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An experimental study on behaviour of SIFCON with replacement of fine aggregates by quarry Dust

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ABSTRACT

Concrete is a composite material which has wider application in construction industry because of strength and durability. The four components used in producing cement concrete generally are cement, water, sand and aggregate. But, natural sand is being depleted at present and also becoming costly, particularly in the rapidly developing countries like India. Hence, there is a necessity to develop a substitute for the fine sand for use in the concrete mixture, one of which is the manufactured sand developed from locally available quarry dust. Therefore, in this study, investigations are carried out to determine the mechanical properties of quarry dust and Slurry Infiltrated Fibrous concrete (SIFCON) made with the quarry dust. SIFCON possesses the high strength as well as large ductility because of its high tensile strength.SIFCON fibre content ranges from 4-20% by volume. The specimen has partial replacement of fine aggregates by quarry dust as 15%, 30% and 45%

Keywords: SIFCON, Cement, Quarry Dust, Steel fiber, Tensile Strength, Ductility, Stiffness.

INTRODUCTION

Civil engineering practice and construction works in India depend to a very large extent on concrete. The most widely used structural material for construction is the concrete. Conventionally, concrete is fabricated from a few well defined components such as cement, water, fine aggregate, coarse aggregate and locally available natural sand from river beds, stream beds, etc. The availability of the natural sand resources is being depleted. Hence, as alternative, manufactured sand can replace the natural sand. The manufactured sand is usually obtained by crushing the stones from the stone quarry by crusher. The type of stone and its properties vary from place to place. In the present study, an attempt was made by completing replacing the natural sand with the manufactured sand to investigate the strength characteristics of SIFCON. SIFCON is a relatively new material which is considered as a new type of Fibre Reinforced Concrete (FRC). The fibre content of FRC varies from 1-31%, whereas SIFCON fibre content ranges from 4-20% by volume. The matrix in SIFCON has no cause aggregates, but has high fibre content. In general, the proportions of cement and sand used for making SIFCON are 1:1, 1:1.15 or 1:2. The water-cement ratio varies from 0.3 to 0.5. Percentage of super plasticizer varies from 1 to 5% by weight of cement. The matrix fineness must be designed so as to properly infiltrate the fibre network placed in the moulds. Otherwise, large number of pores may form, leading to substantial reduction in properties of the concrete. The SIFCON has superior mechanical properties such as compressive and split tensile values. The mechanical properties is of SIFCON depend on the fibre and concrete slurry properties such as fibre type, volume, alignment, compressive strength and modulus of elasticity of slurry. The SIFCON generally used in high security places such as

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seismic and explosive resistant structures, secure concrete applications such as safety vaults and strong rooms, refractory and military applications such as missile hangars, underground bunkers, and nuclear containment shielding. Sometimes, these application areas are exposed to high temperatures.

PROJECT WORK

Materials used and its Properties

Cement

The Cement used in this study was Ordinary Portland cement (OPC) which is the most important type of cement. OPC cement of 53grade of cement use in this experimental work. Conforming weight of each cement bag was 50kg.The property of cement is shown in Table 1[1].

Table 1: Properties of Cement

Physical Properties	Value observed in investigation
Specific gravity	2.8
Fineness of cement	3%
Normal consistency	30%
Initial setting time	150 min
Final setting time	270 min

Fine Aggregate

M-sand was used as Fine aggregate with fineness modulus of 2.68 and it should passing through IS Sieve 4.75mm. It should have fineness modulus 2.50- 3.50 and silt content should not be more than 4.The properties of Fine aggregate are shown below in Table 2 [2-7].

Table 2: Properties of Fine Aggregate

S.No	Property	Value
1	Specific gravity	2.60
2	Grading Zone	II (IS 383- 1970)
3	Fineness modulus	2.50 (2.50-3.50)
4	Sieve analysis	4.75 mm

Coarse Aggregate

The coarse aggregate are the blue granite stone of which particles greater than 4.75mm they should be hard, strong, dense, durable and clean. It should be conical shape. Flaky pieces should be avoided. It creates much better bond between cement paste and the Aggregates. The properties of Coarse aggregate are shown below in Table 3.

Table 3: Properties of Coarse Aggregate

S.No	Property	Value
1	Sieve analysis	4.75 mm
2	Specific gravity	2.53
3	Water absorption	2.71%

Fiber

This study uses a type of fibre made of steel with a unit weight of 7850 kg/m3. The steel fibre is of 1mm and cut into required lengths of 50 mm, with an aspect ratio of 50. The ultimate tensile strength is 417 MPa. The properties of fibre are shown below in Table 4

Figure 1: Steel Fibre

Table 4: Physical Properties of Fiber

S.No	Property	Description
1	Diameter	0.33 mm
2	Length	25 mm
3	Young's modulus	1 N/mm2
4	Aspect ratio(L/D)	75
5	Unit weight	7850 kg/m3

Admixture

The Plasticizer used to improve the workability of SIFCON is CONPLAST X421 It.The properties of conplast x421ic are shown below in Table 5

Table 5: Properties of CONPLAST X421 IC

S.No	Property	Description
1	Color	Dark brown
2	Specific gravity	1.09 at

Mix proportions

This study adopts a fibre content of 8%, 10% and 12% by volume, water cement ratio of 0.5 and super plasticizer about 0.6%. The slurry consists of cement and fine aggregates in the ratio of 1:1. The Mix proportions are shown below in Table 6 [7].

