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Strength Appraisal of High Volume Fly Ash Fibre Concrete

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Abstract – High volume fly ash concrete is a concrete in which at least 50% of cement is replaced by fly ash conservation of natural resources is the key requirement for maintaining ecological balance. So there is a need to find alternate construction materials. This study focuses on the influence of high volume fly ash replacement for cement. Fly ash is replaced in various replacement levels of 0%, 50%, 55% and 60% by weight of cement in concrete and addition of glass fibres of length 12mm and diameter of 14 micron in two different volume fractions of 0.5%, 1% slump, compressive strength (150mm x 150mm x 150mm) and split tensile strength (150mm dia x 300mm height) mixes were evaluated at the age of 7 days and 28 days. The test results indicate that the addition of fly ash improves the slump and strength properties of concrete.

Index Terms – Cement, fly ash, glass fiber, slump, compressive strength, split tensile strength.

1. INTRODUCTION

Cement is the mostly & commonly used composite material in civil engineering. For producing one ton of cement in its production, 1.5 tons of lime stone is required. Present the cost of Portland cement is escalating beyond control. For producing every ton of Portland cement clinker uses approximately one ton of carbon dioxide, a major contributor to green house gas emission that are responsible for global warming which is now at that of the long list of man-made environmental problems. Globally environmental release of carbon dioxide from all the sources is estimated at 23 billion tons a year. It means that Portland cement production today accounts for above 7% of total carbon emissions. Fly ash is the common replacement material in concrete by replacing of Portland cement.

The use of high volume fly ash concrete is introduced by Malhotra in 1986(HVFA Concrete). He defined as at least 50% of the binder material consists of class F fly ash. The HVFA concrete is good for the low cost and high workability of the concrete. More over fly ash containing the slow puzzolanic properties to decrease the early age strength of concrete, but longer period the strength will be increased.

Fly ash is the by product of coal combustion material. Generally fly ash has been considered as a waste material in the past, and disposal of fly ash as become a major environmental issue. The addition of fly ash in concrete gain strength and gives various other application in construction over the last 20 years, without affecting the mechanical and durability properties of concrete. Several laboratory and field investigation have reported that the partial replacement of cement by fly ash give and mechanical and durability properties. Fly ash improves the workability of concrete depending the shape of the particle.

2. EXPERIMENTAL INVESTIGATION

Materials used:

In the present experimental investigation the following materials were used

2.1 Cement

Ordinary Portland Cement (OPC) or 53 grade. The Specific Gravity of Cement is 3.116.

2.2 Fly ash

The class F fly ash is obtained from Vijayawada Thermal Power Station in Andhra Pradesh the fly ash used for the study belong to class F fly ash.

2.3 Aggregate

Crushed stone aggregates of 20mm size obtained from locally crushing plants and locally available river and passing through IS 4.75mm sieve conforming to zone-2 of IS383-1970 is used in the present study. The properties of coarse aggregate and fine aggregate used are shown in table-1.

Table: 1 Properties of aggregate.

S.No.	Particulars	Fine aggregate	Coarse aggregate
1	Specific gravity	2.57	2.61

2.4 Glass Fibres:

CEM FIL anti-crack HD glass fibers were used. Percentage of glass fibre used are 0.5% and 1%.

Table 2. Properties of glass fiber

S.No.	Property	Value
1	Pilament diameter	14 micron
2	Length	12 mm
3	Specifc gravity	2.68
4	Aspect ratio (l/d)	857.14

2.5 Super plasticizer:

Super Plasticizer CONPLAST SP430 is used. A commercially available SP was used as chemical admixture to enhance the workability of concrete.

2.6 water:

Portable water which is free from oils, chemicals and other forms of impurities is used for mixing concrete as per IS: 456-2000, for mixing and curing of the specimens.

2.7 Silica Fume:

Percentage of Silica fume used are 5% - 10%.

3. MIX PROPORTIONS

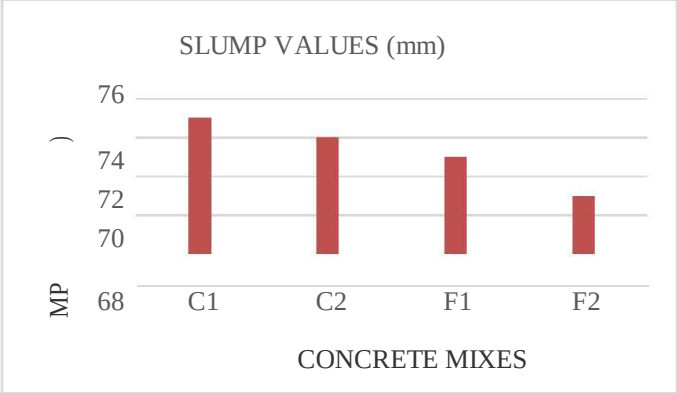
C1: 100% OPC + 5% silica fume + fine aggregate + coarse aggregate + addition of fibres @ 0.5% by weight of binder
C2: 100% OPC + 5% silica fume + fine aggregate + coarse aggregate + addition of fibres @ 1% by weight of binder
Mixes with cement replaced by fly ash:
F1: 50% OPC + 50% fly ash + 5% silica fume + fine aggregate + coarse aggregate + addition of fibres @ of 0.5% by weight of binder
F2: : 50% OPC + 50% fly ash + 5% silica fume + fine aggregate + coarse aggregate + addition of fibres @ of 1% by weight of binder.

