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Effect of Partial Replacement of Sand and Cement with Lathe Scrap Fibre and Steel Fibre in Concrete

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***ABSTRACT:** Aim of this investigation was to study the effect of lathe scrap fibre and steel fibre replacement in concrete at different percentage so that we can achieve an improved and more durable concrete comparative to conventional concrete. Concrete is weak in tension and good in compression and also it is less ductile therefore, to terminate those weaknesses of concrete reinforcement bar is combine with it, but the reinforcement bar can't fulfil the requirement of mechanical strength of concrete so to fulfil the requirements lathe scrap fibre and steel fibre is added so that the better composite material is achievable. After the investigation on several researcher work, we find 1.2% to 1.5% of lathe scrap fibre or steel fibre replacement according to weight of concrete, this is the optimum replacement in concrete to improve mechanical strength. But according to another research paper in which fine aggregate is partially replaced by lathe scrap fibre at percentage of 15%, 30% and 60% by its weight and it also improves the mechanical strength in compare to conventional concrete. Therefore, the review study characterize the utilisation of lathe scrap fibre and steel fibre in FRC improves the tensile strength and provides better resistance for early crack development in concrete. And also inexpensive, easily available and furthermore best for retrofitting and shotcrete techniques.*

***Keywords** – Lathe Scrap fibre, Compressive Strength, Split Tensile Strength, Flexural Strength, Concrete workability, FRC(Fibre reinforced concrete).*

I. INTRODUCTION

Concrete is one of the most significant materials in developments these days that guarantees plenty of points of interest. The capacity of cement concrete itself can be moulded in any shape, excellence protection from water and high temperature, required less upkeep are among the undeniable preferences. Concrete is called as economical material while contrasted with all other accessible materials. Concrete is a mixture of coarse aggregate, fine aggregate, cement and water, where fine aggregate fill the voids which retain from coarse aggregate, where cement bind all material and water trigger the hydration reaction by this process fresh concrete blend are prepared, but after querying still there some voids remains such as micro voids, which occurs after the completion of hydration process and also due to stress. To overcome this, we use steel fibre. Steel fibre reinforced concrete can be characterize as a composite material comprising blends of steel strands and lathe scrap fibre. Fibre has tensile strengthening properties having certain attributer properties. They may be round about or flat or deform. The fibre is frequently depicted by a helpful parameter called "perspective proportion". The perspective proportion of the fibre is the proportion of its width to its length, perspective range varies from 30 to 150. Steel fibre reinforcement concrete is widely applied in shotcrete but it can also applied in usual concrete by machine mixing. Steel fibre reinforcement concrete mainly is used for heavy structures such as hydraulic structure, tunnels, and flyover and also can be used for wide range of construction parts either alone or with hand tied rebar. Steel fibre develops enormous strength in concrete for the minimize the thermal stresses by overcome the micro voids which is developed by due to stresses, shrinkage and etc., steel fibre and lathe scrape fibre have amazing protection from creep also. Along these lines the direction and volume of steel fibre minimize the micro voids and increases the tensile strength It is a magnificent assignment to present this type of lathe waste generated from lathe machines, considering the ecological factor with the goal that it can decrease the degree of contamination, numerous methodologies are these days made in solid innovation for well reasonable utilization of generated lathe waste fibre. By utilizing machine scrap material, it improves the durability of steel scrap fibre concrete under various kinds of stacking and furthermore builds quality. It has numerous solid properties contrast with plain concrete. Basically FRC is a matrix fill with the steel fibre which is distributed in randomly manner or orderly manner (fig.1). The optimize volume of fibre enhance the tensile strength but also too much of fibre volume decreases the workability and forms matt and ball in concrete matrix.

Fig.1: Steel fibre reinforcement concrete

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II. STEEL FIBRE

Steel strands were used in concrete so its tensile strength increases, properties of concrete are dependent on the properties of fibre, amount and orientation of fibre. Fibres are of various types such as organic fibre, steel fibre, glass fibre, lathe scrap steel fibre, etc. Steel fibre are classified on shape such as straight, hooked, crimped, enlarged end, irregular, round wire and rectangular sheet, etc. (fig.2). Steel strands are discrete and small, its size varies from 10mm to 70mm.

