Development of High Strength Concrete using Fly Ash and Rice Husk Ash

A major project report submitted

in partial fulfillment of the requirements for the award of the degree of

Master of Technology

in

Civil Engineering (Structure Engineering)

Submitted by

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Roll no. 15/STR/2010

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DECLARATION

This is to certify that the major project entitled "Development of High Strength Concrete using Fly Ash and Rice Husk Ash" which is being submitted by the undersigned a student of Master of Technology in Civil Engineering (structure Engineering) at Delhi Technological University, Delhi in partial fulfillment for the award of the degree of Master of Technology in Civil Engineering (structure Engineering) is the record of bonafide work carried out by the undersigned. The matter embodied in this project has not been submitted for the award of any other degree.

(A.S.Yadav)
15/STR/2010

The above declaration made by A.S.Yadav is true to the best of my knowledge.

(Dr. Awadhesh Kumar)
Associate Professor

DELHI TECHNOLOGICAL UNIVERSITY

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I thank all the people directly or indirectly involved in successful completion of this project.

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ABSTRACT

Cement is expensive among main constituents of concrete. The entire construction industry is in search of a suitable and effective waste product that would considerably minimize the use of cements and ultimately reduces the construction cost. Rice husk ash (RHA) and Fly ash have the pozzolonic properties to their use might be beneficial. The possibility of using RHA and Fly ash as a construction material need to be investigated.

Fly ash is a by-product of burned coal from thermal power station and rice hush ash is the product of burned rice husk at higher temperature from rice mills. Considerable efforts are being taken worldwide to utilize natural waste and by-product as supplementary cementing materials to improve the properties of cement concrete. Rice husk ash (RHA) and Fly ash (FA) are such materials. RHA is by-product of paddy industry. Rice husk ash is a highly reactive pozzolonic material produced by controlled burning of rice husk. Fly ash (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 has being carried out in the present study for the partial replacement of cement with Rice husk ash (RHA) and Fly ash (FA) in concrete.

In this project I started proportion form, 30% Fly Ash and 0% Rice Husk Ash mix together in concrete by replacement of cement, last proportion taken 0% Fly Ash and 30% Rice Husk Ash. With gradual increase of Rice Husk Ash by 5% and simultaneously gradual decrease of Fly Ash by 5%. It is observed that though the

strength of Rice Husk Ash concrete goes on decreasing after the 15% addition of Rice Husk Ash. The composition of 9% Rice Husk Ash + 21% Fly Ash gives maximum strength results as well as shows the potential to be used as useful material for different building materials.

CONENTS

1. INTRODUCTION

Cement is expensive among main constituents of concrete. The entire construction industry is in search of a suitable and effective waste product that would considerably minimize the use of cements and ultimately reduces the construction cost. Rice husk ash (RHA) and Fly ash have the pozzolonic properties so their use might be beneficial. The possibility of using RHA and Fly ash as a construction material need to be investigated.

The fly ash or pulverized fuel ash (PFA) is the residue from the combustion of pulverized coal collected by mechanical dust collectors or electrostatic precipitators or separators from the flue gases of a thermal power plants. Like Portland cement, fly ash contains oxides of calcium, aluminums and silicon. The carbon content in fly ash should be a low as possible, where as the silica content should be as high as possible.

Controlled combustion of Rice Husk Ash in electric generation plants produces amorphous or non crystalline silica with about 85.90% cellular particles. Even with small dosages, for instance 10 percent by weight of cement Rice Husk Ash can produce a very strong transition zone and very low permeability rating in concrete mixtures.

In this project, efforts have been made to search the proper ratio for partial replacement of cement by Fly Ash and Rice Husk Ash to get higher strength of the concrete and also reduce the cost of concrete.

