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A COMPARATIVE STUDY ON STRENGTH OF JUTE FIBRE OR POLYPROPYLENE FIBRE REINFORCED CONCRETE (JFRC OR PFRC) WITH PLAIN CEMENT CONCRETE (PCC)

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Abstract - *Plain cement Concrete is brittle material .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 application in indisputable.*

Jute or polypropylene fibre reinforced concrete (JFRC or PFRC) 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 Mix proportion of various constitution of 0.35 %, 0.70%, 1.05% and 1.4% adding this material fibre with the replacement of cement weights. Jute fibre is a natural material and strongly, polypropylene fibre is a artificial fibres and its also increasing strength of structural properties. The highest split tensile value 3.41 N/mm2 for the dosage 0.7% used and other dosage decreasing value.

***Key Words*: - JFRC, PFRC, CONCRETE PROPERTIES, JUTE FIBRE, POLYPROPYLENE FIBRE**

1. INTRODUCTION

1.1 GENERAL

The most desirable and the most commonly used material in construction industry is Concrete. This is due to the flexibility it offers in being able to cast it into any shape. In some places it is also been used for the construction of walls which were mostly built using stone and brick masonry. The major questions that arise in using concrete as building material are resilience, flexibility and ability to distribute stresses. The current experiment discusses the chances of using polypropylene fibres, jute fibre and coconut coir in concrete at different proportion of fibres. The main purpose of study this new technology is to develop the various cement products as thin elements. In cement-based composites, the use of fibres as reinforcement helps in enhancing its mechanical behaviour. In recent times, innovative techniques have resulted in development of various types of fabrics with better control over the geometry and orientation of the yarn.

1.2 Fibre reinforced concrete

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. Short, discrete fibres are mixed with the concrete during batching. The concrete is then thoroughly mixed in order to distribute the fibres uniformly in the mix and randomly orient them. FRC includes steel, glass, nylon, coir, glass, carbon, jute, polypropylene, polyester and many other synthetic and natural materials which induce various properties to the concrete. In addition, the characteristic of FRC changes for different concrete mixes, the quantity of fibre materials, its distribution and orientation. The concept of using fibres as reinforcing agents in concrete is not a recent technology. FRC technology has been present around for a long time. Fibre reinforced concrete provides crack resisting against opening and propagation. It enhances the ductility of the concrete and its energy absorption and improves the durability, tensile strength and reduces the shrinkage properties.

1.3 JUTE FIBRE

Jute is a long, soft, shiny vegetable fibre that can be spun into coarse, strong threads. It is produced primarily from plants in the genus corchorus, which was once classified with the family tiliaceae, and more recently with malvaceae. Jute is one of the most affordable natural fibres, and secondly only to cotton in the amount produced and variety of uses. Jute fibres are composed primarily of the plant materials cellulose and lignin. Fibre surface and Appearance is yellow to brown to dirty grey in colour and natural Silky lustrous appearance. An elastic property of a fibre is stiff and not tends to return its original length completely when the tension is relaxed.

1.4 POLYPROPYLENE FIBRE

Polypropylene fibre was first used to reinforce concrete in the 1960s. Polypropylene is a synthetic hydrocarbon polymer, the fibre of which is made using extrusion processes by hot drawing the material through a die. Polypropylene fibres are produced as continuous mono-filaments, with circular cross section that can be chopped to required lengths, or fibrillated films or tapes of rectangular cross section.

Polypropylene fibres are hydrophobic and therefore have the disadvantages of poor bond chacteristics with cement matrix, a low melting point, high combustibility and a relatively low modulus of elasticity. Long polypropylene can prove difficult to mix due to their flexibility and tendency to wrap around the leading edges of mixer blades. Polypropylene fibres are tough but have low tensile strength and modulus of elasticity; they have plastic stress-strain characteristics.

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 splite tensile strength and compressive strength in concrete by partially replacing of Jute fibres or polypropylene fibres with respect to weight of cement.
3. Comparison of structural characteristics of PCC with JFRC OR PFRC 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 Jute fibre other Artificial Polypropylene 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. Literature 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. Gopi and Maulik, (2017).

They carried out research on the effects of the jute fibres on fibre reinforced concrete. They used M25 grade concrete for their work. They casted cube and cylinder specimens for their study and tested at 7, 14 and 28 days of curing. They varied jute percentages by 0, 0.1, 0.5 and 1% replacement. They selected the aspect ratios as 200, 400 and 666.7 respectively. 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/mm^2 and 2.7 N/mm^2 respectively.

