Research on Coir Fiber Reinforced Cement Concrete

NEERAJ AGARWAL

Civil Engineering department, Krishna Institute of Engineering and Technology
Ghaziabad - Meerut Highway, NH-58, Ghaziabad, Uttar Pradesh, India- 201206

ABSTRACT: - Fiber reinforced concrete (FRC) is a new structural material which is gaining increasing importance. Addition of fiber reinforcement in discrete form improves many engineering properties of concrete. An FRC is a composite material consisting of a cement based matrix with an ordered or random distribution of fiber which can be steel, nylon, coir polythene etc. Development in technology enhances not only human comforts but also destroy the eco-system. FRC is generally made with high cement content & low water content. Plain concrete fails suddenly once the deflection corresponding to ultimate flexural strength is exceeded, on the other hand, fiber reinforced concrete continue to sustain considerable loads ever at deflection considerably in excess of the fracture deflection of plain concrete. Research and developmental work in fiber reinforced concrete composites began in India in the early 1970s. Fiber concrete technology is no longer confined to laboratory experiments-it is used in the production of precast concrete components and for in situ strengthening and repairs of concrete structures.

Keywords: -Compressive Strength, flexural strength, Coir fiber, fiber, reinforced concrete

INTRODUCTION: -

Concrete is weak in tension and has a brittle character. The concept of using fibers to improve the characteristics of construction materials. Use of reinforcement in concrete (reinforced concrete) increases strength and ductility but requires careful placement and labor skill. Alternatively, an introduction of fibers in discrete form in plain or reinforced concrete may provide a better solution. Fibers have been produced in various shapes and sizes from steel, carbon, glass, polypropylene, nylon, rayon, polyethylene, and asbestos, as well as from cotton, coir, sisal, and other natural fibers. Low-modulus fibers such as nylon and polypropylene may not lead to significant improvement in composite strength, but they do help absorb huge amounts of energy and resist impact and shock loading. The compressive strength of concrete is a vital parameter as it decides the other parameters like tension, flexure etc. It was observed that the compressive strength of Recycled Aggregate Concrete (RAC) is about 80% or more than that of the control concrete with Natural Aggregates (NA) when the relative water absorption of aggregate is below 1.8%. However, when the relative water absorption of aggregate is above 5.5%, the compressive strength of RAC drops significantly about 40% as compared with the control concrete mix with NA. The poor development of the RAC compressive strength can be due to a large amount of old cement paste on the surface of recycled aggregates because it causes insufficient hydration and weak interface-zone formed between different components of the concrete matrix. Annual production now approaching about 100 m3. The principal applications are slabs on grade, shotcrete, and precast members, as well as a number of specialty applications. Until now, most of the production of FRC has been for "non-structural" applications, with the fibers added primarily for control of cracking due to plastic or drying shrinkage.

MECHANICAL PROPERTIES OF FRC: -

- **Flexure**

The use of fibers in reinforced concrete flexure member's increases ductility, tensile strength, moment capacity, and stiffness. The fibers improve crack control and preserve post cracking structural integrity of members.

- **Torsion**

The use of fibers eliminates the sudden failure characteristic of plain concrete beams. It increases stiffness, torsional strength, ductility, rotational capacity, and the number of cracks with less crack width. Shear Addition of fibers increases shear capacity of reinforced concrete beams up to 100 percent. Addition of randomly distributed fibers increases shear-friction strength, the first crack strength, and ultimate strength.

- **High Strength Concrete**

Fibers increase the ductility of high strength concrete. The use of high strength concrete and steel produces slender members. Fiber addition will help in controlling cracks and deflections.

- **Cracking and Deflection**

Tests have shown that fiber reinforcement effectively controls cracking and deflection, in addition to strength improvement. In conventionally reinforced concrete beams, fiber addition increases stiffness and reduces deflection.

- **To Increase the Durability of Coir Fibers**

They can be treated with "Benzene diazonium chloride" at PH of concrete about 8.5 to increase the durability of coir fibers (natural fiber).

Experimental Program.

We have taken coir fibers to perform the experiment.it is a natural fiber extracted from the husk of coconut and used in products such as floor mats, doormats, and mattress. Coir is the fibrous material found between the hard, internal shell and the outercoat of a coconut. One of the most important benefits of coir fibers is relatively waterproof and is one of the few natural fibers resistant to damage by salt water.

- **Materials and Properties:**

The materials selected for this experimental study includes normal natural recycled coarse aggregate, manufactured sand as fine aggregate, cement, coir fiber, reinforcement and portable drinking water. The physical and chemical properties of each ingredient have considerable role in the desirable properties of concrete like strength and workability.

- **Cement:**

The cement used for this project work is Portland slag cement. It gives low heat of hydration.

