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Experimental Examination on Blended Concrete by Incorporating Fly ash and Silica Fume

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Abstract: ***Now days, concrete mixture contains additional cementitious material which imparts additional strength. The admixtures and pozzolanic materials are produced large tons from the fast growth of industries, which is used for this material such as Fly ash, Silica fume, GGBS, copper slag, etc. By using these types of materials improve the concrete dressed in fresh and hardened states. In this present work different tests are held to have tentative results for comparison of conventional concrete including various possessions of concrete mixes developed by using OPC 53 grade cement. These mixes are improved by replacing 5%, 8%, and 10% Silica Fume. After best results of Silica Fume, it is intermingled with Fly Ash with 10%, 22%, 10%, by varying the cement content to 75%, 70%, and 80% in terms of volume. Properties like compressive, split tensile and bending strength are studied for 7, 28 and 56 days.***

Keyword: GGBS, OPC 53.

I. INTRODUCTION

Oridinary Portland Cement is used as binder material for constructing Buildings. Now a days many people are engrossed on the usage of different waste materials having Cementous properties which can be partially replaceable in cement, without negotiating its strength. Pozzolanic admixtures like Fly Ash, Silica Fume having cementitious properties can be partially replaceable in cement. The optimistic outcomes of such materials used in concrete increases demand for cementitious materials. Blended (unified) concrete prepared by using Fly Ash and Silica Fume at proportions able to produce concrete with acceptable strength and thereby we can Perimeter the use of cement, Without Conceding strength.B. Muhit et al., (2013) partial replacement of Fly Ash and Silica Fume can affect water porousness and high concrete strength.

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S.Suresh Sankaranarayannanl et al., c comparison between fly ash concrete of high strength by using nano silica fume on various mixes. K. R. S Maruthi Raj et al., (2017) cement is totally replaced by Fly Ash and Silica Fume. The author observed mechanical properties of concrete. S. Sundararaman et al., (2016) cement is partially replaced by Fly Ash and Silica Fume. It was observed that optimum value is 10% for Silica Fume and 50% for Fly Ash which gives the better results in both Compressive and Split tensile strength of concrete. Osama Ahmed Mohamed et al., (2017) strength and stability of sustainable self-consolidating concrete containing fly ash, silica fume, and GGBS. Sadaqat UUah Khan et al., (2013) studied about durability of concrete with different mineral admixtures. Anilkumar et al., (2014) studied about durability characterstics of concrete using Fly Ash and Silica Fume. V. Prakash et al., (2018) cement is partially replaced by Silica Fume and Fly Ash in Pervious Concrete. L. Lam et a., (2017) effects on compressive and fracture behaviour of concrete due to usage of Silica Fume, Fly Ash. Kovler et al (2000) Enveloped a standard relationship between the compressive strength of HPC. Water-binder ratio, silica fume concentration and the concrete age. It was observed that compressive strength showed the maximum at Silica Fume replacement in cement.

Sakthieswaran N et al., (2013) Flexural Performance of Concrete Beams Including Fly Ash, Silica Fume, Copper Slag, and Fibres. Jayaranjini et al., (2017) Flexural Behaviour of HPC Beams Using Industrial by-products. Krishna et al., (2017) did research on study on compressive strength of Fly Ash concrete. Rao and Rao (2017) worked on effect on mechanical properties of M30 and M60 grade concrete using Fly Ash. Daya Rani B and Kameswara Rao (2019) done research on B.Service life prediction of high-performance concrete with respect to chloride ion penetration incorporated by Silica Fume and Fly Ash. Priya N.Y.S and Kameswara Rao (2019), worked on Accelerated method of mix design for concrete by using GGBS and silica fume. Nikitha P and Kameswara Rao (2019) done Accelerated method of concrete mix proportioning by incorporating Fly Ash and Silica Fume.

II. EXPERIMENTAL WORKS

Materials used:

Binding materials: In this present work Silica Fume and Fly Ash are partially replaced in cement are shown in Fig: 1.

Physical properties of all binding materials are shown in Table: 1.

Cement- Argillaceous and calcareous material is grinded and mixed to form clinker at high temperature. Gypsum is added to clinker to obtain an inorganic material called cement. The properties of cement as mentioned below.

Silica fume is a byproduct of Silicon or Ferrosilicon metal, from thermal plants.

Silica fume is used in variability of cementitious concrete and polymer applications. Silica fume is also well-known as pyrogenic silica.

Fly Ash is a mix of different materials which is produced from heating of coal form power stations. Fly ash contains different materials like lime and other Cementous materials. The fly ash we used type C in that the Cao percent is 10% higher.

Silica Fume Fly Ash

Fig:1 Mineral Admixtures

Table 1 physical properties of binding materials

Properties	Cement	Silica Fume	Fly Ash
Specific gravity	3.15	2.2	2.2
Bulk Density (Kg/m3)	1865	750-850	540-860
Shape	Spherical	Irregular	Spherical
Average particle size	1.5μ	0.1μm	0.5μm-300μm

Fine aggregates. The sand which we utilized for our project is river sand. Aggregate is relatively containing some clay content we use filtered process to separate clay and fine sand. The fraction we used 4.75 mm to 150 μm.

Coarse aggregates. Range of course aggregate is used from 20mm to 4.75mm are used in our project. The sources of aggregate are crushed from basalt rock can be use according to IS:383 are used. The elongation and flakiness index are below less than 15%. Physical properties of aggregates of both fine aggregates and coarse aggregates are shown in Table: 2.

