An Experimental Study on Effective Utilization of Rice Husk Ash as an Additive in Concrete

I Femi Sunny [1], II Abhilasha P. S. [2], III Vilas Shankar K. P.[3]

Abstract— This thesis focused on the experimental study on utilization of rice husk ash as a weight reducing additive in concrete. So that, maximum amount of aggregate in concrete can be reduced by using rice husk ash as an additive in concrete and compare the properties and behavior of members against that of conventional mix. In this study, a different method of mix design was adopted to reduce the weight of structural members. The effect of rice husk ash on the compressive and split tensile strength of concrete was studied initially. The experimental results shows that, the addition of 15% rice husk ash reduce maximum amount of aggregate without compromise in strength. Based on this result, beam of size 3X0.15X0.2m was casted. The flexural behaviour and strength of prototype beams were studied by conducting four point bending test.

Index Terms— *Additive, Flexural behaviour, Four point bending test, Rice husk ash*

1 INTRODUCTION

Concrete is a well known heterogeneous mix of cement, aggregates and water. The admixtures like fly ash, rice husk ash and silica fume may be added to concrete in order to enhance some properties of concrete. Rice husk ash is a by-product of paddy industry. Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk. Rice husk ash is an agricultural by-product available in large quantities causing detrimental effect due to crop residue burning. One of the solutions for this is to utilizing rice husk ash in a proper way. By the utilization of rice husk ash in concrete, greener and economical concrete can be achieved.

2 METHODOLOGY

2.1 Objectives of the study

The main objectives of the study to determine contribution of RHA as a weight reducing additive in concrete and disposal of rice husk ash in an effective way.

2.2 Experimental Study

Various studies were conducted to determine the properties of rice husk ash as a cement replacement material in concrete. While this study was focused on the utilization of rice husk ash as a weight reducing additive in concrete.This project includes three stages- determination of material properties, experimental study and the analysis of results. In the initial stage various tests like specific gravity and water absorption tests were conducted to determine the properties of different constituents in concrete. In the second stage experimental work was conducted. It deals with the casting and testing of cube and cylindrical specimens. To select appropriate percentage of rice husk ash, compressive strength of specimens was founded at 10%, 15% and 20% rice husk ash content. For that 9 No's of cubes of size 150x150x150mm was casted for conventional concrete and for each variation. Split tensile strength was also conducted on cylinders of 15cm diameter and 30cm height. Based on that beam of size 3X0.15X0.2m was casted. The last stage included analysis of results.

[1]*Dept. of Civil Engineering, Kerala Technological University of Kerala,Trivandrum,Kerala,,Femisunny1995@gmail.com*
[2]*Dept. of Civil Engineering, Kerala Technological University Kerala,Trivandrum,Kerala,,abhilasha@vidyaacademy.ac.in*
[3]*Dept. of Civil Engineering, University of Nizwa, Oman,vilas@unizwa.edu.om*

3 MIX PROPORTIONS

TABLE 1
MIX PROPORTION OF CONCRETE CONSTITUENTS

w/c ratio	RHA (%)	Water (L/m³)	Cement (Kg/m)	FA (kg/m³)	CA (kg/m³)	RHA (kg/m³)
0.45	0	190	422.22	688.04	1312.68	0
	10	220	459.5	429.11	1214.19	48.88
	15	240	485.3	376.15	1157.5	79.90
	20	250	488.8	336.64	1134.95	111.11

4 TEST ON HARDENED CONCRETE

It is carried out to obtain compressive strength and split tensile strength. The test results were taken as the average of three test results for each category of test.

4.1 Compressive Strength Test

One of the important properties of concrete is its compression. Most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. Compressive strength test was conducted on cubes of size150x150x150mm. Specimens were cured for 7 days and 28 days. Test specimens were tested in Compression Testing Machine.

Fig.1 Compressive Strength Test

4.1 Split tensile strength test

The split tensile strength test is the indirect measurement of the tensile strength by placing a cylindrical specimen horizontally between the loading surfaces. This method consists of applying a diametric compressive force along the length of cylindrical specimen.

Fig.2 Split Tensile Strength Test

5 TEST RESULTS ON HARDENED CONCRETE

In this section, evaluation of these results was shown below.

5.1 Compressive Strength

TABLE 2
COMPRESSIVE STRENGTH RESULT

Percentage of rice husk ash	Days of curing	Average compressive strength (N/mm^2)
0%	7	29.8
	28	38.6
10%	7	22.8
	28	32.01
15%	7	25.7
	28	36.8
20%	7	15.1
	28	26.3

Compressive strength result of various percentage of rice husk ash at 7 and 28 days are shown in Fig. 4. From the result it is clear that 15% is the optimum percentage of rice husk ash content without compromising strength.Similar result was obtained in split tensile strength also.

