TO STUDY THE PROPERTIES OF SELF-COMPACTING CONCRETE USING MICROSILICA & FLY ASH

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Abstract: **Self compacting concrete (SCC) is a creative concrete that doesn't need vibration for setting and compaction. It can stream under its own weight, totally filling formwork and accomplishing full compaction, even within the sight of clogged support. The hardened concrete is thick, homogeneous and has same designing properties and solidness as customary vibration concrete. To convey SCC with common trimmings, mineral admixtures like silica fume, fly ash and useful expert Super-plasticizers are moreover used. The use of mineral admixtures in the strong improves its quality properties just as toughness. The compressive quality are inspect tracking down the ideal use of mineral admixture (Silica fume levels 0, 2.27, 4.65, 7.14, 9.75, 12.5 and 15.38 % at 7 days and 28 days of relieving). The current assessment means to give arrangement mix for Self-compacting concrete by using Silica fume, fly ash and super-plasticizers.**

Keyword: Self-compacting Concrete (SCC), Fly ash, Silica Fumes, Micro-Silica, Flow ability, Compressive Strength.

I.INTRODUCTION

Self-compacting concrete (SCC) surpasses the properties and constructability of ordinary concrete. Typical and exceptional materials are utilized to make these uncommonly designed concrete that should meet a mix of execution prerequisites. SCC are made with painstakingly chose excellent fixings and upgraded blend designs. SCC will have a low water concrete proportion of 0.2 to 0.45. Super Plasticizers are normally used to make these concretes liquid and serviceable. SCC quite often has a higher strength than ordinary traditional vibration concrete. There are numerous methods of blend design for SCC. In this examination, Indian Standard method IS 10262: 2019 is utilized. In this method, the accompanying information is required for example Evaluation of concrete, Maximum size of total, Minimum concrete substance, Maximum w/c proportion, Workability as far as droop, Exposure conditions, Maximum temperature at the pouring point, Grading zone of fine total, Type of total, Maximum concrete substance, Admixture kind, Specific gravity of the relative multitude of materials utilized and dosages. In this trial, silica fume is utilized from 0 % to 15.38 % with expansion of consistent mass of fly-ash and super-plasticizer on self-compacting concrete with substitution of silica fume 0 – 15.38 % and the SCC mixes are tried tentatively for usefulness, pressure, split strain and flexure and reasoned that the presentation of the design mixes are excellent.

II.RESEARCH SIGNIFICANCE

The principle objective of this current examination is to foster a blend design methodology, for SCC by shifting the level of Silica fume (0 to 15.38%) just as substance of concrete at consistent dose of super-plasticizers, fly-ash and different fixings. Analyses were completed on SCC utilizing the IS 10262: 2019 Self-compacting concrete blend methodology for M50 concrete to get great functionality and accomplish mechanical properties of the blend design and to track down the ideal level of Silica Fume. Thus in the current examination more accentuation is given to contemplate strength attributes of SCC utilizing mineral and compound admixtures like Silica fume and Super-plasticizer, fly-ash for accomplishing the better composite and furthermore to expand utilization of Silica fume and fly-ash to keep up biology and furthermore support the utilization of silica fume and fly-ash.

III.EXPERIMENTAL PROGRAM

A. DESIGN STIPULATION

1.	Type of Mix	Design Mix
2.	Grade of Concrete	M 50 SCC
3.	Characteristic cube compressive strength @ 28 days	50 Mpa
4.	Current Margin as per MORTH	13 Mpa
5.	Target Mean Strength (As per Morth)	63 Mpa

6.	Nominal Maximum size of aggregate	20 mm
7.	Workability in terms of Slump @ placement	Self-Compacting
8.	Degree of quality control	Good
9.	Mode of Pouring	Pump
10.	Cement content (Minimum)	400 Kg
11.	Water Cement Ratio	(0.29 Assumed)

