# INVESTIGATION OF PERFORMANCE OF CONCRETE ON ADDITION OF LATHE STEEL SCRAPS UNDER ELEVATED TEMPERATURES.

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**Abstract**
**Scrap which is a waste can be used as reinforcing material in concrete to enhance the various properties of concrete. Scrap from lathe machine act in a same way as steel fibres, dumping of these wastes in the barren land causes the contamination of soil and ground water which builds an unhealthy environment. In this paper, M20 concrete is used and lathe scrap fibre is added with different proportions (10%, 20%, 30%, and 40%) to check the strength variations in concrete. The fibre used is irregular in shape and with varying aspect ratio. The main idea of this research work is to use waste scrap steel fibre in concrete which provides cost-effective and eco-friendly sustainable development.**
**Keywords- Lathe Machine Scrap, Compressive Strength, Split Tensile Strength, Concrete, Workability, Fibres.**

## I. INTRODUCTION

To introduce these kinds of lathe wastes generated from the lathe machines is the great task, keeping the environmental factor into mind as it can reduce the pollution level, strategies for solid waste management. By using the lathe scrap material, it improves toughness of the steel scrap fibre concrete under different types of loading & also increases the strength. It decreases the permeability, and increases the ductility. This type of concrete can be used where the plain concrete fails. It can be used in dams, bridges & multi-storeyed structures. It has high strength as compared to plain concrete.

When the steel scrap reinforced in concrete it acquire a term; fibre reinforced concrete and lathe scrap fibres in concrete defined as **Lathe scrap fibre reinforced concrete** (LSFRC). In this investigation, a comparison have been made between plain cement concrete and the fibre concrete containing steel (lathe) scarp in various proportions by weight.

## II. SCOPE AND OBJECTIVES

The objectives of this research are as follows:
1. Analyze the effect of the addition of lathe waste on the concrete.
2. Assessing the strength increased between Normal concrete and with the addition of lathe waste on concrete.
3. To study the effect of elevated Temperatures from $200^0$c till $600^0$c for 6 hours and then air cooled.
4. To compare Results Obtained with M20 concrete at room Temperature (Unheated).

## III. METH0DOLOGY

Methodology has been divided in to two phases. The **first phase** of the experiment covers to evaluate the strength deterioration when concrete is subjected to various temperatures and cooled either slowly or suddenly. Three cases of heating and cooling regimes are to be studied. The **second phase** of experimentation involved to quantify the amount of strength recovered by concrete subjected to elevated temperatures from 200°C to 600°C with time of 28 days. In this study, a comparison has been made between plain cement concrete and steel scrap fiber reinforced concrete (SSFRC). The results of tests done on SSFRC having different proportion of steel scrap (i.e. 10%, 20%. 30%, 40%) by weight of Fine Aggregates.

## IV. MATERIALS USED

Cement

For the entire experimental work, a popular commercial brand of Ordinary Portland Cement (OPC) 53 grade is used. The cement is tested accordance with IS codal provisions. A sample of cement to be used for the research was tested for compressive strength as per the procedure mentioned in IS 4031(Part 2):1999.

Fine Aggregates (River Sand)

In the present study locally available river sand is used. The fine aggregate (River sand) conforming to zone III (I.S 383-2016 grading requirements) with specific gravity 2.65 is used. For the casting of concrete, the sand passing through 4.75 mm IS sieve is used. For mortar preparation sand passing through 2.36 mm IS sieve is used.

Coarse Aggregates

The crushed coarse aggregate of 20mm-12.5 mm (downsize) is used and tested as per the IS 2386-1963. The coarse aggregate is tested for its specific gravity is 2.70.

Super plasticizer

CONPLAST SP 430 is based on sulphonated napthalalane polymer and supplied as a brown liquid, instantly dispersible in water. Specific gravity is 1.222, Chloride content nill. As per IS 456-2000, optimum dosage is in the range of 0.5-2.0 litre/100kg cement. It is used in pumpable concrete, to produce high strength. It is used for Improve workability, easier and quicker placing and compaction. Higher cohesion risk of segregation and bleeding minimized.

