“Behaviour of Jute and Polypropylene fibre reinforced concrete”

A PROJECT REPORT

Submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

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To

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT SOLAN – 173 234

HIMACHAL PRADESH INDIA

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CERTIFICATE

This is to certify that the work which is being presented in the project title **"Behaviour of Jute and Polypropylene fibre reinforced concrete"** in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology and submitted in the Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Shubham Singh (141643), Akash Sharma(141666)** during the period from August 2017 to May 2018 under the supervision of **Chandra Pal Gautam**, Assistant Professor (Grade-II), Civil Engineering Department, Jaypee University of information technology,Waknaghat.

The above statement made is correct to the best of our knowledge.

Date:- ….-05-2018

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Abstract

In present world, the construction of humongous civil engineering structures are progressed with great difficulty and challenges. Oftenly, the most useful and important material made in use in the construction of civil engineering structures is concrete which should have a very high strength and upto the mark workability properties. Some major efforts are being done in the field of concrete technology to develop such kind of concrete having special and enhanced properties. In today's world, researchers are experimenting to develop high performance concretes by using some additional material in traditional concrete such as fibres and admixtures up to certain proportions. Regarding the concept of global sustainable development, it has been found that some fibres like carbon, polypropylene, jute etc. provide enhancement in concrete properties such as compressive strength, shrinkage characteristics, durability, resistance to erosion and concrete's serviceability. Fibres are used to increase the absorption of energy, impact resistance and toughness to traditional concrete.

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CHAPTER-1

INTRODUCTION

1.1. GENERAL INTRODUCTION:

In general, civil engineering construction works require concrete which is proven to be one of the most basic and important materials used in comparison to other building materials. Many experiments, research and studies have been put in progress to enhance the strength, quality and durability of concrete. Simultaneously, a lot of work is also in progress to economize concrete construction. It has been seen that plain concrete has good compression ability but it is not so good in tensile strength having very limited ductility and poor resistance to cracking. The microcracks generated in concrete leads to reduced tensile strength and eventually to brittle fracture of concrete. A lot of work has been made in order to decrease the generation of the propagating cracks and impart improvements in tensile strength of concrete members using conventionally reinforced steel bars. It gives the tensile strength to concrete members, however it does not increase the tensile strength of concrete itself. In traditional concrete, there is generation of micro cracks before the load is even applied due to shrinkage and drying leading to volume change. When load is applied these microcracks propagate and open up leading to the effect of stress generation.

On adding tiny fibres which are spaced very closely and uniformly in traditional concrete, we have distinguished that there is some increase and enhancements in concrete's mechanical properties. This kind of concrete is called fibre reinforced concrete(FRC).

1.2. STATEMENT OF THE PROBLEM:

Since the concrete performing poor and weak in tension, heavy reinforcements are must to be made to the concrete in order to increase its tensile and flexural strength. This leads to an increase in the cost of the structure to a greater extent. Also there is a problem with reinforcements known as corrosion. Since, concrete being brittle in nature leads to low impact strength.

1.3. OBJECTIVE OF THE STUDY:

The following are the main objective of study:

- Compare the crushing strength of plain cement concrete with fibre reinforced concrete.
- To evaluate flexural strength of plain cement concrete and fibre reinforced concrete.
- Evaluate split tensile strength of plain cement concrete with fibre reinforced concrete.

1.4. SCOPE OF THE WORK:

Much work and research has been performed to know the effects on strength of recron 3s fibre reinforced concrete(RFRC) mixes by changing its properties. By adding recron fibre it has been found out that the modulus of rupture and impact resistance are relatively greater than the traditional concrete.
On the other hand**,** it has also been found out that the use of natural fibres such as jute has significant effect on the properties of concrete such as compressive strength and split tensile strength but on using jute fibres we are faced with challenges such as degradation of jute overtime and agglomeration of the chopped jute fibres.

Figure:1 -Recron Fibre

1.5 PROPERTIES OF RFRC

SHRINKAGE CRACKS :

Overtime, concrete will experience cracks which may be micro or macro . With the usage of recron fibre, the formation of micro cracks is avoidable and it also prevents the propogation of micro cracks into macro cracks. The recron fibres having good tensile strength links the cracks even after their opening. Due to the formation of cracks, water seeps inside the cracks leading to the corrosion of the reinforcements. The use of recron fibre leads to decrease the penetration of water and permeability upto a percentage of 50. They reduce the shrinkage cracks and ehance the elastic properties.

FLEXURAL STRENGTH:

the polypropylene fibre have less modulus of elasticity, which decreases the intial stiffness and strength on their addition in the concrete mix. On using recron fibre, after they have been bend after the first split, achieves its crest at a definitive quality of most extreme static load.

DETERIORATION RESISTANCE:

Concrete is often exposed to the atmosphere leading to cyclic wet/dry exposure. On using recron fibrein traditional concrete, there is considerable improvement in the resistance to deterioration due to water exposure in the polypropylene mixed concrete.

1.6 PROPERTIES OF JUTE FIBRE

Jute is a natural fibre, It is easily available mostly everywhere. Just like recron fibre, jute fibre can also also be used in traditional concreten mix. On the addition of jute fibre in traditional concrete mix there is significant increment in tensile strength of the concrete. It leads to the reduction in cracking and decreases permeability. It is cheap and easily available. Though, it is bio degradable, with some modification it can be used for long term in concrete structures.

SPECIFICATIONS OF RECRON FIBRE (TABLE 1.1)

diameter	“33-35 micron”
cut length	“6 mm, 12 mm, 24 mm”
tensile strength	“6000kg/cm2”
Melting point	">2500C”
Dispersion	“Excellent”
Acid Resistance	“Excellent”
Alkaline resistance	“Good”
Elongation	“45-55%”

