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INVESTIGATION OF STRENGTH PARAMETERS IN JUTE FIBER REINFORCED CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT WITH METAKAOLIN

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ABSTRACT

Concrete is one such fundamental component that has always been improved throughout time by adding several admixtures to improve the strength properties. Fibers eliminate the unexpected failure that is common in plain concrete beams. Stiffness, tensional strength, ductility, rotational capacity, and the quantity of cracks with smaller crack width are all improved. The following are some of the benefits of fiber-reinforced concrete: When compared to non-reinforced concrete, fiber-reinforced concrete has a higher tensile strength. It improves the concrete's long-term resilience. It slows the spread of cracks and improves impacts resistance. This paper reveals the role of Jute fibre in concrete strength with special reference to compressive strength.

Keywords: Jute Fiber Reinforced Concrete, Metakaolin, Compressive Strength, Flexural Strength

Sub Area : Structural Engineering

Broad Area : Civil Engineering

INTRODUCTION

1.2.2 Advantages of Metakaolin in concrete are:

- Enhances the strength of concrete
- Also improves the longevity.
- Increase in early age behavior
- Contribute to sustainability
- The usage of Metakaolin in concrete reduces the time it takes for concrete to firm up.
- It aids in the improvement of concrete's early age strength, allowing form work to be removed earlier and thereby increasing production pace.
- Metakaolin consumes calcium hydroxide, avoiding the alkali-silica reactions. Metakaolin improve resistance to sulphate assault, chemical attack, and freeze-thaw action.
- Dryer shrink age and efflorescence are reduced.
- It enhances concrete's water-tightness and impermeability, making it suitable For use in water-retaining structures, off shore structures, and other applications.
- It can improve the refractory concrete residue.

Compressive Strength Test Testing with Cube Sampling

Procedure for Compression Strength test is as follows:

- Degrease and clean the mounds.
- Lay 5cm thick layers of concrete in the molds (Referfigure7forcubecasting)
- Compact each layer with at least 35 blows each utilizing a tamping rod(steel bar16mm diameter and 60cm long, bullet-pointed at lower end)
- Even and flatten the top surface with a trowel.
- The test pieces are kept in moist air for 24hours before being labeled, extracted from the molds, and submerged in clear freshwater until the time of the test.
- Then curing water must be checked every seven days, and the temperature should be 27 degrees Celsius.

Procedure for Testing Concrete Cubes

- After the curing period has expired, remove the sample from the water and wipe away any remaining water from the surface.
- Measure the length of the test piece to the nearest 0.2m.
- Clean the bearing surface of the investigation machine.
- Place the specimen in the device so that the load is distributed evenly across the cubes cast.
- Place the specimen the device's lower surface plate in the center.
- Rotate the moveable piece by hand until it lands on the specimen's upper surface.
- At a speed of 140 kg/cm2/minute, apply the load gradually and consistently until the specimen fails.
- Make a note of any unpredicted elements of the type of failure, as well as the maximum load.
- Fill the mould with concrete in three layers of about similar thickness to create the test specimen. Tamp every layer 35 times with the tamping bar as directed. Tamping should be applied consistently over the beam mold’s cross section and throughout the depth of every layer.
- Cleanse the bearing surfaces of the supporting and loading rollers, as well as any loose sand or other debris from the surfaces of the specimen that will came in contact with the rollers.
- Circular rollers made of steel with a cross section diameter of 38 mm will be utilized to provide support and loading locations for the samples. The rollers must be at least 10 mm longer than the breadth of the test specimen. The distance across the outside rollers (i.e span) is 3d, while the distance between the internal rollers is d. The inner rollers must be evenly positioned between the outer rollers in order for the system to be methodical.
- The distance between both the internal rollers is d, while the spacing to the outside rollers is 3d.In order for the system to be methodical, the internal rollers must be evenly spaced between the outer rollers.
- Water-housed samples must be evaluated as soon as possible after being removed from the water, while they are still wet. The test specimen must be oriented correctly in the machine, with the longitudinal axis of the specimen at right angles to the rollers. For modeled specimens, the filling direction must be parallel to the loading direction.

- For the 15.0 cm specimens, the load must be applied at a rate of 400 kg/min and for the 10.0 cm specimens, at a rate of 180kg/min.

Compressive Strength Test

The test results of compressive strength test with addition of varying percentage of Jute Fiber and Metakaolin as Replacement for Cement.

