Strength Properties of HVFA Concrete by using Fly Ash and Silica Fume

R. Venkata Krishnaiah, P. Dayakar, K. Venkatraman

Abstract**: *Concrete is the most generally utilized development material on the planet. Fly Ash use is a worldwide intuition as its expansion to bond solid supplements for strong concrete. At that point the high volume fly debris has been utilized in numerous elevated structures, modern structures, water text style structures, solid streets and moved compacted solid dams. Expansion of silica smoke and Super plasticizer to high volume fly debris solid found to expand the quality properties. Fly debris improves the nature of solid, prompting the expanded assistance life of solid structures. Cements having a lot of fly debris (generally from half) are named as high-volume fly debris (HVFA) concrete. Silica smolder, which is seen as more receptive than the fly debris and it fundamentally, improves the quality of cement. In the present examination, an endeavor is made to contemplate the impact of compressive quality of high volume fly debris concrete with differing extent of silica smoke and fly debris. Concrete is supplanted by fly debris and silica rage 50 to 80% and 0 to 15% by weight individually. The compressive quality advancement of silica smolder altered high-volume fly debris blends drenched in water up to 7 to 45 days is accounted for. As the water content is low in high volume fly debris concrete, the draining is low and regularly insignificant. Setting time is minimal longer than that of traditional cement. This is a result of low concrete substance, low pace of response and high substance of super plasticizer. The examination uncovered that by keeping up a consistent measurements of superior super plasticizer alongside fly debris and silica seethe, it is conceivable to keep up an ideal droop esteem for example functionality, along these lines fulfilling the vast majority of the cutting edge basic applications. Additionally the confined impact of silica seethe on the high volume fly debris concrete with a water bond proportion of 0.40 as been examined. The outcomes show that there is a momentous increment in the compressive quality of cement on substitution of bond by silica smoke and fly debris and furthermore acquired 10% substitution of silica seethe by bond on high volume fly debris solid invigorates higher compressive in the present examination.***

Keywords—Cement, Compressive strength, Fly ash, High volume fly ash concrete, Silica fume, Super plasticizer.

I. INTRODUCTION

The high volume fly debris (HVFA) concrete has gotten extremely well known in India during the most recent couple of decades because of different reasons, for example, to limit utilization of Ordinary Portland Cement required delivering excellent cement for various sorts of uses, execution, cost and practicability [1-5]. HVFA concrete is one of the answers for wipe out the natural corruptions being brought about by bond industry. Concrete having huge measure of fly debris (FA) (generally from half of the absolute cover material) is named as HVFA. It has been utilized in numerous elevated structures, mechanical structures, water front structures, solid burdens and roller compacted solid dams [6,7]. FA is one of the mechanical results delivered liberally all through the world. The physical properties of a FA add to progress of solid quality. Usefulness of cement is improved with the expansion of debris in light of the expanded in glue content, increment in the measure of fines, and the round state of the FA particles. The utilization of FA may hinder the setting of cement. FA concrete is less penetrable on the grounds that FA diminishes the measure of water expected to deliver a given droop. The principle commitment of the silica flume (SF) to the quality improvement in solidified cement at ordinary restoring temperatures happens from around 3 days onwards. At 28 days the quality of SF concrete is constantly higher than the quality of the practically identical Portland bond concrete. As the extent of SF builds, the usefulness of solid reductions in any case its momentary mechanical property, for example, 28-day compressive quality improves [8-11].

II. MATERIALS AND METHODS

This study comprises of both preliminary and experimental, these are presented as follows:

In the preliminary investigation, both the physical and chemical properties of micro silica or silica fume, fly ash and cement were determined for checking the suitability of these materials to use as construction materials in concrete. The present examination is an exertion towards forming a superior knowledge into the impact of compressive quality on changing extent of fly debris and silica smolder concrete with a water cementitious material proportion of 0.40 and silica smoke and fly debris substitution rates of 0, 5, 10, 15% and 50, 60, 70, 80% individually by weight of absolute folio with water diminishing admixtures for optimizing its impact on concrete [12-15]. The samples are casted for standard size of 150mm x 150mm x 150 mm for 7, 28 and multi day's compressive quality. Likewise examples are tried for non-damaging tests to discover compressive quality attributes, respectively by weight of total binder with water reducing admixtures for opmizing its effect on concrete. The specimen is casted for standard size of cubes 150mm x 150mm x 150 mm for 7, 28 and 45 day's compressive strength. Also specimens are tested for non-destructive tests to find out compressive strength characteristics [16-18].

