A STUDY ON COAL ASH IN REINFORCED CONCRETE BEAMS REPLACED WITH FINE AGGREGATES

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ABSTRACT

Now a day's the availability of aggregates decreases so we have decided to replacement of fine aggregates and partial replacement of cement with coal ash. A comparative analysis of the experimental results of the properties of fresh and hardened concrete with full replacement of fine aggregates with quarry dust and also partially replacing cement with varying ratio of coal ash is to be carried out in this project. Five types of concrete mixtures were tested concrete made entirely with natural aggregate concrete (NAC) as a control concrete and four types of concrete made with varying ratio of coal ash (10%, 20%, 30%,40%). Five specimens were made for the testing of the basic properties of hardened concrete. Load testing of reinforced concrete beams made of the investigated concrete types is also to be carried out in this project.

KEYWORDS: Quarry Dust, Coal Ash, Density, Water absorption, Compressive strength, Split tensile strength and Flexural Strength.

I. INTRODUCTION

Concrete is a mixture of cement, water, and aggregates, with or without admixtures. The cement and water will form a paste that hardens as a result of a chemical reaction between the cement and water. Concrete has relatively high compressive strength, but significantly lower tensile strength. The amount of industrial by-products, such as coal ash produced by coal-fired

power plants, continues to increase with the demand for more electricity. The study of the utilization of fly ash which is an industrial by-product dates back to the 1950s. Since then, owing to the results of many studies, fly ash has become utilized in diverse fields such as cement, concrete, civil engineering, agriculture, forestry, fisheries and construction. The utilization of fly ash in the fields of cement, in particular, accounts for approximately 90% of total use of coal ash in India . However , since the product amount of cement has decreased, caused by the recent stagnancy of construction demands, an increase in the utilization of coal ash in this field cannot be expected. Therefore, new ways of utilizing of coal ash should be developed.

Kenji Kabayama.,et al[7]Utilization of the coal ash is an urgent and important objective for the ecological and resources problem. Static loading tests were carried out to investigate shear characteristics of short R/C column containing high volume of coal ash, which included both fly ash and cinder ash. Lateral strength of the columns was able to estimate by the proposed formula for R/C members used normal concrete.. From these results, it is anticipated of using concrete containing high volume coal ash for R/C building structural member.

Hideo Araki., et al[2] Two types of static loading tests using full scale concrete columns containing high volume coal sash were carried out in the laboratory. The first one was the monotonic compressive loading tests of unreinforced full scale concrete columns to clarify the mechanical properties of concrete containing coal ash. In these tests, considered parameter was a mix property for concrete containing coal ash. The second one was the seismic loading tests of reinforced concrete columns which were designed as the flexural- shear failure type, subjected to lateral reversal loadings under the constant axial load, to clarify the seismic performance of those columns. From results of full scale columns, it is anticipated that there is strong possibility of using concrete containing high volume coal ash for reinforced concrete building structures.

P. Bhuvaneshwariand.,et al[5]Bottom ash is a hazardous by-product from coal based thermal power plants. In this study fine aggregate in concrete mix has been replaced with bottom ash and glass fibre isadditionally used to enhance the strength characteristics of concrete. The concrete mix design is done for M30 grade concrete. Results showed that there was no degradation of strength for beams with bottom ash as replacement for fine aggregates.

The properties of mineral admixtures are studied by carrying out strength and workability test. Then the concrete beams are filled with concrete by partial replacement of fine aggregate in concrete by mineral admixtures with various depths and the specimens are subjected to loading separately up to the failure. The load carrying capacity, deflection and crack pattern of the concrete beams are studied.

II. EXPERIMENTAL PROGRAM

2.1.MATERIALS USED

2.1.1.CEMENT

1. In the present investigation OPC 53 Grade PENNA brand cement confirming to(OPC) (IS 1489 PART I 1991)was used and its properties are tabulated in Table 1.

Sl.No	Physical properties of cement	Results
1	Specific gravity	3.12
2	Standard consistency (%)	28%
3	Initial setting time (min)	35
4	Final setting time (min)	500

Table 1: Properties of Cement

2.1.2. FINE AGGREGATE

The fine aggregate used in this experimental investigation was natural river sand confirming to zone II as per IS: 383-1987. Specific gravity is taken as 2.7

2.1.3. COARSE AGGREGATE

Crushed aggregates particles passing through 20mm and retained on 10mm I.S sieve was used as natural aggregates which met the grading requirements. Specific gravity is taken as 2.67

2.2. MIX PROPORTIONING

Concrete mix design for in this experiment was designed as per the guidelines specified in I.S. 10262-1982. The Table 4 shows mix proportion of concrete.