Water Clean Tap water is used throughout in this work for both mixing and curing of concrete.

Lathe waste: Lathe waste is a material from lathe machines and that can be used as steel fibres. But the aspect ratio was not constant.

Fig.1: Lathe scraps

**Concrete Mix Design:**

Concrete Mix is prepared using Ordinary Portland Cement (OPC– 53 Grade), with locally available crushed granite stone as coarse aggregates (12.5 mm down and 20 mm down) and river sand as a fine aggregate. Mix design of concrete is done based on the guidelines laid by IS 10262-2009. The mix proportion adapted for the present investigation is presented in Table 1.0.

| Water | Cement | Fine agg. | Coarse aggregate | |
|---|---|---|---|---|
| 0.45 | 1 | 2.83 | 3.45 | |
| | | | 30% 12.5mm =1.035 | 70% 20mm= 2.415 |

Table 1.0 Mix proportion

**CUBES CASTED AND TESTING DETAILS:**

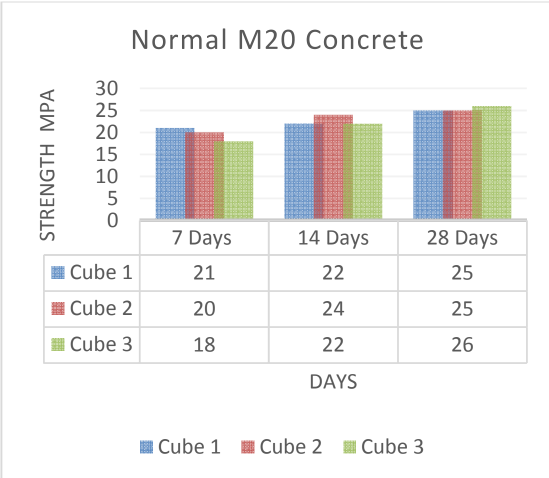
The concrete mixture is prepared in a horizontal pan-type mixer of 0.1 $m^3$ capacity. The interior surface of mixer was cleaned and moistened before it was used. Freshly mixed concrete is tested for its density and used to cast a number of test specimen's standard cubes in steel moulds. A table vibrator is used to achieve full compaction for the moulded test specimens. The specimens used for compressive strength of size 100mm x 100mm x 100mm sized cubes are used for the entire experimental investigation. The concrete is mixed in the mixer and poured in the moulds.

Total of 50 cubes. Scrap Steel Fibre were added in concrete in 4 different percentage starting from 10% and raised the mixing of Scrap Steel fibre up to 40%, at an interval of 10%. For each percent of scrap steel fibre addition, 12 cubes where casted. Final strength of cubes will be tested after 7, 14, 28 days curing. Compression testing machine is used for testing the compressive strength of cube. The crushing loads were noted and average compressive strength for three specimens is determined.

**Compression tests conducted:**

For Normal M20 Grade concrete the Compressive strength Obtained is given on Chart 1.1.1

Chart 1.1.1: Normal concrete

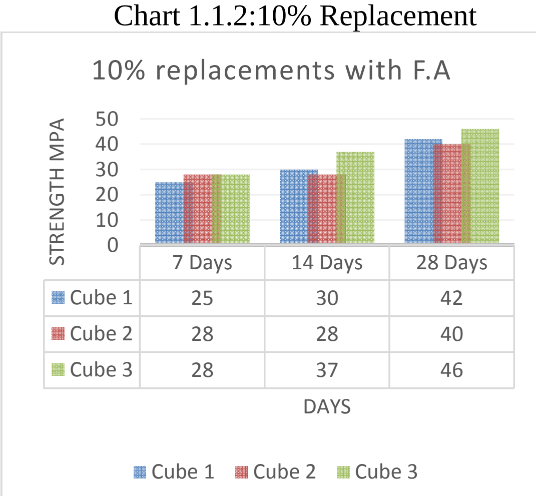



Observation:

- Target strength of M20 Concrete = 26 MPa
- Target strength is achieved at 28 days.
- Slump is normal as 100mm.

