Experimental Study on High Strength Rice Husk Ash Concrete Incorporating Lathe Waste

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***Abstract*- This research investigates the mechanical properties of high strength concrete with different replacement levels of ordinary Portland cement by Rice Husk Ash (RHA) and replacement of fine aggregate by Lathe waste (LW). M50 grade was designed caste and tested. There are totally 6 mixes with 10% replacement of cement with rice husk ash for each mix and lathe waste replacement of fine aggregate with an increment of 10% for each mix. The compressive strength, split tensile strength and flexural strength at 7 and 28 days have been obtained. The optimum replacement of rice husk ash found to be 10%. It is concluded that mix containing 10% replacement of RHA and 20% replacement of LW shows greater strength comparing to other mixes.**

Keywords: **Rice Husk Ash, lathe waste, Fine Aggregate**

1. INTRODUCTION

1.1 General

Concrete is most widely used construction material in the world due to its ability to get cast in any form and shape. It also replaces old construction materials such as brick and stone masonry. The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cementitious material, aggregate and water and by adding some special ingredients. Hence concrete is very well suitable for a wide range of applications.

1.2 Rice Husk Ash

Rice husk ash (RHA) is a material that can play a similar role to silica fume as a pozzolanic material in concrete. Raw rice husks, which are residues from dehusked paddy rice, pose an enormous disposal problem and environmental load. RHA is produced from the controlled incineration of raw rice husks, which is then ground to the required fineness. On average, each unit weight of raw husks would yield approximately 18–20% of RHA, which can be optimized positively in concrete technology. The beneficial effects of RHA on concrete with respect to its mechanical properties and durability have been widely discussed. It is deduced that high-strength concrete (HSC) with a compressive strength of 80 MPa can be produced by the combined utilization of RHA and superplasticizer from the concrete age of 14 days onwards.

1.3 Lathe Waste

Lathe waste which exhibits the property of steel fiber largely, can be used as an alternate for steel fiber in the FRC production. Various experimental studies were conducted on lathe waste reinforced concrete. We found that there is a considerable increase in the compressive strength when compared to plain cement concrete and also when tested for flexural Strength. The lathe waste reinforced concrete shows an increase in flexural strength to the mechanical property of concrete the major issues are development of cracks and failure of concrete pavement due to impact load. Several works are been conducted in exploring the relation between permeability and crack width and reported that using steel fibre have decreased the permeability of the specimens with reduced crack width up to 100 microns. Steel-fibre-reinforced concrete containing tested for impact strength has substantially improved resistance to impact and greater energy absorption concrete.

2. NEED FOR THE RESEARCH

The search for newer material and newer technology, especially in the construction industry is on in view of growing awareness on protection of environment and the conservation of natural resources. Together with this, the problem of waste disposal has become a major concern for planners and engineers in developing countries. With the enormous increase in the quantity of waste materials from industries, the continuing shortage of dumping sites, increase in the transportation and disposal cost.

3. OBJECTIVES

- ✓ To investigate the properties of ingredients such as rice husk ash, lathe waste.
- ✓ To develop structural high strength rice husk ash concrete mix.
- ✓ To use lathe waste as a partial replacement of sand in concrete mix.

4. SCOPE OF THE PROJECT

- ✓ To compare the properties of RHA concrete with lathe waste and OPC (Ordinary Portland Cement) concrete with lathe waste.
- ✓ Conventional cubes and cylinder would be prepared for determining the strength of RHA concrete.
- ✓ To find the mechanical properties of high strength RHA concrete.

5. PREVIOUS STUDY

Raman (2010), The use of quarry dust as a partial substitute for sand result in some minor negative effects in compressive strength and other mechanical properties of concrete. These outcomes can easily be computed by a good mix design and by incorporating of RHA. The findings of the research assert that quarry dust can be used as a viable replacement material to sand to produce high strength RHA concrete.