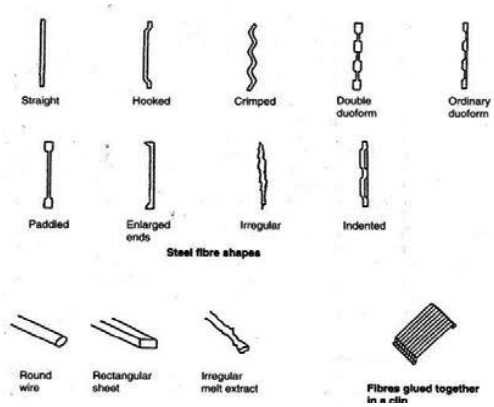

Fig.2: Types of steel fibre

III. LATHE SCRAP FIBRE

Lathe scrap fibre is a waste material which is produced by the working on the lathe machine. Lathe scrap fibre is deformed and lower in cost. According to the research approximately 3kg to 4kg lathe waste is produced from lathe machine per day [5, 2]. Lathe scrap fibre pollutes our environment like a slow poison, so it is necessary to find a better way to use lathe scrap fibre. Use of lathe scrap fibre in concrete is the best way to implement it. In concrete, we should use an optimum amount of lathe scrap fibre, so that its workability doesn't affect or we can use superplasticizer to increase workability. Lathe scrap fibre have no uniform shape or it is irregular in shape (fig.3) that's why before the

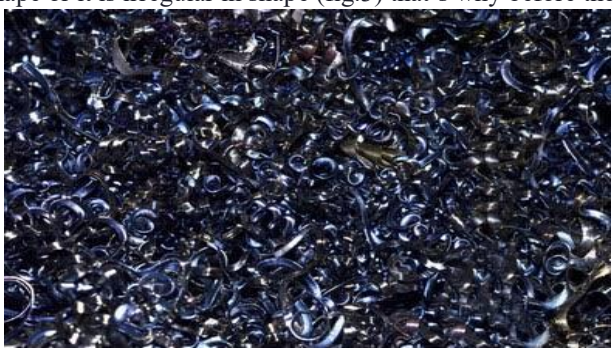

Fig.3: Lathe scrap fibre

use of lathe scrap fibre in concrete mix a manual sieve analysis should be performed. Lathe scrap fibre addition in concrete provide enormous strength, durability and ductility undergo the load and pressure.

IV. LITRATURE REVIEW

Ibrahim I.S. et al (2011)[2] In this research paper, researcher saw the evaluation of the impact of steel fibre on the properties of concrete, after test analysis researcher recognized the Steel fibre mixes slowly and thoroughly in the dry concrete mix after that water should mix properly so that the mat and ball formation did not occur. According to the test results shows steel fibre dose 0.5% and 0.75% is not very effective on strength test while at 1% and 1.25% of steel fibre effects on concrete is significantly appreciable, but 1% of steel fibre is optimum dose and Superplasticizer was used to increase the workability of concrete.

Prof. Kumaran M et al (2015)[5] The purpose of this paper is to find the effect of lathe scrap fibre in concrete and also examine the ductile nature, geometry of cracks development in concrete segment (column and beams with stirrups and without stirrups) meanwhile Compressive strength of 7 days and 28 days for cement concrete were considered ideal at 1.5% lathe waste fibre replacement, expended 8.4% and 11.25% and split tensile strength expended at ideal lathe waste fibre replacement is 14.75% and flexural strength increases by 18%.

Poorva Haldkar et al (2016)[7] The fundamental goal of this paper is to supplant the cement in concrete with lathe scrap fibre and investigate the variation of strength in concrete. Find out the optimum replacement percentage, after the test work on M30 concrete demonstrates that the compressive quality, flexural quality and split tensile quality seems to increment step by step till 1.2% lathe scrap fibre in concrete and afterwards a progressive decline in the strength. It also shows that compressive strength is expanded by 11%, split tensile strength is expanded by 25.7% and flexural strength is expanded by 19%-32.3% at the similitude of conventional concrete.

Karththekeyan.T et al (2016)[4] Researcher motivation behind this paper is to discover the impact of machine scrap fibre in concrete, it has been perceived that compared to .77%, 0.93%, 1.00%, 1.07%, and 1.47%, compressed strength and tensile strength for 0.86% strands is high, resulting is the SFRC's ductile behaviour and it also perceived that the workability of the SFRC was reduced by excessive amount of steel fibre so to overcome this problem, we use superplasticizer in adequate quantity.

To overcome the matt and ball formation of steel fibre during the fresh concrete mixing following steps were taken such as:-

1. Steel strands washed by water and isolated.
2. Fibre added in to the mixer in constant speed so they don't form ball and matt.
3. After adding and mixing other ingredients of concrete, presenting the fibre in the mixer.

