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Experimental investigation for RCC structural element using the sustainable material like Fly ash and Rice husk ash.

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Abstract - Both the strain capacity at fracture and the tensile strength of unreinforced concrete are low. Traditionally, concrete has been strengthened by adding rice husk ash (RHA) to address these deficiencies. It is commonly recognized that Aggregate mixtures are heterogeneous in concrete, water, and cement. To create the desired properties in concrete, a variety of sustainable ingredients are added, including rice husk ash and fly ash. Proper component proportioning, mixing, and compacting are essential for producing strong, long-lasting concrete. A thorough experimental examination will be conducted to examine the impact of partially replacing cement in concrete with rice husk ash. Ash made from burning rice husks is an agricultural waste product with a high degree of reactivity. A by-product of the agriculture sector, rice husk ash (RHA) has a high silicon dioxide (SiO2) content. An effort was made to figure out the ideal burning temperature and duration. The ideal combination, according to the results, is 650 degrees Celsius and a burning time of 60 minutes. Afterwards, a number of tests were run to ascertain the characteristics of concretes with the ideal RHA.

Keywords: Rice Husk Ash ,Fly Ash, Compressive Strength, Pozzolanic materia

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INTRODUCTION

The shells formed when paddy rice dehisces are called rice husks. About 200 kg of husk can be produced from one tone of paddy rice, and 40 kg of ash can be produced when the husk is burned. Before 1970, uncontrolled burning was the usual method used to make rice-husk ash (RHA), which was typically crystalline and had poor pozzolanic characteristics. The impact of pozzolanic reactivity of RHA on pyroprocessing parameters A fluidized-bed furnace was designed based on the research to allow for the controlled incineration of rice bran. The rice husks were burned in an environment and temperature regulated to produce a highly reactive RHA. According to studies, rice husks are burned at 600°C yields an ash that is ideal for pozzolanic material. The silica that forms below this temperature is pozzolanic in nature. The study's second section examines the RHA's performance in concrete. India is a global leader in rice production, and the leftover husk from milling is often burned in boilers to process paddy and generate energy. Table 1.1 illustrates the yearly production of rice husk ash (RHA), which amounts to about 120 million tonnes. How varying the amount of rice husk ash added to concrete can affect its mechanical and physical characteristics. Sample cubes were tested with varying w/c ratios and RHA percentages, substituting quantity of cement. Evaluations were done on characteristics including compressive strength, water absorption, and slump.

METHODOLOGY

This research examines methodology using experimental analysis to examine the mechanical characteristics of fly ash and rice husk ash concrete. The current study intends to perform a reliability analysis of the concrete mix by substituting fly ash and rice husk ash for ordinary Portland cement in amounts of 0%, 4%, 8%, 12%, 16%, and 20%, respectively, for M25 grade concrete. The material properties will be taken into consideration.

Table 1 : The physical attributes of cement

Sr. No	Test Name	Result
1	Brand	ACC 53 Grade
2	Fineness By dry sieving (%)	1
3	Consistency (%)	30.50
4	Setting Time Initial (minutes) Final (minutes)	111 221
5	Soundness (mm)	0.8
6	Strength in Compression After three days (N/mm2), seven days (N/mm2), and twenty-eight days (N/mm2)	30.210 38.248 54.200

Table 2: Fine Aggregate's physical attributes

Sr. No.	Description	Sand / Fine Aggregate
1	Sender's Identification	Sand
2	General Description	Natural Sand
3	Particle Shape	Rounded & Coarser
4	Surface Texture	Rough
5	Color	Black
6	Fineness Modulus	3.895
7	Specific Gravity	2.820
8	Absorption %	1.270

Table 3 :Physical Characteristics of Coarse Aggregate

Sr. No.	Description	Metal/Coarse Aggregate 20 mm		Metal/Coarse Aggregate 10 mm
1	Sender's Identification	Metal		Metal
2	General Description	Crushed Basalt		Crushed Basalt
3	Particle Shape	Angular		Angular
4	SurfaceTexture	Rough		Rough
5	Color	Grey		Grey
6	Fineness Modulus		7.136	5.829
7	Specific Gravity		2.90	3.016
8	Absorption %		0.85	0.65
9	Bulk Density (kg/ltr)			
	A	Loose	2.100	1.898
	B	Compacted	2.340	1.967

