

Characteristic Strength of Concrete by Addition of Flyash and Rice Husk

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ABSTRACT :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) 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. The detailed experimental investigation done to study the effect of partial replacement of cement with FLY ASH and RICE HUSK ASH on concrete. In this paper I started proportion from 10%(FA+RICE HUSK ASH) such as 5% FA and 5% RHA mix together in concrete by replacement of cement ,last proportion was taken 15% FA and 15%RHA, with gradual increase of fly ash and rice husk ash by 10%, 20%, 30% of partial replacement of cement .

KEYWORDS: Fly Ash, Rice husk Ash, Flexural Strength, Admixture, Compressive Strength, Split Tensile Strength

I. INTRODUCTION

Concrete is well known as 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, 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

II. LITERATURE REVIEW

EARLIER RESEARCHES

1. Hwang Chao-Lung , Bui Le Anh-Tuan, Chen Chun-Tsun, (2011) In this, they have founded that compression strength and electrical resistance of rice husk concrete. In this project, they added different proportions of ground rice husk ash such as 10%, 20%,30% by the replacement of cement. The compressive strength of concretes with up to 20% ground RHA added attain values equivalent to that control concrete after 28 days. finally they found two this project, compressive strength of RHA concrete and electrical resistance of RHA concrete After 91 days of curing, the electrical resistance of all RHA concrete becomes higher than 20 k X-cm. Similarly, for all RHA concrete samples, the UPV are all higher 3660 m/s after 91 days of curing. The strength efficiency of cement in ground RHA concrete is much higher than that of the control concrete

2. V. Ramasamy ,(2011) :In this, he has studied about the strength and durability properties of concrete with partial replacement of cement by rice husk ash. The paper presents the experimental investigation conducted on Rice Husk

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Ash (RHA) concrete to evaluate the compressive strength and to study its durability properties. In the preparation of rice husk concrete, cement was replaced at various percentage levels such as 5%, 10%, 15% and 20%. Besides control concrete was also prepared for comparison purpose. Two grades of concrete, namely M30 and M60, were prepared. The strength of the concrete increased with the levels of percentage of replacement of 10% at which the increase in strength was 7.07% at 90 days compared to normal concrete.

3. SATISH D. KENE1, PRAVIN V. DOMKE2, SANDESH D. DESHMUKH3, R.S.DEOTALE (2011) In this, they have studied on the strength studies of concrete with partial replacement of cement by fly ash and rice husk ash with different proportions. The detailed experimental investigation done to study the effect of partial replacement of cement with RHA and FA on concrete. In this paper I started proportion form 30% FA and 0% RHA mix together in concrete by replacement of cement ,last proportion taken 0% FA and 30% RHA, with gradual increase of RHA by 1% and simultaneously gradual decrease of FA by 1%. They prepared cubes, cylinders, prisms. Finally they found compressive strength, spilt tensile strength, flexural strength of fly ash and rice husk of concrete

4. RAMADHANSYAH PUTRA JAVA, BADORUHISHAM ABUBASKAR, MEGAT AZMIMEGAT JOHARI, MAHAHAZIMAM WAN IBRAHIM (2011) In this, they have found strength and permeability properties by addition of different sizes of rice husk ash to the partial replacement of cement. The cement was replaced with the Rice husk ashes with a different grain size were used to the partial *i.e.* coarse original rice husk ash 17.96 μm (RHA0), 10.93 μm (RHA1) 9.74 μm (RHA2), 9.52 μm (RHA3), 9.34 μm (RHA4), 8.70 μm (RHA5), 6.85 μm (RHA6) and 6.65 μm (RHA7). They have found two things, by adding different grain sizes of rice husk ash. The RHA3 produced the concrete with good strength and low porosity. The influence of OPC and RHA materials on the concrete permeability was affected by the grinding time and age (*i.e.*, curing time).