B. SOURCE / TEST DATA FOR MATERIALS

1.	Cement Type / Brand	OPC-53 / Ultratech
2.	Admixture Type / Brand	BASF Masterglenium 8341
3.	Crushed Coarse Aggregates	Crushed Aggregates
4.	Natural sand as fine aggregate	Khijrabad (100% natural)
5.	Micro-silica	Elkem
6.	Specific Gravity / Water Absorption of Materials	
	a. Cement	3.15
	b. Natural Sand	2.61 / 2 %
	c. Coarse Aggregates **20 mm**	2.62 / 0.8 %
	10 mm	2.64 / 1 %
	d. Fly-ash	2.2

7. Gradation of Combined graded coarse aggregates as per IS 383 has been enclosed

20 mm down : 10 mm down = 21 % : 79 %

8. Gradation of all in aggregates as per IS 383 has been enclosed

Coarse Aggregate : Fine Aggregate = 51 % : 49 %

9. Flakiness Index of Coarse Aggregate : 20 mm – 15.20 % & 10 MM – 11.5 %

10. Impact Value of coarse Aggregate : 20.18 %

C. Optimum Mix Design Calculation For Unit Volume of Concrete

1.	Volume of concrete	= 1.00 CUM
2.	Total Cementitious Content	= 550 Kg
3.	Fly-ash	= 100 Kg
4.	Cement	= 450 Kg
5.	Microsilica (Elkem)	= 50 Kg
6.	Volume of Cement	= 0.126 cum
7.	Volume of Fly-ash	= 0.04545 cum
8.	Volume of Microsilica	= 0.0227 cum
9.	Volume of Water	= 0.160 cum
10.	Volume of Admixture	= 0.0046 cum
11.	Volume of all in aggregates	= (1-(0.126+0.04545+0.0227+0.160+0.0046)) = 0.642 cum
12.	Mass of Fine aggregates (Natural Sand)	= e X Vol of F.A. x Sp. Gr. of F.A. X 1000 = 0.642 X 0.49 X 2.61 X 1000 = 821 Kg
13.	Mass of coarse aggregates M1 (20 mm)	= e X Vol of C.A. x Sp. Gr. of C.A. X 1000 = 0.642 X 0.51 X 0.21 X 2.62 X 1000 = 180 Kg
14.	Mass of coarse aggregates M2 (10 mm)	= e X Vol of C.A. x Sp. Gr. of C.A. X 1000 = 0.642 X 0.51 X 0.79 X 2.64 X 1000 = 683 Kg

Table.1 Properties of Fine Aggregate

Sieve Size	Weight Retained in Sieve (Grams)	% Retained	% Cumulative Retained	% Passing
10 mm	-	-	-	100
4.75 mm	55	5.5	5.5	94.50
2.36 mm	90	9.0	14.5	85.50
1.18 mm	143	14.3	28.8	71.2
600 micron	204	20.4	49.2	50.80
300 micron	312	31.2	80.4	19.60
150 micron	178	17.8	98.298.2	1.80
Pan	18	1.8	100	0

Table.2 Properties of Coarse Aggregate

Coarse aggregate	Specific gravity	Bulk density (kg/m^3)	Water absorption (%)
CA	2.62	1535	0.8

Table.3 Properties of Cement

Property	Result
Normal Consistency	30 %
Setting Time **Initial** **Final**	 130 min 375 min
Specific Gravity	3.15
Fineness of Cement **(By 90 micron sieve)**	 2 %
Compressive Strength **7 days** **2 days**	 53 N/mm^2 60 N/mm^2

Table.4 Slump flow class for SCC

Slump-Flow classes Class	Slump-Flow in mm
SF 1	550 to 650
SF 2	660 to 750
SF 3	760 to 850

Table.5 Viscosity class for SCC

Viscosity Classes class	T_{500}, s	V-funnel time in Second
VS1 / VF1	≤ 2	≤ 8
VS2 / VF2	> 2	9 to 25

Table.6 Passing ability classes (L-box)

Passing ability classes (L-box)	Passing ability
PA1	≥ 0.80 with 2 rebars
PA2	≥ 0.80 with 3 rebars

