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Studies on the Flexural Behavior of Concrete Beams with Lathe Waste in RC

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Abstract: ***This paper emphasis on the study of using lathe scrap as fiber reinforced concrete in the innovative construction industry. Every day about 3 to 4kgs of lathe waste are generated by each lathe industries in the Pondicherry region and dumped in the barren soil there by contaminating the soil and ground water, which creates an environmental issue. Hence by adopting proper management by recycling the lathe scrap with concrete is considered to be one of the best solutions. The test were conducted as per the Indian standard procedure for its flexural, split tensile and compressive strength and compared with FRC and conventional PCC.***

Also the workability of fresh concrete that containing different ratios of lathe scrap was carried out by using slump test. The result showed that addition of lathe scrap in to PCC mixture enhanced its compressive strength while it decreased the workability of the fresh concrete containing the lathe scrap.

Keywords: Fiber Reinforced Concrete (FRC), Plain Cement Concrete (PCC), lathe scrap reinforced concrete, lathes scrap.

I. INTRODUCTION

Great quantities of steel waste fibers are generated from industrial lathes. This really represents an environmental problem since that steel waste fibers are difficult in biodegradation and need a large area if it is stored. Furthermore, with increasing in population and industrial activities, the quantity of waste fibers generated from various industries will increase manifold in the coming years. These scraps can be effectively used in concrete to increase its ductile property by incorporating after chopping the raw wave into small pieces. Lathe scrap is a composite material consisting of hydraulic cement, sand, coarse aggregate, water and lathe scrap. In this composite material, short discrete fibers are randomly distributed throughout the concrete mass.

The behavioral efficiency of this composite material is far superior to that of plain concrete and many other construction materials of equal cost.

Due to this benefit, the use of lathe scrap has steadily increased during the last two decades and its current field of application includes: airport and highway pavements, earthquake-resistant and explosive-resistant structures, mine and tunnel linings, bridge deck overlays, hydraulic structures, rock-slope stabilization. Extensive research work as done on lathe scrap has established that addition of various types of fibers such as steel, glass, synthetic, and carbon in plain concrete improves strength, toughness, ductility, post-cracking resistance, and etc .

Literature survey indicated that very limited studies have been conducted on lathe scrap using industrial waste fibers. Furthermore, with increasing in population and industrial activities, the quantity of waste fibers generated from various industries will increase manifold in the coming years. [1] These industrial waste fibers can effectively be used for making high-strength low-cost FRC after exploring their suitability. With the addition of lathe scrap, the crack widths are smaller at service load in the case of lathe scrap concrete beams as compared to plain concrete beams. To study and compare the performance of concrete using steel fibre and lathe scrap and also determine the optimum percentage of lathe scrap in concrete. To determine and compare the rate of corrosion on steel fibre and lathe scrap.

II. REVIEW OF LITERATURE

The investigation reported in this paper was carried out to study the feasibility of application of industrial scraps for achieving high strength concrete. They collect the waste from wire winding industries and wire drawing industries. The literature survey indicated that very limited studies have been conducted on lathe scrap using industrial waste fibers. [1] The study of the prism to tensile loading, it clearly seen that adding lathe scrap to a concrete matrix significantly reduces the crack width. To better understand the cracking behavior and be able to predict crack widths, it is necessary to increase the knowledge of bond slip behavior of robbed bars embedded in lathe scrap concrete and also to gain better understanding of how to accurately the characteristic length. [2][6]

A. *Lathe Scraps*

This paper is achieved to study the effect of using industrial steel solids wastes that resulted from lathes as fibers reinforced concrete. That steel waste is representing an environmental issue and its management by recycling it with concrete is considered to be a good solution. These results showed that the addition of lathe steel waste scrap into the plain concrete mixture enhanced its compressive strength while it decreased the workability of the fresh concrete containing the steel waste scrap. [1]