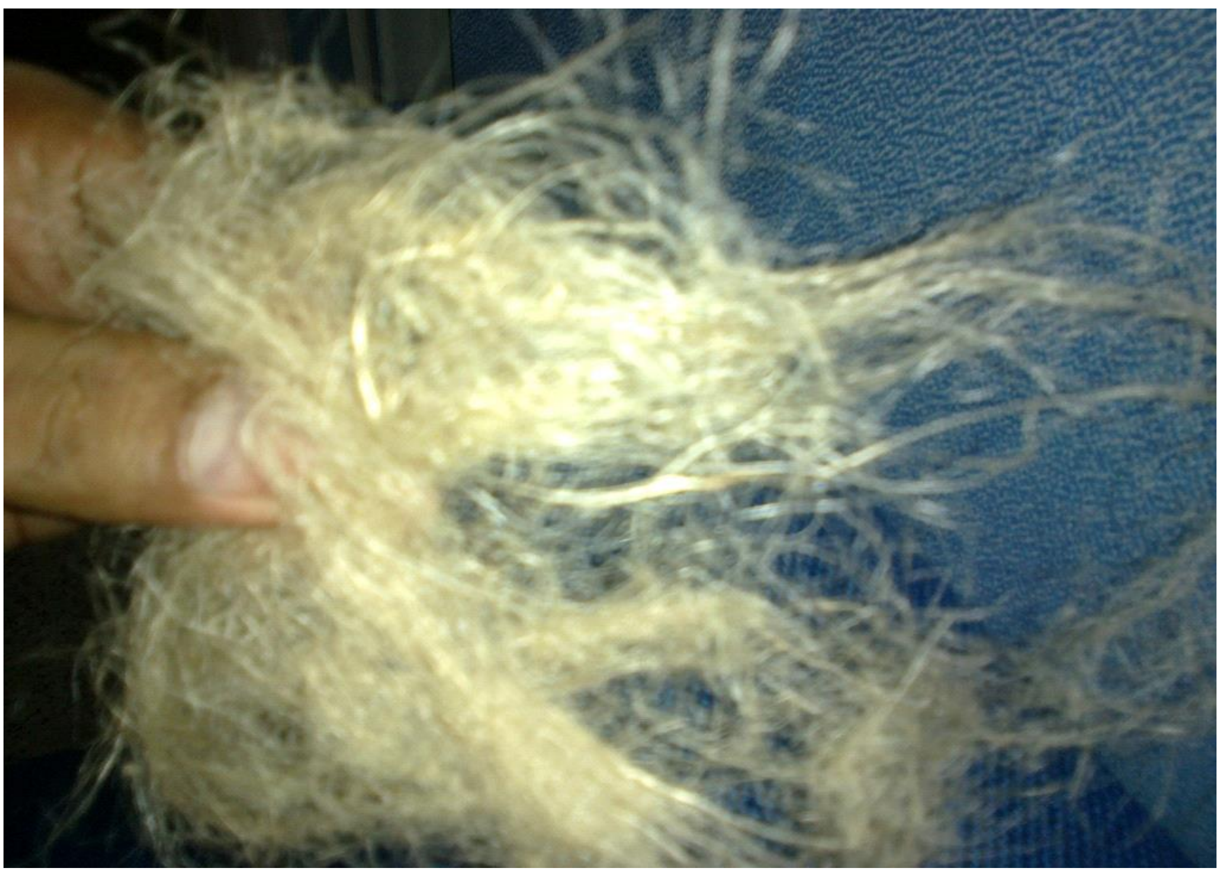

Figure:2- Jute Fibre

Chapter-2

LITERATURE REVIEW

M.A.Mansur, M.A.Aziz et al (1982)

The investigation conducted by them on the concrete and mortar having jute fibres with various lengths as reinforcements which were randomly oriented and uniformly presented in the matrix. The outcome of the experiment has shown that in order to develop a low cost construction material, jute fibres can be feasible.

A.Razmi , M.M.Mirsayar et al (2017)

The tests conducted by adding jute fibres there is great improvement in compressive, tensile, and flexure strength of concrete. The mode fracture toughness is also enhanced by these jute fibres in the concrete mixture.

H.S. Ramaswamy, B.M.Ahuja, S.Krishnamoorthy et al (1983)

Different vegetable or natural fibres like jute and bamboo are tested for their proportioning in cement concrete. Generally compressive and split tensile strengths of vegetable fibre concretes are not so higher than those of normal concrete, but there is improvement in ductility, Impact and fracture toughness and also reduced shrinkage.

T. Aly, J. G. Sanjayan et al (2008)

Polypropylene fibres are added to the concrete in resrained and hostile conditions in order to test the plastic shrinkage and cracking produced in the concrete.

Rana A. Mtasher, Dr. Abdulnasser M. Abbas, Najaat H. Ne’ma et al (2011)

Study shows the investigation on the effects of natural and synthetic fibres on the compressive and flexural strength of normal concrete.

J.A. Larbi and R.B. Polder et al (2007)

Results show that by use of appropriate amount of synthetic fibres (PP) the amount of explosive spalling and the extent of cracking can be reduced.

Alan Richardson and Urmil V. Dave et al (2008)

It is being examined the effects of various fibres which is added to concrete with respect to explosive spalling when it is subjected to high temperature like those in buildings and fire tunnels.

K. Murahari and Rama Mohan Rao et al (2015)

They founded that by appropriate use of polypropylene fibres, the mechanical properties like compressive and flexure strength of fibre reinforced concrete gets relatively high.

Chapter-3

OBJECTIVE OF THE PROJECT

The following are the main objectives of the study:

- Compare the compressive strength of plain cement concrete with fibre reinforced concrete.
- To evaluate flexural strength of plain cement concrete and fibre reinforced concrete.
- Evaluate split tensile strength of plain cement concrete with fibre reinforced concrete.

Chapter 4

EXPERIMENTAL METHODOLOGY

4.1 MATERIAL USED AND THEIR PROPERTIES

The materials which are used in the experimental work are
1. Cement
2. Water
3. Coarse aggregate
4. Fine aggregate
5. Recron 3s fibre and Jute fibres

CEMENT:
In our present investigation, Ordinary Portland cement of grade M30(for recron 3s fibres) and M40(for jute fibres) Ultra Tech cement is used. Tests are progessed in conformance with the Bureau of Indian Standards (BIS) confining to IS-12269: 19870. The physical characteristics of the tested cement have been shown in table Physical characteristic of cement.

COARSE AGGREGATE:
The coarse aggregates in concrete mainly contributes to stability and durability, so they are added in greater volume. They must possess proper shape and they should be hard, strong and well graded. Coarse aggregate are retained on IS sieve no. 4.75 for structural concrete. We have used crushed stone in our project which is known to be a common coarse aggregate.

Table:4.2 Sieve analysis of coarse aggregate.

Sl No.	IS sieve distribution	% of passing	Standard requirement
1	20mm	95	95-100
2	10mm	29	25-55
3	4.75mm	2	0-10

FINE AGGREGATE:
Locally available natural river sand was used as the fine aggregate in the mortar mix. The test conducted on fine aggregates are in conformation with IS: 650-1966 7 IS: 2386-1968 to determine specific gravity and fineness modulus.

Table 4.3: Grading of fine aggregates

SL NO	IS sieve Distribution	% of passing	Standard requirement
1	4.75mm	99	90-100
2	2.36mm	97	75-100
3	1.18mm	88	55-100
4	600 micron	66	35-59
5	300 micron	53	80-30
6	Pan	NIL	0.00

Table 4.4 : Physical Characteristics of fine Aggregates

SL NO	Particular of test	Results
1	Fineness modulus	2.68
2	Specific gravity	2.83
3	Zone	2
4	Water absorption	4.64%

4.2. MIX DESIGN FOR RFRC

The mix prepared from the addition of water to dry ingredients for a period of two hours is called the concrete mix. The mix designed should lead to the formation of concrete having proper and required strength, and workability by as suitable choice of materials and proportions.
Concrete designation : M30
Characteristic compressive strength = fck = 30N/mm^2
Cement:Sand:Aggregates = 1:1.4:2.08

4.3. CONCRETE MIX DESIGN FOR JUTE FIBRE REINFORCED CONCRETE(JFRC)

The mix designed should lead to the formation of concrete having proper and required strength, and workability by as suitable choice of materials and proportions.
Concrete designation : M40
Characteristic compressive strength = fck = 40N/mm^2
Cement:Sand:Aggregates= 1:1.4:2.6

