Experimental Study on Self Compaction Concrete with Robo Sand using Silica Fume

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Abstract:

Self - compacting concrete (SCC), flows into place and around obstructions under its own weight, is extensively applied in many construction projects. In recent years, manufactured sand produced by crushing of rock is being identified as a suitable alternative source of river sand in concrete. Mineral admixtures usually added to concrete in large amount to enhance the workability of fresh state and durability of concrete in the hardened state. This paper covers the effect of replacing river sand by manufactured sand on SCC produced by using Silica fume as a filler material. The method is being used for mix design, optimum mix proportion finalized with percent Silica fume as the replacement for cement at water powder ratio of 0.45 for M40 grade concrete. The study has shown that SCC with 5 percent silica fume and 20, 30 percent replacement of river sand by manufactured sand indicate fresh SCC within IS10262-2009 guidelines and enhanced strength properties.

Keywords - *Silica Fume, Manufactured Sand, Aura Mix 300, SikaViscoCrete-2100(HP).*

I. INTRODUCTION

Self-compacting concrete has excellent deformability and segregation resistance which does not require vibration for placing process. In the mix design, the number of aggregates required is determined and the paste binders are then filled in voids of aggregates to obtain flowability and self-compacting ability [1]. Commonly SCC mixes have a greater amount of filler materials like silica fume, fly ash along with cement which helps in filling air voids between particles. The addition of Silica fume will reduce superplasticizer requirement to achieve required slump [2, 3, 4]. To achieve fluidity, the cement paste should have both fluidity and viscosity [5] and to for higher flowability and stability, high powder volume is required with low water powder ratio and sufficient Hyperplasticizer [6]. In SCC, the aggregates contribute 60-70 percent of total volume [7]. Aggregate characteristics such as shape, texture and grading influence fresh concrete and hardened concrete properties. The effect of shape and texture of fine aggregate are much more important than the effect of coarse aggregate [9]. Strength and durability properties were increased with the proper addition of supplementary cementitious materials like fly ash, GGBS and silica fume [10, 11].

Table I Quantites Obtained From Mix Design

S.No	Materials	Quantities(Kg/m^3)
1.	Cement	529.54
2.	River Sand	917.12
3.	Manufacture Sand	Depends on percentage of replacement
4.	Coarse Aggregate	720
5.	Silica fume	5.29
6.	Water	150
7.	Hyper plasticizer	Depends on percentage of replacement by different plasticizer

II. BODY OF ARTICLE

A. Experimental Work

The method of mix design is followed from IS10262-2009 of M40 grade concrete. Trail mixes were carried out for both fresh and hardened properties. Optimum mix finalized was with 5 percent of Silica fume replacement for cement at water-powder ratio of 0.45 and used 2 different types of Hyper plasticizer were used separately in different trial mixes and suitable plasticizer was finalized. Based on fresh properties of SCC, fresh state properties of SCC like flow ability and passing ability in accordance IS10262-2009 guidelines were found with different percentage replacement of river sand by M-sand and obtained 20, 30 percent replacement as optimum. It is observed that the increase in percentage reduced the flow ability and passing ability of SCC of M40, with 2 percent Silica Fume and compressive, flexural strength and bond strength of SCC with 5 percent Silica fume and 20, 30 percent M-sand are being studied.

1) FRESH CONCRETE PROPERTIES:

- Cement characteristics

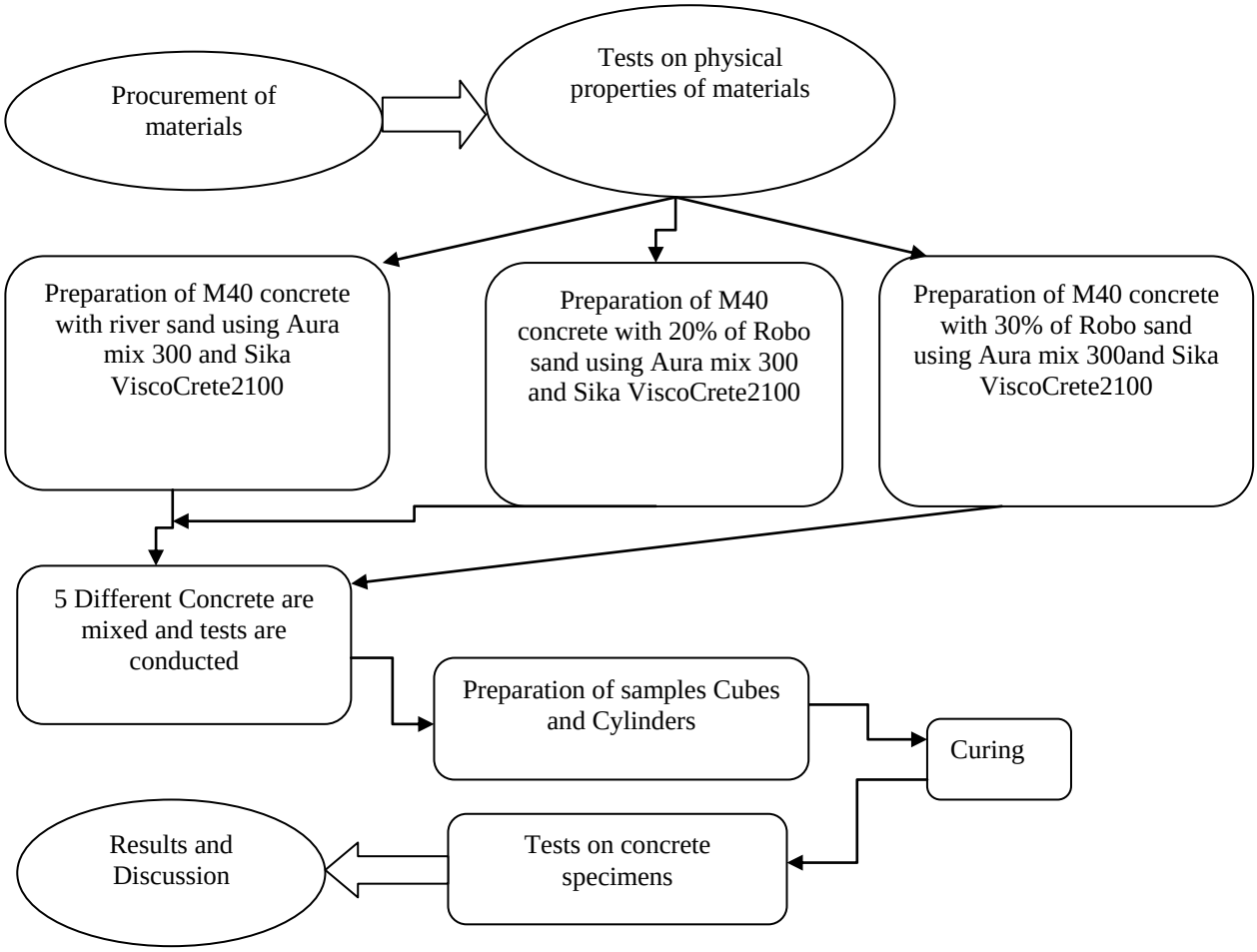
- Addition characteristics
- Grading of aggregates
- Moisture content of aggregates,
- Temperature
- Mixing procedure
- Time of testing

2) *Fresh Properties*

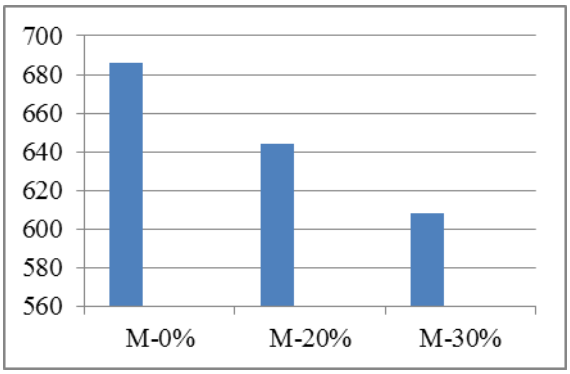
The Slump flow test, L-Box test and V-funnel tests are conducted to know the fresh properties of SCC. All above test results were compared with EFNARC guidelines. The test results and respective figures for the tests are shown below.