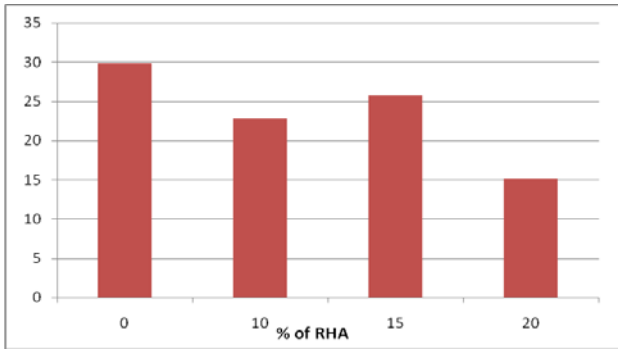

Fig.3 Compressive Strength at 7 days

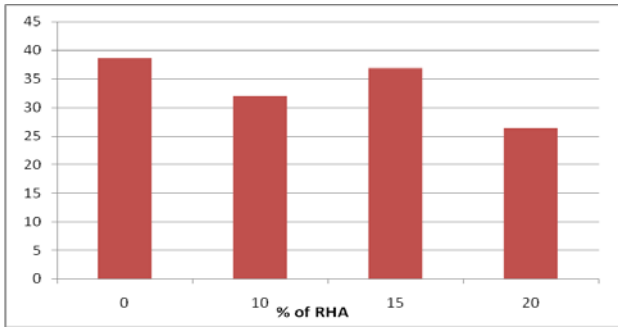

Fig.4 Compressive Strength at 28 days

5.2 Split Tensile Strength

TABLE 3
SPLIT TENSILE STRENGTH RESULT

Percentage of rice husk ash	Days of curing	Average split tensile strength (N/mm^2)
0%	7	2.32
	28	2.71
10%	7	1.32
	28	2.16
15%	7	1.81
	28	2.56
20%	7	1.22
	28	2.04

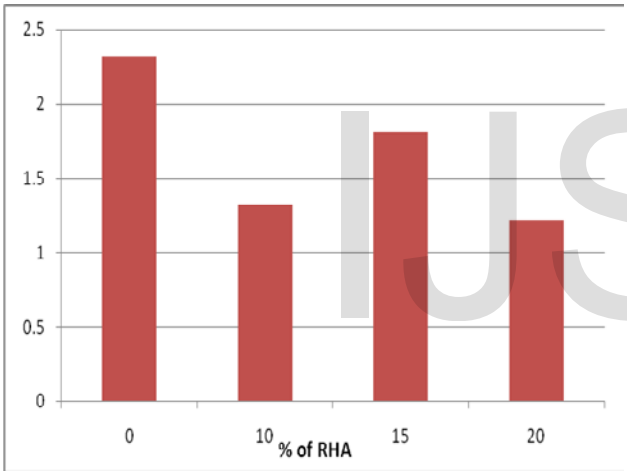

Fig.5 Split Tensile Strength at 7 days

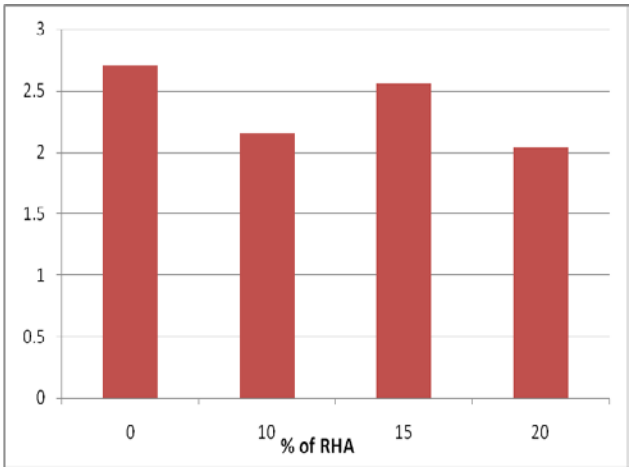

Fig.6 Split Tensile Strength at 28 days

6 EXPERIMENTAL WORK ON BEAMS

The experimental set up consists of a loading frame, hydraulic jack, hydraulic pump, load cell, LVDT and indicators to measure the load and deflection. The loading frame, as shown in Figure.3, available in the lab is of 20 ton capacity.It has one loading platforms for placing the specimen. The test specimens can be placed on the platform provided at the base of loading frame by using a support which is designed to act as a hinge. At the top a hinged support will be provided on which axial load can be given using 20 ton hydraulic jack. The magnitude of the applied load can be seen from the digital indicator. It expresses the load in tons with a least count of 0.01 ton. The vertical deflections and deflections at the mid-span can be measured using two linear variable differential transducers (LVDT). The LVDT has a capacity to measure 60 mm deflection. The LVDTs is to be connected to digital indicator to read the deflection. It reads the deflection in mm with a least count of 0.01 mm.


Fig.7 Loading frame

7 RESULTS AND DISCUSSIONS

The rice husk ash specimen has taken an average load of 3.5 ton and in the case of control specimen maximum obtained average load is 3.1 ton. In terms of crack morphology, crack progression of control and rice husk ash beams were virtually identical.Crack in beams begin with flexural cracks followed by the additional crack between load and support. After further increasing applied load, the cracks were propagated in upward direction.Rice husk ash beams shows more ductile behavior than control specimen.


Fig.8 Beam before loading


Fig.9 Beam after loading


Fig.10 Cracks developed during loading


Fig.11 Ductile behavior of rice husk ash beam

8 Summary of Results

Based on the work presented in this thesis following findings are obtained:

1. Utilization of RHA in concrete helps to reduce the weight of concrete specimens. Thus light weight concrete can be achieved.
2. 15% RHA gives almost same strength of conventional concrete.
3. In terms of crack morphology, crack progressions of control and rice husk ash beams were virtually identical.
4. Rice husk ash beams show more ductile behavior than control specimen.
5. By the utilization of rice husk ash in concrete, environmental pollution can be reduced.

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