ANALYZING THE ENGINEERING PROPERTIES OFCEMENT CONCRETE CEMENT PREPARED WITH RHA & STEEL FIBRE

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ABSTRACT: Concrete has basic naturally, cheaply and easily available ingredients as cement, sand, aggregate and water. After the water, cement is second most used material in the world. But this rapid production of cement creates two big environmental problems for which we have to find out civil engineering solutions. In addition, Due to increasing environmental awareness as well as stricter policy on managing industrial waste, the world is progressively more spinning to researching properties of industrial waste and judgment of solutions on using its valuable component so that those might be used as secondary raw material in other industrial branches. The present experimental investigation is done to study the effect of partial replacement of cement by Rice husk ash (RHA) with using Steel fibre in concrete. The experimental investigation carried out on steel fibre up to entire fibre volume portion of 0.5%, 1%, 1.5% and 2.0 % and cement was partially replaced with 10%, 20%, 30% and 40% of RHA on the basis of previous research results. The engineering properties like compressive strength, splitting tensile and flexural strength were studied for concrete prepared. All results were determined at the age of 7, 14 and 28 days of curing. The laboratory results showed that addition of steel fibres reinforced RHA into concrete increases the mechanical properties.
Keywords: Cement Concrete, Rice Husk, Steel Fibres, Environment, Engineering Properties, Durability.

I. INTRODUCTION

GENERAL

Concrete is the most significant constituent for the growth of infrastructure, buildings, industrialized structures, flyovers and highways etc. In today's circumstances concrete needs extraordinary combinations of appearance and uniformitynecessities that cannot be always achieved by using conventional constituents and normal mixing. Construction industry is one of the highest increasing sectors in India. Rapid construction action and rising requirement of houses has guide to the short fall of conservative building supplies like bricks, cement, sand and wood. Requirement of good features of building supplies to replace the conservative materials and the requirement for cost effective and durable materials for low cost construction has necessitated the researchers to expand variety of new and inventive construction materials.

As we know Concrete is a versatile construction material. Firstly it was innovated as protective cover of steel members, after that it was revised and now a day's concrete is worn as a structural member and steel is provided to adapt its properties and give better strength to the concrete. Concrete has benefits like fire resistance, excellent resistance to water, has ability to mould into various shapes and sizes easily as per requirement, economic and readily available material on the work site. It was observed that the normal concrete have many inadequacy such as low value of strength to weight ratio since compared to steel. So because to overcome this inadequacy resulted in the growth of high strength concrete.

II. PROBLEM STATEMENT

The construction business is rising very fast so there is great needed of cement in concrete manufacture. Constructors need to be confident that their structure can be more hard-wearing for a long time. Our current production of regular concrete is inadequate to support the growth and requirement of the construction industry particularly in the high rise building and Highway. In addition to this the large scale manufacturing for cement generates huge amount of poisonous gases such like carbon di oxide which results in environmental contamination. Therefore, a need for long-lasting concrete is there while maintaining its economicality.

AIM & OBJECTIVES

This work aimed to present the property of Rice Husk Ash (RHA) and steel fibres adding together on the properties of cement concrete on substitution with agro In arrangement to see the effects of inclusion in concrete, there are number of objectives that are needed to be achieved. They are as follow:

- To study miscellaneous properties of Rice Husk Ash and Steel Fibre.
- To appraise strength of Rice Husk Ash and Steel Fibre concrete compared to traditional cement concrete.
- To execute workability test on rice husk ash and steel fibre concrete.

To find the effect of Rice Husk Ash and Steel Fibre coupled with cement concrete in mix extent of M30 grade concrete

GENERAL

This chapter deals with the presentation of results derived from various tests conducted on material collected for developing RHA and steel fibre modified concrete. In order to achieve the objectives of current study, an investigational program was planned to investigate the consequence of RHA and steel fibre on compressive strength, split tensile and flexural strength of concrete so as to evaluate its feasibility for use in pavement. The experimental plan consists of casting, curing and testing of controlled and RHA-steel fibre concrete specimen at different ages.

