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EXPERIMENTAL INVESTIGATION ON HIGH STRENGTH CONCRETE USING JUTE FIBRE

PREETHAM N[1], Karthick B[2]

[1]PG Student, Dept. of Structural Engg, CSI College of Engineering, Tamil Nadu, India,
[2]Associate Professor, Dept of Structural Engg, CSI college of Engineering, Tamil Nadu, India,
[3]Head of the Department, Dept. of Structural Engg, CSI college of Engineering, Tamil Nadu, India,

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Abstract: *The objective of this experimental investigation is to study the behaviour of high strength concrete beams using Jute fibre. M-Sand is used as Fine Aggregate and Super plasticizers are used to achieve the required workability. In this investigation High Strength Concrete of M_{60} grade will be used and the laboratory investigation will be carried out with a constant water/binder ratio of 0.30. High Strength Concrete M_{60} grade concrete with Jute fibre using of 0%, 2% , 4% and cement and coarse aggregate of 20mm, will be used and the mechanical properties of concrete such as Compressive Strength, Flexural Strength and Split Tensile Strength of the concrete specimens will be studied and compared.*

KEYWORDS: *Jute* fiber, compressive strength, split tensile strength, flexural strength.

1. INTRODUCTION

The design of durable and low cost fiber plain cement concrete for building construction is a technological challenge in developing countries. The type of fibres currently been used include steel, glass, polymers, carbon and natural fibres. Considerable researches are being done for use of reinforcing fibres like jute, bamboo, sisal, coconut husk, sugarcane bagasse in cement composites mostly in case of building materials. The moderate and severe earthquakes have struck different places in the world, causing severe damage to reinforcement concrete (RC) structure Retrofitting of existing structures is a major challenge that modern Civil Engineering field is a facing these days. Recent evaluation of Civil Engineering structure has demonstrated is that most of them will need major repairs in the near future. . Economic considerations have restricted the use of carbon fibers in cementations composites on a commercial level for their non-ecological performance.

Natural fibers have the potential to be used as reinforcement to overcome the inherent deficiencies in cementations materials. Considerable researches are being done for use of reinforcing fibres like jute, bamboo, sisal, aware, coconut husk, sugarcane bagasse in cement composites mostly in case of building materials. Use of natural fibers in a relatively brittle cement matrix has achieved considerable strength, and toughness of the composite. The durability of such fibres in a highly alkaline cement matrix must be taken into consideration by effective modifications. A specific chemical composition has to be chosen that can modify the fibre surface as well as strengthen the cement composite.

A. Jute Fiber

Jute is used as a fibre reinforcing material in concrete for the following reasons: i. It has a high tensile strength which is equal to that of a copper wire (200Mpa) with similar diameter. ii. Jute, a non-degradable matter is creating an environmental problem so its use as a fiber reinforcing material can minimize the problem. iii. It is also available in abundance and at a very low cost. iv. It reinforces the mortar and prevents it from sapling. The aspect ratio of the jute fibre ranges from 30 to 150. And the length of jute used in this project varies from 15mm to 60mm. Aspect ratio (the length of a fibre divided by its diameter), Orientation and distribution of the fibres in the matrix. Divided by its diameter), Orientation and distribution of the fibres in the matrix.

2. MATERIALS AND MIX PROPORTIONS

The materials used for the preparation of concrete mix are cement paste, coarse and fine aggregates, water, superplasticizers and water.

Mix design of M_{20} grade of concrete is designed using IS 10262:2009. A mix proportion of 1: 1.03: 1.973:0.26 (cement: fine aggregates: coarse aggregates: water) for M_{20} grade was calculated. Portland cement of grade 53 was used confirming to IS 12269:2013; water cement ratio of 0.26 was maintained for all mixes. Jute fiber of dosages 0%, 2%, 4 % by volume fraction of concrete.

Different dosages of basalt fiber is given below

M1- 0 % Jute Fiber Reinforced Concrete.

M2- 2 % Jute Fiber Reinforced Concrete.

M3- 4 % Jute Fiber Reinforced Concrete.

3. EXPERIMENTAL SETUP

Cube of mould size 150mm x 150mm x 150mm, cylinders of mould size 100mm x 200mm and beam mould of size 100mm x 150mm were cast and cured.

4. TESTS ON CONCRETE

4.1 Basic Tests on Materials

Specific gravity test was done on fine and coarse aggregates using pycnometer. The fineness modulus was calculated using sieve analysis test.

The impact test was done to determine the toughness using impact testing machine,

A. Tests on Fresh Concrete

The workability of fresh concrete is measured using the Vie Bee Consist meter apparatus. This test is used to measure the change in the concrete shape from slump cone to cylinder by mode of vibration.

B. Tests on Hardened Concrete

Compressive strength

Compressive strength tests were carried out on concrete cubes in Universal Testing Machine (UTM) of capacity 2000kN under 140kg/sq.cm/min loading rate, until the resistance of the specimen to the increasing load can be sustained. The results are shown in Table-IV. The compressive strength of concrete can be calculated using Equation (1).

$$f_{cu} = P / A \ (N/mm^2) \quad (1)$$

Where,

f_{cu} = compressive strength of concrete (N/mm^2)

P = load applied (N)

A = cross sectional area (mm^2)

Flexural strength

The flexural strength or modulus of rupture of concrete was determined for the beams cast. The results are shown in Table-V. The flexural strength of concrete can be calculated using Equation (2).

