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Effects of Structural Characteristics of Coconut-Coir Fibre Reinforced Concrete (CFRC) with Plain Cement Concrete (PCC)

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Abstract - *Plain cement Concrete is brittle materials. To failure suddenly without any warning. So used fibres materials to reduced shrinkage, drying shrinkage, deflections, micro cracking. Frc used in concrete to also improving structural characteristics properties such as compressive strength, split tensile strength, flexural strength. The usefulness of fibre reinforced concrete (frc) in various civil engineering applications in indisputable. Fibre reinforced concrete has so far been successfully used in slabs on grade, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repair, crash barriers, footings, hydraulic structures and many other applications.*

Coconut coir fibre reinforced concrete (cfrc) is gaining attention as an effective way to improve the performance of concrete. To check structural characteristics properties in laboratory use in cubes, cylinders and checked characteristics strength, split tensile strength.

***Key Words*- CFRC, Concrete Properties, Coconut Coir.**

1. INTRODUCTION

1.1 GENERAL

The fibre reinforced concrete (frc) is termed so because of the presence of materials having fibrous properties, which helps in enhancing the integrity and stability of a structural member. Natural reinforcing materials can be obtained at low cost levels of energy using local manpower and technology Coconut fibre reinforced concrete have been used for making roof tiles, corrugated sheets , pipes , silos and tanks .

There are two types of coconut fibres, brown fibre extracted from matured coconuts and white fibres from immature coconuts. Brown fibres are thick, strong and have high abrasion resistance. White fibres are smoother and finer, but also weaker.

Coconut fibres are commercial available in three forms, namely bristle (long fibres), mattress (relatively shorts) and decorticated (mixed fibres). These different types of fibres have different uses depending upon the requirements .In engineering brown fibres are mostly used. They are resistant to fungi and rot , provide excellent insulation against temperature and sound , not easily combustible , flame retardant ,unaffected by moisture and dampness ,tough and durable , resilient ,springs ,back to shape even after constant use , totally static free and easy to clean .

2. OBJECTIVES

1. To study the properties of materials by conducting basic tests on sand, cement, coarse aggregate and coconut – coir fibre.
2. To study the strength parameters like split tensile strength and compressive strength in concrete by partially replacing of coconut coir fibres with respect to weight of cement.
3. Comparison of structural characteristics of PCC with CFRC by conducting compressive and split tensile strength tests.
4. Comparing of natural fibre replacement and artificial fibre replacement in concrete by compressive and split tensile strength tests.

3. FUTURE SCOPE

1. The workability of concrete is increased by the addition of different fibre proportion.
2. By changing aspect ratio it is able to check strength parameters of concrete.
3. Instead of coconut coir other natural fibres will be used for compression with conventional concrete.
4. Using natural or synthetic fibres as constant it is possible to study the behaviour of concrete by finding a suitable replacement for cement, fine aggregate, coarse aggregate.

4. LITRATURE SURVEY

4.1 GENERAL

This chapters broadly deals with the various literature reviews carried out by many researchers to increase or to study the effects of fibres in concrete.

1. Salwick and Amit (2017)

The experimental investigation carried out a research work on the coconut coir and polypropylene reinforced concrete. Use grade of concrete M25. They casted cubes and cylinders specimens for their study and tested at 7, 14 and 28 day of curing. They varied jute percentage by 0, 0.1, 0.5, and 1 % replacement. They selected the aspect ratio as 200, 400, 666.7 resp. They got ultimate compressive and split tensile strength at 0.1 % replacement of fibre. They got highest compressive and split tensile value are 33.3 N/mm2 and 2.7 N/mm2 respectively.

2. Anthony and Joshua, (2015)
In this paper studies are carried out on the use of coconut husk fibres for improved compressive and flexural strength of concrete. They varied the fibre percentages from 0, 0.25%, 0.75%, and 1% with respect to weight of the aggregate .They casted 16 beams and 40 cubes. The test result shows that both compressive and tensile strength shows increased strength at 0.5% dosage after that the strength gradually decreases up to 0.75%, to 1%.