Table 2: Physical properties of aggregates

Physical property	Fine aggregate	Coarse aggregates
Shape	Irregular	Angular
Size	4.75	10-20
Specific gravity	2.65	2.24
Fineness modulus	3.18	6.7
Bulk density	1.683 g/cc	1800
Water absorption	1.07	0.71
Surface Moisture	0.1%	0.5%
Silt Content	5.65%	--

Chemical Admixture: Concrete containing Rheobuild 1000 admixture could maintain a rheoplastic state. The workability required when slump value ranges from 200-280mm value. The admixture we are using cannot be precise be contingent temperature, the cement we use, mix proportion and aggregate nature.

Mix Design:

After all the material testing the concrete mix is designed as per Indian standards for different mix proportions. All the mix proportions are shown in Table.3.

Table 3 Mix proportions

Proportions	Cement (%)	Silica Fume (%)	Fly Ash (%)
C	100	0	0
M1	80	10	10
M2	75	15	10
M3	70	8	22

The mix quintiles are calculated for one m^3. All the quintiles for all mix proportions are presented in Table.4.

Table.4 Quantities

Material	C	M1	M2	M3
Cement	394	325.5	346.72	303.38
Coarse Aggregate	1255.57	1237.53	1243.04	1237.31
Fine Aggregate	706.26	672.24	675.23	673.2
Fly Ash	0	65.01	65.01	95.34
Silica Fume	0	43.34	21.67	34.67
Water	157.7	157.6	157.6	157.6
Super Plasticizer	2.364	2.6	2.6	2.6

Casting and testing of specimens.

The specimens are casted as standard dimensions for all strength studies like Compressive (150 x 150 x 150 mm – cube) , Split tensile (150 mm dia and 300 mm long cylinder), bending strength (500 x 100 x 100 mm – Prisms) are caste and cured in portable water. After curing the specimens are tested under compression. The loading conditions are shown in Fig: 2.

Results and Discussion

Compression strength Cubes are tested for compressive strength in compressive testing machine. The cubes strength is gradually increased from 20% - 25% of fly ash and silica fume replacement. The optimum forte obtained at the additional of 10% silica fume and 15% of fly ash. Specimens were cured for 7, 28, 56 days. The outcome gained are displayed in beneath table. Fig.2 shows Mix ID's along X-axis and Strength along Y-axis.

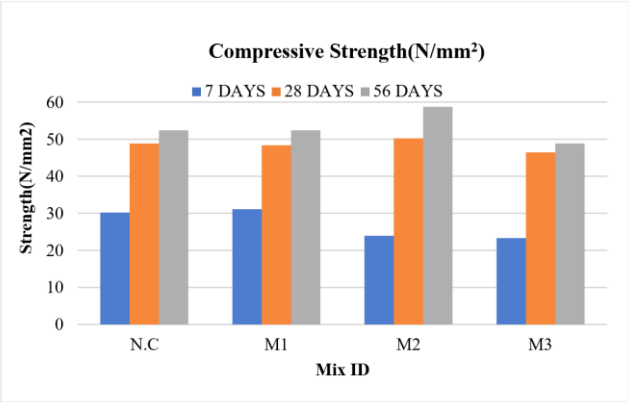

Fig: 2 Compressive strength

Split Tensile strength Cylinders which are casted, tested in compression testing machine. The experimental results increased since M1 to M2 and gradually decreased from M2 to M3. So, the optimum value was M2 in split tensile test. Later On specimens are cured for 7, 28, 56 days. Results gained are shown in below table. Fig.3 shows Mix ID's along X-axis and Split tensile strength along Y-axis.

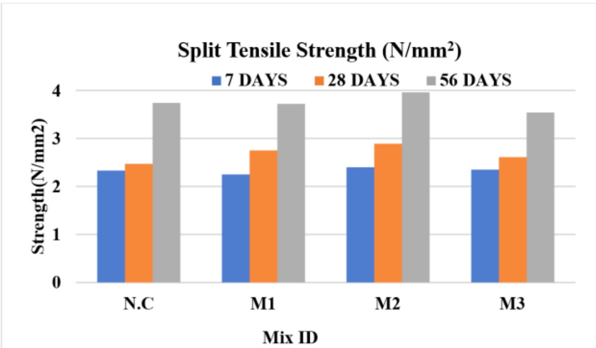

Fig: 3 Split Tensile strength

Bending strength The bending strength is gradually increased from 20% to 25% of Silica Fume and Fly Ash is replaced. The optimum strength obtained by the auxiliary of 10% of Silica Fume and 15% of Fly Ash (i.e. 25% of cement replacement). The outcomes attained are shown in Fig:4

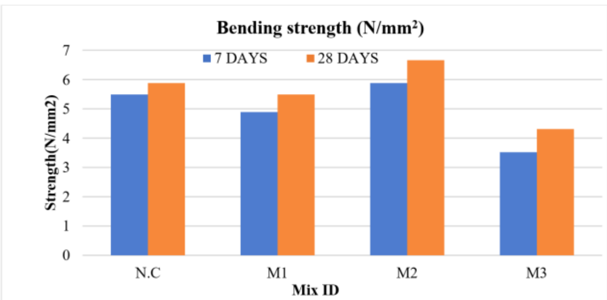

Fig: 4 Bending Strength

III. CONCLUSION

The following conclusion was obtained by the addition of Fly Ash and Silica Fume in cement by partial replacement.

- ✓ The addition of Fly Ash and Silica Fume has improved workability of concrete.
- ✓ The combination of optimum compressive strength of 2nd proportion of having 75% cement, 15% Fly Ash and 10% Silica Fume provides maximum compressive value.
- ✓ Split tensile strength reaches its maximum value when cement is exchanged with 10% of Silica Fume and 15% Fly Ash.
- ✓ The bending strength of composite beam is more than the conventional beam comparatively.
- ✓ The preliminary strength expansion is slow in concrete comprising Fly Ash but if curing is continued upto 28 days strength become comparable to that OPC concrete.

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