Experimental Investigation on Strength Properties of Concrete by Using Slurry Infiltrated Fiber Reinforced Concrete (SIFCON)

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***Abstract*- There Are Many Special Types of Concretes Are Practiced All Over India. We Know That Concrete Strong in Compression and Weak in Tension. To Increase the Tensile Strength of Concrete We Introduce Various Types of Fiber. In This Project We Introduce Steel Fiber Incorporate With Cement Mortar Slurry. Introducing SIFCON into the Field to Increase the Tensile Strength and Arresting a Crack in the Concrete. In This Paper Different Volume Fraction of Steel Fiber I, E 6%,8%,10%,12% And Cement, Sand, Silica Fume, Fly Ash Are Used In The Proportion of 1:1:0.15:0.5 M40 Concrete Mix Design Has Been Used In This Project (10262:2019) The Strength Properties of Concrete Has Been Found Out by Fresh And Harden Concrete Test. The Fresh Concrete Test Are Slump Cone Test And Compaction Factor Test Are Taken Into Account Like Wise Harden Concrete Test Are Compressive, Split Tensile, Flexural Strength At The Age of 7,14,28 Days. In This Project the Quality of Concrete Has Been Found Out by NDT Test (UPV Test) At the End of This Project We Have Find Out the Optimum Percentage of Steel Fiber in SIFCON**

***Index terms*- SIFCON, Mechanical Properties, fly ash, steel fiber**

I.INTRODUCTION

Slurry-infiltrated fibers concrete (SIFCON) can be considered as a special type of fiber concrete with high fibers content. The matrix usually consists of cement slurry or flowing mortar. SIFCON has excellent potential for application in areas where high ductility and resistance to impact are needed. Only very limited information is available about its behavior under different types of loading. This research is performed in the department of Civil Engineering Sinhgad College Vadgoan (BK) Pune India. It consist of workability tests like V funnel test, flow table test and L box flow test for slurry and mechanical tests like compressive strength, flexural strength and splitting tensile strength tests. To study both strength and deformation characteristics of the specimens. Which combined of ordinary Portland cement, ordinary sand, water, silica fume and super plasticizers. The results obtained from these tests have been added and the major conclusions drawn from the investigations are presented. Slurry-infiltrated fibers concrete (SIFCON) is a relatively new material that can be considered as a special type of fiber-reinforced concrete (FRC). In two aspects, however namely, fibers content and the method of production SIFCON is different from normal FRC. The steel fibers percentage varies between 2 to 8 percent. And for trail mix design water cement ratio was considered 0.45 and ordinary sand is pass out from 4.75 sieve of IS recommendations. This performed in shape of cubes 150*150*150 mm, beams 100*100*500 mm and cylinder of size D =150 mm and L = 300 mm.

SIFCON has been used successfully for refractory applications, pavement overlays, and structures subjected to blast and dynamic loading. Because of its highly ductile behavior and far superior impact resistance, the composite has excellent potential for structural application in which accidental or abnormal loads such as blasts are encountered during service. However, the composite was developed only recently, and only limited data are available on its behavior under different types of loading. Therefore, investigations were undertaken at the Sinhagad College Engineering Pune India,

II EXPERIMENTAL PROGRAM

The experimental work was carried out by casting cubes of size 150 x 150 x 150mm to find the compressive strength and prism of size 100mm x 100mm x 500mm to find the flexural strength and cylinder of 100mm diameter and 200mm height were casted to obtain the stress strain curve. The SIFCON specimens (say F1,F2,F3,F4,F5) and without fibre (only slurry, say S1,S2,S3,S4,S5) were casted and compared with the conventional concrete (say C) of grade M40 to study the compressive strength and flexural strength. The edges of the mould were sealed with plaster of paris to prevent the leakage of slurry. The fibre is dispersed in a random manner to the volume fraction. Compaction by table vibrator was used to ensure complete penetration of the slurry into the fibre pack. Twenty four hours after casting, the cubes were demoulded and cured in water for 7 and 28 days.

