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AN EXPERIMENTAL INVESTIGATION ONPARTIAL REPLACEMENT OF CEMENT WITH FLY ASH AND RICE HUSK ASH IN M30 CONCRETE

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Abstract: ***The production of rice on a global scale results in significant quantities of agricultural waste. A leading constituent of this waste is rice husk. On combustion, it has been identified that the cellulose-lignin matrix of rice husk burns away leaving only a silica skeleton, along with small quantities of trace elements. In response to the continual evolution towards an environmentally aware society, there is increasing demand for the application of sustainable building materials and minimising of waste to landfill. The aim of this research is to determine the optimum quantity of Rice Husk Ash (RHA) and Fly Ash that can be incorporated as a supplementary cementitious material for partial replacement of Portland cement in M30 Concrete. This will be conducted through testing of the Compressive, Split Tensile Strength and Flexural strength of differ in amounts of RHA and Fly Ash ranging from 20% to 50% total replacement percentage. In the ancient period, construction work was mostly carried out with help of mudstone from industry. Fly ash is a by-product of burned coal from power station and rice husk ash is the by – product of burned rice husk at higher temperature from paper plant..Considerable efforts are being taken worldwide to utilise natural waste and bye–product as supplementary cementing materials to improve the properties of cement concrete. Rice husk ash (RHA) and Fly ash (FA) with using Steel fiber is such materials. RHA is bye-product of paddy industry..The test results revealed that the workability and strength are slightly better than the standard concrete by satisfying the limits initiated endorsed by standard. The reduction on cost by 3.08% relative to the initial values.The results of investigation and evaluation of study has proved that the selected materials as mentioned above may be useful for partial replacement of cement as presented in the results and ultimately helping the environment.***

Keywords: - Fly Ash, Rice Husk Ash, Super Plasticizer, Compressive Strength, Split Tensile Strength, Flexural Strength

I. INTRODUCTION

Concrete can be defined as the mixture of cement, sand, aggregate, and water. It is most extensively used man made building material all over the world. The popularity of the concrete is due to fact that the common ingredients, the properties of concrete can meet the demand of any type of engineering project. Concrete can be casted in almost every shape, that's why it is very popular and is used in various typical architectural forms. Several researchers have studied and reported the impact of using Fly Ash and Rice Husk Ash in Concrete, whereas few researches have been carried out using FA, RHA and Super plasticizers.Presently these materials are not being used commonly in construction industry of India. This research gives us the conclusion that how Fly Ash and Rice Husk Ash can be successfully and optimally used specially in nominal mixes say M30. Due to the environment concerns, the needs to save energy, various research efforts have been directed toward the utilization of waste materials. Fly ash is one of the residues produced in the combustion of coal in power generation facilities. Furthermore, the production and use of concrete has an enormous environmental effect this is because Cement is an energy consumer and CO2 fabricated material. Other factors and causes of CO2 emission are things such as products that use high temperature processes to produce elements such as cement, bricks; these are considered as a main user of energy and emitter of greenhouse gases. Other material productions that can lead to CO2 emission are lead, iron and other chemical creation such as ammonia and titanium dioxide that can definitely cause negative impact to the environment.The rice husk ash is obtained by burning of rice husk ash at temperature between 550 oC to 700 oC, then the rice husk may forms as cellular micro structure is produced. The rice husk ash has rich silica content of non-crystalline (or) amorphous silica form. It shows that rice husk can be used as supplementary cementitious materials due to its pozzolanic action.

Fig. 1.1 Rice Husk Ash

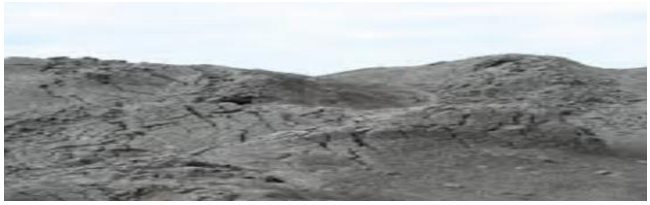

Fig. 1.2 Fly Ash

II. MATERIALS AND THEIR PROPERTIES

A. Cement

The cement use for the experimental studies was Ultra tech cement 43 grade OPC as per the specifications of Indian Standard Code IS: 8112-1989. The specific gravity of the cement was 3.10. The initial and final setting times were found as 65 minutes and 490 minutes respectively.

Table 2.1 Characteristics Properties Of Cement

Sr. No.	Characteristics	Experimental value	Specified value as per IS:8112-1989
1	Consistency of cement (%)	33%	---
2	Specific gravity	3.10	3.15
3	Initial setting time (minutes)	65	>30 As Per IS 4031-1968
4	Final setting time (minutes)	490	<600 As per IS 4031-1968
5	Compressive strength (N/mm^2) (I) 3 days (II) 7 days (III) 28days	 20.40 23.90 33.45	 >23 >33 >43
6	Soundness (mm)	1.00	10
7	Fineness of Cement	5%	10% As Per IS 269-1976

B. Coarse Aggregate:

The coarse aggregate used were a mixture of two locally available crushed stone of 20 mm and 10 mm size in 70:30 proportion.Coarse aggregate of maximum size 20mm and minimum 10 mm is used throughout the concrete. The specific gravity of course aggregate is 3.09.