Table.7 Conformity criteria for the properties of SCC

Property	Criteria
Slump-flow class SF1	≥ 520 mm, ≤ 700 mm
Slump-flow class SF2	≥ 640 mm, ≤ 800 mm
Slump-flow class SF3	≥ 740 mm, ≤ 900 mm
Slump-flow class specified as a target value	+/- 80 mm of target value
V-funnel class VF1	≤ 10 s
V-funnel class VF2	≥ 7 s, ≤ 27 s
V-funnel specified as a target value	+/- 3 s
L-box class PA1	≥ 0.75
L-box class PA2	≥ 0.75
L-box specified as a target value	Not more than 0.05 below the target value
Sieve segregation resistance class SR1	≤ 23
Sieve segregation resistance class SR2	≤ 18

D. Test on Fresh Properties of SCC: Trial mix 6 gives the satisfactory results for slump flow and 28 days compressive strength with accelerated curing and further tested for the fresh and hardened properties. EFNARC guidelines are followed through the world to check the rheological properties of self-compacting concrete.

Table.8 Plastic properties of SCC Mixtures

Trial Mix	% Replacement of Micro-silica	Slump Flow (mm)	T-50 (sec)	L-Box (H2/H1)	U-Box (H2-H1)	V-Funnel (sec)
Trial Mix 1	**0**	**670**	**7**	**0.90**	**15**	**9**
Trial Mix 2	**2.27**	**680**	**6**	**0.90**	**14**	**8**
Trial Mix 3	**4.65**	**685**	**5**	**0.92**	**12**	**6**
Trial Mix 4	**7.14**	**690**	**5**	**0.95**	**12**	**4**
Trial Mix 5	**9.75**	**710**	**4**	**0.92**	**11**	**3**
Trial Mix 6	**12.5**	**740**	**4**	**0.96**	**11**	**3**
Trial Mix 7	**15.38**	**730**	**4**	**0.96**	**10**	**3**

E. Trial Mix Proportions of SCC: For SCC there is no specific method of design mix. In the present investigation Indian Standard method and as also the available literatures on SCC are used. In order to achieve high strength lower w/c ratio is adopted and to achieve good workability super-plasticizer and fly-ash are used. The trial mix proportions of the concrete are shown in **Table 9.** In the present investigation w/c ratio used is 0.29 and dosage of Super-plasticizer is 5.5 Kgs/Cum. The 28 days target mean strength for all mixes was 63 **Mpa** as per Morth.

Table 9 Mix proportions of Self compacting concrete (kg/m^3)

Trial Mix	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (20 mm) (Kg)	Coarse Aggregate (10 mm) (Kg)	Water (Kg)	Water cement ratio	Super Plasticizer (Kg)	Silica Fume (Kg)	Fly-ash (Kg)
SCC Trial 1	450	821	180	683	160	0.29	5.5	0	100
SCC Trial 2	440	821	180	683	160	0.29	5.5	10	100
SCC Trial 3	430	821	180	683	160	0.29	5.5	20	100
SCC Trial 4	420	821	180	683	160	0.29	5.5	30	100
SCC Trial 5	410	821	180	683	160	0.29	5.5	40	100
SCC Trial 6	400	821	180	683	160	0.29	5.5	50	100
SCC Trial 7	390	821	180	683	160	0.29	5.5	60	100

F. ***Preparation of Test Specimens:*** Seven concrete mixes were cast with replacement of 0, 2.27, 4.65, 7.14, 9.75, 12.5 and 15.38 % silica fume with cement, at a 0.29% w/c ratio. The slumps are measured and the slump values increases when the silica fume increases. The cubes are casted and cured in curing pond. At 7 days and 28 days (cubes of size 150 mm x 150 mm x 150 mm) were tested for compressive strength of cubes and the results are shown in Table 10. The compressive strength of cubes are shown in Fig.1

Table. 10 Average value of Cube Strength of concrete (MPa)

Trial Mix	Cube compressive strength (f_{cu}) 7 days	Cube compressive strength (f_{cu}) 28 days
SCC Trial 1	44.5	60.5
SCC Trial 2	46	61.5
SCC Trial 3	46.35	62.85
SCC Trial 4	47.5	63.25
SCC Trial 5	48.25	63.85
SCC Trial 6	49.75	64.5
SCC Trial 7	49.5	64

