Experimental Study on Mechanical Properties of Concrete Using Mineral Admixtures

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***Abstract*- This paper illustrates admixtures advantages such as fly ash, silica fume and granulated blast furnace slag in concrete as it influence the properties of it. The properties such as compression, split tensile and flexural strength which are of mechanical for the specimens of different grades are obtained. The specimens are of M35 grade which includes fly ash are in proportions 5%, 10% and 15%, silica fume of 5%,10% and 15% together as the replacement of cement and granulated blast furnace slag of 5%, 10% and 15% as the small replacement of filler material which is fine aggregate. The water cement ratio by trials is kept as 0.45 for all proportions. The ground granulated blast furnace sand improves the compactness and slows the chemical activity. The use of different admixtures in concrete gives a high performance in concrete construction. The mechanical properties such as compression, split tensile strength and flexural strength are determined on 28 day.**

***Index terms*- Silica Fume, Fly Ash, GGBS, high performance concrete**

I.INTRODUCTION

The material which is simple and complex with more advantageous and economical is concrete. Except cement other natural materials varies in quality, performance and properties. Concrete are used in different conditions were ordinary conventional concrete does not exhibit the durability and performance properties. In such cases admixtures are used to make it more suitable. These admixtures impart economy and desired characteristics. The recent trend of high performance concrete is a heterogeneous material reduces the water cement ratio thereby increasing the slump value which results in high strength. The mineral admixtures improve the strength and durability of concrete. High performance concrete provides all enhanced properties in precast members for all types of constructions. The concrete which is of high performance usually contains both filler and chemical admixtures. Therefore, hydration rate of cement and the development of strength in HPC is quite varying from that of ordinary conventional concrete. Silica fume strengthens the transition zone whereas fly ash and GGBS are used nominal benefit of others. The two main folds, first is to produce concrete using alternate materials and secondly, to reduce the emission of carbon di oxide emission in concrete. This project work study deal with mechanical properties of these materials in the concrete construction.

METHODOLOGY AND MATERIALS USED

To experiment the effect of fly ash, silica fume and GGBS the experimental work was done. The characteristic compression strength property of High Performance concrete is determined by the combinations given in the Table listed below. Fly ash and silica fume are done by replacement the cement in percentage of 5%, 10%, 15% each. Whereas GGBS is replaced by fine aggregate in 5%, 10% and 15%.

II.FLY ASH

The disposal of ashes from different materials has become thoughtful problem. Hence for the economical and conservation of cement in this project Fly ash of class type F is used which is produced by burning bituminous coal. This type of fly ash has less than 5% Calcium oxide. The fly ash shall confirm the chemical requirements in accordance to IS: 1727-1967. The composition of fly ash in chemical proportions are Tabulated below.

III.SILICA FUME AS ADMIXTURE

Silica fume is considered as artificial pozzolanic admixture. This is the backbone of High Performance Concrete in addition with super plasticizers and hence it is essential. Silica fume is covered under IS: 15388:2003 and has confirmed the following It has both cementious and pozzolanic properties. The composition of silica fume are listed in the below table.

IV. GRANULATED BLAST FURNACE SLAG (GBFS) ADMIXTURE

GGBS is the by-product obtained from iron and steel. GGBS has cementious properties for optimum cement content and high water cement ratio. It is generally used as both of fine aggregate and cement replacement to restrict the surplus amount of using river sand in construction. Its physical properties are listed in table below.

V. M SAND

M sand is the artificial sand obtained from crushing rocks or quarry stone. It is economical and eco-friendly which does not contain silt. The strength on compression and strength on flexure are higher than natural sand. Manufactured sand is falling under Zone II grading as specified by IS 383-1930.

VI. COARSE AGGREGATE

The determined use of aggregate size is generally limited to20mm. The aggregates used should be of even quality with respect to shape and grading. The aggregates used in concrete should confirm IS 2386-1963.

VII. CEMENT

Ordinary Portland cement is the type of cement most important which is generally use for all types of construction work. For high performance concrete grade43 or 53 are used. The grade of OPC53 grade used and is governed by IS 269-1987. The physical and chemical properties are illustrated in the Table4.