Table 6: Mix proportion of SIFCON

S.No	Fiber	W/C ratio	Plasticizer content	Mode of vibration
1	8%	0.5	0.6%	Hand damping
2	10%	0.5	0.6%	Hand damping
3	12%	0.5	0.6%	Hand damping

RESULT AND DISCUSSION

Compressive Strength Test

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform and partly because most of the desirable properties of concrete are qualitatively related to its compressive strength. The strength of concrete is usually defined and determined by the crushing strength of 150mm x

150mmx150mm, at an age of 7 and14 days. The mould and its base rigidly clamped together so as to reduce leakages during casting. The sides of the mould and base plates were oiled before casting to prevent bonding between the mould and concrete. The cube was then stored for 24 hours undisturbed. The testing of cube under compression was shown in figure

Figure 2: Compressive Strength of Concrete

Table 7: Test results for Compression Strength

Mix	**Compression Strength N/mm^2**	
	7DAYS	**14DAYS**
Mix 1 (0%)	20.22	32.132
Mix 2 (15%)	23.55	24.66
Mix 3 (30%)	30.22	28.04
Mix 4 (45%)	30.84	32.48

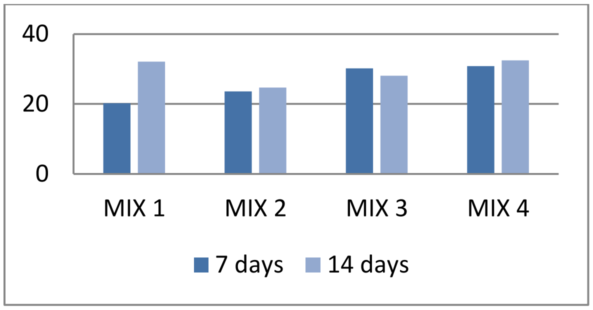

Figure 3: Graphical Representation of Compression Strength Test

Split Tensile Strength Test

For tensile strength test, cylindrical specimens of dimension 150 mm diameter and 300 mm length were cast. In this test three cylinders were tested and their average value was reported. The split tension test was conducted by using digital compression machine having 2000 kN capacity [8].

Split tensile strength was calculated as follows:

Spilt Tensile strength (MPa) = $2P / \pi DL$

Where, P = Failure Load (kN)

D = Diameter of Specimen (150 mm)

L = Length of Specimen (300 mm)

Test Results of splitting tensile strength for M60 grade of concrete shown in table 8

Three cylinder specimens were casted in each percentage, in order to find the average value of split tensile strength. These cylinder specimens were left for 28days curing in a curing tank. After the course of curing, the specimens were ready for testing. All the cylinders were tested.

Figure 4: Split Tensile Strength of Concrete

Table 8: Test results for Split Tensile strength test

Mix	Split Tensile Strength Test N/mm^2	
	7DAYS	**14DAYS**
Mix 1 (0%)	2	2.9
Mix 2 (15%)	2.45	2.74
Mix 3 (30%)	2.62	2.58
Mix 4 (45%)	2.31	2.36

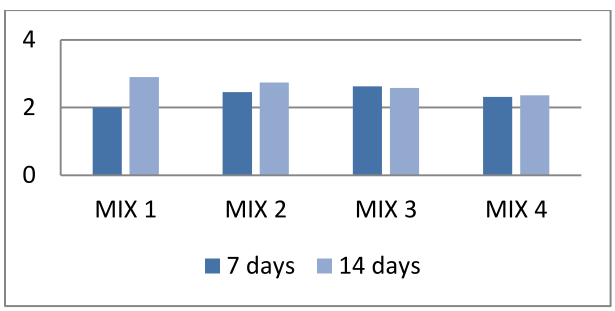

Figure 5: Graphical Representation of Split Tensile Strength of Concrete

CONCLUSIONS

In summary of the above investigations, the following conclusions are made from the experimental results indicated following:

- ✓ Addition of steel fibres in concrete significantly increased the Compressive and Split tensile
- ✓ SIFCON (with manufactured sand) made with 6% fibre fraction showed the optimum value in compressive and

- ✓ Manufactured sand can be used as an alternative to the regular river sand in making SIFCON.
- ✓ Manufactured sand can be successfully be used as an alternative to the natural sand where the natural sand availability does not meet the requirement.

REFERENCE

[1]. Parameswaran V.S., “Studies on Slurry Infiltrated Fibrous Concrete”, Transportation Research Record 1382, 1990.

[2]. Ahsanollah Beglarigale, “Flexural Performance of SIFCON Composites Subjected to High Temperature”, Construction and Building Materials, 104, 2016, 99-108.

[3]. Yogesh N Dhamak and Madhukar R Wakchaure, “Use of Precast SIFCON Laminates for Strengthening of RC Beams”, Int. Journal of Engineering and Computing, 4(9), 2015, ISSN: 2319-7242, 14261-14266.

[4]. Kuldeep Dagar, “Slurry infiltrated fibrous concrete”, International Journal of Applied Engineering and Technology vol. 2 (2), 2012, ISSN: 2277-212X, 99-100.

[5]. Arun Aniyan Thomas and Jeena Mathews, “Strength and Behaviour of SIFCON with Different Types of Fibres”, International Journal of Civil Engineering and Technology (IJCIET) 5(12), 2014, 25-30.

[6]. Vinayaka N M, “An Experimental Investigation on SIFCON using Mono Fibres”, International Journal of Civil and Structural Engineering Research, 3(1), 2015, 267-272.

[7]. Subathra B and Pradeep T, “Experimental Study on Mechanical Properties of SIFCON, International Journal of Science and Engineering Research (IJOSER)”, 3(2), 2015.

[8]. Hager, “Behavior of Cement Concrete at High Temperatures”, Bulletin of the Polished Academy of Sciences, 61, 2013