

Mechanical Properties of Concrete Mixed with Chopped Jute Fibers

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Abstract: Mechanical properties of concrete can be enhanced by using jute fibers. In order to analyse the effect of jute fibers on the properties of concrete. The compressive strength test, split tensile strength test and flexural strength test were performed. The ratio of jute fiber in concrete is varied from 0 to 5%. Test results shows that the compressive strength, split tensile strength and flexural strength increases from 10 to 20% in comparison with concrete without fibers. The result of the compression test indicate that the present of jute fibers tends to reduce the compressive strength at higher jute fiber contents there is improvement in ductility after cracking of concrete. Similarly tensile and flexural characteristics increases up to a certain percentage beyond which strength characteristics decreases. Jute fiber concrete significantly improves the toughness behavior of concrete. Tests results shows that the concrete mix with jute fibers can be used in pavements as reinforcing materials.

Keywords: Chopped Jute fibers, Compressive Strength, Tensile Strength, Flexural Strength

1. Introduction

As we know that the sustainable development with higher strength is the growing demand of construction industry. Natural fiber can be obtained at very low cost and requires local manpower and technology. Jute fibers is one of the cheapest natural fibers. These fibers are extracted from the ribbon of the stem. The increased demand of natural fibers is due to their low cost, low density and abundance. Fibers can be used as reinforcing materials. Fibers rein-

Forced concrete is a concrete which contain fibers material to increase the structural strength. The concrete has a advantage that it has sufficient compressive strength but has the drawback that concrete it is brittle has poor resistance to crack opening, negligible elongation at the point of fracture and poor tensile strength. To overcome this deficiency reinforcement along with dispersed fibers might play some role. As fibers are mostly used to control cracking due to both plastic shrinkage and dry shrinkage. They also make concrete more impermeable. Some fibers produce greater impact and abrasion in concrete. Generally there is not impact of fibers to increase the flexural strength of concrete. So, cannot change moment resisting or structural steel reinforcement.

Jute fibers are used for making cloth to wrap bales of cotton, gunny bags, rope, string, jute carpets and various furnishing materials like shopping bags, sail cloth etc

2. Literature Survey

The natural jute fibers can be the effective material to reinforce concrete strength which will not only explore a way to improve the properties of concrete but it also explore the use of jute and restrict the utilization of polymer which is not eco-friendly. Concrete with jute fiber is an aspiring step towards the sustainable development in India. When the different tests are performed to examine the strength of the concrete experimentally by adding jute fibers. By adding jute in concrete it is observed the compressive strength, tensile strength, flexural strength is increased as compared to

normal concrete i.e 0.533KN/cm², 0.054KN/cm², 0.192KN/cm² respectively after 28 days.

3. Methodology and materials

3.1 Methodology

The methodology used in the research work is as follows:-

- 1) The jute fibers were soaked in a 6% sodium hydroxide (NaOH) solution.
- 2) The initial weight of fabric pieces was noted.
- 3) The fibers were kept immersed in the alkali solution for 2, 3, 5, 7 and 8 hours
- 4) The fibers were then washed several times with fresh water to remove any sodium hydroxide sticking to the fiber surface.
- 5) Then the fibers were dried at Room Temperature for 48 Hours followed by Oven drying at 100 C for three hours.
- 6) The fibers are the weighted but there is no significant change in weight of the fibers.



Chopped fibers

A) Compressive Strength Test

Cement is a binding material. It is main constituent of concrete which decide its strength during its age. It is the resistance to crushing. It is measured in N/mm². The compressive strength of concrete depends upon the type of cement used, size and shape of aggregates, water-cement ratio, degree of compaction and curing. Concrete is very strong in compression and for structural design purposes,

one has to know the compressive strength by testing hardened concrete specimen.

Procedure:

- 1) Take the six cube moulds for each mix (M25/ 1:1:2). Assume three moulds for plane cement concrete and three for fiber reinforced concrete (5% by weight of the cement) each .Cleaned the inside of the mould and saw the joints are perfectly tight.
- 2) Pour properly mixed samples for the given mix to the cube moulds.
- 3) Compaction is done by placing concrete in three layers each layer is compacted with the help of standard tamping rod by means of 25 blows.
- 4) Level the concrete at the top of the mould by means of trowel and gave proper identification mark to the specimens.
- 5) Keep the cubes in laboratory for 24 hours .After 24 hours, dismantle the plates of cube moulds and take out the hardened concrete cubes carefully .So, that edges of specimens are not damaged.
- 6) Immersed the cubes in curing tank filled with water .
- 7) Tested the cubes after 3,7,28 days of curing for finding compressive strength.
- 8) Result is shown below in the observation table 1.1