Slurry Infiltrated Fibers Concrete (SIFCON):

SIFCON is fiber reinforced concrete but it is produced using a method very different from that for 'ordinary' fiber concrete. Fiber concrete is usually produced by adding fibers into fresh concrete. All components are then mixed together and cast into a mould. SIFCON, on the other hand, is produced by placing fibers into an empty mould first and then infiltrating them with cement slurry. The development of 'self-compacting' slurry, which is able to infiltrate itself among fibers without vibration, is very useful for the practical application of this material in construction. An investigation into the area of cement slurries was the major part of this research into SIFCON.

Objectives:

The objective of our project work is to make high strength of concrete by slurry infiltrated fibers by using steel fibers, silica fume, super plasticizer with cement and sand.

- To make more strength.
- More compacted and having more resistance.
- Develop suitable mix design.
- Develop tests for fibers.
- Increase fatigue, impact and absorption resistance.
- Increase ductility, tensile and flexural strength.

Materials Used

The materials used for Conventional Concrete was, cement, fine aggregate, coarse aggregate and water. The materials used for preparing SIFCON was cement, Mineral admixtures that includes Fly Ash, GGBS and Silica fume, steel fibre, plasticizer and water.

1) Cement

Ordinary Portland cement of 53 grade conforming to IS: 12269 were used. The specific gravity of cement was found to be 3.15.

2) Fine aggregate

The size of aggregates which are lesser than 4.75mm are considered as fine aggregate. The most commonly used fine aggregate is the river sand. It passes through 4.75mm sieve.

3) Coarse aggregate

Aggregates are the most mined materials in the World. The coarse aggregate is the important material to be added in concrete. The aggregates of size greater than 4.75mm are generally termed as coarse aggregates.

4) Steel fibers

Steel fibers are added to concrete to improve the structural properties, particularly tensile and flexural strength. The extent of improvement in the mechanical properties achieved with SFRC over those of plain concrete depends on several factors, such as shape, size, volume, percentage and distribution of fibers.

Plain, straight and round fibers were found to develop very weak bond and hence low flexural strength. For a given shape of fibers, flexural strength of SFRC was found to increase with aspect ratio (ratio of length to equivalent diameter).

5) Fly ash

Fly ash or flue ash, also known as pulverized fuel ash in the United Kingdom, is a coal combustion product that is composed of the particulates (fine particles of burned fuel) that are driven out of coal-fired boilers together with the flue gases. Ash that falls to the bottom of the boiler's combustion chamber (commonly called a firebox) is called bottom ash. In modern coal-fired power plants, fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys. Together with bottom ash removed from the bottom of the boiler, it is known as coal ash. Depending upon the source and

composition of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO_2) (both amorphous and crystalline), aluminium oxide (Al_2O_3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata.

6) Super plasticizer

In modern concrete practice it is essentially impossible to make high performance concrete at adequate workability in the field without the use of super plasticizer conplast -SP430 (200ml/50kg) was used for the experimental work.

Properties

- Specific gravity- 1.220 to 1.225 @ 300C
- Chloride content- nil to IS: 456
- Air entrainment- approx. 1% additional air is entrained

7) Water

Fresh water available from local sources was used for mixing and curing of specimens.

A. Mix proportions

Fibre content of 8% by volume was adopted for SIFCON. Water cement ratio of 0.4 and super plasticizer about 2% was adopted. The slurry consisted of cement, silica fume, fly ash and GGBS. The cement, silica fume, fly ash ratio is 1:0.15:0.5 by weight and GGBS varied from 0.2 to 0.6.The mix ratio adopted for conventional concrete of grade M40 is 1:1.62:2.98 with w/c ratio of 0.4. The following table shows the mix proportion of and SIFCON

TABLE 1 MIX PROPORTION FOR SIFCON

Cement	Fine aggregate	Fly ash	Steel fiber	Super plasticizer
1	1	0.25	4%	1
1	1	0.5	4.5%	1
1	1	0.35	5%	1

Fresh Concrete

Though fresh state is transient, its condition seriously affects the behavioral properties of the final product. Poor compaction and improper curing will lead to porous concrete with low strength and high permeability. Fresh concrete is freshly mixed material which can be moulded into any shape. The relative quantities of cement, aggregate and water mixed together control the properties of concrete in wet state as well as in hardened state.