2. Materials Used

2.1 Rice Husk Ash (RHA)

Rice is a heavy staplë in the world market as far as food is concerned. It is the *second largest* amount of any grain produced in the world. The first largest is corn, that is produced for alternative reasons as opposed to rice which is produced primarily for consumption. The leading region of the world which produces rice is Asia, especially South-East and East Asia (table 1.1 show the world rice consumption in million metric tons). Rice milling generates a byproduct know as husk. This surrounds the paddy grain. During milling of paddy about 78 % of weight is received as rice, broken rice and bran .Rest 22 % of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the boiling process. This husk contains about 75 % organic volatile matter and the balance 25 % of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA). This RHA in turn contains around 80 % - 95 %amorphous silica (table 1.2). So for every 1000 kgs of paddy milled, about 220 kgs (22 %) of husk is produced, and when this husk is burnt in the boilers, about 55kgs (25 %) of RHA is generated. India is a major rice producing country, and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion and/or by gasification. About 20 million tons of RHA is produced annually (table 1.3). This RHA is a great environment threat causing damage to the land and the surrounding arëa in which it is dumped.

Rice husk ash (RHA) is a product received after the burning of rice husk. Rice husk is extremely prevalent in East and South-East Asia because of the rice production in this area. The rich land and tropical climate make perfect conditions to cultivate rice and is taken its advantage by these Asian countries. The husk of the rice is removed in the farming process before it is sold and consumed. It has been found beneficial to burn this rice husk in kilns to produce heat which is used for various purposes. The rice husk ash is then used as a substitute or admixture in cement. Therefore the entire rice product is used in an efficient and environmental friendly approach. The Figure – 2.1 shows the photographs of different phases of rice husk.

Figure – 2.1 Structure of different phases of rice husk

Lots of ways are being thought for disposing them by making commercial use of this Rice husk ash (RHA). Rice husk ash (RHA) is good super-pozzolan. This super-pozzolan can be used in big way making by special concrete mixes. The particle size of the cement is about 35 microns. From Rice Husk Aash (RHA) we manufacture organic micro- silica/ amorphous silica with silica content of above 89% is very small particle size of less than 35 microns.

Table: 1.1

World Rice Consumption 2003-2004
(million metric tons)

Country	**Rice Consumption (million metric tons)**
China	135
India	**125**
Egypt	39
Indonesia	37
Bangladesh	26
Brazil	24
Vietnam	18
Thailand	10
Myanmar	10
Philippines	9.7
Japan	8.7
Mexico	7.3
South Korea	5.0
United States	3.9

Malaysia	2.7

Table: 1.2

TECHNICAL SPECIFICATIONS OF RICE HUSK ASH (RHA)

Silica(SiO_2)	80 % to 95 %
Humidity	2 % maximum
Particle size	25 microns
Colour	Grey
Loss on ignition at 800°C	4 % maximum
pH value	8

Table: 1.3

World Production Rate for Rice Paddy and Rice Husk (Million Metric Tons)

Country	Rice Paddy (In Million Metric Tons)	Rice Husk (In Million Metric Tons)
Bangladesh	27	5.4
Brazil	9	1.8
Burma	13	2.6
China	180	36.0
India	**110**	**22.0**
Indonesia	45	9.0
Japan	13	2.6
Korea	9	1.8
Philippines	9	1.8
Taiwan	14	2.8
Thailand	20	4.0
US	7	1.4
Vietnam	18	3.6
Others	26	5.2
Total	500	100

Burning:-

During the burning process, the carbon content is burnt off and all that remains is the silica content. The silica must be kept at a non-crystalline state in order to produce an ash with high pozzalonic activity. The high pozzalonic behavior is a necessity if you intend to use it as a substitute or admixture in concrete. It has been tested and found that the ideal temperature for producing such results is between 600 °C and 700 °C (Fig 2.2 show the rice husk ready to burn).

Figure – 2.2 Burning Process

If the rice husk is burnt at too high temperature or for too long the silica content will become a crystalline structure. If the rice husk is burnt at a too low temperature or for too short a period of time the rice husk ash will contain too large an amount of un-burnt carbon.