ZeeshanNissar Qureshi et al (2016)[9] The purpose of such work is to study the properties of M20 concrete whose mix design 1:1.88:2.86 and the water-cement ratio was 0.52. After the testing final result shows that slum value and or other mechanical properties where decreased constantly while lathe scrap fibre is increased. All this work shows the optimum lathe scrap steel fibre is 1.5%, results show significant changes in strength such as compressive strength ($28.4N/mm^2$),

split tensile strength (3.37N/mm^2) and flexural strength (5.66N/mm^2).

Sajad Ahmad Mir et al (2017)[8] The essential explanation behind this assessment is to locate a strong mix extent using machine scrap fibre as the partial substitution of concrete through carried out this whole process to achieve an optimal percentage of steel strands because if steel strands are higher in percentage than workability will be affected and It further shows that the compressive power of SFRC increases by 12% at 1.6% of scrap steel strands comparatively to neoteric concrete. It has been presumed that the utilization of 1.6% of scrap steel strands of concrete weight, is the ideal proportion.

KSudhakar et al (2018)[3] In this investigation, the researcher is trying to inspect the mechanical properties of concrete, while partially mixing machine scrap fibre and steel fibre meanwhile observe that the compressive quality decreases when machine scrap steel fibre increases with conventional concrete. Lathe waste and steel fibre was replaced with fine aggregate and cement respectively, provides optimal compressive strength at ratio (10%+2%) (LS+SF) respectively. However, we get optimal split tensile strength at ratio (15%+2%) (LS+SF) and optimal flexural strength at ratio (20%+2%) (LS+SF).

Namrata M. Mannade et al (2018)[6] This paper exhibit to us the determinations of a test done on mechanical properties of cement with the blend of machine scrap steel fibre as the fractional substitution of concrete, results shows that up to 1.5% of lathe scrap increases the mechanical strength and ductile behaviour, but after 1.5% if we do further increment in fibre percentage then all mechanical strength decreases slightly and that's why utilization of steel scrap strands in concrete because of improved protection of cracks development from the temperature stresses and heavy vehicle loads.

Bhagyawati M et al (2018)[1] Through this study paper researcher modified the concrete properties by adding the waste steel chips. They focus on selected waste of iron and steel industries as a partial replacement of sand in production of concrete. It shows concrete produced with waste steel chips as a substitute of sand. Sand is replaced by waste steel chips in proportion (15%, 30% and 60%) by weight of sand.

V. ANALYSIS OF TEST RESULTS

A. ***Flexural Strength Test-*** The flexural strength of concrete is gradually increased by an optimum percentage of fibre. Table no.1 shows that the test results of Flexural strength on M30 concrete in which lathe scrap fibre partially replaced at an optimum percentage. [5] [6] & [7]

Table 1: Flexural strength of LSRFC at optimum replacement at 28 days on M30

Optimum Lathe Scrap Fibre %	A	B	C
0%	4.47	4.31	5.79
1.20%	5.68		
1.50%		4.89	6.35

Graphical representation for comparison of flexural strength test results at the optimum lathe fibre percentage is taken from different research studies which are given below in fig.4.

A - [7] **B** - [6] **C** - [5]

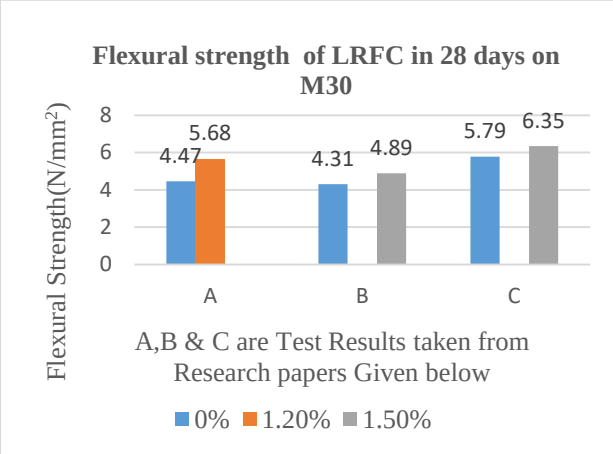

Fig.4: Graph showing flexural strength variation at 28 days

B. ***Split Tensile Strength Test-*** split tensile strength of concrete is varies at the ratio of fiber in concrete. Maximum Strength is observed at 1.2% or 1.5% fiber added concrete [5] [6] & [7] Which shows in table no.2

Table 2: Split Tensile Strength of LSRFC at optimum replacement at 28 days on M30

OPTIMUM LATHE SCRAP FIBRE %	A	B	C
0%	2.78	2.68	2.98
1.20%	3.76		
1.50%		3.68	3.42

Graphical representation for comparison of split tensile strength test results at the optimum lathe fibre percentage is taken from different research studies, which are given below in fig.5.