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A. Experimental Investigations

Cement: The binder is a OPC and suitable to codal provisions.

Silica Fume (SF): A high quality very active SF supplied by Elkem India Pvt Limited was used for the present study.

Fly Ash (FA): A siliceous FA conforming to IS: 3812 (2003) Part – I from Ennore Thermal Power Plant, Chennai was used.

Fine and Coarse Aggregate: Natural sand confirming to codal provisions of 3rd zone and the maximum size is limited to 12.5mm

H2o and Chemical Admixture: Potable water and Conplast SP-430 was used [19, 20].

III. RESULT AND DISCUSSION

Compressive strength tests are conducted on samples of 150 mm x 150 mm x 150 mm at 7, 28 and 45 days of curing periods and these values have been presented in table.3. The table depicts the compressive strengths at different SF (0, 5, 10 and 15% by weight of cement) and FA at 50, 60, 70, and 80% replacements with H2o/binder ratio of 0.40. The compressive strength increases with increase of curing period when cement replaced with 50% FA and SF of 0 to 15% than cement replaced with 60 to 80% FA and SF of 0 to 15% by its weight [21-24].

In other hand, when cement is replaced with SF of percentage 0 to 15% with FA replacement of 50 to 80%, 10% replacement of SF gives higher compressive strength than 0, 5 and 15% SF. For FA of 50 to 80% with SF 0 to 15%, rebound number trends to increases continuously i.e. at initial replacements of FA and SF, rebound number decreases. In general, it is observed that at 10% SF replacement with FA 50 to 80%, rebound value increases. Higher Rebound value indicates the good quality concrete and confirmed to codal provisions. Increasing trends of silica fume shown higher USPV value, where fly ash kept constant for each silica fume percentages. Ultra Sonic Pulse Velocity values were tabulated in table. 4 and the higher and lower values were observed as 4.0 and 2.9km/sec at 0.40 H2o/binder ratio. Compressive strength graphs were presented in figure 1 to 5.

Table 1: Physical and Chemical Properties of Materials

Properties	Cement	Fly Ash	Silica Fume
G for binder	3.15	2.09	2.2
Std Con (%)	34	-	-
$T_{Initial}$ (Minutes)	240	-	-
T_{Final} (Minutes)	300	-	-
Status	-	Powder form	Powder form
Type of FA	-	TypeF	-
Chemical Composition (%)			
SiO_2	25.02	60.78	88.7
Al_2O_3	6.26	24.67	0.4-0.5
Fe_2O_3	1.24	6.76	0.3-0.6
MgO	2.28	0.99	0.6-1.2

Table 2: Physical and Mechanical Characteristics of Aggregates Used

Particulars	Coarse Aggregate	Fine Aggregate
G for Aggregate	2.7	2.6
Water Absorption (%)	1.17	0.6
Unit weight (t/m3)	1.63	1.61
Los Angeles Abrasion value (%)	27	-
Elongation index (%)	18	-
Flakiness Index (%)	30	-

Table 3: Compressive Strength Results

Fly ash	SF(%)	Comp. Strength (Mpa)		
		7 Days	28 Days	45 Days
50	0	19.0	25.0	27.5
60	0	15.5	22.5	23.5
70	0	11.0	14.5	16.0
80	0	7.5	9.0	12.5
50	5	24	30.5	31.0
60	5	18.5	26.0	26.0
70	5	12.5	17.0	23.5
80	5	8.5	10.5	11.5
50	10	26.0	34.0	37.0
60	10	19.5	29.0	30.5
70	10	13.5	18.5	25.0
80	10	9.5	13.0	15.0
50	15	21.0	32.0	32.0
60	15	16.5	24.5	27.0
70	15	11.5	16.0	22.0
80	15	8.0	11.5	13.0

Table 4: Rebound Hammer Number and UPV values obtained at curing of 28 Days

RHN (N)	UPV(km/sec)
34	3.7
35	4.0
42	4.4
39	4.2
36	3.5
37	3.8
38	3.9
36	3.6
38	3.3
35	3.4
36	3.5
30	3.6
23	2.9
25	3.1
26	3.4
24	3.2

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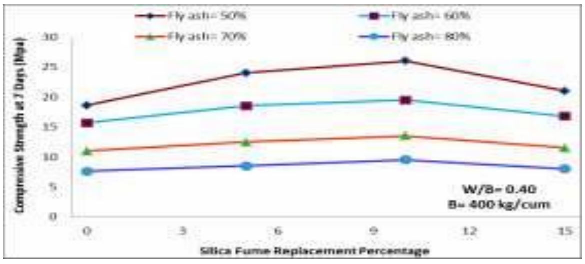

Fig.1: Relationship between strength at 7 days of different Proportions of SF.