S.NO	SPECIMEN	CEMENT(%)	COAL ASH(%)	FINE AGGREGATE(%) 100		COARSE AGGREGATE(%)
				SAND	QUARRY ROCK DUST	
1	Controlled	100	0	100	0	100
2	0%	100	0	0	100	100
3	10%	90	10	0	100	100
4	20%	80	20	0	100	100
5	30%	70	30	0	100	100
6	40%	60	40	0	100	100

Table 2: Mix proportioning

III.EXPERIMENTAL METHODOLGY

The specimen of standard cube of 150mm x 150mm x 150mm and cylinders of 300mm x150mm and beam of 500x 100x100mm were casted and used to determine the compressive strength, split tensile strength and flexural strength of concrete. The constituents were weighed and the materials were mixed by machine mixing and vibrated by hand compaction. The water cement ratio adopted was 0.40 through all the mix proportions. The concrete was filled in different layers and each layer was compacted. The specimens were demoulded after 24 hrs, cured in water for 7 and 28 days and Compression Testing Machine (CTM) with capacity of 2000KN were used to test its compressive strength ,split tensile strength and flexural strength.

IV.RESULTS AND DISCUSSIONS

4.1. COMPRESSIVE STRENGTH

Compressive strength of concrete mixes made with and without Coal ash was determined at 7 and 28 days of curing. The test results are given in table and shown in figs. the variation of compressive strength with coal ash percentage at different ages. From the test results, it can be seen that the compressive strength of coal ash concrete mixes with 0%, 10%,20%,30% and 40% with fine aggregate replacement with quarry rock dust.

S.NO	SPECIMEN	COMPRESSIVE STRENGTH(N/mm^2)
1	CONTROLLED	16.12
2	0%	14.33
3	10%	15.23
4	20%	16.36
5	30%	14.96
6	40%	14.37

Table 3 Compressive strength at 7 days

The maximum compressive strength attained at 20% of partial replacement with cement gives 16.36 N/mm^2

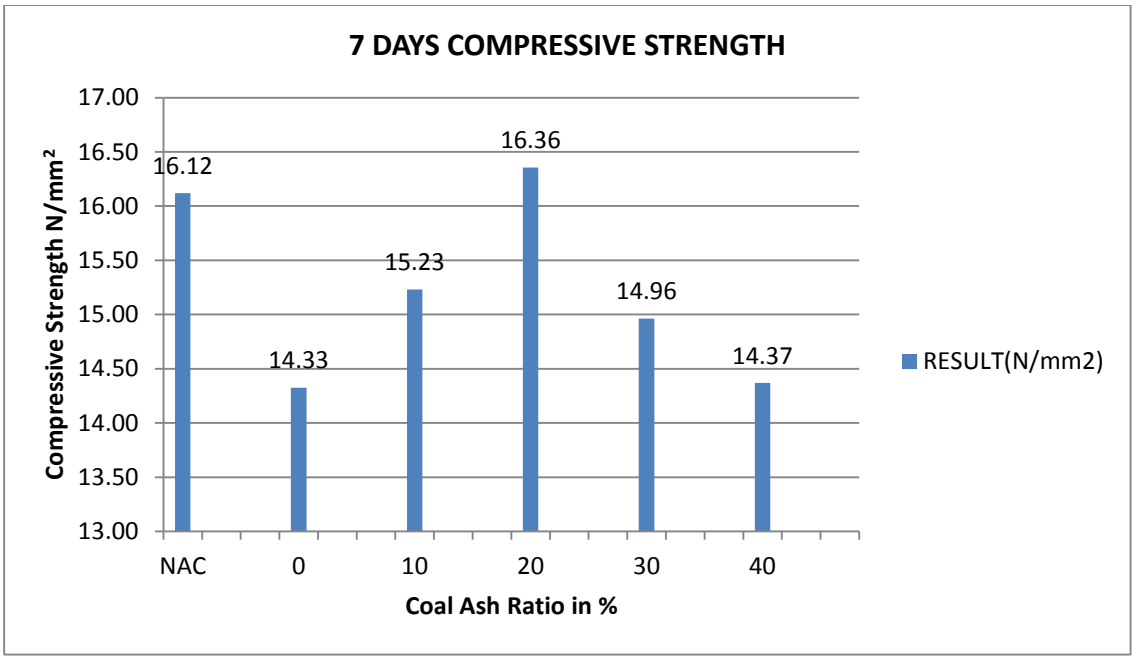

Figure 1. Graph result for compressive strength at 7 days

S.NO	SPECIMEN	COMPRESSIVE STRENGTH(N/mm²)
1	CONTROLLED	26.89
2	0%	22.46
3	10%	24.18
4	20%	26.96
5	30%	22.22
6	40%	21.66

Table 4 Compressive Strength at 28 days

The maximum compressive strength attained at 20% of partial replacement with cement in 28 days gives 26.96 N/mm^2