VII. WATER

Water confirming to the code IS 456-2000 specifications was used.

PROPERTIES- PHYSICAL	
Specific gravity value by test	2.01
Class	F
CONFORMATION IN CHEMICAL FORM	
SiO_2	33.3
Al_2O_3	26.3
Fe_2O_3	4.6
CaO	0.56
MgO	0.35

TABLE 1. PROPERTIES OF FLY ASH

VIII. SUPER PLASTISIZER

Sulphonated Naphthalene formaldehyde of 1% is used for all types of mix proportions.

TABLE 2. PROPERTIES OF SILICA FUME

PROPERTY- PHYSICAL	
Specific gravity value	2.2
CHEMICAL ARRANGEMENT	
SiO_2	90%
Al_2O_3	0.68%
Fe_2O_3	0.35%
CaO	0.2%
MgO	0.61%

TABLE 3. PROPERTIES OF GGBS

PROPERTY-PHYSICAL	
Specific gravity	2.88
CHEMICAL ARRANGEMENT	
SiO_2	32.5%
Al_2O_3	37.65%
Fe_2O_3	7.82%
CaO	0.56%
MgO	0.11%

TABLE 4. PROPERTIES OF CEMENT

PROPERTY-PHYSICAL	
Value of Specific gravity	2.93
Initial setting time result	32
Final setting time result	603
CHEMICAL ARRANGEMENT	
SiO_2	19.78%
Al_2O_3	3.44%
Fe_2O_3	2.6%
CaO	63.7%
MgO	3.6%

EXPERIMENTAL INVESTIGATION

WORKABILITY

Workability of fresh concrete shall be determined by test performed on slump cone. The apparatus slump cone is the most normally used way of computing stability of concrete as per IS 7320-1974. It consists of a big funnel of height 300mm, bottom width 200mm and top width 100mm. The mould is placed on the clean and smooth surface. The conical mould is filled with concrete in layers and each of its layer is stuffed 25 times using the tamping rod. After substantial of top layer, the concrete is levelled. The cast is then removed slowly by levitating it carefully. The difference in the levels amid the height of the mould and that of the maximum point is measured. The difference in the heights dignified is the slump value of the concrete. The slump readings for different quantities of concrete are listed below.

MIX PROPORTION	*SLUMP VALUE*
M1	100
M2	110
M3	125
M4	135

TABLE 5. BASIC TESTS OF AGGREGATES

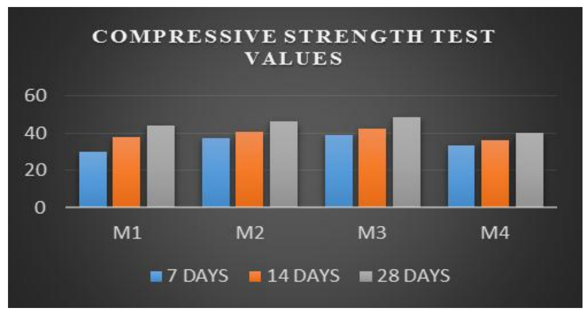
PROPERTY	*FINE AGGREGATE*	*COARSE AGGREGATE*
Fineness modulus value by test	3.01	4.02
Determined Specific gravity	3.61	2.7
Water absorption (%)	0.86	1.12

CASTING OF CUBES AND TESTING OF SPECIMENS PROCEDURE

1. Samples of concrete mixes are taken and used for casting cubes of 150 × 150 × 150 mm, cylinder of 300x150mm beam of 150x150x700mm.
2. The concrete shall be occupied in layers and is compressed. The top layer is levelled by using trowel without any extras and air gaps..
3. The specimen is tested after the removal from water afterwards 7th day, 14th day and 28th day.
4. The test such as compressive, split tensile and flexural strength are conducted. The maximum load for the specimen is recorded.