Rice Husk Ash Properties

Table 4 :Chemical Characteristics of Rice Husk Ash

Sr. No.	Content	Result Analysis
1	pH	7.21
2	Bulk Density	0.37 (gm/ml)
3	Sp. Gravity	1.04
4	SiO2	93.80%
5	Al2O3	0.74%
6	Fe2O3	0.30%
7	TiO2	0.10%
8	CaO	0.89%
9	MgO	0.32%
10	Na2O	0.28%
11	K2O	0.12%
12	Loi	3.37%

Table 5: Characteristics of Rice Husk Ash Physically

Sr. No.	Content	Result Analysis
1	Physical State Solid	Non Hazardous
2	Appearances	Very fine powder
3	Particle size	25 microns-mean
4	Color	Grey
5	Oduor	Odorless

Fly Ash Properties :

Table 6:Chemical Characteristics of Fly Husk Ash

Sr. No.	Content	Result Analysis
1	pH	6.12
2	Bulk Density	0.994gm/cm3
3	Sp. Gravity	2.40
4	SiO2	65.6 %
5	Al2O3	28.0 %
6	Fe2O3	3.0 %
7	TiO2	1.0 %
8	CaO	1.0 %
9	MgO	1.0 %
10	Na2O	0.71 %
11	K2O	1.15 %
12	Loi	0.29 %

Table 7: Physical Properties of Fly Ash

Sr.No	Content	Result Analysis
1	Physical State Solid	Non-Hazardous
2	Appearances	Very fine powder
3	Particle size	6.92 microns-mean
4	Colour	Grey
5	Odour	Odourless

Mix Design Stipulation for Rice Husk Ash Concrete:

Table 8: Concrete Mix Design Stipulation

Sr. No.	Particular	M25		
a)	Grade designation	25		
b)	Type of cement	OPC 53 Grade		
c)	Maximum nominal size of aggregate	20		
d)	water-cement ratio	0.47		
e)	Workability	Medium		
f)	Exposure condition	Moderate		
g)	Method of concrete placing	Manual		
h)	Degree of supervision	Good		
i)	Type of aggregate	Crushed angular aggregate		
j)	Chemical admixture type	-		
k)	Proportions	C	S	M
		1	1.932	3.057
				100%
				20mm

Experimental Details:

The experiments are performed on concrete grade of M25. In first phase normal concrete and in second phase high strength concrete were used .The test specimens were divided into categories depending upon the total percentage of volume of Rice Husk Ash (RHA) and Fly Ash (0%, 4%, 8%, 12%, 16%, and 20%) for both grade of concrete. The casting and tests were conducted to find the compressive strength on the cubes of size150mm X 150mm X 150 mm and also compressive strength on cylinder of size 150 mm in diameter& 300 mm & to find the split tensile strength on cylinder of size 150 mm in diameter & 300mm inlength. In addition to this the flexural strength on beams of size 700mm X 150mm X 150mm with a c/c distance of 600 mm under two point loads.

Figure 1.Testing of C Specimen on CTM

RESULTS & DISCUSSIONS

Every category sample undergoes testing and analysis to determine its fresh concrete qualities, such as density, compaction factor, and slump. These samples are also used to measure the deflection values, flexural strength, split tensile strength, and compressive strength of the hardened concrete.

- **Fly Ash (FA) M25 Grade of Concrete:**

The samples are called sample F (FA), where The first category M25 grade is indicated by the letters F0 (0%), F1 (4%), F2 (8%), F3 (12%), F4 (16%), F5 (20%), and so on. FA stands for the percentage of fly ash in the sample.Ratio: - Cement: 1: 1.932: 3.057 = F.A.: C.A.

- **Properties of Fresh FA Concrete (i.e. Slump, Compaction Factor & Density)**

Table 9 :Slump, Compaction Factor & Density for M25 Grade of FA Concrete with Different % of Fly Ash

SeriesF (FA)	Slump Value (mm)	Compaction Factor	Density of concrete (kg/m^3)
F0	120	0.94	2654.81
F1	101	0.94	2648.88
F2	96	0.90	2640.88
F3	91	0.89	2637.04
F4	76	0.88	2634.07
F5	62	0.83	2604.44

- **Observations for M25 grade of Fly Ash (FA) concrete in fresh state:**

1. Except control specimen F0 (0%) compaction factor is varying for various mix series i.e.F1 (4%) to F5 (20%) series of concrete.
2. As volume of FA increases in concrete, the density of concrete decreases in various mix category.
3. The workability is high for F1 (4%) Fly Ash.
4. As percentage of FA reduces, workability increases.