B. *Steel Fiber*

Steel fibers have been used in concrete since the early 1900s.The early fibers were round and smooth and the wire was cut or chopped to the required lengths. The use of straight, smooth fibers has largely disappeared and modern fibers have either rough surfaces, hooked ends are crimpedorundulated through their length .Modern commercially available steel fibers are manufactured from drawn steel wire, from slit sheet steel or by the melt-extraction process which produces fibers that have a crescent-shaped cross section. Typically steel fibers have equivalent diameters (based on cross-sectional area) of from 0,15 mm to 2 mm and lengths from 7 to75 mm.[4]

Aspect ratios generally range from 20 to 100. (Aspect ratio is defined as the ratio between fiber length and its equivalent diameter, which is the diameter of a circle with an area equal to the cross-sectional area of the fiber).Carbon steels are most commonly used to produce fibers but fibers made from corrosion-resistant alloys are available.

Stainless steel fibers have been used for high-temperature applications .Some fibers are collated into bundles using water-soluble glue to facilitate handling and mixing. Steel fibers have high tensile strength (0, 5 – 2 GPa) and modulus of elasticity (200 GPa), a ductile/plastic stress-strain characteristic and low creep. Steel fibers' have been used in conventional concrete mixes, shotcrete and slurry-infiltrated fibber concrete. [4]

Typically, content of steel fiber ranges from 0.25% to 2.0% by volume. Fiber contents in excess of 2% by volume generally result in poor workability and fibber distribution, but can be used successfully where the paste content of the mix is increased and the size of coarse aggregate is not larger than about10 mm. Steel-fiber-reinforced concrete containing up to 1, 5% fiber by volume has been pumped successfully using pipelines of 125to 150 mm diameter. Steel fiber contents up to 2% by volume

.From the experimental studies and subsequent pavement analysis carried out as per IRC: 58-2002, it is concluded that the compressive strength of SSFRC increased when compared to plain cement concrete. Addition of steel scraps increases the flexural strength of SFRC to great extent. The mechanical properties of the concrete are increased by increasing the proportion of the steel scrap up to 1.5%. From 1.5% to 2.0%, it shows slight decrease in mechanical strength. At 2.0% of steel proportion, there is considerable reduction in the mechanical strength of SSFRC. It the pavement thickness is decreased by 41% and which is economical when compared to plain cement concrete slab. [9]

Corrosion is defined as the degradation of a material or its properties due to a reaction with the environment. Corrosion exists in virtually all materials, but is most often associated with metals. Metallic corrosion is a naturally occurring process whereby the surface of a metallic structure is oxidized or reduced to a corrosion product such as "rust" by chemical or electrochemical reaction with the environment.

The effect of immersion time of all the plant extracts at the optimum concentration showed maximum efficiency in 3h immersion time at 30^{o}c and found sufficient for pickling process. [11]

III. MATERIALS USED

The materials which are used in this experimental investigation are:-

1) *Cement*: ordinary Portland cement (OPC).[12-15]
2) *Fine Aggregate*: locally available river sand has a specific gravity of 2.65, fineness modulus of 2.80, and bulk density of1560 kg/m^3 [16-19]
3) *Coarse Aggregate*: gravel coarse aggregate of maximum size 20 mm and has a specific gravity of 2.7, fineness modulus of 7.4 and bulk density of 1420 kg/m^3.[20-25]]
4) *Lathe Scraps*: Lathe scarps are the waste materials which are collected from workshops and other steel industries at very minimum cost. They are similar to the steel fiber but they don't have any regular shape and size. The dimension varies with nature of source that is depends upon the type of industries. Scraps considered in this work are 0.5mm thickness as shown in figure.1,2&3

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Fig 1. Lathe Scraps chopped


Fig 2. Lathe Scraps

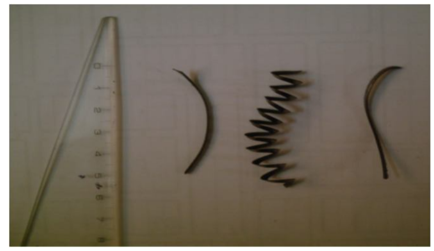
Fig 3. Types of Lathe Scrap

IV. EXPERIMENT WORK

In this study work, a total 60 numbers of concrete specimen were casted with and without lathe scraps and also we were casted for with and without steel fiber for finding the comparisons result. The specimens considered in this study consisted of 150mm cubes. A total 24numbers of beams and cylinders were casted with lathe scrap, with steel fiber and without fiber and lathe scrap. The specimen considered for beam and cylinders consisted of 100x100x500 and 150x300mm. The nominal mix proportion used for casting the specimen was.

