A COMPARITIVE STUDY ON FLEXURAL STRENGTH OF STEEL BINDING WIRE AND JUTE FIBERS IN CONCRETE OVER ORDINARY CONCRETE

M.K.S.S.KrishnaChaitanya[1*] M.K.M.V Ratnam
[1] Assistant Professor, Department of Civil Engineering, Anil Neerukonda Institute of Technology and sciences, Visakhapatnam
[2] Assistant Professor, Department of Civil Engineering, D N R College of Engineering and Technology, Bhimavaram

Abstract: *Fiber Reinforced Concrete (FRC) is defined as a composite material essentially consisting of conventional concrete or mortar reinforced by the random dispersal of short, discontinuous, and discrete fine fibres of specific geometry. Since Biblical times, approximately 3500 years ago, brittle building materials, e.g. clay sun baked bricks, were reinforced with horse-hair, straw and other vegetable fibres. Although reinforcing brittle materials with fibre is an old concept, modern day use of fibre in concrete is only started in the early 1960's. Realizing the improved properties of the fibre reinforced concrete products, further research and development on Fibre Reinforced Concrete (FRC) has been initiated since the last three decades. This present study concentrates on flexural strength of steel binding wire a fiber reinforced concrete (SFRC) and Jute fiber reinforced concrete, over ordinary concrete. Results show that optimum percentage of 1% for SFRC and 0.5% for JFRC.*

Keywords: Fiber reinforced concrete, Jute fiber reinforced concrete, Steel fiber reinforced concrete,

1. INTRODUCTION

Concrete is a combination of binding materials, fine aggregate, coarse aggregate and water. Concrete is hard and strong like stone, this is caused by the chemical reaction which take place between water and cement. The benefit of concrete is its most multipurpose use in construction field. Concrete is the material which can be molded in some shapes and well to cast from regular rectangular or circular structure to dome or hemispherical form. The strength of concrete regularly enhances with times up to a limit and it has minimum maintenance during the tune-up time of structure like calculate to further construction materials similar to steel, wood etc. But concrete is a brittle material and weak in tension therefore forming cracks easily. For this reason, reinforcement is required to strengthen and durability of concrete. Fibre reinforced concrete is an attempt for enhancing the inherent property of concrete to make it more valuable. Fibre reinforced concrete can be considered to be a composite material made using concrete and short, discrete, and randomly distributed fibres. Research and development work in Fibre Reinforced Concrete (FRC) started in India at the early 1970. Fibre reinforced concrete was developed to overcome the problems associated with cement base materials for example low tensile strength, poor fracture toughness and brittleness of cementitious composites. Fiber reinforced concrete is use to raise the tensile strength and toughness of concrete. It is randomly distributed fibre within the concrete matrix. In the beginning, FRC was primarily used for pavements and industrial floors. But now a days, the FRC compound is being use for a broad range of application including bridges, tunnel and canal linings, hydraulic structures, pipes, slab, precast etc. Fibre concrete also used use in the repair work of structure to avoid spalling of concrete from repair structure. The use of FRC in structural members such as beams, columns, staircase, slabs and pre-stressed concrete structures is individual investigate by a number of researchers at present in India and abroad.

Advantages of Fibre reinforced concrete

- Fibres increase the structural integrity.
- They can provide high tensile strength to plain concrete.
- Greater reduction in permeability of concrete.
- More resistance to impact load.
- Fibre can reduce the quantity of re-bars without loss of strength.
- Greater abrasion and shatter resistance.
- Elimination of cracks by bridging action of fibre.

Disadvantages of Fibre Reinforced Concrete

- Reduction in workability.
- Cost is high.

2. LITERATURE REVIEW

- GopiRaval(2017),et.al., in their project of "Effect Of Jute Fibres On Fibre Reinforced Concrete" studied that with the addition of jute fiber they observed that jute fiber have not only improved the compressive, flexural, split tensile strengthand doesn't have any environmental damage.
- Ankur yadav(2018), et.al., in their project studied the use of steel fiber in structural concrete to enhance the mechanical properties of concrete .In their study they found that workability of concrete is significantly reduced as fiber content increases.
- Anurag Mishra,et.al., in their project of "Experimental study on Steel Fiber Reinforced Concrete" studied the effect of performance of concrete by varying the percentage of fibers. They observed that increase in fiber content up to the optimum value increases the strength of concrete.
- Seyed Hamed Ahmadipourinaeim et,al. in their study, the effect of polypropylene fibers on the compressive strength and heat resistance of concrete with high strength has been investigated. Polypropylene fibers with different lengths, including 5, 10, 15 20 and 25 mm and different weight, including 0.5, 0.8, 1.3 and 1.7 kg/m was 3 used in the concrete.

