USE OF RICE HUSK ASH AND STEEL FIBRE CONCRETE IN RURAL ROAD

Maheshbhai Prajapati[1], Dr. Jayeshkumar Pitroda[2]

Final Year Student, ME C.E.&M., BVM Engineering College, Vallabh Vidyanagar, Gujarat, India [1]

Assistant professor, Civil Engineering Dept., BVM Engineering College, Vallabh Vidyanagar, Gujarat, India [2]

ABSTRACT

Concrete is well known is a heterogeneous mix of cement, water and aggregates. Globally concrete is the backbone for the development of infrastructure, buildings, industrial structures, bridges and highways etc. In today's situation concrete needs special combinations of performance and uniformity requirements that cannot be always achieved by using conventional constituents and normal mixing. It is weak in tension, has limited ductility and little resistance to cracking. Mineral admixtures such as fly ash, silica fume, blast furnace slag, rice husk ash, are finely divided siliceous materials and are added to concrete as a partial replacement for cement. The addition of these admixtures also results in significant savings in energy and cost. The detailed experimental investigation is doing to study the effect of partial replacement of cement by Rice husk ash with using Steel fiber in concrete. Thus the present research study includes the experimental investigation of concrete by adding rice husk ash with using steel fiber different proportion in M30 grade of concrete.

Key Words: Rice Husk Ash, Steel Fibre, Construction Industry, Compressive *Strength*

1. INTRODUCTION

Globally concrete is the backbone for the development of infrastructure, buildings, industrial structures, bridges and highways etc. In today's situation concrete needs special combinations of performance and uniformity requirements that cannot be always achieved by using conventional constituents and normal mixing. Rice husk is an agricultural residue which accounts for 20% of the 649.7 million tons of rice produced annually worldwide. Burning the husk under controlled temperature below 800 °C can produce ash with silica mainly in amorphous form. Today inspired from the ancient application of techniques artificial fibers are commonly used now a day in order to improve the mechanical properties of concrete. The main objective of the project is to find out alternative materials for road pavements to meet the demands of bitumen for the upcoming years, to provide adequate serviceability at minimum cost, to make the eco-friendly roads with safety, and speed for the flow of traffic. In this investigation, an attempt has to be made to determine the feasibility of industrial waste products such as Steel Slag and Rice Husk Ash use in base layer of concrete road pavements.

2. LITERATURE REVIEW

Following are the critical literature reviews on various papers based on experimental research work on use of Rice Husk Ash and Steel Fibre into the concrete.

Hossain et al. (2011) found that addition of rice husk ash in cement increases its normal consistency and setting times. It has also been found that addition of rice husk ash in brick does not affect its shape and size**. [1]**

Krishna et al. (2012) stated that applications of Rice Husk Ash as repair mortars, coatings and soil stabilization. Rice Husk Ash contributes significantly to a green building. **[10]**

Mohod et al. (2012) found that the workability of steel fibre reinforced concrete gets reduced as the percentage of steel fibres increases.Compressive strength and flexural strength of concrete goes on increasing with the increase in fibre content. **[17]**

Deotale et al. (2012) stated that rice husk ash concrete low workability and fly ash concrete high workability also increasing fiber content reduced workability. **[29]**

Kumar et al. (2014) found that addition of Rice Husk Ash at 25% decreases the compressive strength and inclusion of polypropylene fibres into concrete mixes increases the compressive strength at 0.5% fibres content as compared to the control mix. **[26]**

3. OUTLINE OF REASEARCH WORK

A. OBJECTIVES OF THE STUDY

Objectives which have covered in this project study are as follows:

1. To study various properties of Rice Husk Ash and Steel Fibre.
2. To assess strength of Rice Husk Ash and Steel Fibre concrete compared to conventional cement concrete.
3. To perform compressive strength test on rice husk ash and steel fibre concrete.
4. To find the effect of Rice Husk Ash and Steel Fibre associated with cement concrete in mix proportions of M30 grade concrete.
5. To accomplish Rice Husk Ash and Steel Fibre concrete usage in the field of rural road construction.

4. DESIGN MIX MATERIALS

4.1 Supplementary Cementitious Material: Rice Husk Ash

Rice husk is the outer cover of paddy and accounts for 20-25 % of its weight. It is extensively used in rural India because of its widespread availability and relatively low cost. The annual generation of rice husk in India is 18-22 million tons.

Rice Husk Ash depends on (i) silica content, (ii) silica crystallization phase, and (iii) size and surface area of ash particles. In addition, ash must contain only a small amount of carbon.

Following Table 1 shows Physical properties of RHA.