M40 Mix Design

Data:

a) Grade : "M40"

b) Minimum cement content : "220 kg/m^3"

c) Maximum nominal size of aggregate : "20mm"

d) Max. W/C ratio : "0.40"

e) Exposure conditions : "Mild"

f) Workability : "100mm"

g) Type of aggregate : Crushed angular

h) Maximum cement content : 450 kg/m^3

i) Chemicals used : None

j) Type of sand : Zone II

Data of materials :

a) Cement used = PPC
b) S.G. of cement = 3.15
c) S.G. of fine Aggregates = 2.72
d) S.G. of coarse aggregates = 2.8
e) Water absorption of fine aggregates = 1.2 %
f) Water absorption of coarse aggregates = 0.8%

Target Mean Strength

$$f'_{ck} = f_{ck} + 1.65\ s$$

$$= 40 + 1.65 \times 5$$

$$= 48.25\ N/mm^2$$

Water/Cement Ratio -

Assume water-cement ratio = 0.40

Water content selection -

Max. water content for 20 mm aggregate = 186 litre (25 to 50 mm slump range)

Estimated water content for 100 mm slump= $186 + 6/100 * 186 = 197 litres$

Calculation of Cement Content

Water-cement ratio = 0.40

Cement content = 197/0.40

= 492.5 kg/m^3

In accordance to Clause 8.2.4.2 of IS 456 states that max. cement content should not exceed 450 kg/m^3

Therefore we reduce the cement content to 450 kg/m^3

Proportion of Volume of Coarse and Fine Aggregates Content

size aggregate water-cement ratio of 0.50 = 0.62"

"For w/c ratio of 0.4, it is necessary to increase vol. of coarse aggregate in order to decrease the contents of fine aggregate. On lowering the W/C ratio by 0.1, there is .02 increase in the prop. of vol. of coarse aggregates(at the rate of -/+ 0.01 for every± 0.05 change in water-cement ratio)"

"Therefore,for w/c ratio of 0.40, corrected prop. of vol. of coarse aggregate = 0.64"

Volume of fine aggregate = 1 – 0.64 = 0.36

a) The mix calculations are given below
Volume of concrete = 1 m^3

b) Volume of cement = $\frac{Mass\ of\ cement}{Specific\ gravity\ \ of\ cement} * \left(\frac{1}{1000}\right)$

= 450/3.15*.001

= 0.143 m^3

c) Volume of water = $\frac{Mass\ of\ cement}{Specific\ gravity\ \ of\ cement} * \left(\frac{1}{1000}\right)$

= 197/1*0.001

= 0.197 m^3

d) Volume of all aggregates = {a-(b+c)}

= 1-(0.143 + 0.197)

= 0.660 m^3

e) Mass of coarse aggregates = d*Volume of coarse aggregates*S.G. pf coarse aggregates *1000

= 0.66*0.64*2.8*1000

= 1183 kg

f) Mass of fine = d*volume of fine aggregates*S.G. of coarse aggregates*1000

= .66*.36*2.72*1000

= 647 kg

g) Ratio= Cement : fine aggregates : coarse aggregates

= 450:647:1183

= 1:1.4:2.6

M30 MIX DESIGN

Specified minimum strength	M30
Cement Type	OPC 53 Grade
Maximum Aggregate Size	12.5mm
Minimum cement content	250 kg/m^3
Water cement ratio	0.5
Workability	Medium(50-100mm)
Exposure	Severe
Type of Aggregate	Crushed angular

Fine Aggregates

Type	Natural river sand
Zone of sand	zone II
Passing 600 micron sieve(%)	46.75%
Specific gravity	2.83
Water Absorbtion	4.60%

Coarse Aggregates

Type	Angular
Specific gravity	2.65
Water Absorbtion	1.0%

Target Mean Strength

Standard Deviation	5 N/mm^2
Value of 't' selected	1.65
Target Mean Strength	30 + 1.65*5
	=38.25 N/mm^2
Let us assume w/c ratio	0.43
Maximum water content for 20mm MAS	205 kg/m^3

Calculation of cement content

Cement content 205/0.43 =476.74 kg/m^3

Minimum cement content 250 kg/m^3

476.74>250 OK

Coarse Aggregate Proportion:-

Volume of coarse aggregate corresponding to 12.5mm size

Aggregate for w/c ratio of 0.5=0.60(60%).

Our new w/c ratio=0.43

Water cement ratio decreases by 0.07.the proportion of

Coarse aggregate is increased by 0.02(+/- 0.01for every 0.05 w/c)

= 0.6 + 0.015 = 0.615

So,

Corrected coarse aggregate = 61.5%

Corrected fine aggregate =100-61.5=38.5

Mix Calculation:-

Mix calculations per unit volume of concrete are as follows:

Volume of Concrete = 1m^3

Volume of cement =(mass of cement/specific gravity of cement *1000)

= 476.64\(3.15x1000) = 0.15m^3

Mass of water = 205 kg

Volume of aggregates = 1-0.15-(205/1x1000)

= 0.645 m^3

Volume of coarse aggregates = 61.5% of vol. of aggregates

= 0.39 m^3

Mass of coarse aggregates = specific gravity x volume x1000

= 997.41 kg

Mass of fine aggregates	=specific gravity x volume x 1000
	= 667.296 kg

Weight Batching :-

Cement	476.64 kg
Water	205 kg
Coarse Aggregate	997.41 kg
Fine Aggregate	667.29 kg
W/C ratio	0.43

4.4 Details of Specimens and Testing

For testing of "Recron 3s" fibre reinforced concrete, M30 design was used and for testing of jute fibre reinforced concrete M40 design was used.
The purpose of our study is to find out the change in compressive, flexural and split tensile strength of fibre reinforced concrete in comparison to traditional concrete.

Casting and Curing

Moulds of cube having dimension 150 mm x 150 mm x 150 mm, cylinder of diameter 150 mm and height 300 mm and beams of dimensions 100 mm x 100 mm x 500 mm were used for testing purposes.

Concrete is poured in the moulds in three layers and is compacted with the help of tamping rod. After it has been allowed to rest for 24 hours, concrete moulds are disassembled and they are kept in a normal curing tank for 7 days and 28 days. Further tests are conducted after moulds have been surface dried.

Table 4.5 Specimen details of RFRC and JFRC

Sl. No.	Name of test	Specimen dimensions(mm)	% Recron 3s fibres	No. of specimens	% Jute fibres	No. of Specimens
1	**Compressive test**	150 x 150 x 150	0	3		
			0.5	3	0	3
			1	3	0.5	3
			1.5	3	1	3
			2	3		
2	**Split tensile strength**	150Φ x 300	0	3		
			0.5	3	0	3
			1	3	0.5	3
			1.5	3	1	3
			2	3		
3	**Flexural strength**	100 x 100 x 500	0	3		
			0.5	3	0	3
			1	3	0.5	3
			1.5	3	1	3
			2	3		

4.4.1 "Compressive Strength Test"

Procedure

- Place the mould on the platen of testing machine directly under the spherical seated bearing block in such a way that its hardened face is in upward direction.
- Place the mould centrally.
- Rotate the moving portion by hand as soon as the spherical seated block is brought to bear the specimen so as to obtain uniform seating.
- Apply a constant loading rate of 4KN/s
- The test is continued till the cube yields

Figure: 3 CTM Machine

4.4.2 "Split Tensile Test"

Procedure

- Place a plywood strip on the seated platen and then place the cylindrical specimen on it ny aligning carefully.
- Apply a constant load in a way that there is no application of shock on it.
- Keep applying the load until the cylinder(specimen) yields
- Note the maximum load on which the specimen yields.