5. C.Marthong, T.P.Agrawal (2012): They have found strength studies by addition of fly ash to the partial replacement of cement. The utilization of fly ash in concrete as partial replacement of cement is gaining immense importance today, mainly on account of the improvement in the long-term durability of concrete combined with ecological benefits. Three grades of ordinary Portland cement (OPC) namely: 33, 43 and 53 as classified by Bureau of Indian Standard (BIS) are commonly used in construction industry. This paper reports a comparative study on effects of concrete properties when OPC of varying grades were partially replaced by fly ash. The main variable investigated in this study is variation of fly ash dosage of 10%, 20%, 30% and 40%. The compressive strength, durability and shrinkage of concrete were mainly studied.

III.COMPOSITION OF FLY ASH AND RICE HUSK ASH CONCRETE

AN OVERVIEW OF FARHAC INGREDIENTS

Concrete as is well known 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 on 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 byproduct of burned coal from power station and rice husk ash is the byproduct of burned rice husk at higher temperature from paper plant artificial fibers nowadays in order to improve the mechanical properties of concrete.

CEMENT

A high quality binder is necessary for FARHAC. Cement that yields high compressive strength at the later stage is obviously preferable. The choice of Portland cement for high strength concrete is extremely important. Within a given cement type, different brands will have different strength development characteristics because of the variation in compound composition and fineness. The effect of cement characteristics on water demand is more noticeable in

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FARHAC . Strength development will depend on both cement characteristics and cement content. Some of the controlling factors that play an important role in the performance of concrete are

High C3A content generally leads to a rapid loss of flow in fresh concrete. Therefore, high C3A content should be avoided in cements used for FARHAC. The fineness of cement is the critical parameter. Increasing fineness increases early strength development, but may lead to Theological deficiency. The compatibility of cement with retarders if used is an important requirement

FINE AGGREGATE Fine aggregate with a fineness modulus in the range of 2.5 to 3.2 are preferable for FARHAC. Concrete mixtures made with a fine aggregate that has a fineness modulus of less than 2.5 may be sticky and result in poor workability and higher water requirement.

COARSE AGGREGATE In the proportioning of FARHAC, The aggregates require special consideration since they occupy the largest volume of any ingredient in the concrete, and they greatly influence the strength and other properties of the concrete Many studies have shown that crushed stone produces higher strengths than rounded gravel. For each concrete strength level, there is an optimum size for the coarse aggregate that yield the greatest compressive strength per kg of cement. A 20-25mm nominal maximum size aggregate is common for producing concrete strengths up to 60 MPa and 10-12 mm above 60 MPa.

WATER

Water is an essential component of concrete for mixing and curing. It should be free from harmful impurities, which may hinder the normal hardening process of concrete. Water found satisfactory for mixing is also suitable for curing should not produce any objectional stain or unslight deposition on the concrete surface. The requirements for water quality for a FARHAC no more stringent than those for conventional concrete. Usually water for concrete is specified to be of potable quality. This is certainly conservative but usually does not constitute a problem since most concrete is produced near a municipal water supply

ADMIXTURE

The major difference between conventional cement concrete and FARHAC is essentially the use of mineral admixtures. The mineral admixtures are generally industrial by products and their use can provide a major economic benefit.

MINERAL ADMIXTURE Mineral admixtures, also called as cement replacement materials (CRM), act as pozzolonic materials as well as fine fillers, thereby the microstructure of hardened cement matrix becomes denser and stronger. These materials possess little or no cementitious properties themselves, but in finely divided form and in presence of moisture, can chemically react with calcium hydroxide generated in cement hydration process at ordinary temperatures to form compounds possessing cementitious properties. However, the effect of a CRM on the strength of concrete varies with their properties of FLY ASH Fly ash used was obtained from NIVELI Power Plant TAMILNADU

RICE HUSK ASH

Rice husk ash used was obtained from SIVA OIL Pravite limited located in Dindigil near to Thiruchirapalli .The Specific gravity of rice husk ash is 2.10 and bulk density is 0.781 g/cc RHA, produced after burning of Rice husk (RH) has high reactivity and pozzolonic property. Indian Standard code of practice for plain and reinforced concrete, 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. As per study RHA produced by burning rice husk between 600 and 700°C temperatures for 2 hours, contains 90-95% SiO₂, 1-3% K₂O and < 5% un burnt carbon.