3. MATERIALS & METHOD

1. Collecting Of Materials
2. Testing of Materials
3. Mix Design
4. Casting and curing of Prisms
5. Testing Prisms for Different Curing Days
6. Calculation of Flexural Strength

Collecting of Materials: All the materials are collected that are used in our project like coarse aggregate ,fine aggregate, sand, jute fibers, steel bending wires, super plasticizer. Locally available sand is used as a fine aggregate.Super Plasticizer: Super Plasticizer of 430 Grade (Fosroc Sulphonated Naphthalene Formaldehyde) was used to increase the workability.

Testing of Materials:

Specific gravity tests are conducted for binder (cement), coarse aggregate and fine aggregate and results are tabulated.

SI.No	Materials Used	Specific Gravity
1	Cement	3.15
2	Fine aggregate	2.69
3	Coarse aggregate	2.75

Zoning of sand is determined by conducting Sieve Analysis. Zone-II sand was used for present experimental work

Mix Design:

Present study design mix of cement: FA: CA as 1:1.77:2.92 was considered.

Casting of Specimens:
Standard prisms of size 50cm x 10cm x 10cm
A total number of 72 specimens were casted.

- 27 Steel Fibre Reinforced Concrete prims
- 27 Jute Fibre Reinforced Concrete cubes
- 18 Controlled Concrete (CC) Prisms

Sample Estimation of Quantities:

- Volume of prism = 50cm x 10cm x 10cm = 5 x10-3m3
- No. of Prisms to be cast =63
- Mix proportion = 1: 1.77: 2.92
- Wet volume of concrete = 5 x10-3 x 63
- Dry volume of concrete = 5 x10-3 x 1.5 x63 = 0.47 cu.m
- Cement = 391.11 x 0.47 = 185kg
- Fine aggregate = 669 x 0.47 = 315 kg
- Coarse aggregate = 1202 x 0.47 = 565 kg

The concrete after thoroughly missing is placed in prism moulds and demoulded after 24 hrs. The concrete specimens are cured in water for curing duration of 3, 7 and 28 days. The specimens are tested after completion of specified curing duration to study the early age strength and also the strength after hardening.
Testing of Prisms:
Circular rollers manufactured out of steel having cross section with diameter 38 mm will be used for providing support and loading points to the specimens. The length of the rollers shall be at least 10 mm more than the width of the test specimen.
The distance between the outer rollers (i.e. span) shall be 3d and the distance between the inner rollers shall be d. The inner rollers shall be equally spaced between the outer rollers, such that the entire system is systematic. Location of rollers and their distances are as mentioned in figure 1.

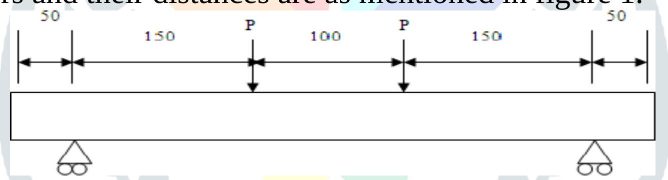

Figure 1: Location of rollers for application of loads

A total of four rollers shall be used, three out of which shall be capable of rotating along their own axes. The test specimen shall be placed in the machine correctly centred with the longitudinal axis of the specimen at right angles to the rollers. Formoulded specimens, the mould filling direction shall be normal to the direction of loading. The load shall be applied at a rate of loading of 180 kg/min for the 10.0 cm specimens.