Arrangement for Burning of Rice Husk:-

This comprise of a small basket which is placed concentrically inside the larger basket. The larger basket should be about 600mm in diameter and 900mm high. Whereas the inner basket should have 250mm diameter and 750mm deep as shown in figure 2.3.

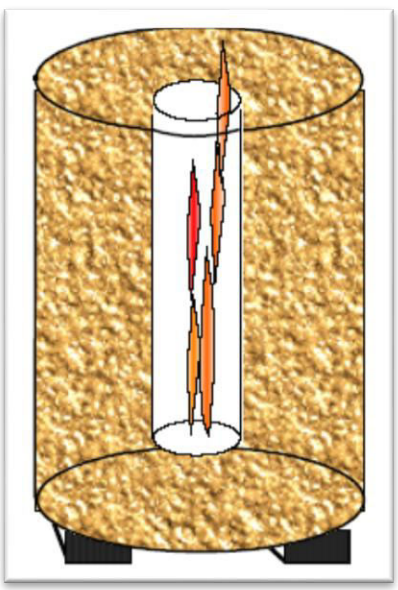

Figure – 2.3 Arrangement for Burning

Both baskets are made from steel mesh having no less than four holes to a centimeter.

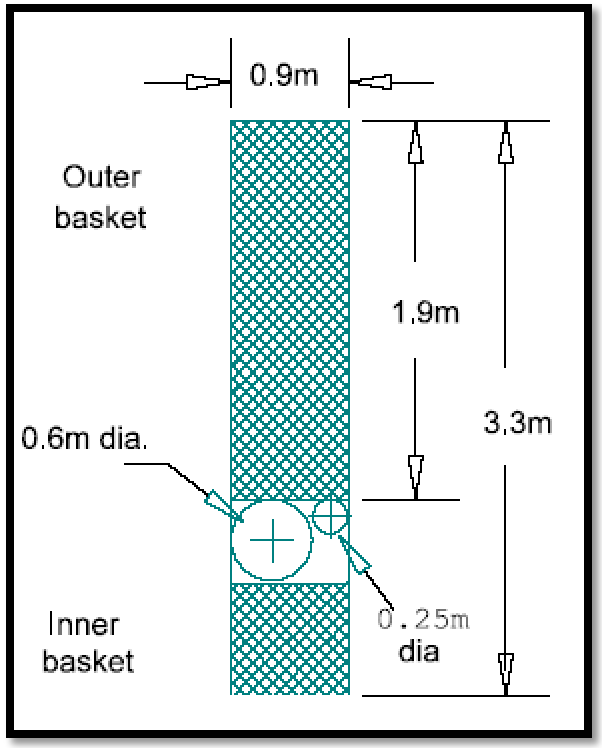

Figure: 2.4 Arrangement for Cutting from roll of mesh

The figure 2.4 shows how the mesh can be cut from a roll of mesh to minimize waste.

However stainless steel mesh is worth using. This is because it can stand the high temperature, rain and some rough handling without corrosion occurring.

The basket may have to be placed in a 200 liter drum and fitted with a cover. It is also a good idea to put bricks under the drum as well as under the basket, to let air get underneath it.

2.2 FLY ASH

The fly ash or pulverized fuel ash (PFA) is the residue from the combustion of pulverized coal collected by mechanical dust collectors or electrostatic precipitators or separators from the flue gases of thermal power plant. Its composition varies with the type of fuel burnt; load of the boiler, type of separator etc. Like Portland cement, fly ash contains oxides of calcium, aluminums and silicon, but the amount of calcium oxide is considerably less.The carbon content in fly ash should be a low as possible, where as the silica content should be as high as possible.

The fly ash obtained from electrostatic precipitators is fine than the Portland cement. The electrostatic precipitators fly ashes collected in chambers I and II are generally very coarser with non spherical particles showing large ignition loss. They can be called coal ash rather than fly ash. Such a fly ash is not suitable for use as pozzolana and it does not reduce the water demand. The fly ash obtained from cyclone separators' is comparatively coarser and may contain larger amount of unburned coal.

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, SiO_2) (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 economical benefits.