Mix	%of Fiber Added	% of Metakaolin Replaced	JuteFiber(kg)	Metakolin (kg)	Cement (kg)	Sand (kg)	Aggregate (kg)	Water(kg)
Standard	0%	0%	0	0	40.3	67.3	110.6	18.1
SF1M3	1%	3%	0.40	1.2	39.1	67.3	110.6	18.1
SF2M6	2%	6%	0.80	2.5	37.8	67.3	110.6	18.1
SF3M9	3%	9%	1.20	3.7	36.6	67.3	110.6	18.1
SF4M12	4%	12%	1.61	4.9	35.4	67.3	110.6	18.1
SF5M15	5%	15%	2.01	6.1	34.2	67.3	110.6	18.1
SF6M18	6%	18%	2.41	7.3	33.0	67.3	110.6	18.1

Table 1: Mix proportioning of samples

Legends, S: Sample

F1: Percentage Fiber

M3: Percentage Metakaolin
S=Sample, F1=1%JuteFiber, F2=2%,
JuteFiber,F3=3%JuteFiber,F4=4%JuteFiber,F5=5%JuteFiber;
M3=3% Metakaolin, M6=6% Metakaolin, M9=9% Metakaolin,
M12=12%Metakaolin, M15=15%Metakaolin

M3=3% Metakaolin, M6=6% Metakaolin, M9=9% Metakaolin, M12=12%Metakaolin, M15=15%Metakaolin, M18=18%Metakaolin.

No. of Mix	% of Jute Fiber	%of Metakaolin	7 Days Compressive Strength (N/mm^2)	28 Days Compressive Strength(N/mm^2)
Standard	0%	0%	23.73	34.89
SF1M3	1%	3%	26.31	37.01
SF2M6	2%	6%	29.46	38.32
SF3M9	3%	9%	31.83	39.15
SF4M12	4%	12%	33.17	39.89
SF5M15	5%	15%	35.02	40.63
SF6M18	6%	18%	34.81	39.86

Table : 2

Result of Compressive Test at Addition of Varying % of Jute Fiber and Metakaolin as Replacement of Cement.

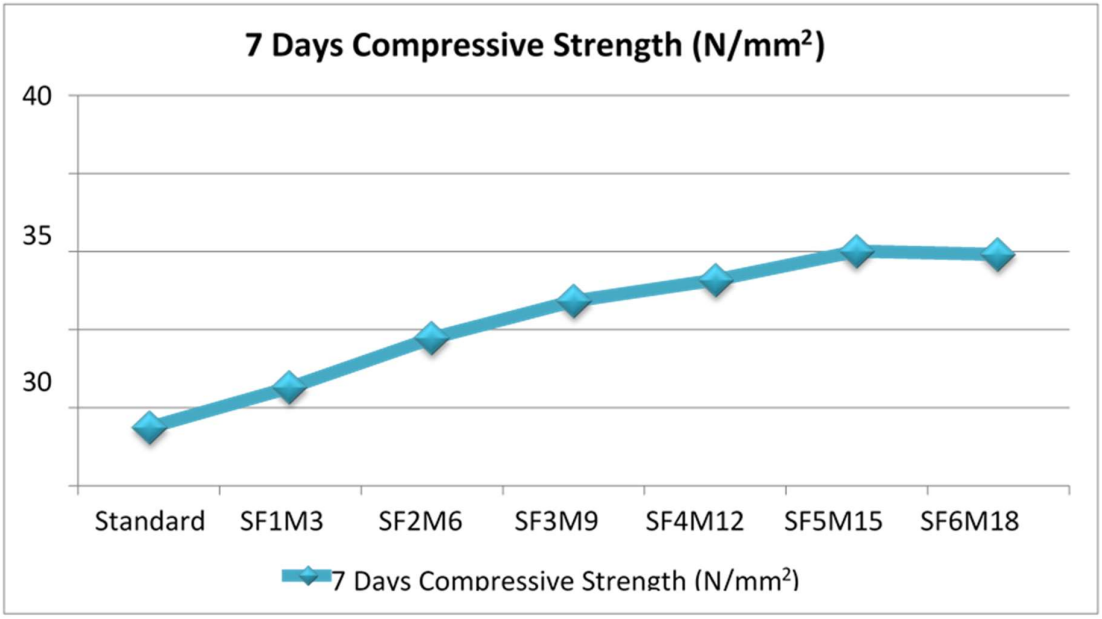

Figure: 1

Compressive Test at 7 Days Addition of varying % of Jute Fiber and Metakaolin as Replacement of Cement

