EXPERMENTAL STUDY ON THE COMBINE EFFECT OF FLY ASH AND RICE HUSK ASH ON CONCRETE BY 35.7% CEMENT REPLACEMENT

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Abstract: ***In this paper, the detailed experimental investigation was done to study the effect of partial replacement of cement by Fly Ash (FA) and Rice Husk Ash (RHA) in combine proportion started from 30% FA and 5% RHA and constant weight of admixture 0.7%@ weight of cement through out different mixes together in concrete by replacement of cement with the gradual increase of RHA by 5% and simultaneously gradual decrease of FA by 5%. Last proportion was taken 15%FA and 20% RHA. The tests on hardened concrete were destructive in nature which includes compressive test on cube for size (150 x 150 x 150 mm) at 7,14,,28, days of curing as per IS: 516 1959, Flexural strength on beam (150 x 150 x700 mm) at 28 days of curing as per IS: 516 1959 and split tensile strength on cylinder (150 mm ø x 300mm) at 28 days of curing as per IS: 5816 1999. The work presented in this paper reports the effects on the behavior of concrete produced from cement with combination of FA and RHA at different proportions on the mechanical properties of concrete such as compressive strength, flexural strength, and split tensile strength. Investigation reported that compressive strength increases by 42% in compared with targeted strength and reduces by 2% compared with control concrete at 28 days, flexural strength increases by 2.86% compared with control concrete at 28 days, split tensile strength decreases by 11% compared with control concrete at 28 days, were obtained at combination of 15% FA and 20% RHA. Partial replacement of FA and RHA reduces the environmental effects, produces economical and eco-friendly concrete.***

Keywords: Fly Ash, Rice husk Ash, Flexural Strength, Admixture(NaoH), Compressive Strength, Split Tensile Strength

I. INTRODUCTION

Concrete is the most widely used construction material on this planet. Concrete is the mixture of cement, coarse aggregates, and fine aggregates with water.Concrete is a heterogeneous mix of cement, water and aggregates. The admixtures may be added in concrete in order to enhance some of the properties desired specially. In its simplest form, concrete is a mixture of paste and aggregates. Various materials are added such as fly ash, rice husk, and admixture to obtain concrete of desired property. The character of the concrete is determined by quality of the paste . The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients.

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 artificial fibers are commonly used nowadays in order to improve the mechanical properties of concrete. 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 admixture is such materials. RHA is bye-product of paddy industry. Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk. FA is finely divided produced by coal-fired power station(Fly ash possesses pozzolonic properties similar to naturally occurring pozzolonic material. Fly ash used in this project was collected from deenbandhu chhotu Ramthermal power station yamnagar Haryana India and Rice used was obtained from Chachu Majra Paper mill Raipura Mohali Punjab

Over the past years, there has been an increasing number of papers on the use and utilization of industrial, agricultural and thermoelectric plants residue in the production of concrete. Different materials with pozzolanic properties such as fly ash, condensed silica fume, blast-furnace slag and rice husk ash have played an important part in the production of high performance concrete. During the late 20th century, there has been an increase in the consumption of mineral admixture by the cement and concrete is met by partial cement replacement . Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy intensive Portland cement. Among the different existing residues and by products, the possibility of using rice husk ash in the production of structural concrete is very important for India. India is the second largest rice paddy cultivating country in the world. Both the technical advantages offered by structural concrete containing rice husk ash and the social benefits related to the decrease in number of problems of ash disposal in the environment have simulated the development of research into the potentialities of this material. A large amount of agricultural waste was disposed in most of tropical countries especially in Asia for countries like India, Thailand, Philippine and Malaysia. If the waste cannot be disposed properly it will lead to social and environmental problem. Recycling of the disposed material is one method of treating the agricultural waste. The used of rice husk ash material in the formation of a composite material that can be used for construction. Rice husk ash is hazardous to environment if not dispose properly

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2 .2 OBJECTIVES OF RESEARCH WORK