2.3 CEMENT

The cement used in the present experimental work was Ordinary Portland cement (43 Grade) with a specific gravity of 3.08. Initial and final setting time of the cement was 50 minutes and 365 minutes respectively.

2.4 WATER

Water used for mixing and curing has been clean, free from injurious amounts of soils, acids, alkalis salts, sugar, organic materials or other substantial that may be deleterious to concrete or steel.

Potable water is generally fined satisfactory and has been used for mixing concrete.

2.5 AGGREGATE

Aggregate shall comply with the requirements of IS: 383 as far possible preference shall be given to natural aggregates.

The nominal maximum size of coarse aggregates should be as large as possible within the limits specified but in no case or later than one fourth of the minimum thickness of the member provided that the concrete can be placed without difficulty so as it surround all reinforced thoroughly. For most of the work, 20 mm aggregates is suitable.

Coarse and fine aggregates shall be batched separately.

Fine aggregate most of which passes through 4.75 mm IS sieve and contains only that much coarser material as is permitted by the specifications. Its may be natural sand, crushed stone sand or crushed gravel sand.

Coarse aggregate most of which are retained on the 4.75 mm IS sieve and contains only that much finer materials as is permitted by specifications are termed coarse aggregate. This may be one of the crushed gravel or stone, uncrushed gravel or stone or partially crushed gravel or stone.

2.6 Admixtures

Admixture if used shall comply with IS 9103. Previous experience with and data on such materials should be considered in relation to the likely standards of supervision and workmanship to the work being specified.

Admixtures should not impair durability of concrete nor combine with any constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

The chloride content of admixtures shall be independently tested for each batch before acceptance.

If two or more admixtures are used simultaneously in the same concrete mix, data should be obtained to assess their interaction and to ensure their compatibility.

The admixture has been used here is a Super Plasticizer named as polycarboxylate ether-based super plasticizer. This super plasticizer is Suitable for the production of high performance concrete. It facilitates extremely high water reduction, high ability flow as well as internal cohesiveness. This admixture used in present study is Viscocrete 5 from Sika Brazil.

The first component – backbone with carboxyl groups – is responsible for the attainable water reduction/initial slump and mixing time respectively.

The second one – side chain determines the slump keeping capability of the super plasticizer, affected by an increasing number of side chains. The crucial factor is the limited space for carboxyl groups and side chains along the backbone. Either a carboxyl group or side chain can be attached at a certain location. This leads to the technological limitation that there are essentially three different types of polymers–water reducing, slump controlling and slump retention polymers.

3. properties of Materials

3.1 Specific Gravity of Rice Husk Ash

Specific gravity of Rice Husk Ash(RHA) is found to be 2.04

3.2 Fly Ash

The chemical composition Fly Ash, Rice Husk Ash and cement are given below:

Materials	MgO (%)	CaO (%)	$Fe_2O_3 + Al_2O_3$ (%)		SiO_2 (%)
Rice husk ash	4.89	0.98	$Al_2O_3+Fe_2O_3$ =15.93		78.20
Fly ash	3.71	19.89	6.00	24.90	40.00
Cement.	2.54	61.90	3.74	5.21	19.70

3.3 Specific gravity of cement

The specific gravity of cement determined by le Chaterliers flask (shown in fig 3.1) which is made of thin glass having a bulb at the bottom. The capacity of the bulb is nearly 250 ml. The bulb is 7.8 cm in mean diameter. The stem is graduated in millimetres. The zero graduation is at a distance of 8.8 cm from the top of the bulb. At 2 cm from the zero, there is another bulb is of length 3.5cm and capacity 17 ml. At 1 cm from bulb, the stem is marked with 18 ml and is grated up to 24 ml.

Figure 3.1 *le Chaterlier,s flask*

OBSERVATION AND CALCULATIONS

(I) Weight of cement used =W gm

(ii)Initial reading of flask =V1 ml

(iii)Final reading of flask =V2 ml

(iv)Volume of cement particle= V2-V1 ml

(v) Weight of equal of water= (V2-V1) x specific weight of water.

