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EFFECT OF FINE AGGREGATE AND CEMENT REPLACEMENT WITH CLASS F AND CLASS C FLY ASH ON THE MECHANICAL PROPERTIES OF CONCRETE

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ABSTRACT

In this paper study is being carried out by the process of experimental investigation to evaluate the mechanical properties of concrete mixtures in which fine aggregate (sand) was partially replaced with Class F fly ash. Fine aggregate (sand) was replaced with five percentages (10%, 20%, 30%, 40%, and 50%) of Class F fly ash by weight. The further research is also being carried out to investigate the optimum percentage of fly ash to be replaced for cement. The fly ash of class C was used to replace cement by percentage of 10, 15, 20, 25 and 30 respectively. Tests were performed for properties of fresh and hardened concrete. Compressive strength, splitting tensile strength, flexural strength were determined at 7, 14, 28 days. Test results indicate significant improvement in the strength properties of plain concrete by the inclusion of fly ash as partial replacement of fine aggregate (sand) and binder (cement) and can be effectively used in structural concrete.

Keywords:- *Fly ash, Ordinary Portland cement, fly ash replacement, strength.*

I. INTRODUCTION

The amount of fly ash created from power plants in India is around 80 million tons every year, furthermore, its rate use is under 10%. Greater part of fly ash delivered is of Class F type. Amid the most recent couple of years, some cement organizations have begun utilizing fly ash in producing cement, known as 'pozzolana Portland cement,' yet the general rate usage stays very low, and a large portion of the fly ash are dumped at landfills. Fly ash is commonly utilized as replacement of cement, as an admixture in concrete, and in assembling of cement. Though concrete containing fly ash as fractional replacement of cement presents issues of deferred early quality improvement, concrete containing fly ash as halfway replacement of fine aggregate will have no deferred early quality improvement, but instead will upgrade its quality on long haul premise. This ponder investigates the likelihood of supplanting some portion of fine aggregate with fly ash as a methods for fusing huge measures of fly ash.

II. MATERIAL AND EXPERIMENTAL PROCEDURE

Fly Ash: The source of fly ash is from the KHEDAR Power Plant in Haryana. The fly ash collected from the precipitators is used in concrete as it is the purest form of Fly Ash compared to other types. The chemical and physical tests were carried out on the Fly Ash sample.

Chemical composition of Fly Ash

Parameter	Test Method	Results	Units
Chemical Analysis			
Silica content (SiO_2)	IS 1727:1967	61.86	%
Silicon Dioxide + Aluminum Oxide + Iron Oxide	IS 1727:1967	99.62	%
Magnesium Oxide (MgO)	IS 1727:1967	0.38	%
Sulphuric Anhydroxide (SO_3)	IS 1727:1967	0.36	%
Sodium Oxide (Na_2O)	IS 1727:1967	0.17	%
Chloride Content (as Cl)	IS 1727:1967	0.018	%
Loss on Ignition	IS 1727:1967	0.49	%
Reactive Silica	IS 1727:1967	35.32	%
Physical Analysis			
Fineness (Blaine's Air Permeability)	IS 1727:1967	345	Kg/m^2
Particle retained on 45 micron IS sieve (By Wet	IS 1727:1967	31	%

Sieving)			
Lime Reactivity	IS 1727:1967	5.6	N/mm^2
Compressive Strength at 28 days (% of the strength of corresponding plain cement mortar cube)	IS 1727:1967	NA	%
Soundness (Autoclave)	IS 1727:1967	0.07	%
Total Parameters	13		

Cement: Ordinary Portland concrete (OPC) of 33 evaluation was utilized as a section of that the structure and properties is in consistence with the Indian standard associationConcrete are going to be outlined because the holding material having robust and glue properties that make it capable to affix the varied development materials and structure the compacted get along.Standard Portland concrete may be a standout amongst the foremost generally used quite hydraulic cement..