The experimental program includes the subsequent points:

- Testing of properties of materials used for production concrete.
- Design of mixes for steel fibre reinforced concrete.
- Casting and curing of specimens.
- Tests to establish the compressive strength, Split Tensile,flexural strength of high strength steel fibre reinforced concrete.

III. WORKABILITY

Slump cone test was conducted on all samples. Concrete mix with 30% RHA gave the highest slump with 38 mm while steel fibre addition showed a slump measurement of 36 mm to 31 mm. Graph shows the reduction in slumpmeasurement when fibre was added. This result shows that concrete mix with higher fibre content of a constant w/c ratio will give a lower workability as the stability of concrete mix with support of fibres.

IV. TEST RESULTS

SLUMP TEST (WORKABILITY)

S.No	RHA (%)	Weight of RHA in Mix (Kg)	Slump Value, mm
1	0	00	40
2	10	43	37
3	20	86	35
4	30	129	32
5	40	172	28

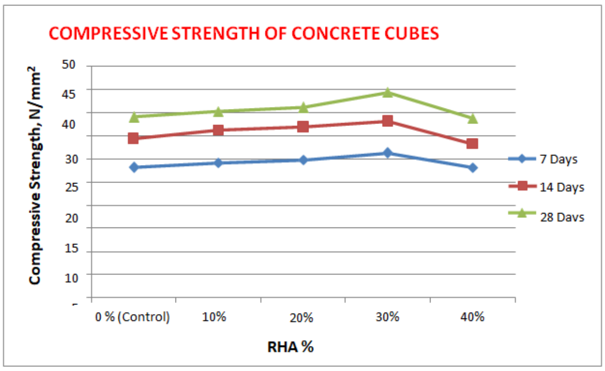
Table 4.1: Workability Test results of cement replaced with RHA.

TEST PROCEDURE AND RESULTS

In this study, the mix was done by manually. The cement and fine aggregate were first assorted dry to uniform color and then coarse aggregate was additional and mixed with the combination of cement and fine aggregates. Water was then added and the whole mass mixed. The fibres were added just before adding water and mixed dry thoroughly. Same in the case of RHA, cement in different percentages was replaced with RHA and added before adding water. The internal surface of the specimen moulds and the bottom plate were oiled before concrete was placed. After 24 hours the specimens were detached from the moulds and placed in dirt free clean water at a temperature of 270± 20C for 28 days curing. For testing in firmness, no cushioning material was placed among the specimen and the plates of the machine. The load was applied axially with a uniform rate of 140 kg/min without shock till the specimen was crushed. Test results of compressive strength test at the age of 28 days are given in the Table 4.2. The cube strength results of concrete mix are also shown graphically.

Test specimens of size 150×150×150 mm were casted for testing the compressive strength of both controlled as well as RHA-steel fibre reinforced concrete. The modified concrete mixtures with varying percentages of steel fibres and fractional replacement of cement with RHA were prepared and cast into cubes.

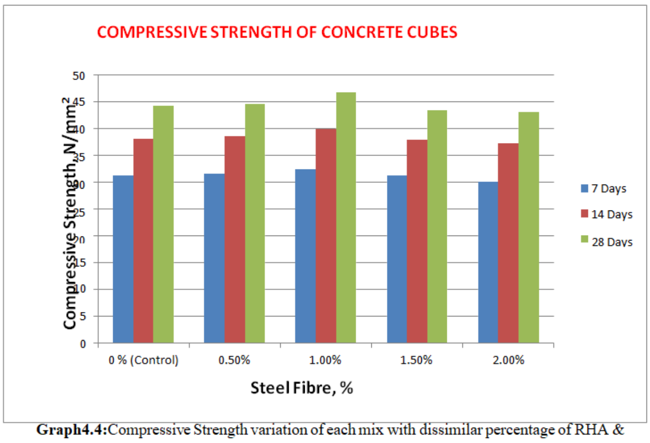
Mix	Average Compressive Strength (N/mm^2)		
	7 days	14 days	28 days
0 % (Control)	28.23	34.4	39.15
10%	29.14	36.23	40.27
20%	29.75	36.95	41.15



Graph 4.3: Compressive Strength testing of concrete cubes with various % RHA.