Calculation

Split Tensile Strength is calculated as

$$T = 2P/\pi lD$$

Here

P= Load at failure

l= Length of Sample

d=Diameter

Figure:4

4.4.3. Flexural Strength Test

Procedure

- Place the specimen on the supporting bearing blocks
- The block which applies load should be in a way that it is in touch with the centre of the beam
- By applying 3.1 N preload, the surface of the beam comes in contact with the load applying block.
- Record the load at which the beam yields.

Calculation

The Flexure strength is calculated as

$$R = Pl/bd^2$$

Where

R= Modulus of rupture in MPa

P= Load at failure

b= Average width of specimen

d= Average depth of specimen

l= Span length in inches

Chapter –5

RESULTS AND DISCUSSIONS

5.1 Compressive Strength of Recron Fibre Concrete Cubes The test performed on the Recron Fibre concrete is done by using 0.5, 1, 1.5and 2 percentage of Recron Fibre in the mix of concrete. The values obtained in the compression testing machine are shown in the table 5.1 with 7 and 28 days of curing the concrete.

Table5.1: Compressive Strength of concrete having recron fibres

SNO.	**Percentage of recron (%)**	**7 days (strength in MPa)**	**28days (strength in MPa)**
1	0	17.7	30.96
2	0.5	18.62	31.77
3	1	19.69	32.98
4	1.5	19.17	32.18
5	2	18.88	31.48

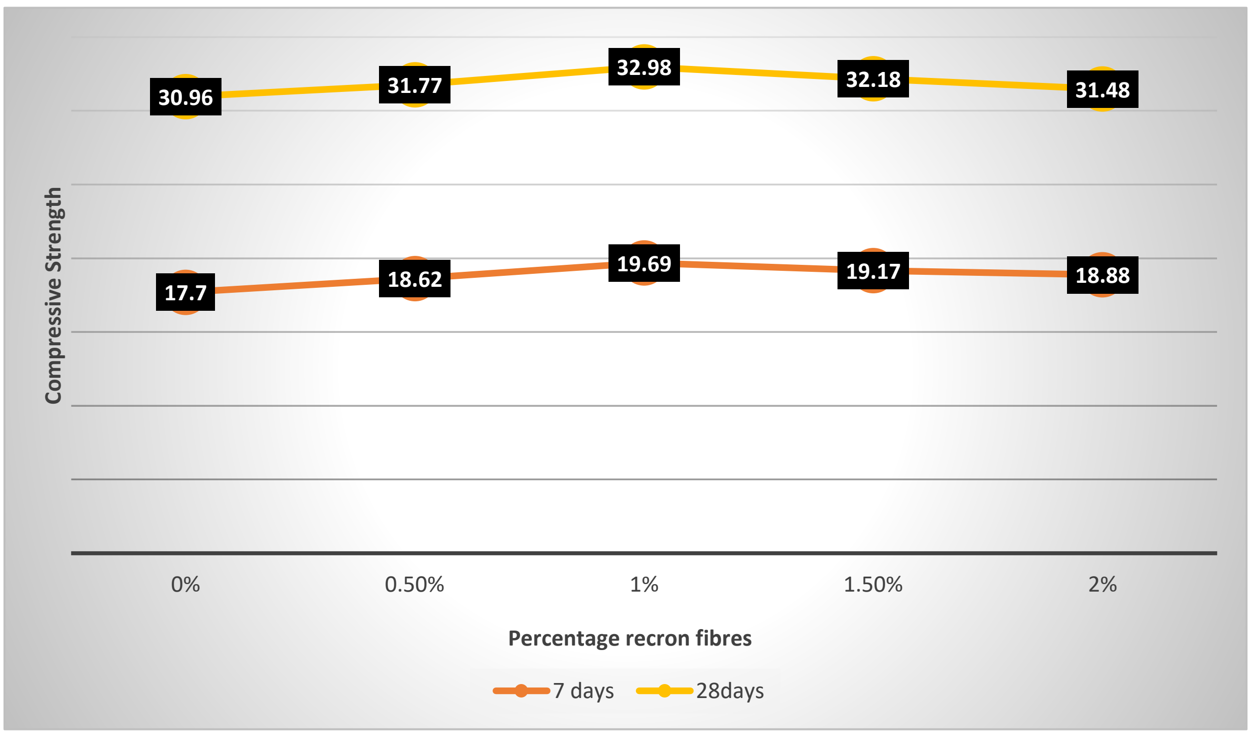

Fig. 5 Compressive strength of RFRC

For 0% fibre content, 3 specimen moulds were made whose compressive strength readings are recorded as

Table5.1.1: Compressive Strength of 0% fibre content for 7 days

SL. No.	**Load(KN)**	**7 days strength(MPa)**	**Avg. Strength(MPa)**
1	390	17.3	
2	396	17.6	17.7
3	410	18.2	

Table5.1.2: Compressive strength of 0% fibre content for 28 days

SL. No.	Load(KN)	28 days strength(MPa)	Avg. Strength(MPa)
1	745	33.2	
2	700	30.98	30.96
3	645	28.7	

For 1% fibre content, 3 specimen moulds were made whose compressive strength readings are recorded as

Table5.1.3: Compressive Strength of 1% fibre content for 7 days

SL. No.	Load(KN)	7 days strength(MPa)	Avg. Strength(MPa)
1	403	17.9	
2	440	19.6	19.7
3	485	21.6	

Table5.1.4: Compressive strength of 1% fibre content for 28 days

SL. No.	Load(KN)	28 days strength(MPa)	Avg. Strength(MPa)
1	770	34.22	
2	740	32.9	32.9
3	716	31.8	

5.2 Split Tensile Strength of Recron Fibre Concrete Cylinder

The compression Testing machine contains loading surfaces. On these loading surfaces the cylindrical specimen is placed horizontally and rested. In order to reduce the high compression stresses, a wooden piece or strip is used. The load application is done without shock and increased continuously. The split tensile strength results of the cylindrical concrete specimen after testing it in compression testing machine are shown

Table5.2: Split Tensile Strength of concrete having recron fibres

SNO.	Percentage of recron(%)	7 days (strength in MPa)	28days (strength in MPa)
1	0	2.21	2.94
2	0.5	2.38	3.09
3	1	2.64	3.38
4	1.5	2.57	3.17
5	2	2.45	3.1