B) Split tensile test

- 1) Specimens when removed from the curing tank shall be tested immediately on removal from the water while they are still wet. Specimens are wiped off and grit/any projecting fins should be removed from the surface .So that they may not come in contact with packing strips.
- 2) Centre lines are drawn on the two opposite faces of the cube and device; that will ensure they are in the same plane.
- 3) Mass/weight of the specimen shall be noted before testing .The specimen are laid in the same plane of the pre-marked lines and the measurements of length to the nearest of 0.2 mm.
- 4) Then the specimen is placed in the testing machine.
- 5) The specimens are placed in the centering jig one by one with packing strips /loading pieces carefully .Now positioning along the top and bottom of the plane of the loading of the specimen . The jig shall be placed in the machine. So, that the specimen is placed centrally .The load shall be placed on the mounded face in such a way that the flexural plane will cross the trowel surface. The ratio of loading is applied without shocks and increased within range of 1.2N/mm²/min to 2.4N/mm²/min till failure.
- 6) Result is shown below in observation table 1.2

C) Flexural test on concrete

Flexural test is used to evaluate the tensile strength indirectly. It tests the ability of unreinforced concrete beam or slab to withstand failure in bending. The flexural test on concrete was conducted using center point load test method (ASTM-293)

It is required for the following purposes:

- >Testing concrete for slabs and pavement construction.
- >Essentially required for concrete mix design for compliance with standards.

Size of specimens: Normally two sizes are used tests. They are:-

- (10x10x50) cm
- (15x15x75) cm

Apparatus required:- Mould(15x15x75)cm, tamping rod/vibrator and testing machine

Sample Preparation:-The same procedure is adopted as was observed in earlier tests.

Procedure

- 1) The test was conducted on the specimen as soon as they are taken out from the curing tank to avoid drying.
- 2) Place the specimen on loading point .The trowel finished surface of the specimen should not be in contact with loading point.
- 3) Centered the loading system in relation to applied loads .
- 4) Brought the block by applying force in contact with the specimen at the loading points.
- 5) Apply the load on the specimen without shocks till the point of failure at constant rate according to British standard.
- 6) Result is shown below in the observation table 1.3

Calculation of measurement

Since the rupture is at a distance is greater than 20cm.The Flexural strength is:-

$$F.S = PL_{eff}/bd^2$$



Split tensile test

3.2 Materials

Fine aggregates

Properties	Description
Water Absorption Test	Water absorption by fine aggregates is 3.30%
Specific Gravity	The specific gravity of fine aggregates (sand) is 2.46
Specific Gravity	The app. specific gravity of fine aggregates is 2.68
Size	The size of sand is 1.18 mm
Bulking of sand	The bulking of fine aggregates is 12.33%
Source	It is obtained from the land quarries.

Cement

Properties	Description
Consistency test	The consistency of cement is about 33%.
Fineness test	The fineness of cement used is 0.023 microns
Initial and final setting time	The initial and final setting time of cement used is 35min and 11hours respectively.
Color	cement should be greenish grey in Colour.
Source	Portland Pozzolana cement of 43 grade

Course Aggregate

Properties	Description
water absorption test	Water absorption by course aggregates is 0.42%
specific gravity	The specific gravity of the course aggregates is 1.81
App. specific gravity	The apparent specific gravity of course aggregates is 2.36
Size	The size of aggregate are 10mm and 12mm
Source	It is obtained from the stone crusher

Water:-The water used in concreting operation is portable water (ph-7)

Jute fibers: The jute fibers used in the study is directly obtained from the field and are used in the concrete of having length 15cm as a reinforcing materials.

4. Results and Discussions

Table 1.1: Observation table for compressive strength of concrete cube specimens

Quantity	Cube ID	load(KN)	Area (cm ²)	Comp. strength (P/A)	Days
0%	A	1500	225	6.666	7
1%	B	1590	225	7.066	
2%	C	1655	225	7.355	
3%	D	1680	225	7.466	
4%	E	1750	225	7.777	
5%	F	1650	225	7.333	
0%	A	2370	225	10.533	28
1%	B	2390	225	10.622	
2%	C	2410	225	10.711	
3%	D	2450	225	10.888	
4%	E	2490	225	11.066	
5%	F	2470	225	10.977	



Compression test on cube

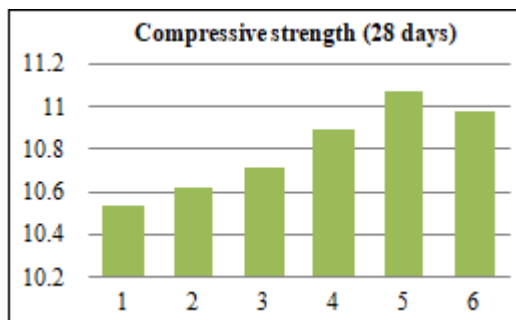
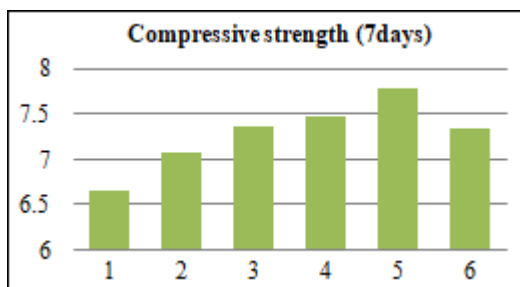
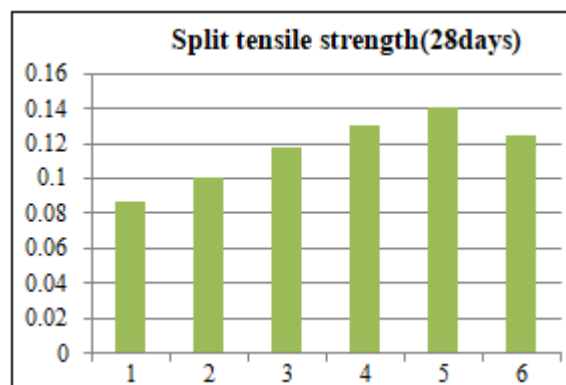
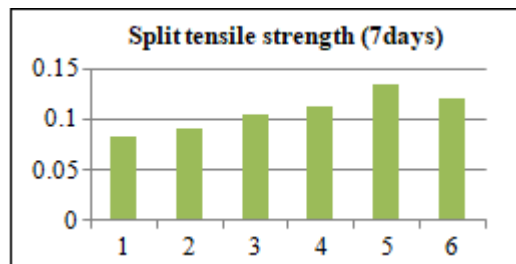