MIX PROPORTION	*FLY ASH IN % OF CEMENT*	*SILICA FUME IN % OF CEMENT*	*CGBS BY % OF F.A*	*ON 7 DAYS STRENGTH (MPA)*	*ON 14 DAYS STRENGTH VALUE (MPA)*	*ON 28 DAYS STRENGTH VALUE (MPA)*
M1	0%	0%	0%	30.07	38	44
M2	5%	5%	5%	37.3	40.7	46.22
M3	10%	10%	10%	38.8	42.15	48.74
M4	15%	15%	15%	33.24	36.18	40.29

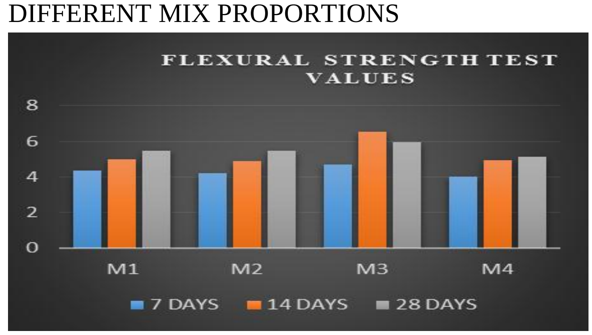
TABLE 6. COMPRESSIVE STRENGTH OF CONCRETE FOR



GRAPH 1 REPRESENTS THE COMPRESSION STRENGTH RESULTS BY TEST

PROPORTION	*FLY ASH BY % OF CEMENT*	*SILICA FUME BY % OF CEMENT*	*CGBS BY % OF F.A*	*STRENGTH OF FLEXURE IN N/MM²*		
				ON 7 DAYS	*ON 14 DAYS*	*ON 28 DAYS*
M1	0%	0%	0%	4.34	4.98	5.49
M2	5%	5%	5%	4.23	4.91	5.46
M3	10%	10%	10%	4.69	6.52	5.92
M4	15%	15%	15%	4.01	4.92	5.15

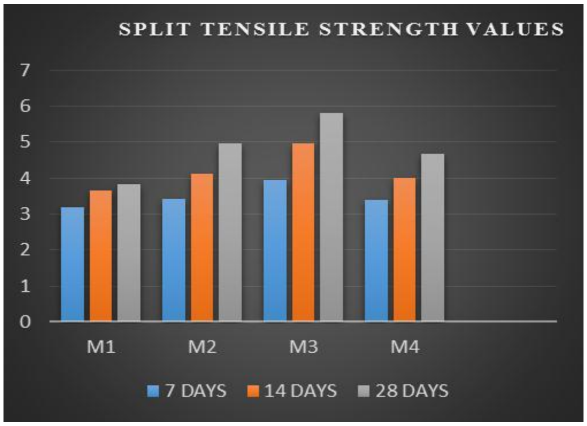
TABLE 7.FLERURALSTRENGTH VALUES FOR DIFFERENT MIX PROPORTIONS



GRAPH 2 REPRESENTS THE FLEXURAL STRENGTH RESULTS BY TEST

PROPORTION	*FLY ASH BY % OF CEMENT*	*SILICA FUME BY % OF CEMENT*	*CGBS BY % OF F.A*	*TENSILE STRENGTH IN N/MM^2*		
				ON 7 DAYS	*ON 14 DAYS*	*ON 28 DAYS*
M1	0%	0%	0%	3.18	3.65	3.82
M2	5%	5%	5%	4.13	4.13	4.97
M3	10%	10%	10 %	4.97	4.97	5.8
M4	15%	15%	15 %	4.02	4.02	4.69

TABLE 8.SPLIT TENSILE STRENGTH FOR DIFFERENT MIX PROPORTIONS



GRAPH 3 REPRESENTS THE SPLIT TENSILE RESULTS BY TEST

IX. CONCLUSIONS

From the above experimental study of this project the following conclusions are made.

1. It is effective to practise silica fume, fly ash and GGBS at the range of 10% each gives higher compression, tensile and flexural strength and gives more workability and quality on fresh concrete.
2. Above 10% of each admixture gives decrease in values and gives good binding properties.
3. It gives more increase in strength wise when related to conventional concrete.

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