The properties of fresh concrete are

- Compatibility
- Mobility
- Stability
- Consistency
- Segregation
- Bleeding
- Curing
- Workability

V funnel test:

Consisting of a V funnel shape which is steel frame; all the slurry is poured fully in side frame the and then the gate is opened and time of flow is recorded

T f avg = 4 – 5 seconds

Types of concrete sample	Flow value in sec
SC1 (4%)	4 Sec
SC 2 (4.5%)	5 Sec
SC 3 (5%)	5 Sec
SC 4 (5.5%)	6 Sec

L box flow test:

It has L shape frame of steel; all the slurry is poured fully then the gate is opining the concrete starting flowing and the time which is spend is recorded.

T f avg = Max 4 seconds

Types of concrete sample	Flow value in sec
SC1 (4%)	4 Sec
SC 2 (4.5%)	5 Sec
SC 3 (5%)	5 Sec
SC 4 (5.5%)	6 Sec

Flow table test:

As we know the basic points should be considered such as upper diameter, lower diameter, first flow and number of blows for our test result is as below. Consisting of half conical shape steel frame and a circular flow table with arrangement of handle producing number of blows.

Types of Concrete Sample	Flow value in Cm
SC1 (4%)	40 cm
SC 2 (4.5%)	45 cm
SC 3 (5%)	50 cm
SC 4 (5.5%)	65 cm

Hardern Concrete Test

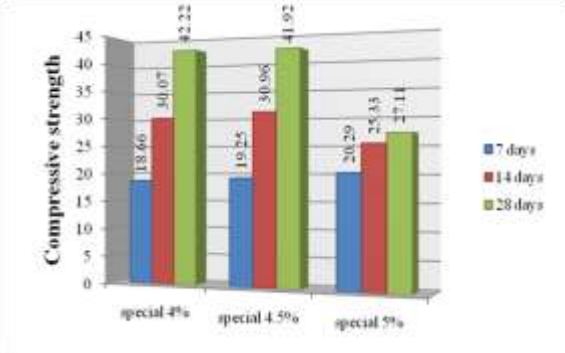
The following tests are conducted

- Compressive strength test

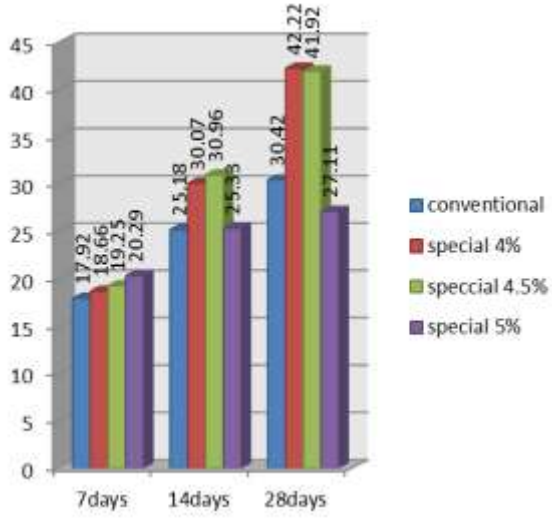
- Split tensile strength test
- Flexural strength test

Compressive Strength Test

For compressive strength test cube specimens of dimensions 150 x 150 x 150 mm are cast using M30 grade of concrete with different percentage of polypropylene and steel fibers taken the volume of concrete. The top surface of the specimen was leveled and finished.



Special Concrete Compressive Strength Test Results by pie chart

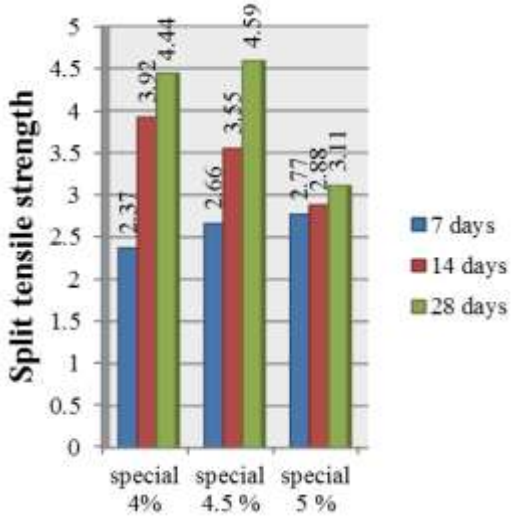


Comparison of Conventional and Special Concrete compressive Strength Test Result pie chart