C. Fine Aggregate:

Fine aggregate is used in this experimental study for concrete is river sand conforming to zone- II. The specific gravity of fine aggregates 2.65.

D .Fly Ash:

Fly Ash is a by-product of the combustion of pulverized coal in electric power generation plants Rajiv Gandhi Thermal Power Plant, Khedar, Hisar. Whenthe pulverized coal is ignited in the combustion chamber, the carbon and volatile materials are burned off. However, some of the mineral impurities of clay, shale, feldspars, etc., are fused in suspension and carried out of the combustion chamber in the exhaust gases. Specific Gravity of Fly Ash is 2.56.

Table No. 2.1

S.No.	Chemical Property	Percentage (%)
1	SiO_2	40
2	Al_2O_3	25
3	$Fe2O_3$	6
4	CaO	20
5	MgO	3.71
6	$K_2O+ N_2O$	1.76
7	SO_3	1.74
8	LOI	3.0

E .Rice Husk Ash (Rha)

Rice Husk Ash is the ash that is obtained by burning the rice husk until it gets reduced by 25%. The Rice Husk for the research was obtained locally. These Husk then were deliberated until fine ash is being produced. These ashes were sieved by the 600 micron where further impurities are being minimized. Specific Gravity of Rice Husk is 2.32.Specific Gravity is 1.09.

TABLE NO. 2.2

S/NO.	CHEMICAL PROPERTY	PERCENTAGE
1	SiO_2	86%
2	Al_20_3	2.6 %
3	Fe_2O_3	1.8 %
4	CaO	3.6 %
5	MgO	0.27 %
6	Loss in Ignition	4.2%

F. Superplasticizer

The superplasticizer “GLENIUM™ B233” procured from SIKA India Pvt. Limited was used in this study. The dosage of superplasticizer recommended is 0.6% to 2% by weight of cementitous material.

G .Water :

Water used for mixing and curing was clean and free from injurious amounts of oils, acids, alkalis, salts and sugar, organic substances that may be deleterious to concrete. As per IS 456- 2000 Potable water is generally considered satisfactory for mixing and curing of concrete. Accordingly potable tap water was used for the preparation of all concrete specimens.

Table No.-2.2 Physical Properties of Aggregates

Sr.No.	Properties of Material	
1	Specific Gravity of Cement	3.10
2	Specific Gravity of Fly Ash	2.56
3	Specific Gravity of Rice Husk Ash (RHA)	2.32
4	Specific Gravity of Coarse Aggregates	3.09
5	Specific Gravity of fine aggregate	2.65
6	Free Moisture Content	1.40%

III. EXPERIMENTAL PROGRAM

As recommended by the IS Standard of a particular size cubical moulds of size 150mm×150mm×150mm and cylinder mould of depth 150mm was ,height 300mm and dia of 100mm and beam mould of 150mm×150mm×700mm made of cast iron were used to cast concrete specimens to test compressive strength ,split tensile strength and flexural strength respectively. The quantities of cement, fine aggregates, coarse aggregates, and water for each batch were weighted to an accuracy of 1kg separately. Silica fume and quarry glass fibre is added to this mixture in dry form. Finally, coarse aggregates were added and thoroughly mixed to get a uniform mixture throughout the batch. Required dosage of water was added in the course of mixing.foe eliminate the voids a proper vibration was doing by the vibrating machine.. Surface of concrete was finished level using a trowel and date along with batch number was marked properly on it. Finished specimens were left to harden and removed from moulds approximate after 24 hours of casting. They were then placed in water tank containing portable water and were left for curing.

Fig 3.1 Fly Ash & RHA Mixing in Concrete

Fig 3.2 Addition of AF & RHA into Mix

IV. TESTING OF CONCRETE

The test compression and split tensile strength was checked at the age of 7 and 28 days of moist curing and were then tested. Specimens were tested on 1000 tones capacity of universal testing machine (UTM). The load was applied gradually without any shock and increased at constant rate of 14 N/mm²/minute until failure of specimen takes place, thus the compressive strength of specimen was found out by dividing the compressive load to area under compression. For flexural strength testing a flexural testing machine was used as recommended by IS code.

Fig. No.4.1: Testing of Cube

Table-4.1: Compressive Strength by Adding Fly Ash and RHA Concrete

Sr. No.	FA+ RHA	Superplasticizer%	Compressivestrength in 7 days	CompressiveStrength in 28 days
1	0	0	22.82	32.74
2	7.5	1	23.26	34.37
3	15	1.2	23.93	36.59
4	22.5	1.4	24.37	37.56
5	30	1.6	22.52	34.00

Table-4.2: Flexural Strength by Adding Glass Fibre & Silica Fume in Concrete.

