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Experimental investigation on fibre reinforced self compacting concrete using foundry sand

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Abstract—The construction activities in the last few decades have increased many folds in almost all the developing countries of the world. Sand is becoming a scarce commodity globally because of its growing demand day by day. It is the need of time to search such alternative materials that would partially or fully replace sand used in concretes without affecting its quality, strength and other characteristics. In order to reduce time and improve the filling capacity of highly congested structural members by its own weight without any vibration self-compacting (SCC) is adopted.

The primary aim of this study is to explore the feasibility of SCC using foundry sand and fibre. As the mix design was designed based on finding the optimum percentage of replacement of foundry sand and fibre based on literature review and development of a suitable mix for SCC using code requirements, that would satisfy the requirements of the plastic state. This offers a unique area of application of self-compacting concrete which can flow through every corner of extensively reinforced area without any vibration and more effective for seismic lo.

Keywords
Self-compacting concrete, foundry sand, fibre

1.INTRODUCTION

Cement based materials are the most abundant of all man made materials and are among the most important construction materials, and it is most likely that they will continue to have the same importance in the future. However, these construction and engineering materials must meet new and higher demands. When facing issues of productivity, economy, quality and environment, they have to compete with other construction materials such as plastic, steel and wood. One direction in this evolution is towards self-compacting concrete (SCC), a modified product that, without additional compaction energy, flows and consolidates under the influence of itsown weight. The use of SCC offers a more industrialised production. Not only will it reduce the unhealthy tasks for workers, it can also reduce the technical costs of in situ cast concrete constructions, due to improved casting cycle, quality, durability, surface finish and reliability of concrete structures and eliminating some of the potential for human error. However, SCC is a sensitive mix, strongly dependent on thecomposition and the characteristics of its constituents. It has to possess the incompatible properties of high flow ability together with high segregation resistance.

1.1 Definition of S-Glass Fibre

Glass fibre also called fibreglass. It is material made from extremely fine fibres of glass Fiberglass is a lightweight, extremely strong, and robust material. Although strength properties are somewhat lower than carbon fibre and it is less stiff, the material is typically far less brittle, and the raw materials are much less expensive. Its bulk strength and weight properties are also very favourable when compared to metals, and it can be easily formed using moulding processes.

1.2 Definition of Foundry sand

Foundry sand is basically a fine material. It can be used in many of the same ways as natural or manufactured sand. This includes many civil engineering applications such as formation of embankments, filling low lying areas, hot mix asphalt (HMA) and for making Concrete. Foundry sand is also being used extensively agriculturally as topsoil in agricultural fields.

1.3 Definition of M-sand

Crushed stone sand is produced by crushing boulders. Manufactured sand is produced by rock-on-rock or rock-on-metal Vertical Shaft Impactor (VSI) in which the process that produced alluvial deposits is closely simulated. Particle size reduction and achieving equidimensional shape is critical to get desired properties. If rock is crushed in compression lot of inherent properties exhibited by natural river sand are lost.

2.Material

a) Cement b) coarse aggregate c) Fine aggregate(M-sand), d)Foundry sand, e)S-glass fibre, f) Viscocrete 20 HE,g)Water.**a)Cement :** Ordinary Portland Cement of 53-grade was used as it satisfied the requirements of IS: 269- 1969 and results have been tabulated in table.

Table no.1

Properties of cement	
Specific gravity	3.15
Consistency	33%
Fineness	6.3
InitialSetting Time	35 min
FinalSetting Time	520 min

b) **Coarse Aggregate:** coarse aggregate shall comply with the requirement of IS 383 as for as possible crushed Aggregate shall be used for ensuring adequate durability. The aggregate used for concrete the nominal maxi size of coarse aggregate used in Production of shall be 20 mm.

c) **Fine aggregate:**Fine aggregate shall be conform to requirement of IS 383.

Test	**Properties of Aggregate**		
	Coarse	Fine	Foundry sand
Specific Gravity	2.66	2.73	2.4
Water Absorption	0.5%	3.2%	3.5%
Moisture content	Nill	Nill	4%

Table no .2

d) Foundry Sand: Foundry sand consists of clean, uniformly sized, high quality silica sand that is bonded to form moulds of both ferrous and non-ferrous metal castings. The physical and chemical characteristics of foundry sand will depend in great part on the type of casting process and industry sector from which it originates. It can be reused several times in foundries but after a certain period it becomes a waste material referred as used spent foundry sand. It is basically a fine aggregate that can be used in many ways as natural and manufactured sands.

e) **S-Glass Fibre:**S-Glass or high strength grade glass was originally developed for high strength in scc. The tensile strength of glass fibers is determined by the structure connectivity of the silicate network, notably,by the absence of alkali oxides, which are not readily integrated into the structure. The structure of boron oxide, though being a part of the network, is weaker than that of silicon oxide, and therefore, boron oxide serves as a flux. Several high-strength glass fibers are known S-glass is preferred.