Specific gravity of cement = (Weight of cement/ Weight of equal volume of water) = W/ (V2-V1)

Weight of cement used(w)	Initial reading of flask(v1)	Final reading of flask(v2)
64 gm	0.45	21.2

Specific gravity = 64/ (21.2-0.45) = 3.08

3.4 WATER

The pH value of water used is 6.9, which was taken from Delhi Jal Board supply.

3.5 AGGREGATE

Good quality river sand was used as a fine aggregate. The fineness modulus, specific gravity and dry density are 3.51, 2.55 and 1752.8 kg/m^3. Coarse aggregate passing through 20 mm and retained 10 mm sieve was used. Its specific gravity and dry density are 2.74 and 1644.38 kg/m^3.

3.5.1 *Fine* aggregate

Dry rodded Unit weight of fine aggregate is 9.7x1000/5.534 = 1752.8 kg/m^3 and Specific gravity of fine aggregate is 2.55

3.5.2 *Coarse* aggregate

Dry rodded unit weight of coarse aggregate is 1644.38 kg/m^3 and specific gravity of coarse aggregate is 2.74

The average specific gravity of majority of natural aggregates lie between 2.6 and 2.8.

3.5.3 Sieve analysis of fine aggregate is shown in fig 3.2 and 3.3

Their weights and other computations are given below in this table.

IS sieve size (mm)	Weight retained(gm)	Cumulative weight retained(gm)	Cumulative percentage retained	Cumulative percentage passing
4.75	113.50	113.50	7.43	92.57
2.36	120.60	234.10	15.33	84.67
1.18	148.40	382.50	25.05	74.95
0.600	259.10	641.60	42.02	57.98
0.300	588.70	1133.30	74.21	25.79
0.150	306.80	1440.10	94.31	5.69
Pan	10.00	1527.00	-	
		Total =	351.34	

Fineness modulus of sand = 3.51

Figure 3.2 Grading of fine aggregate

Figure 3.3 Various particles of fine aggregates

4. Experimental Programme

Experimental programme comprised of test on cement concrete plain with partial replacement of cement by Rice Husk Ash (RHA) and Fly Ash (FA). OPC 43 grade cement is used for this whole experimental study.

M25 mix is designed as per guidelines of IS 10262:2009.

MIXTURE PROPORTIONING

Thë mixture proportioning was done according the Indian Standard recommended method IS 10262- 2009. The target mean strength was 32.1 MPa for the OPC control mixture. The total binder content was 435.45 kg/m^3 fine aggregate 476kg/m^3 and coarse aggregates1242.62 kg/m3.

The water to binder ratio was kept constant as 0.44, the Super plasticizer content was varied to maintain a slump of (150-200) 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 demoulded and placed in the curing tank until the day of testing. Cement, Sand, fly ash, rice husk ash , fine and coarse aggregate were properly mixed together in accordance with code by weight before water was added and were properly mixed together to achieve homogenous mix. Water absorption capacity and moisture content of aggregates were taken into consideration and appropriately added in the water. The blending of rice husk ash (RHA) in cement is recommended in most international building codes now. Hence cement was replaced in up to 30 % with increment of 5% by rice husk ash and fly ash and 150 x 150 x 150 mm3, Beam and Cylinder moulds were used for casting. Compaction of concrete has been done in three layers with 25 stokes to each layers by 16 mm rod. The concrete was left in the mould and allowed to set for 24 hours before the cubes were de molded and placed in curing tank. The concrete cubes were cured in the tank for 7, 14, 28 and 90 days.

TESTING METHODS

Testing is done as per relevant IS codes. The testing is done for compressive strength of cubes as per IS: 516 – 1959, for flexural strength of beam as per IS: 5816 – 1999 and for split tensile strength of cylinder as per IS: 516 – 1959.