2. Milind, (2015).

This paper aims on experimental investigation on performance of polypropylene fibre reinforced concrete. This research paper deals with the study of effects of polypropylene fibre in concrete. He used fibre length of 6.2 mm; diameter of 0.0 445mm and aspect ratio of fibre is 139.33 for the present study. He varied fibre percentages from 0, 0.5%, 1%, 1.5% and 2% in both M30 and M40 grade concrete. The results describes there is a significant increase in compressive, split tensile and flexure strength at 0.5% dosage. Further increase in fibre quantity shows gradual decreased values.

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. Jute Fibre- It is strong and light in weight .Added with fibre 0.35%, 0.7%, 1.05%, 1.4 %.
5. Polypropylene Fibre
6. 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 JUTE FIBRE

Jute is a long, soft, shiny vegetable fibre that can be spun into coarse, strong threads. It is one of the type of natural fibres. The jute fibre for the present project work we have brought from Delhi.

Fig 1- Jute Fibre

Diameter of jute are 30 microns , Length 12mm to 16mm ,Density 1.3 gms/cc , Tenacity 440-533 MN/m2 , Elongation 1-1.2% **.**

6.6 Properties of polypropylene Fibre

Polypropylene is a synthetic fibre which is transformed from 85% propylene. The monomer of polypropylene is propylene. Polypropylene is a by-product of petroleum. It is a thermoplastic. In this study polypropylene triangular type CTP2024 is used. Polypropylene fibre brought from Pune.

Fig 2- Polypropylene Fibre

The properties of polypropylene fibre used in the present project work are listed in the below

Shape of polypropylene is Triangular , Cut length 12mm, Effective Diameter 25-40 microns , Specific gravity 0.9-0.91 ,Melting point 160-165 degree/c , Tensile Strength 4-6 Gpa, Elongation 60-90%, Youngs Modulus > 4000 Mpa, Alkaline stability very good.

6.7 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 4: 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 jfrc or pfrc as per IS 1199-1959. The properties of the tests are listed in table 5

Table 5: Properties of fresh concrete

Type of Concrete	Slump value (jute) fibre in mm	Slump value (polypropylene) fibre in mm
Normal Concrete	97	97
Adding 0.35%	81	87
Adding 0.70%	76	82
Adding 1.05%	70	74
Adding 1.4%	64	71

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 for jute fibre and polypropylene fibre 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 Results

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

1. Polypropylene Fibre :

Table 6 - Compressive strength test results of polypropylene fibre replacement

Sr. No	Percentage of polypropylene fibre replacement	Compressive strength results in (N/mm2)		
		7 days	14 days	28 days
1	0	16.11	21.22	30.43
2	0.35	19.76	22.84	31.56
3	0.7	20.42	24.90	34.83
4	1.05	18.77	21.32	32.24
5	1.4	17.64	20.36	30.19

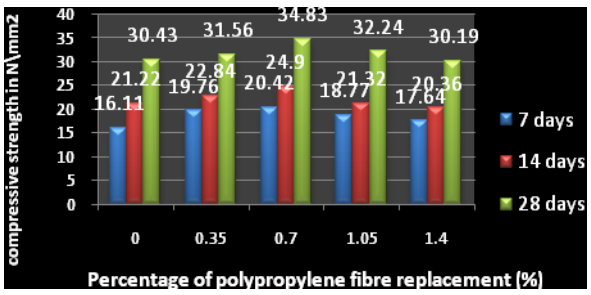

Chart 1: Compressive strength of concrete at various percentages of polypropylene fibre

2. Jute fibre

Table 7 : Compressive strength test results of jute fibre replacement

Sr.no	Percentage of jute fibre replacement (%)	Compressive strength results in N\mm2		
		7 days	14 days	28 days
1	0	16.11	21.22	30.43
2	0.35	20.76	26.75	35.26
3	0.7	19.36	25.26	31.56
4	1.05	18.32	24.98	28.47
5	1.4	17.83	22.42	26.58