The reason for selecting a variable weight fraction of fiber is due to find strength of concrete. Cement, sand and coarse aggregates were mixed in dry state using a laboratory mixer machine and then lathe scrap were added (with the addition of percentage with total quantity) in small quantities and mixed further.

The samples were casted and proper compaction will done then they are curing for various Days 7 and 28. After curing days the compression, flexural testing were conducted to obtain the strength. [25-32]

The pretreated specimens' initial weights were noted through weighing machine and were immersed in the experimental solution by pickling process method. The experimental solution used was in 1N Nacl and 1NHcl solution. The specimens were curing for 14days than after that we immersed in the Nacl solution. Than we remove from the specimen through Nacl solution and again we immersed in Hcl solution for three hours the specimens were taken out, washed out thoroughly with distilled water, and dried completely, and their final weights were noted. From the initial and the final weights of the specimen, the loss in weight was calculated.

V. RESULT DISCUSSION

This paper presents the result and conclusions based on the available literature. The adding of lathe scrap in plain concrete enhances its strength under compression.

Table:1 Compressive Strength (N/mm^2)

% of fiber	3 days		7 days		28days	
	Lathe scrap	Steel fiber	Lathe scrap	Steel fiber	Lathe scrap	Steel fiber
0	9.25	9.25	30.82	30.82	39.60	39.60
0.5	10.70	9.33	35.66	31.10	41.51	40.40
1	10.80	10.32	36.00	34.40	41.81	43.10
1.5	11.76	11.73	39.20	39.10	45.10	43.60
2	9.69	10.92	32.30	36.40	43.40	40.60

