An Experimental Study on Blended Cement Concrete

Kalaiselvi Nivedha.J[#1], Saranya.K.P[#2]

M.E Structural engineering, Department of Civil Engineering, Nandha Engineering College, Erode, India.

Assistant Professor, Department of Civil Engineering, Nandha Engineering College, Erode, India.

[#1]kalainivi2312@gmail.com,

[#2]saranyapalanisamykm@gmail.com

***Abstract*—Blended cement is now being considered superior as compared to conventional OPC category of cement. The partial replacements of cement with combination of admixture such as Fly Ash, Silica Fume are used for making blended cement concrete. This fly ash, silica Fume which is released directly into environment can cause environmental pollution. The various mix proportion used for test are 0% (conventional), 10%, 20% and 30% replacement of cement with combination of fly ash , silica fume .The mechanical properties of conventional cement concrete and blended cement concrete in R.C structures are studied. The mechanical properties of conventional cement concrete and blended cement concrete in R.C structures are compared. From the mechanical property results beam specimens are going to cast for both conventional concrete and blended cement concrete. Final results deflection and crack pattern of obtained by blended cement concrete beams are going to compared with conventional concrete beams. Deflection and crack pattern of blended cement concrete beams and conventional concrete beams are going to compare with theoretical formulas.**

***Keywords*— Blended Cement, Fly Ash, mechanical properties, Silica Fume.**

I. Introduction

In recent years, many researchers have established that the use of supplementary Cementitious materials (SCMs) like fly ash (FA), silica fume, Metakaolin (MK), and rice husk ash (RHS),quarry dust(QD), hypo sludge etc. can, not only improve the various properties of concrete - both in its fresh and hardened states, but also can contribute to economy in construction costs.

Presently large amounts of fly ash are generated in thermal industries with an important impact on environment and humans. Leaving waste materials in to environment directly results to damage of natural climatic conditions, hence use of waste materials is made at most importance in present study. Silica fume is a by- product in the production of silicon alloys such as Ferro-chromium, Ferro- manganese, calcium silicon etc. which also creates environmental pollution and health hazard. Silica fume concrete may be appropriate in places where high abrasion resistance and low permeability are of utmost importance or where very high cohesive mixes are required to avoid segregation and bleeding.

A. Objectives

1) To determine the mechanical properties of conventional and blended cement concrete in R.C structures
2) To compare results of the mechanical properties of conventional and blended cement concrete in R.C structures
3) To compare results of the deflection, crack pattern of conventional and blended cement concrete.
4) To compare results of the deflection of conventional and blended cement concrete with theoretical formulas.
5) To save cement and reduce cost of cement

II. Materials

A. Cement

The cement is a binding material. Conforming to IS456-2000-53 grade.

B. Fly Ash

Fly ash is composed of the non-combustible mineral portion of coal. Particles are glassy, spherical 'ball bearings' finer than cement particles. Sizes of particle are 0.1µm-150 µm. it is a pozzolonic material which reacts with free lime in the presence of water, converted into calcium silicate hydrate (C-S-H) which is the strongest and durable portion of the paste in concrete.

C. Fine Aggregate

The materials smaller than 4.75mm size is called fine aggregates. Natural sand is generally used as fine aggregate. Conforming to grading zone-III of table 3 of IS: 10262-2009.

D. Coarse Aggregate

Coarse aggregate obtained from local quarry processing units has been used for this study.

E. Water

Ordinary potable tap water available in laboratory was used for mixing and curing of concrete.

F. Admixture

Commercially available Super-plasticiser has been used to enhance the workability of fresh concrete for selected proportions of ingredients.

III. Mix design procedure

In present study M40 grade concrete was designed as per IS: 10262-2009. The weight ratio of mix proportion is 1: 2.56: 3.25 keeping water cement ratio 0.4. It was proposed to investigate the properties of concrete, cast and cured in water. In this experimental work, physical properties of materials used in the experimental work were determined. M40 grade of reference concrete was mixed and cured in potable water

TABLE 1 MIX PROPORTION FOR CONVENTIONAL CONCRETE

Cement	Fine Aggregate	Coarse Aggregate	W/C
350kg/m^3	840kg/m^3	1140 kg/m^3	140 kg/m^3

TABLE 2 QUANTITY FOR MIX PROPORTION OF PARTIAL REPLACEMENT OF CEMENT IN CONCRETE

w/c kg/m^3	Fine aggregate kg/m^3	Coarse aggregate kg/m^3	Cement kg/m^3	Fly ash kg/m^3	Silica fume kg/m^3	Cement Saved kg/m^3
140	840	1140	315	17.5	17.5	35
140	840	1140	280	35	35	70
140	840	1140	245	52.5	52.5	105

IV. Experimental Details

A. Compressive strength test

Compressive strength is one of the important properties of concrete. Concrete cubes of size 150 x150x150mm where casted. After 24 hours the specimen was de moulded and subjected to water curing. After 28 days of curing cubes were taken and allowed to dry and tested in compression machine. The ultimate load at which the cubes failed was noted.

Compressive strength $= Ultimate\ load / Area$

B. Spilt tensile strength test

Standard metallic cylinder moulds (150 x 300 mm) are casted After 24 hours the moulds were de moulded and subjected to water curing. Before testing the cubes were air dried for 2 hours. Split tensile strength is noted and average of 3 specimens was determined at 28days. The ultimate load of the specimen is at which the cylinder failed and the stress value is obtained in N/mm².

Tensile stress (N/mm²) =2P / ΠdI

P is the ultimate load at which the cylinder fails.