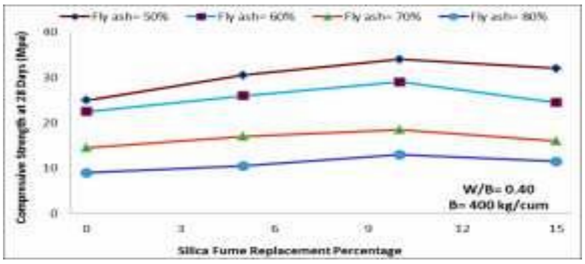

Fig.2: Relationship between strength at 28 of different Proportions of SF.

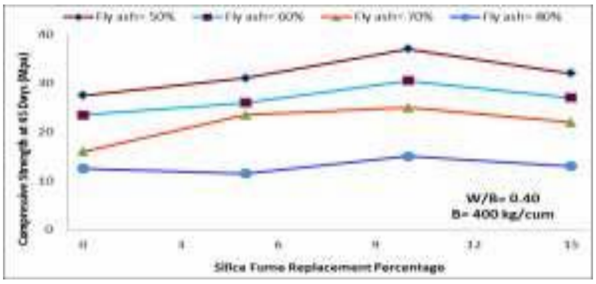

Fig.3: Relationship between strength at 45 of different Proportions of SF.

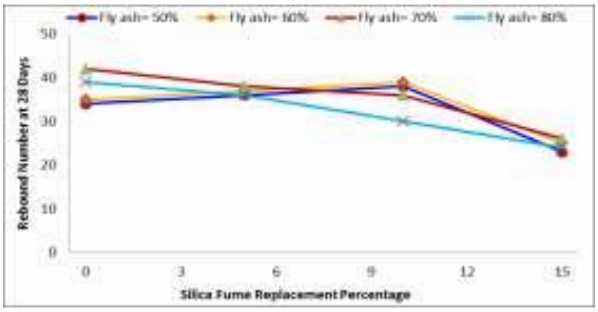

Fig.4: Relationships between RHN and of different Proportions of SF

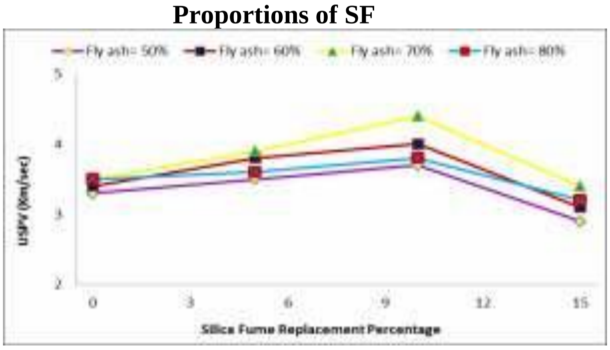

Fig.5: Relationship between UPV and of different Proportions of SF

IV. CONCLUSION

- The strength of concrete generally decreases due to addition of FA, while presence of SF in concrete increases the strength. In the present investigation cement is replaced by high volume FA as well as SF. So that of concrete cube strength is increased up to some level of SF and FA percentages.
- Substitution of binder by FA and SF in various extents has come about impressive variety in the properties like cohesiveness, workability of the blend, isolation and bleeding of concrete.
- It was also observed that cement replaced by silica fume and fly ash, gives higher strength at 50% fly ash and 10% silica fume.
- With the addition of 10% SF is considered as the best which gives highest compressive strength.
- Generally adding of FA to the concrete decreases the workability while subsequent addition of silica fume increases the workability and strength characteristics. In present studies, both were used in concrete, so that workability is increased to an acceptable limit.
- As the percentage of SF increases rebound hammer number values are increasing. However at the level of 15%, the rebound hammer number values decreases marginally, which indicates that strength is reducing.
- As SF content is increased, UPV values increases up to 10% of SF addition. But at 15% of SF, the corresponding UPV values are decreasing, which indicates that strength is reducing.
- For the replacement of 10% of SF with 50% of FA, the strength at 28 days of curing was 34 Mpa, where as the strength at 7 days and 45 days were 26 Mpa and 37 Mpa respectively.

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