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EXPERMENT STUDIES ON DOUBLE BLENDED CONCRETE USING FLY ASH AND SILICA FUME

B.Kalpana[1], M. Achyutha Kumar Reddy[2], Raghava Rani [3]

PG student [1, 2]
Head of the Department [3]
Department of Civil Engineering
Vardhaman College of Engineering
Hyderabad

ABSTRACT:
In concrete the price of cement is higher than other raw materials of concrete. The population is keep on increasing but raw materials for making of concrete is not increasing. Present population is enough to get the corresponding raw materials but, the availability of resources are actually reducing by great extent. This major problem can be solved by replacing the material to some extent with the advanced or by making the properties alterations to the conventional concrete. By using supplementary cementations materials (SCMs) like fly ash (FA), silica fume, we can reduce the cement content and construction costs. Out of a total of about 90 coal-based thermal power stations in the country producing fly ash, an increasing number (presently about 30) has already developed dry mode of collection of fly ash, resulting in the avail- ability of better quality fly ash with better consistency of product than ever before in the country. This study investigated strength characteristics strength properties of silica fume and flu ash concrete The main objective of present project work is to find the compressive strength and split tensile strength of concrete flexural strength. High performance concrete a set of different concrete mixture were cast and tested with different cement replacement levels of fly ash and silica fume as addition by wt of cement. This study has shown that between 15 to 23% replacement levels, concrete will develop strength sufficient for construction purpose. Its use will lead to reduction in cement quantity required for construction purpose and hence sustainability in the construction industry as well as aid economic construction.

KEY WORDS- Durability, Fly ash, Silica fume, High performance Concrete, Water absorption.

INTRODUCTION:

Concrete is the mixture of cement, fine aggregate, coarse aggregate and water. Concrete is the non-homogeneous construction material is being used for the constructions of various projects as the major construction material by which the design criterions are satisfied. In concrete the price of cement is higher than other raw materials of concrete

Industrial wastes, such as silica fume, blast furnace slag, fly ash are being used as supplementary cement replacement materials and recently, agricultural wastes are also used as pozzolanic materials in concrete. High performance concrete a set of 7 different concrete mixture were cast and tested with different cement replacement levels (0%, 2.5%, 5% ,7.5% ,10%, 12.5% and 15%) of Silica fume (SF) with Fly ash (FA) as addition (0%, 5%, 10%, 15%, 25 and 30%) by wt of cement and /or each trial super plasticizer has been added at constant values to achieve a constant range of slump for desired work ability with a constant water – binded (w/b) ratio of 0.40. Specimens were produced and cured in a curing tank for 3, 7, 14 and 28 days. The cubes were subjected to compressive strength tests after density determination at 3, 7, 14, 28 days respectively. The chemical composition and physical composition of micro silica, fly ash and cement were determined. The density of the concrete decreased with increased in percentages of micro silica, fly ash and cement. This study has shown that between 15 to 30 % replacement levels, concrete will develop strength sufficient for construction

purpose and hence sustainability in the construction industry as well as economic construction.

EXPERIMENTAL WORK:

This work primarily deals with the strength characteristics such as compressive, split tensile and flexural strength. High performance concrete a set of 7 different concrete mixture were cast and tested with different cement replacement levels (0%, 2.5%, 5% ,7.5% ,10%, 12.5% and 15%) of Silica fume (SF) with Fly ash (FA) as addition (0%, 5%, 10%, 15%, 25 and 30%) by wt of cement and /or each trial super plasticizer has been added at constant values to achieve a constant range of slump for desired work ability with a constant water – binded (w/b) ratio of 0.40. Specimens were produced and cured in a curing tank for 3, 7, 14 and 28 days. The program consists of costing and testing of standard size of cubes. The specimen of standard cubes (150 x 150 x 150 mm), cylinders (150mm diameter 300 mm height), and prism (100x100x500mm) was casted for compression, split tensile strength. The specimens were casted with M60 grade concrete with different replacement levels of cement.

CEMENT:

Ordinary Portl and cement (OPC) conforming to Indian standard code IS 8112-1995 and fly ash as per IS4031 (part-II) 1999 was used.

AGGREGATES:

In this present study used sand confirming zone -11 of fine aggregate of specific gravity 2.75 and water absorption 0.8% and fineness moulds 2.75 coarse aggregate used with maximum size of 20mm and specific gravity 2.74 and water absorption 0.04% and fineness modulus 4.01.

SILICA FUME:

The silica fume obtained from the ELKEM Pvt Ltd, Bombay confirming to ASTM C1240 was used.

FLY ASH:

For this present study we have used fly ash of class C procured from thermal power station, Vijayawada. Physical &chemical properties of fly ash as per ASTMC -99d for this study.

FRESH PROPERTIES OF HPC:

Slump flow, compaction factor test and flow table test were performed in the laboratory to find workability.