Test performed for cement are as follows

1. Fineness Test

Fineness (As per IS : 4031- Prat-2) 1988			
Sr. No.	Item	Sample 1	Sample 2
1.	Sample taken in gm.	100	100
2.	Passing through IS 90 micron sieve	98.72	99.10
3.	Retained on IS 90 micron sieve	1.28	0.90
4.	Fineness (%)	1.28	0.90
5.	Average		1.09

2. Consistency of cement was found to be 28.5%
3. Setting time test

Setting Time as per (IS 4031 – Part 5) 1988			
1.	Initial setting time in minutes	128 mins	30 min. – 600 min.
2.	Final setting time in minutes	245 mins	

Sand: The sand was purchased from local market of Sonipat which is generally Yamuna Sand

1. Grading of sand (IS 383: 1970)

IS Sieve	Wt. Retained	Comulative Weight Retained	% Wt.Retained	Ratio
10	0	0	0	100
4.75	60	60	4.29	95.71
2.26	132	192	13.71	86.57
1.18	262	454	32.43	87.57
0.60	330	774	55.23	44.71
0.30	446	1220	87.14	17.86
0.15	132	1352	96.57	8.43

Coarse Aggregate: The coarse aggregate used in experiments were purchased from local market Kishanganj in Rajasthan

1. Grading of coarse aggregate (20 mm)

IS Sieve	Wt. Retained	Cumulative Weight Retained	% Wt. Retained	Ratio
40	0	0	.0	100
20	1210	1246	6.42	58.88
10	15246	16456	27.35	58.65
4.75	2066	18522	92.35	8.65

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2. Specific gravity of Coarse Aggregate (20 mm) = 2.82
3. Grading of coarse aggregate (10 mm)

IS Sieve	Wt. Retained	Cummulative Weight Retained	% Wt. retained	Ratio
12.5	0	0	0	100
10	1352	1352	8.13	91.87
4.75	13660	15012	90.32	9.68
2.36	1250	16262	97.88	2.15

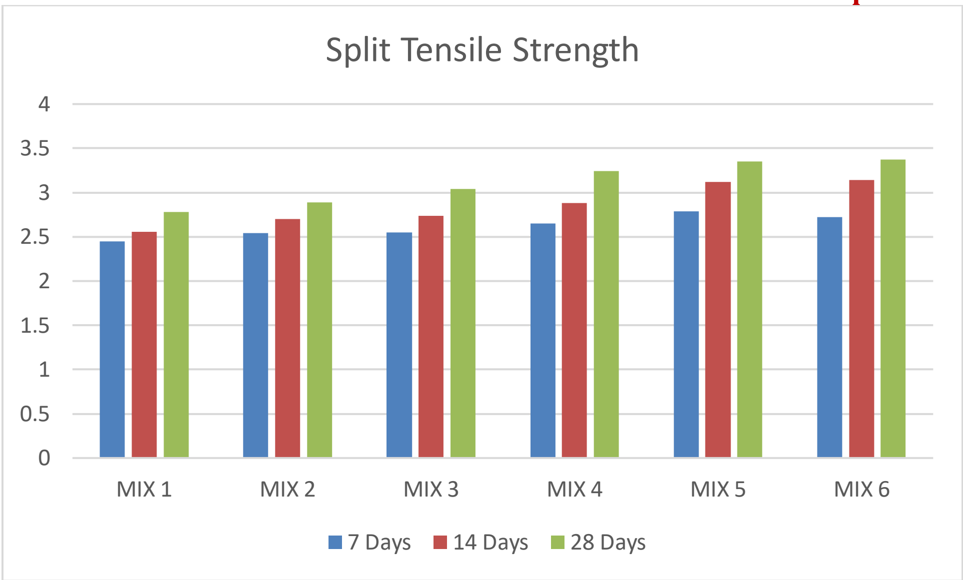
Specific gravity of coarse aggregate (10 mm) = 2.67
The proportions of aggregate to be mixed was found to be 60% (20 mm) and 40% (10 mm) to obtain well graded aggregate as per IS 383:1970 requirements

Superplasticizer:-A commercially available melamine-based superplasticizer was used in all mixes.