Table 1: Physical properties of RHA

No	Particulars	Proportion
1	Colour	Gray
2	Shape texture	Irregular
3	Mineralogy	Non crystalline
4	Particle size	>45 micron
5	Odour	Odourless
6	Specific gravity	2.3

Following Table 2 shows Chemical properties of RHA.

Table 2: Chemical properties of RHA

No	Particulars	Proportion
1	Silicon dioxide	86.94%
2	Aluminum oxide	0.2%
3	Iron oxide	0.1%
4	Calcium oxide	0.3-2.2%
5	Magnesium oxide	0.2-0.6%
6	Sodium oxide	0.1-0.8%
7	Potassium oxide	2.15-2.30%

4.2 Steel Fibre

Steel Fibres are filaments of wire, deformed and cut to lengths, for a reinforcement of concrete, mortar and other composite material.

The presence of micro cracks in the mortar-aggregate interface is responsible for the inherent weakness of plain concrete. The weakness can be removed by inclusion of fibres in the mixture. Different types of fibers, such as those used in traditional composite materials can be introduced into the concrete mixture to increase its toughness, or ability to resist crack growth. The fibres help to transfer loads at the internal micro cracks.

Steel Fibres were used Hook Ended Steel Fibre (HESF) and Flat Crimped Steel Fibre (FCSF) in concrete.

Following Table 3 shows Properties of steel fibre .

Table 3: Properties of steel fibre

Type	Length L(mm)	Diameter d (mm)	Aspect ratio(L/d)
RCSF	25	0.55	45
FCSF	30	2 mm thick	15
HESF	25	0.55	45

4.3 Ordinary Portland Cement

Cement is essential material in any concrete mix, which works as a bonding material in concrete mix. Use of Ordinary Portland Cement OPC 53 grade.

4.4 Coarse Aggregate

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock.

4.5 Fine aggregate

Those fractions from 4.75 mm to 150 microns are termed as fine aggregate. The sand used locally available clean, well-graded, natural river sand.

5. METHODOLOGY

Following is the methodology for casting and testing for compressive strength of concrete made by Replacement of Cement by Rice Husk Ash and Addition of Steel Fiber in different proportions.

a) Casting of Standard M30 Concrete Mixes.
b) Casting of M30 Concrete Mixes with Replacement of Cement by Rice Husk Ash and Addition of Steel Fiber.
c) Testing was done for Compressive strength on Universal Testing Machine.
d) Analysis of Results.

6. MIX DESIGN OF M30 GRADE CONCRETE (As per IS-10262:2009)

Following Table 4 shows Various Materials for M30 Grade Concrete and Table 5 shows Different Mixes of M30 Grade Concrete.

Table 4: Various Materials for M30 Grade Concrete

For 1 m^3 concrete	
Cement	424.5 Kg
Water	191 L
Coarse Aggregate	1178 kg / m^3
Fine Aggregate	702.78 kg / m^3

CONCRETE MIXES

Table 5: Different Mixes of M30 Grade Concrete.

Concrete Mixes	Description
A	M30 grade of concrete
B1	10% Replacement of RHA + 2% addition of FCSF
B2	15% Replacement of RHA + 2% addition of FCSF
B3	20% Replacement of RHA + 2% addition of FCSF
C1	10% Replacement of RHA + 2% addition of HESF
C2	15% Replacement of RHA + 2% addition of HESF
C3	20% Replacement of RHA + 2% addition of HESF

RHA=Rice Husk Ash (Replace by cement)

FCSF= Flat Crimped Steel Fibre

HESF= Hook Ended Steel Fibre

7. RESULTS OF COMPRESSION TEST FOR M30 GRADE STANDARD CONCRETE AND CEMENT REPLACEMENT OF RICE HUSK ASH AND ADDITION OF STEEL FIBRE IN DIFFERENT PROPORTIONS.

Following Table 6 shows Comparative Experimental Results for Compressive Strength Test for M30 Mixes, Standard Concrete and Cement Replacement of Rice Husk Ash and addition of FCSF in Different Proportions

Table 6: Comparative Experimental Results for Compressive Strength Test for M30 Mixes, Standard Concrete and Cement Replacement of Rice Husk Ash and addition of FCSF in Different Proportions

Concrete Mixes	Average Compressive Strength (N/mm^2)	
	7 Days	28 Days
A	20.68	33.58
B1	26.51	40.07
B2	27.11	41.41
B3	25.92	39.73