COMPRESSIVE STRENGTH OF HPC:

Compressive strength combination of SF and FA blended cement HPC cube was determined as IS 9013-1997 after 7 28 days of moisture curing.

SPLITTING TENSILE STRENGTH OF HPC:

Splitting tensile strength test was conducted on combination of SF and FA blended HPC cylinder as per IS 5816-1999 after 28days of moisture curing.

FLEXURAL STRENGTH OF HPC:

Flexural strength test was conducted on combination of SF and FA blended HPC prism of size 100mm x 100mm x 500mm were tested as per IS 516-1959 after 28 days of moisture curing.

COMPRESSIVE STRENGTH TEST ON CUBES:

The cube compressive strength results of High Performance Concrete mixes at ages of 3, 7, 14, 28 days are presented in table .The development of compressive strength of M60grade of concrete mixes containing 0,2.5,5,7.5,10,12.5and15 percent of silica fume and 0,5,10,20,25,30 percent of fly ash at the various stages are plotted in the form of graphs are show .According to result combination of MK and FA show higher compressive strength than normal concrete (concrete with 0% replacement of cement).It is interesting to see that the compressive strength of concrete with 15 % FA was higher than that of the Controlled mix. This result shows the benefit of using FA in combination with SF to produce concrete with higher replacement of cement about 15 % (FA10%+5%). The maximum compressive strength of concrete in combination with fly ash and silica fume depend on two parameters namely the replacement levels and water cement ratio. And the compressive strength are varying with days also.

SPLITTING TENSILE STRENGTH OF CONCRETE:

The splitting tensile strength combination of FA and SA blended concrete after 28days curing is shown in fig. It can be clearly seen that the splitting tensile strength value increases with the combination of SF and FA UP TP 22.6% (7%SF+15%FA) the splitting tensile strength is higher than the controlled mix. But cement replacement beyond 30% (SF+FA) there is a decrease in splitting tensile strength for 28 days curing period to the controlled mix.

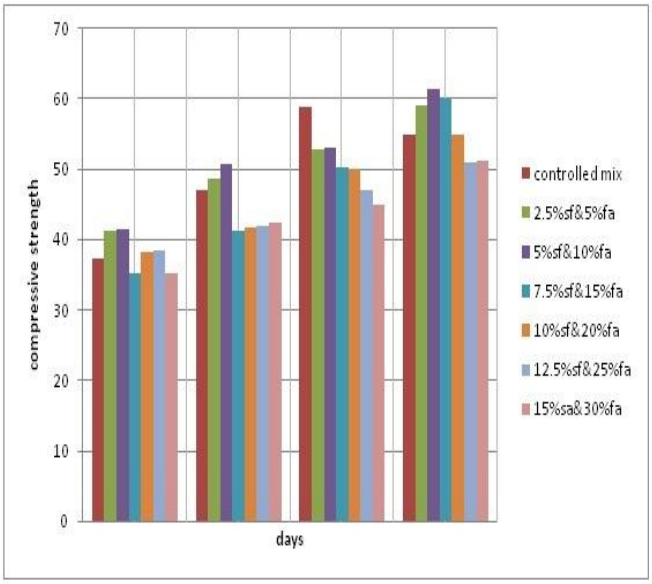
FLEXURAL STRENGTH OF CONCRETE:

The Flexural strength combination of FA and SA blended concrete after 28 days curing are shown in fig. It can be clearly seen that the flexural strength value increases with the combination of SF and FA up to 22.8 % (7%SF+15%FA) the flexural strength is higher than the controlled mix. But cement replacement beyond 30% (SF+FA) there is decrease in strength for 28 days.

COMPRESSIVE STRENGTH RESULTS (N/mm^2):

Days	Controlled mix	%SF,%FA					
		2.5 5	5,10	7.5, 15	10,2 5	12.5,2 5	15,30
3	37.3 0	41.1 8	41.5 6	35.2 5	38.2 3	38.54	35.15
7	47.1 5	48.6 7	50.6 8	41.1 8	41.7 6	41.89	42.39
14	58.8 7	52.8 7	53.0 8	50.3 9	50.0 2	46.97	44.98
28	55	59.0 1	**61.5**	60.0 5	55.0 3	51	51.12

COMPRESSIVE STRENGTH COMPARISON



SPLIT TENSILE TEST RESULTS

S.NO	FLY ASH CONTENT%	SILICA FUME%	RESULT(N/mm2)
1	0	0	3.20
2	5	2.5	3.33
3	10	5	3.30
4	**15**	**7.5**	**3.62**
5	20	10	2.60
6	15	12.5	2.71
7	30	15	2.86