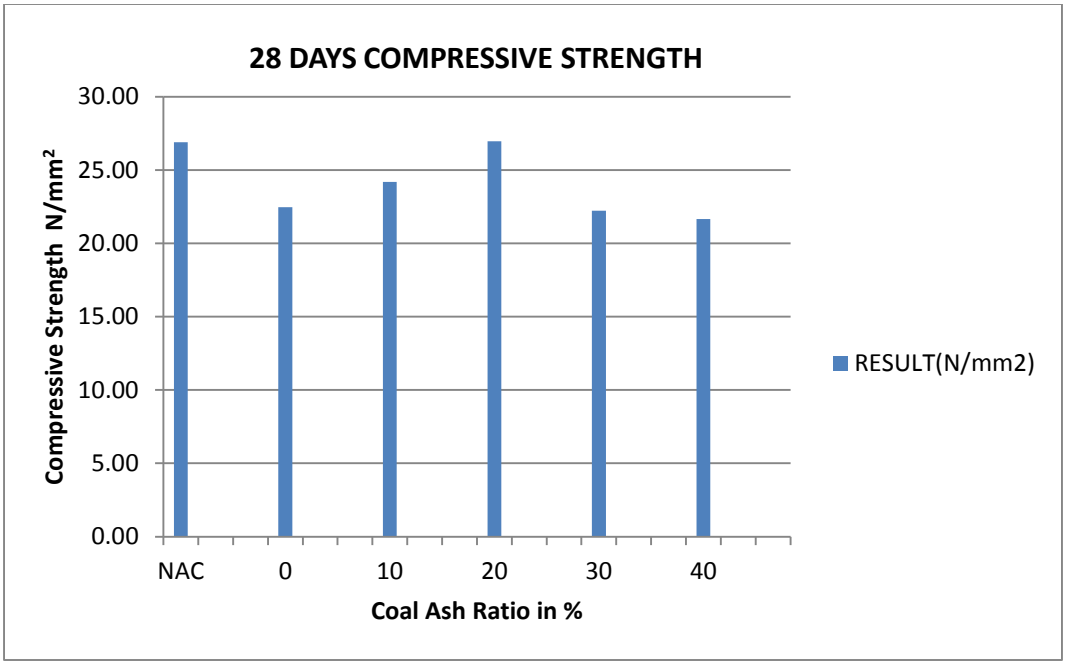

Figure 2. Graph result for compressive strength at 28 days

4.2. SPLIT TENSILE STRENGTH

A standard test cylinder of concrete specimen (300 mm X 150mm diameter) is placed horizontally between the loading surfaces of Compression Testing Machine .The compression load is applied diametrically and uniformly along the length of cylinder until the failure of the cylinder along the vertical diameter. To allow the uniform distribution of this applied load and to reduce the magnitude of the high compressive stresses near the points of application of this load, strips of plywood are placed between the specimen and loading platens of the testing machine. Concrete cylinders split into two halves along this vertical plane due to indirect tensile stress generated by poisson's effect.

S.NO	SPECIMEN	COMPRESSIVE STRENGTH (N/mm^2)
1	Controlled	1.42
2	0%	1.56
3	10%	1.92
4	20%	2.35

5	30%	1.98
6	40%	1.85

Table 5 Split Tensile Test [Cylinder]

