

Investigation on the effect of mineral admixtures on mechanical property of self compacting concrete

Rayees Ali Khan

ABSTRACT: Concrete is the mixture of cement sand and aggregate with a designed water-cement ratio. In RCC structural's concrete is vibrated heavily to flow through reinforcement bars which are less spaced. To solve this problem self compacting concrete is used. In this research ordinary Portland cement is partially replaced with silica fume and fly ash with different percentages 5%, 10%, 15% and 20% of fly ash and 1%, 2.5%, 5%, 7.5% and 10% of silica fume for controlled mix design. In this research, the fresh and the hardened properties of concrete is determined it is shown that the fresh property of concrete is increased by increasing the percentage of silica fume and fly ash. It is observed that the mechanical properties of concrete are increased by the increase of silica fume and decreased the mechanical property by increasing the percentage of fly ash.

KEYWORDS: SELF COMPACTING CONCRETE, SILICA FUME, FLY ASH, FRESH PROPERTY, MECHANICAL PROPERTY.

I. INTRODUCTION

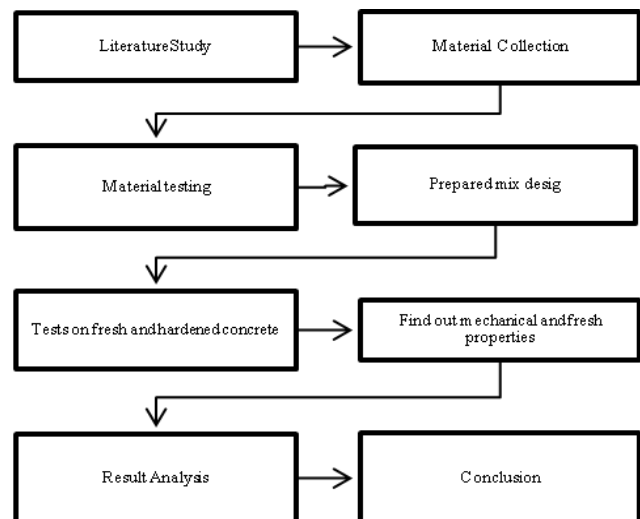
Self compacting concrete is one of the most used materials in civil engineering construction these days because of its good mechanical and fresh properties. There are many types of research done in this field with different names like self consolidation concrete, self-leveling concrete, highly-flow able concrete, super-workable concrete, and non-vibrating concrete. Self compacting concert flow easily at formwork even in the place of congested reinforcement under its own weight without using compacting machines. It is easily workable so reduce the extra labor charges. In this different chemical and mineral admixture are used to make it workable and increased the initial setting time for transportation. To reduce the cost the self compacting concert utilizes the waste and industrial by-products. The three main properties of self compacting concrete are its filling ability, passing ability, and segregation resistance. To measure these properties different tests are conducted. To test filling ability T50cm slump test, V funnel is used, for passing ability L box, U box, J ring test and for segregation V funnel test at T5 minutes, etc are done. The main advantages of self compacting concrete are that the permeability of concrete is decreased, provide freedom for designing structural, time reduced, compacting machines eliminated hence reduce noise and coast for these things. But some limitations are the design mix needs more trials and more accuracy needed for measurement and monitoring of material. In the present study, the fresh and mechanical properties of

concrete should be determined by the use of silica fume and fly-ash with different percentages.

SCOPE:

The aim of the research is as we know the rate of growing industries is very fast so, we need some quick and accurate methods of construction and also utilize the waste materials by-products self compacting concrete can do this.

II. METHODOLOGY



III. MATERIAL TESTING:

a) Cement:

As we know that cement is a binding material in mortar and concrete and composed of raw materials. In this research ordinary Portland cement of grade 43 used with a specific gravity of 3.1 and finesse 2% retained upon the 90 microns IS sieve.

b) Fly ash:

It is a coal combusted product compost of fine particles by the use of fly ash workability significantly improved. In physical property, the specific gravity of fly ash is 2.25.

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Table I: Chemical properties of fly ash.

S.NO	Chemical component	Percentage of chemical component
1	SiO ₂	50.1
2	Fe ₂ O ₃	14.12
3	Al ₂ O ₃	22.4
4	CaO	3.6
5	MgO	1.22
6	K ₂ O	0.59
7	Na ₂ O	0.42
8	SO ₃	0.98

c) Silica fume:

Silica fume is a very fine amorphous silica product also known as micro silica. It is a by-product of silica-alloys. The specific gravity of silica fume 2.21 .silica fume is added to ordinary Portland cement to increase the mechanical property of cement.