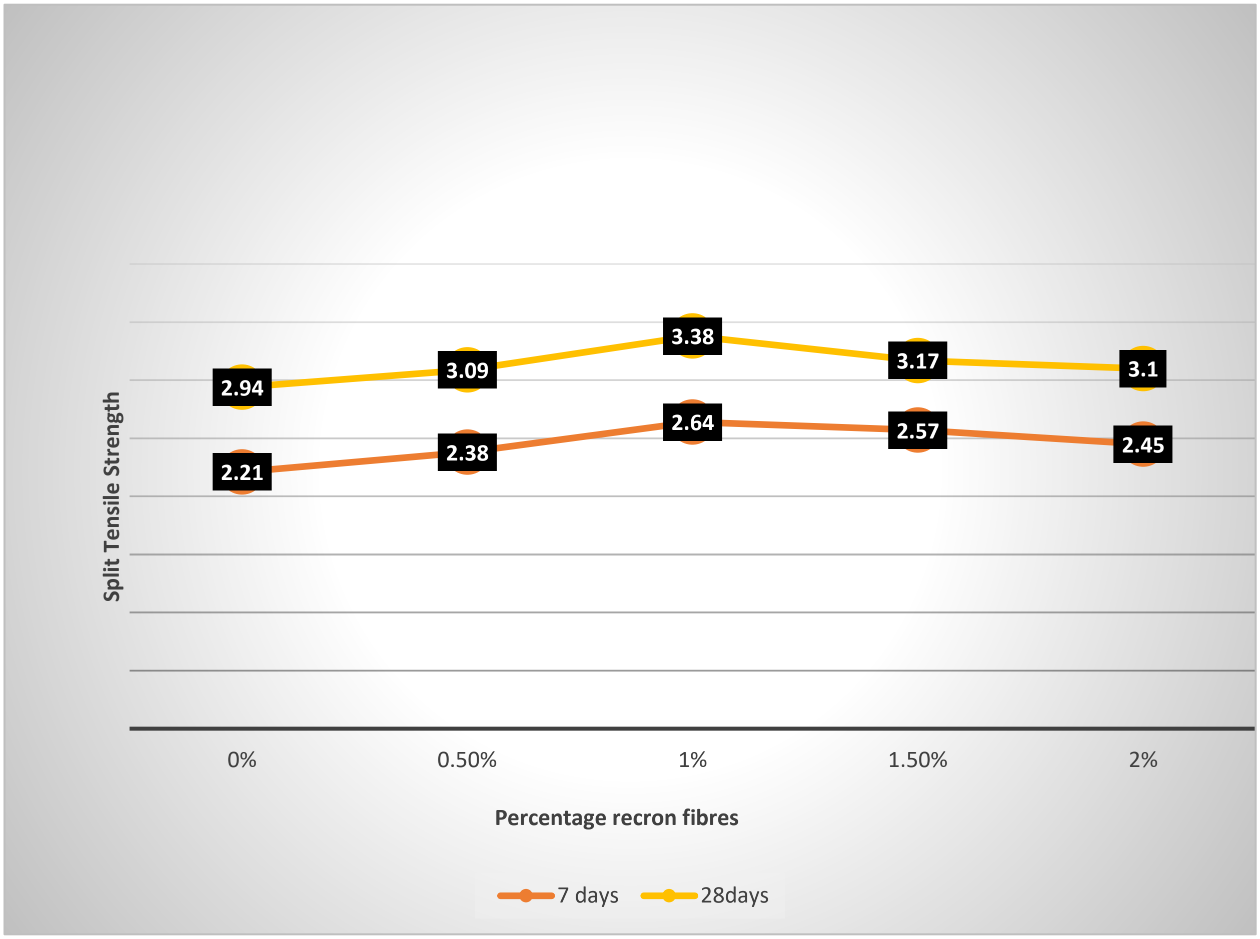

Fig. 6 Split tensile strength of RFRC

For 0% fibre content, 3 specimen moulds were made whose split tensile strength readings are recorded as

Table5.2.1: Split Tensile Strength of 0% fibre content for 7 days

SL. No.	**Load(KN)**	**7 days strength(MPa)**	**Avg. Strength(MPa)**
1	102	1.45	
2	150	2.1	2.22
3	220	3.1	
SL. No.	**Load(KN)**	**28 days strength(MPa)**	**Avg. Strength(MPa)**
1	185	2.62	
2	190	2.7	2.94
3	247	3.5	

For 1% fibre content, 3 specimen moulds were made whose split tensile strength readings are recorded as

Table5.2.3: Split Tensile Strength of 1% fibre content for 7 days

SL. No.	Load(KN)	7 days strength(MPa)	Avg. Strength(MPa)
1	167	2.36	
2	203	2.86	2.64
3	190	2.7	

Table5.2.4: Split Tensile Strength of 1% fibre content for 28 days

SL. No.	Load(KN)	28 days strength(MPa)	Avg. Strength(MPa)
1	235	3.33	
2	233	3.29	3.38
3	248	3.52	

5.3 Tensile Strength of Polypropylene fibre (recron fibre)

It is the ultimate longitudinal stress an object or material can bear with fracture or permanent deformation. It is also called as tension. It is an important property because due to various kinds of effects and loadings, concrete structures are likely to get affected to tensile cracking. In general, concrete has low tensile strength as compared to its compressive strength.
Therefore fibres are being added to it to help it resist the direct tensile stresses and hence prevent cracking at very low stresses.

5.4 Flexural strength of recron fibres:

It is a material property which defines the stress in a material before yielding in a flexure test.
Another word used for defining the stress capability of a material is known as the modulus of rupture.Flexural strength MPa after 7days and28 days are noted and shown in table 5.3

Table 5.3: Flexural Strength of concrete having recron fibres

SNO	Percentage of recron(%)	7 days (strength in MPa)	28days (strength in MPa)
1	0	3.52	5.96
2	0.5	4.11	7.67
3	1	4.48	8.74
4	1.5	4.36	8.61
5	2	4.30	8.55