A - [7] **B** - [6] **C** - [5]

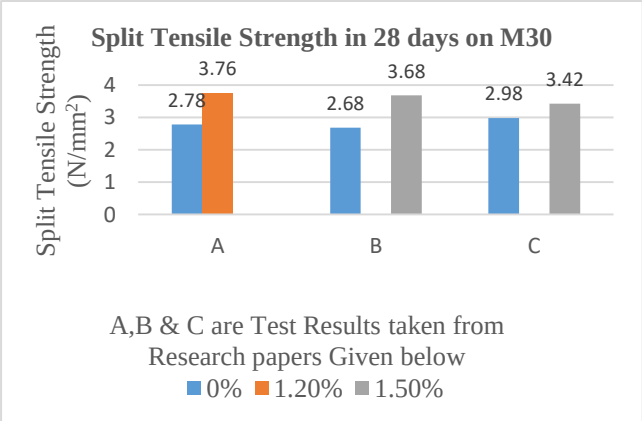

Fig.5: Graph showing split tensile strength variation at 28 days

C. ***Compressive Strength Test-*** The compressive strength of the concrete pavement for various extent shows a steady increment up to 1.2% of fibre included concrete and afterwards a continuous reduction in the strength (5, 6, & 7). Which shows in table 3

Table 3: Compressive Strength of LSRFC at optimum replacement at 28 days on M30

OPTIMUM LATHE SCRAP FIBRE %	A	B	C
0%	42.07	33.9	39.1
1.20%	46.66		
1.50%		37.93	43.5

Graphical representation for comparison of Compressive strength test results at the optimum lathe fibre percentage is taken from different research studies, which are given below in fig.6.

A - [7] **B** - [6] **C** - [5]

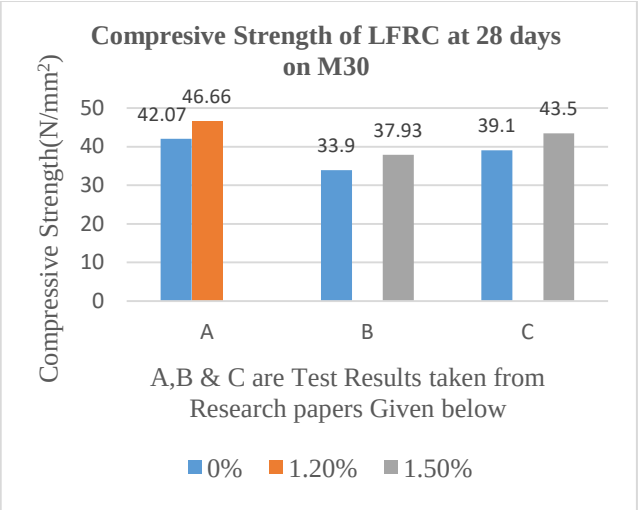

Fig.6: Graph showing compressive strength variation at 28 days

VI. CONCLUSION

This review study states that the lathe scrap fibre and steel fibre was replaced with concrete by weight at specific percentage such as 0.2% to 2.4% and it was examined that from 1.2% to 1.5% were ideal percentage of replacement of lathe scrap fibre and steel fibre.

If more replacement of fibres goes above this percentage, we see slight decrements in mechanical strength of concrete and workability. But there is another study shows that, if we partially replace lathe scrap fibre with sand in production of concrete at proportion (15%, 30% and 60%) by weight of sand, then the mechanical strength of concrete also increases mechanical strength of concrete were increase at optimum percentage of lathe scrap fibre and steel fibre, increment of compressive strength from 37.93 N/mm^2 to 46.66 N/mm^2, increment of split tensile strength from 3.42 N/mm^2 to3.76 N/mm^2 and increment of flexural strength from 4.89N/mm^2 to 6.35 N/mm^2 [3, 4, & 6]. By all extensive scrutinise, it has been concluded, the combination of lathe scrap fibre and steel fibre is more efficient compared to separate replacement of lathe scrap fibre or steel fibre in concrete.

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