S.No	RHA (30%) + Steel Fiber %	Average Compressive Strength (N/mm^2)		
		7 days	14 days	28 days
1	0 % (Control)	31.27	38.15	44.36
2	0.5%	31.50	38.60	44.68
3	1.0%	32.43	39.85	46.76
4	1.5%	31.25	38.00	43.50
5	2.0%	30.10	37.25	43.15

Table 4.4: Test results of compressive strength of dissimilar mix with different percentage of 30 % RHA & Steel fibre



Graph4.4: Compressive Strength variation of each mix with dissimilar percentage of RHA & Steel fibre

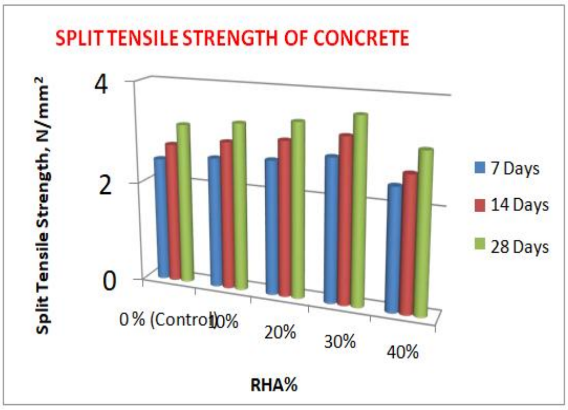
SPLIT TENSILE STRENGTH

The split tensile strength of all the mixes was determined at the ages 28 days for various replacement levels of RHA and variable percentages of steel fibres in concrete mix. The

150mm × 300 mm size cylinders were casted and tested in the compression testing machine with a uniform rate of 180 kg/min. The results of split tensile strength of concrete are reported in Table 4.3 shows the gain in split tensile strength for different levels of RHA replacement with concrete and addition of steel fibre at different time. The split tensile strength results of individual concrete mix are also shown graphically.

From the results, it is observed that the optimum value of split tensile strength is achieved with addition of 1% of steel fibre in controlled concrete mix. **Mix**	**Average Split Tensile Strength (N/mm²)**		
	7 days	**14 days**	**28 days**
CM	2.46	2.77	3.18
10%	2.58	2.92	3.30
20%	2.65	3.05	3.42
30%	2.82	3.23	3.63
40%	2.40	2.65	3.10

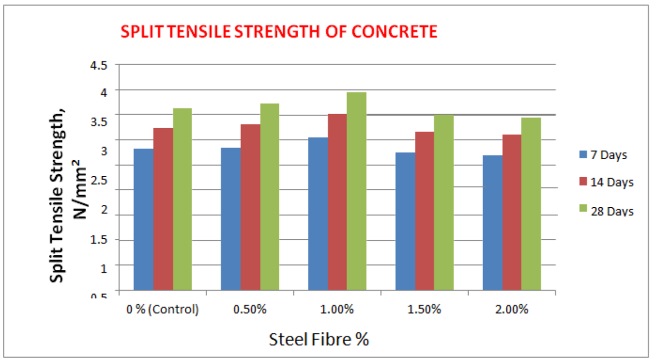
Table 4.5: Details of Split Tensile Strength test with different % of RHA



Graph 4.5: Split Tensile Strength testing of concrete cylinders with various RHA%.

S.No	RHA (30%) + Steel Fiber %	Average Split Tensile Strength (N/mm²)		
		7 days	14 days	28 days
1	0 % (Control)	2.82	3.23	3.63
2	0.5%	2.85	3.31	3.72
3	1.0%	3.05	3.52	3.95
4	1.5%	2.75	3.15	3.50
5	2.0%	2.70	3.10	3.45

Table 4.6: Split tensile strength of different mix with 30% of RHA & Steel fibre.



