A STUDY ON STRENGTH PROPERTIES OF CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY FLY ASH AND SILICA FUME

Sudhakar G N
Assistant Professor, Department of civil Engineering, New Horizon college of Engineering, Bengaluru, Karnataka, India

Abstract
Results of an experimental study carried out to find the effect of fly ash and silica fume by partially replacing cement of M-35 grade concrete are presented. Improved performance on compressive, and split tensile strength are observed. The controlled concrete specimen of M-35 grade was prepared using OPC 53 grade cement. The other specimens were prepared by replacing cement with 15% fly ash and silica fume at 5%, 10%, 15% and 20%. The various strengths parameters were compared with controlled specimens leading to a conclusion that there is an increase in compressive strength up to 43 %, and split tensile strength up to 17.5 %.
Key Words: Cement concrete, Silica fume, Fly ash, , Compressive Strength, Split tensile strength.

I. INTRODUCTION

The Field of application of concrete and mortars, the strength, workability, durability and other characteristics of the ordinary concrete needed modification to make it more suitable for various applications.

As an outcome of various research works carried out it is observed that alternative cementitious materials such as fly ash, Silica fume, Rice husk ash, metakaolin etc have better contribution for higher performance and economy.

It is observed from the literature that Workability and other properties of concrete can be improved by the addition of fly ash. Also The production of cement can be reduced with the use of fly ash as an alternative and hence the reduction in the emission of CO2 and hence conserves the existing resources and greatly improves consistency.

2. MATERIALS AND METHODOLOGY

2.1. Materials

2.1.1 Cement: Portland cement of 53 grade confirming to Indian Standards was used for the present study and specific gravity was evaluated and the same has been tabulated in Table2.1.

2.1.2 Fine aggregates: River sand with fineness modulus 2.65 conforming to zone II was used ity. present study and specific gravity was evaluated and the same has been tabulated in Table2.1.

2.1.3 Coarse aggregates: Crushed granite with fineness modulus 7.2 having size between 20 mm and 4.75 mm was used for the experimental study and the tests were conducted to evaluate specific gravity. The results have been tabulated in Table 2.1.

2.1.4 Water: potable water was used for the experimental work.

2.1.5 Fly ash: The specific gravity of fly ash was evaluated and is tabulated in Table 2.1.

2.1.6 Silica fume: The specific gravity of fly ash was evaluated and is tabulated in Table 2.1.

Table 2.1: Significant properties of materials used

Materials	Specific gravity
Cement	3.11
Fine aggregates	2.58
Coarse aggregates	2.65
Fly ash	2.23
Silica fume	2.1

Table 2.2: Mineral Composition of Silica fume

Major Minerals	Percentage
Lime (Cao)	1.2
Silica (SiO2)	79.8
Alumina (Al2O3)	17.97
Iron oxide (Fe2O3)	0.93
Magnesium oxide (MgO)	0.06
Sodium oxide (Na2O)	0.04

2.2 Concrete Mix Proportion

The mix proportion was evaluated as per IS 10262-2009. The various mix proportions for conventional concrete (Control specimen) and fly ash based Silica fume concrete (by partially replacing OPC with fly ash and Silica fume) are presented in Table2.3.

Table 2.3: M-35 Mix proportion

Mix Proportion	Cement content	Silica fume (MK)	Fly ash (Kg/m^3)	F.A (Kg/m^3)	C.A (Kg/m^3)	W/C
Control specimen	451	….	….	673	1080	0.4
MK 5% Fly ash 15%	352.6	24.6	73.8	673	1080	0.4
MK 10% Fly ash 15%	328	49.2	73.8	673	1080	0.4
MK 15% Fly ash 15%	303.6	73.8	73.8	673	1080	0.4
MK 20% Fly ash 15%	279	98.4	73.8	673	1080	0.4

3. Experimental Program

3.1 Specimen

Concrete specimens (150X150X150 mm) and cylinder (150 X 300 mm) were cast and tested.

3.2 Compressive strength

Nine cubes were cast for each concrete mix and tested using 200T capacity Compression Testing Machine (CTM).

3.3 Split Tensile strength

Nine cylinders were cast and tested using 200T capacity Compression Testing Machine (CTM).

