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Experimental Study on Strength Behavior of Concrete Containing Fly Ash and Chemical Admixture

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Abstract: ***High strength concrete is used for resisting high compressive load and improved strength. The cement content of the mix proportion for high strength concrete is incredibly high compared with conventional concrete strength.***
Fly ash is the by product of coal burning. Such material was used as a partial replacement of cement in high strength concrete, reducing carbon dioxide gas emissions into the atmosphere and minimizing the negative impact on the environment released fr om industrial waste disposal as landfill. The objective of this study is to find the max compressive load on the concrete by partia l replacement of cement by fly ash. Experimental laboratory tests were conducted.Slump height is measured to determine the w orkability of the fresh concrete. The cube size is (150mm x150mm x150mm) which is used for testing compressive strength for t he age of 3, 7 & 28 days of curing. Cement's % replacement with fly ash varies from 0%,10%,15% & 20%. The study result sho ws that the replacement of cement by fly ash upto 20% increases the slump value. However, the replacement of cement beyond 20% by ash decreases the workability of fresh concrete. The compressive strength of concrete becomes improved and increased when the cement is replaced by fly ash upto 20%. At the curing day of 28th days, the concrete containing 15% and 20% fly ash as cement gained 2.98% and 4.84% of strength, respectively. This study suggests that the partial replacement of cement by fly a sh upto 20% increases the capacity of high strength concrete and fresh concrete's workability.

KeywordsFly Ash, Super Plasticizer, Workability, Compressive Strength.

I. INTRODUCTION

There is growing realization throughout the world that raw materials resources used in the production of cement are finite and non-renewable and need to be conserved for future generations. With the objective of attaining sustainable construction a strong trend f avoring the increased use of admixtures in concrete is emerging throughout the world. The mineral admixtures are basically the wa ste products of industrial processes, produced to the tune of millions of tonnes whose disposal is a great concern. Ash from coal ba sed power plants is one such waste which is abundantly available in the different parts of India. Concrete can serve as the safest ho me of fly ash and has a tremendous potential for its utilization. Fly ash or pulverized fuel ash, an industrial waste of coal based the rmal power plants, consists of finely divided spherical particles of silicate glass modified with aluminum and iron and can be used in concrete due to economic and technical advantages. Incorporation of fly ash results in considerable improvements in concrete pr operties. Fly ash is the most widely used pozzolana in the world.

II. OBJECTIVE

A. To enhance the workability of the mixed concrete.
B. Select a suitable admixture throughout the flow test.
C. To find out the optimum proportion of fly ash on concrete.
D. To determine the contribution of fly ash on normal concrete.
E. To find the max compressive load on the sample concrete cubes.

III. METHODOLOGY

A. Material Used

1) Cement

The cement used was a Ordinary Portland cement grade 43 (manufacturer name: Ultratech) compliant with IS: 8112 - 1989. Table 1 provides the test results for the basic concrete structures.

Table 1 Fundamental Properties of Cement

Properties	Cement
Specific gravity	3.12
Type of Cement	OPC
Grade of Cement	43
Initial Setting Time	230 minutes
Final Setting Time	550 minutes

2) Fine Aggregate

Fine aggregate can be determined as passing through 4.75mm IS sieve and retained on 0.075mm sieve is termed as fine aggregate. Fine aggregates are obtained from river bed.

Table 2 fundamental properties of sand

Properties	Fine aggregate
Specific Gravity	2.60
Water Absorption	1.0

3) Coarse Aggregate

Aggregates are used as a base material beneath the foundations, roads. Different sizes of aggregate used are 10mm, 20mm, 31.5m m, 40mm and other sizes as well. For the project work, aggregates of 20mm size are used. Aggregate used is of good quality and o f angular shape; which provides good interlocking bond.

Table 3 fundamental properties of coarse aggregate

Properties	Coarse aggregate
Specific Gravity	2.95
Water Absorption	0.5

4) Fly Ash

Fly ash is a fine powder that is a byproduct of burning pulverized coal in thermal power plant during production of electricity.