Where,

$f_{cr} = PL / bd^2$ (N/mm^2) (2)

Where,

f_{cr} = flexural strength of concrete (N/mm$^{2)}$

P = load applied (N)

L = effective span (mm)

b = breadth (mm)

d = depth (mm)

Split tensile strength

Cylindrical specimens were cast and cured to determine the split tensile strength of concrete. They were loaded in compression side along the diameter plane. The results of the split tensile strength are tabulated in Table-VI. The formula to calculate the split tensile strength is given in equation (3).

Where,

$f_t = 2P / \Pi DL$(N/mm^2) (3)

Where,

f_t = split Tensile strength of concrete (N/mm^2)

P = load applied (N)

D = diameter (mm)

L = effective span (mm)

5. RESULTS AND DISCUSSION

- The Vee Bee times for plain concrete, M1.M2.and M3 is 7s, 8s, 9.1s, and 12.5s.In this study, mechanical properties such as compressive strength, spilt tensile strength, and flexural strength were investigated.
- The results of the basic tests, compressive strength, flexural strength and split tensile strength are shown in Tables – II, III, and IV below.

A. BASIC TEST ON MTERIALS

Table-I: Basic tests on materials

S.NO	PROPERTIES	VALUE
1	Specific gravity of coarse aggregates	3.5
2	Specific gravity of fine aggregates	3.07
3	Fineness modulus	2.25
4	Impact value	14.9%
5	Abrasion value	34
6	Consistency of Cement	30%

B. COMPERSSIVE STRENGTH

Table-II: Compressive Strength value

COMPERSSIVE STRENGTH (N/mm²)			
Mix Ratio	**7 days**	**14 days**	**28 days**
M1	42.3	48.4	53.67
M2	51.3	52.23	61.7
M3	47.3	52.6	56.7

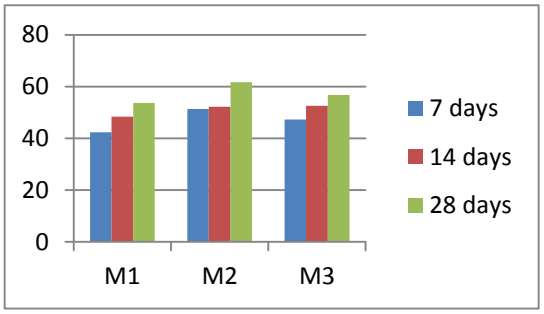

Chart- 1: Compressive Strength

C. FLEXURAL STRENGTH

Table-III: Flexural Strength value

FLEXURAL STRENGTH (N/mm²)			
Mix Ratio	7 days	14 days	28 days
M1	2.5	3.5	4.5
M2	2.8	3.73	5.6
M3	2.75	3.65	5.1

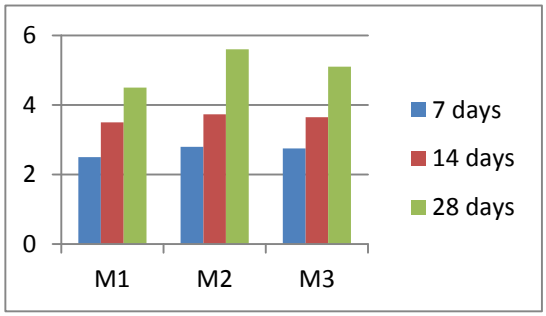

Chart- 2: Flexural Strength

D. SPLIT TENSILE STRENGTH

Table-IV: Split tensile Strength value

SPLIT TENSILE STRENGTH (N/mm²)			
Mix Ratio	7 days	14 days	28 days
M1	4.9	5.3	5.75
M2	5.4	5.7	6.0
M3	5.3	5.59	5.8

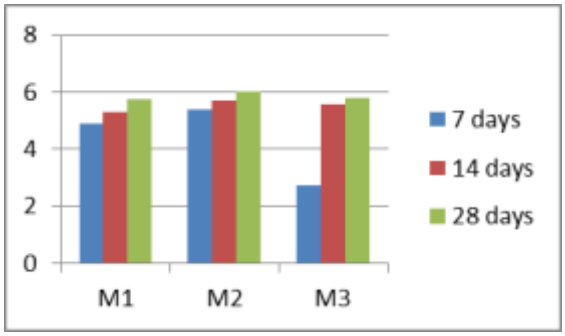

Chart- 3: Split Tensile Strength

6. CONCLUSION

The characteristics strength of Based on the experimental study of high performance concrete using Jute fiber, the following conclusions are made:

- The use of Jute fiber to a certain percentage of addition enhanced the strength of concrete.
- The maximum compressive strength, split tensile strength and flexural strength was found at 2% replacement of Jute fiber.
- Flexural strength of M40 grade FBGC increases over conventional concrete by 20.5 percentages.

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