- Study the combined effect of Rice Husk ash and fly ash as partial replacement with cement on the properties of fresh concrete (Workability)
- Study the combined effect of Rice husk ash and fly ash as partial rerplacement with cement on the strength of the concrete after desired period of curing
- **Study the binding peoperties of Rice husk ash and fly ash on partial replacement witjh cement**
- To reduce the carbondixoide emission by replacement of cement witn Rice husk ash and fly ash to make the environment eco-friendly

2.3 EXTENT OF INVESTIGATION WORK

- Characterization of the material
- Prepare conventional design mix
- Preparation of concrete mixes with replacement cement
- Studying the properties of fresh plain concrete with Rice Husk Ash and fly ash
- Testing for strength properties of plain concrete with Rice husk ash and fly ash
- Testing for workability properties of plain concrete , with Rice husk ash and fly ash

3.1 IMPORTANCE OF RESEARCH

There has been growing trend of using waste materials for various purposes. Disposing of waste materials has adverse impact on environment. Hence degradation of environment takes place. Also accumulation of industrial waste and excessive use of resource are main concern in present day. Therefore waste materials like granulated blast furnace slag ,,rice husk Ash,, fly ash , Silica fume have been used as partial replacement of cement . For making concrete cheap and protecting the environment utilizing the waste material. Utilization of Rice Husk ash and fly ash in concrete is not common throughout the world. In India there was no significant research has been done on utilization of fly ash. Use of Rice husk Ash, and fly ash has two main advantages, utilization as construction material and better dumping method.

4.1 LITRATURE REVIEW

4.2 (Deepa G Nair,) Investigated on high strength and high performance concrete which are being widely used all over the world. Most of the applications of high strength concrete have been found in high rise buildings, long span bridges etc. The potential of rice husk ash as a cement replacement material is well established .Earlier researches showed an improvement in mechanical properties of high strength concrete with finely ground RHA as a partial cement replacement material. A reviewof literature urges the need for optimizing the replacement level of cement with RHA for improved mechanical properties at optimum water binder ratio. His findings discusses the mechanical properties of RHA- High strength concrete at optimized conditions.

4.3 (Makarand Suresh Kulkarni,) In this investigation optimized RHA, by controlled burn and or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. Up to now, little research has been done to investigate the use of RHA as supplementary material in cement and concrete production in Vietnam.The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the various structural properties of concrete like compressive strength.His findings from the entire experimental work & studies concluded that mix M2 (M0+20%RHA) is the best combination among all mixes, which gives max, tensile, flexure & compression strength over normal concrete.

4.4 (Alvin Harison, 2014) Investigated out to study the utilization of non-conventional building material (fly ash) for development of new materials and technologies. It is aimed at materials which can fulfil the expectations of the construction industry in different areas. In this study, cement has been replaced by fly ash accordingly in the range of 0% (without fly ash), 10%, 20%, 30%, 40%, 50% and 60% by weight of cement for M-25 mix with 0.46 water cement ratio. Concrete mixtures were produced, tested and compared in terms of compressive strength. It was observed that 20% replacement Portland Pozzolana Cement (PPC) by fly ash strength increased marginally (1.9% to 3.2%) at 28 and 56 d respectively. It was also observed that up to 30% replacement of PPC by fly ash strength is almost equal to referral concrete after 56 d. PPC gained strength after the 56 d curing because of slow hydration process.

4.5 (Dr S L Patil, 2012) Investigated out to study the utilization of fly ash in cement concrete as a partial replacement of cement as well as an additive so as to provide an environmentally consistent way of its disposal and reuse. This work is a case study for Deep Nagar thermal power plant of Jalgaon District in MS. The cement in concrete matrix is replaced from 5% to 25% by step in steps of 5%. It is observed that replacement of cement in any proportion lowers the compressive strength of concrete as well as delays its hardening. This provides an environmental friendly method of Deep Nagar fly ash disposal.

A) Camoes, 2003) Investigated the possibility of producing low cost enhanced performance concrete or even low ost High performance concrete(HPC), with 28 day strength in the range of upto 60 MPa, using low quality as received materials like fly ash and locally available crushed aggregates.
B) In this wa,significant reduction in the use of Portland cement, as well as that scarce natural resources would be obtained. The effect of amount of fly ash was evaluated using0, 20%, 40% and 60% cement replacement in the mixures with different quantities of toatal binder (400kg/m3, 500kg/m3 and 600kg/m3). Workability, mechanical and durability properties of the produced concretes were studied. Findings indicate that it is possible to produce HPC with upto 60 MPa by replacing upto 40% of cement by fly ash and using local available crushed granite aggregates.

