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RESEARCH ARTICLE

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COMPARATIVE ANALYSIS OF COMPRESSIVE STRENGTH AND SPILT TENSILE STRENGTH OF SIFCON WITH FERROCEMENT

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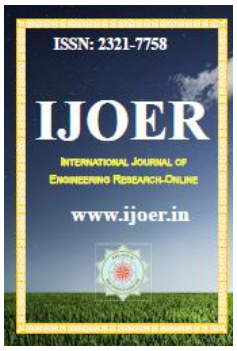

ABSTRACT

Concrete is a composite material composed mainly of water, aggregate, and cement. The desired physical properties of the finished material can be achieved by including additives and reinforcements in the mixture. Generally, fibers used in concrete are to control cracks, shrinkage and to reduce permeability. Fibers also show excellent resistance towards impact and abrasion. SIFCON (slurry infiltrated fiber reinforced concrete) is one of the recently developed construction material. It is a special type of fiber reinforced concrete with high fibre content. It is a unique construction material possessing high strength, as well as large ductility and it contains excellent potential for structural applications when accidental or abnormal loads are encountered.

"Ferro cement is a type of thin wall reinforced concrete, commonly constructed of hydraulic cement mortar, reinforced with closely spaced layers of continuous and relatively small size wire mesh. The mesh may be made of metallic or other suitable materials"

In this project, we are using steel fibers of aspect ratio 50, steel mesh of diameter 0.62mm with spacing of 5mm.1:1 mix was taken to cast the cylinders (30cm X 15cm). Tests were conducted on cylinders to determine compressive strengths & split tensile strength. Fibers of 5%,10% & 15% were added in both parallel and random orientation. Steel mesh of 5%,10% & 15% were added in parallel manner and results are compared among those and as well as with conventional cement mortar.

Key words: SIFCON, FERROCEMENT, hooked steel fibers and steel mesh.

1. INTRODUCTION

In comparison to normal concrete, fiber reinforced concrete scores higher in toughness, and resistance to impact. Fiber reinforcing has added versatility into concrete so as to overcome its brittleness. Fiber is a small piece of reinforcing material possessing certain characteristics properties.

SIFCON is a high-strength, high-performance material containing a relatively high volume percentage of steel fibers as compared to SFRC. It is also sometimes termed as 'high-volume fibrous concrete'. The origin of SIFCON dates to 1979, Prof.Lankard carried out extensive experiments in his laboratory in Columbus, Ohio, USA and proved that, if the percentage of steel fibers in a cement matrix could be increased substantially, then a material of very high strength could be obtained, which he christened as SIFCON.

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spaced layers of continuous and relatively small size wire mesh. The mesh may be made of metallic or other suitable materials".

2. LITERATURE REVIEW

Naman and boccouche[5], presented the shear response of dowel reinforced SIFCON.They observed that the shear strength of SIFCON is 10 times higher than that of plain matrix. The behavior of reinforced concrete beam with SIFCON matrix has been studied by Namanetal[6]. They reported that use of SIFCON eliminates the need of shear stirrups in RCC beams.

The behavior of SIFCON under pure torsion has been presented by Balasubramanianetal[8]. SIFCON with straight, crimped and trough shaped fibers has been prepared and investigated for tensional resistance.

Parameswaranetal[9] have studied the flexural behavior of SIFCON beam specimen under cyclic loading and reported that the flexural strength is 500 % more when compared with plain mortor specimens and 100% more to that of Ferro cement specimens.

In 1972, the National Academy of Sciences of the United States of America set up an Adhoc Panel on the utilization of ferrocement in developing countries under the chairmanship of Prof. James P. Romualdi of Camegie-Mellon University, U.S.A. The report of the panel was first published in early 1973. As a result of the report people became aware of this material and started using it.

The ACI committee 549[1] has defined Ferro cement a "thin wall reinforced concrete commonly constructed of hydraulic cement mortar reinforced with closely spaced small diameter wire mesh". The mix is generally of cement and sand mortar, where the wire mesh having wide openings which makes adequate bonding of mixture.

