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Functional Analyzed of Self-Compaction Concrete with Used Micro Silica And Variation of Admixture

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Abstract - *In current years, self-compacting concrete (SCC) has gained comprehensive use for placement in congested reinforced concrete structures with difficult casting conditions. Self-compacting concrete (SCC) consists one of the very modern developments in concrete technology. With its excellent deformability, high fluidity, and better durability potential, it marks a milestone in the construction industry. It also offers a rapid rate of concrete placement, with faster construction pace and ease of flow around congested reinforcement. Use of SCC can also support reduce hearing-related damages on the worksite that are induced by vibration of concrete. In this present investigation the performance of SCC by varying the range of micro silica as partial replacement of cement is studied. The experimental mixes are formed based on the EFNARC specifications. Cement is replaced with various percentage of micro silica (5%, 6%, 7%, 8%, and 9%). The workability properties of combination are evaluated by workability tests such as slump flow test, V-funnel, L-Box tests. In this learning the performance of concrete mix with micro silica, super plasticizer evaluated. This project focuses on the effects of micro silica on all the main properties of self-compacting concrete in the fresh and hardened state.*

Keywords- *Self-Compacting Concrete, Micro Silica, Admixture, Slump Test, V-Funnel, L-Box, Compressive Strength,*

I. INTRODUCTION

These days, apart from steel, concrete is the supreme common and widely used as structural material in construction arena. Concrete defined as a composite material finished up of composed granular material (the aggregate or filler) embedded in a hard matrix of material (cement or binder) and water. They are many categories of concrete with different material used in mix design. The Self-Compacting Concrete is a concrete which flows and settles due to its own mass lacking segregation and bleeding. SCC has several advantages over normal conventional concrete. It can flow simply in congested reinforced areas such as in beam column joints.

One of the most important differences between self-compacting concrete and conventional concrete is the incorporation of inorganic admixture. Since cement is one of the most expensive components of concrete, reducing the cement content is one of the economical solutions. Besides these economic benefits, the use of by-products or waste materials reduces environmental pollution. SCC is not affected by skills of employments, the shape and amount of reinforcement or the arrangement of a structure and due to its high fluidity and resistance to segregation it can be pumped longer distances.

Owing to the high content of powder, SCC may show extra plastic shrinkage or creep than ordinary concrete mixes. These aspects should therefore be considered during designing and specifying SCC. Current knowledge of these aspects is limited and this is an area requiring further research. Special care should also be taken to begin curing the concrete as initial as possible. Compaction plays a significant role in the growth of hardened concrete properties. When certain properties are considered for performance of concrete structures it is assumed that concrete is well compacted and homogenous; the purpose of compaction hence is therefore to achieve the highest possible density.

II. OBJECTIVES OF THE STUDY

The main objective of this examination is to determine the suitable percentage of quarry micro silica and effect of different proportioning of super plasticizers in SCC that gives the highest value of concrete compressive strength.

III. MATERIALS USED IN THIS EXPERIMENT

A) Cement: - In this experimental study, Ordinary Portland Cement conforming to IS: 8112-1989 was used. The physical and mechanical properties of the cement used are shown in Table1.

***Table: 1** –properties of cement*

SR.NO.	Physical Properties	Result
1	Fineness (retained on 90 µm Sieve)	8%
2	Specific gravity	3.15
3	Normal consistency	28%
4	Vi-cat Initial setting time(minutes)	73
5	Vi-cat Final setting time(minutes)	212

B) **Super Plasticizer (Admixture): -** In order to progress the workability, a high range water reducer super plasticizer added to the mixture. In our project we used "MasterGlenium®51" super plasticizer in self-compacting concrete.

C)

***Table: 2** –properties of admixture*

Structure of the Material	Polycarboxylic ether based
Color	Amber
Density	1.082-1.142 kg/liter

D) Aggregates: -The influence of fine aggregates on the new properties of the SCC is significantly greater than that of coarse aggregate. Sand was tested for the degree purpose and found to be confirmed to zone-III as per IS: 383-1970 recommendations and we would check physical properties also. Sieve analysis results of fine aggregates of 1000gm weight are given in Table-3.

