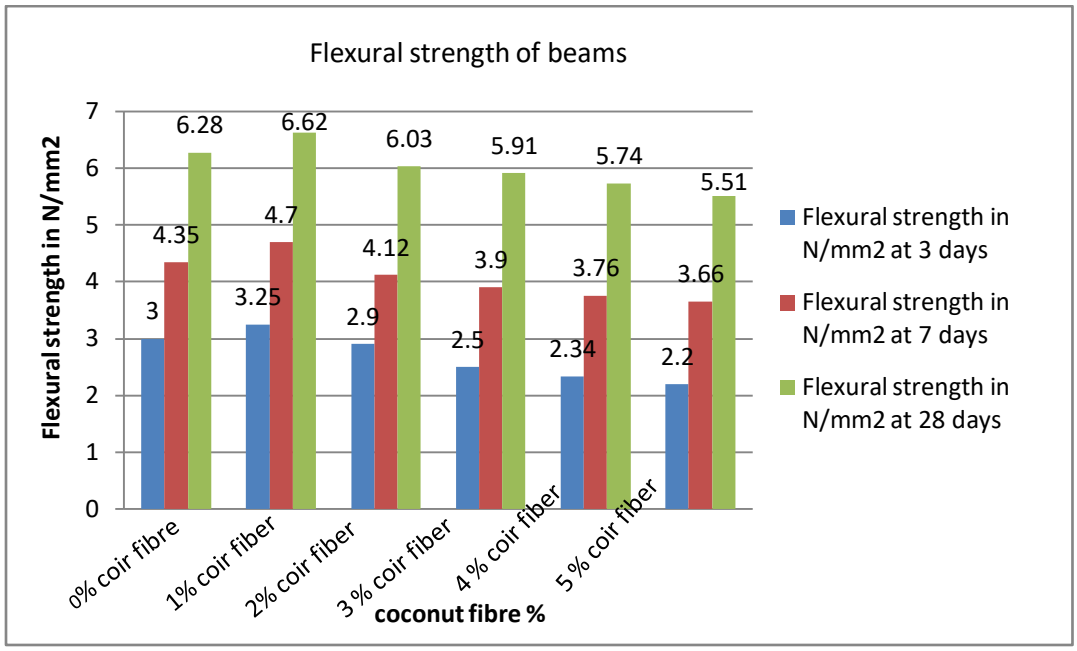

Fig 3.3. Flexural strength variation for various proportions of Coir fiber at 3, 7 and 28 days

4. Conclusions:

1. Coconut fiber being low in density reduces the weight of the fiber reinforced concrete.

2. From the results we can conclude that the maximum compressive split tensile and flexural strength obtained at the 1% of the inclusion of the fibers with respective to normal mix.

3. Since by addition of fibers in the concrete the strengths of the specimens get decreasing and it can be concluded that the fiber should not be used beyond 1%.

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