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MATERIAL PROPERTIES

The properties of the materials used in the experimental work are presented in this chapter. The material specifications for cement, fine aggregate, coarse aggregate and admixtures are discussed. Sieve analysis was done for sand, coarse aggregate to test their suitability for use in concrete.

CEMENT

In the present study Ordinary Portland Cement (OPC) 43 grade was used. CHETTINADU brand OPC was used. The specific gravity of cement is given in Table

Specific Gravity of Cement				
Sl. No.	Observations	Trial 1	Trial 2	Trial 3
1.	Weight of the specific gravity bottle(W1), g	35.8	35.8	35.8
2.	Weight of bottle + 1/3rd filled cement(W2), g	53.8	53.6	53.8
3.	Weight of bottle + 1/3rd filled cement + kerosene(W3), g	89.4	89.3	89.4
4.	Weight of bottle + kerosene (W4), g	76.2	76.2	76.2
5.	Specific gravity	3.11	3.10	3.13

Average specific gravity of cement = 3.11

FINE AGGREGATE :Locally available river sand conforming to grading zone-II as per IS: 383 -1970 was used. The sand was screened at site to remove deleterious material Sieve analysis was done and the analysis results are given .The specific gravity of sand is given in Table

Sieve Analysis of Fine Aggregate				
Sieve size (mm)	Weight Retained(g)	Cumulative Weight retained(g)	Cumulative % retained	% Passing
4.75	0	0	0	100
2.36	11	11	2.2	97.8
1.18	52.7	63.7	12.74	87.26
0.6	138.3	202	40.4	58.6
0.3	249.5	451.5	90.3	9.7
0.15	42.1	493.6	98.72	1.28
<0.15	6.4	500	100	0

Fineness modulus of sand = 2.45

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Specific Gravity of Fine Aggregate				
Sl. No.	Observations	Trial 1	Trial 2	Trial 3
1.	Weight of the specific gravity bottle(W1), g	44.1	44.1	44.1
2.	Weight of the bottle + 1/3rd filled sand(W2), g	99.6	99.8	99.8
3.	Weight of bottle + 1/3rd filled sand + water (W3), g	141.9	141.6	142.1
4.	Weight of bottle + water (W4), g	176.5	176.5	176.5
5.	Specific Gravity	2.65	2.67	2.63

Average specific gravity of sand = 2.65

COARSE AGGREGATE

In the present study a locally available coarse aggregate (12.5 mm) from quarry was used. The specific gravity of coarse aggregate is given in Table

Specific Gravity of Coarse Aggregate				
Sl. No.	Observations	Trial 1	Trial 2	Trial 3
1.	Weight of the specific gravity bottle (W1), g	595.2	595.2	595.2
2.	Weight of bottle + 1/3rd filled sand (W2), g	965.2	969	961.7
3.	Weight of bottle + 1/3rd filled sand + water (W3), g	1706.8	1710.2	1703
4.	Weight of bottle + water (W4), g	1472.3	1472.3	1472.3
5.	Specific gravity	2.73	2.75	2.7

Average specific gravity of coarse aggregate = 2.72

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CHEMICAL COMPOSITION OF CEMENT AND ADMIXURES:

Materials	Cement	Fly ash	Rice husk ash
SiO ₂	19.71	40	78.21
Al ₂ O ₃	5.20	25	
Fe ₂ O ₃	3.73	6	
CaO	62.91	20	0.99
Mgo	2.54	3.71	4.89
LOi	0.96	3.0	4.89
SO ₃	2.72	1.74	-
K ₂ O	0.90	0.80	-
Na ₂ O ₃	0.25	0.96	-

IV. EXPERIMENTAL INVESTIGATION AND MIX DESIGN

EXPERIMENTAL PROGRAMME:

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

RICE HUSK ASH

- 1) Normal Consistency = 17%
- 2) Initial and Final Setting time = 195min. and 265min.
- 3) Compressive Strength = 11 N/mm²
- 4) Specific Gravity = 2.10

ORDINARY PORTLAND CEMENT

OPC 43 grade cement is used for this whole experimental study. The physical test results on OPC are as follows.