4.6 (Shaswata Mukherjee, 2012) Investigated out to study the physical and mechanical property of high volume fly ash cement paste. Ordinary portland cement was replaced by 0, 20, 30, 40, 50, 60 and 70 % class F fly ash (by weight). Water- binder ratio in all mixture was kept constant at 0.3. Cube specimens were compacted in table vibrator. As expected bulk density decreases with fly ash increment in the mixture. Apparent porosity and water absorption value increases with replacement ofcement by fly ash. Results confirm the decrease in compressive strength at 3, 7 and 28 day with fly ash addition and it is more prominent in case of more than 30% fly ash content mixes. Ultrasonic pulse velocity test results indicate that the quality of the paste deteriorate with increase of fly ash content in the mixture

5.1 Materials and Methods

The work presented in this paper reports an investigation on the behaviour of concrete produced from partial replacement of cement with RHA and FA. The physical and chemical properties of RHA, FA and OPC were first investigated. Mixture proportioning was performed to produce high workability concrete with target strength of 38.25 Mpa (M30) for the control mix. The effects of RHA and FA on concrete properties were studied by means of the mechanical properties of concrete i.e. compressive strength, split tensile strength, and flexural strength.

5.2 Cement

A cement is a binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together.The cement used was Ordinary Portland cement (43 Grade) with a specific gravity of 3.15. Initial and final setting time of the cement was 23 min and 365 min, respectively, conforming to I.S-8112- 1989.

Table5. 1 Chemical Compopsition of Opc 43 Grade Cement

Particular	Praportion
Lime	60-67%
Silica	17-25%
Alumina	3-8%
Iron Oxide	0.5-6%
Magnesia Oxide	0.1-4%
Sulphur trioxide	1-3%

Soda and Potash	0.5-1.3%

The proportions of the above four compounds vary in the various Portland cements. Tricalcium silicate and dicalcium silicates contribute most to the eventual strength. Initial setting of Portland cement is due to tricalcium aluminate. Tricalcium silicate hydrates quickly and contributes more to the early strength.The contribution of dicalcium silicate takes place after 7 days and may continue for up to 1 year. Tricalcium aluminate hydrates quickly, generates much heat and makes only a small contribution to the strength within the first 24 hours. Tetracalcium alumino-ferrite is comparatively inactive.All the four compounds generate heat when mixed with water, the aluminate generating the maximum heat and the dicalcium silicate generating the minimum. Due to this, tricalcium aluminate is responsible for the most of the undesirable properties of concrete.Cement having less C3A will have higher ultimate strength, less generation of heat and less cracking. Table below gives the composition and percentage of found compounds for normal and rapid hardening and low heat Portland cement.

5.3 Rice Husk Ash

Rice husk ash used was obtained from chachu Majra Paper mill Plant located in, rajpora Mohali Punjab India India .The Specific gravity of rice husk ash is 2.14 and bulk density is 0.781 g/cc RHA, produced after burning of Rice husk (RH) has high reactivity and pozzolanic property. IS 456- 2000 , recommends use of RHA in concrete but does not specify quantities. Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature.

Table5. 2 Chemical Compositions of RHA

Particular	**Praportion**
Silicon Dioxide	36-94%
Aluminium Oxide	0.%
Iron Oxide	0.1%
Calcium Oxide	0.3-0.2
Sodium Oxide	0.1%
Potassium Oxide	2.15%
Ignition Oxide	3.15-4%

4 Fly Ash

Fly ash used was obtained deenbandhu chhotu Ram thermal Power Plant Yamna nagar haryana India. Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of power generation facilities, whereas bottom ash is, as the name suggests, removed from the bottom of the furnace. In the past, fly ash was generally released into the atmosphere via the smoke stack, but pollution control equipment mandated in recent decades now require that it be captured prior to release. It is generally stored on site at most US electric power generation facilities. Depending upon the source and makeup of the coal being burned, the components of the fly ash produced vary considerably, but all fly ash includes substantial amounts of silica (silicon dioxide, SiO2) (both amorphous and crystalline) and lime (calcium oxide, (CaO). Fly ash is commonly used to supplement Portland cement in concrete production, where it can bring both technological and economic benefits, and is increasingly finding use in synthesis of geopolymers and zeolites