Table 3. Properties of S-Glass Fibre

Materials	Density (g/cm^3)	Specfic gravity	Young modulus(GPa)
S-Glass	2.48	2.68	91

f)**Viscocrete 20 HE:**ViscoCrete 20 HEis a third generation super plasticizer for concrete and mortar. The product is suitable for tropical and hot climatic conditions.ViscoCrete-20 HEis especially suitable for

the production of concrete mixes which require high early strength development, powerful water reduction and excellent flowability.

g) **Water:** The water used for mixing concrete mix should be potable drinking water having PH 6 TO 8.

3 Design Mix

The mix design for M40 grade concrete is carried out using the Indian standard code 10262:2009. For which the water cement ratio is kept as the least value of 0.4 for the slump value is assumed as 100mm, the fine aggregate of Zone II, coarse aggregate of 20mm size and below.

- Cement = 350 Kg/m3
- Water = 140 liter
- Fine Aggregate =798 Kg/m3
- Coarse Aggregate = 1140 Kg/m3
- Admixture = 10% of superplasticizer
- The proportion for the mix is **1:2.56:3.26**

4.Results and Discussion:

4.1 Fresh Properties:

SCC containing different proportion of waste foundry sand was tested for Slump flow, V- funnel, U-Box, L-box. The results of fresh properties of all Self-compacting concretes with waste foundry sand and fibre are included in table below.

Table no .4
Fresh concrete test calculation for M_{40}

Combination	Slump flow(s)	V-Funnel(s)	L-Box	U-Box
SCC	5	9	0.9	9
MIX-1	4.8	11	0.72	8
MIX-2	5.4	17	0.60	7.3
MIX-3	5.6	11.8	0.80	8.6
MIX-4	5.9	13	0.68	7.5

4.2 Hardened Properties:

The strength test that are considered for are Compressive strength, split tensile and the flexural strength test.

4.2.1 Compressive strength

Effect on compressive strength of M40 Grade concrete mixes MIX-1 (10%FS&1% F), MIX-2 (10%FS &1.5% F), MIX-3 (10%FS &2% F), and MIX-4(10%FS &2.5% F), at the age of 7, 28days are shown below.

Table no .5 Compression strength result

Combination	Compressive strength(N/mm2)	
	7 days	28 days
SCC	32	40.6
MIX-1	34.27	43.4
MIX-2	35.4	45.7
MIX-3	37.3	47
MIX-4	36	46.1

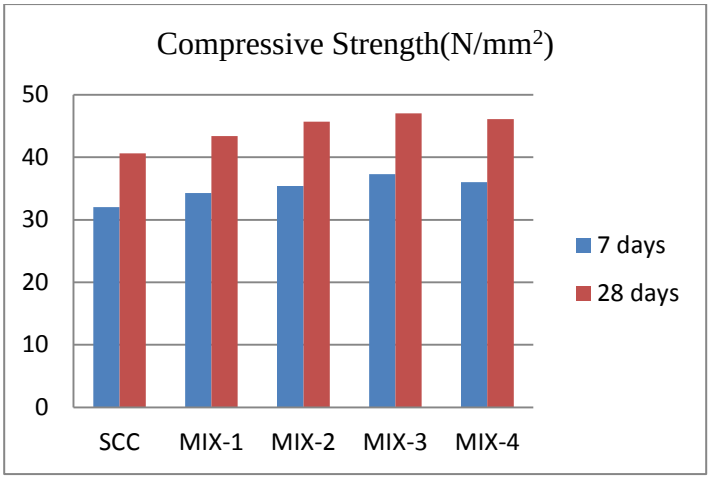

Fig 4.1 comparison of compressive strength test results

When the replacement of fine aggregate with 10% foundry sand , 1% fibre it gives good results in

compressive strength with increase in 11% thancontrolscc. Whenthe replacement of fine aggregate with 10% foundry sand , 1.5% fibre it gives good results in compressive strength, of increase in 20.3%.When the replacement of fine aggregate with 10% foundry sand , 2% fibre it gives good results in compressive strength, with increase in 26% than normal scc.Whenthe replacement fine aggregate with 10% foundry sand, 2.5% fibre it gives good results in compressive strength, with increase in 22.3% than normal scc.

4.2.2 Split Tensile Strength

Effect on split tensile strength of M40 Grade concrete MIX-1 (10%FS &1% F), MIX-2 (10%FS &1.5% F), MIX-3 (10%FS &2% F), and MIX-4(10%FS &2.5% F), at the age of 7, 28days are shown below

Table.6 Split Tensile Strength result

Combination	Split Tensile Strength(N/mm2)	
	7 days	28 days
SCC	4.9	5.7
MIX-1	5.5	6.53
MIX-2	5.25	6.7
MIX-3	5.63	6.85
MIX-4	5.4	6.68

