iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** VIII **Month of publication:** August 2022

DOI: https://doi.org/10.22214/ijraset.2022.46443

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue VIII Aug 2022- Available at www.ijraset.com

Investigation on Partially Replacement of Cement with Silica fume and Fly Ash

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Abstract: ***A strong and stable construction appears to prefer high overall performance concrete. Industries produce a significant amount of spinoffs and wastes, such as fly ash, copper slag, silica fume, and others, which cause health and environmental issues due to dumping and disposal. The most frequently used additional cementitious material that results from the operation of an electrical furnace is silica fume. The concrete's water permeability and strength are affected by silica fume and fly ash. Fly ash and silica fume are excess characteristics of concrete. Concrete's mechanical and durability properties are both enhanced by the proper introduction of silica fume. Due to its affordability, durability, and ability to ensure safety, this type of concrete is employed in many large projects. Fly ash and silica fume have replaced cement in the range of 0%, 5%, 10%, 15% and 0%, 5%, 7.5%, 12.5%, respectively. The specimens has tested by compressive and split tensile strength.***
Keywords: Flyash, silica fume, compressive strength, split tensile strength.

I. INTRODUCTION

Concrete has been the most frequently used construction material, producing over six billion tons annually. Cement, water (the binder), crushed or uncut stone, and sand or stone dust are the four main ingredients of typical concrete in India. In order to enhance a few qualities, concrete may occasionally also contain a few more chemicals in addition to the aforementioned additions. Additional elements with mineral roots are added to concrete to increase its strength and sturdiness. Fly ash and silica fume are two examples that are both frequently fine. A substance that when added to cement in the right quantity, the strength and durability of concrete while also acquiring HPC. May be finer than cement.

II. OBJECTIVES

1) To maximise the use of fly ash with cement
2) To use cement with silica fume as efficiently as possible.
3) To assess the concrete's compressive and split tensile strength.

III. MATERIALS

The properties of cement are presented in Table 1.

Table 1 Physical properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.15
2	Fineness	7.18%

1) *Silica Fume:* Silica fume is a by product of the manufacturing of silicon metal or ferrosilicon alloys. One of the most advantageous uses of silica fume is in concrete. Its chemical and physical properties make it a highly reactive pozzolan. Silica fume may make concrete exceptionally durable and robust. Silica fume is available from concrete additive manufacturer sand, if specified, is simply added during the concrete manufacturing process.

2) *Fly Ash:* The byproduct of burning coal is a naturally cementitious substance called fly ash. To lessen pollution, fly ash is collected from the precipitators put in place in the smokestacks of coal-burning power stations. It is anticipated that the number of thermal power plants would increase in the near future due to the increasing demand for coal and power. Fly ash forms as a suspension in exhaust gases and has a spherical shape.

IV. EXPERIMENTAL RESULTS

A. *Compressive Strength Results*

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 2 to 4.

Table2: Compressive strength of concrete with Silica fume as partial replacement of cement in concrete

Sl.no	SILICA FUME	28 days (N/mm^2)	56 days (N/mm^2)	90days (N/mm^2)
1	0%	61.54	66.88	71.93
2	5%	66.67	72.65	77.85
3	7.5%	71.93	78.07	83.41
4	12.5%	66.10	71.89	77.32

Table3: Compressive strength of concrete with fly ash as partial replacement of cement in concrete

Sl.no	FLYASH	28 days (N/mm^2)	56 days (N/mm^2)	90days (N/mm^2)
1	0%	61.54	66.88	71.93
2	5%	63.39	69.06	74.14
3	10%	65.50	71.32	76.46
4	15%	69.47	75.55	81.12

Table 4:- Compressive strength of concrete with Silica fume and fly ash as partial replacement of cement in concrete

Sl.no	FLYASH +SILICA FUME	28 days	56 days (N/mm^2)	90days (N/mm^2)
	0%	61.54	66.88	71.93
1	15FH+7.5%SF	75.89	82.49	88.62

B. *Split Tensile Strength Results*

At the age of 7 and 28days, the cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength. The experiment is performed by putting a cylindrical sample horizontally between a compression testing machine loading surface and the load is applied until the cylinder fails along the vertical diameter.

Table 5: Split tensile strength of concrete with Silica fume as partial replacement of cement in concrete

Sl.no	SILICA FUME	28 days (N/mm^2)	56 days (N/mm^2)	90days (N/mm^2)
1	0%	6.08	6.59	7.10
2	5%	6.49	7.02	7.59
3	7.5%	7.11	7.72	8.42
4	12.5%	6.67	7.26	7.78

Table 6: Split tensile strength of concrete with fly ash as partial replacement of cement in concrete

Sl.no	FLYASH	28 days (N/mm^2)	56 days (N/mm^2)	90 days (N/mm^2)
1	0%	6.08	6.59	7.10
2	5%	6.21	6.72	7.24
3	10%	6.43	6.98	7.47
4	15%	6.76	7.34	7.50

Table 7: Split tensile strength of concrete with Silica fume and fly ash as partial replacement of cement in concrete

Sl.no	FLY ASH+SILICA FUME	28 days (N/mm2)	56 days (N/mm^2)	90 days (N/mm^2)
	0%	6.08	6.59	7.10
1	15FH+7.5%SF	7.44	8.06	8.68