- 1) Normal consistency = 22%
- 2) Initial Setting time = 30 min.
- 3) Final Setting Time = 10 hrs.
- 4) Specific Gravity = 3.11

TEST ON CONCRETE : An M25 mix is designed as per guidelines in IS 10262, 1982 based on the preliminary studies conducted in the constituent materials. Tests on fresh concrete are obtained as follows

- 1) Slump Test = 55mm
- 2) Vee-Bee = 13sec.
- 3) Compaction factor = 0.95
- 4) Flow Test = 78 %

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TESTING METHODS :Testing is done as per following IS code. The testing done for compressive strength of cubes as per IS: 516-1959 the testing done for flexural strength of beam as per IS: 5816-1999 and the testing done for split tensile strength of cylinder as per IS: 516-1959

MIXING :Mixing was carried out in a pan mixer machine. The mixing methodology adopted was as follows: 1) 25 per cent of total water, coarse aggregates and admixtures were added to the mixer machine and allowed to mix for 1 minute. 2) Cement and 50 per cent water were then added to the mix and mixed for 1 minute. 3) Super plasticizer was blended with the balance 25 percentage water and then added to the mix. Mixing was continued for 5 minutes after adding the blend. 4) Total time taken for mixing 7 minutes.



FRESHLY CASTED CONCRETE SPECIMENS (IS :10086-1982)

Cubes of 150x150mm size for compressive strength. Cylinders of size 150X300mm for split tensile test and beam size for flexure test is 100X100X500mm are casted for the testing of the fly ash and rice husk ash concrete



FRESHLY CASTED CUBE, CYLINDER AND PRISM SPECIMENS



NWC USED FOR CURING OF CONCRETE SPECIMENS

MECHANICAL PROPERTIES The compressive strength, flexural, split tensile strengths of FRC of 150 x150mm cubes was measured according to IS 516:1959.

Compressive Strength :Compressive strength of concrete can be found according to IS:516-1959. Concrete cubes are loaded uniaxially by using standard testing machine until the specimen fails. The compressive strength is defined as the maximum compressive load divided by cross-sectional area of the specimen.

TEST: To calculate the compressive strength of concrete cubes the universal testing machine (UTM) having capacity of 300 tone was used. In this test the strength obtained in tone. Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. For cube test two types of specimens either cubes of 15 cm X 15 cm X 15 cm or 10cm X 10mm X 10 cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15 cm x 15cm x 15 cm are commonly used. These specimens are tested by compression testing machine after 7 days curing, 14 days curing, 28 days curing and 56 days curing. Load should be applied gradually at the rate of 140 kg/cm² per minute till the Specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

$F_c = P/A$ Where, F_c - Compressive strength of concrete ,P - Maximum Compressive load ,A - Cross sectional area

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CONCRETE CUBE SPECIMENS TESTING FOR COMPRESSIVE STRENGTH

FLEXURAL STRENGTH TEST ;:Two-point load method was adopted to measure the flexural strength of CSAC. As per ASTM C78-84 guidelines [180], beams of 100x100x500 mm size were adopted. The load was applied without shock and was increased until the specimen failed, and the maximum load applied to the specimen during the test was recorded. Modulus of rupture, PL/bd

$$F_b = (P L) / (bd^2)$$

$$= (3P \times a) / (bd^2)$$

COMPONENT	30% of cement replaced by Fly ash and Rice husk ash in Kg cu-m		
Fly ash	10	15	5
Rice husk	10	5	15
Water	186	186	186
Cement	256	256	256
Fine aggregate	790	790	790
Coarse aggregate	1048	1048	1048
Fly ash	55.5	74	35
Rice husk ash	55.5	74	35