Zerbino (2010) Mixing RHA together with the coarse aggregate during a convenient period of time, before incorporating the other component materials.Fresh and Mechanical properties and the water permeability were analysed in concrete replacing by RHA.The incorporation of this RHA in concrete represents a good alternative for the disposal of the residue.

Gritsada Sua-iam (2012) It examined the feasibility of using limestone powder (LS) as a modifying agent in self-compacting concrete in which a portion of the fine aggregate was replaced with untreated rice husk ash (RHA). Suitable levels of fine aggregate replacement by RHA and LS provide development of high compressive at early ages due to filling effects and pozzolanic reactions.

Vijayakumar (2012) The workability of fresh concrete that containing different ratios of lathe waste was carried out by using slump test. The result showed that addition of lathe scrap in to Plain Cement Concrete (PCC) mixture enhanced its compressive strength while it decreased the workability of the fresh concrete containing the lathe waste. The impact strength of concrete mixed with lathe waste shows increased impact strength when compared with Plain Cement Concrete (PCC).

6. EXPERIMENTAL INVESTIGATIONS

6.1 Preparation and Casting of Specimen

The total mixes that need to be prepared in this studies is about 6 mixing and this included a preparation of 36 cube samples (150 × 150 × 150 mm) for compressive strength test, 18 samples of beam (100 × 100 × 500 mm) for flexural test and 36 samples of cylinder (150 mm diameter × 300 mm height) for split tensile strength test. All the samples have been prepared for conventional concrete and rice husk ash concrete was prepared by replacement of cement with used rice husk ash for 10% and followed by replacement of fine aggregate with for 10%, 20%, 30% and 40%. The samples were categorized by age of the concrete at the day of testing, rice husk ash and lathe waste content. For each mix, 3 cubes were tested for compressive strength at 7 days and 28 days of curing, 3 samples of cylinder were tested for split tensile strength for 7 days and 28 days of curing and 3 samples of beam were tested for flexural strength at 28 days.

Table 6.1 Designation of concrete & Percentage of replacement of RHA & LW

MIX	**Designation of concrete**	**Percentage of replacement of RHA**	**Percentage of replacement of LW**
CC	M1	-	-
10% RHA	M2	10%	-
10% RHA 10% LW	M3	10%	10%
10% RHA 20% LW	M4	10%	20%
10% RHA 30% LW	M5	10%	30%
10% RHA 40% LW	M6	10%	40%

CC - Conventional concrete, RHA – Rice husk ash, LW – Lathe Waste

6.2 Compression test Results

Table 6.2 comparison of compression strength

Concrete Type	**7 days Compressive strength (N/mm^2)**	**28 days Compressivestrength (N/mm^2)**
M1	25.82	55.37
M2	25.32	52.13
M3	33.33	56.64
M4	36.77	57.18
M5	34.78	53.72
M6	36.62	56.88

6.3 Split tensile test Results

Split tensile strength was calculated using the Equation

$$f_{sp} = 2P / \pi D L \ N/mm^2$$

Table 6.3 Split Tensile Strength of concrete for 7 days and 28 days

Concrete Type	7 days Compressive strength (N/mm^2)	28 days Compressive strength (N/mm^2)
M1	1.80	2.27
M2	1.69	2.16
M3	2.03	2.84
M4	2.78	3.55
M5	2.35	2.77
M6	2.22	3.18

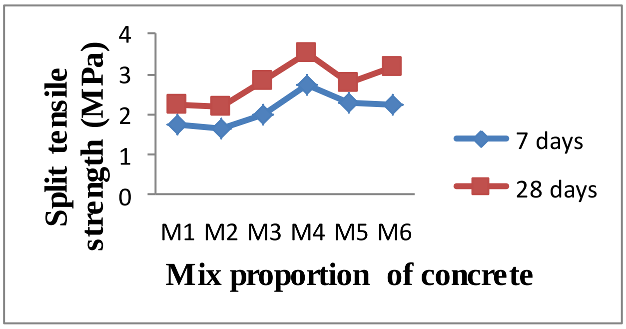

Figure 6.1 Comparison of 7 days and 28 days Split tensile strength of Conventional concrete and other mix