Coarse Aggregates are the significant constituents in concrete. Almost all natural aggregate materials originate from bed rocks. It was tested for gradation resolve and physical properties like specific gravity, Impact value and index value were also determined. Single sized gradation has been used in our experimental study as shown in Table-3 and 4.Sieve analysis results of coarse aggregates of 5000gm weight are given in Table-3.

***Table: 3** – Sieve Analysis*

Sr. No.	Sieve Size	Fine Aggregate (% passing)	Remark	Coarse Aggregate(% passing)
1	40 mm	-	Zone-IIIsand asper Table-4of IS : 383- 1970	100
2	20 mm	-		28.5
3	10 mm	-		0
4	4.75	100		0
5	2.36	100		-
6	1.18	93		-
7	0.6	62		-
8	0.3	12		-
9	0.15	2		-
10	Residue	0		

***Table: 4** – Physical Properties of coarse Aggregate*

SR.NO.	Properties	Coarse Aggregate Result	Fine Aggregate Result
1	Specific Gravity	2.75	2.66
2	Flakiness Index	3/5th of their average	-
3	Elongation Index	9/5th of their average	-
4	Impact Value	4.55%	-
5	Water absorption	1.20%	1.48%

E) Water: - Normal tap water is used.

F) Micro Silica: - The term "micro silica" is the one usually used to describe the very fine powder, which is extracted from exhaust fumes of silicon and ferrosilicon smelting furnaces and utilized in concrete to improve the properties of the concrete. Other terms for the same product are silica fume and condensed silica fume.

IV. SCC Mix Design

Table: 5 *– Mix Proportions by mass*

SR. NO.	Mix Batch	SCC Design Mix Proportions					% Micro silica
		Water	Cement	F.A.	C.A.	Super plasticizer	
1	A0	190	345	693	884	2.5%	0 %
2	A1	190	327.75	693	884	2.5%	5%
3	A2	190	324.30	693	884	2.5%	6%
4	A3	190	320.85	693	884	2.5%	7%
5	A4	190	317.40	693	884	2.5%	8%
6	A5	190	313.95	693	884	2.5%	9%

V. Testing Fresh Properties of SCC

1) **Slump Flow Test:** -Slump test is one of the most significant tests in self-compacting concrete. Slump test is measured spread or flow of concrete to check workability of concrete. In different type of conventional concrete for measured workability find height of slump cone. While in SCC for measured workability find diameter of fresh concrete with respect to time. Typically, slump flow values of approximately 24 to 30 inches are within the acceptable range; acceptable T50 times series from 2 to 5sec.
2) **J - Ring Test: -** Jring test denotes the passing ability of the concrete. The equipment consist Of rectangular section of 30mm*25mm open steel ring drilled vertically with holes to accept threaded section of reinforcing bars 10mm dia. 100mm in length the bars and section can be placed at different distance apart to simulate the congestion of reinforcement at the site.
3) **V - Funnel Test: -** This test was developing in Japan. The apparatus consists of v shape funnel shown in figure below. V funnel test is used to determine the filling ability of the concrete with maximum size of aggregate 20 mm the funnel is filled with about 12 litter of concrete.
4) **U - Box Test: -** This standard covers the test method for transient ability through spaces of self-compacting concrete with a maximum coarse aggregate size of 25 mm or less using a U-shaped or Box-shaped container.
5) **L – Box Test: -**In this test, new concrete is filled in the vertical section of L-Box and the gate is lifted to let the concrete to flow into the horizontal section. The height of the concrete at the end of horizontal unit represents h2 (mm) and at the vertical section represents h1 (mm). The ratio h2/h1 represents blocking ratio.