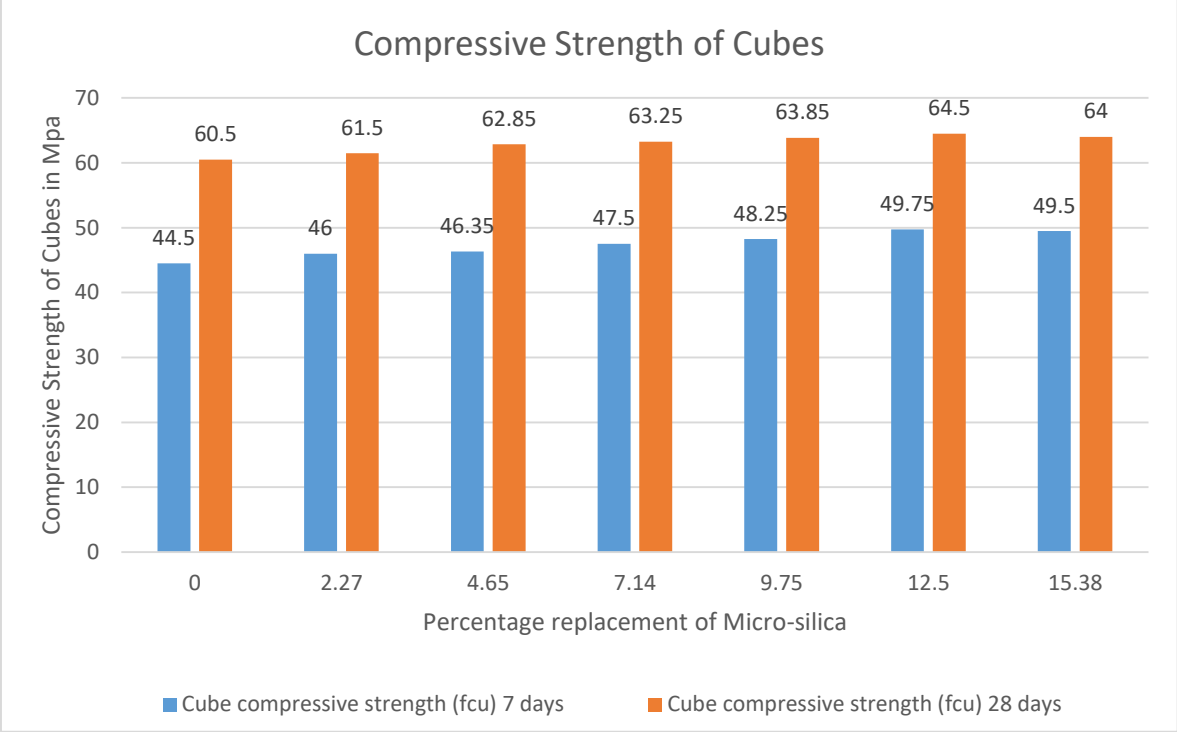

Fig. 1 Percentage of silica fume replacement with cement Vs compressive strength

IV. DISCUSSION OF TEST RESULTS

Replacement of cement by silica fume in SCC improved compressive strength and after that the strength were reduced both for 7 days and 28 days. This may be due to the fact that the decrease of strength is due to pozzolonic reaction and filler effect of Silica fume.

V. CONCLUSION

The following conclusions can be made on the basis of the current experimental results.

1. A mix design procedure for SCC using silica fume and super plasticizer is formulated by Indian Standard method of mix design and available literature on SCC.

2. As the silica fume content increases the compressive strength increases [**SCC Trial 6**] and then decreases. Hence the optimum replacement is 12.5 %.

3. The 7 days and 28 days cube compressive strength ratio of SCC is **0.73 to 0.78**.

APPENDIX

1. Target Mean Strength

63 Mpa for M50 grade concrete mix. (As per MORTH Table 1700-5)

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