

Experimental Investigation on Hybrid Fibre Reinforced Concrete by Partial Replacement of M-Sand with Fine Aggregate

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Abstract: Over many years, there has been a huge expansion in the utilization of fibre in concrete for further developing its properties like elasticity and pliability. The fibre concrete is utilized in retrofitting existing substantial constructions. Among numerous kinds of strands accessible today, glass fibre is a new presentation in field of substantial innovation. Hybrid fibre in suitable combination may potential improve the overall properties and performance of concrete. Jute and glass fibre is used as a hybrid fibre. M-sand is delivered from hard granite stone by smashing. Fine aggregate is replaced by M-sand as 10%, 15% and 20%. For this study M25 grade concrete is used. Fibres are used in different proportion such as 0.2%, 0.4%, 0.6% and 0.8% respectively. In this study experiment were led in investigation the impact of Jute and Glass Fibre in various extent in solidified cement. Compressive strength, split rigidity and flexural strength test for 7, 14 and 28 days were tested.

Keywords: Jute and glass fiber, M-sand, compressive strength, split tensile strength, flexural strength.

I. Introduction

The plan of a sturdy and minimal expense fibre reinforced cement concrete for building development is a mechanical difficulties in non-industrial nations. The sorts of fibre right now been utilized incorporate steel, glass, polymer, carbon and regular strands. Monetary thought for confined the utilization of carbon fibres in cementations composites on a business level for their non-financial exhibition [1]. Significant exploration are being accomplished for utilization of supporting filaments like jute, sisal, bamboo, akwara, coconut husk, sugarcane bagasse in concrete composites generally in the event of building materials. Utilization of regular fibres' in a moderately weak cement grid has accomplished extensive strength and sturdiness of the composite[2]. The strength of such strands in an exceptionally antacid concrete network should be thought about by compelling change. A particular substance organization must be picked that can alter the filaments surface just as reinforce the concrete composites[3]. Jute fiber assumes a significant part in middle economy. This fiber of trade is extricated from the stem of two developed types of jute tossa jute and white jute. The jute business creates around 40,000 tons of handling waste as results, generally known as jute caddies. The significant constituent of this waste is unspinnable jute fiber. Different constituents are clumping oil, machine oil and oil, barks of jute plant and inorganic earth's, consequently improvement of primary breaks might be diminished generally by utilizing fiber supported cement [3,6]. Generally the jute business utilized this loss alongside coal as fuel for the evaporator to create steam, which was needed to run the measuring and calendaring machines. This potential waste can discover its application from multiple points of view biogas creation, nonwoven items, composites, biomass energy and handcrafted paper. The upsides of utilizing all around compacted concrete incorporate high compressive strength, great imperviousness to fire, high water opposition, low upkeep, and long help life [1,4&5].

A Hybrid Fiber built up concrete is framed from a mix of various sorts of filaments, which vary in material properties, remain reinforced together when included cement and hold their characters and properties [5]. The hybridization of filaments gives worked on explicit or synergistic trademark not possible by any of the first fiber acting alone. In a crossover fiber supported substantial at least two unique kinds of fiber are normally joined to create a cementations composite that gets profits by every one of individual strands and shows a synergistic reaction [6].

II. Literature Review

Vikrant S. Vairagade et.al [7] Performed "Test Investigation on Hybrid Fiber Reinforced Concrete" The utilization of at least two sorts of fiber in a reasonable blend may possibly work on the general properties of