<u>10% Replacement</u> of lathe scraps for Fine aggregates:
Slump= 80mm

Chart 1.1.2:10% Replacement

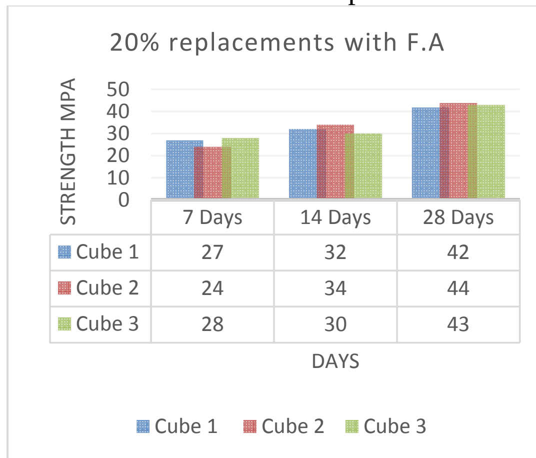



Observation:

- Compared to normal concrete with 10% replacement, the strength drastically increases and the workability conditions are good.
- Strength is almost double the strength of normal concrete.

<u>20% Replacement</u> of lathe scraps for Fine aggregates:
Slump= 55mm

Chart 1.1.3:20% replacements

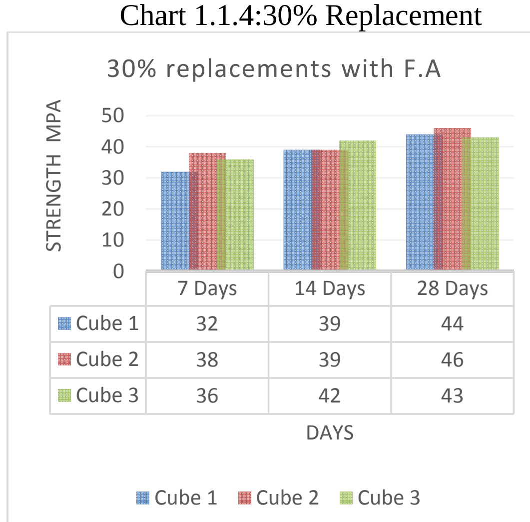



Observation:

- Compared to normal concrete the strength is almost twice.
- But there is a decrease in slump value due to the increase in the percentage of lathe wastes.

<u>30% Replacement</u> of lathe scraps for Fine aggregates:
Slump= 40mm

Chart 1.1.4:30% Replacement

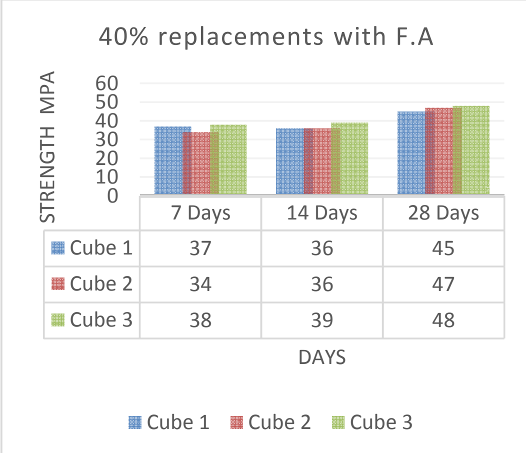



Observations:

- Since the increase in the lathe waste percentage the workability is reduced by almost 50% compared to normal concrete.