Mix proportions:-Six mixture proportions were made. First was control mix (without fly ash), and the other five mixes contained Class F fly ash. Fine aggregate (sand) was supplanted with fly ash by weight. The proportions of fine aggregate supplanted gone from 10% to half. Mix proportions. The control mix without fly ash was proportioned according to Indian Standard Specifications May be: 10262-1982, to get a 28-day 3D square compressive strength of 26.4 MPa. Concrete mixes were made in power-driven rotating type drum mixers of limit 0.76 m3.

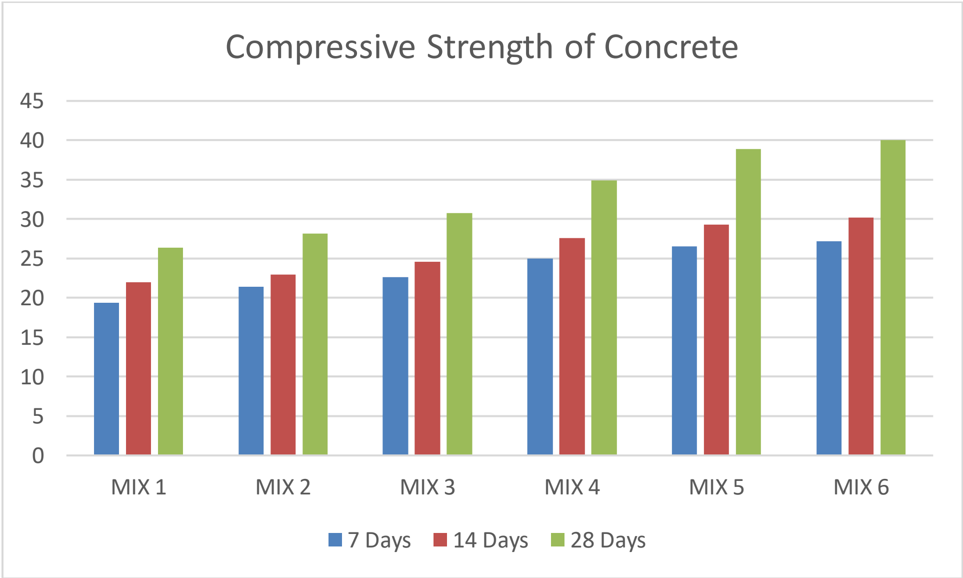
Preparation and casting of test specimens
The 150-mm concrete blocks were thrown for compressive strength, 150 X 300 mm barrels for part tractable strength, 101.4 X 101.4 X 508 mm shafts for flexural strength, and 150 X 300 mm barrels for modulus of flexibility. Subsequent to casting, all the test specimens were done with a steel towel. Following completing, the specimens were secured with plastic sheets to limit the dampness misfortune from them. All the test specimens were put away attemperature of about 23 C in the casting room. They weredemolded after 24 h, and were put into a water-curing tank.

Split Tensile Strength of Sample
The split tensile strength was being tested for various mix i.e. MIX 1, MIX 2, MIX 3, MIX 4, MIX 5 for 0%, 10%, 20%, 30%, 40% and 50% of fly ash replacement respectively and checked for split tensile strength as shown in table



Compressive Strength of Concrete

The compressive strength of mix was tested at Compression Testing Machine (CTM). The strength of mix



III. CONCLUSION

- Compressive strength, splitting tensile strength, flexural strength, and modulus of elasticity of fine aggregate (sand) replaced fly ash concrete specimens were higher than the plain concrete (control mix) specimens at all the ages. The strength differential between the fly ash concrete specimens and plain concrete specimens became more distinct after 28 days.
- Compressive strength, splitting tensile strength, flexural strength, and modulus of elasticity of fine aggregate (sand) replaced fly ash concrete continued to increasewith age for all fly ash percentages.

- The maximum compressive strength was foundof Mix 5 having cement replaced with 50% fly ash content at all ages. It was 40.0 MPa at 28 days.
- Results of this investigation suggest that Class F fly ash could be very conveniently used in structural concrete
- At all the ages, the maximum splitting tensile strength was observed with 50% fly ash content. It is 3.5 MPa at 28 days.

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