I. **Compressive Strength of cube**

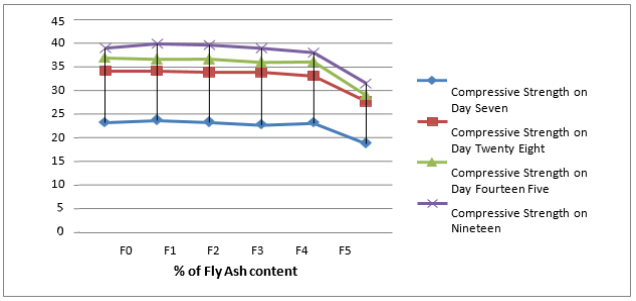


Figure 2: Compressive strength at different age of M25 grade of Fly Ash concrete

OBSERVATIONS & DISCUSSIONS

1. F1 to F4 has given performance for achieving reasonable workability & good strength.

2. In all series for M25 grade concrete, we get M30 grade concrete strength only due to addition of Fly Ash.

3. It is observed that F1 & F2 FA content is 4% & 8% respectively as compared to F5 20% which FA content is more. It seems as % of FA increases, the homogeneity of mix affected due to which workability as well as strength reduces.

4. From the result of 7th & 28th day compressive strength it is observed that series F5 (20%) got poor strength as compared to other series, because % of FA is high which makes mix non homogeneous.

5. From the result of 45th & 90th day compressive strength it is observed that strength of concrete increases 7% of 28th day compressive strength.

II. Compressive Strength of cylinder

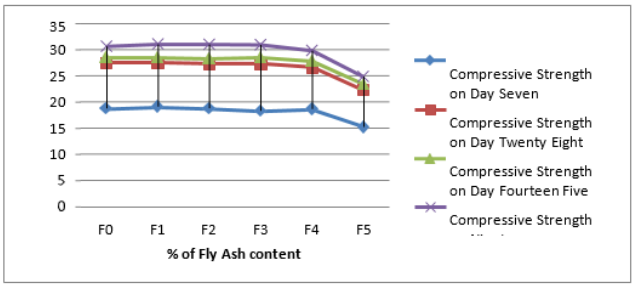


Figure 3. Compressive Strength at Different Age of M25 Grade of FA Concrete

- **Observations& Discussions: -**

1. F1 (4%) has given performance for achieving reasonable workability & good strength.

2. It is observed that compressive strength of cylinder F0 to F5 FA content is 0% to20% respectively is near about 20% to 25% less than compressive strength of cube.

3. More than 20% use of FA in total volume of concrete is not preferred fromworkability & strength point of view.

4. From the result of 45th & 90th day compressive strength it is observed that strength ofconcrete increases 10% of 28th day's compressive strength.

5. F1 & F3 series found good result in 45th & 90th day compressive strength.

III. Flexural Strength

Table 10 : Flexural Strength for M25 Grade FA Concrete with Various Fly Ash Content at Day 28

Series F (FA)	Flexural Strength(N/mm^2)
F0	4.72
F1	4.67
F2	4.55
F3	4.49
F4	4.45
F5	3.96

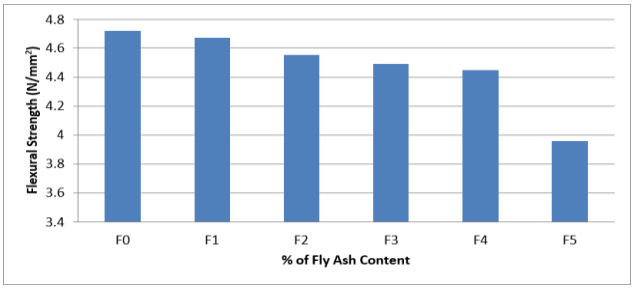


Figure 4: Flexural Strength at 28th Day for M25 Grade of FA Concrete with % of Fly Ash Content

- **Rice Husk Ash M25 GRADE OF CONCRETE**

Sample F (RHA) is the name given to the samples, where F0 (0%), F1 (4%), F2 (8%), F3 (12%), F4 (16%), F5 (20%), and so on indicate the first category M25 grade. RHA stands for the percentage of rice husk ash in the sample.