Fresh state properties of SCC for Different Percentage Replacement of River Sand by M-sand And Aura mix 300

S.NO	Type of Mix	Slump Flow Test (mm)	L-Box (H_2/H_1)	V-Funnel Test (Sec)
1.	Normal Mix	686	0.92	5.32
2.	Variation-I	644	0.84	7.14
3.	Variation-II	608	0.77	9.20
	LIMITS	600-800	0.8-0.9	6-12



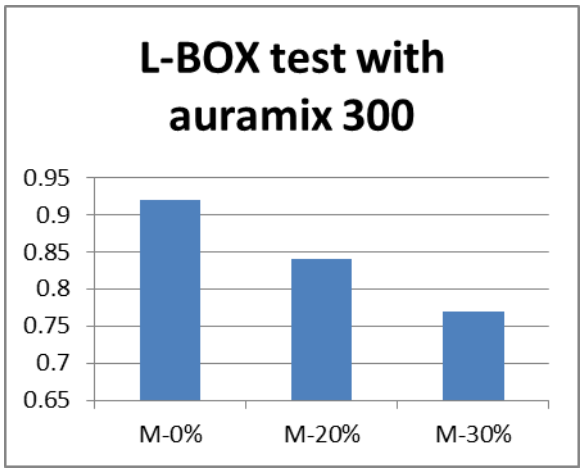
The Flow Chart of the Steps Involved in the Research Work is as Shown in the Fig. 1.1