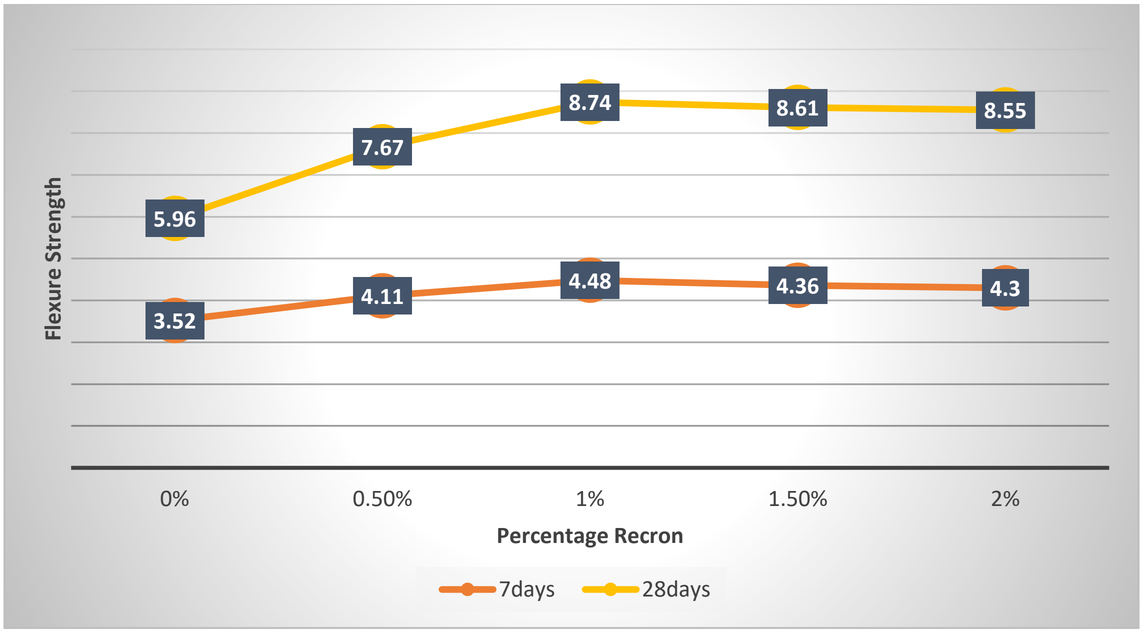

Fig. 7 Flexure Strength of RFRC

For 0% fibre content, 3 specimen moulds were made whose flexural strength readings are recorded as

Table5.3.1: Flexural Strength of 0% fibre content for 7 days

SL. No.	**Load(KN)**	**7 days strength(MPa)**	**Avg. Strength(MPa)**
1	6.5	3.25	
2	6.9	3.4	3.52
3	7.8	3.9	

Table5.3.2: Flexural Strength of 0% fibre content for 28 days

SL. No.	**Load(KN)**	**28 days strength(MPa)**	**Avg. Strength(MPa)**
1	10.7	5.36	
2	12.2	6.1	5.96
3	12.8	6.4	

For 1% fibre content, 3 specimen moulds were made whose flexural strength readings are recorded as

Table5.3.3: Flexural Strength of 1% fibre content for 7 days

SL. No.	**Load(KN)**	**7 days strength(MPa)**	**Avg. Strength(MPa)**
1	8.2	4.1	
2	9.2	4.6	4.48
3	9.6	4.78	
SL. No.	**Load(KN)**	**28 days strength(MPa)**	**Avg. Strength(MPa)**
1	17.32	8.67	
2	17.8	8.9	8.74
3	17.32	8.6	

5.5 Compressive Strength of Jute Fibre Concrete Cubes The test performed on the Jute Fibre concrete is done by using 0, 0.5 and 1 percentage of Jute Fibre in the mix of concrete. The values obtained in the compression testing machine are shown in the table 5.4 with 7 and 28 days of curing the concrete.

Table 5.4: Compressive Strength of concrete having jute fibres

SNO.	**Percentage of jute (%)**	**7 days (strength in MPa)**	**28days (strength in MPa)**
1	0	26.45	40.85
2	0.5	28.89	43.88
3	1	24.4	40.75

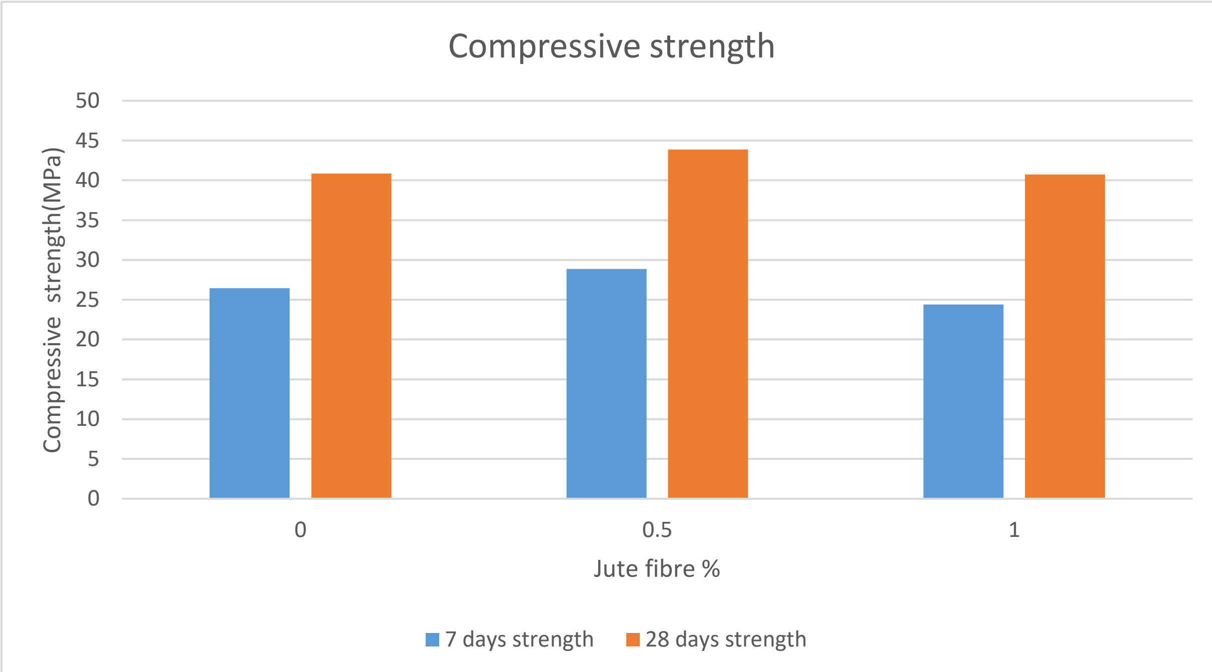

Fig 8 Compressive strength of JFRC

For 0% fibre content, 3 specimen moulds were made whose compressive strength readings are recorded as

Table5.4.1: Compressive strength of 0% fibre content for 7 days

SL. No.	Load(KN)	7 days strength(MPa)	Avg. Strength(MPa)
1	525	23.3	26.45
2	615	27.35	26.45
3	645	28.7	26.45

Table5.4.2: Compressive strength of 0% fibre content for 28 days

SL. No.	Load(KN)	28 days strength(MPa)	Avg. Strength(MPa)
1	855	37.9	
2	935	41.5	40.85
3	970	43.1	

For 0.5% fibre content, 3 specimen moulds were made whose compressive strength readings are recorded as

Table5.4.3: Compressive strength of 0.5% fibre content for 7 days

SL. No.	Load(KN)	7 days strength(MPa)	Avg. Strength(MPa)
1	605	26.9	
2	670	29.7	28.89
3	678	30.1	

Table5.4.4: Compressive strength of 0.5% fibre content for 28 days

SL. No.	Load(KN)	28 days strength(MPa)	Avg. Strength(MPa)
1	985	43.7	
2	970	43.1	43.88
3	998	44.8	

5.6 Split Tensile Strength of jute Fibre Concrete Cylinder. The Compression Testing machine contains loading surfaces. On these loading surfaces the cylindrical specimen is placed horizontally and rested. In order to reduce the high compression stresses, a wooden piece or strip is used. The load application is done without shock and increased continuously. The split tensile strength results of the cylindrical concrete specimen after testing it in compression testing machine are shown in table 5.5