Mix			Strength at different ages in(N/mm2)					
S/No	Mix proportion		7 days	14 days	28 days	90 days	Flexural strength (N/mm2) 28 days	Split tensile strength (N/mm2) 28 days
	Fly ash (%)	Rice husk ash(%)						
1.	**Control mix**		24.88	27.55	40.89	45.00	10.58	6.5
2.	30	0	19.50	24.00	36	40.88	10.58	3.4
3.	25	5	43.55	44	45	53.33	13.75	3.53
4.	20	10	30.66	33.55	35.86	42.66	9.2	3.25
5.	15	15	31.11	33.77	34.22	39.56	6.2	3.11
6.	10	20	27.11	29.77	30.66	33.78	5.25	2.91
7.	5	25	23.55	24.88	25.33	30.67	4.36	2.81
8.	0	30	18.33	20	20.44	25.78	3.45	2.26
9.	21	9	33.77	40.88	42.66	52.44	8.5	3.67
10.	22	8	40.44	42.66	44.03	51.56	10.98	3.58
11.	23	7	35.55	42.22	44.44	53.33	11.25	3.53

5. Discussion of Test Results

After completing the testing and compilation of test results it informed that maximum compressive strength after 28 days got by replacement of cement by 21 percent of fly ash and 9 percent of Rice Husk Ash. Compressive strength 42.66 N/mm2 which is more than the strength of the control mix as 40.89 N/mm2 which is completely fulfill the first aim of this project.

The second aim of this project was to reduce the cost of concrete. I have done the analysis of rates as per Delhi scheduled of rates followed by Central Public Work Department (CPWD) which is shown in AR-I, AR-II,AR-III and AR-IV.

After the study of AR-I and AR-II we find as follows:-

Cost of cement with carriage in concrete as per AR-I =Rs 2749.70

Cost of cement, fly ash, rice husk ash with carriage in concrete as per AR-II =Rs 1930.70

Cost saving by partial replacement of cement by Fly Ash and Rice Husk Ash =Rs 819.00

Cost saving in cement in percentage =29.79%

Overall cost saving for one cubic meter concrete as per AR-III and AR-IV = (7794.42-6835.83) /7794.42 *100=12.3%

Hence as per above analysis, we have got fulfill our second aim of this project as cost reducing approximately 30 percent after partial replacement of cement by Fly Ash and Rice husk Ash on the basis of cement and 12.3% on the basis of overall cost for the quantity of one cubic meter.

AR-I

Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge.

All works above plinth level upto floor V level

Details of Cost for cement used in : 1.00 Cum

	Description	Unit	Quantity	Rate	Amount
	MATERIAL:				
	Stone Aggregate (Single size) : 20 mm nominal size	cum	0.00	1175.00	0.00
	Stone Aggregate (Single size) : 10 mm nominal size	cum	0.00	1175.00	0.00
	Carraige of Stone aggregate below 40 mm nominal size	cum	0.00	106.49	0.00
	Coarse sand (zone III)	cum	0.000	1200.00	0.00
	Carraige of Coarse sand	cum	0.000	106.49	0.00
	Portland Cement	tonne	.0435	6300.00	2709.00
	Carraige of Cement	tonne	0.435	94.65	40.70
	Plasticizer / super plasticizer				
	0.50% OF cement	kilog	0.00	38.00	0.00
	Production cost, pumping to respective floors and laying in position				
	Production cost of concrete by batch mix plant.	cum	0.00	350.00	0.00
	Pumping charges of concrete including Hire charges of pump, piping work & accessories etc.	cum	0.00	150.00	0.00
	LABOUR:				
	Labour for pouring, consolidating & curing				
	Mason (average)	Day	0.00	417.00	0.00
	Beldar	Day	0.00	329.00	0.00
	Bhisti	Day	0.00	363.00	0.00
	Vibrator (Needle type 40mm)	Day	0.00	350.00	0.00
	Sundries	L.S.	0.00	1.78	0.00
	Extra labour for lifting upto floor five level				
	0.75 x 2.50 = 1.88				
	Coolie	Day	0.00	329.00	0.00
	Total:-				2749.70

AR-II

Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge.