cement and furthermore bring about execution concrete. In light of test considers, the paper distinguishes fiber mixes that exhibit greatest compressive and split rigidity of concrete. Chaitanya kumar J.D and Abhilash G.V.S et.al [8] led an "Exploratory Studies on Glass Fiber Concrete" The advancement of cement has achieved the fundamental requirement for added substances both synthetic and mineral to work on the exhibition of cement. Mohankar R.H and Pidurkar M.D et.al [9] conducted an "Hybrid Fibre Reinforced Concrete" studies on the mechanical performance of hybrid fibre reinforced concrete. The addition of small closely spaced and uniformly dispersed fibres to concrete would act as crack resistor and would substantially improve its properties. Dilipan M and Ramkumar S et.al [10] conducted an "Trial Investigation dependent on regular Fiber Banana and Jute in concrete" Generally concrete is acceptable in pressure and feeble in strain. The fiber in concrete for the most part increments both pressure and strain in concrete. In this project we are composite two diverse regular strands it is that jute fiber and banana fiber in cement to know the better outcomes. Sindhu R Nanthini T et.al [11] focused on "Test examination by fractional supplanting of fine total with foundry sand expansion of mixture fiber in concrete" The expansion of half breed fiber utilized in this venture is to build strength of cement. Kavita S Kene, Vikrant S Vairagade and Sathish Sathawane et.al [12] conducted an "Trial Study on Behavior of Steel and Glass Fiber Reinforced Concrete Composites" Fiber built up concrete is a substantial in which little and intermittent strands are scattered consistently. Pooja Warke and Shrinkhala Dewangan et.al [13] has contemplated the "Investigate the Properties of Concrete by Using Jute fiber" Different level of jute fiber is utilized in concrete as 0.2%, 0.3% and 0.4% volume of cement and examine the property of cement. The compressive test was completed at substantial ages of 7 and 28 days. Deepa M and Arul kumar et.al [14] did considered the "Crossover Fiber Concrete with utilizing GGBS and M-sand". As of now huge measure of GGBS produced in enterprises with an effect on climate and people. Ordinary cement has two significant imperfections low elasticity and damaging and weak disappointment. Puneet Gondal and Abhishek Verma et.al [15] led an "The Experimental Study of Sisal and Jute Fiber Based Biocomposite" The composite assembling has been a wide space of exploration and it is the favored decision because of its unrivaled properties like low thickness, solidness, light weight and has better mechanical properties. N. Dayananda and B.S. Keerthigowda et.al [16] studied to investigate the effect of reinforcing raw jute fibers on the mechanical properties of cement concrete composites. Pooja warke and Shrinkhala Dewangan [17] presented the properties of concrete by using of jute fibers. Kaiser Bukhari and Ayaz mohmood et.al [18] concentrated to absolutely dependent on the tests did on jute mortar to notice the different changes and to think about its various properties. Priyanka goel and Mohd. usman et.al [19] concentrated to examine the impact of jute fiber supported on the strength and flexibility properties of cement. Flexural and pressure test showed that the presence of jute fiber built up concrete is estimated tentatively. Yaseen alisalih and nadian azhatsabeehet et.al [20] introduced to examine impact of width and thickness of jute fiber strips on the mechanical properties of built up concrete beams (RC beams).

III. Material Used

Cement

The customary Portland concrete of 53 grades, adjusting to IS 12269-1987 was utilized. The concrete were put away in impenetrable air, liberated from dampness and bought from single hand. The tests were done on different actual properties of concrete. The particular gravity was 3.15 and fineness was 5.0% and standard consistency 29.6% and compressive strength test on 3 days is 35MPa, 7 days is 46.5MPa, 28 days is 64MPa.

Fine aggregate

Normal stream sand was utilized as fine total. Consistently reviewed sand accessible Dindigul was delivered and utilized. It was perfect, liberated from natural matter, residue and earth. The outcomes show that the sand greatest size 4.75mm adjusts to Zone II of IS: 383-1970. The particular gravity was 2.59 and fineness was 4.89 and water assimilation was 0.80% is applied in this examination.

Manufacturing sand

M-sand was utilized as fine total rather than regular sand on the grounds that the accessibility of normal sand is less. Also, the expense M-sand is low contrasted with regular sand and it has a similar property of the normal sand. In this task, M-sand going through 2.36mm sifter was utilized. The particular gravity of M-sand is 2.73 and water assimilation of M-sand is 1% and mass thickness of M-sand is 1705kg/m³.