Table5.5: Split Tensile Strength of concrete having jute fibres

SNO.	Percentage of jute(%)	7 days (strength in MPa)	28days (strength in MPa)
1	0	3.8	4.42
2	0.5	4.2	4.95
3	1	3.9	4.16

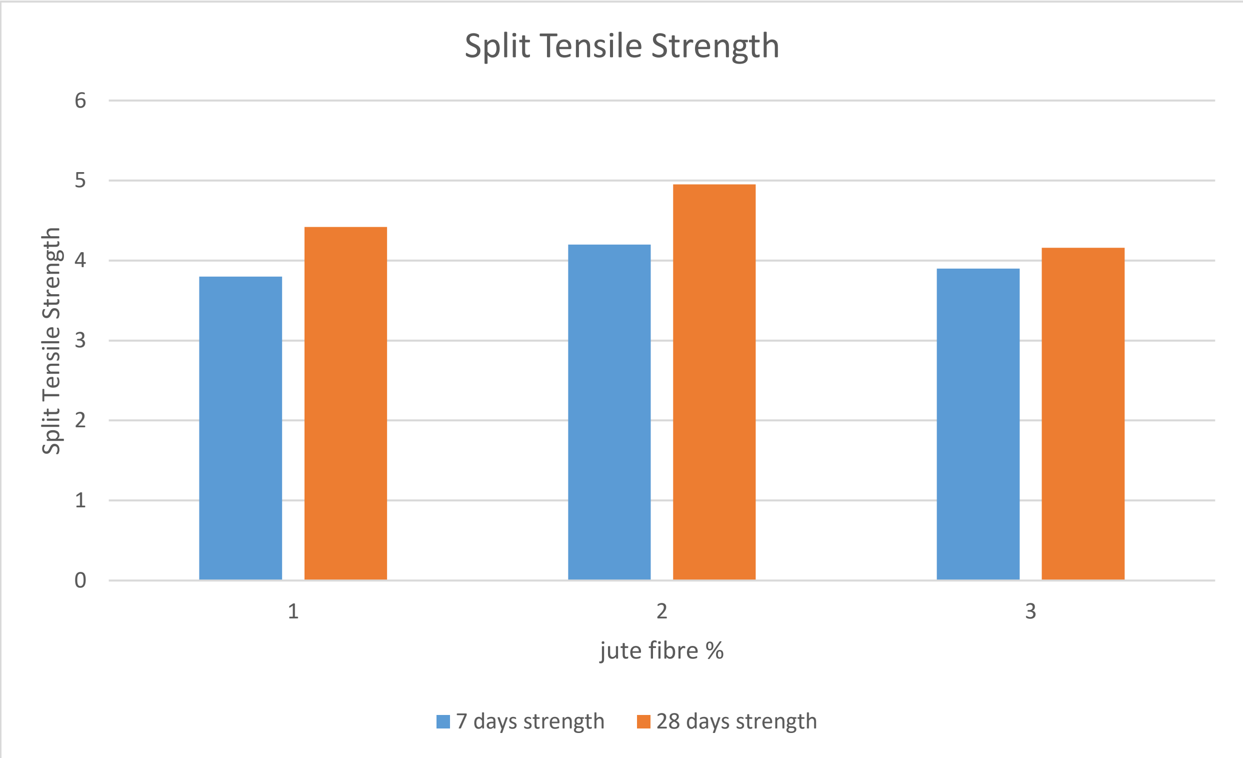

Fig. 9 Split tensile strength of JFRC

For 0% fibre content, 3 specimen moulds were made whose split tensile strength readings are recorded as

Table5.5.1: Split Tensile Strength of 0% fibre content for 7 days

SL. No.	**Load(KN)**	**7 days strength(MPa)**	**Avg. Strength(MPa)**
1	235	3.3	
2	275	3.9	3.8
3	297	4.2	

Table5.5.2: Split Tensile Strength of 0% fibre content for 28 days

SL. No.	**Load(KN)**	**28 days strength(MPa)**	**Avg. Strength(MPa)**
1	300	4.26	
2	310	4.4	4.42
3	325	4.6	

For 0.5% fibre content, 3 specimen moulds were made whose split tensile strength readings are recorded as

Table5.5.3: Split Tensile Strength of 0.5% fibre content for 7 days

SL. No.	Load(KN)	7 days strength(MPa)	Avg. Strength(MPa)
1	275	3.9	
2	305	4.3	4.2
3	311	4.45	

Table5.5.4: Split Tensile Strength of 0.5% fibre content for 28 days

SL. No.	**Load(KN)**	**28 days strength(MPa)**	**Avg. Strength(MPa)**
1	328.5	4.65	
2	340	4.8	4.95
3	380	5.4	

5.7 Flexural strength of jute fibres:
It is a material property which defines the stress in a material before yielding in a flexure test. Another word used for defining the stress capability of a material is known as the modulus of rupture. Flexural strength MPa after 7days and28 days are noted and shown in table 5.6

Table5.6: Flexural Strength of concrete having jute fibres

SNO	**Percentage of jute(%)**	**7 days (strength in MPa)**	**28days (strength in MPa)**
1	0	4.98	6.69
2	0.5	5.4	7.67
3	1	4.48	6.22