All works above plinth level upto floor V level

Details of Cost for : 1.00 Cum

	Description	Unit	Quantity	Rate	Amount
	MATERIAL:				
	Stone Aggregate (Single size) : 20 mm nominal size	cum	0.00	1175.00	0.00
	Stone Aggregate (Single size) : 10 mm nominal size	cum	0.00	1175.00	0.00
	Carraige of Stone aggregate below 40 mm nominal size	cum	0.00	106.49	0.00
	Coarse sand (zone III)	cum	0.000	1200.00	0.00
	Carraige of Coarse sand	cum	0.000	106.49	0.00
	Portland Cement (30% of Cement replace by rice husk ash and fly ash)	tonne	0.30	6300.00	1890.00
	Carraige of Cement	tonne	0.43	94.65	40.70
	Plasticizer / super plasticizer				
	0.50% OF cement	kilog	0.00	38.00	0.00
	Production cost, pumping to respective floors and laying in position				
	Production cost of concrete by batch mix plant.	cum	0.00	350.00	0.00
	Pumping charges of concrete including Hire charges of pump, piping work & accessories etc.	cum	0.00	150.00	0.00
	LABOUR:				
	Labour for pouring, consolidating & curing				
	Mason (average)	Day	0.00	417.00	0.00
	Beldar	Day	0.00	329.00	0.00
	Bhisti	Day	0.00	363.00	0.00
	Vibrator (Needle type 40mm)	Day	0.00	350.00	0.00
	Sundries	L.S.	0.00	1.78	0.00
	Extra labour for lifting upto floor five level				
	0.75 x 2.50 = 1.88				
	Coolie	Day	0.00	329.00	0.00
				Total:	1930.70

AR-III FOR OVERALL COST FOR CONTROL MIX

Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge.

All works above plinth level upto floor V level

Details of Cost for : 1.00 Cum

	Description	Unit	Quantity	Rate	Amount
	MATERIAL:				
	Stone Aggregate (Single size) : 20 mm nominal size	cum	0.57	1175.00	669.75
	Stone Aggregate (Single size) : 10 mm nominal size	cum	0.28	1175.00	329.00
	Carraige of Stone aggregate below 40 mm nominal size	cum	0.85	106.49	90.52
	Coarse sand (zone III)	cum	0.425	1200.00	510.00
	Carraige of Coarse sand	cum	0.425	106.49	45.26
	Portland Cement	tonne	0.44	6300.00	2740.50
	Carraige of Cement	tonne	0.44	94.65	41.17
	Plasticizer / super plasticizer				
	0.50% OF cement	kilog	1.65	38.00	62.70
	Production cost, pumping to respective floors and laying in position				
	Production cost of concrete by batch mix plant.	cum	1.00	350.00	350.00
	Pumping charges of concrete including Hire charges of pump, piping work & accessories etc.	cum	1.00	150.00	150.00
	LABOUR:				
	Labour for pouring, consolidating & curing				
	Mason (average)	Day	0.17	417.00	70.89
	Beldar	Day	2.00	329.00	658.00
	Bhisti	Day	0.90	363.00	326.70
	Vibrator (Needle type 40mm)	Day	0.07	350.00	24.50
	Sundries	L.S.	13.00	1.78	23.14
	Extra labour for lifting upto floor five level				
	0.75 x 2.50 = 1.88				
	Coolie	Day	1.88	329.00	618.52
	Total:-				6710.65

Add water charges @ 1% on	67.11
Total:-	6777.76
Add C.P & OH @ 15% on	1016.66
Cost for 1.00 Cum	7794.42

AR-IV

FOR OVERALL COST AFTER PARTIAL REPLACEMENT OF CEMENT BY FLY ASH AND RICE HUSK ASH

Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge.