Table 4 fundamental properties of GGBS

Properties	GGBS
Specific gravity	2.13
Material retained on 45 u Sieve (%by mass)	40%

5) Super Plasticizer

It is mainly used for high strength concrete (M_{20} toM_{50}). In this project we use PC-300 superplasticizer is used (Asian paints). The specification is listed in below Table 5.

Table 5 Specification of Super Plasticizer

Name	Maximo plats PC 300
Color	Orange yellow
Specific gravity	1.13
PH	6 - 6.5

6) Water

Potable water was used in current of ingredients are discussed IS: 456 was used.

B. Mix Design of M40 Grade Concrete

The mixed design method was kept as simple as possible with a water cement ratio of 0.36 and cement was replaced by Fly Ash @ 0%, 10%, 15%, and 20% replaced by cement weight.

Table 6 Mix Ratio Obtained For M40 Grade of Concrete of Different % of Fly Ash

FLY ASH (% by weight of cement)	CEMENT	FINE AGGREGATE	COARSE AGGREGATE
0%	1	1.28	2.4
10&	1	1.30	2.87
15%	1	1.37	3.02
20%	1	1.44	3.19

Table 7 Proportion of Fly Ash and Super Plasticizer

Sample	Fly Ash %	Super plasticizer %
S1	10	1.2
S2	15	1
S3	20	0.8

Table 8 Test Required

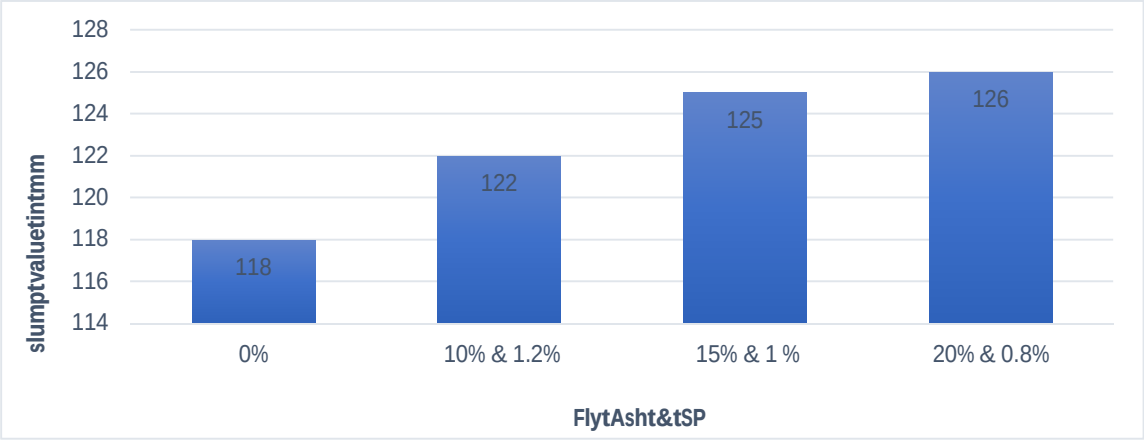
S. No.	Test for material	Test for concrete
1	Sieve analysis	Slump cone test
2	Specific gravity	Compressive strength test
3	Water absorption	-

IV. RESULT AND DISCUSSION

A. Slump Cone Test

It is the workability test, that ease with which we can work with concrete and the following test result obtained in table .