Figure 2: Flexural testing machine


Figure 3: Failure of prism

Calculation of Flexural Strength:
Flexural strength of the concrete can be determined by the following two formulae:

- When a>13.3 cm for 10cm specimen fb = pl /bd2
- When a<13.3 cm for 10cm specimen fb =3pa/bd2

Where,
fb= Flexural Strength of concrete
a = the distance between the line of fracture and the nearer support, measured on the centre line of the tensile side of the specimen.
b = Width of the specimen (cm)
d= Depthof the specimen (cm)
l= Supported length (cm)
p= Maximum load (KN)

4. RESULTS & DISCUSSION:

Flexural strengths of ordinary concrete without any fibers and steel binding wire concrete and jute fiber concrete as given in table 1 for different during conditions and different percentage of fibers.

S. NO.	Type of Prisms		Flexural Strength		
			3 Days (N/mm2)	7 Days (N/mm2)	28 Days (N/mm2)
1	Controlled Concrete		2.8	3	4.87
2	Steel Fiber Reinforced Concrete	0.50%	3.17	3.7	4.53
		1.00%	3.83	4.62	7.32
		1.50%	4.27	4.8	6.32
3	Jute Fiber Reinforced Concrete	0.15%	1.77	2.33	3.5
		0.25%	1.87	2.52	3.8
		0.50%	2.7	3.33	5.27