Table5.3 : Physical properties of the fly ash used

Particular	**Compositions**
Colour	Whitish grey
Bulk density	(g/cm3)0.994
Specific gravity	2.288
Moisture	3.14%
Average particle size	6.92 (ppm)

5.5 Fine Aggregates

fine aggregate obtained from river is considered as best fine aggregate but we use meachine crushed fine aggregate The fineness modulus, specific gravity and dry density are 2.32, 2.47and 1500 kg/m^3. Coarse aggregate passing through 20mm and retained 10mm sieve was used. Its specific gravity and dry density was 2.7 and 1550 kg/m

5.6 COARSE AGGREGATE

Coarse aggregate is a inert material which retains on the sieve of mesh having size 4.75mm is callled coarse aggregate.Gravels obtained from river bed are best in making common concrete if they are not easily available, suitable rock types are crushed to desired particle size for making coarse aggregates.its specific gravity and dry density is as follows 2.54 and 1600kg\mm

5.7 CHEMICAL ADMIXTURE (NaoH*)*

The main aim to used admixture was to maintain the workability of concrete with constant w/c by partial replacement of cement combination of FA and RHA. Due to high specific surface area of RHA which would increase the water demand, the experimental work need addition of super plasticizers. Sodium Hydroxide, also known as lye,it is an inorganic compound with the formula NaOH. It is a white solid ionic compound consisting of sodium cations Na^+ and hydroxide anions $OH^−$, the main aim of using sodium hydroxide crystals in this project was to decrease the intial setting time, water cement rationand increase the strength of concrete

6.1 EXPERIMENTAL PROGRAMME

Slump Test :- Slump test was used performed to find out the workability of fresh concrete.

Compaction Factor Test:- Compaction factor test was performed in laboratory to determine the consistency of fresh concrete.

6.2 Results Determined On Fresh Concrete

Slump =**110mm**

Compaction factor = **0.92**

Experimental programme comprises of test on cement, RHA, FA, concrete with partial replacement of cement with RHA and FA.

6.3 Rice Husk Ash

Rice Husk Ash was tested for different tests and test results as follows:

Normal Consistency = 17%

Initial and Final Setting time = 195 min. and 265 min.

Compressive Strength = 11 N/mm^2

Specific Gravity = 2.86

5.3 Ordinary Portland Cement

OPC 43 grade cement is used for this whole experimental study.

Ordinary Portland cement of 43 grade were tested for different tests and physical test results on OPC were as follows:

Normal consistency = 22%

Initial Setting time = 23 min.

Final Setting Time = 365 min.

Specific Gravity = 3.15

7.1 MIX DESIGN FOR M30 GRADE OF CONCRETE (1:2.15:3.30)

The mix proportion was done as per the IS 10262- 1982 The target mean strength was 38.25 Mpa (M30) for the OPC control mixture, the total binder content was 335 kg/m^3 , fine aggregate was taken 715.32kg/m^3 and coarse aggregate was taken 1104.62 kg/m^3. The water to binder ratio was kept constant as 0.5, the Super plasticizer content was varied to maintain a slump for all mixtures. The total mixing time was 5 minutes, the samples were then casted and left for 24 hrs before demoulding They were then placed in the curing tank until the day of testing Cement, sand, Fly ash, Rice husk ash and fine and coarse aggregate were properly mixed together in ratio 1:2.15:3.30by weight before water was added and was properly mixed together to achieve homogenous material. Water absorption capacity and moisture content were taken into consideration and appropriately subtracted from the water/cement ratio used for mixing reported the blending of rice husk ash (RHA) in cement is recommended in most international building codes now. Hence, cement was replaced in 30% with fly ash and 5% rice husk ash , Beam and Cylinder moulds were used for casting. Compaction of concrete in three layers with 25 strokes of 16 mm rod was carried out for each layer. The concrete was left in the mould and allowed to set for 24 hours before the cubes were de moulded and placed in curing tank. The concrete cubes were cured in the tank for 7, 14, and 28 days for compression test.