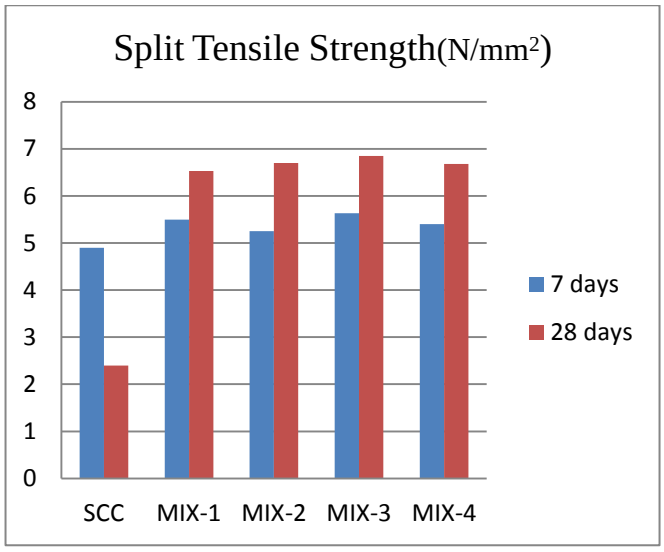

Fig 4.2 Comparison of split tensile strength test results

When the replacement of fine aggregate with 10% foundry sand , 1% fibre it gives good results in split tensile strength with increase in 10.7% than control scc. When the replacement of fine aggregate with 10% foundry sand , 1.5% fibre it gives good results in split tensile strength, of increase in 11.1% than control scc. When the replacement of fine aggregate with 10% foundry sand, 2% fibre it gives good results in split tensile strength, with increase in 17.7% than normal scc. When the replacement fine aggregate with 10% foundry sand, 2.5% fibre it gives good results in split tensile strength, with increase in 11% than normal scc.

4.2.3 Flexural Strength

Effect on Flexural strength of M40 Grade concrete mixes concrete MIX-1 (10%FS &1% F), MIX-2 (10%FS &1.5% F), MIX-3 (10%FS &2% F), and MIX-4(10%FS &2.5% F), at the age of 7, 28days are shown below

Table.7 Flexural Strength result

Combination	Flexural Strength(N/mm2)	
	7 days	28 days
SCC	3.93	4.7
MIX-1	4.52	5.05

MIX-2	4.63	5.32
MIX-3	4.71	5.27
MIX-4	4.6	5.16

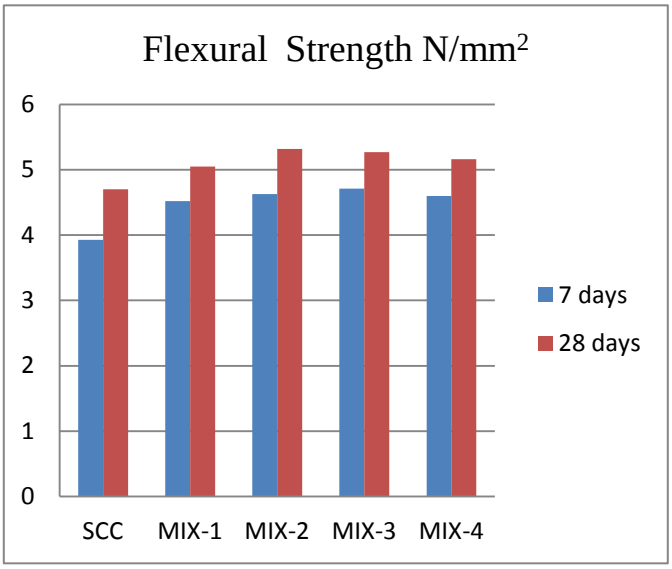

Fig 4.3 Comparison of flexural strength test results

When the replacement of fine aggregate with 10% foundry sand , 1% fibre it gives good results in Flexural strength with increase in 10.7% than control scc. When the replacement of fine aggregate with 10% foundry sand, 1.5% fibre it gives good results in Flexural strength, of increase in 11.85% than control scc. When the replacement of fine aggregate with 10% foundry sand , 2% fibre it gives good results in Flexural strength, with increase in 11.8% than normal scc. When the replacement fine aggregate with 10% foundry sand, 2.5% fibre it gives good results in Flexural strength, with increase in 11% than normal scc.

5.Conclusion

1. Compressive strength of concrete mixes increased due to replacement of fine aggregate with foundry sand and fibre.
2. Maximum compressive strength was achieved with10% replacement of fine aggregate with foundry sand and 2% fibre.
3. Maximum increase in splitting tensile strength was observed at 10% replacement of fine aggregate with foundry sand and2%fibre.
4. Flexural strength of all concrete mixes was found to increase in with varying percentage of foundry sand and fibre.
5. Maximum increase in Flexural strength was observed at 10% replacement of fine aggregate with foundry sand and 1.5% fibre.

6. Reference

1. Amar R Dongapure, Brijbhushan , D K Kulkarni,A study on strength properties of hybrid fiber reinforced concrete, Sep (2015)

2. Bobby Ramteke, Asst. Prof. R. K. Parve, Asst. Prof. AnandKhangan, Asst Prof. Nikhil Bandwal, experimental study on flexural behavior of the self-compacting concrete with hybrid fibres, May (2015)

3. Radhika R.S, Vennila A, venkatasubramani R., Sreevidya V behaviour of hybrid fibre reinforced self compacting concrete using Foundry Sand oct (2017).