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Figure: -1.*Slump Flow test*

Figure: -2.V-Funnel Test

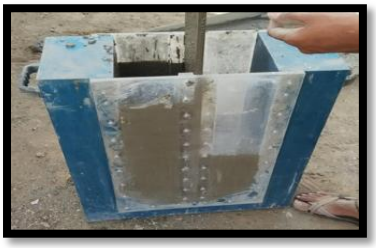


Figure: -3.*U- Box Test*

Figure: -4.*L- Box Test*

Figure: -5.*Cube Casting*

Figure: -6.*Testing Of SCC Cubes*

VI. RESULT AND SUMMARY

Based on the above experimental results, the observations are as follows. Slump flow increases with the increase of micro silica content. T50 time, V-funnel time, T5 time and values are decreasing with the increase of micro silica%. L-

box value increases with the micro silica%. All the workability test results are well in complete with the EFNARC specifications of SCC.

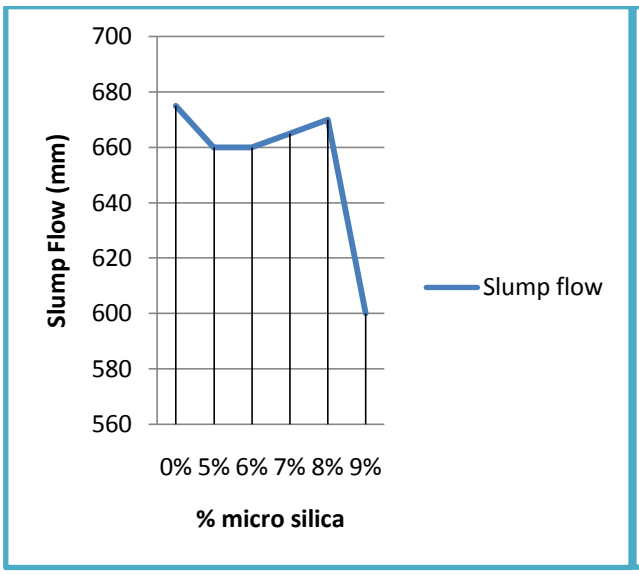
***Table: 6** –Test Result*

Test Results on Fresh Concrete and Acceptance Criteria for SCC								
S. No	Method	Unit	**Micro silica proportion**					
			0%	5%	6%	7%	8%	9%
1	Slump Flow Test	mm	675	660	660	665	**670**	600
2	T50	sec	3.88	3.90	3.88	3.82	**3.80**	3.88
3	V-Funnel	sec	8	7.89	7.00	7.00	**6.90**	7.54
5	L-Box	h2/h1	0.95	0.80	0.79	0.86	**0.89**	0.87
6	U-box	h2-h1(mm)	0.92	0.85	0.90	0.96	**0.92**	0.95

***Table: 6** - 7&28 Days Compressive strength results*

Test Results on Hardened` Concrete				
Concrete Mix	**Compressive Strength (N/mm^2)**			
	7days	28days	% variation with respect to M0 (7days)	**% variation with respect to M0 (28days)**
A0	19.65	36.98	0	**0**
A1	23.52	44.92	19.69	**21.47**
A2	24.89	47.63	26.66	**28.79**
A3	25.23	49.52	28.39	**33.91**
A4	25.95	49.00	32.06	**32.50**
A5	24.58	45.12	25.08	**22.01**

The slump value plays a major role in SCC. By the value of slump, it is possible to know the effectiveness of Flow in SCC.The minimum value of slump is to be 650mm and the maximum value 800 mm for a fresh SCC. The slump values for different mixes are shown in fig. -7.