5. MATERIALS USED

1. Cement – OPC 43 Grade
2. Fine Aggregate – Passing through 4.75 sieve
3. Coarse Aggregate- 20 mm and down size
4. Coconut Coir- It is strong and light in weight .Added with fibre 0.35%, 0.7%, 1.05%, 1.4 %.
5. Water – Potable water

6. EXPERIMENTAL PROGRAMME

6.1 GENERAL

The properties of cement like standard consistency , specific gravity , fineness , soundness test etc. , and the properties of fine aggregates and coarse aggregate like specific gravity , water absorption ,etc. is calculated. According to the obtained properties of materials as IS :10262-2009, the proportions of water: cement: fine aggregate: coarse aggregate for grade M20 are determined and executed.

6.2 TESTS ON CEMENT

The cement is tested as per IS 8112 -1989 and the properties are listed below and current project work opc 43 grade with parashakti cement is used

Table 1 - Properties of cement

Sr .No	Property	Value
1	Fineness Test	4.6%
2	Consistency Test	32%
3	Setting Time	
A	Initial setting time	38 Min
B	Final setting time	450 min
4	Specific gravity	3.05
5	Soundness Test	5mm

6.3 TESTS ON FINE AGGREGATE

The fine aggregate passing through 4.75 mm sieve is tested as per IS 2386- 1967 (Part –III) and the properties are listed below

Table 2- Properties of fine aggregate

Sr. No	Property	Value
1	Sieve Analysis	Zone-II
2	Specific gravity	2.06
3	Absorption of water	0.5%

6.4 TEST ON COARSE AGGREGATE

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

Table 3- Properties of coarse aggregate

Sr . No	Property	Value
1	Crushing value	18.01%
2	Impact value	11.26%
3	Abrasion value	54.49%
4	Specific gravity	2.56
5	Water absorption	1%

6.5 PROPERTIES OF COCONUT – COIR

The coconut coir fibre is collected from hanuman temple, Nilanga, Dist- Latur. Average diameter of fibre measured from vernier calliper is 30 microns. Average length of fibre measured is 12mm to 30mm and Density of coconut coir is 1.15 gms/cc.

6.6 CONCRETE MIX DESIGN

The mix design for concrete was carried out with guidelines from IS 10262: 2009 For M20 grade concrete with the water cement ratio of 0.45

1. **Water =** 199.39 litres

2. Cement = 442 kg /m3

3. W/C Ratio = 0.45

4. Aggregate

- coarse aggregate fraction = 0.6

- Fine Aggregate fraction =1-0.64=0.36

5. a. Volume of concrete = 1 m3

b. volume of cement =0.140 m3

c. volume of water = 0.199 m3

d. volume of aggregate in all = 0.67 m3

e. coarse aggregate =1083.01 kg/m3

f. Fine aggregate = 598.176 kg/m3

Table 5: Properties of Concrete for 1 m3

Water	Cement	Fine aggregate	Coarse aggregate
2.37 lit	442 kg/m3	598.176 kg/m3	1083.01 kg/m3

Mix Proportion is 1 :1.35 :2.45 :0.45 **(C: S: A : W)**

7. TEST ON FRESH CONCRETE

Tests on fresh concrete were carried out determine the workability of normal concrete as well as cfrc as per IS 1199-1959 . The properties of the tests are listed in below .

Table 6: Properties of fresh concrete

Type of concrete	Slump value
Normal concrete	97
Adding with 0.35% coir	83
Adding with 0.70% coir	79
Adding with 1.05% coir	66
Adding with 1.4% coir	66

8. CASTING

8.1 SPECIMEN DETAILS

Various concrete cubes of dimension 150*150*150 mm and cylinders of diameter 150 mm and height of 300 mm were casted to check compressive strength at 7 , 14, and 28 days . Total cube 45 and cylinder 45 are casted in this project and check in laboratory. Curing after 7 days , 14 days and 28 days checks value of compressive strength and split tensile strength.

9. TESTING AND RESULT

9.1 COMPRESSIVE STRENGTH TEST

Compressive strength is the maximum force per unit area in compression which a material can withstand before breaking.

The compressive strength of the various mix cubes were recorded after crushing under compression testing machine (CMT). The size of cubes is 150*150*150 mm. The specimen cured for 7, 14, and 28 days are crushed and the pertaining loads at ultimate (break) compression are calculated.