Graph4.6: Test results of split tensile strength of different mix with 30% of RHA & Steel fibre.

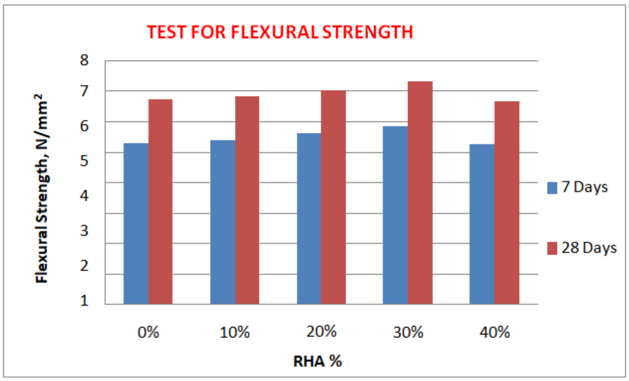
4.3 FLEXURAL STRENGTH

The most general concrete structure subjected to flexure is a highway or airway pavement and potency of concrete for pavements is usually evaluated by use of bending tests. When concrete is subjected to bending, then tensile and compressive stresses and in many cases direct shear stresses are developed. When fibre reinforced concrete and composite beams are loaded in pure bending, then the tensile strains develop. The load at first crack would increase with admiration to steel fibre reinforced concrete due to crack arresting mechanism of the closely spaced fibres. After the concrete matrix cracks, the fibres continue to take higher load which is provided. Thus the ultimate flexural strength is increased.

Test specimens of beam size 100 mm×100 mm×500 mm were prepared for determining the flexural strength of steel fibre reinforced concrete and substitute of cement with RHA. The beam moulds containing the test specimens were placed in moist air (at least 90% relative humidity) and a temperature of 27° ± 2 °C for 24 hours ⁄hour from the time of accumulation of water to the dry ingredients. After this the specimens were detached from the moulds and placed in clean new water at a temperature of 27°±2° C for the remaining curing period. After 28 days of curing the specimens were observedfor bending on a flexure Testing Machine. Loadswere applied at the one third points at a constant rate of 180 kg/minute. The distance between the centres of two rollers was kept 20 cm

S.No	RHA %	7 Days strength, N/mm²	28 Days strength, N/mm²
		Average of 3 samples	
1	0	5.30	6.75
2	10	5.41	6.82
3	20	5.63	7.03
4	30	5.85	7.32
5	40	5.27	6.66

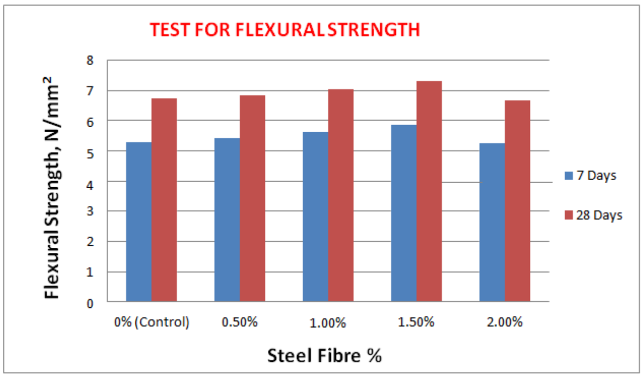
Table 4.7: Details of Flexural Strength test with different % of RHA.



Graph 4.7: Flexural Strength testing of concrete Beam with RHA%.

S.No	RHA (30%) + Steel Fiber %	7 Days strength, N/mm^2	28 Days strength, N/mm^2
		Average of 3 Samples	
1	**0 % (Control)**	5.85	7.32
2	**0.5%**	5.92	7.43
3	**1.0%**	6.25	7.85
4	**1.5%**	5.75	7.25
5	**2.0%**	5.66	7.20

Table 4.8: Flexural strength test results of each mix with 30 % of RHA & Steel fibre.