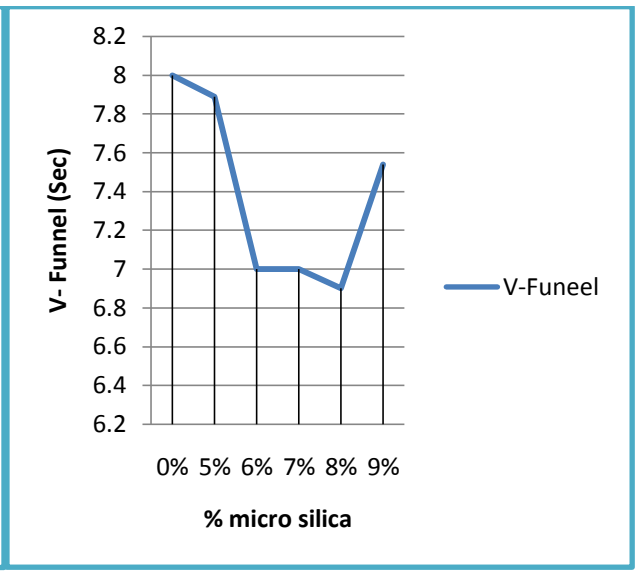
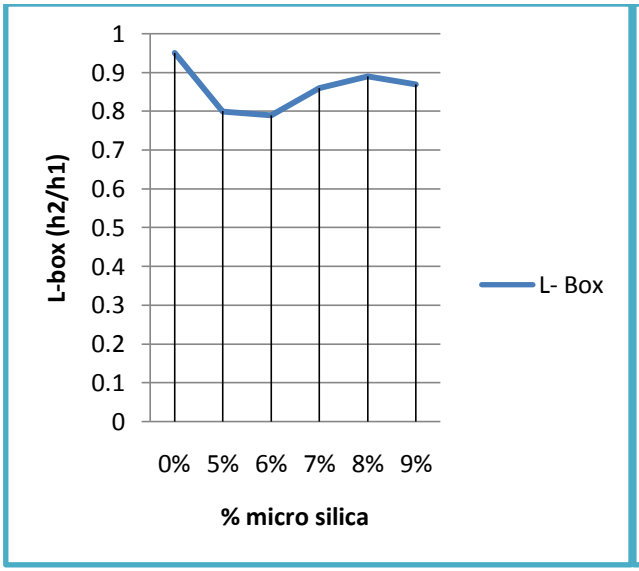


Figure: - 7. *Slump Flow test of SCC with micro silica*

Figure: - 8. *V-Funnel test of SCC with micro silica*

Expending L-box test, the passing ability of SCC beyond the reinforcing bars can be found. The mix having high powder content and lesser coarse aggregate passes easily through the reinforcing bars.U-box test is used to find the passing ability of SCC through the reinforcing bars, similar to that of the L-box test.The L-box values for different mixes are shown in fig. -9 and The U-box values for different mixes are shown in fig. -10.