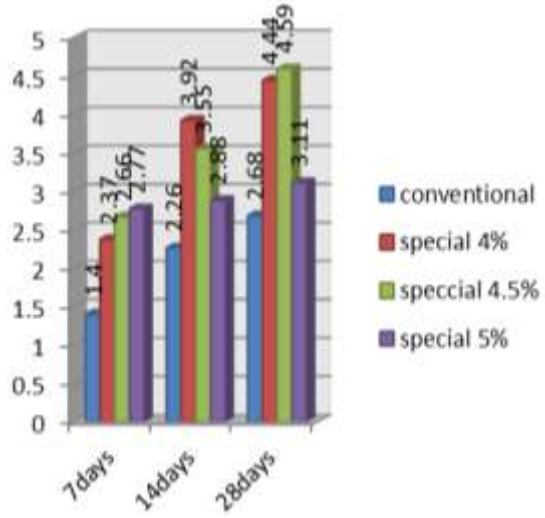
Split Tensile Strength Test:

For 3 specimens of cylindrical shape of diameter 150 mm and length 300 mm were tested under a compression testing machine of 2000 kN capacity under a compressive load across the diameter along its length till the cylinder split tensile strength. The tension develops in a direction at right angles to the line of action of the applied load. The split tensile strength was calculated as follows

Split tensile strength (Mpa) =2P / π DL



Special Concrete Split Tensile Strength Test Result by pie chart

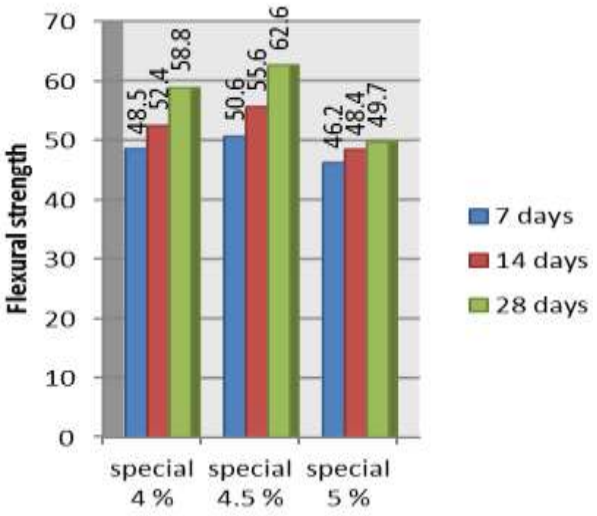


Comparison of Conventional and Special Concrete Split Tensile Strength Test Result pie chart

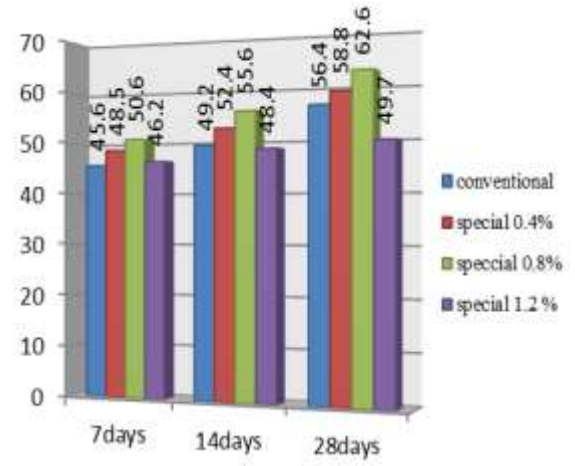
Flexural Strength Test

For the flexural strength of concrete, beam specimen size of 500x100x100 mm were casted. The samples are demouled after 24 hours from casting and kept into water tank for 28 days curing. The specimens were placed in UTM and tested for flexural strength. The average value is reported. This flexural strength calculated by following formula,

Flexural strength = 3Pa/bd2(N/mm2)



Special Concrete Flexural Strength Test Result



Comparison of Conventional and Special Concrete Flexural Strength Test Result

III. CONCLUSION

- Compressive, split tensile strength and flexural strength properties of conventional and special concrete strength compared at various proportions like 4,4.5&5% of steel and polypropylene fiber added finally get results were drawn graph.
- The strength properties of fiber reinforced concrete increased up to 5% percentage of steel fiber therefore gradually decrease the strength properties
- The optimum % of steel fiber in the SIFCON
- The special concrete achieves 10-15% more strength compare with conventional concrete.

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