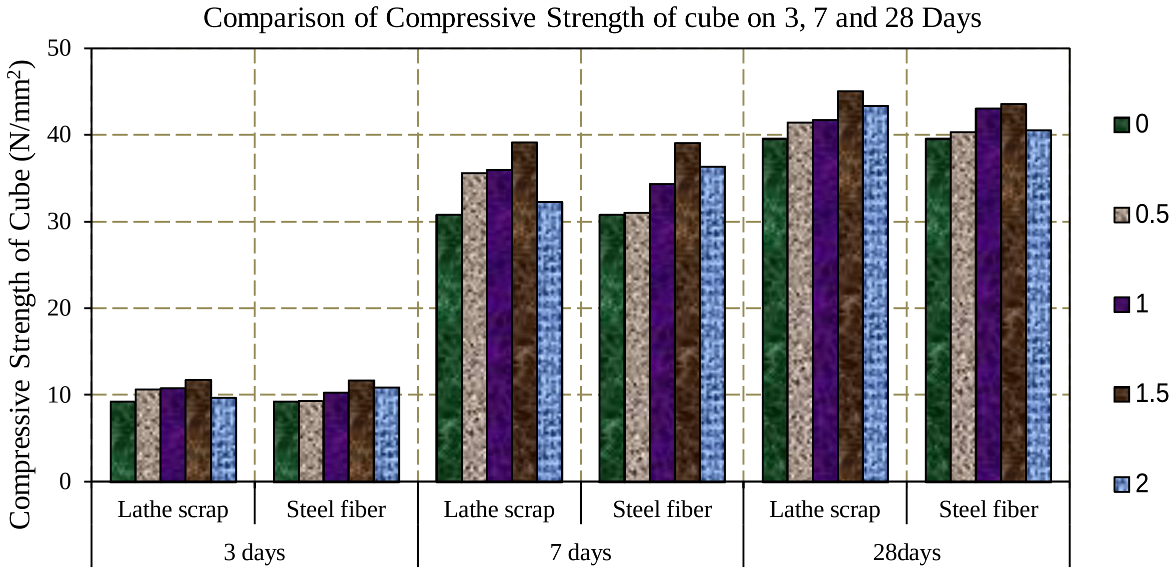

Table 2.Flexural Strength

% of fiber	Concrete N/mm^2		Concrete with lathe scrap N/mm^2		Concrete with steel fiber N/mm^2	
	Flexural strength N/mm^2	Tensile strength N/mm^2	Flexural strength N/mm^2	Tensile strength N/mm^2	Flexural strength N/mm^2	Tensile strength N/mm^2
0	4.09	2.68	4.09	2.68	4.09	2.68
0.5	-	-	4.3	2.912	4.74	4.49
1	-	-	4.5	2.970	4.9	4.59
1.5	-	-	5.1	3.57	5.49	4.73
2	-	-	4.74	3.3	5.2	5.06

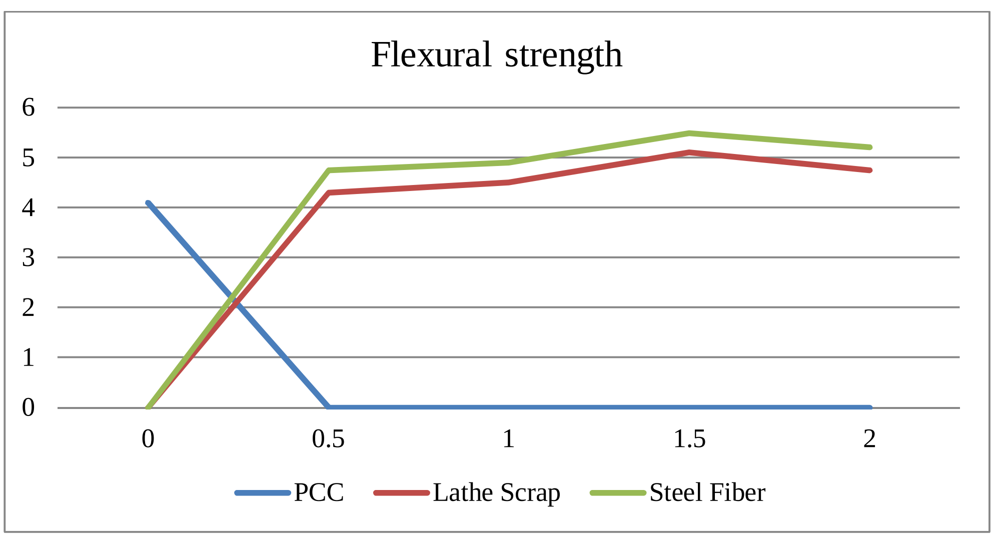

Table 3.To determine the corrosion rate

Sl.no	Percentage of lathe scrap added	Corrosion rate (mmpy)	Inhibition efficiency (%)
1	0.5	1.98	1.41
2	1	1.78	1.247
3	1.5	0.363	0.25
4	2	0.396	0.277

VI. CONCLUSION

Addition of lathe scrap and steel fiber in concrete has some significant effect in the increase of compressive, flexural and split tensile strength when compared with P.C.C .At 0.5% of lathe scrap and steel fiber in concrete has shown no considerable increase in the strength when compared with P.C.C. About 20% to 30% increase in compressive strength of concrete mixed with lathe scrap and 50% increases in compressive strength of concrete mixed with steel fiber for 1%, 1.5% and 2% of lathe scrap and steel fiber when compared with strength of P.C.C. Additional increment of lathe scrap and steel fiber in concrete has shown no significant effect in the compression strength. From the above study it was concluded that usage of lathe scrap in concrete can reduce the waste in a large volume and thereby it may lead to a good environmental management. The lathe scrap of concrete can be used in the pavement construction, door/window frames in cost effective building.