- Brand of cement PPC
- Standard consistency 34%
- Initial setting time (in mins) 147
- Final setting time (in mins) 325
- Specific gravity 2.91

- **Fine aggregates:**

It should be passed through IS Sieve 4.75 mm. It should have fitness modulus 2.50-3.50 and silt contents should not be more than 4%. Manufacturer's sand has been used for the present investigation; it is also called M sand. Manufactured sand has been regularly used to make quality concrete for decades in India and abroad. M-sand has crushed aggregates produced from hard granite stone which is cubically shaped with grounded edges, washed and graded with consistency to be used as a substitute of river sand.

- **Coarse aggregates:**

It should be hard, strong, dense, durable and clean. It must be free from the vein, adherent coatings and injurious amount of disintegrated pieces, alkalis, vegetable matters and other deleterious substances. It should be roughly cubical in shape. Flaky pieces should be avoided. It should confirm to IS 2838(I). Coarse Aggregate used are of two sizes 20 mm maximum size and 12.5 mm maximum size.

- **Water**:

Water should be free of acids, oils, alkalies, vegetables or other organic impurities. Soft waters also produce weaker concrete. Water has two functions in a concrete mix. Firstly, it reacts chemically with the cement to form the cement paste in which the inert aggregates are held in suspension until the cement paste has hardened. Secondly, it serves as a lubricant in the mixture of fine aggregates and cement.

Research: -

Research to analyze the percentage of increase in compressive strength and flexural strength of concrete beam due to coir fibers. To analyze better result worked on individual one by one on Plain cement concrete(PCC) and then Reinforced cement concrete(RCC) and compare with the normal concrete beam.

1. Plain Cement Concrete Beam(PCC): -

Calculation: -

Standard Size of Beam = (500*100*100) mm

= 0.005 m^3

Weight of Concrete Beam = 2400*0.005

= 12 Kg

Coir Fibers used 0.2% of 12 Kg

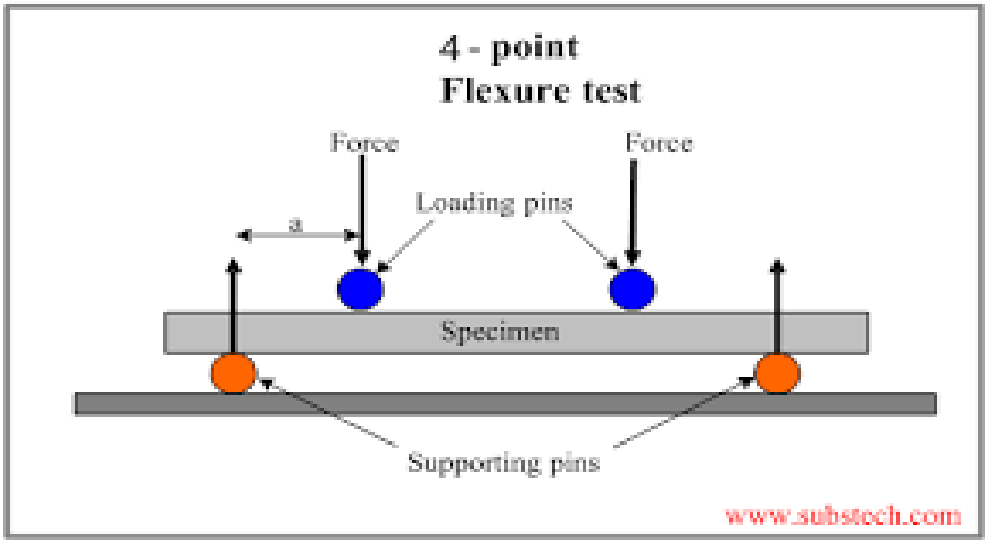
Means 24 gm of coir fibers is used

Now, Total weight of Plain Concrete Beam = 12.024 Kg

Water Cement Ratio = 0.5

Result: -

- Flexural Strength of Normal Beam is 2.9 N/mm^2
- Flexural Strength of Coir fiber concrete beam is 3.96 N/mm^2
- ✓ Increment of 36 % in Flexural Strength of Plain Concrete Beam
- Tested by the use of 4-point Bend Setup