3. EXPERIMENTAL DETAILS

In the present investigation the following materials were used

- Ordinary Portland Cement of 53 Grade cement conforming to IS:169-1989
- Fine aggregate conforming to IS: 2386-1963.
- Water.
- Hooked steel fibers conforming to ASTM A 820 TYPE 1
- Square steel mesh

3.1 CEMENT

The colour of OPC is grey colour and many types of cements are available in market. Ordinary Portland Cement of 53 Grade of brand name KPC, available in the local market was used for the investigation. The physical properties of the cement are listed in Table 1

Table.1 Properties of Cement

S.NO	Characteristics	Values obtained	Standard values
1	Normal consistency	33mm	33 to 35 mm
2	Initial setting time	130 min	Not be less than 30mins
3	Final setting time	270 min	Not be greater than 600min
4	Fineness Test	5%	Not more than 10%
5	Specific gravity	3.14	3.12 to 3.19

3.2 FINE AGGREGATE

Sand is an inorganic material. It consists of small angular or rounded or sharp grains of Silica. Sand is formed by decomposition of sand stone under the effect of weathering agencies. Various sizes or grades of sand are formed depending on the amount of wearing. The characteristics of sand are listed in Table 2.

Table 2. Characteristics of Sand

S.NO	CHARACTERISTICS	VALUE
1.	Specific gravity	2.65
2.	Water absorption	1.85%
3.	Fineness modulus	2.485

3.3 WATER

The water used for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth and other substances that may be deleterious to bricks, stone, concrete or steel.

Potable water is generally considered satisfactory for mixing. The pH value of water should be not less than 6.

3.4 STEEL FIBRES

These steel fibers are hooked in shape and having a diameter of and a length of

Appearance : Hooked
Diameter : 0.6 mm
Length : 30 mm
Aspect ratio : 50

Fig 1. Hooked steel fibers

3.5 STEEL MESH

Appearance : Square steel mesh
Diameter : 0.62 mm
Spacing : 5 mm

Fig 2. Square steel mesh

3.6 MIX PROPORTIONS

In this study the mix taken is 1:1 cement and sand ratio and the steel fibers are mixed with different proportions of 5,10, &15 %. Providing a water cement ratio of 0.35.

4. RESULTS AND DISCUSSION

4.1 WORKABILITY RESULTS

Table 3. workabilty of SIFCON with random orientation of hooked steel fibres

S.No	Percentage of addition of fibres to mortor in random orientation	Percentage of flow
1	0	20
2	5	17
3	10	13
4	15	9

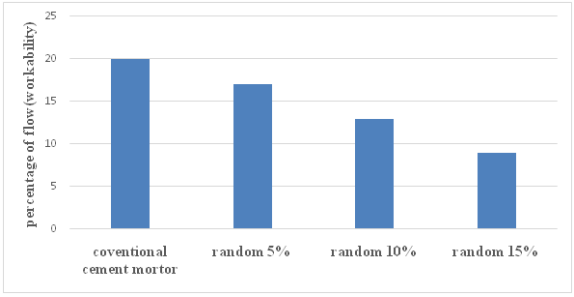

Fig 3.workability comparison between conventional cement mortar with different percentages of hooked steel fibers in random manner.

4.2COMPRESSIVE STRENGTH

These results are obtained by testing total 20 specimens after 28 days and by considering the average of the test results and that are tabulated in table 3.We got 28.29 N/mm^2 compressive strength for conventional cement mortar.

Table 4. Compressive Strengths of SIFCON (parallel and random) and FERROCEMENT

S.No	Percentage of addition of fibres and mesh to mortor	Compressive strength for parallel orientation of fibers (N/mm^2)	Compressive strength for random orientation of fibers (N/mm^2)	Compressive strength for parallel orientation of mesh (N/mm^2)
1.	5	36.78	40.74	36.78
2.	10	39.5	41.47	24.89
3.	15	40.74	44.13	22.63

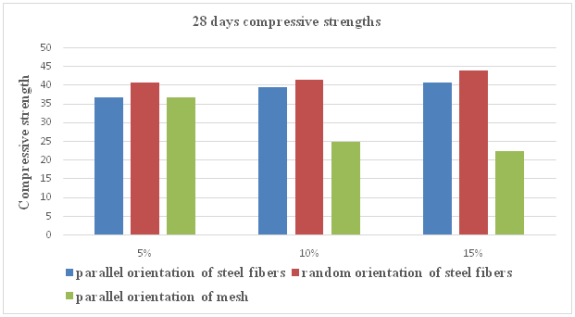

Fig 4. Comparison of compressive strengths among parallel orientation of steel fibers, random orientation of steel fibers and parallel orientation of mesh.