Course aggregate

Squashed rock stones got from neighborhood quarries were utilized as course total. Course totals are inactive materials utilized for expanding the volume and strength of cement. Evaluated, squashed hard blue stone

jam of 20 mm size and adjusting to IS 383-1963. The particular gravity was 2.63 and fineness was 7.23 and water retention 0.51% was utilized.

Jute fibres

Jute plant has a place with the class, corchorus, family tiliaceae and jute is acquired from the stem of the jute plant. Jute plants develop to about 2.5 to 3.5. Natural retting is an interaction utilized for eliminating fiber from stem. Jute fiber has a significance among the normal filaments since jute develops richness in Bangladesh and eastern piece of India and jute built up composites have moderate malleable and flexural properties contrasted and other natural fibres. Explicit gravity 1.49, Length of fiber 10-12mm, Density g/m³ 1.4, Tensile strength 54-754Mpa, Young's modulus 30Gpa.

Glass fibres

The Glass fiber was initially created for stalemate covers for electrical wiring. It was subsequently found to have great fiber shaping capacities and is presently utilized only as the building up stage in the material regularly known as fiber glass. Length 12mm, Specific gravity 2.68, Density 2.48g/cm³, Young's modulus 91Gpa, Tensile strength 1700Mpa.

IV. MIX Proportions and Material Quantity

Table: 1 Mix proportions

Water	Cement	Fine aggregate	Coarse aggregate
197 litre	448kg	659.4kg	1090.1kg
0.43	1	1.45	2.43

Mix Proportions for (M25) Grade for Jute and Glass fibres Table: 1

Table: 2 Material Quantity details

S.No	Jute and Glass fibre(%)	W/C Ratio	Mix proportions(kg/m ³)				
			Cement	Jute and glass fibre	Sand	Aggregate	Water
1	0	0.43	448	0	659.4	1090.1	197
2	0.2	0.43	447.1	0.89	659.4	1090.1	197
3	0.4	0.43	446.2	1.79	659.4	1090.1	197
4	0.6	0.43	445.3	2.6	659.4	1090.1	197
5	0.8	0.43	444.4	3.5	659.4	1090.1	197

V. Results and Analysis

A. Compressive Strength of Concrete

Effect of compressive strength of M25 grade concrete. Mixes MIX- 1(10%MS&0.2%JGF), MIX-2(20%MS&0.4%JGF), MIX-3(30%MS&0.6JGF), MIX-4(40%MS&0.8JGF)

Table: 3 compressive strength for raw JGFC cubes

COMBINATION	COMPRESSIVE STRENGTH (N/mm ²)		
	7 days	14 days	28 days
CC	26.2	30.1	36.46
MIX-1	29.0	34.2	38.62
MIX-2	28.9	31.7	35.64
MIX-3	27.1	32.1	36.1
MIX-4	30.2	34.3	39.1