S. No.	Fly Ash (%)	Super plasticizer (%)	Slump value (mm)
1.	0%	0%	118
2.	10%	1.2%	122
3.	15%	1%	125
4.	20%	0.8%	126

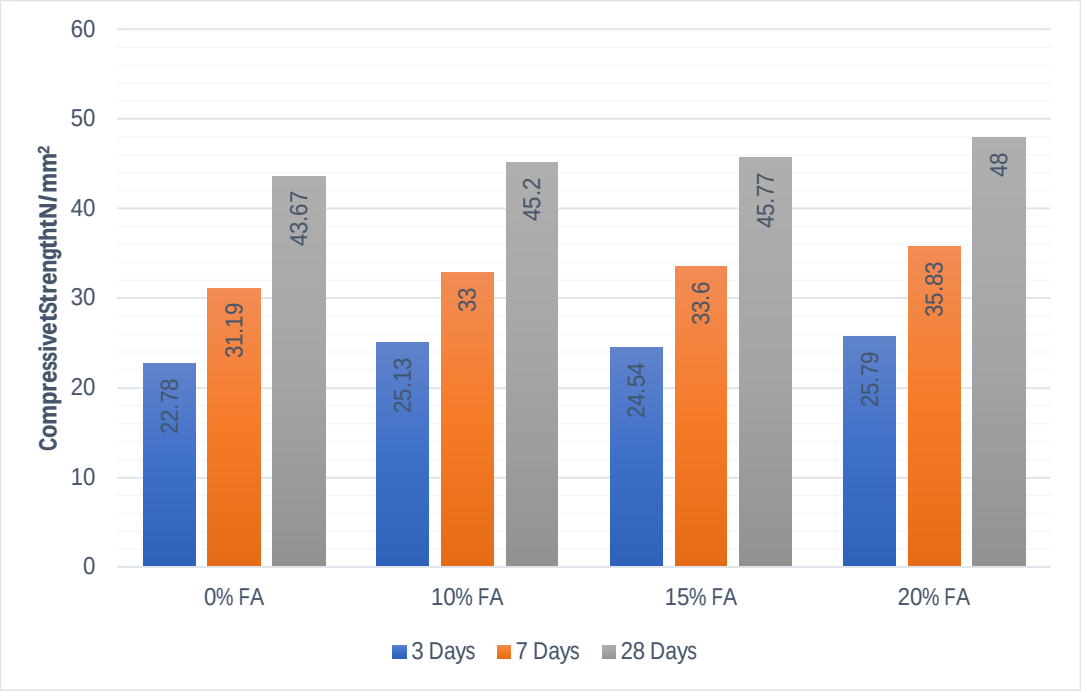


Graph 1: Slump Cone Test

B. Compressive Strength Test

Mechanical test which measures the maximum amount of load in which specimen fail are shown in the table below value in (N/m m^2)

Number Of Cube Sample	Fly Ash (%)	Super Plasticizer (%)	Average Ultimate Compressive Strength Test (N/mm^2)		
			3 Days	7 Days	28 Days
S1	0%	0%	22.78	31.19	43.67
S2	10%	1.2%	25.13	33.00	45.20
S3	15%	1.0%	24.54	33.60	45.77
S4	20%	0.8%	25.79	35.83	48.00



Graph 2: Result of Compressive Strength Test

V. DISCUSSION

The compressive strength results of fly ash and super plasticizer concrete (cubes) where M40 grade of concrete with 10% ,15% an d 20% replacement of fly ash and super plasticizer tested for 3 days ,7 days and 28 days the result are presented. The specimens w ere casted with conventional materials; that is, fine aggregate is natural river sand with M40 grade by using Ordinary Portland Cem ent (OPC 43).

With the increase in age of concrete the compressive strength increases up to 20% replacement of fly ash and plasticizer as a ceme nt. The partial replacement of fly ash and superplasticizer gave a 28 days peak compressive strength at 20% replacement level.

VI. CONCLUSION

From the experimental study it is concluded that the fly ash and super plasticizer can be used as a substitute for cement. It is deter mined that values of compressive strength gradually increase up to 20% replacement of cement by fly ash and super plasticizer giv e good result in strength than normal concrete for M40.

The result possess that 20% replacement of cement by the fly ash and super plasticizer induced higher compressive strength. Thus t he environment effects and waste can be significantly reduce.