Table 1.2: Observation table for split tensile strength of cube specimens

Quantity	Cube ID	Crushing Load(KN)	length (cm)	Depth (cm)	$\frac{2P}{\pi ld}$	days
0%	A	29.00	15	15	0.082	7
1%	B	32.00	15	15	0.090	
2%	C	37.00	15	15	0.104	
3%	D	40.00	15	15	0.113	
4%	E	48.00	15	15	0.135	
5%	F	43.00	15	15	0.121	
0%	A	31.00	15	15	0.087	28
1%	B	36.00	15	15	0.101	
2%	C	42.00	15	15	0.118	
3%	D	46.00	15	15	0.130	
4%	E	50.00	15	15	0.141	
5%	F	44.00	15	15	0.124	





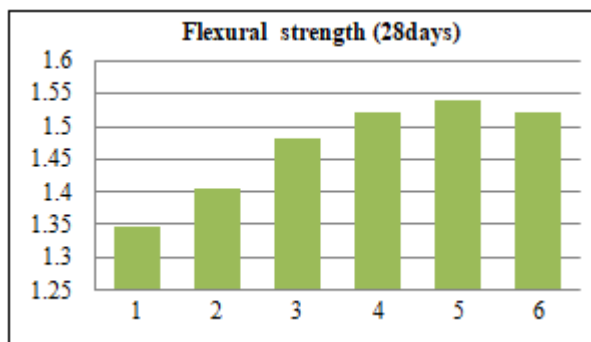
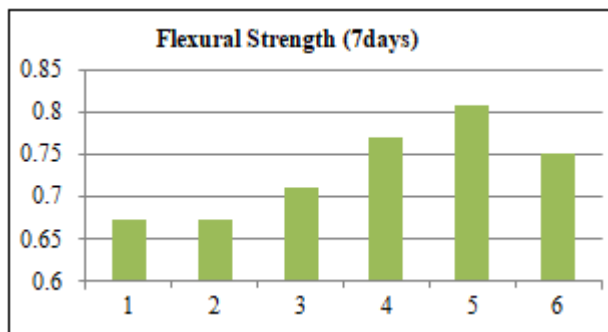
Freshly prepared Beams



Flexural test on UTM

Table 1.3: Observation table for flexural strength of beam Specimens

Quantity	Cube ID	Load (P)KN	L_{eff} (cm)	D cm	b cm	PL_{eff}/bd^2	Days
0%	A	35	65	15	15	0.674	7
1%	B	35	65	15	15	0.674	
2%	C	37	65	15	15	0.712	
3%	D	40	65	15	15	0.770	
4%	E	42	65	15	15	0.808	
5%	F	39	65	15	15	0.751	
0%	A	70	65	15	15	1.348	28
1%	B	73	65	15	15	1.405	
2%	C	77	65	15	15	1.482	
3%	D	79	65	15	15	1.521	
4%	E	80	65	15	15	1.540	
5%	F	79	65	15	15	1.521	



5. Conclusion

The result obtained by this research work indicates that jute fiber reinforced concrete have best mechanical properties. It is hereby concluded that by adding jute fibers the compressive strength, split tensile strength and flexural strength increases to 33%, 10% and 12% respectively.

When there is increase in fiber proportion beyond 4% then there is decrease in compressive strength, split tensile strength and flexural strength of concrete as due to increase in fiber proportion the water absorption increases which leads to increase in porosity there by decreases the strength characteristics. If there is increase in fiber aspect ratio also leads to decrease in the strength characteristics.

6. Future Scope

It is observed that by using jute fiber in concrete there sufficient improvement in the mechanical properties of the concrete which are giving justifying results:-

- 1) As we know reinforcement (steel) is the costly material used in RCC structures. Jute fibers (by-products) acts as fiber reinforcement to reduce the quantity of steel in RCC. structures.
- 2) Fiber reinforced concrete (F.R.C) have future scope in different construction works i.e road pavements, sewers ,canal bed construction etc.

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