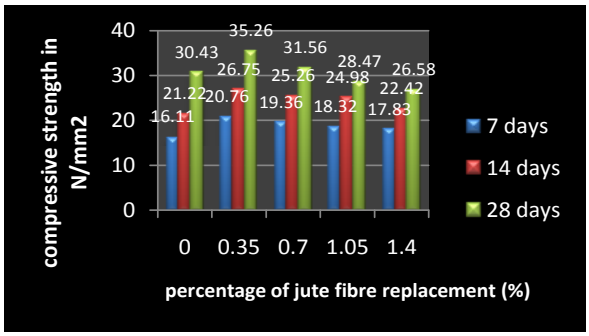

Chart 2: Compressive strength of concrete at various percentages of jute fibre

Fig 3: Casting & Testing

Fig 4 : Mixing & 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/π DL

Where, P= Applied load in N

D= Diameter of cylinder in mm

L= Length of cylinder in mm

1. POLYPROPYLENE FIBRE

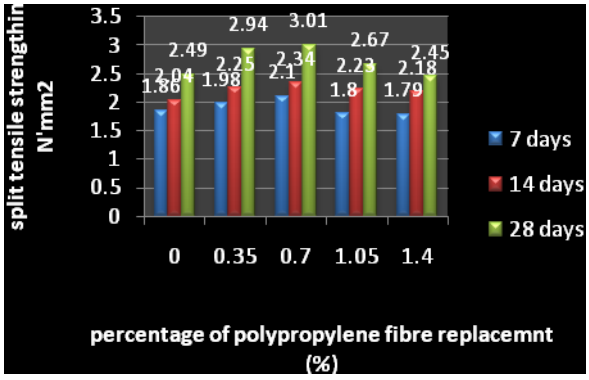

Chart 3 :TEST RESULTS OF VARIOUS % POLYPROPYLENE OF SPLIT TENSILE STRENGTH

2. JUTE FIBRE

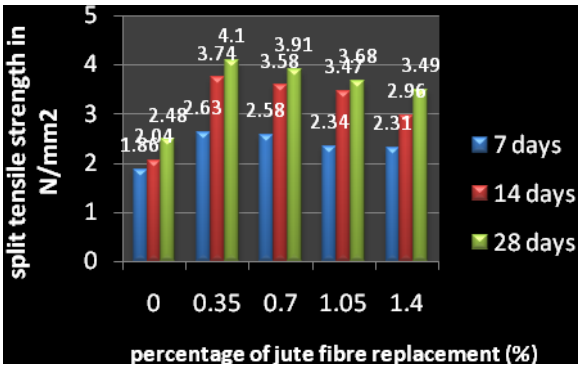

Chart 4 : Testing result of various (%) of jute fibre Split tensile strength

Fig 5-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 JFRC highest or ultimate strength 35.26 N/mm2 for dosage 0.35% 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.

7. Compressive strength for PFRC highest value or Ultimate strength 34.83 N/mm2 for the dosage 0.7 % and after increasing dosage the compressive strength are decreases.

8. Split tensile strength value for 3.01 N/mm2 polypropylene fibre for the dosage 0.7% and 4.1 N/mm2 Jute fibre for the 0.35%.

11. REFERENCES

[1]. Nithin Sam and Sheeja M K,(2016) , "Durability study on coir fibre reinforced concrete ," IJERT Vol.5,ISSN:2278-0181,pp 481-484

[2].Shreeshail B H, Jaydeep Chougale , Dhanraj Pimple , Amar Kulkarni , (2014), " Effects of coconut fibre on the properties of concrete ," IJERT , Vol 03, Issue 12, e-ISSN: 2319-1163, p-ISSN:2321-7308, pp.5-11

[3].Salwick kumar verma and Prof. Amit Kumar Ashirwar ,(2017), "Coconut coir and polypropylene reinforced concrete ," IJERT ,Vol.6, Issue 05 , ISSN:2278-0181

[4]. Milind V Mohad,(2015) , " Performance of polypropylene fibre reinforced concrete" , Journal of mechanical and civil engineering , Vol 12, Issue 01, ver 1 , e-ISSN:2278-1684, p-ISSN:2320-334X, pp-28-36.

[5]. Gopi Raval and Maulik Kanasagra , (2017), " Effects of jute fibres on fibre reinforced concrete ," International Journal of Innovative and Engineering Research in Engineering , Vol.4 , Issue 8 ,e-ISSN:2394-3343,p-ISSN:2394-5494 ,pp.7-12

[6]. IS 456-2000 Plain and reinforced concrete – code of practice. IS 516-1959 method of test for strength of concrete.

[7]. Using Internet

[8]. Concrete Technology, reference book by M.S. Shetty.

BIOGRAPHIES

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