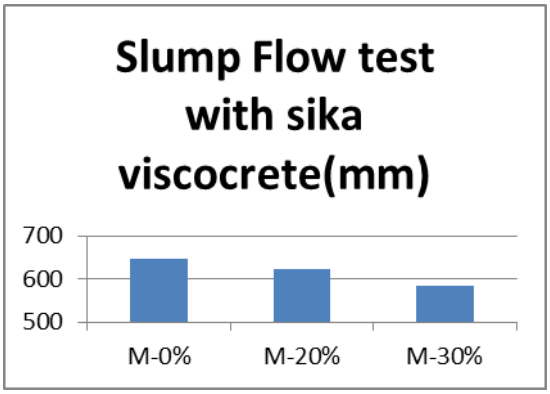


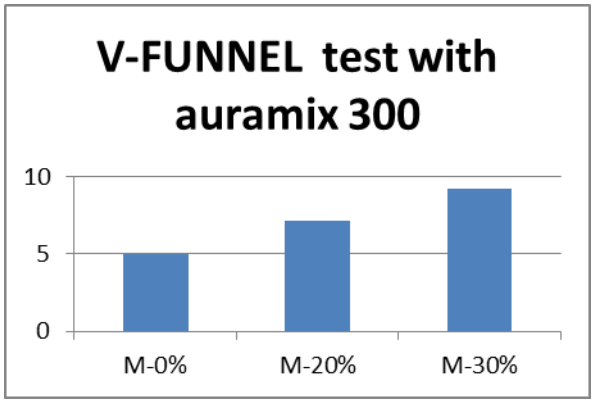
Slump Cone Test with Aura mix 300

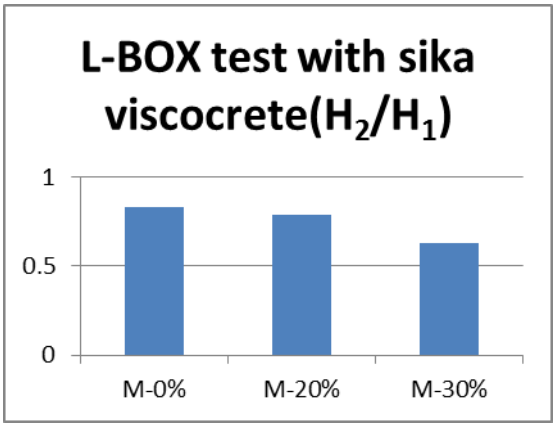
Fresh State Properties of SCC for Different Percentage Replacement of River Sand by M-sand And Sika ViscoCrete-2100(HP)

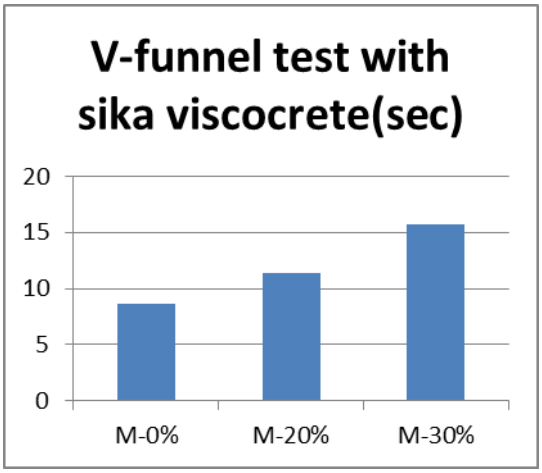
S.NO	Type of Mix	Slump Flow Test (mm)	L-Box (H_2/H_1)	V-Funnel Test (Sec)
1.	Normal Mix	647	0.83	8.62
2.	Variation-I	623	0.79	11.35
3.	Variation-II	584	0.63	15.73
	LIMITS	600-800	0.8-0.9	6-12



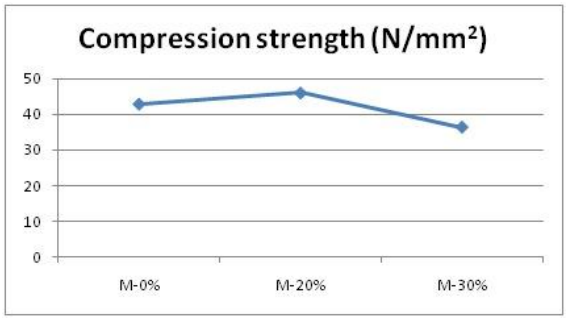




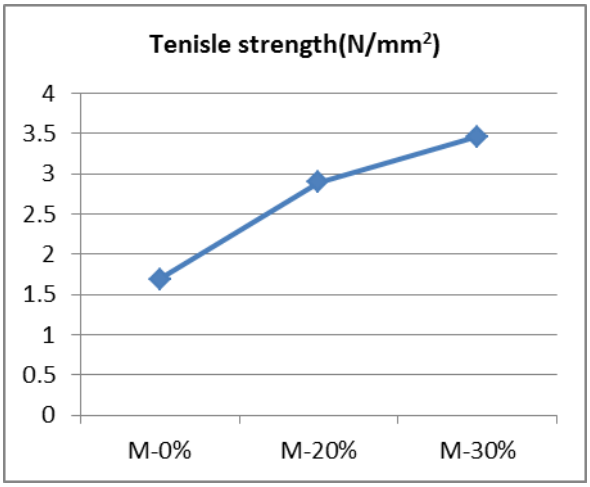




The below graph represent the Compressive strength after 28 days



The Below Graph Represent The Tensile Strength After 28 Days



From the test results obtained, it has been observed that the reduction in flowability and passing ability were observed with the replacement of river sand by M-sand for a given mix proportion. Maximum replacement of 20 percent has been obtained as optimum. More fines present in the M-sand increase the flow ability and passing ability of SCC.

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