Fly ash and superplasticizer as a material is very much similar to cement in physical properties and is very cheaply available.

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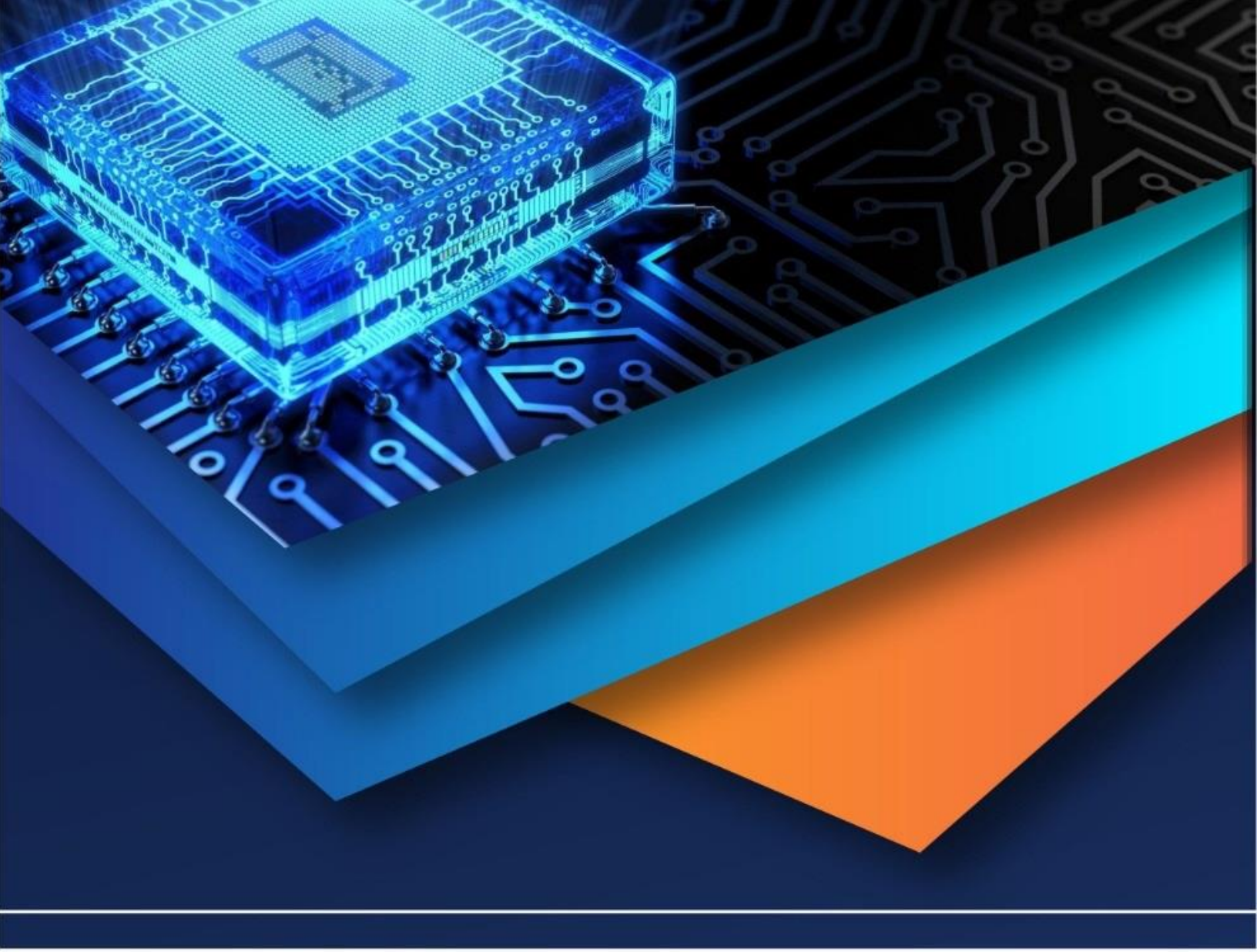

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