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STRENGTHENING ON CONCRETE BY PARTIALLY REPLACEMENT OF CEMENT WITH FLY ASH AND SILICA FUME

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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 excessive characteristics of concrete. Concrete's mechanical and durability properties are both enhanced by the proper introduction of silica fume. This particular type of concrete is utilized in many large-scale efforts because they are well within your budget, long-lasting, and safe. This paper provides a review of the literature on replacing cement with silica fume that takes into account current and upcoming research trends. In the range of 0 %, 5 %, 10 %, 15%,20% and 0 %, 5 %, 7.5%, 12.5%, fly ash and silica fume have replaced cement as the primary building material. The specimens' compressive and cut-up tensile strength is measured.

Keywords*: fly ash, silica fume, compressive strength, split tensile strength.*

1. INTRODUCTION

The most frequently used product created by humans is concrete. With a production of over six billion tonnes annually, despite its internal complexity, adaptability, durability, and affordability, concrete has been the most widely used construction material. The four basic components of conventional concrete in India are cement, water (the binder), crushed or uncrushed stone, and natural sand or stone dust. In addition to the aforementioned additions, sometimes a few other chemicals are also used in the formula of concrete in order to improve a few properties. To improve the strength and sturdiness of concrete, extra materials with mineral roots are added. Examples include fly ash and silica fume, both of which are typically fine. When added to cement in the proper amount, a material that may be finer than cement can improve the strength and durability of concrete, acquiring HPC in the process.

2. OBJECTIVES

The objectives of this study are as follows

a) To optimize the usage of cement with flyash
b) To optimize the usage of cement with silica fume.
c) To evaluate the compressive and spilt tensile strength of concrete.

3. 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%

3.1 SILICA FUME: - The production of silicon metal or ferrosilicon alloys produces silica fume as a byproduct. Concrete is one of the most beneficial applications for silica fume. It is a highly reactive pozzolan due to its chemical and physical characteristics. Concrete with silica fume can be extremely strong and long-lasting. Silica fume is available from concrete additive manufacturers and, if specified, is simply added during the concrete manufacturing process. The concrete contractor must pay extra attention to the placement, finishing, and curing of silica- fume concrete Silica fume is available in both wet and dry forms for usage in concrete. Illustrated in the photo, it is commonly added during the manufacture of concrete at a concrete plant. Both central-mix and dry-batch operations have successfully manufactured silica fume- concrete. All aspects of handling silica fume and using it to generate consistent, high-quality concrete can be handled with ease.

3.2 FLYASH: Fly ash is a naturally cementitious substance produced as a by- product of coal combustion. Fly ash is retrieved from the precipitators installed in coal-burning power plants' smokestacks to reduce pollution. With the rising need for power and coal, it is projected that the number of thermal power plants would expand in the near future. Fly ash has a spherical shape and solidifies in the form of a suspension in exhaust gases. Fly ash is made of silica (SiO2), alumina (Al2O3), and iron oxide (Fe2O3) (Fe2O3). The physical and chemical requirements of fly ash vary depending on the need and use. Fly ash is divided into two categories, Class F and Class C are two different types of classes. The amount of calcium, silica, alumina, and iron in these two classes differs significantly. The chemical makeup of the fly ash is determined by the qualities of burned coal, such as anthracite and bituminous. When older, harder anthracite burns, Class F fly ash is produced, which is pozzolanic in nature and contains 10% lime (Cao). Class F fly ash with glassy silica and alumina requires a cementing agent such as Portland cement, quicklime, or hydrated lime to have cementitious properties.

4. EXPERIMENTAL INVESTIGATIONS

4.1 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.

Table 2: Compressive strength of concrete with Silica fume as partial replacement ofcement in concrete

Sl. no	SILICAFLUME	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	34.41	49.52
2	5%	37.20	53.45
3	7.5%	39.81	57.46
4	12.5%	36.97	52.91

Table 3: Compressive strength of concrete with Fly ash as partial replacement ofcement in concrete

Sl. no	FLYASH	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	34.41	49.52
2	5%	35.09	50.94
3	10%	36.37	52.34
4	15%	38.65	55.30
4	20%	38.07	54.49

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

Sl. no	FLYASH +SILICAFLUME	7 days	28 days
	0%	34.41	49.52
1	15FH+7.5%SF	42.85	60.36

4.2 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 ofcement in concrete

Sl. no	SILICA FLUME	7 days (N/mm^2)	28 days (N/mm^2)
1	0%	3.42	4.93
2	5%	3.66	5.27
3	7.5%	4.02	5.81
4	12.5%	3.62	5.24

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

Sl. no	FLYASH	7 days(N/mm^2)	28 days (N/mm^2)
1	0%	3.42	4.93
2	5%	3.49	5.07
3	10%	3.62	5.19
4	15%	3.88	5.52
5	20%	3.74	5.36

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

Sl. no	FLYASH +SILICA FLUME	7 days (N/mm2)	28 days (N/mm2)
	0%	3.42	4.93
1	15FH+7.5%SF	4.29	6.05

5. CONCLUSION

In this study the concrete ingredient like cement is replaced by Fly ash and Silica fume with0%,5%,10%,15%,20% and 0%,5%,7.5%.12.5%.

- The Compressive strength of normal concrete at the age of 7 days and 28 days are 34.41N/mm^2 & 49.52 N/mm^2.
- At 7.5% replacement of cement by Silica fume the achieved compressive strength of concrete 7days and 28 days are 39.81N/mm^2 &57.46 N/mm^2
- At 15% replacement of cement by Fly ash the achieved compressive strength of concrete is 38.65N/mm^2 for 7days and55.30 N/mm^2 for 28days.
- At 7.5% replacement of cement by Silica fume the achieved Split tensile strength of concrete is 4.02 N/mm^2 for 7days and 5.81 N/mm^2 for 28days.
- At 15% replacement of cement by Fly ash the achieved Split tensile strength of concrete is 3.88N/mm^2 for 7days and 5.52N/mm^2 for 28days.
- At Combined replacement of cement by Silica fume and Fly ash the achieved compressive strength of concrete is 42.85N/mm^2 for 7days and 60.36 N/mm^2 for 28days.
- At Combined replacement of cement by Silica fume and Fly ash the achieved Split tensile strength of concrete is 4.29 N/mm^2 for 7days and 6.05N/mm^2 for 28days.

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