MIX DESIGN FOR M30 GRADE OF CONCRETE

Mix proportion for M30 grade of concrete per cubic meter as follows

TABLE 7.1

MATERIAL	QUANTITY	PROPORTION

Cement	335 Kg/ m^3	1
Sand	715.32 Kg/ m^3	2.15
Coarse Aggregates	1104.62 Kg/ m^3	3.30
Water	167.5 Kg/ m^3	0.00
Slump	75-100 mm	-----

Mix proportion for compressive strength test having cube size 150x150x150mm

Mix Design	% of cement	weight of cement in kg	% of fly ash by weight of cement	% of RHA by weight of cement	(NAOH)@ 0.7%by weightof cement.	Fine aggregate in kg	Coarse Aggregate
Mix C	99.3%	1.152	0%	0%	.00812 kg	2.55kg	4.23kg
Mix 1	64.3%	0.7458	30%	5%	.00812 kg	2.55kg	4.23kg
Mix 2	64..3%	0.7458	25%	10%	.00812 kg	2.55kg	4.23kg
Mix 3	64.3%	0.7458	20%	15%	.00812 kg	2.55kg	4.23kg
Mix 4	64..3%	0.7458	15%	20%	.00812 kg	2.55kg	4.23kg

In this experimentation, cement was partially replaced by combinations of Rice Husk Ash (RHA) and Fly ash (FA). Test was started with control concrete of M30 grade. Then, replaced the 35 % cement with RHA and FA with first mix by 30% fly ash and 5% rice husk ash, different mixes were prepared increasing the 5% of RHA up to 20% and decreasing fly ash by 5% upto 15% .adding admixture at constant rate of .7% by weight of cement through out different mixes

Following table shows the percentage variations of cement, fly ash and rice husk ash.

Table 7.2 Proportion of Cement, Rice Husk Ask and Fly ash for testing

Design MIXES	% of Cement	% of FlyAsh	% of RHA
CONT	100%	0%	0%
MIX 1	64.3%	30%	5%
MIX 2	64.3%	25%	10%
MIX 3	64.3%	20%	15%
MIX 4	64.3%	15%	20%

8.1 Experimental Methodology

Test on Fresh Concrete

Fresh concrete was tested using slump cone test to find the workability of control concrete and concrete of combination of FA and RHA with partial replacement of cement.

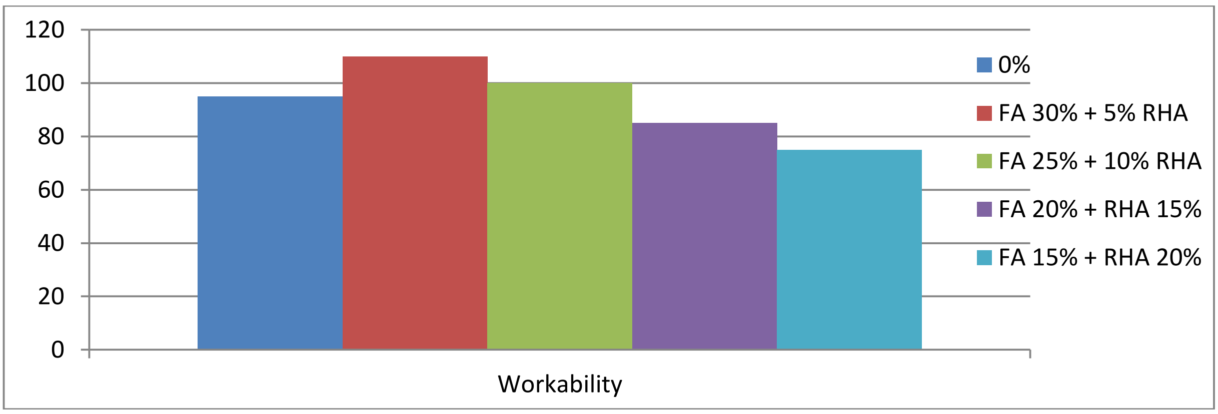


Fig.2 Workability of concrete using slump cone method

Along Y axis of Histogram is different Slump Values and along Xaxis is control mix and mixes with different replacement of Fly ash and Rice Husk Ash