V. CONCLUSIONS

A. The compressive strength of normal concrete at 28, 56 and 90 days is 61.54, 66.88 and 71.93 N/mm^2.
B. The split tensile strength of normal concrete at 28, 56 and 90 days is 6.08, 6.59 and 7.10 N/mm^2.
C. The compressive strength at 7.5% silica fume with partial replacement of cement is 71.93, 78.07 and 83.41 N/mm^2.at 28, 56 and 90 days.
D. The split tensile strength at 7.5% silica fume with partial replacement of cement is 7.11, 7.72 and 8.42 N/mm^2.at 28,56 and 90 days.
E. The compressive strength at 15% fly ash with partial replacement of cement is 69.47, 75.55 and 81.12 N/mm^2.at 28,56 and 90 days.
F. The split tensile strength at 15% fly ash with partial replacement of cement is 6.76, 7.34 and 7.50 N/mm^2.at 28,56 and 90 days
G. By combination of 7.5% silica fume and 15% fly ash the compressive strength is 75.89, 82.49 and 88.62 N/mm^2.
H. By combination of 7.5% silica fume and 15% fly ash the compressive strength is 75.89, 82.49 and 88.62 N/mm^2.
I. By combination of 7.5% silica fume and 15% fly ash the compressive strength is 7.44, 8.06 and 8.68 N/mm^2

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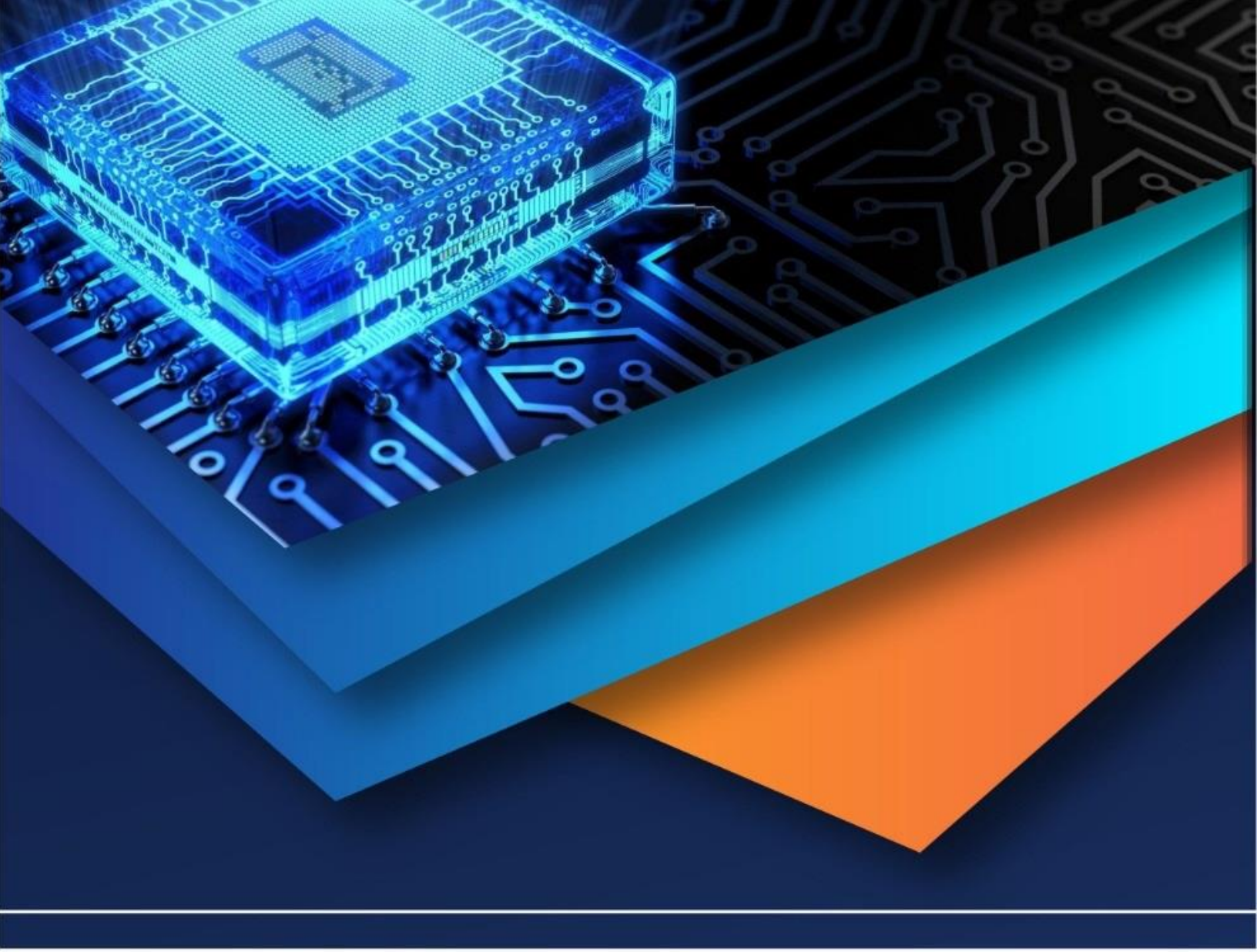

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