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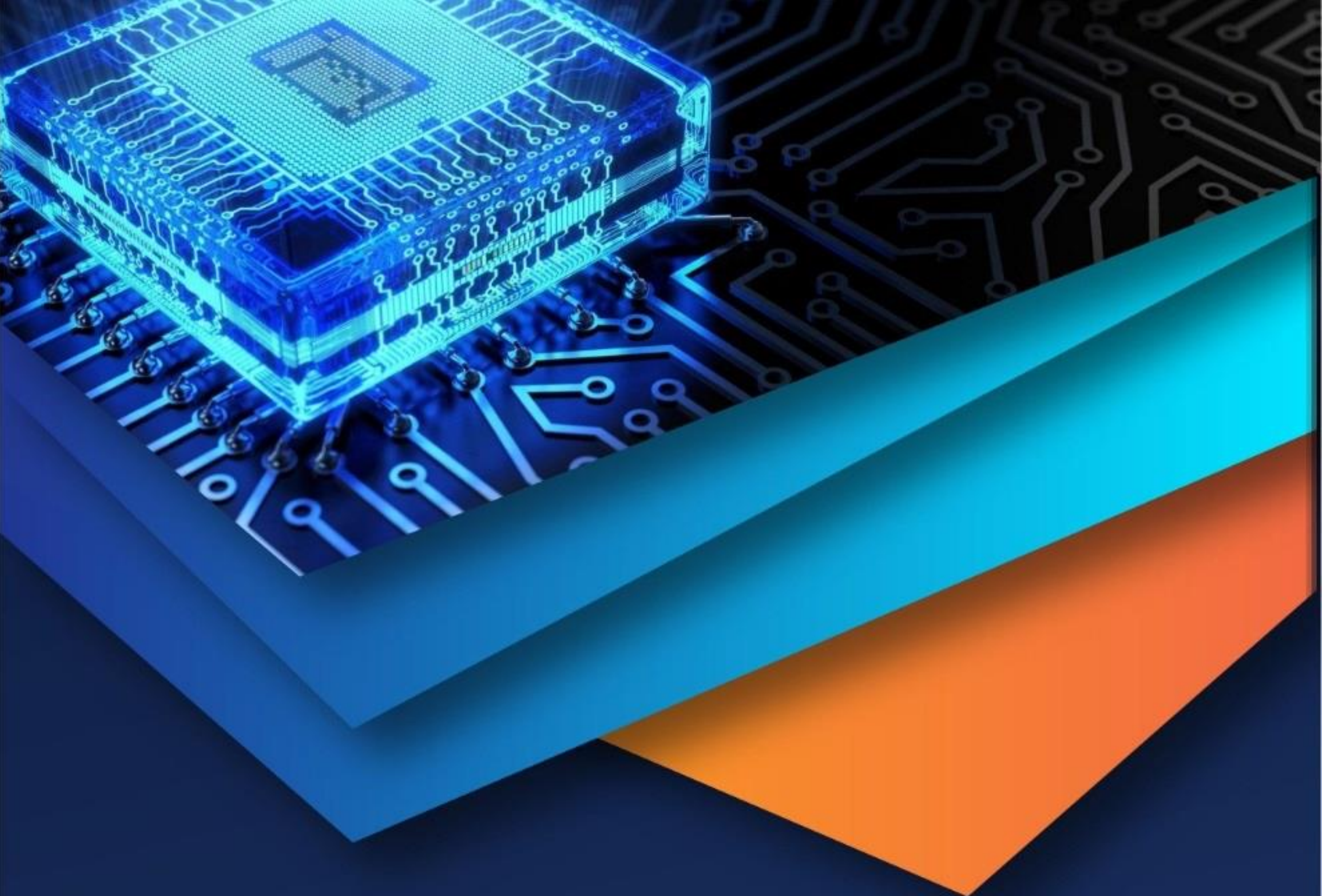

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