Figure2 shows the comparative effects of addition of FA and RHA on workability of concrete. It was obser ved that FA increases the workability of concrete upto 15% as compared to control concrete. Gradual increase of RHA and gradual decrease FA shows gradual decrease in workability upto 20% as compared to compared concrete.
Addition of FA increases in workability because it has very low binding property and addition of RHA decreases workability due to water absorbent property because it has high specific surface area

8.2TESTS ON HARDNED CONCRETE

Tests were done as per following codes of Bureau of Indian Standards. The test for compressive strength on cubes were measured at 7, 14, and 28 days of curing as per IS : 516 1959, test for flexural strength on beam was measured at 28 days of curing as per IS : 516 1959 [12] and test for split tensile strength on cylinder was measured at 28 days of curing as per IS : 5 816 1999

8.3 Compressive Strength Test

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M30 grade of concrete. The moulds were filled with different proportions of cement, Rice Husk Ash and Fly Ash. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank where in they were allowed to cure for 7,14 and 28 days. After 7,14,,and 28 days curing, these cubes were tested on digital compression testing machine as per I.S. 516 1959. The failure load was noted. In each category, three cubes were tested and their average value is reported.it was observed that 42% strength was increased as compared to target mean strength and 2% strengtrh decrease as compared to control concrete at 28days of curing at combinatioin of 25% of fly ash and 10% of rice husk ash
The compressive strength was calculated as follows:
Compressive strength (MPa) = Failure load / cross sectional area.

8.4Flexural Strength Test

The standard sizes of beam specimen were 15x15x70 cm. The beam moulds conform to IS:10086 1982 . Compacting of concrete wil l be done by vibration as per IS: 516 1959. Curing: Test specimens shall be stored in water at a temperature of 24^0 34 ^{0}c for 48 hours before testing. The specimens shall be tested immediately on removal from the water while they are still in the wet condition. The Flexure test was performed on two point loading system.Flexural tensile strength using beam specimen for M 30 grade of concrete.It was observed that maximum flexural strength was obtained at combination of 25% fly ash and 10% of rice husk ash and strength was increased by 2.86% as compared to control mix after 28 days of curing

8.5 Tensile strength test

For tensile strength test of M30 grade concrete , cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category, three cylinders were tested and their average value was reported.It was observed that split tensile strength at combination of 25% of fly ash and 10% of rice husk ash decreases by 11% as compared to control mix after 28 days of curing. Tensile strength was calculated as follows as split tensile strength:

$\text{Tensile strength (MPa)} = 2P / \pi DL$ Where, P = failure load, D = diameter of cylinder, L = length of cylinder.