Where P = Maximum load applied, N , L = Supported length of the specimen, mm and b = Measured width of the specimen, mm ,d = Measured depth of the specimen at the point of failure, mm

COMPONENT	10% OF CEMENT REPLACED BY FLY ASH AND RICE HUSK ASH IN KG/CU-M		
Fly ash	10	0	5
Rice husk	0	10	5
Water	186	186	186
Cement	333	333	333
Fine aggregate	790	790	790
Coarse aggregate	1048	1048	1048
Fly ash	37	0	1805
RICE HUSK ASH	37	18.5	55.5

V.RESULTS AND DISCUSSIONS

COMPARISION OF COMPRESSIVE STRENGTH :Compression test according to IS: 516(1959) was carried out on the 150 x 150 x 150 mm cubes were tested for the compressive strengths of concrete specimens were determined after 7 and 28 days of standard curing. For combination of fly ash and rice husk ash concrete, the results show that the addition of fly ash and rice husk ash resulted in a significant reduction in concrete compressive strength compared with the control concrete. This reduction increased with increasing percentage of fly ash and rice husk ash content in the

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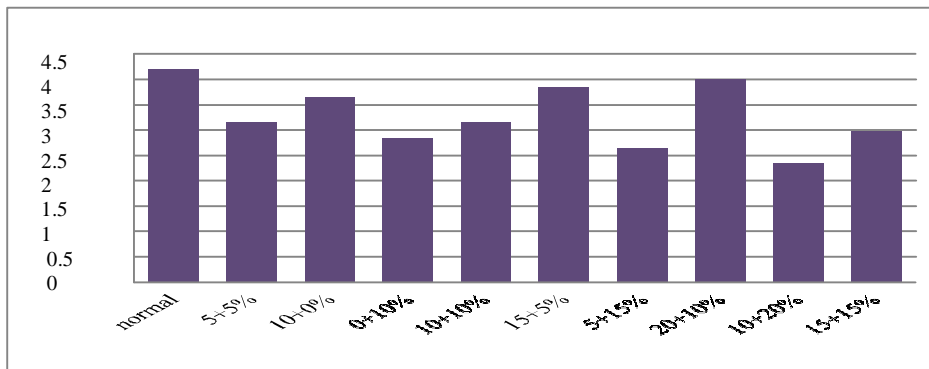
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replacement of cement. Table 5.1 below shows the results of the 7th and 6.2 below shows the results of the 28th day compressive strength tests. The comparison of the results with the control concretes are shown graphically below

Compressive strength of FA+RHA CONCRETE at 28 days

MIX	FLY ASH	RICE HUSK ASH	COMPRESSIVE STRENGTH AT 7 DAYS in Mpa	CHANGE IN STRENGTH in %age
Normal	0%	0%	36.12	0
10% of FA and RHA	10%	0%	33.15	-8.22
	0%	10%	29.15	-19.29
	5%	5%	31.62	-12.45
20% of FA and RHA	15%	5%	34.36	-4.83
	5%	15%	30.15	-16.52
	10%	10%	32.78	-9.24
30% of FA and RHA	20%	10%	35.42	-1.93
	10%	20%	31.52	-12.73
	15%	15%	32.58	-9.81



FLY ASH AND RICE HUSK VARIATION

Split tensile strength-Comparison of ncc and fly ash and rice husk ash concrete.