Table 1: Flexural strength of prims

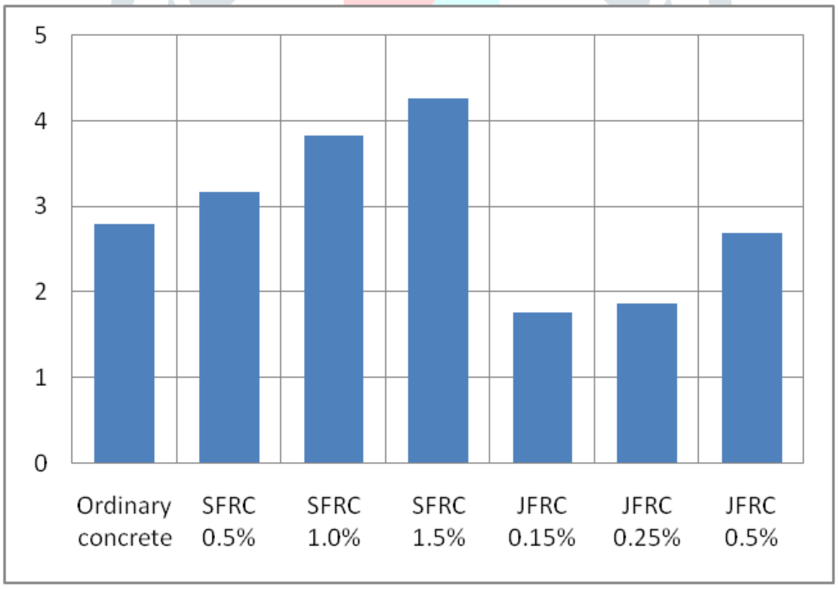

Figure 4: Flexural strength of test specimens for 3 days curing duration

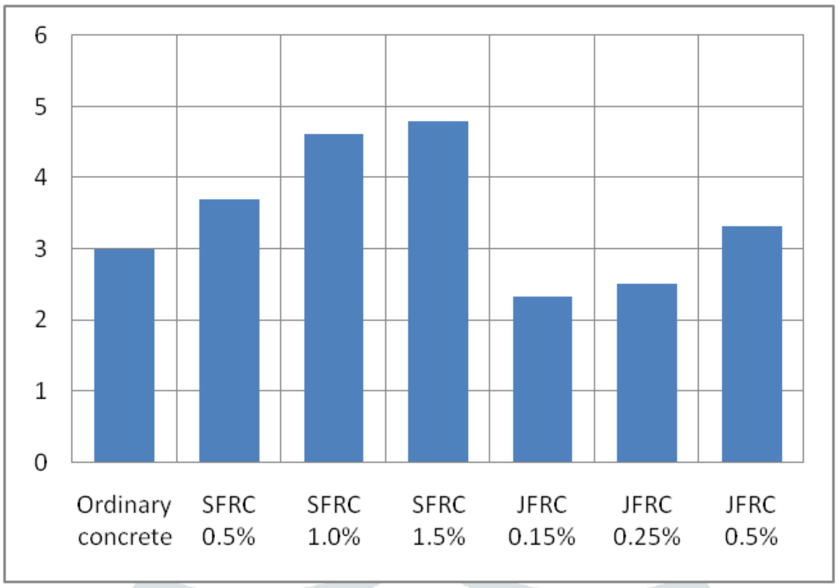

Figure 5: Flexural strength of test specimens for 7 days curing duration

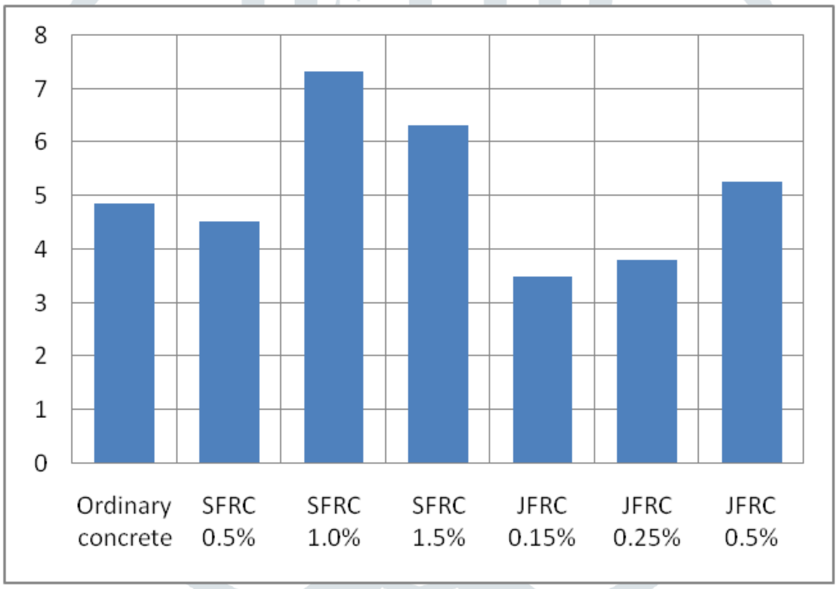

Figure 6: Flexural strength of test specimens for 8 days curing duration

The results obtained for various percentages of steel binding wire and jute fibers after 3, 7 and 28 days of curing are tabulated in table 1. The flexural strength for the control specimen, without fibers was observed to be 2.8 N/mm2 after 3 days, 3 N/mm2 after 7 days and was observed to be 4.87 N/mm2 after 28 days. At 3 days, the flexural strength increased by 26.8% compared to ordinary concrete when steel binding wire as fiber was used. At 7 days, the flexural strength increased by 37.5% and 11% compared to ordinary concrete when steel binding wire and jute fibers was used respectively. At 28 days, the flexural strength increased by 33.4% and 7.5% compared to ordinary concrete when steel binding wire and jute fibers was used respectively.

After 28 days, it is interestingly observed that the flexural strength was in no case less than the conventional concrete for 1.0% volume fraction in case of steel binding wire and 0.5% in case of jute fiber concrete. From the tables and graphs it is evident that the flexural increases upto 33% of SFRC conrete both at 7 days and 28 days over ordinary concrete. With regard to the addition of fibers, it can be concluded that addition of fibers till 1.0% and 0.5% by volume is acceptable for steel binding wire and jute fiber. Beyond this the strength is reduced.

5. CONCLUSIONS

1. Flexural strength of jute fibre reinforced concrete is greater than controlled concrete. Flexural strength of 0.5% (optimum percent) Jute fibre reinforced concrete is 7.5% greater than that of controlled concrete.
2. Flexural strength of steel (binding wire) fibre reinforced concrete is greater than controlled concrete. Flexural strength of 1.0%(optimum percent) Steel fibre reinforced concrete is 33.4% greater than that of controlled concrete.
   Flexural strength of Steel (binding wires) fibre reinforced concrete is greater than Jute fibre reinforced concrete. Flexural strength of 1.0% (optimum percent) Steel fibre reinforced concrete is 28% greater than that of 0.5% (optimum percent) Jute fibre reinforced concrete.
3. It is safe then to say that the increase in flexural strength is due to the increased bonding effect between the fibre and the concrete matrix which made for better transference of stress between the aggregates
4. As the amount of fibre exceeded the optimum value (steel 1% and jute 0.5%), the excess fibre weakens the aggregate interlock there by reducing the strength of concrete.

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