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International Journal of Research Publication and Reviews

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An Experimental Study on Self Compacting Concrete with Partial Replacement of Cement with Silica Fume and Flyash

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A B S T R A C T

Click here and insert your abstract text. Concrete is a mixture of cement, fine aggregate, coarse aggregate, water. Concrete plays a vital role in the development of infrastructure i.e., buildings, industrial structures, bridges etc., leading to utilization of large quantity of concrete. On the other side cost of concrete is attributed to the cost of its ingredients which is expensive. Due to this reason alternative materials are being chosen for economical production of concrete. In this project cement is partially replaced with silica fume and fly ash. Substantial energy can result when industrial by products like silica fume and fly ash are used as partial replacements for the energy intensive Portland cement. Silica fume (SF) is a very fine powder consists of spherical particles of mean diameter about 0.15 microns, with a very high specific surface area. Fly ash (FA) is a solid waste generated by industry. In the present study the mechanical properties of concrete at 7 and 28 days are tested by partially replacing cement with silica fume and fly ash of different percentages.

Keywords: Silica Fume, Flyash, Cement, Self-Compacting Concrete, Split Tensile Strength, Compressive Strength.

1. Introduction

The production of one metric tonne of cement leads to the emission of one metrictons of CO_2, which is a powerful greenhouse gas responsible for the global warming .One way of reducing this environmental problem is to reduce the consumption or production of cement. Since the cement is the basic material which is used in construction industry, it is essential to find the suitable material for the replacement of cement. The flyash obtained from thermal power plant sand silica fume produced from elemental silicon can be used as partial replacement of the cement.

When compared to conventional concrete Self Compacting Concrete (SCC) is a relatively new type of concrete with high flowability and cohesiveness SCC may be used in pre-cast applications or for concrete placed on site. (SCC) requiring no compaction work at site or concrete plans it has been developed in Japan to improve the durability and uniformity of concrete in 1988. There is no standard method for SCC mix design and many academic institutions, concrete and construction chemical manufacturing companies and ready-mix concrete producers and contracting companies have developed their own proportioning methods by following EFNARC guidelines (2005).

2. Aim of the Project

The main aim of the project is to study the strength properties of concrete mix of M30 grade on partial replacement of cement with silica fume and fly ash with varying percentages.

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3. Materials Used

a) Cement: Ordinary Portland Cement of 53 grade evaluation adjusting to both thenecessities of IS:12269 and ASTM C 642-82 sort I was utilized.

b) Fine aggregate:

The test results of fine aggregates are as follows

S.No.	Test	Natural sand
1	Sieve analysis	Zone II
2	Fineness modulus	2.60
3	Specific gravity	2.44

c) Coarse aggregate:

The test results of coarse aggregates are as follows

Property	Result
Type	Crushed
Specific gravity	2.67
Fineness modulus	7.01

d) Silica fume:

Silica fume generally used as mineral admixture. The main aim of the project is to study the strength properties of concrete mix of M30 grade on partial replacement of cement with silica fume and fly ash with varying percentages. The specific gravity of silica fume is2.63. Silicafume is also called micro silica. Its usage in concrete widely increased in present days.

S.No	Particulars of tests	Test results	Requirements as per IS codes
1	Standard consistency	28%	IS 4031-1988(Part-4)
2	Fineness	5%	
3	Specific gravity	3.12	
4	Setting time		
	(a)Initial	42 minutes	As per 12269-2013,30mins,Minimum
	(b)Final	450 minutes	As per 12269-2013,600 min. Maximum

e) Fly Ash:

Fly ash is generated by the combustion of coalat thermal power plant sasa by-product. Fly ash is also named as pulverized fuel ash. The specific gravity of flyash is 2.75.

4. Concrete Mix Proportion

The steps involved in the design of concrete mix as per IS: 10262-2009, IS: 456-2000.

Stipulations for proportioning
Grade designation : M30.
Type of cement : OPC 53 grade
Size of aggregate : 10 & 12 nm
Degree of supervision : Good
Minimum cement content : 320 kg/m^3
Workability : 50-75 mm (slump)
Exposure condition : Severe
Maximum water cement Ratio : 0.40
Chemical add mixture : Super Plasticizer

Mix proportion of concrete is
Cement : F.A : C.A = 1 : 2.46 : 2.16

5. Results and discussions

The study is carried out to find the compressive strength and split tensile strength.

5.1 Compressive Strength (CS)

S.No.	%S.F	%F.A	C.S at 7 days	C.S at 28 days
1.	0	0	25.55	38.4
2.	5	10	26.84	38.9
3.	5	20	27.5	40.26
4.	5	30	28.2	42.42
5.	10	10	28.86	44.1
6.	10	20	29.26	45.5
7	10	30	28.48	43.9
8	15	10	27.6	44.1
9.	15	20	28.24	43.8
10	15	30	27.5	42.8

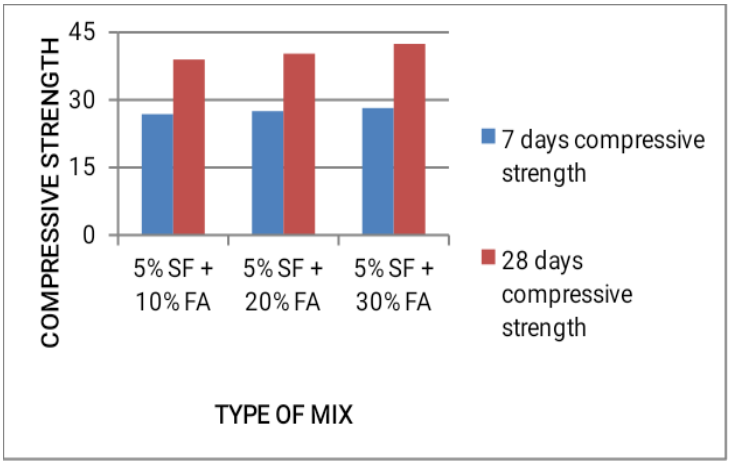

Figure : Graph showing compressive strength at 5 % silica fumeand varying percentages of fly ash.