Procedure:

The specimen to be tested are taken out from water and wiped to remove excess water and grit present on the surface. The specimen are tested for each type of the machine in such a manner that the laod shall be applied to opposite sides of the cubes as cast, that is not the top and bottom. The load shall be applied without shock and increased continuously at a rate of approximate 140 kg/sq cm/min until resistance of the specimen to the increasing load applied three specimen shall then be recorded and compressive strength is find out by ,

COMPRESSIVE STRENGTH = P/B*D

Where , P = Applied load in N

B= Breadth of cube in mm

D= Depth of cube in mm

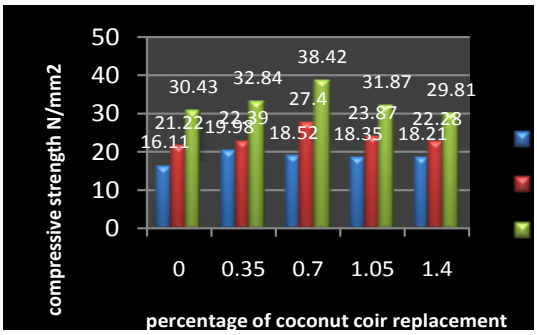

Chart 1- Test result of compressive strength

Fig 1- Testing and casting

Fig 2 -Mixing and curing

9.2 SPLIT TENSILE STRENGTH TEST

Specimens are prepared in cylindrical shape and the size of cylinder is 300mm length and 150mm diameter. The specimen cured for 7,14 and 28 days are crushed and the pertaining loads at ultimate(break) split tensile are calculated

Procedure:

The specimen to be tested are taken out from water and clean with cloth. The bearing surfaces of the supporting and loading part of CTM is wiped and clean and any loose sand or other material removed from the surface of the specimen where they are to make contact with the surface .Apply the load without shock and increase it continuously at the rate to produce a split tensile stress of approximately 1.4 to 2.1 N/mm2/min, until no greater load can be sustained. Record the maximum load applied to specimen and calculate split tensile strength using the relation,

SPLIT TENSILE STRENGTH = $2P/\pi DL$

Where , P= Applied load in N

D= Diameter of cylinder in mm

L= Length of cylinder in mm

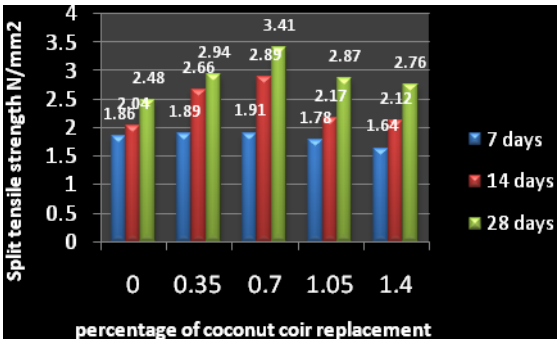

Chart 2 – Testing of split tensile strength

Fig 3- Testing of cylinder

10. CONCLUSIONS

On the objectives set in the present study and the experimental Based work carried out in the laboratory the following conclusions are drawn.

1. Basic tests for materials such as cement, sand, and coarse aggregates determined successfully.

2.The properties of cement such as specific gravity, standard consistency ,initial setting time , final setting time and soundness test results values 3.05 ,32 %,38 min ,450 min and 5mm respectively. These are found to be in the range of permissible limits as per code book standards.

3.Then the properties fine as well as coarse aggregate like specific gravity, crushing value, impact value ,abrasion value are range from 2.56, 18.01 %, 11.26%, and 54.49 % respectively which comes under permissible limits .

4. Compressive strength for pcc 16.11 N/mm2, 21.22 N/ mm2, 30.43 N/mm2 for 7 , 14 and 28 days .

5. Compressive strength for CFRC highest or ultimate strength 38.42 N/mm2 for dosage 0.7% fiber and increase again dosage decreasing in compressive strength.

6. Split tensile strength value for pcc 1.86 N/mm2, 2.04 N/mm2, 2.48 N/mm2 for 7, 14, and 28 days respectively, the

highest split tensile value 3.41 N/mm2 for the dosage 0.7% used and other dosage decreasing value.

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