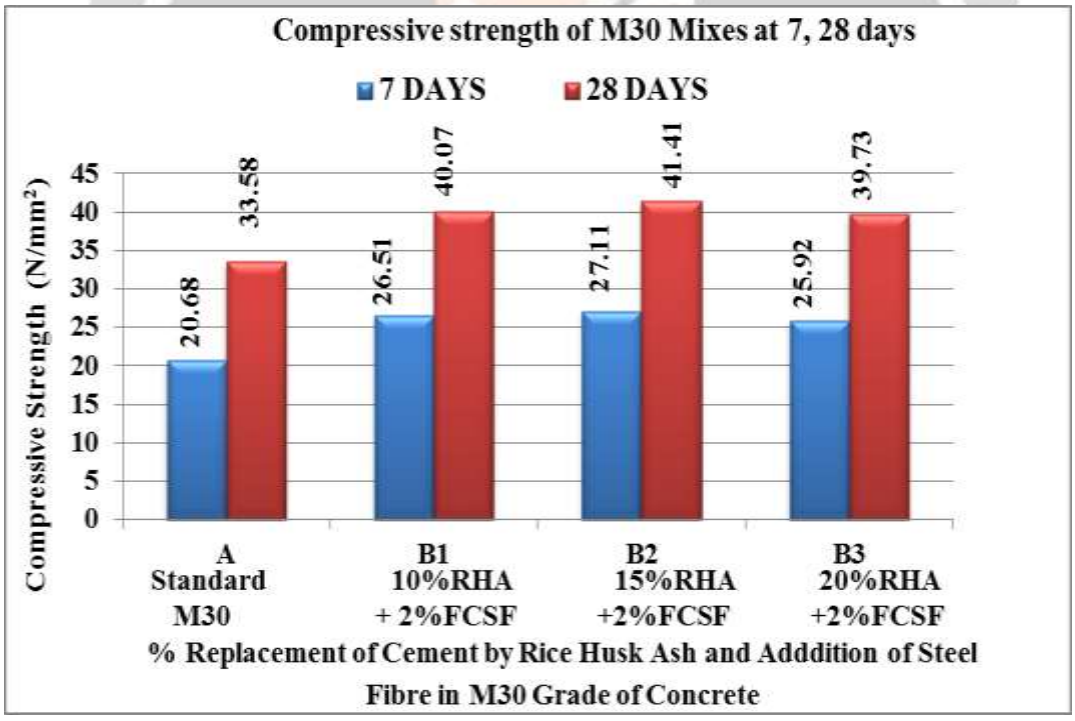

Figure 1: Compressive Strength of all M30 Mixes: Standard Concrete and cement replacement of Rice Husk Ash and addition of FCSF in Different Proportion at 7, 28 Days

From above figure 1, it can be said that compressive strength of all the M30 mixes increased with increase in days. Also compressive strength increases with increase in Rice Husk Ash and Addition of Steel Fiber, after it

further increase in Rice Husk Ash content decrease the compressive strength results but it was higher than the standard mixes. So optimum Rice Husk Ash content for maximum compressive strength was 15% replacement.

Following Table 7 shows Comparative Experimental Results for Compressive Strength Test for M30 Mixes, Standard Concrete and Cement Replacement of Rice Husk Ash and addition of HESF in Different Proportions

Table 7: Comparative Experimental Results for Compressive Strength Test for M30 Mixes, Standard Concrete and cement replacement of Rice Husk Ash and addition of HESF in Different Proportions

Concrete Mixes	Average Compressive Strength (N/mm^2)	
	7 Days	28 Days
A	20.68	33.58
C1	26.11	39.76
C2	27.15	40.06
C3	25.76	39.50