6.4 Flexure test Results

Flexural strength was calculated using the equation

$$f_b = PL / BD^2 \ N/mm^2$$

Table 6.4 flexural Strength of concrete for 7 days&28 days

Concrete Type	7 days flexural strength (N/mm^2)	28 days flexural strength (N/mm^2)
M1	1.53	4.1
M2	1.45	4.5
M3	2.61	6.2
M4	3.24	5.58
M5	2.18	5.54
M6	1.63	3.51

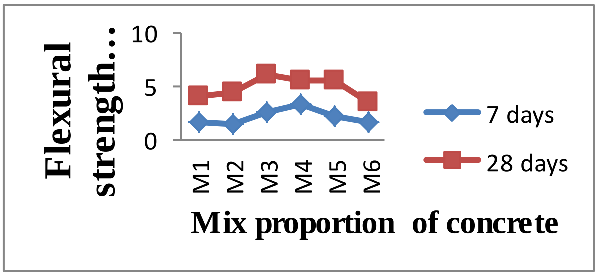

Fig. 6.2 Comparison of 7 days and 28 days Flexural strength of Conventional concrete and other mix

7. RESULT DISCUSSION

7.1. Comparison of compressive strength results

The 7 days and 28 days compressive strength result for different mixes were presented in Table 6.2. The Table 7.1 given below shows that the percentage increase or decrease in compressive strength of the mixes after 28 days of curing with respects to conventional mix.

Table 7.1 Percentage increase/decrease in compressive strength after 28 days

Nominal Mix	Other mixes	Increase/decrease in strength (%)
Conventional Concrete mix M1	M2	+3.04
	M3	+9.87
	M4	+3.45
	M5	+8.28
	M6	+1.04

7.2 Comparison of split tensile strength results

The 7 days and 28 days split tensile strength result for different mixes were presented in Table 6.3. The Table 7.2 given below shows that the percentage increase or decrease in split tensile strength of the mixes after 28 days of curing with respects to conventional mix.

Table 7.2 Percentage increase/decrease in split tensile strength after 28 days

Nominal Mix	Other mixes	Increase/decrease in strength (%)
Conventional Concrete mix M1	M2	+5.55
	M3	+14.16
	M4	+9.59
	M5	+10.52
	M6	+4.24

7.3 Comparison of flexural strength results

The 28 days flexural strength result for different mixes were presented in Table 6.4. The Table 7.3 given below shows that the percentage increase or decrease in flexural strength of the mixes after 28 days of curing with respects to conventional mix.

Table 7.3 Percentage increase/decrease in flexural strength after 28 days

Nominal Mix	Other mixes	Increase/decrease in strength (%)
Conventional Concrete mix M1	M2	+3.76
	M3	+7.54
	M4	+5.28
	M5	+5.78
	M6	+2.01

8. CONCLUSIONS

- ✓ The compressive strength of the blended concrete with 10% RHA has increased significantly.
- ✓ Therefore specimen with 10% RHA and 20% LW was found to be good in compression which has the compressive strength of 31.66% more than the conventional concrete.
- ✓ It is found that cement can be replaced by RHA up to 20% without adversely affecting the strength.
- ✓ Increase in split tensile strength was achieved with the addition of 10% RHA and 20% LW concrete. The strength has increased up to 30.87% when compared to that of the conventional concrete specimen.
- ✓ In flexure the specimen with 10% RHA and 10% LW proportions was found to be good. While adding lathe waste the flexural strength is increased by 15.88%.
- ✓ The water absorption is 5-8% higher in blended concrete when compared to conventional concrete.
- ✓ Therefore, it is concluded that the properties are better in blended concrete with 10% RHA and 20% LW for compressive strength and split tensile strength whereas 10% RHA and 10% LW for flexure strength when compared to the conventional concrete.

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