<u>40% Replacement</u> of lathe scraps for Fine aggregates:
Slump= 10mm

Chart 1.1.5:40% Replacement

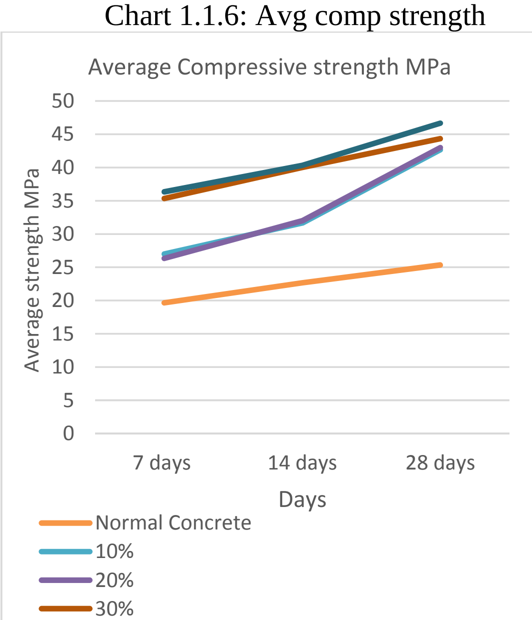



Observation:

- Slump is almost less than the workable conditions.
- Since the lathe contents are more and cement contents are not sufficient to fill the voids there is a honey comb structures formed in cube and the aesthetic look is compromised.
- Beyond this percentage of replacement the concrete will not be at workable conditions.

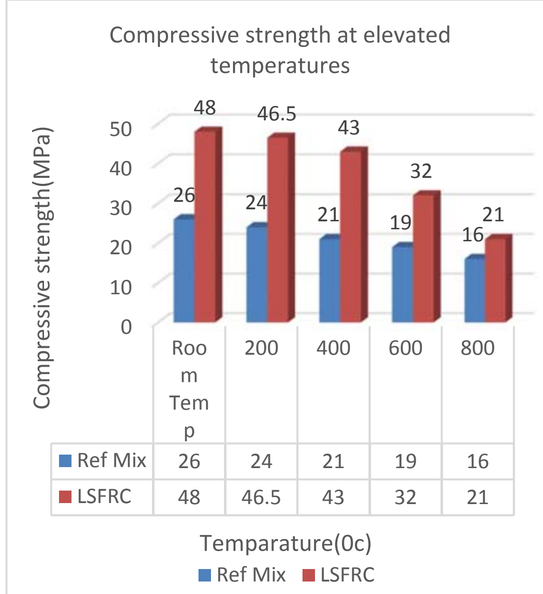
## Average Compressive strength:

Chart 1.1.6: Avg comp strength




## Compressive Strength under Elevated Temperature:

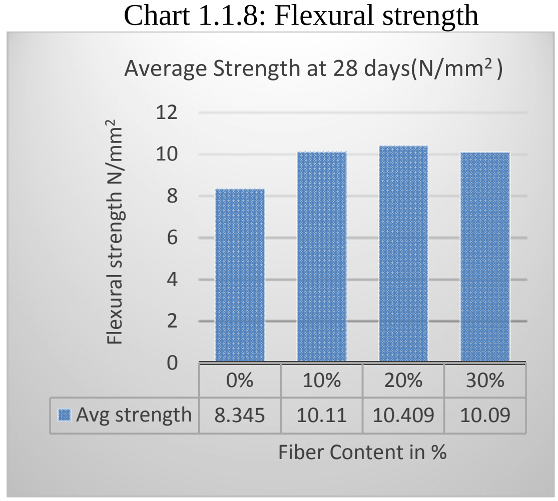
Chart 1.1.7: Comp strength at elevated temp




## Flexure Strength:

8 Beams have been Casted of size 50x10x10 for the percentage of 10, 20 and 30 percent of lathe waste the results are as follows:

Chart 1.1.8: Flexural strength

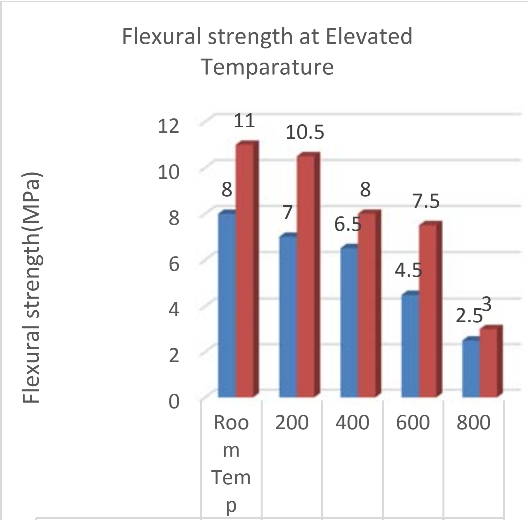



## Observation:

- Flexural strength effectively increases nearly 25% but reduces after addition of 20 % of lathe wastes.

Flexural Strength at elevated temperature:

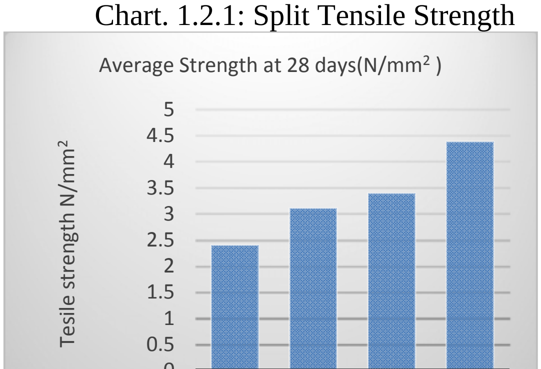
Chart 1.1.9: Flexural strength at elevated temp




| | Room Temp | 200 | 400 | 600 | 800 |
|---|---|---|---|---|---|
| Reference Mix | 8 | 7 | 6.5 | 4.5 | 2.5 |
| LSFRC | 11 | 10.5 | 8 | 7.5 | 3 |

**Split Tensile Strength:**

- Total of 8 cylinders were casted of the size for the percentage of 10, 20 and 30 percent and the results are as follows:
Chart. 1.2.1: Split Tensile Strength




| | 0% | 10% | 20% | 30% |
|---|---|---|---|---|
| Avg strength | 2.4 | 3.11 | 3.393 | 4.382 |

## V. FUTURE SCOPE:

The effect of rusting of the steel lathe scrap on the strengths of concrete can be determined. Also, the effect of addition of lathe scrap on the reinforcement provided in R.C.C structure can be determined.

## VI. RESULT AND DISCUSSION:

A graphical representation of the compressive strength plotting percentage of scrap steel fibre in abscissa (X-axis) and compressive strength of concrete at ordinate (Y-axis).

Another graphical representation of the compressive strength for same percentage of scrap steel fibre in abscissa (X-axis) and compressive strength of concrete at ordinate (Y-axis) but under elevated temperatures.

Following results are achieved, after 28 days i.e.

1. Compressive strength of drastically increases twice as compared to plain concrete.
2. Flexural strength effectively increases nearly 25 %.
3. M20 Grade concrete Exhibits decrease in compressive strength with increase in Temperature.
4. There is weight loss for M20 grade concrete subjected to elevated temperature. Loss is between 0%-10.9 percent under dry conditions.

## VII. CONCLUSIONS

- Highest average strength obtained is 46.66 MPa at 40% replacement of lathe wastes.
- But at this percentage the workability is not feasible for large concreting.
- If we keep on increasing the percentage beyond 50% the strength will also be reduced and it will be under zero workability conditions.
- 20%-30% is the best range for the replacements of the lathe wastes and it will be under good workability conditions and the strength is almost twice the Normal concrete.

## VIII. REFERENCES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Vol. 2, Issue 12, 2015 | ISSN (online): 2321-0613

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