Proportion: - Cement: F.A.: C.A. = 1: 1.932: 3.057

I. Compressive Strength of cube

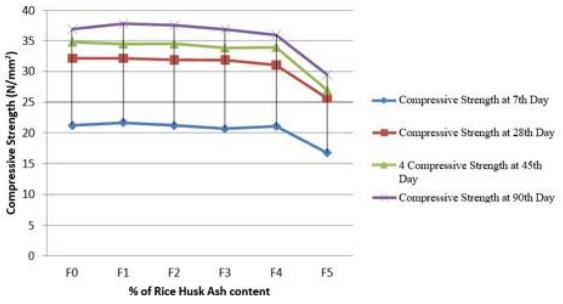


Figure 5: Compressive strength at different age of M25 grade of RHA concrete

- **Observations & Discussions: -**

1. F1 to F4 has given performance for achieving reasonable workability & good strength.

2. In all series for M25 grade concrete, we get M30 grade concrete strength only due to

addition of Rice Husk Ash.

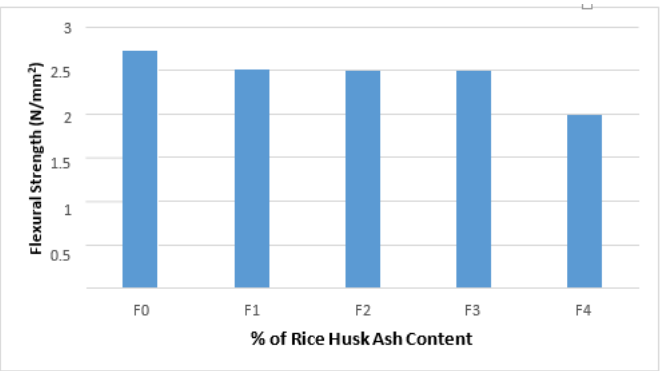
3. It is observed that F1 & F2 RHA content is 4% & 8% respectively as compared to F5 20% which RHA content is more. It seems as % of RHA increases, the homogeneity of mix affected due to which workability as well as strength reduces.

4. From the result of 7th & 28th day compressive strength it is observed that series F5 (20%) got poor strength as compared to other series, because % of RHA is high which makes mix non homogeneous.

5. From the result of 45th & 90th day compressive strength it is observed that strength of concrete increases around by 5% of 28th day compressive strength

Flexural Strength for Rice Husk Ash Concrete

Table 10: Flexural Strength at 28th Day for M25 Grade of RHA Concrete with Different % of RiceHusk Ash Content



CONCLUSIONS

The investigation into the effects of varying proportions of fly ash and rice husk ash has potential because concrete's brittleness and workability are persistent issues that need to be resolved. The current study allows for the deduction of the following conclusions.

Few Prominent General Conclusions for Rice Husk Ash (RHA) Concrete:

1. The workability of concrete decreases as the percentage of RHA rises. This decrease is somewhat significant.

2. 3% to 6% more amount of water is required in comparison with normal concrete for gettingdesired workability using RHA.

3. The weight of Rice Husk Ash concrete is reduced up to 4% to 6% in comparison withnormal concrete.

4. Rice husk ash can replace cement up to 20% of the cement content with safe outcomes.

5. The cube's maximum 28-day compressive strength of 32.16N/mm2 was achieved with 4%, or rice husk ash, in the mixture.

6. The highest 28-day compressive strength of the cylinder was achieved by adding 4%, or 25.52N/mm2, of rice husk ash to the mixture.

7. The highest 28-day split tensile strength of 2.80 N/mm2 was achieved with 4% of rice husk ash in mixture.

8. The highest 28-day flexural strength of 2.72 N/mm2 was achieved with 4% of rice husk ash in mixture.

Few Prominent General Conclusions for Fly Ash (FA) Concrete:

1. Concrete becomes less workable as the percentage of FA rises. This decrease is somewhat significant.

2. 4% to 6% more amount of water is required in comparison with normal concrete for gettingdesired workability using RHA.

3. In the case of fly ash, the replacement rate may exceed 20%.

4. The cube's maximum 28-day compressive strength of 34.16N/mm2 was achieved with 4% fly ash in the mixture.

5. The maximum 28-day compressive strength of the cylinder was achieved with 4% fly ash in mix, or 27.50 N/mm2.

6. The highest 28-day split tensile strength of 2.82 N/mm2 fly ash in mix was achieved at 4%.

7. The highest 28-day flexural strength of 4.67 N/mm2 was achieved with 4% fly ash in mixture.

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