Sr. No.	FA+ RHA	Superplasticizer %	Flexuralstrength in 7 days	Flexuralstrength in 28 days
1	0	0	1.45	2.17
2	7.5	1	1.49	2.28
3	15	1.2	1.64	2.42
4	22.5	1.4	1.68	2.48
5	30	1.6	1.50	2.16

Table-4.3: Split Tensile Strength by Adding Glass Fibre & Silica Fume in Concrete

Sr. No.	FA+ RHA	Superplasticizer %	Split Tensilestrength in 7 days	Split Tensilestrength in 28 days
1	0	0	1.75	3.20
2	7.5	1	1.86	3.37
3	15	1.2	2.03	3.47
4	22.5	1.4	2.07	3.61
5	30	1.6	1.53	2.75

4.1 INTERPRETION OF TEST RESULTS

4.1.1 Compressive strength

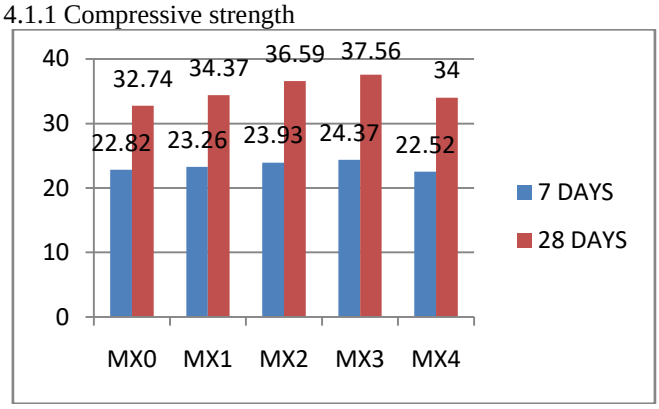

Fig.4.2 : Graph comparing compressive strength for 7 and 28 days

4.1.2 Flexural Strength

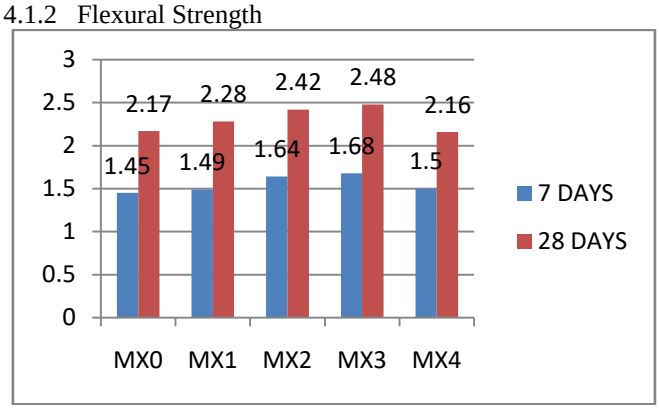

Fig 4.3 Graph comparing Flexural strength after 7 & 28 days

4.1.3 Split Tensile Strength

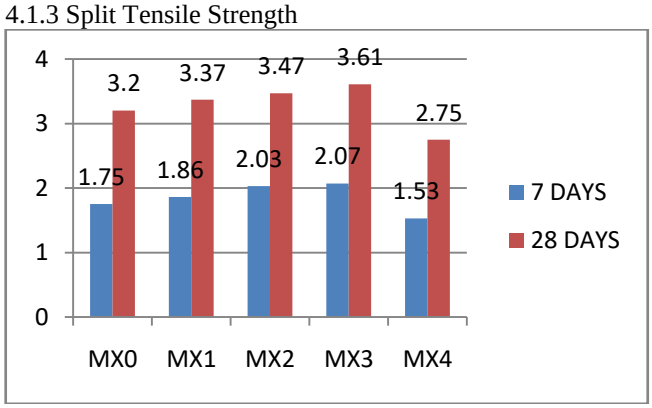

Fig. 4.4: Graph comparing Spilt Tensile strength for 7 and 28 days

V. CONCLUSION

1. From the results of the present research the following conclusion may be drawn:-
2. The workability of concrete had been found to be increase with fly ash(FA).
3. The workability of concrete had been found to be decrease with increasing the rice husk(RHA) in concrete.
4. The inclusion of steel fiber reduces the workability with increasing fiber content.
5. Maximum compressive strength obtained for 28 days is 53.77 N/mm2 with the replacement of 22.5% of cement by fly ash (FA) and Rice Husk Ash (RHA)
6. Maximum flexural strength obtained for 28 days is 5.89 N/mm2 with the replacement of 22.5% of cement by fly ash (FA) and Rice Husk Ash (RHA).
7. Maximum split tensile strength obtained for 28 days is 4.21N/mm2 with the replacement of 10% of cement by fly ash (FA) and Rice Husk Ash (RHA).
8. Compressive strength increase with increasing the percentages of fly ash (FA), rice husk(RHA) upto replacement (15% FA and 7.5%RHA) of cement in concrete.
9. Flexural strength increase with increasing the percentages of fly ash(FA), rice husk(RHA) upto replacement (15% FA and 7.5 %RHA) of cement in concrete.
10. Split tensile strength increase with increasing the percentages of fly ash(FA), rice husk(RHA) and upto replacement (15% FA and 7.5 %RHA) of cement in concrete.
11. It is found that the addition of Super Plasticizer into concrete the small change in compressive strength, flexural strength and split tensile strength.

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