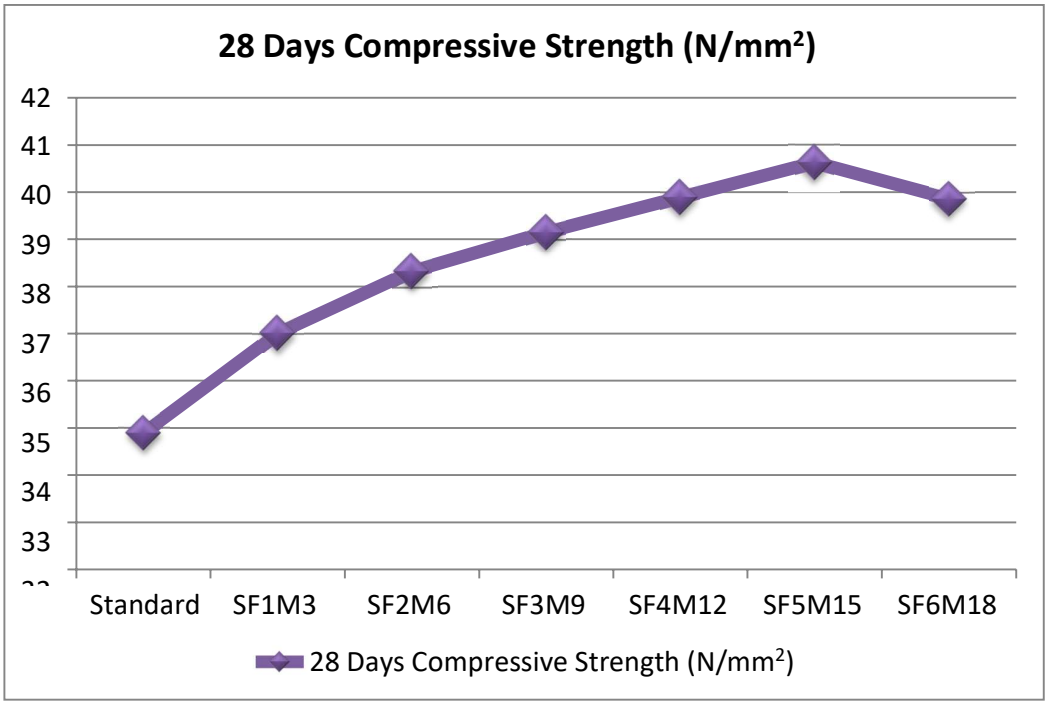

Figure : 2

Compressive Test at 28 Days Addition of varying % of Jute Fiber and Metakaolin as Replacement of Cement.

Flexural Strength Test

Procedure for Flexural Strength test is as follows:

Apparatus- Tamping rod, steel, iron cast, or other non-absorbent material molds (150mmX150mmX750mm) Testing equipment capable of delivering loads ata consistent pace without generating shocks , Scoop, trowel, and balance with a 1g precision Table vibration is used to compress concrete in molds when concrete mixer is powered by electricity.

- To make the test specimen, fill the mould with concrete in three layers of roughly equal thickness. Using the tamping bar, tamp each layer 35 times as recommended. Tamping should be placed evenly over the cross section of the beam mold and throughout the depth of each layer.
- Clean the supports and loaded rollers' bearing surfaces, as well as any loose sand or other material from the sample surface that will come into contact with the rollers.
- Support and loading positions for the specimens will be provided by circular steel rollers having a cross section dimension of 38mm.Therollershouldbeatleast 10 mm longer than the test specimen's width. The distance between the internal rollers is d, while the range between the exterior rollers is 3d. In order for the system to be systematic, the internal rollers must be uniformly spaced between the outer rollers.
- The specimen should used in water must be analyzed instantly after being removed from

the water, while they are still wet. The test specimen must be properly oriented in the machine, with the specimen's longitudinal axis at right angles to the rollers. The mold filling direction for molded specimens must be normal to the loading direction.

- The load must be imposed at a rate of 400 kg/min for the 15.0 cm samples and180 kg/min for the 10.0 cm samples.

No.of Mix	% of Jute Fiber	% of Metakaolin	7 Days Flexural Strength (N/mm^2)	28 Days Flexural Strength (N/mm^2)
Standard	0%	0%	2.99	3.56
SF1M3	1%	3%	3.15	3.65
SF2M6	2%	6%	3.33	3.73
SF3M9	3%	9%	3.46	3.77
SF4M12	4%	12%	3.54	3.81
SF5M15	5%	15%	3.63	3.84
SF6M18	6%	18%	3.61	3.82

Table : 3

Result of Flexural Strength Test at Addition of Varying % of JuteFiber and Metakaolin as Replacement of Cement