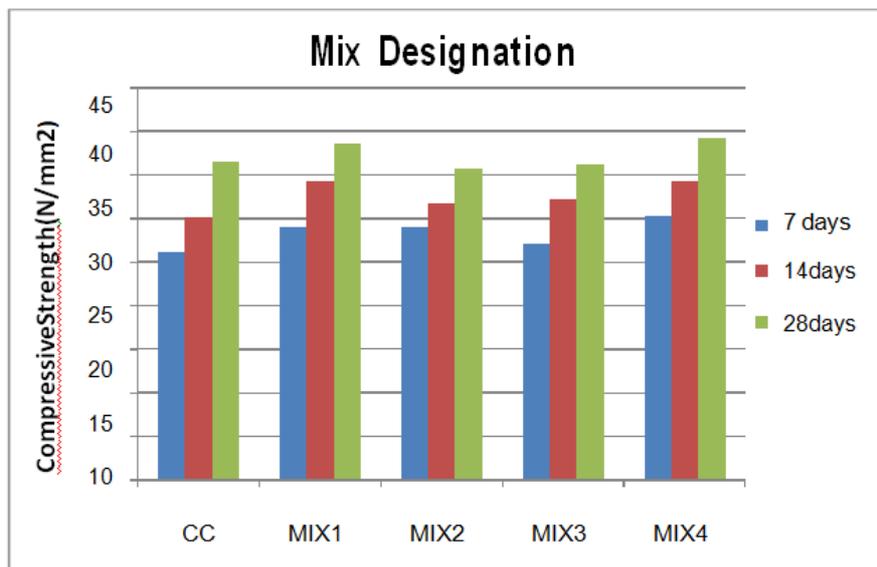


Fig 2 compressive strength test for 7, 14 and 28days

B. Tensile strength test

Effect of Tensile strength of M25 grade concrete. Mixes MIX- 1(10%MS&0.2%JGF), MIX- 2(20%MS&0.4%JGF), MIX-3(30%MS&0.6JGF), MIX-4(40%MS&0.8JGF)

Table: 4 Split tensile strength for raw JGFC cylinders

COMBINATION	TENSILE STRENGTH (N/mm ²)		
	7 days	14 days	28 days
CC	3.5	4.12	4.50
MIX-1	3.9	4.56	4.70
MIX-2	3.5	3.80	4.40
MIX-3	3.67	4.10	4.52
MIX-4	3.73	4.43	4.71

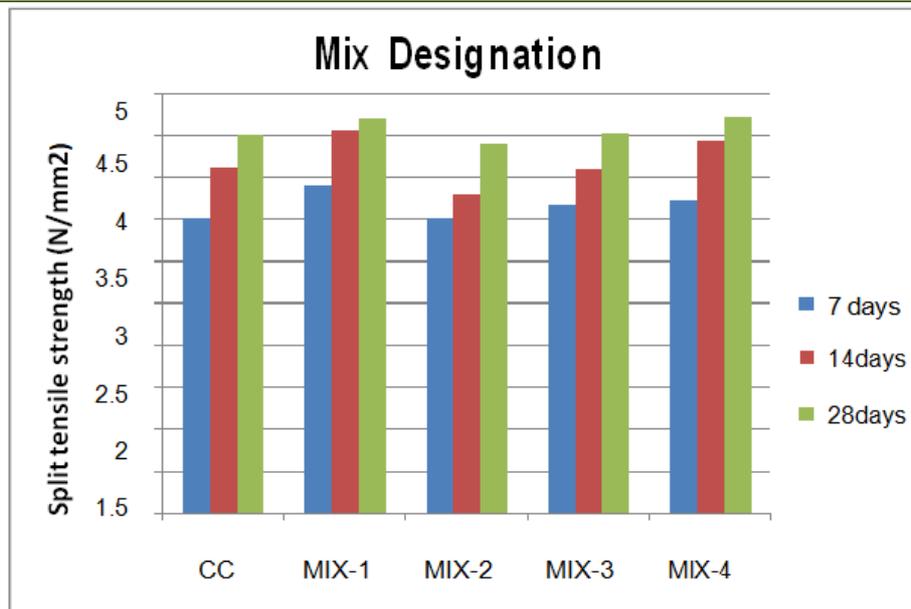


Fig 3 split tensile strength test for 7, 14 and 28days

C. Flexural strength test

Effect of Flexural strength of M25 grade concrete. Mixes MIX- 1(10%MS&0.2%JGF), MIX-2(20%MS&0.4%JGF), MIX-3(30%MS&0.6JGF), MIX-4(40%MS&0.8JGF)

Table: 5 flexural strength for raw JGFC beams

COMBINATION	FLEXURAL STRENGTH (N/mm ²)		
	7 days	14 days	28 days
CC	3.78	4.58	5.84
MIX-1	3.86	5.60	7.16
MIX-2	3.89	5.96	7.50
MIX-3	3.81	5.81	7.20
MIX-4	3.85	5.95	7.92