COMPARISON OF FLEXURAL STRENGTH: Flexural strength test according to IS: 516(1959) was carried out on the 100x 100x500 mm prisms were tested for the flexural strengths of concrete specimens were determined after 28 days of standard curing. For combination of fly ash and rice husk ash concrete, the results show that the addition of fly ash and rice husk ash resulted in a significant reduction in concrete compressive strength compared with the control concrete. This reduction increased with increasing percentage of fly ash and rice husk ash content in the replacement of cement. Table below shows the results of at 28th days the flexural strength tests. The comparison of the results with the control concretes are shown graphically in Figure below

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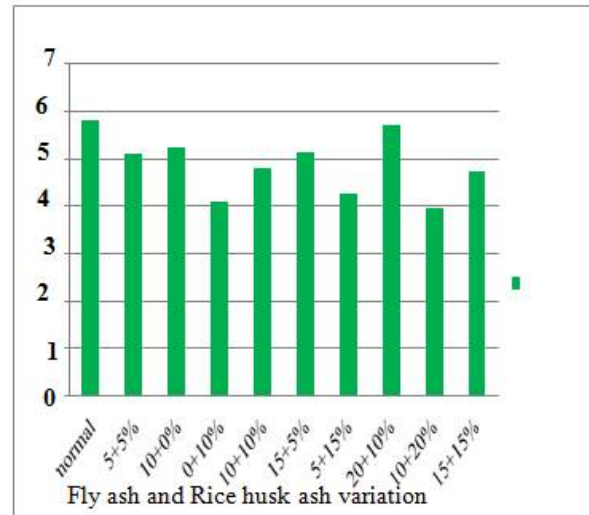
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flexural strength in N/mm²

	FLY ASH	RICE HUSK ASH	FLEXURAL STRENGTH	CHANGE IN STRENGTH
Normal	0%	0%	5	0
10% of FA and RHA	10	0%	5	-8.6
	0%	10	4	-28.69
	5%	5%	5	-
20% of FA and RHA	15	5%	5	-9.0
	5%	15	4	-
	10	10	4	-16.17
30% of FA and RHA	20	10	5	-
	10	20	3	-
	15	15	4	-20.89



VI. SUMMARY AND CONCLUSION

SUMMARY : The main aim of the present investigation was to study the strength studies of blended cement of RHA and FA with partial replacement of cement. And deduce the Relation between age of concrete vs. compressive strength, age of concrete vs. split tensile strength, and age of concrete and flexural strength of FA and RHA of concrete strength results based on NWC and ACT were discussed.

CONCLUSION : Based on the experimental investigations carried out, the following conclusions are drawn 1) Compressive strength increases with the increase in the percentage of Fly ash and Rice Husk Ash up to replacement (20%FA and 10% RHA) of Cement in Concrete for different mix proportions. 2) The maximum 28 days split tensile strength was obtained with 20% fly ash 10% rice husk ash mix. 3) The maximum 28 days flexural strength was obtained again with 20% fly ash and 10% rice husk ash mix. 4) Concrete requires approximate increase in water cement ratio due to increase in percentage of RHA. Because RHA is highly porous material. 5) The workability of RHA concrete has been found to decrease with increase in RHA replacement. 6) It was found that rice husk when burned produced amount of silica (more than 80%). For this reason it provides excellent thermal insulation. 7) Rice husk ash contains more silica, and hence we prefer rice husk ash use in concrete than silica fume to increase the strength. 8) Through Rice husk ash is harmful for human being, but the cost of rice husk ash is zero and thus we prefer RHA use in concrete as compared to silica fumes. 9) The workability of RHA concrete has been found to decrease but FA increases the workability of concrete so RHA and FA mix together in concrete to improve the workability of concrete. 8) Rice Husk Ash can be used with admixtures, plasticizers, and super plasticizers, for increasing the strength of concrete with partial replacement of cement. 9) The transition zone gets improved and densified with the use of ternary mix concretes containing rice husk ash and fly ash. 10) The mechanical properties in terms of flexural and tensile strength have been significantly improved with the addition of RHA.

Scope for future work • Effect of addition of fly ash and rice husk ash on durability studies of concrete has to be investigated.

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