Table II: Chemical properties of silica fume.

S.NO	Chemical component	Percentage of chemical component
1	SiO ₂	86
2	Fe ₂ O ₃	0.5
3	Al ₂ O ₃	0.2
4	CaO	0.21
5	MgO	0.5
6	K ₂ O	0.5
7	Na ₂ O	0.2
8	SO ₃	0.14
9	C ₁	0.01
10	H ₂ O	0.5

d) Fine aggregate:

Aggregate which passed through 4.75mm IS sieve. In this research local available fine aggregate is used. Fineness modulus 2.68 and specific gravity 2 .6.

e) Coarse aggregate:

Aggregate which retains upon the IS 4.75mm sieve. In this research maximum of 20mm single-sized aggregate used. The specific gravity of course aggregate is 2.7, water absorption 0.65 and Bulk density kg/m³ equal to 1630.1

f) Auramix 350:

Auramix 350 is a high-performance superplasticizer suitable for low and high-grade concrete and intended for applications where high water reduction and long workability retentions are required.ph value is 6 and specific gravity 1.1 appx.

g) Water:

The water used in this research is drinkable water of Ph 6.7-8.4

IV. MIX DESIGN:

The mix design proportion is designed as per the IS IS10262-2009. Use of Superplasticizer Auramix 350 (0.9%) by weight of cement to increase the workability.

Water (Kg/m ³)	Cement (Kg/m ³)	Fine aggregate (Kg/m ³)	Coarse aggregate (Kg/m ³)
202.77	550	775.312	788.12
0.36	1	1.40	1.43

From the mix proportion, the weight of fly ash and silica fume required is calculated.

Table III: In different percentage weight of cement and silica fume required.

Sample name	Replacement percentage of cement by fly ash	Silica fume (Kg/m ³)	Cement (Kg/m ³)
SF1	1%	5.5	544.5
SF2	2.5%	13.75	536.25
SF3	5%	27.5	522.25
SF4	7.5%	41.25	508.75
SF5	10%	55	495

Table IV: In different percentage weight of cement and fly ash required.

Sample name	Replacement percentage of cement by fly ash	Fly ash(Kg/m ³)	Cement (Kg/m ³)
FA1	5%	27.5	522.5
FA2	10%	55	495
FA3	15%	82.5	467.5
FA4	20%	110	440

V. RESULTS AND DISCUSSION:

A. Fresh properties of concrete

a) **Workability:** easy by which concrete can be a mixture, transported and compacted without bleeding and segregation. It is a physical parameter that affects the strength and durability of concrete.

Table V: Workability of Concrete.

S.NO	SPECIMEN	WORKABILITY (mm)
1	Conventional With Auramix 350 (0.9%)	110
2	SF1	115
3	SF2	123
4	SF3	128
5	SF4	134
6	SF5	139
7	FA1	145
8	FA2	130
9	FA3	122
10	FA4	119

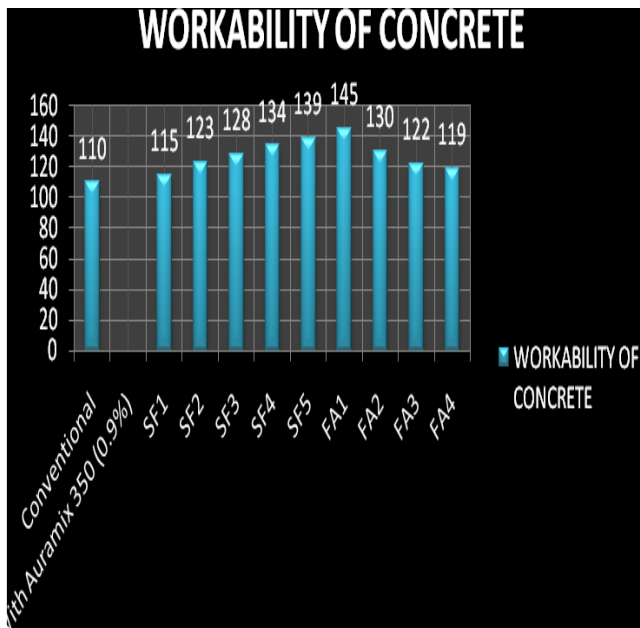


Figure 1: Workability Of Concrete.

B. Hardened Properties:

a) **Compressive Strength:** It is the ability of a material to resist compressive forces which tends to compress it. Cubes of dimension 150x150x150mm are cast both for conventional as well as for self compacting concrete. Concrete is filled in three layers and fully compacted allow to sit for 24 hours and then demoulding and put under the curing process after 28 days cubes are taken out and tested under the compressive testing machine.