4. Results and discussions

4.1 Compressive strength: The compressive strength was determined at the age of 3, 7 and 28 Days after normal water curing. The results are presented in Table 4.1 and are also depicted graphically in figure 4.1.

Table 4.1 Compressive Strength Test results

specifications	Compressive strength (N/mm^2)		
	3 Days	7 Days	28 Days
Control specimen	16	24.5	41
MK 5% Fly ash 15%	21.63	29.2	46
MK 10% Fly ash 15%	24	36	49.5
MK 15% Fly ash 15%	26	41.2	53.4
MK 20% Fly ash 15%	27	44	58.36

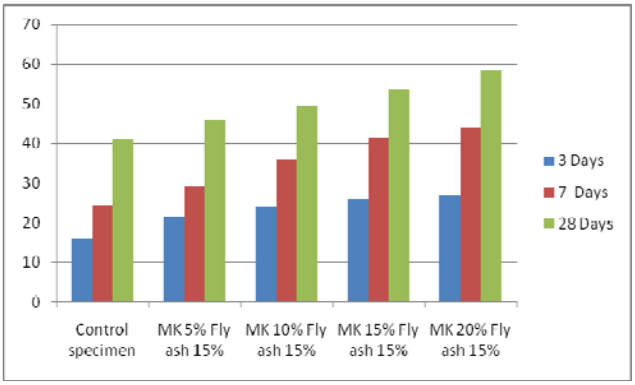

Fig. 4.1 Compressive strength test results

4.2 Split Tensile strength

The split tensile strength was determined after normal curing for 28 days. The results are presented in Table 4.2.

Table 4.2 Split tensile test results

Specifications	Split Tensile Strength (N/mm^2)
Control specimen	2.17
MK 5% Fly ash 15%	2.45
MK 10% Fly ash 15%	2.67
MK 15% Fly ash 15%	2.95
MK 20% Fly ash 15%	3.05

The results indicate that there is a substantial increase in the compressive strength with the increase in % of Silica fume replacing cement.

5. Conclusions

The study led to the following conclusions**.**

1. Enhancement in the early strength and ultimate strength of concrete was observed due to addition of fly ash and silica fume.
2. The partial replacement of cement results in reduction in the emission of green gases.
3. Since Silica fume and flyash are easily available economy can be achieved.

4. REFERENCES

1. Effects of Silica Fume and Fly Ash as Partial Replacement of Cement on Water Permeability and Strength of High Performance Concrete I. B. Muhit , S. S. Ahmed , M. M. Amin1 and M. T. Raihan Department of Civil Engineering, Chittagong University of Engineering & Technology, Chittagong-4349, Bangladesh and Applied, Memorial University of Newfoundland. DOI: 02.AETACE.2013.4.13 © Association of Civil and Environmental Engineers, 2013
2. Mohammad Azhar, Mohammed Moshin Ali Qureshi, Sensale GR. (2006), "Strength development of concrete with rice husk ash", Cement and Concrete Composites, 28(2), 158-160.
3. Mohammad Iqbal Khan and RafatSiddique (2011), "Utilization of silica fume in concrete: Review of durability properties", Resources, Conservation and Recycling, 57, 30–35
4. M. Islam, S. Islam (2012), "Prospect of Green Concrete Production by Using Boropukuriya Fly Ash," Conf. Proceedings of 1st International Conference on Advances in Civil Engineering 2012 (ICACE 2012), CUET, Chittagong, Bangladesh
5. A.M. Neville (1996), "Properties of Concrete", 4th ed., ELBS with Addison Wesley Longman, England
6. X. Cong, S. Gong, D. Darwin, S.L. McCabe (1992), "Role of silica fume in compressive strength of cement paste, mortar, and concrete," ACI Mater. J. 89 (4) 375– 387.
7. S. Bhanja, B. Sengupta (2003), "Optimum silica fume content and its mode of action on concrete", ACI Mater. J. 100 (5)407–412.
8. S. Bhanja, B. Sengupta (2002), "Investigations on the compressive strength of silica fume concrete using statistical methods",Cem. Concr. Res. 32 (9) 1391– 1394.