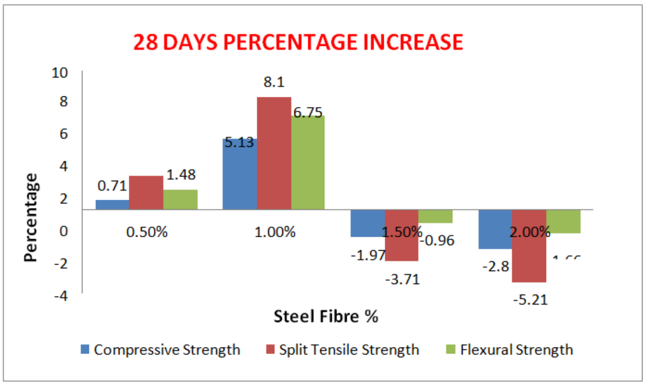
Graph4.8: Flexural Strength variation of each mix with 30 % RHA & Steel fibre.

4.6 CALCULATION OF OPTIMUM FIBRE CONTENT

From the test outcome conducted in different days with the dissimilar percentage of RHA-Steel fibre, it is observed that the optimum content of fibre in concrete mixes is 1%. The variation of compressive, split tensile and flexural strength with the different percentage of RHA-Steel fibre can be concluded from the curve shown in graph 4.2, 4.3 and 4.4. However at the same percentage of RHA-Steel fibre in the mix the percentage increase difference in between compressive, split tensile and flexural strength, the flexural strength development is comparatively more. The 28 days percentage increase variation is described below:

S.No	RHA (30%) + Steel Fiber %	Average Compressive Strength, %	Split Tensile Strength, %	Flexural Strength,%
1	**0.5%**	0.71	2.41	1.48
2	**1.0%**	5.13	8.10	6.75
3	**1.5%**	-1.97	-3.71	-0.96
4	**2.0%**	-2.80	-5.21	-1.66

Table 4.8: 28 Days percentage increase of strength with dissimilar percentage of RHA & Steel fibre.



Graph 4.5: 28 Days percentage increase of strength with 30% of RHA & dissimilar % of Steel fibre

V. CONCLUSIONS

- Concrete mixes when reinforced by steel fibre 1% shows an increased compressive strength when compared to nominal mix.
- The split tensile strength also tends to increase with 1% increase percentages of steel fibres in the mix.
- The flexure strength also tends to increase through the increase percentages of steel fibres, a trend similar to enhance in split tensile strength and compressive strength.
- Maximum strength (compressive, split tensile as well as flexure) of concrete incorporating RHA and steel fibres, both, is achieved for 30% RHA replacement and 1% steel fibres. Though, if the steel fibre content is increased, the increase is not very significant.
- From the percentage increase graph, it can be concluded that due to the addition of Steel fiber concreteresist more tensile stresses when compared tocompressive stresses.
- Although testing the specimens, the plain cement concrete specimens have shown a characteristic crack dissemination outline which tends into splitting of beam in two piece geometry. But due to addition of steel fibres in concrete cracks gets ceased which results into the ductile behavior of steel fibres inclusion.

RECOMMENDATIONS

The partial replacement of RHA-Steel fibre in concrete results in development of compressive strength split tensile and Flexural strength. On the beginning of this results, modified concrete made using RHA-Steel fibre may be suggested to be used with different types of concrete structures in India especially for the propose of concrete pavements. Even thoughfor the mixes rich in cement, the dosage of RHA-Steel fibre needs to be adjusted to maintain required workability of concrete. It isrecommended that percentage of RHA-Steel fibre content between 30% and 1% respectively, to be used in arrangement to get the maximum strength. It is also recommended that this studies to be done in a longer period oftime to see the possessions of RHA-Steel fibre use for construction,it is essential that the material used is long lasting.

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