Table VI: Compressive strength of concrete by using silica fume and fly ash.

S.NO	SPECIMEN	COMPRESSIVE STRENGTH (MPa)
1	Conventional with 0.9% of Auramix	50.48

S.NO	SPECIMEN	COMPRESSIVE STRENGTH (MPa)
2	SF1	52.8
3	SF2	54.1
4	SF3	55.2
5	SF4	57.4
6	SF5	58.1
7	FA1	48
8	FA2	48.9
9	FA3	46.7
10	FA4	44.8

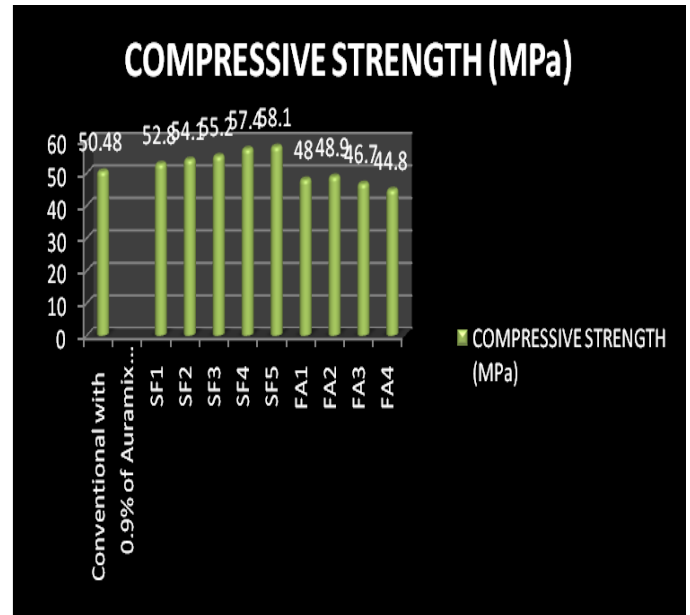


Figure 2: Compressive strength of concrete by using silica fume and fly ash.

b) **Split Tensile Strength:** In this test cylinder of dimension 150mm dia. 300mm height is used to determine the split tensile strength this method is an indirect method to determine the tensile strength of concrete. In this test, cylinder put longitudinally and a compressive force is applied, cylinder split into two parts the reading is noted own and find the split tensile strength of concrete by using formula $T=2P/\pi DL$

Table VII: Split tensile strength of concrete by using silica fume and fly ash.

S.NO	SPECIMEN	Split tensile STRENGTH (MPa)
1	Conventional with 0.9% of Auramix 350	4.21
2	SF1	4.25
3	SF2	4.38
4	SF3	4.51
5	SF4	4.8
6	SF5	4.97
7	FA1	3.91
8	FA2	3.98
9	FA3	3.67

10	FA4	3.46
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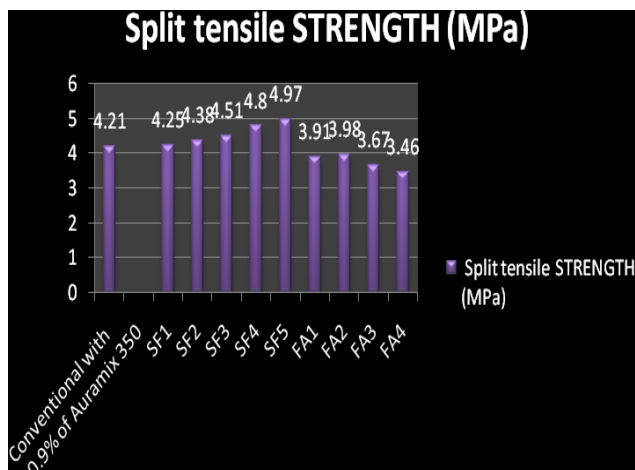


Figure 3: Split tensile strength of concrete by using silica fume and fly ash.

VI. CONCLUSION:

The outcome from the above research is:

- Form the above result is shown that the compression strength decreased with an increase in the percentage of fly ash while as it increased with increasing the percentage of silica fume.
- As considering a fresh property the workability of concrete increased with the increased percentage of silica fume but in the cause of fly ash cement replaced upto 5% it increased if we increased the replacement percentage cement with fly ash it gets decreased.
- While in the cause of tensile strength when cement is replaced with fly ash the tensile strength decreased but in the cause when we replaced cement with silica fume tensile strength increased.

It is shown that the use of silica fume increased the fresh and hardens property of concrete and the use of its environmental hazards gets reduced. Among both of them, silica fume and fly ash the silica fume gives more positive results.

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