D is the diameter of the cylinder

L is the length of the cylinder

C. Flexural strength test

Concrete is relatively strong in compression and weak in tension. Direct measurement of tensile strength of concrete is difficult. Concrete beams of size 100 x 100 x 500 mm are found to be dependable to measure flexural strength property of concrete. The systems of loading used in finding out flexural strength are central point loading and third point loading. The testing machine may be of any reliable type of sufficient capacity for the tests and capable of applying the load at the rate specified.

Flexural strength $=\frac{Pl}{BD^2}$

P is the ultimate load at which the beam fails.

D is the diameter of the beam

B is width of beam

V. Results of conventional cement and blended cement concrete specimens

A. Comparison of Compressive strength test for 28 days

Compressive strength of all the 3 cubes are tabulated below

TABLE 3 COMPARISONS OF COMPRESSIVE STRENGTH TEST RESULTS FOR 28DAYS

Sl. No	Specimens	Conventional N/mm²	Blended		
			10% N/mm²	20% N/mm²	30% N/mm²
1	Cube 1	42.53	43.86	40.89	38.17
2	Cube 2	42.16	43.33	41.02	38.88
3	Cube 3	42.65	42.89	40.22	39.77
Average		42.43	43.36	40.71	38.74

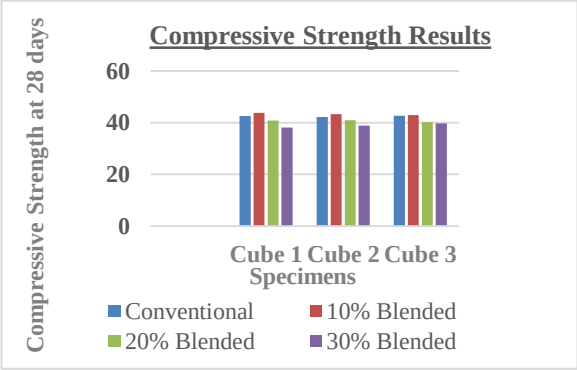

Figure 1 Compressive Strength of Conventional Concrete

B. Comparison of Spilt tensile strength test for 28days

Spilt tensile strength of all the 3 cylinders are tabulated below

Table 4 Comparisons Of Split Tensile Strength Test Results For 28days

Sl. No	Specimens	Conventional N/mm²	Blended		
			10% N/mm²	20% N/mm²	30% N/mm²
1	Cylinder 1	5.38	5.45	5.40	5.37
2	Cylinder 2	5.41	5.65	5.45	5.39
3	Cylinder 3	5.43	5.49	5.43	5.35
Average		5.41	5.54	5.42	5.37

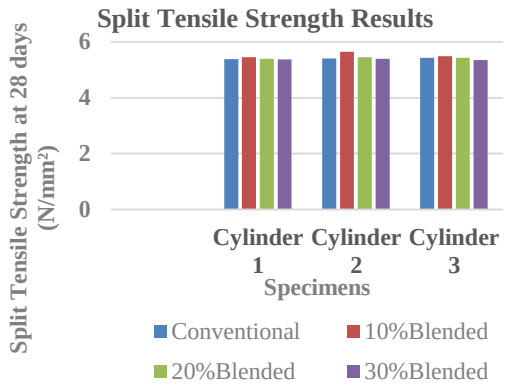

Figure 2 Split Tensile Strength Of Conventional Concrete And Blended Cement Concrete At 28 Days

C. Comparison of Flexural strength test for 28 days.

Flexural strength of all the 3 beams are tabulated below

TABLE 5 COMPARISONS OF FLEXURAL STRENGTH TEST RESULTS FOR 28DAYS

Sl. No	Specimens	Conventional N/mm²	Blended		
			10% N/mm²	20% N/mm²	30% N/mm²
1	Prism 1	6.69	6.73	6.70	6.65
2	Prism 2	6.65	6.78	6.75	6.61
3	Prism 3	6.68	6.89	6.72	6.69
Average		6.67	6.8	6.73	6.65

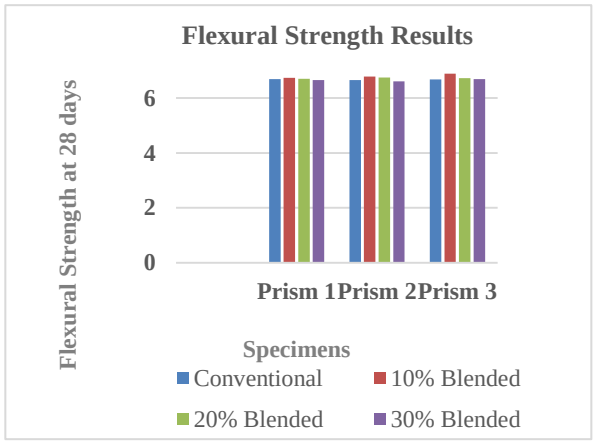

Figure 3 Flexural Strength Of Conventional Concrete And Blended Cement Concrete 28 Days

VI. Conclusion

- The properties of the cement fly ash and silica fume are determined and compared in this paper
- The replacement materials are said to have similar material properties as that of the cement and can be used as a replacement for cement
- The conventional cement concrete and blended cement concrete specimens are casted and the strength values are represented in this experimental work
- The mechanical properties are calculated for both blended and conventional concrete
- 10% Replacement of fly ash and silica fume gives the optimum result

VII. Works to be done

- To Cast reinforced concrete beams for conventional cement concrete and 10% replacement of fly ash and silica fume in cement
- To determine deflection and crack pattern of conventional cement concrete and blended cement concrete beams
- To Compare the results of conventional cement concrete and blended cement concrete beams

VIII. Acknowledgment

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