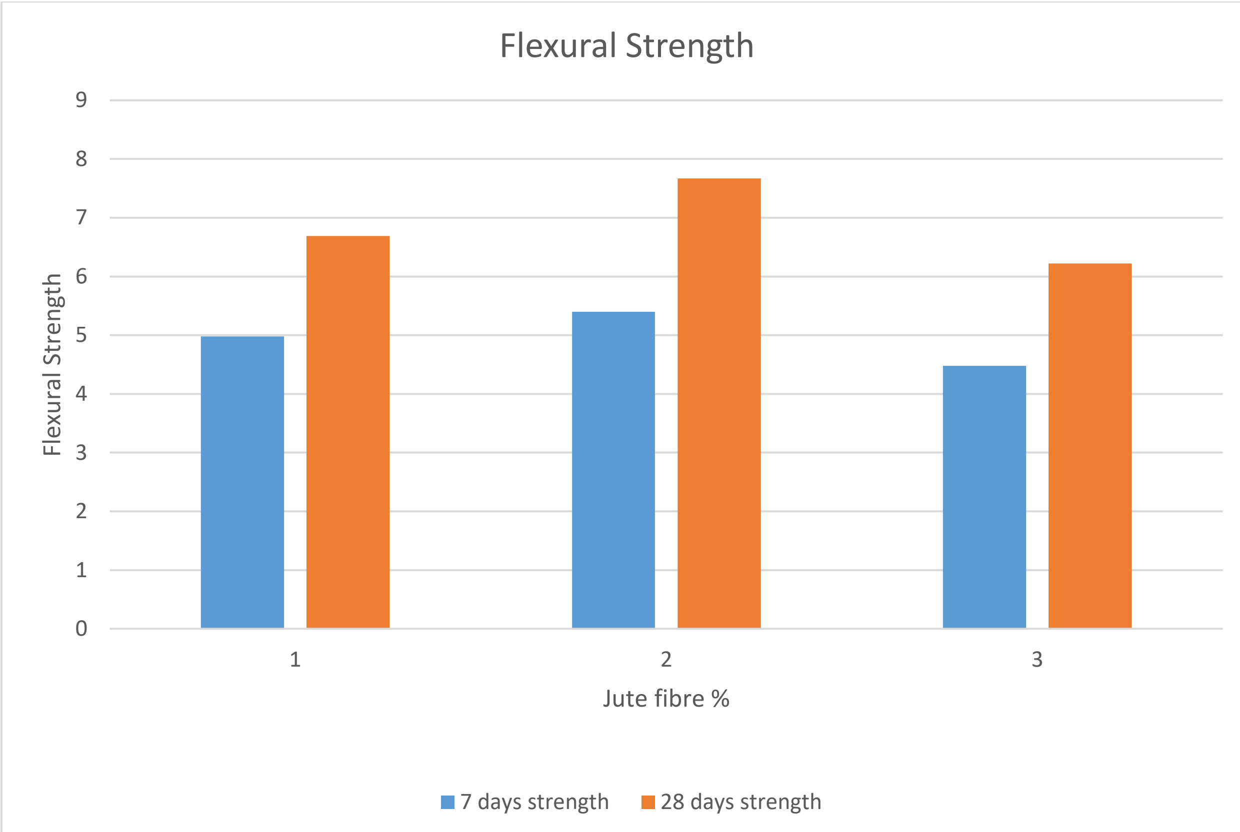

Fig. 10 Flexural Strength of JFRC

For 0% fibre content, 3 specimen moulds were made whose flexural strength readings are recorded as

Table5.6.1: Flexural Strength of 0% fibre content for 7 days

SL. No.	Load(KN)	7 days strength(MPa)	Avg. Strength(MPa)
1	9.5	4.74	
2	10	5.0	4.98
3	10.4	5.2	

Table5.6.2: Flexural Strength of 0% fibre content for 28 days

SL. No.	Load(KN)	28 days strength(MPa)	Avg. Strength(MPa)
1	13.12	6.56	
2	13.2	6.6	6.69
3	13.8	6.91	

For 0.5% fibre content, 3 specimen moulds were made whose flexural strength readings are recorded as

Table5.6.3: Flexural Strength of 0.5% fibre content for 7 days

SL. No.	Load(KN)	7 days strength(MPa)	Avg. Strength(MPa)
1	10.8	5.38	
2	11.0	5.5	5.4
3	10.65	5.32	

Table5.6.4: Flexural Strength of 0.5% fibre content for 28 days

SL. No.	**Load(KN)**	**28 days strength(MPa)**	**Avg. Strength(MPa)**
1	15.36	7.68	
2	15.0	7.5	7.67
3	15.65	7.83	

5.8 Increase in strengths of Recron fibre reinforced concrete

Table:5.7.1 Increase in compressive strength

SL. No.	**% fibre**	**7 days increase(%)**	**28 days increase(%)**
1	0.5	5.19	2.61
2	1	11.24	6.52
3	1.5	8.3	3.94
4	2	6.67	1.68

Table:5.7.2 Increase in split tensile strength

SL. No.	**% fibre**	**7 days increase(%)**	**28 days increase(%)**
1	0.5	7.69	5.1
2	1	19.45	14.96
3	1.5	16.28	7.82
4	2	10.85	5.44

Table:5.7.3 Increase in flexural strength

SL. No.	% fibre	7 days increase(%)	28 days increase(%)
1	0.5	16.76	28.69
2	1	27.27	46.64
3	1.5	23.86	44.46
4	2	22.15	43.45

5.9 Increase in strengths of Jute fibre reinforced concrete

Table:5.8.1 Increase in compressive strength

SL. No.	% fibre	7 days increase(%)	28 days increase(%)
1	0.5	9.22	7.41
2	1	-8.4	-0.24

Table:5.8.2 Increase in split tensile strength

SL. No.	% fibre	7 days increase(%)	28 days increase(%)
1	0.5	10.52	11.99
2	1	2.63	-5.88

Table:5.8.3 Increase in flexural strength

SL. No.	% fibre	7 days increase(%)	28 days increase(%)
1	0.5	8.43	14.69
2	1	-11.16	-7.55

Chapter- 6

Conclusion

On the addition of recron 3s fibre and jute fibres, it has been found that there is significant increase in compressive strength, split tensile strength and flexure strength. We have tested the specimen moulds after both 7 days and 28 days of curing, and we have found some impressive results.

- The maximum increase in the mechanical properties of RFRC is seen on the addition of 1% recron fibre in traditional concrete mix.

- The maximum increase in mechanical prooerties of JFRC is seen on the addition of 0.5% jute fibre in traditional concrete mix.

- After 7 days of curing, it has been noted that the compressive strength is increased by 11.24% on the addition of 1% recron fibre and 9.22% on the addition of 0.5% jute fibre.

- After 28 days of curing, it has been noted that the compressive strength is increased by 6.52% on the addition of 1% recron fibre and 7.41% on the addition of 0.5% jute fibre.

- After 7 days of curing, it has been investigated that the split tensile strength is increased by 19.45% on the addition of 1% recron fibre and 10.52% on the addition of 0.5% jute fibre.

- After 28 days of curing, it has been reasearched that the split tensile strength is increased by 14.96% on the addition of 1% recron fibre and 11.99% on the addition of 0.5% jute fibre.

- After 7 days of curing, it has been seen that the flexural strength is increased by 27.27% on the addition of 1% recron fibre and 8.43% on the addition of 0.5% jute fibre.

- After 28 days of curing, it has been seen that the flexural strength is increased by 46.64% on the addition of 1% recron fibre and 14.69% on the addition of 0.5% jute fibre.

- It has been seen that on addition of further recron or jute fibre beyond the optimum content, there is decrease in workability and the mechanical properties of concrete.

Chapter-7
Future Scope

The work done by us leaves a wide scope and many opportunities to the future investigators to reasearch and explore many aspects of jute fibre and recron fibre. Some recommendations which can be used for future experimentaions are:

- The experiments can be further extended by the addition of other potential natural fibres, and by changing their orientation and percentage content and therefore their mechanical characteristics may be checked and analysed.
- By increasing the machining parameters, for example, tool geometery, tool materials etc. the experiments can be extended.
- The machining processes such as milling, reaming etc. can be used to perform experiments
- Using other modelling techniques the experimental data can be analysed and can be modelled.
- Jute fibre can be improved by its surface modification. The jute fibre can be washed with water and dried at 50 degree celcius for a complete day in oven. It is pretreated by 0.1% sulphuric acid solution for 1 hour and washed with water 3-4 times.After that, the cleaned fibre is surface modified by soaking in DPNR latex for 60 minutes and dried at 50 degree celcius for 24 hours in oven. After that the modified fibre can be cut down in strands accordingly.

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