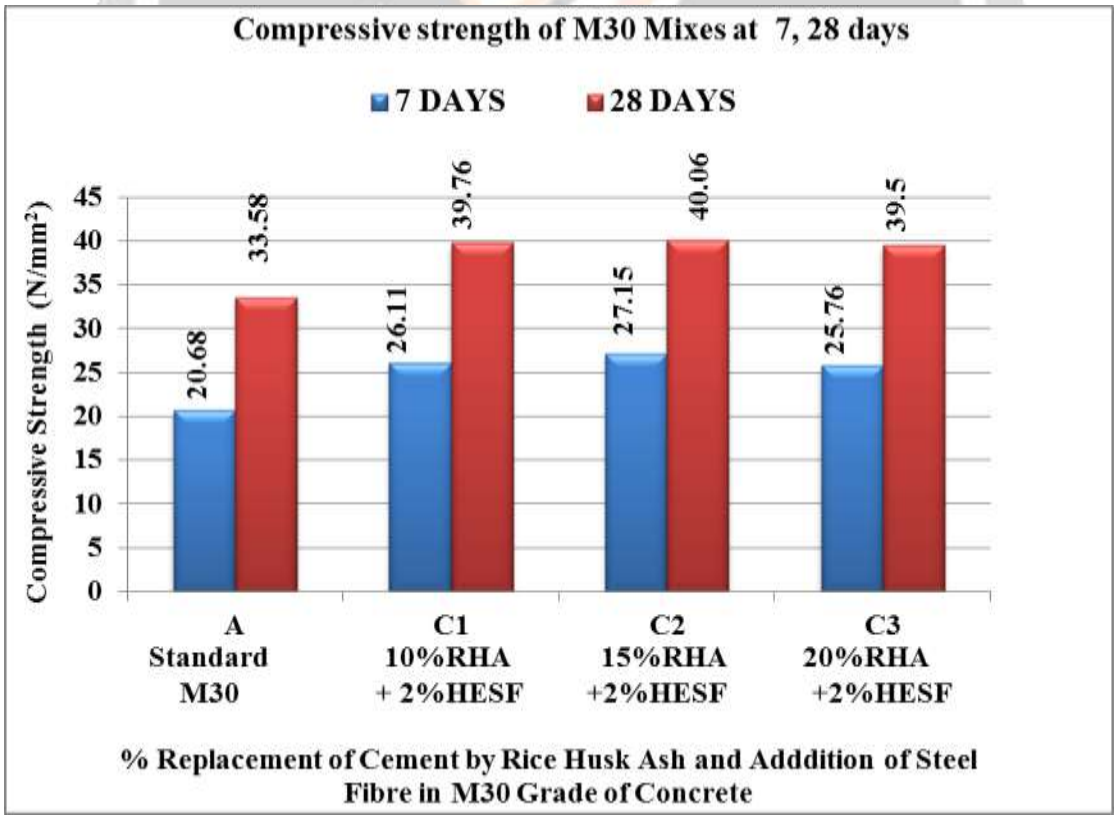

Figure 2: Compressive Strength of all M30 Mixes : Standard Concrete and cement replacement of Rice Husk Ash and addition of HESF in Different Proportion at 7, 28 Days

From above figure2, it can be said that compressive strength of all the M30 mixes increased with increase in days. Also compressive strength increases with increase in Rice Husk Ash and Addition of Steel Fibre, after it further increase in Rice Husk Ash content decrease the compressive strength results but it was higher than the standard mixes. So optimum Rice Husk Ash content for maximum compressive strength was 15% replacement.

8. CONCLUSION

From above experimental test, following conclusions are drawn:

1) Compressive strength of concrete increases after Replacement of Cement by Rice Husk Ash and Addition of Steel Fibre in it.
2) Compressive strength increases as increase in Rice Husk Ash content up to 15% replacement, further increase in Rice Husk Ash content shows decrease in compressive strength of concrete.
3) For M30 grade concrete, optimum mix is B2 and C2 with 15% replacement of Rice Husk Ash and Addition of Steel Fibre
4) For M30 grade concrete there was **23.31**% maximum increase of replacement of Rice Husk Ash and Addition of FCSF compressive strength as compared with standard A M30 mix and **19.30**% maximum increase of replacement of Rice Husk Ash and Addition of HESF compressive strength as compared with standard A M30 mix.
5) Use of Rice Husk Ash and Addition of Steel Fibre increases strength. Thickness of rigid rural road pavement decreases with increase in compressive strength of concrete by Replacement of Cement by Rice Husk Ash and Addition of Steel Fibre.

9. REFRENCES

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AUTHOR'S BIOGRAPHY

Mahesh N Prajapati was born in 1992 in Anand City. He received his Bachelor of Engineering degree in Civil Engineering from Birla Vishvakarma Mahavidyalaya, Gujarat Technological University, in 2014. At present, he is Second year student of Master's Degree in Construction Engineering & Management from Birla Vishvakarma Mahavidyalaya, Gujarat Technological University. He has published papers in National Conferences.

Dr. Jayeshkumar R. Pitroda received his Bachelor of Engineering degree in Civil Engineering from the Birla Vishvakarma Mahavidyalaya, Sardar Patel University in 2000. In 2009 he received his Master's Degree in Construction Engineering and Management from Birla Vishvakarma Mahavidyalaya, Sardar Patel University. In 2015 he received his Doctor of Philosophy (Ph.D.) Degree in Civil Engineering from Sardar Patel University. He joined Birla Vishvakarma Mahavidyalaya Engineering College as a faculty in 2009, where he is Assistant Professor of Civil Engineering Department with a total experience of 15 years in the field of Research, Designing and education. He is guiding M.E. (Construction Engineering & Management) Thesis work in the field of Civil/Construction Engineering. He has published many papers in National/ International Conferences and International Journals..