ISSN: 2394-3696, Website: www.ijiert.org, June, 2022

EXPERIMENTAL STUDY ON FIBER REINFORCED SELF COMPACTING CONCRETE

Mr. B. M Malagimani
Assistant professor Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

Dr. M. G. Deshmukh
To Associate professor Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra

Gosavi Shriyash
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra
Gavali Sujit
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra

Masal Vivek
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra

Adamane Saurabh
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra

Bhange Suraj3,
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra

Namade Soham3,
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra

Aldar Shankar
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur, Maharashtra

ABSTRACT

The usefulness of fiber reinforced concrete (FRC) in various civil engineering applications is indisputable. Fiber reinforced concrete has so far been successfully used in slabs on grade, architectural panels, precast products, offshore structures, structures in seismic regions, thin and thick repairs, crash barriers, footings, hydraulic structures and many other applications. Fiber Reinforced Concrete (FRC) is gaining attention as an effective way to improve the performance of concrete. Fibers are currently being specified in tunneling, bridge decks, pavements, loading docks, thin unbonded overlays, concrete pads, and concretes slabs. These applications of fiber reinforced concrete are becoming increasingly popular and are exhibiting excellent performance. Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers. This study presents understanding strength of fiber reinforced concrete.

Keywords: - fiber reinforcement, Self compacting concrete, strength, workability.

1. INTRODUCTION:

One of the most notable developments in concrete technology over the past ten years is self-compacting concrete (SCC). Concrete that can compress itself only through its own weight without the need for vibration is referred to be SCC. Even in heavily reinforced concrete members, it fills every crevice, reinforcing area, and void, and it flows freely and almost evenly. The usage of SCC benefits the construction industry in a variety of ways. For example, the elimination of compaction operations lowers placement costs, reduces construction time, and increases productivity. The use of SCC also improves working conditions, reduces casting noise, and opens up the option of extending placement hours in urban settings. Other benefits of SCC include enhanced concrete production homogeneity and superior surface quality free of blowholes or other surface flaws. However, when SCC is used wisely, costs are reduced due to increased productivity, shorter construction times, and better working conditions. Flowable concrete that has the ability to consolidate under its own weight is known as self-compacting concrete. There is no need for outside vibration to cause compaction.

2. OBJECTIVES:

- To compare the strength properties of normal concrete with Fiber Reinforced Self Compacting Concrete.
- To check tensile strength of normal concrete and FRC.
- To check flexural strength of normal concrete and FRC.

3. MATERIALS USED:

- The different materials used are:-

1. **Cement: -** Cement is a binder, a chemical used in construction that binds things together by setting, hardening, and adhering to them. PPC of Grade 53 is the type of cement that is used.

2. **Fine Aggregate: -** Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 4.75mm sieve.

3. **Coarse Aggregate: -** Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 4.75mm sieve.

4. **Super Plasticizer: -** Sika is used as a superplasticizer.

5. **Water: -** Portable water or tap water is used.

6. **Steel Fibers: -** The steel fibers used in this project are of 60 mm in length and 0.75 mm in thickness. The aspect ratio (fiber length over diameter) of steel fiber is 80. Aspect ratio between 40-80.

3.1 Cement:

Cement used in the experiment work is pozzolona Portland cement of grade 53 conforming to IS: 10262:2010. The properties of cement are shown in below Table 1.

Table 1: Physical Properties of Cement

Sr.No.	Characteristics	Value
1	Specific Gravity	3.15
2	Standard Consistancy	35
3	Setting Time 1) Initial (Min) 2) Final (Min)	 Min 28 Max 500

3.2 Fine Aggregate:

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone III as per the specification of IS:383:1970

Table 2: Physical Characteristics of fine aggregate

Sr.No	Charactertics	Value
1.	Specific Gravity	2.7
2.	Fineness	2.71

3.3 Coarse Aggregate:

As coarse aggregate, crushed sand with a maximum particle size of 10 mm has been employed. The combined aggregates' sieve analysis reveals that they meet the requirements of IS 383: 1970 for graded aggregates.

Table 3: Physical Characteristics of coarse aggregate

Sr.No	Characteritics	Value
1.	Specific Gravity	2.64
2.	Fineness	6.816

3.4 Water:

Water used was normal water from tap, which was free from salt and conforming the requirement of IS: 456-2000.