All works above plinth level upto floor V level

Details of Cost for : 1.00 Cum

	Description	Unit	Quantity	Rate	Amount
	MATERIAL:				
	Stone Aggregate (Single size) : 20 mm nominal size	cum	0.57	1175.00	669.75
	Stone Aggregate (Single size) : 10 mm nominal size	cum	0.28	1175.00	329.00
	Carraige of Stone aggregate below 40 mm nominal size	cum	0.85	106.49	90.52
	Coarse sand (zone III)	cum	0.425	1200.00	510.00
	Carraige of Coarse sand	cum	0.425	106.49	45.26
	Portland Cement (30% of Cement replace by rice husk ash and fly ash)	tonne	0.30	6300.00	1915.20
	Carraige of Cement	tonne	0.44	94.65	41.17
	Plasticizer / super plasticizer				
	0.50% OF cement	kilog	1.65	38.00	62.70
	Production cost, pumping to respective floors and laying in position				
	Production cost of concrete by batch mix plant.	cum	1.00	350.00	350.00
	Pumping charges of concrete including Hire charges of pump, piping work & accessories etc.	cum	1.00	150.00	150.00
	LABOUR:				
	Labour for pouring, consolidating & curing				
	Mason (average)	Day	0.17	417.00	70.89
	Beldar	Day	2.00	329.00	658.00
	Bhisti	Day	0.90	363.00	326.70
	Vibrator (Needle type 40mm)	Day	0.07	350.00	24.50
	Sundries	L.S.	13.00	1.78	23.14
	Extra labour for lifting upto floor five level				
	0.75 x 2.50 = 1.88				
	Coolie	Day	1.88	329.00	618.52
				Total:	5885.35
	Add water charges @ 1% on				58.85

	5944.20
Add C.P & OH @15% on	891.63
Cost for 1.00 Cum	6835.83
	958.59

6. CONCLUSIONS

Based on results presented in the table, the following conclusions have been drawn.

1. Compressive strength increases with the increase in the percentage of fly ash and Rice Husk Ash up to replacement (21%FLY ash and 9% Rice Husk Ash) of cement in concrete for different mix proportions.
2. Concrete requires approximate increase in percentage of Rice Husk Ash because Rice Husk Ash is highly porous material.The workability of Rice Husk Ash concrete has been found to decrease with increase in Rice Husk Ash replacement.
3. It was found that rice husk when burned produced amount of silica (more than 80%). For this reason it provides excellent thermal insulation.
4. Rice husk ash contains more silica, and hence we prefer rice husk ash use in concrete than silica fume to increase the strength.
5. Through Rice husk ash is harmful for human being, but the cost of rice husk ash is zero and thus we prefer Rice Husk Ash use in concrete as compared to silica fumes
6. The workability of Rice Husk Ash concrete has been found to decrease but FLY ash increases the workability of concrete so Rice Husk Ash and FLY ash mix together in concrete to improve the workability of concrete.
7. Rice Husk Ash can be used with admixtures, plasticizers, for increasing the strength of concrete with partial replacement of cement.
8. Present work is aimed at developing predictive tool with respect to normal density aggregate and normal weight concrete. However, the work can be extended to the concrete of light weight and heavy density.

9. The maximum 90 days compressive strength was obtained with 23% Fly ash 7% rice husk ash mix.
10. The maximum 28 days split tensile strength was obtained with 25 % Fly ash 5 % rice husk ash mix.
11. The maximum 28 days flexural strength was obtained again with 21 % Fly ash and 9 % rice husk ash mix.
12. The transition zone gets improved and densified with the use of ternary mix concretes containing rice husk ash and Fly ash.
13. Due to the high specific surface area of the Rice Husk Ash, the dosage of super plasticizer had to be increased along with Rice Husk Ash fineness to maintain the desired workability.
14. The mechanical properties in terms of flexural and tensile strength have been significantly improved with the addition of Rice Husk Ash
15. Rate analysis shows that as the percentage of Rice Husk Ash and FA added on the concrete the cost goes decrease up to 30 %.
16. Rice Husk Ash when added in the concrete reduces the weight of the concrete up to 15% after 90 days of curing.

7 REFERENCES.