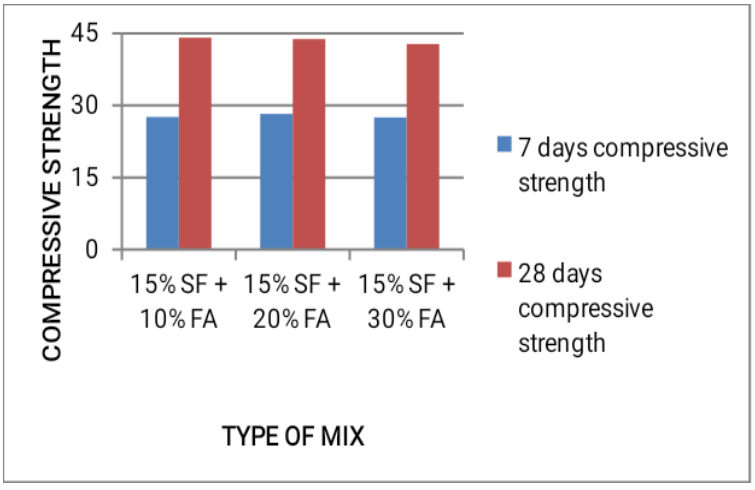

Figure: Graph showing compressive strength at 15 % silica fumeand varying percentages of fly ash.

5.2. **Split tensile strength (STS)**

S.No.	%SF	%FA	STS at28 days
1.	0	0	3.25
2.	5	10	3.30
3.	5	20	3.41
4.	5	30	3.60
5.	10	10	3.74
6.	**10**	**20**	**3.86**
7.	10	30	3.72
8.	15	10	3.74
9.	15	20	3.71
10.	15	30	3.63

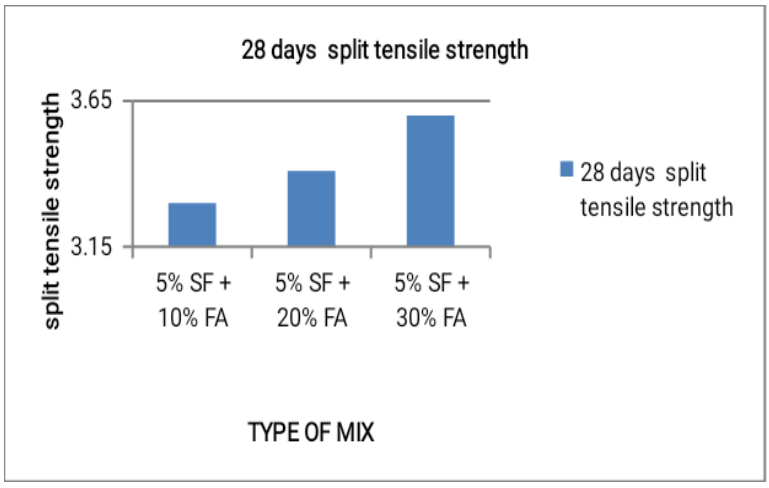

Figure: Graph showing split tensile strength at 5% silica fume and varying percentages of fly ash.

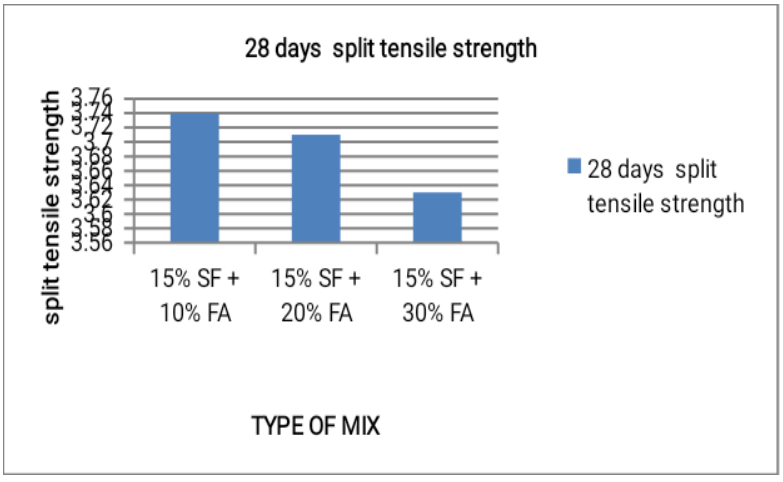

Figure: Graph showing split tensile strength at 15% silica fume and varying percentages of fly ash

6. Conclusion

After the analysis of the result of the experimental programme the following conclusions were arrived. By the partial replacement of cement with silica fume and fly ash the mechanical properties of concrete have increased. The optimum compressive strength when cement is partially replaced with 10%silica fume and 20% flyash is obtained 45.5N/mm^2.The optimum split tensile strength when cement is partially replaced with10% silica fume and 20%fly ash is obtained 3.86N/mm^2.

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