4. METHODOLOGY:

The goal of the project was to assess the properties of different fibers and how they can affect concrete mixtures. To accomplish this goal, the following objectives were established:

- Create a mix design for the concrete with steel fibers
- Assess strength, corrosion, and fire resistance

ISSN: 2394-3696, Website: www.ijiert.org, June, 2022

- Provide recommendations for use

5. SAMPLE CALCULATIONS:

Cement =1.350(kg) X 18(cubes) = 24.3 kg

Sand=2.41(kg) X 18(cubes) = 43.38 kg

C.A = 4.36(kg) X 18(cubes) = 78.48 kg

Water = 8.50 Liter

6. RESULTS:

6.1. Compressive Strength of Plain Cement Concrete:

Table 4: Compressive Strength (MPa)

Plain Concrete	Load (kN)	Compressive Strength (MPa)	Load (kN)	Compressive Strength (MPa)
	7 days	7 days	28 days	28 days
	750	33.33	1160	51.55
	740	32.89	1140	50.67
	770	32.67	1155	51.33
Average		32.96		51.18

6.2 Compressive Strength of FRC:

Table 5: Compressive Strength (MPa)

Steel Fiber 1%	Load (kN)	Compressive Strength (MPa)	Load (kN)	Compressive Strength (MPa)
	7 days	7 days	28 days	28 days
	760	33.78	1200	53.33
	740	32.89	1130	50.52
	770	34.22	1190	52.89
Average		33.63		52.15

It is seen from table 5 that for the control mix, the average compressive strength of concrete (with the help of 1% steel fiber) at 7 days is 33.63MPa which is greater than 32.96MPa and at 28 days is 52.15MPa which is greater than 52.15MPa.

Hence the results are satisfied.

Table 6: Compressive Strength (MPa)

Steel Fiber in 1.25%	Load (kN)	Compressive Strength (MPa)	Load (kN)	Compressive Strength (MPa)
	7 days	7 days	28 days	28 days
	780	34.67	1220	54.22
	750	33.33	1180	56.89
	760	34	1200	53.33
Average		33.99		54.81

It is seen from table 5 that for the control mix, the average compressive strength of concrete (with the help of 1.25% steel fiber) at 7 days is 33.99MPa which is greater than 32.96MPa and at 28 days is 54.81MPa which is greater than 52.15MPa.

Hence the results are satisfied.

6.3 Split Tensile Test:

Table no.6.3.1 split tensile test for Normal Concrete

Ordinary concrete	Split tensile test (MPa)	
	7 Days	28 Days
	2.88	4.8

Table no.6.3.2 Split tensile test for FRC

FRC	Split tensile test (N/mm^2)	
	7 Days	28 Days
1 %	5.88	7.6
1.25%	6.12	7.95

When we use the steel fiber material of 1 % tensile test is 5.88 MPa for 7 days and 7.6 MPa for 28 days, steel fiber and like 1.25 % the tensile test is 6.12 MPa, 7.95 MPa for 28 days.

6.4 Flexural strength test:

Table no.6.4.1 Flexural Strength for Normal Concrete

Normal concrete	Flexural Strength (N/mm^2)	
	7 Days	28 Days
	5.93	8.43

Table no.6.4.2 Flexural Strength for FRC

FRC	Flexural Strength (N/mm^2)	
	7 Days	28 Days
1 %	11.2	14.35
1.25%	11.8	14.35

When we use the steel fiber material of 1 % flexural strength is 11.2 N/mm2 for 7 days and 14.35 N/mm2 for 28 days, steel fiber like 1.25 % the flexural strength is 11.8 N/mm2, 14.35 N/mm2 for 28 days.

7. CONCLUSIONS:

I. In this project study we have used steel fibers and super plasticizer (sika) to increase compressive strength of concrete

II. As the percentage of steel fiber increases compressive strength of concrete increases upto certain limit.

III. From the result, we have obtained appropriate replacement percentage for steel fiber. It is around 1.25%.

IV. However more than 1.5 percentage replacement is not satisfactory as it affects the strength of the concrete. Let us consider a beam. We know that load carrying capacity of beam is directly proportional to the square of depth of beam that's why an optimum limit of steel fiber is specified (min-0.5% to max- 1.5%).

V. From above tables we can see that the strength of fiber reinforced concrete is more than Plain Concrete.

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