COMPRESSIVE STRENGTH COMPARISON

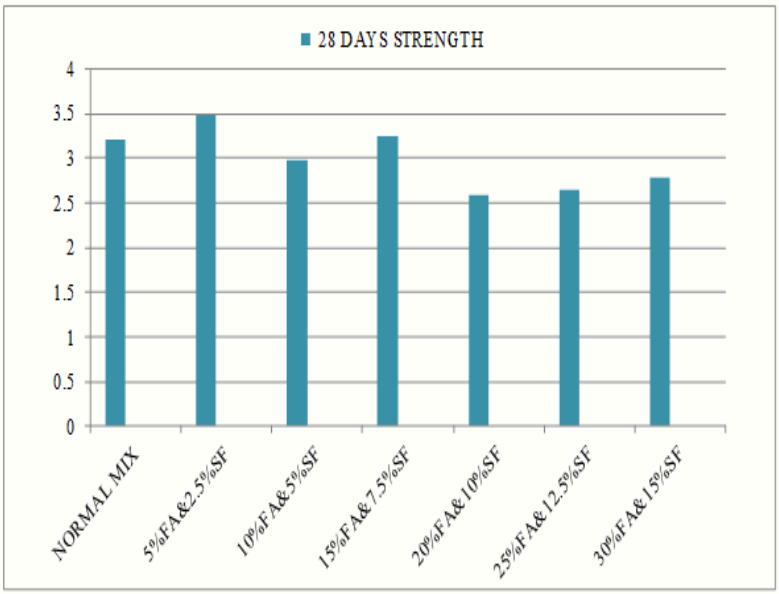


Fig no.5.2 Relationship between Split tensile strength of varying SF&FA replacement levels in (N/mm^2).

FLEXURAL STRENGTH TEST RESULTS

S.NO	F .A %	S. F %	NO OF CYLINDERS	CURING PERIOD (DAYS)	RESULTS (Mpa)
1	0	0	3	28	9.41
2	5	2.5	3	28	9.91
3	10	5	3	28	7.15
4	15	7.5	3	28	11
5	20	10	3	28	7.66
6	15	12.5	3	28	6.83
7	30	15	3	28	6.75

FLEXURAL STRENGTH COMPARISON

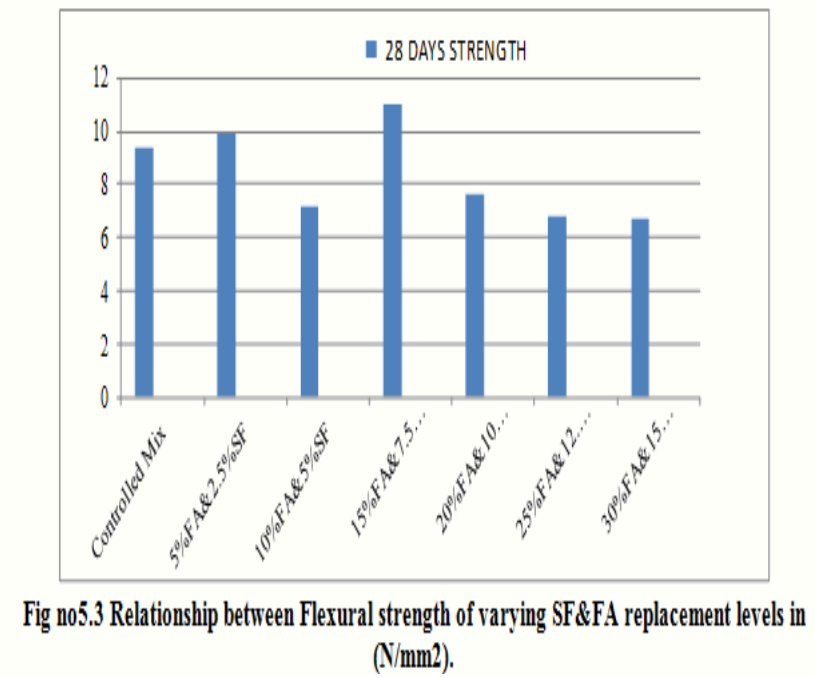


Fig no5.3 Relationship between Flexural strength of varying SF&FA replacement levels in (N/mm2).

CONCLUSION:

After several studies on partial replacement of fly ash and silica fume in concrete strength is increasing little bit. So we can use this technique to the construction. The Compressive strength is increased by 14% for the replacement of cement by 10 %fly ash and 5 % silica fume mix.

Split tensile strength is increased by 12.20 % for the replacement of cement by 15% fly ash and 7.5 % silica fume mix.

Flexural strength increased by 18 % for the replacement of cement by 15 % fly ash and 7.5 % silica fume mix. This study has shown that between 15 to 23 % replacement levels, concrete will develop strength sufficient for construction purposes. Its use will lead to a reduction in cement quantity required for construction purposes and hence sustainability in the construction industry as well as aid economic construction .

FUTURE SCOPE:

We are just implementing this technique for cement mortars. It is requires a proper mixing proportions for the development of high strength, high performance concrete which may not be possible manually. So its need some global optimizations technique to develop the desired results with greater accuracy and time saving.

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