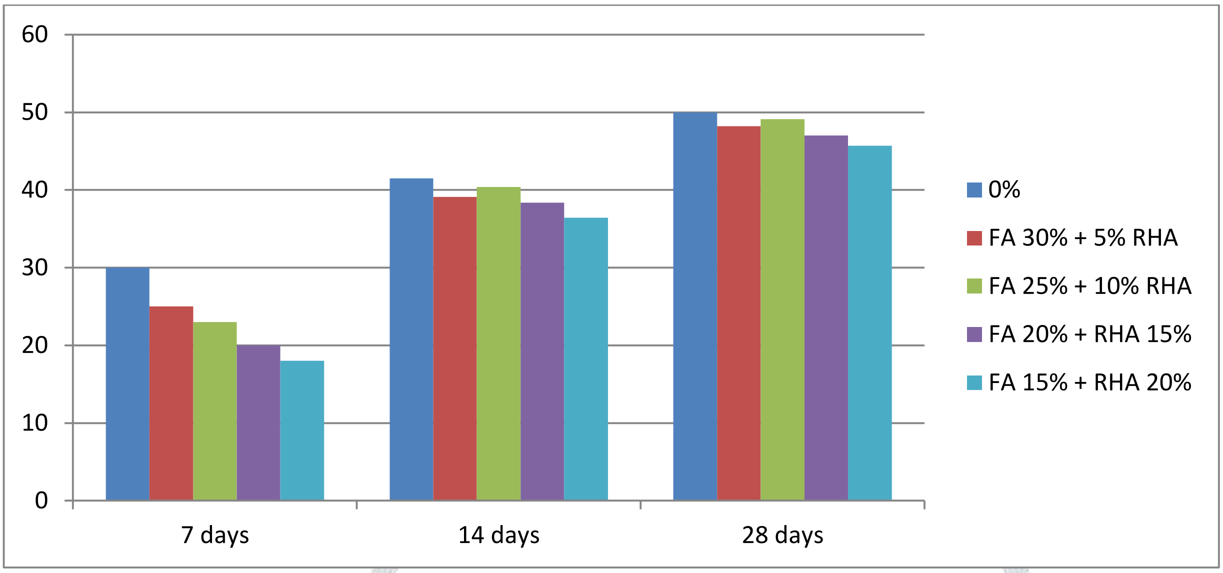
9.1 Experimental Results

Results of M30 grade of OPC concrete filled with various proportions of Rice Husk Ash and Fly Ash for compressive strength, split tensile strength also for flexural strength test are shown in table below.

TABLE 9.1 Results of Compressive Strength

DESIGN MIX	% OF FLY ASH	% OF RICE HUSK ASH	COMPRESSIVE STRENGTH AFTER 7 DAYS	COMPRESSIVE STRENGTH AFTER 14 DAYS	COMPRESSIVE STRENGTH AFTER 28 DAYS
MIX C	0	0	30	41.50	50
MIX 1	30	5	25.22	39.10	48.22
MIX 2	25	10	23.37	40.37	49.10
MIX 3	20	15	20.33	38.31	47.00
MIX4	15	20	18.17	36.44	45.68

HISTOGRAM FOR COMPRESSIVE TEST



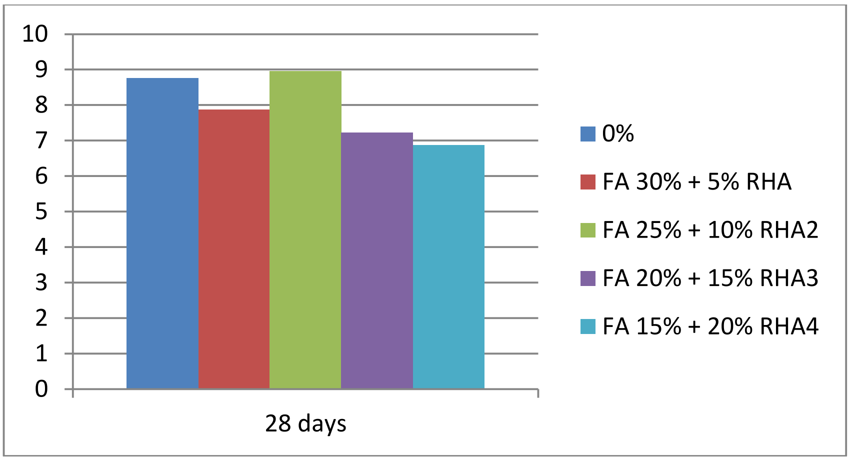
In the histogram above along the Y-axis is Compressive strength of different mixes and along X-axis is control mix and mixes with different replacement of Fly ash and Rice Husk Ash after 7, 14, 28 days of curing

Fig . Comparison of compressive strength for different % of RHA and FA

Figure 6 indicates the comparison of results of compressive strength using cube specimen of M30 grade of concrete for different percentage of cement, RHA and FA. Target strength of M30 concrete was 38.25 Mpa, but convention concrete gives 49.10 Mpa compressive strength at 28 days of curing. Comparative work shows maximum compressive strength obtained at combination of 25% FA and 10% RHA which was less than strength of control con rete but greater than target strength. It was observed that 42% strength was increase as compared to target strength and 2% strength decreases as compared to control concrete at 28 days of curing