4. EXPERIMENTAL PROGRAM

4.1 Slump Test

Slump test is the most commonly used to determine the workability and consistency of fresh concrete. All mixes for the slump value to determine the workability of concrete in the fresh state. The dimensions of mould are top diameter 100mm, bottom diameter 200mm and height 300mm.

Mix	Slump values mm
C1	75
C2	74
F1	73
F2	71



4.2 Compressive strength

Cubes of size 150mm x 150mm x 150mm were used for the determination of compressive strength. Average of three specimens tested in each mix is considered as the compressive strength of the concrete.

The compressive strength was calculated as follows. Compressive strength (MPa) = Failure load /cross sectional area.

MIX	COMPRESSIVE STRENGTH N/mm^2	
	7 days	28 days
C1	27	36
C2	28	37.5
F1	29.54	39
F2	29.60	43

4.3 Split Tensile Strength

Split tensile strength of all mixes were determined using concrete cyulinders of diameter 150mm and height 300mm. Average of three specimens tested in each mix is considered as the split tensile of concrete.

The split tensile strength was calculated as follows: Split tensile strength (MPa) = $2P/\pi dl$

Where p = failure load,
d = diameter of cylinder,
l = length of cylinder.

MIX	SPLIT TENSILE STRENGTH N/mm^2	
	7 days	28 days
C1	2.7	3.6
C2	2.8	3.7
F1	2.9	3.8
F2	2.93	4.3

CONCLUSIONS

The following conclusions are drawn from the present investigation.

- Compressive strength, split tensile strength of high-volume flyash concrete increased with age in comparision with 28 days strength. Increase in the strengths of HVFA concrete clearly indicated the pazzolanic reaction flyash.
- By the addition of mineral admixtures & glass fibres the workability of concrete decreases.
- Slump and compaction factor value decreases with fibre addition
- The formation of cracks is more in case of controlled concrete, less in glass fibred concrete.
- The strength gaining at 28 days is higher for fibre added flyash based concrete than OPC based concrete.
- Flyash based concrete performs well at later stage than at early days.
- The use of fibres can be beneficial for obtaining green concretes as alternative building materials in construction industry.
- With the increasing the quantity of cement replacement by flyash. The compressive strength will decreases in the case of addition of glass fibres.

REFERENCES

[1] Falah M. Wegian, Anwar A. Alanki, Hana M.AISaeid, Fahad A.Alotaibi, Mubara S. A1-Mitairi and Fahad A. Kandari, "Influence of Fly Ash on Behaviour of Fibers Reinforced Concrete Structure", Journal of Applied Sciences, 11:3185-3191, 2011.

[2] Haque M.N., High Fly Ash Concrete, ACI Materials Journal, 1984, 81(1), pp.54-60.

[3] IS: 10262-2009, Concrete mix proportioning-Guidelines, Bureau of Indian Standards, New Delhi.

[4] IS: 456-2000, Code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.

[5] Jo Jacob Raju and Jino John, "Strength study of High volume fly ash concrete with fibres" – International Journal of Advanced structures and Geotechnical Engineering – ISSN 2319-5347, Vol.03, No.01, Jan.2014.

[6] K.Kaviya and J.Chamundeeswari, "Utilization of Fly Ash and Fiber in Concrete", Volume 8(32), 2015.

[7] Malhotra V.M., Durability of concrete incorporating high volume of low – Calcium (ASTM Class F) Fly Ash, Cement and Concrete Composites, 1990, 12(4), pp.271-277.

[8] Marinela Barbuta, Roxana Bucur, Adrian Alexandru Serbanoiu, Sorin Scutarasu, Andrei Burlacu, "Combined effect of fly ash and fibers on properties of cement concrete" – Procedia Engineering 181(2017) 280-284.

[9] Mini Soman, Sobha.K, Strength and Behaviour of High Volume Fly Ash Concrete, International Journal of Innovative Research in Science, Engineering and Technology ISSN:2319-8753, vol.3, Issue5, May 2014.

[10] Pandurangan S, Vimalanandan G, Dr. S.Senthil Selvan, " Performance of high volume fly ash concrete". International Journal for Innovative Research in Science and Technology, volume-I, Issue 11, April 2015, Page No: 247-250.

[11] Properties of High Volume Fly Ash Concrete Reinforced with Natural Fibres.

[12] R.M.Karthikeyan, N.Vellingiri, D.Jayalin. "Experimental Study on Strength Properties of High Volume Fly Ash Concrete with Polypropylene Fibre". International Journal of Chem Tech Research Coden (USA): IJCRGG, ISSN:0974-4290, ISSN(online):2455-9555, Vol.10, No.8, pp.284-289, 2017.

[13] Siddique R., Performance characteristics of concrete containing High Volumes of class F Fly Ash, Cement and Concrete Research, 2004, 34(3), pp.487-493.

[14] Tarun R. Naik, Bruce W.Ramme and John H. Tews, "Use of High volumes of class C and class F Fly Ash in concrete", Volume 16, No.1, 1994.