2. Reinforcement Cement Concrete: -

Calculation: -

Mixing of coir fiber and rapping of coir fiber on steel bar as well

Standard Size of Beam = (500*100*100) mm

= 0.005 m^3

Weight of Reinforcement Cement Concrete = 2500*0.005

= 12.5 Kg

Coir fiber 0.3% of 12.5 Kg is used

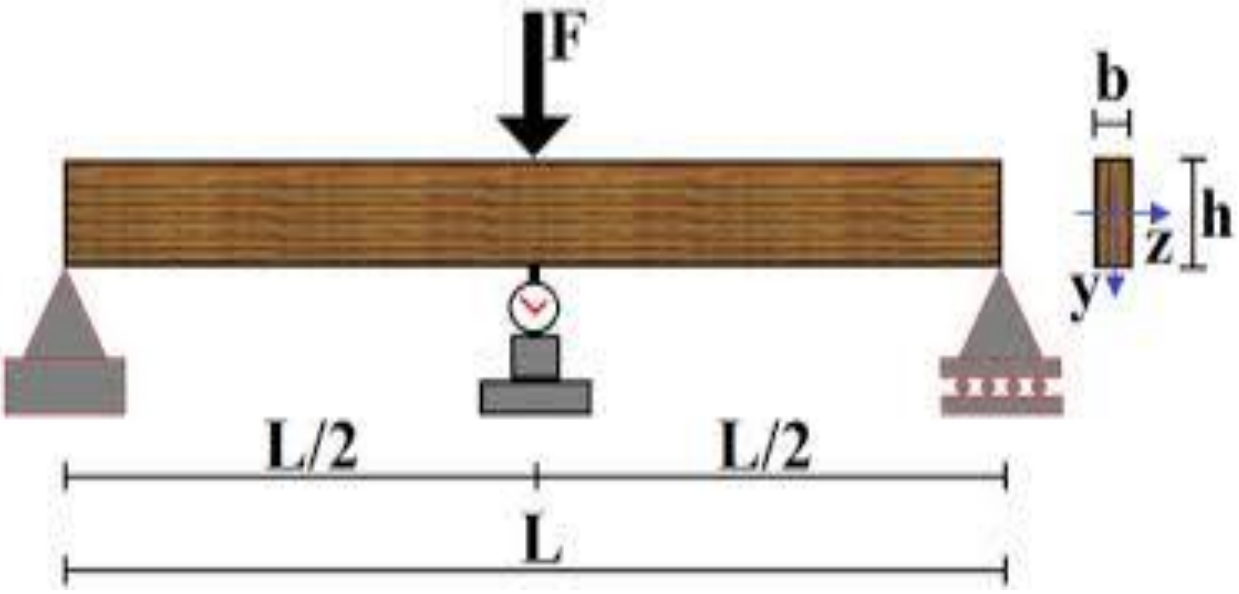
Means, 35 gm of Coir Fiber

Now, Total Weight of beam = 12.535 Kg

Water Cement Ratio = 0.5

Result: -

- Flexural Strength of Normal Beam is 12.35 N/mm^2
- Flexural Strength of Coir reinforcement is 18.30 N/mm^2
- Flexural Strength of Coir reinforcement + fiber is 19.50 N/mm^2
- Compressive Strength of Normal beam is 20.9 N/mm^2
- Compressive Strength of Coir reinforcement is 26.1 N/mm^2
- Compressive Strength of Coir reinforcement + fiber is 29.1 N/mm^2
  - ✓ Increment of 30% in compressive strength and 35 % in flexural Strength
  - ✓ Tested by the use of 3-pt bending setup



Applications: -

The uniform dispersion of fibers throughout the concrete mix provides isotropic properties not common to conventionally reinforced concrete. The applications of fibers in concrete industries depend on the designer and builder in taking advantage of the static and dynamic characteristics of this new material. The main area of FRC applications are-

- **Runway, Aircraft Parking, and Pavements**

For the same wheel load, FRC slabs could be about one half the thickness of the plain concrete slab. Compared to a 375mm thicknesses of the conventionally reinforced concrete slab, a 150mm thick crimped-end FRC slab was used to overlay an existing asphaltic-paved aircraft parking area. FRC pavements are now in service in severe and mild environments.

- **Tunnel Lining and Slope Stabilization**

Steel fiber reinforced shotcrete (SFRS) is being used to line underground openings and rock slope stabilization. It eliminates the need for mesh reinforcement and scaffolding.

- **Blast Resistant Structures**

When plain concrete slabs are reinforced conventionally, tests showed (llj that there is no reduction of fragment velocities or the number of fragments under blast and shock waves. Similarly, reinforced slabs of fibrous concrete, however, showed 20 percent reduction in velocities, and over 80 percent in fragmentations.

- **Thin Shell, Walls, Pipes, and Manholes**

Fibrous concrete permits the use of thinner flat and curved structural elements. Steel fibrous shotcrete is used in the construction of hemispherical domes using the inflated membrane process. Glass fiber reinforced cement or concrete (GFRC), made by the spray-up process, have been used to construct wall panels. Steel and glass fibers addition in concrete pipes and manholes improves strength, reduces thickness, and diminishes handling damages.

- **Dams and Hydraulic Structure**

FRC is being used for the construction and repair of dams and other hydraulic structures to provide resistance to cavitation and severe erosion caused by the impact of large Waterboro debris.

- **Other Applications**

These include machine tool frames, lighting poles, water and oil tanks and concrete repairs.

CONCLUSIONS: -

1. Fiber addition improves the ductility of concrete & its post-cracking load carrying capacity.

2. Increases the cube compressive strength of concrete in 7 days to an extent of 0.30%

3. The most important contribution of fiber reinforcement in concrete is not to strength but to the flexural toughness of materials.

4. The increase in the various mechanical properties of the concrete mixes with coir fiber is not in the same league as that of the steel fiber.

5.Coir Reinforcement is non-corrosiveness, low weight, high strength and low–thermal conductivity.

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