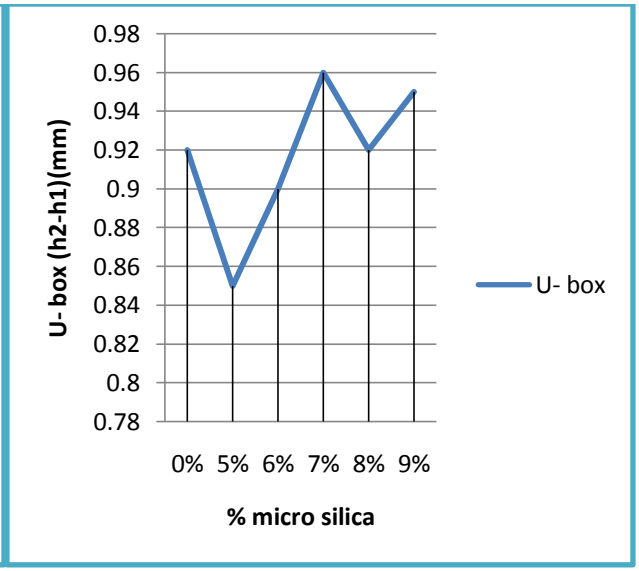
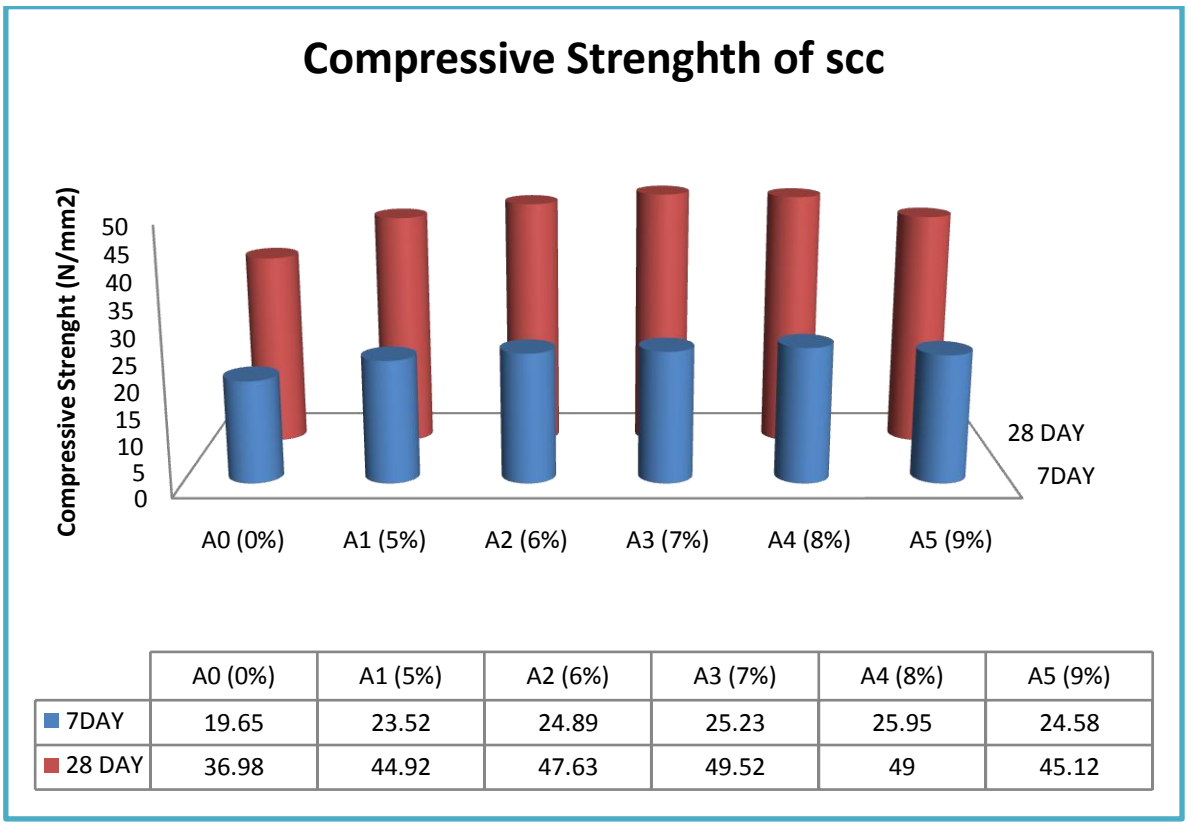


Figure: - 9. *L-Box test of SCC with micro silica*

Figure: - 10. *U- Box test of SCC with micro silica*

V- Funnel test is used to find out the ability of the SCC. The test result shows that the time taken for a higher replacement is much less due to fineness in the mix. The influence of time is shown in fig. – 8. The minimum time for the flow of the entire concrete dumped in the V- Funnel is 6 second and maximum time fall is 12 second.



	A0 (0%)	A1 (5%)	A2 (6%)	A3 (7%)	A4 (8%)	A5 (9%)
7DAY	19.65	23.52	24.89	25.23	25.95	24.58
28 DAY	36.98	44.92	47.63	49.52	49	45.12

Figure: -11. *Day V/S Compressive strength of cube at 7 & 28 Days*

CONCLUSION

Various tests were carried out on mixes of concrete containing. Various admixture doses along with control mixes Conclusions based on the results and discussions are summarized below:

1. All the mixes used in these learning exhibits the good workability characteristics, in accordance with the EFNARC specifications.
2. Self-compacting concrete compressive strength for 7 days was increase by 32.06%.and the 28 days compressive strength increased by 33.91% with respect to micro silica%.
3. Workability characteristics i.e., passing ability, filling ability and segregation resistance of the SCC mixes are linearly increasing with the increase of admixture.
4. There was a reduction in V funnel time duration by 1 to 2 secondsand Slump flow increases with the increase of micro silica content. Similarly, L- Box value increase with the micro silica.

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