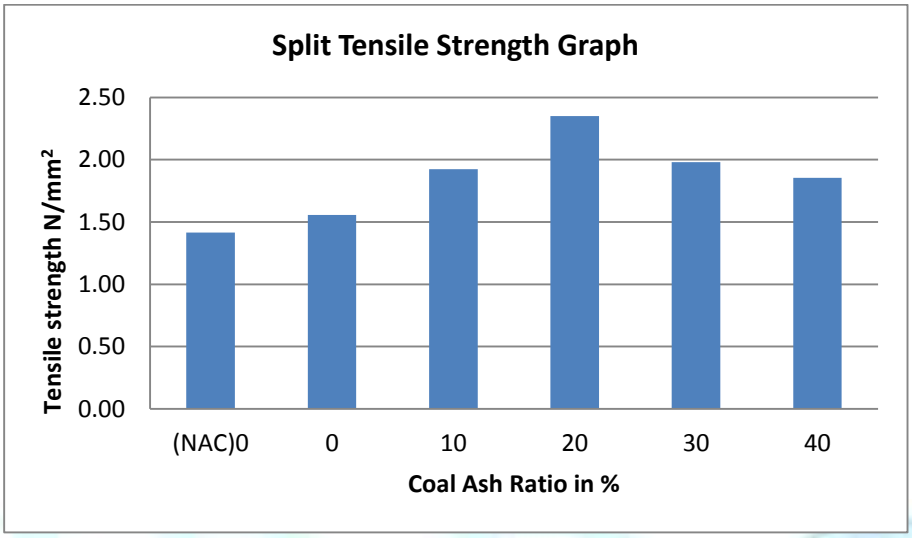

Figure 3.Graph result for Split tensile strength at 28 days

4.3 FLEXURAL STRENGTH

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength,a mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture.

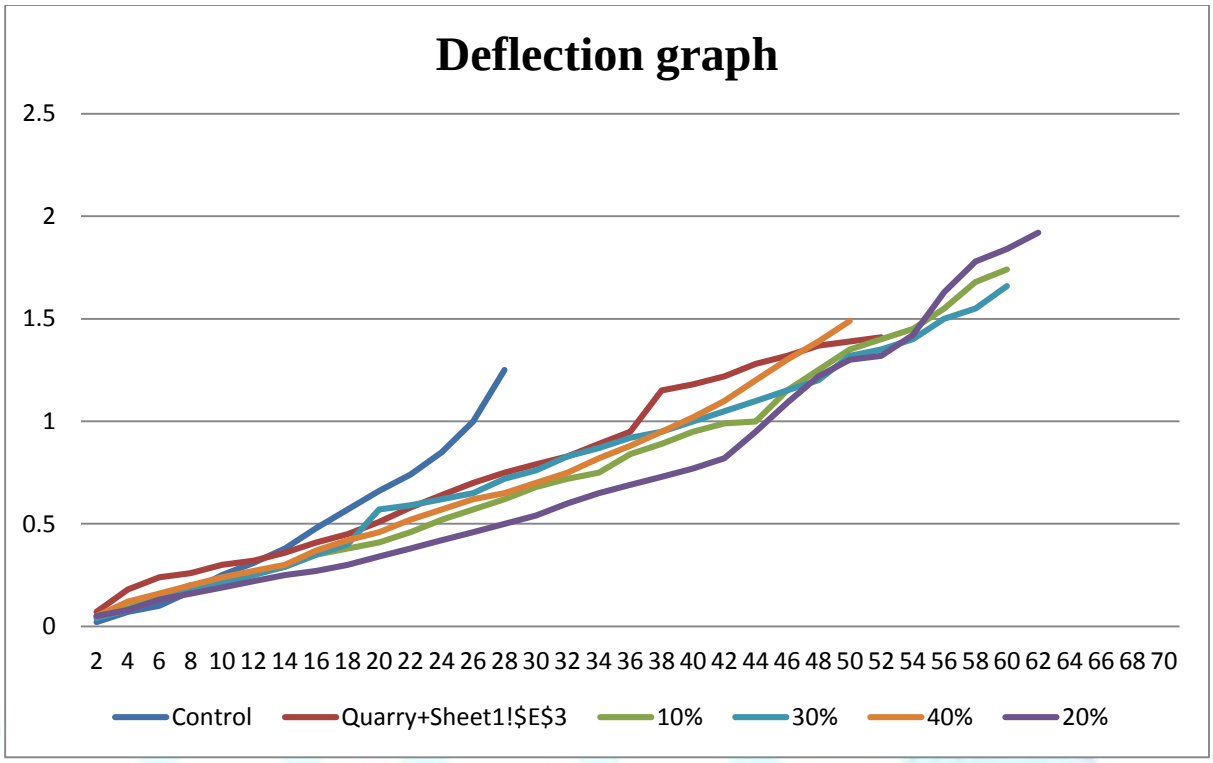

Figure 4 . deflection graph for beam

v . CONCLUSIONS

The following conclusions can be made on the basis of this study. The concrete with 20% coal ash cement replacement give the optimum compressive strength.It was generally observed that the flexural behaviour of coal ash concrete is comparable to that of ordinary Portland cement concretes and this investigation gives encouraging results for coal ash to be used as cement replacement substitutes in the production of structural concrete.The tested specimen results show that 20% coal ash ratio has similar compressive strength with NAC.The result obtained with 20% coal ash ratio along with complete replacement of sand by quarry dust was 2% higher than control specimen.From the graph,20% coal ash shows the maximum split tensile strength with 2.35N/mm^2 compared to other ratio. From the test results, it is confirmed that 20% replacement of coal ash show better result compared to other ratio

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