- Experimental observations establish an increase in compressive strength in comparison with conventional cement mortar when 5%, 10% and 15% of hooked steel fibers addition in parallel manner.
- It is observed that there is an increase in compressive strength in comparison with conventional cement mortar when 5%, 10% and 15% of hooked steel fibers addition in random manner.
- It is evident from the study that there is decrease in compressive strength in comparison with conventional cement mortar when 5%, 10% and 15% of steel mesh addition in parallel manner.

Decrease in compressive strength is due to the obstruction of mesh which is added by 3 layers in cylinders. Due to this, cylinder is divided into four zones. The top most layer and bottom most layer is taking the load and middle two layers are not taking the load due to obstruction of mesh. Mesh is not allowing the load to pass through it.

4.3 SPILT TENSILE STRENGTH

These results are obtained by testing total 20 specimens after 28 days and by considering the average of the test results and that are tabulated in table 4.Wegot 4.18 N/mm^2 spilt tensile strength for conventional cement mortar.

Fig 5. Specimen under tension

Table 5. Spilt tensile Strengths of SIFCON (parallel and random) and FERRO CEMENT

S.No	Percentage of addition of fibres and mesh to mortor	Spilt tensile strength for parallel orientation of fibers (N/mm^2)	Spilt tensile strength for random orientation of fibers (N/mm^2)	Spilt tensile strength for parallel orientation of mesh (N/mm^2)
1	5	4.1	4.25	3.225
2	10	3.34	4.39	2.221
3	15	2.87	4.47	2.1

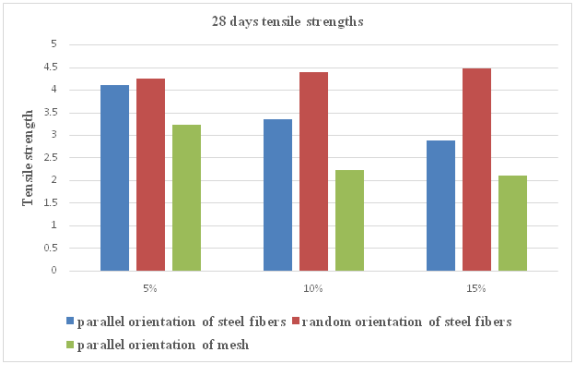

Fig 6. Comparison of tensile strengths among parallel orientation of steel fibers, random orientation of steel fibers and parallel orientation of mesh.

- Observations concluded that the tensile strength of conventional cement mortar with 5%, 10% and 15% of hooked steel fibers

addition in parallel manner got decreased when compared with conventional cement mortar.

- It is established that the tensile strength of conventional cement mortar with 5%, 10% and 15% of hooked steel fibers addition in random manner got increased when compared with conventional cement mortar.
- Computations established that the tensile strength of conventional cement mortar with 5%, 10% and 15% of steel mesh addition in parallel manner got decreased when compared with conventional cement mortar.

It is observed that the tensile strength of SIFCON with parallel orientation of fibers and FERRO CEMENT got decreased when compared with conventional cement mortar. The decrease in strength is due to alignment of fibers to the direction in which load is applied. We are applying the load in perpendicular direction to the fibers in spilt tensile strength test, this is because we have to place the cylinders in horizontal direction to perform spilt tensile test.

5. CONCLUSION

The following conclusions are drawn based on the experimental investigations on compressive strength and split tensile strength

- Workability got reduced than compared to conventional cement mortar.
- SIFCON concrete has high compressive strength than conventional cement mortar and FERRO CEMENT.
- Stress –strain behavior of FERRO CEMENT and SIFCON is similar to conventional cement mortar.
- FERRO CEMENT has shown less tensile strength when compared to conventional cement mortar and SIFCON with random orientation of fibers.
- SIFCON concrete has shown greater increase in tensile strength than conventional cement mortar when fibers are placed in random orientation.
- SIFCON concrete has shown decrease in tensile strength than conventional cement mortar when fibers are placed in parallel orientation.
- SIFCON concrete and FERROCEMENT are capable of handling compressive loads. These can be used where there is necessary to withstand compressive loads of huge amount.
- More amounts of fibers addition is leading to turn the mix harsh.

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