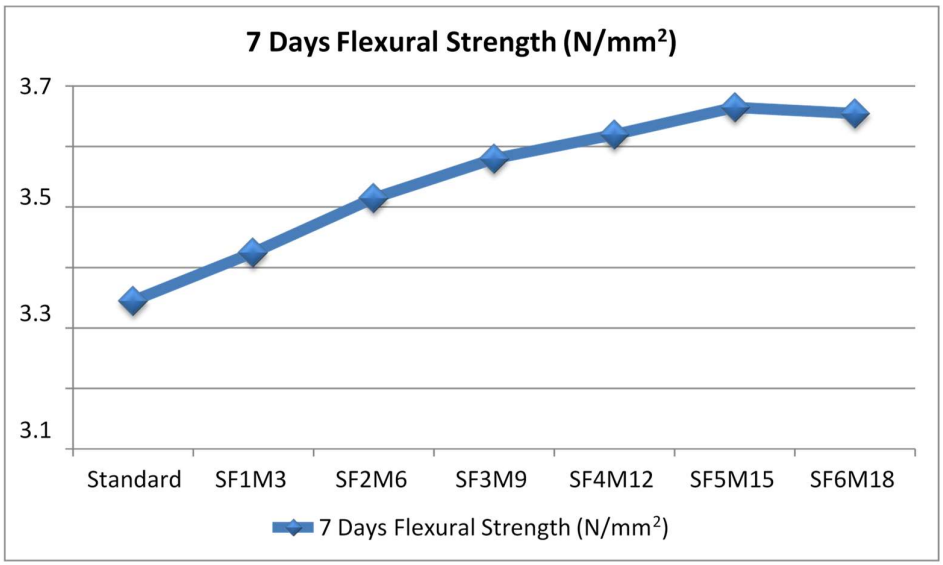

Figure : 3
Flexural Strength at 7 Days addition of varying % of Jute Fiberand Metakaolin as Replacement of Cement

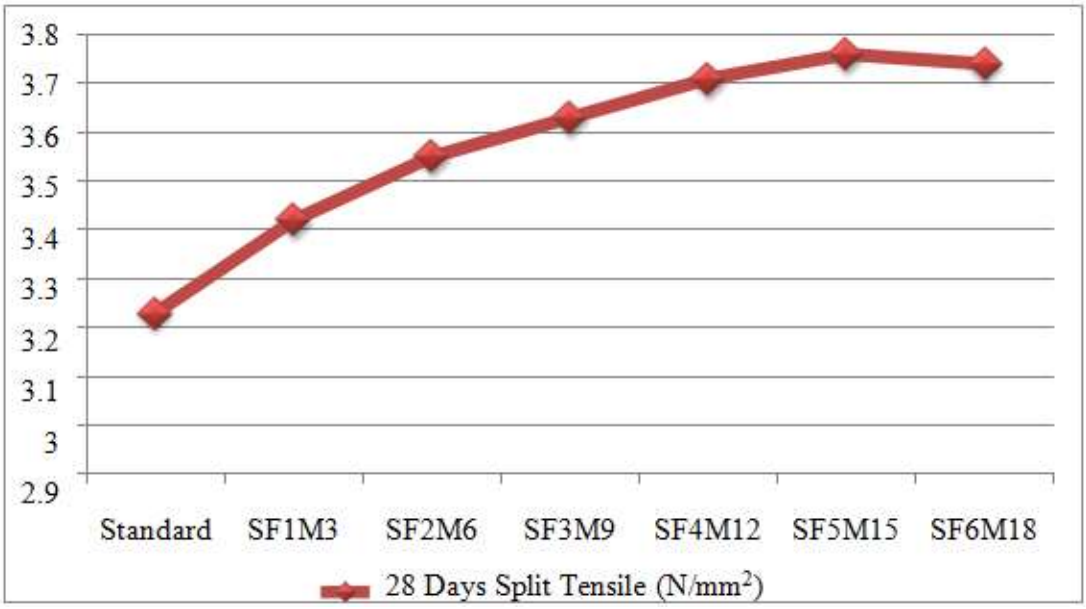

Figure : 4

Flexural strength at 28 days addition of varying % of Jute Fiber and Metakaolin as Replacement of Cement

CONCLUSION

- At 7days Compressive strength of at Addition of varying % of Jute Fiber and Metakaolin as Replacement of Cement linearly increases and maximum compressive strength of concrete is 35.02N/mm^2 till 15% Metakaolin after that compressive strength start dropping.
- At 28 days Compressive strength of at Addition of varying % of Jute Fiber and Metakaolin as Replacement of Cement linearly increases and maximum compressive strength of concrete is 40.63N/mm^2 till 15% Metakaolin after that compressive strength start dropping.
- At 7 days Flexural Strength of at Addition of varying % of Jute Fiber and Metakaolin as Replacement of Cement linearly increases and maximum flexural strength of concrete is 3.63N/mm^2 till 15% Metakaolin after that flexural strength start dropping.
- At 28 days Flexural Strength of at Addition of varying % of Jute Fiber and Metakaolin as Replacement of Cement linearly increases and maximum flexural strength of concrete is 3.84N/mm^2 till 15% Metakaolin after that flexural strength start dropping.

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