TABLE 9..2 FLEXURAL STRENGTH AFTER 28 DAYS OF CURING

DESIGN MIX	% OF FLY ASH	% OF RICE HUSK ASH	FLEXURAL STRENGTH AFTER 28 DAYS
MIX C	0	0	8.76
MIX 1	30	5	7.87
MIX 2	25	10	8.96
MIX 3	20	15	7.23
MIX4	15	20	6.87

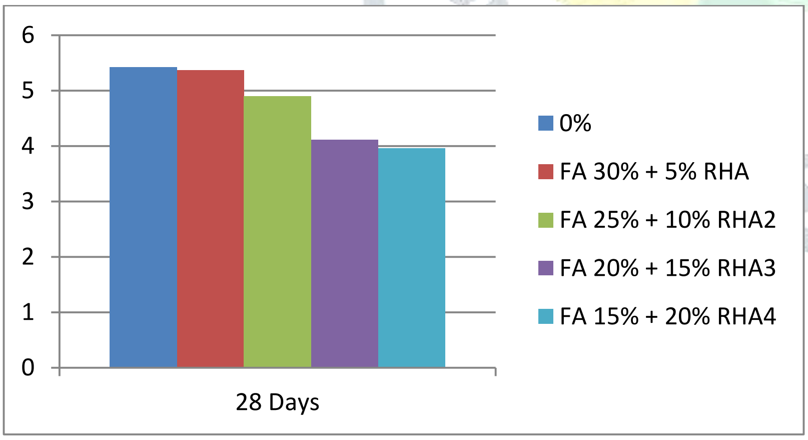


In the histogram above along the Y-axis is Flexural strength of different mixes and along X-axis is control mix and mixes with different replacement of Fly ash and Rice Husk Ash after 28 days of curing

Fig Comparison of flexural strength for different % of RHA and FA at 28 days of curing and deflection of beam
Figure indicates the comparison of result of flexural tensile strength using beam specimens of M30 grade of concrete Beams wer tested after 28 days of curing for Flexural Strength. It was observed that maximum flexural strength was obtained at combination of 25% FA and 10% RHA and strength was increase by 2.86% as compared to control concrete at 28 days of curing

TABLE 9.3 SPLIT TENSILE STRENGTH AFTER 28 DAYS OF CURING

DESIGN MIX	% OF FLY ASH	% OF RICE HUSK ASH	SPLIT TENSILE STRENGTH AFTER 28 DAYS
MIX C	0	0	5.42
MIX 1	30	5	5.37
MIX 2	25	10	4.90
MIX 3	20	15	4.11
MIX4	15	20	3.96



In the histogram above along the Y-axis is Split Tensile Strength of different mixes and along X-axis is control mix and mixes with different replacement of Fly ash and Rice Husk Ash after 28 days of curing

Figure indicates the comparison of result of splitting tensile strength using cylindrical specimens of M30 grade of concrete It was observed that split tensile strength at the combination of 25% FA and 10% RHA decreases by 11% as compared to control concrete at 28 days of curing.

10.1 CONCLUSION

In this research it was investigated that fly ash is a pozzolanic material but having very low binding property so it increases the workability of concrete when it is replaced 25% with gradual increase of Rice husk ash and decrease of fly ash reduces the workability of concrete as Rice husk ash is highly poros material so it has more water absorbent property on the other side it has low specific gravity which reduces mass per unit volume so it makes the structure light in weight.Excess of tthese two materials in our environment create more environment pollution so these can be used with cement replacement in concrete to reduce its ill effects on environment. As we know cement is costly material.when cement is replaced with these waste minerals can make our strucrture economical.

Compressive strength increases with the increase in the percentage of Fly ash and Rice Husk Ash up to replacement (25%FA and 10% RHA) of Cement in Concrete for different mix proportions.

The maximum 28 days split tensile strength was obtained with combination of 25% Fly ash and 10% rice husk ash mix in all combinations which was less than control concrete.

The maximum 28 days flexural strength was obtained with combination of 25% fly ash and 10% rice husk ash mix.

The percentage of water cement ratio is reliant on quantity of RHA used in concrete. Because RHA is a highly porous material The workability of concrete had been found to be decrease with increase RHA in concrete .

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