Fig: 4 tested beam specimen and crack pattern

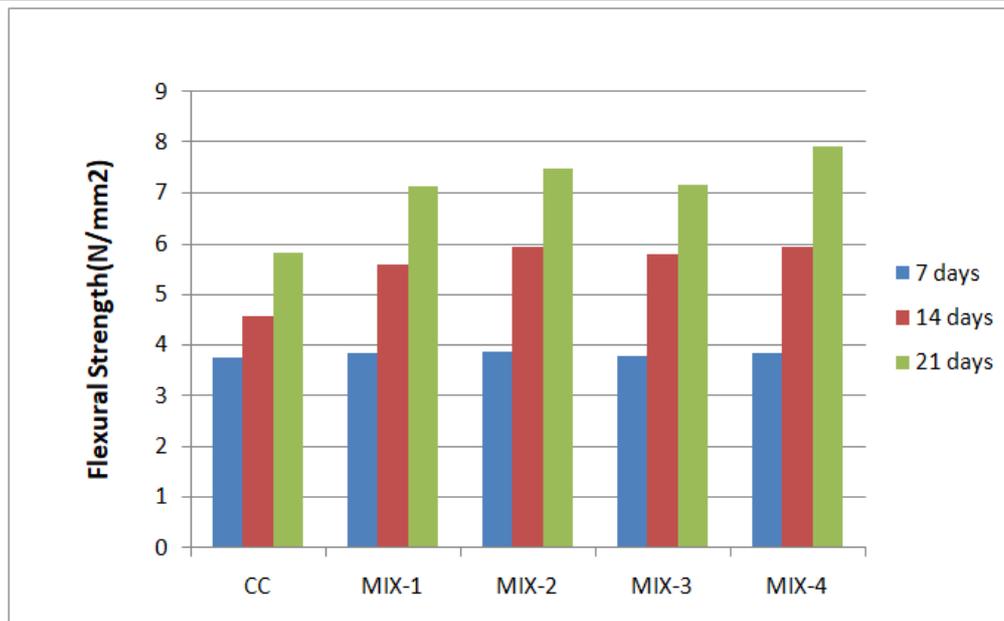


Fig: 5 flexural strength tests for 7, 14 and 28days

VI. Conclusion

In light of the tests, the examination on expansion of glass fiber and jute fiber in concrete. Expansion of crossover fiber increment compressive and split rigidity of cement. With 0.2 percent expansion of fiber and 10% of assembling sand is continuously expansion in the compressive strength is 13%, the increment in flexural strength is 42% and the increment in split elasticity is 20% over traditional cement. With 0.8 percent expansion of fiber, the increment in the compressive strength is 35%, the increment in flexural strength is 75% and the increment in elasticity is 37 percent. Hence supporting with jute and glass fiber contributes hugely in improving the compressive strength of concrete and the expansion is 1.78 occasions that of typical cement. From the test outcomes, it is tracked down that the glass fiber has the high flexural strength. Overall jute strands can be adequately utilized as a financially savvy substitution for glass filaments and customary filaments. It works on the properties of substantial which are essential in tremor safe designs.

Based on these extensive experimental investigations, important conclusions have been arrived as follows:

1. The addition any fibre damages the workability of fresh concrete
2. Thick fibres increases the percentage of air content compared to thin fibres irrespective of the length and quantity of fibre added.
3. The volume fraction of fibres increases air content significantly irrespective of the length.
4. The ideal volume part of filaments from 0.5% to 1%. The fibre reinforcing index is the most persuasive boundary and expansion in strength of stringy cement is corresponding to FRI.
5. Addition of fibres results in a concrete which can fail safely; a preferred property under seismic loading conditions.
6. Utilization of this fiber in concrete leads to an effective solid waste management techniques.

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